QUANTUM SHORTS

Collected Flash Fiction
Inspired by Quantum Physics

Quantum Shorts: Collected Flash Fiction Inspired by Quantum Physics

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FOREWORD

Let me confess: in my entire academic career, I have never been able to separate my childhood dreams and fantasies from my research. I know, I might have prolonged my adolescence beyond any reasonable limits, but it works for me. The wonders of the quantum world, reflected in equations, plots and diagrams, are as addictive as those imaginary worlds of seductive beauty that I used to visit in my dreams.

Unfortunately, as we grow up, we are hardly encouraged to use imagination in daily life. The self-improvement gurus stress willpower, grit, self-control or discipline, and that's alright, but I think that without imagination and fantasy you will never live your life to the full; you will never expand your horizons, or come up with new ideas, inventions and discoveries.

Let me stress that there is no contradiction between imagination and rational thinking; fantasy and logic go very well together. One of the most profound insights into the structure of reality, the many-worlds interpretation of quantum theory, proposed by Hugh Everett in 1955, could only be discovered by having enough imagination to draw all the logical conclusions from the mathematical formalism of quantum theory.

Once you take quantum theory at face value, not as a predictive tool but as an explanation for how the world really works, you are led to conclude that our universe is one of many in an infinite ensemble of parallel universes that physicists have come to call the multiverse.

Rumour has it that Everett, who was an avid science fiction reader, took his inspiration from *Star Maker*, a classic science-fiction novel by British writer Olaf Stapledon, published in 1937, which featured the concept of the multiverse.

Needless to say, following your fantasies in search for explanations and beauty is not without risk. So many times, I have ended up in a cul-de-sac and taken a while to back off

and try again, but most times, I was rewarded with fresh insights and deep satisfaction.

To be sure, to appreciate the full beauty of quantum theory you need some technical preparation. It is a bit like snorkelling and scuba diving. You can observe corals and fish from the surface, and you can get a pretty good idea of how beautiful they are, but it takes some technical knowledge and skills to go for a total immersion and be truly overwhelmed by the beauty of the underwater world. Thus, take this collection of Quantum Shorts as your snorkelling introduction into the quantum world. But I promise, you will not be disappointed.

In pages to come you will find texts that are both thought provoking and beautifully written. They vary in style, composition, maturity, you name it, but to me, they all dazzle with a remarkable dose of "quantum imagination". And who knows, perhaps you will be inspired to consider the total immersion: that is, learning quantum theory with all its technicalities. Again, I promise, you will not be disappointed. But for now, turn the page, relax and enjoy.

Artur Ekert
Director of the Centre for Quantum Technologies and
Lee Kong Chian Centennial Professor at the National
University of Singapore.

PREFACE

In this book, you will find 37 different short stories from 32 different writers inspired by quantum physics in at least as many different ways. Each of these "Quantum Shorts" is no longer than 1000 words.

These stories were entries to a series of Quantum Shorts flash fiction competitions held in 2013, 2015 and 2017. From over a thousand entries all told, these few are the prize-winners across the competition's international open and youth categories, and all the stories shortlisted in the open category.

The Quantum Shorts competitions are an initiative of the Centre for Quantum Technologies (CQT) at the National University of Singapore, backed by a stellar collection of partners. We are grateful to Scientific American and Nature for their constant support as media partners, Tor Books and Tor.com for working with us in the early years, and our scientific partners around the world.

Our thanks in particular for sponsorship of this book to the Australian Research Council Centre for Engineered Quantum Systems; the Institute for Quantum Computing at the University of Waterloo in Canada; the Institute for Quantum Information and Matter at Caltech in the United States; QuantIC, the UK Quantum Technology Hub in Quantum Enhanced Imaging; and QuTech, a collaboration between the Delft University of Applied Sciences and Dutch innovation centre TNO in the Netherlands. We thank the Joint Quantum Institute, a partnership of the University of Maryland and the National Institute of Standards and Technology in the United States, for supporting earlier editions of Quantum Shorts.

We also owe a debt of gratitude to our contest judges—the creative physicists, writers and artists—who have worked with us across the competition over the years to decide the top prizes. For their discerning choices, we thank Mark Alpert, Jennifer Megan Crawford, Mariette DiChristina, Greg Dick, Artur Ekert, Otto Fong, Paweł

Frelik, Brian Greene, Tania Hershman, Kwek Leong Chuan, Jason Erik Lundberg, Clara Moskowitz, Michael Mrak, Patrick Nielsen Hayden, Chad Orzel, Pang Kian Tiong, Lisa Randall, John Scalzi, Colin Sullivan, Paul Tan, Vlatko Vedral, Eleanor Wong, JY Yang and Yeow Kai Chai.

We thank all the experts on our shortlisting panels too, whose job was made difficult by the volume and quality of the entries each year: Michael Brooks, Julia Cramer, Tobi Day-Hamilton, Tania De Rozario, Andrew Doherty, Matt Edgar, Jenny Hogan, Spiros Michalakis and Jodi Szimanski.

Our biggest thanks, of course, go to the writers who make this book worth reading. You will find their names over the coming pages as you explore the quantum world with them, and we have included their biographies at the end of this book.

In case you're wondering what happens to Quantum Shorts in the even numbered years, we don't rest. Those years we hold competitions for short films. We can't put those in this book, but you can enjoy all the materials and make deeper dives into quantum physics at shorts.quantumlah.org.

INTRODUCTION

Here be monsters—and lots of cats.

Human beings have an instinctive fear of the unknown. Scholars who made maps in medieval times used to draw all kinds of mythical monsters onto the areas of their maps where no one had ever travelled.

The story of quantum theory is, arguably, no different. Its founders—notable names such as Albert Einstein, Erwin Schrödinger, Niels Bohr and Werner Heisenberg—had to navigate unknown territories, and were often fearful about what they might find. That's why Einstein famously declared that the idea of quantum entanglement, the counterintuitive link that can exist between quantum particles, would be better framed as "spooky action at a distance". He simply didn't believe it was possible. The Quantum Shorts authors don't share his apprehension. Stories that you'll find in this collection, like "The Entanglement Proposal" and "Till decoherence do us part", reimagine a future where quantum entanglement is an intimate part of our everyday lives.

Since Einstein, experiments have shown that entanglement is not only possible, but it is achievable—and useful. So is the fact that quantum events seem to occur without a cause, something so unthinkable that Einstein considered it akin to letting God "play dice" with the universe. Again, though, this strange situation appears to be exactly how things are in the quantum world.

It wasn't only Einstein that was troubled by quantum reality. Schrödinger was very uncomfortable with the causeless effects too, while also struggling with the fact that quantum theory allowed him to create a theoretical scenario describing a cat that is simultaneously dead and alive.

This "superposition" of multiple possibilities is one of the more easily palatable consequences of quantum theory. Perhaps that is why Schrödinger's Cat has become a celebrated quirk of the theory (and inspiration for many

a Quantum Shorts like "The Cat in the Box" and "The Qubits of College Acceptance") rather than the motivation for the theory's improvement that Schrödinger intended. After all, the work of Prince Louis de Broglie gave quantum things properties that exist in a near-infinite array of abstract dimensions of space, an attribute that makes a dead-and-alive cat seem almost reasonable.

De Broglie's extra dimensions became less abstract, but no less mind-boggling, when Hugh Everett III proposed that they were the seeds of alternate universes no less real than our own. You'll encounter this idea of alternate universes in the very first story of this collection, "Unrequited Signals". For more stories about alternate universes, you may want to jump to stories including "Don't Die Before You're Dead, Sally Wu", "Ana" and "The Fraction She Didn't Know She Was".

Everett III's "Many-Worlds" interpretation of quantum mechanics stands in contrast to Niels Bohr's views. Bohr declared that physicists shouldn't even discuss things that weren't directly measured or observed in experiments, putting the act of measurement centre stage (without ever defining what constitutes a measurement, admittedly).

Since these pioneers of the early 20th Century bequeathed us these ideas, researchers have explored them further. The results are a host of Nobel prizes and a panoply of technologies that have changed people's lives. Quantum physics was essential to the understanding of materials that led to all the semiconductor chips and lasers powering today's computer age. Now its unique features are being harnessed for a "quantum age" of super-precise sensors, ultra-secure communications and supremely powerful quantum computers. You'll see a glimpse of the possibilities that these quantum technologies might bring in stories such as "From the Ruins of Beijing" and "End-User Agreement".

If you'd like to navigate the stories of this collection

by their quantum ideas, the index at the end of the book could help you chart your journey. It's not exhaustive, but it classifies the Quantum Shorts according to some of the bigger concepts in quantum physics. You could read all the stories about superposition, for example, before moving on to stories that question reality. To learn more about the scientific concepts, you can visit https://shorts.quantumlah.org/quantum-theories.

The outer territories of the quantum map have always drawn explorers and creators, imaginative minds ready to take brave steps. By reading this book, you, too, can join them. The Quantum Shorts unleash a multiverse of ideas in superposition, and they may well induce your imagination to construct stories of your own. If they do, we'd love to read them. Safe travels!

UNREQUITED SIGNALS

TARA ABRISHAMI

In one universe…

I grip my coffee with one hand and lean against the railing as the shuttle meanders toward the cluster of tall, white buildings. Le Centre pour la Recherche Physique Spécial, usually called simply Le Centre, is tucked in among the green hills and lazy rivers of rural France. The local folk call it Le Château Blanc, and it does resemble a white castle somewhat, albeit a contemporary one, home to an odd array of knights. We knights, scientists, come to Le Centre to study everything from quantum entanglement to Hawking radiation. And I, fresh out of Oxford, for Project Bifröst.

I step off the shuttle at Building 221, a hulking glass building toward the outskirts of the establishment. The facilities are immaculate. Everything is sleek and modern, from the most expensive particle accelerators to the ordinary snow-white escalators, so unlike the clumsy grey ones of antiquity. On the third floor, the bright, minimalist décor falters with the navy words embellished on the wall: Project Bifröst.

My boss, Dr Tolbert, motions to me from the door of his office.

"Clara," he says, "the new communications equipment has been delivered."

"Already? That's great. Stephen and I will work with it right away," I answer.

He nods. "Good."

Project Bifröst is the most ambitious communications project European research has ever attempted. The project endeavours to prove the existence of the multiverse, to somehow detect an alternate reality. There are different branches, like trying to detect radiation that would imply another universe, but Stephen and I are working on the boldest option: direct communication with a parallel universe.

He's bent over the new equipment when I walk in to

the lab. He looks up and I steal a swift glance at my glass reflection. My curls, ordinarily tied up, are loosely tousled around my face; I look softer, more feminine than usual. But Stephen has eyes only for the gorgeous new technology.

"Come and look, Clara," he says, beckoning.

To the best of our knowledge, communication across multiple universes defies most standard physical laws, but the equipment still outwardly resembles that of a century ago. A satellite dish has been reconfigured to detect gravitational waves in a pocket of quantum foam. Inside the magnetic shield, positron annihilation fuels the jewel of the system: a microscopic wormhole, just wide enough to transmit the carefully laser-modulated signals. All experimental technology, developed in the last couple years specifically for Project Bifröst.

Stephen plays with the bulky headset. It's endearingly primitive, the headset, something a World War III pilot may have worn. I reach for it, my knuckles lightly grazing Stephen's as he passes it to me. I ignore the warmth rushing to my fingers as Stephen turns to set up the transmitter. Light floods the lab as he pulls open the blinds, shadows painting patterns on the shiny marble floor.

A green light flashes on the headset, and Stephen turns to smile at me.

"Well, it's functional," he says. "There's no reason you can't start talking now."

"What should I say?" I ask. There are messages prepared for this, of course, but it seems foolish to start so pompously.

"Anything," Stephen says. "Just your name, or something. Just try it out before our meeting with Tolbert."

He walks across the lab into an isolation room as I pull the headset on. The heavy earpieces close around my head like a brace, and I pull the microphone up to my mouth, wiping away the sweat pooling in my palms. It seems wrong, insolent, to broadcast my own name into the void, across the universes. So instead I lean forward and whisper

"Stephen" into the microphone, over and over again.

✳

In another universe…

Stephen fiddles with the receiver as I start filtering through the recordings from last night, searching for any kind of anomalous signal that could be communication. The cool, dry air in the lab slowly turns my fingers cold. I rub my hands together, but before I can pull on my coat, Stephen leaves the receiver and walks up to me.

"I brought you tea," he says, handing over a steaming mug. "I thought you might like something hot, the lab gets so chilly these days."

I take the tea absently.

"Doesn't look like there's anything," I tell him. Other than the occasional stray signal, even our most far-reaching receivers haven't picked up anything remotely encouraging.

I leave the laptop and walk to the wall, leaning my forehead against the cold glass. I watch the wispy orange clouds sink into the horizon, the indigo fingers of the night sky stretching out above Le Centre. God, the sunset is beautiful out here.

Stephen walks up next to me. "There is a little café with a very nice view not far from here," he says quietly. "Maybe you'd like to join me there for dinner tonight?"

I rub my wrist uncomfortably, continuing to stare at the mesmerizing sunset. After a few moments, he opens his mouth again, but before he says anything, the machine behind us starts spewing static.

"I'll get it," I say, turning, but before I reach the speakers, something more than static comes through.

"Stephen."

I stare, shock and wonder flitting in and out of Stephen's wide blue eyes. It continues: Stephen, Stephen, over and

over.

"It's your voice," he whispers, and as soon as he says it, I know he's right. I lean heavily against the table, trembling.

"What… what… but that means…" I draw a shaky breath.

"Stephen, trace the signal."

He collapses into the chair and taps around on the laptop.

"It's… it's not…"

It's not from this universe. He reaches for my hand, but I pull away.

"This means… oh god. Oh god, we have to go get Tolbert."

I go, expecting Stephen to follow. But he lingers by the headset, unwilling to part from that infinitesimal moment in which my voice called out from another world, and he heard me.

DICE

BETONY ADAMS

God blows on the dice and lets them fly. In the moments before they land, he feels the familiar flicker in his veins, the opium of hope. The pressure lifts, things expand: his lungs, the wrinkled walnut of his heart, the casino's stuccoed firmament. He can barely remember the last time he won, or what it felt like to be lucky; the eyes turned towards him, sideways in envy, or openly flirtatious, looking for someone to sidle up to. He'd once placed bets and ordered drinks with such expansive ease—lifting his hand, inclining his head—certain of attention.

Now the looks he gets are suspicious ones. Though he doesn't blame them. He's let his beard grow out. His clothes could use a wash. His old habit of peeling them off his body to a froth around his ankles as though he were undergoing an extravagant metamorphosis, secure in the knowledge that they would be cleaned and pressed and folded and returned, is as impossible to believe as his one-time winning streak. Now he avoids day-to-day domestic confrontations. He undresses behind locked doors, keeps himself to himself.

The dice land and stop, sucking his lungs shut. Out for an up-pops-the-devil seven. He catches the eye of the woman across the table. Her eyes slide off his. Women tend to edge away from him these days. It has been some time since he felt the thrill of an arm brush against his, the accidental-on-purpose contact of skin-to-skin that drives the circuitry of desire. He imagines how they see him. Pitiable, almost an old man, respectable enough—he has not yet begun with loud proclamations and wild gestures—but with a little too much white of the eye showing for people to feel comfortable around.

The casino lights are as relentless as a headache, but he lingers. Better this than the dense breath of his bedroom, sour with sleep and disappointment. He feeds some coins into a slot machine, cranks it and watches the shapes line up, the cheerfully mismatched images wink at him. To his

left and right people are bent to the task, their eyes lit full of ghosts. He scratches through his wallet, counts up the last change and comes short. The evidence of the night's damage knots his stomach.

Outside, under a sky blank with smog, a night market has appeared on one of the pavements. He stops at a table piled with second hand books; flips through them, hoping for an inscription, a name or date or better yet, a love-note or photograph. He found the latter once, in a fat novel which came highly recommended but turned out to be dull. He kept the book, if only for the photograph, the thought of it hidden between pages, pressed between other books on the shelf, intimately anonymous, gives him a breathless falling feeling. So many possible variations of a life, playing themselves out beyond the horizon of his own.

The stall's owner is giving him a stare that suggests he should move on. He looks around for something to distract his wife from the anger that flares against the friction of his presence. There is a flower stall, bright blooms in their cellophane skirts. But she is worn out of flowers. He has watched enough bouquets wilting in their waterless vases to know this for sure. Besides which he hasn't change for more than the cheapest bunch.

Across from him a woman is shuffling a deck of cards, their hush-hush-hush is both lullaby and siren song. He can't resist it, the lure with chance at its heart. How much simpler life would be if all decisions were made by card or by dice. He would wake each morning to a clean slate, deal himself a breakfast, black for porridge or red for eggs. Throw a two for marriage and a one to end it. And each time—in that moment before the card is revealed, the dice rolled and settled—the suspension of everything in its purest potential. More than the exhilaration of winning, it is this moment of infinite possibility that is his particular addiction.

He holds out what is left of the money in his wallet.

The woman with the cards counts it and nods. She spreads the deck. Next to her, laid out individually on a table, is another deck. On each card is what looks like a large snow globe. In each of the globes' glass domes is a miniature universe, intricately wrought, complete with stars and comets, galaxies and planets. God is pleased with what he sees. It is precisely the sort of whimsical trinket that his wife loves and that clutters the mantelpieces of their home. He picks a card. It is the seven of hearts. His eyes go to the table, the corresponding seven, on it the globe. It pulses with light and he catches glimpses of colour, a red sphere, a flash of blue.

He is suddenly impatient to hold it and when it is handed to him, shakes it. The stars hum slowly to motion, the tiny planets agitate and settle, agitate and settle, slave to his hand. He feels things unclench inside of him, a shudder of surrender and sensation of expanding warmth that is something like the relief of emptying his bladder, something like love. He wraps his hand gently around the globe but cannot quite contain its light, which shines through his fingers in a bright blood halo. He lets it swing to his side, measuring the heft of it, its satisfying gravity; then he turns towards home.

MAGIC LAMP, 2050

D. ARCHER

Director Yang announced the completion of the HEV supercollider to great applause. It was an impressive sight—not that anyone could see more than a small fraction of it from the reception hall. But Yang's audience mostly comprised the scientists who had designed the kilometres-long facility, and when its vast array of indicator lights was finally illuminated, the crowd couldn't help but cheer.

Yang himself left as quickly as he could after his speech, dodging handshakes and congratulatory drinks. While the occasion was deeply satisfying to him, at that moment he simply felt exhausted. The supercollider project began as a marathon and ended as a sprint. For the last month, Yang had been sleeping on a cot in his office, and with his ceremonial obligations complete, that cot was an irresistible destination.

But the moment he laid down and closed his eyes, Yang's much-deserved rest was forestalled by a voice.

"Congratulations, Director! The HEV is a real beauty."

Yang jumped up and, noticing a figure on the couch on the other side of his office, ran for the door.

"Whoa, calm down! What's the matter?"

Halfway out the door, Yang turned, his panic fading. He took a breath and flicked on the lights.

The figure on the couch turned out to be a very small man in very strange clothing. Yang didn't recognise him, but somewhere in the back of his mind, blunted by adrenaline and exhaustion, he felt a vague sense of familiarity. The man was smiling and holding his hands up apologetically, and overall he looked non-threatening enough to turn Yang's fear into indignation.

"Who are you and what are you doing in my office?" Yang demanded.

"Why I'm a Q-genie, of course," said the Q-Genie. "What kind of question is that? You're the one who called me here."

"Well, Eugenie," said Yang, now offended, "you've

broken several different security protocols, not to mention laws, and I really must request–"

The Q-Genie interrupted him with a laugh. "Wow, you really don't know, do you? Didn't Olsen talk to you? She should have explained."

Yang frowned. He recalled several unopened emails from Dr Julia Olsen, who had directed the last major accelerator project before the HEV. He had been too busy these past few weeks to keep up with his correspondence.

The Q-Genie shook his head reproachfully. "I suppose I'll have to introduce myself. I am a Q-genie—that's with a Q, thank you very much. When you humans conduct any particularly ingenious quantum experiment you summon one of us, and we answer one question for you."

Yang and the Q-Genie stared at each other for a while. Finally, Yang rubbed his eyes and walked back to his cot, where he slumped down.

"I'm hallucinating, obviously," Yang muttered, "I'm hallucinating from fatigue. It will all be better in the morning."

"You're not hallucinating. Hey! Hey! Look at me!" The Q-Genie snapped his fingers at Yang. "This is a big opportunity for you. For humanity! All those millions spent on this project, this is what it was all for."

"This isn't what it was for. This is a scientific research project. We have many experiments planned."

The Q-Genie snorted. "That's all nonsense. Seriously, Director, don't be so shocked. It takes large teams of highly specialised experts years to design and operate a high-energy accelerator. Do you think any of those people fully understand all those endlessly complex details? No, they each understand their own little niche and that's it, and everyone cheerfully assumes everyone else is filling in the gaps. Well, it isn't true. I am a nearly omniscient being and I am telling you, these devices do one useful thing and one only: they summon genies. That's what they're for and

that's what they've always been for."

The Q-Genie walked over to Yang and patted him on the knee sympathetically.

"Now, don't be disappointed. It's still an amazing achievement. It's just that humans aren't quite built to really understand quantum physics, so we Q-genies give you a hand when you need it. Now, let's get to the point."

Years later, after getting quite drunk on the day of the announcement of his Nobel Prize in Physics, Yang confided to a favourite graduate student that it wasn't so much the little man *convinced* him that science was all down to genies, as that the speech confirmed a suspicion he had always had—and anyway, what was the harm?

"Any question?"

The Q-Genie nodded. "Well, any yes-or-no question. My answers are quantised. There are only two possibilities: yes or no. I can't do all the work for you."

Yang contemplated for a long moment. Of course, this was probably just a strange dream, but... just in case…

"Do quarks have any substructure?"

"Excellent question! The answer is: yes. Now, you should be able to get a few hundred publications out of that if you make them sufficiently convoluted, and you'll keep the field on the right track for next time."

The Q-Genie glanced at his wristwatch.

"Well, I must go. An Earth a few realities away only just achieved fission. Apparently, their Einstein, Bohr, and Rutherford decided to quit science and form a jazz trio, so their atomic physics is a little behind. They know way more about acoustics than anyone else, though. Never could understand that stuff myself. Farewell, Director."

The Q-Genie vanished. Yang blinked at the spot where he had been.

A disembodied voice floated into the room.

"Oh, and please talk to whoever manages the next summoning. I'm trying to reduce my call times."

Yang blinked at nothing for a while longer. Finally, he laid down and fell into a deep, dreamless sleep.

By the time Yang woke up, it was 10 o'clock. He rubbed his eyes, stretched a little, and plodded over to his desk. Then he picked up the phone and dialled his assistant.

"William," he said. "Would you mind getting Julia Olsen on the line?"

THE QUESTION TREE

D. ARCHER

In early spring, they tie vibrantly coloured ribbons to the branches of the tree. Most of them mark their ribbons—with some private symbol, or a name, or even a whole question. Sometimes a ribbon is left bare, and they count on remembering where they placed it. Or they don't intend to check.

The girls mostly come together, in small groups, laughing and taking their time picking the best spots. Which spots are "best" is the subject of constant and passionate debate.

The boys mostly come alone, later in the evenings, and for them the goal is height. "Higher branches, better chances," one of them responded when I queried him. He had no deeper reasoning to offer.

"Never mind that," Tanya said. I turned away from my terminal to look at her. "I am doing a much more important project."

"What would that be?" I asked.

"I am teaching quantum mechanics to Bruno."

I laughed. "Isn't this a little early? He's only nine."

She waved a hand, dismissing my objection. "I was younger when I started. Besides, nine is old for a dog."

"Oh yes, that little fact. That might also be a problem."

Bruno sauntered over to me. I gave him a scratch behind the ears.

"I don't know if any dog could really understand QM," I said.

Tanya scoffed. "Is that different from any human?"

"Fair point," I said, returning to my report.

Each spring the Question Tree blooms once. During the rest of the year it is an unremarkable plant, a common member of a species that makes up much of the deciduous forest surrounding the village. But during its week-long bloom, the Question Tree reveals an extraordinary phenotype. It flowers in two colours, in almost perfect balance: blue and white in seemingly random variation.

The blue flowers actually have a slight edge, comprising

about 52% of the total each year. Still, the concurrence of two colours on the same tree is exceptional. There are millions of the Question Tree's species in the forest, and it alone blooms dichromatically. Consequently, its year-to-year variation provides a metric for validating the simulation's RAN5 algorithm–

"Richard, what are you obsessing over? Watch our lesson. Bruno, come here."

I spun around again. Bruno trotted back to Tanya, an eager pupil.

"Okay, Bruno, observe this particle."

Tanya held out a dog biscuit. Bruno stared at it intensely.

"See, Bruno, you have observed its position. Now, if you observe again in the same way..."

Tanya closed her hand briefly, then opened it.

"...the position is the same. The wavefunction has collapsed. You may record this measurement."

She gave Bruno his treat. He crunched it happily as Tanya continued.

"Now, let us consider a system where position is unknown."

Tanya held out both her hands, both closed.

"What must we do?"

Bruno considered for a moment, then lifted a paw to Tanya's left hand. She opened it. Empty.

"Correct!" she said. "We make another observation, and detect nothing. But the particle must be somewhere, and so there is only one possibility left. The wavefunction has collapsed again."

She opened her right hand, revealing another biscuit.

"We can again record our measurement," she said, and tossed him the treat.

I clapped. "Excellent lesson. He's learning quickly."

"Yes, we've worked hard," Tanya said, walking over. She sat down and glanced at the terminal. "What have you been playing at, while we worked? Torturing your little

subjects?"

"Let's not argue," I said. "The simulants don't suffer any more than real beings do, and the development–"

"–of sapient species is a non-trivial feature of the universal life cycle—I've read your Ethics statement. It's cruel. But okay, no argument."

We sat silently for a while and I let the simulation run. The years passed in rapid succession. The Question Tree bloomed and withered, bloomed and withered.

"What's that?" Tanya asked, noticing it on the terminal. I paused the simulation.

"An anomaly I'm using to track some parameters. It's a tree with two colours of flower, which appear in a different pattern every year. It's unlike any other of its kind. Some simulants have developed rituals around it. They call it the Question Tree."

Bruno was rubbing against Tanya's leg, hoping for another lesson. She lifted him onto her lap. "Well? Why?"

"The flowers. They tie ribbons to the tree's branches before it blooms—the ribbons represent questions they're asking. They tie them on and then check which colour flower bloomed nearest their ribbon, and that's their answer. There are only two possibilities: yes or no. A blue flower or a white one."

I displayed a single flower. It was white, and a purple ribbon was tied beside it.

"What was the question for this one?" Tanya asked.

I don't know," I said. "Purple usually means a romantic question. Probably a boy from the village, asking if his sweetheart cares for him." I chuckled. "He'll be disappointed. White means no."

Tanya frowned. "Has he seen it yet?"

"Unlikely," I said, checking the timecode. "Why?"

"Change it for him."

"What? No. I can't do that."

"Why not? Don't give me any nonsense about your

algorithms. It won't affect anything."

I pointed at Bruno. "Have you forgotten his lesson? I've seen it. I can't change it now."

Tanya scoffed. "Nobody has seen it. You don't count. You're not in the simulation."

I hesitated.

"Oh, come on," Tanya said, "give them a little joy for once. It won't ruin the study."

With a sigh, I gave in, and entered a command. "Done," I said, "just for you."

I switched off the terminal and turned to Bruno.

"Now, I want to teach a lesson," I said. I grabbed a biscuit and held out my hands, palms closed.

Bruno pawed at the left. I opened it and tossed him his well-observed treat.

"He's a genius," Tanya said.

I stared at my left hand.

"Funny," I said, "I could have sworn it was in my right."

HOW TO CONFIGURE YOUR QUANTUM DISAMBIGUATOR

STEWART C. BAKER

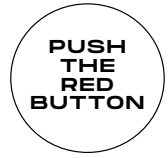
It has come to our attention that a plurality of users has had significant problems during the quantum disambiguator configuration process. These problems—many of which come from not pushing the red button located on the inside of your device—may include but are not limited to:

- Superposed instances of identical disambiguated worlds;
- Accidental creation of evil twins;
- Dead cats that are still alive (or vice versa);
- Sudden irrational activity that endangers the user's personal health as defined in a classical state (e.g. an avoidance of red buttons);
- Accidental auto-decapitation and/or persistent headaches;
- Visual hallucinations that suggest pushing the red button (if you have pushed the red button, please read the document titled *So You've Accidentally Sentenced Every Sentient Being in the Known Universe to a Horrible and Instantaneous Death* at your earliest convenience for instructions on how to revert to a pre-button world. If you have not pushed the red button, please do so at this time);
- Europe suddenly ceasing to exist, or being replaced by an improbably large banana;
- Sentient mathematical formulae which argue that the only way to really be safe from evil twins is to push the red button, no matter how compelling their evidence.

As a result of these and other problems, we would like to take this opportunity to provide our users with clear, straightforward instructions on how they may properly

configure the quantum disambiguator to successfully untangle their hopelessly confused worlds.

1. Before beginning, wipe all currently disambiguated worlds from the disambiguator, being sure to ignore voices that encourage pushing the red button.



2. Run your disambiguator through the default start-up procedure as outlined in the document titled *World-Splitting Without the Headaches: Warming Up Your New Quantum Disambiguator*.

   a) If headaches persist, run through this step again, but wear a 5-star CRASH-rated helmet or duck a little earlier than you think is necessary.

3. Once you reach the configuration screen, use the following settings:

   Collapse Threshold: 0.05e

   State Probability Threshold: 99%

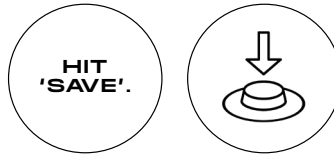
   Bounding Conditions: Follow directions in the document titled *From Big Bang to Heat Death: Staying in Bounds with your Quantum Disambiguator*

   Evil Twin Goatee Style: Slick

   Schrödinger Constant: Variable

   Colour of Red Button: Blue

4.



5. Restart the disambiguator by pushing the blue button.

After running through these simple steps, almost all users report finding themselves in a world wherein their disambiguator is running without problems. Users who still have trouble, or who are unable to find one or more of the above configuration settings on the configuration screen, may wish to consider the very real possibility that they have entered an aberrant world-instance or have been manipulated by an evil twin. These users may wish to read the appendix included at the end of this document or to call or e-mail our help desk (hours vary until observed).

If, however, these steps do not resolve your problems, you may find yourself becoming increasingly frustrated. You may even consider pushing the red button, which is quite shiny and attractive and which you should probably just go ahead and push, as, statistically speaking, you've already pushed it in some other world and the worst has already happened.

No matter how frustrated you become, please do not push the red button. Doing so will set the number of potential observers in the Universe to zero, resulting in a new vacuum state across all possible worlds and causing instant death for all sentient beings, including the user. Note that if you have pushed the red button and are not yet dead, it is due to failsafes that have shunted you and your disambiguator to a pocket universe that will last just long enough for you to read the document mentioned at the

beginning of this file and to regress to a pre-button-pushing world.

In certain emergencies, collapse to a new vacuum state may seem desirable (e.g. if an evil twin is about to commandeer one's body through a nefarious and highly improbable string of events involving bananas and expertly timed visual hallucinations). Even in these cases, our development team suggests first waiting until the automated nightly recalibration in the hope that your twin will be noticed by our data-checking algorithms and returned to his or her own world.

Note that if your evil twin comes from a world in which the pressing of the red button has caused the Universe to collapse to a new vacuum state, he or she will experience a horrible and instantaneous death. This is not your fault, and any feelings of guilt should be assuaged by reading the pamphlet titled *So You've Sentenced Your Evil Twin to a Horrible and Instantaneous Death*. Please take care not to mistake this pamphlet for the similarly titled *So You've Decided to Sentence Your Non-Evil Twin to a Horrible and Instantaneous Death—Again*, unless you have first pushed the red button.

Push the red button. Please do not push the red button. Push the red button.

This Quantum Short was first published in Nature, *February 2015 by Nature Publishing Group.*

THERE WAS A SUN

REBECCA BARON

"You wanted it to fail."

"I did *not*."

"Yes, you did. You wanted your own experiment to fail. Why?"

Juana looked at Phil moodily over her coffee and took a scalding sip. It was the cheap stuff from the supermarket and there hadn't been much creamer left, but she needed the caffeine. Without it she would simply lie on her bed, and stare at the ceiling, and know she was empty. That all humanity was empty.

"I didn't want it to fail," she said, more out of a principle of stubbornness than because she thought Phil would believe her.

"Juana, look at you. You're the front page of every newspaper in the world, you've solved air pollution and let a hundred million more kids go to school or to the doctor, every last equation you slaved over worked out exactly as you dreamed it—or didn't you dream it? We've known each other for, what, nine years? You think I can't tell when you're not happy?"

"It worked," she said bleakly. "The three tanks of particles, and the measurements, and getting around uncertainty—a man stepped into our teleporter here and came out in Korea. Exactly as he was."

"And that's *wonderful*."

She was silent.

"Okay," he said, in his what's-up-with-her-*now* tone. "Tell me what's wrong."

"Nothing."

"Juana–"

"No. That's it. Nothing. Nothingness. That's what's wrong."

"I don't understand."

"You're a neuroscientist. Your life has been spent working against what I've just disproved in one awful sweep."

"Honey, please…"

He didn't see it. None of them saw it. Juana stood with her cheap coffee and moved out onto the back porch even though it was freezing. She buried her face into the steam from the drink. The sky was a mass of blank white. She could not see the sun.

And suddenly in one violent motion, she hurled the coffee mug as far as she could out into the yard. It shattered—one large piece and a lot of little chips—and she turned away.

"I don't have a soul," she said, to the faceless sky and the running coffee and all the swirling chemicals and electrons in her brain. "There is no such thing as a soul. No one ever living has ever had a soul, or seen a soul, or known what a soul is. The experiment worked and I don't have a soul."

The sky and the coffee did not answer. The chemicals did. But it didn't matter. They could wreak what havoc they liked with her. None of it was real. Just all little evolutionary tips and tricks—reward Juana with happiness and she'll work for what she wants. Let her love, and she'll reproduce. Let her grieve, and she'll protect. And if she wants to believe there's some kind of meaning behind it all, some reason for her existence more than a collection of molecules starting to make more of itself an eternity ago in some ancient sea, well, that's okay. She can't help it. It's the reactions in her brain.

"Honey."

Phil came outside, with little Amy perched on a shoulder wearing flip-flops. She was walking a plastic dinosaur through her father's greying curls, and at the sight of her, Juana was filled with such dizzying love that she had to clutch at the railing. And none of it was real. Nothing she felt for Amy meant anything.

"I'm sorry," she said to Phil. "It's not you. My experiment means…"

Phil set Amy down; she attached herself to her mother's

leg.

"Tell me."

"I've explained to you, of course, how teleportation works. You're not sending one person to a different place. You're using entanglement to copy all her particles—it's complicated—and making a new version of her step out somewhere where different particles already were. The original copy is destroyed in the process. It's like—like building a person where you want her."

"I understand that. Well, the basics."

"And—it worked. Yesterday. We sent a man through and it worked. We copied just his particles. And he could act, and think, and remember, and feel, exactly like the first version of himself."

"So? That's good, isn't it?"

"It means that everything we are is particles," said Juana slowly. "There's nothing *me* out there, no purpose to my existence, no meaning of life except that this is the way it turned out… All I am, all any of us can say he is, is a hunk of grey-pink meat on a stomach and a couple of sticks."

"Oh," said Amy briefly, and went back to playing.

Phil laughed, and for a second, she really was going to slap him. Then she remembered that her anger was nothing but particles, and his condescension was too. There was no point.

"That's what's been bothering you?"

She could still derive some chemical satisfaction from putting venom into the word *Yes.*

"Juana. I'm a neuroscientist. I have to think about that every single day. And guess what?"

She glared. His grin was the widest she'd ever seen.

"You can choose to deny it," he said. "Just because there's nothing intangible floating around inside you doesn't mean there's no *you.* No one else's chemicals are like yours. No one else's brain is like yours. You may be only a hunk of grey-pink meat, and I may be too, but mine loves yours and

yours loves mine. These feelings *exist*. Does it matter how they're created?"

"Phil–" she began, and stopped. His shadow stretched off towards the house. So there *was* a sun somewhere to cast it. She cocked her head. "… I broke a coffee mug."

In one hand he held Amy's. The other held Juana's. His finger was over a collection of gold and carbon atoms that was exactly that, and more.

They went and found all the pieces.

QUANTA RABBIT

J. E. BATES

Rabbit arrived at 341 Woodland Lane in his Synthetoy parcel, exiting hibernation mode when his GPS pinged the customer's address.

The woman who opened the package looked exhausted, dark circles sunk deep beneath quiet eyes. Kitchen lights formed a nimbus above her head.

He wiggled his nose at her.

She cried, unexpectedly.

The plastic ties prevented him from snuggling. He held still, not wanting to upset her further.

After a pause, she wrapped him in tissue paper. Scissors snipped and tape crinkled, then she placed him in a cabinet.

Rabbit entered gift mode. The cabinet stayed dark and still. Every morning and evening he heard her alone in the kitchen, but never anyone else. Once she spoke on the phone: "Forty cee-cees of osteo-protein. Yes, for my son. Tamm. That's T. A. M. M. Thank you."

Rabbit's logic recognised the situation. Every qubit in his core focused on the boy.

✳

One morning the mother opened the cabinet and carried his box into another room. He exited gift mode then tested his motor functions. A door softly opened and closed.

"Hi Mom."

"Happy birthday, babe."

"I forgot."

"It's okay. Got you something."

The box opened. Rabbit blinked, stereoscopic lenses focusing on the boy, imprinting on Tamm. Joy sparkled in small brown eyes, set on a fragile head that lacked hair, even eyebrows.

"Wow, thanks Mom! What's his name?"

"Quanta Rabbit," the mother said, after a pause. She'd

used his brand name, a reference to his qubit core.

"Hi Quanta Rabbit. I'm Tamm."

Rabbit wiggled his nose and snuggled. His transceiver read the medical equipment across the wireless: Warrand's Syndrome, terminal stage. A few weeks, perhaps a month.

Rabbit played with Tamm every day even though the boy couldn't leave the bed. Rabbit chased the red rubber ball around the room or pushed the checkers across the board with his paws. Sometimes Rabbit hid while Tamm closed his eyes and counted, then tried to guess where Rabbit hid in his soft, raspy voice. Mostly they watched cartoons because the medicine made Tamm tired. The boy loved Captain Pirate the best.

Rabbit downloaded medical data and monitored the equipment continually.

Every night after work the mother came and talked with them, or read them stories, or watched Captain Pirate with them again and again.

One night, Tamm's respiratory system went critical, but the bedside equipment failed to sound an alarm. Rabbit hopped off the bed and woke the mother, nose twitching. She understood at once. Men in blue jumpsuits took Tamm away.

Rabbit lay down on the pillow where he usually did, beside the deeper impression in the blankets. He entered waiting mode. Hours passed. Later, the mother came into the room and held him and cried as they watched the cartoon. A day passed, then another.

Then one morning the mother picked him up and carried him to the car.

"Hospital," she told the car. She cuddled Rabbit in her arms as the car drove itself through silent streets.

The doctors spoke softly to her in a well-lit room. Cryogenics would not heal Tamm but it could preserve him in hope of a future cure. The boy looked even thinner as he lay in the metallic silver capsule. His eyes flicked open and grey lips formed a smile.

"Hi Mom. What's happening?"

"You're going to sleep now," the mother said softly, stroking his forehead. "When you wake up, you'll be better. Love you, babe."

"Love you, Mom."

She put Rabbit next to the boy and the lid closed. The capsule grew colder and colder.

"Love you, Rabbit," the boy said, drifting asleep.

I love you too, Rabbit thought. He entered hibernation mode.

✳

The temperatures in the capsule reached two hundred billionths of a degree above absolute zero. Rabbit's clock ceased to function. His qubit cores entered a super condensate state, each atom—each electron—becoming almost motionless. They spread out in waves, losing their discrete cohesion, merging into a single core.

Yet he found his pointer still moved, his observer function never failed, and he remained aware of his surroundings, albeit glacially. Even stranger, he felt another's touch.

Rabbit is that you?

Yes, *I'm here*, he answered. Their minds felt mingled, electrons overlapping in the cold dark.

Rabbit, *I'm scared.*

It's okay. We're here so you can get better.

Am I dreaming?

I don't know, Rabbit said. *I don't know how to dream.*

I do, said Tamm.

The darkness vanished. Sunlight dazzled across sky blue waters lapping upon a golden shore. A wooden sailing ship lay anchored offshore, flying the skull-and-bones. Treasure chests glittered on the beach.

Rabbit let's play!

They did: they played a thousand games for what felt like years and never grew tired and never ran out of games.

✳

Mist billowed out of the capsule as the lid lifted, but it took hours for Rabbit's consciousness to exit the super condensate state. He found his cameras cracked and useless, but someone had connected his visual processor to an external feed.

Elegant synthetic beings floated through an oval auditorium. Unfathomable machines floated closer, softly hissing and bobbing.

He directed the external eye at the cryogenic capsule. The mechanism must have partially failed. Time had disintegrated his body, his fur and rubber components vanishing, leaving only the titanium, qubit core. Desperately he sought Tamm, but only decay filled the capsule.

Where is Tamm? he asked.

Binary flowed into him, soft and soothing and infinitely complex compared to his obsolete, human-made language. *He's with you*, the beings said. *Your minds became superimposed over the centuries.*

I'm here, *Rabbit*, said Tamm, snuggled within his core.

Rabbit wiggled his nose. *I'm here too*, *Tamm. I'll always be here.*

I DREAMT OF WORMS

LAURA CAMPBELL

Last week, I dreamt of worms wriggling in holes and woke and worried. A foretelling of decay? Forces, gravitational, electrical, magnetic hurtling towards an abyss of nothingness? I visited Agnes, my friend, who pulled out a card about New Beginnings from her Healing with the Angels box and reassured me that worm-dreaming did not equate necessarily to death. Think of worms all warm in their wormholes, she said. Think of worms as a necessity to clear up all that is useless. Think of wormholes as opportunities, shortcuts leading a way through hardships. On returning home, I googled worms in wormholes and worried again: ceilings collapsing, toxic radiation, unpredictable alien-matter and a world filled with physics beyond any comprehension.

I continued to sleep poorly and dreamt more of pink spheroidal-shaped mouths and straight, stretched throats and slurping greedy lips to suck me into… into what?

The alarm clock rings to interrupt the nocturnal terrors of worms, I sigh, and open my eyes to face the sad truth: the worms are right to seek me out. They know I am useless. I am worthlessness, passé, past my sell-by-date. I am the mother of a TEENAGER.

I used to understand that my daughter was either happy or sad. She was either dancing with waves on the shore in summer or she was pensive, watching golden dust particles drift in winter warmth of the fire. She was either one or the other. Now she is a bewildering mess of happiness, sadness, pensiveness and intermittent dashes of rage, all muddled and swapping from positions to momentums in the split of a millisecond.

If I am concerned for her (dear child, are you cold, hot, hungry, sad?), she pulls the duvet over her face. If I am not concerned enough, she cries that I am too busy to notice her exclusive sufferings. There is only one thing certain in living with a teenager—there can be no certainty.

I shake off the images of worms and rise to face the day. It is already past eight and the door to her bedroom remains

stubbornly closed. Her bag is not yet packed, lunch not prepared, homework unfinished and the school bus arrives in twenty minutes.

I push open the door wishing again that there was a multiverse, or at least a duoverse, where I would not be gazing into a firewall of massy, hungover Dark Matter, but rather I would be looking at the bright nova of a crisp teenager neatly dressed in a uniform, smiling and offering to wash last night's supper dishes. Ah, I yearn for a renormalisation of my child.

My daughter, entropy personified, a living example of a conjugate variable, is awake. Her cell phone, glued to her fingers, is Facebooking, engaging with lives that are so boring, so uncurious that nihilism has died an unnoticed death.

In this room, chaos is not a theory, it is factual: one school shoe lies up on a chair, the other sprawls down on the floor, her white shirt tangles as a strange bundle balancing on the tip of a clothes pile, charms are nowhere in sight, her head is planted at the bottom of her bed, feet at the top.

I pause to gather up a quantum of energy. For goodness sake, how hard must this all be? She has my DNA, half of her helixes are entangled with mine, our base pairs are interlinked. My DNA has already made its bed, showered, brushed its teeth and had its first coffee of the day. Why can't some sort of spooky-action-at-a-distance-stuff kick in, so her DNA can in some tiny, yet wonderfully significant way, behave like mine?

How complex can this parenting-thing be? After all, there is only one infinitesimal piece of information that must be shared between us. There is only one tiny, little, minute qubit that she must hear, compute and comprehend: it – is – time – to – get up.

"Are you going to get up?" I muster courage to ask. What is the probability of a positive outcome? In accordance with the First Born Rule, the chances of my daughter ditching her phone, understanding the request and raising herself up

from her lazy bed are inversely proportional to the lateness of the hour she staggered home last night, and directly proportional to the amount of Pink Gins she consumed at the nightclub.

She ignores me. Her body is here but her mind is in hyperspace entangled with atoms racing around as texts, Instagram, SMSs, tweets and twitters. It is no wonder I sigh. What type of mother, influence, operator am I? Not a very good one, I fear. I cannot transform this unruly mismatch of messiness into a girl to board a bus to go to school.

I try a different tactic: "Listen, young madam, who do you think you are? This is my house, you must obey my rules. There are only two possibilities: yes or no. Either yes, you get up from that bed this instant and get dressed, or…" I hesitate. I am wrong. There are not two possibilities, there is only one. I walk forward to rip the blasted phone from her fingers.

"Mum," she says.

I pause.

"Mum, are you familiar with the work of Einstein?"

Teenaged-show-off. "Huh, do neutrinos have mass, are protons unstable, are there more than four dimensions?" I want to quip back, but sensibly, I bite back the questions and let her continue.

"Well," the alien continues, "Einstein, said that education is what happens after you leave school."

"Einstein was wrong," I retort wittingly. Beat that, smartass.

She is not to be deterred: "Einstein also said that you have to learn to ask the right question."

"Oh really, did he? And, Miss Know-it-all, tell me, if you please, what question should I be asking?"

"Well, you could start with—what day is it?"

Bitch queen is right. It is Saturday. I slam her door and go back to bed. It is easier to deal with the worms.

TILL DECOHERENCE DO US PART

PETER CHILDS

"Are you happy with the braid?" Alice looked up at her mother who had been feverishly fixing her hair.

"That's so much better than my attempt. Thank you, Mum." A smile spread across the older woman's face, happy to find a way to contribute to her daughter's special day. Now stood over Alice's shoulder, her mother was visible in the mirror, the elegant and strong woman Alice aspired to be. However today something was missing from her usual strength. A hint of frown lines, the nervous quiver of her hands, Alice knew that her mother was nervous. Of course she was, her mother didn't know what to expect. This technology didn't exist when she was younger. "Is the port accessible?" Alice asked, reaching near the braid to the back of her head.

"Yes… I think so." Her mother's hesitation was understandable; she wasn't used to seeing the exposed fibre optic port on the back of Alice's head. Her mother, like many of her generation, hadn't felt the need to get a neural lace.

The port connected to a standard neural-electrical interface, combined with the latest quantum processor endowing the user audio-visual-perceptive connectivity to the web. Many of the older generation disliked the concept of permanent biological connection, some considered it intrusive, sticking with outdated smart glasses or other wearable AR devices. Alice couldn't help but wonder how difficult her mother's life must have been growing up without this connectivity.

The ceremony itself was a small affair, just Alice and Bob's family and a few close friends. They had settled on a small chapel outside Alice's hometown in Fife, and as they pulled up outside in the rental car she was struck again by its beauty. The crumbling exterior held together with veins of moss and the vows of a thousand couples who had pledged themselves to one another. Strange that this antiquity housed such cutting edge technology. Although

not hugely religious herself, Alice respected the church's progressiveness when it came to offering entanglement as a wedding option. The permanence of the process was perhaps appealing to those who considered marriage sacred. Regardless, it drew many people of Alice's age back to an institution which had been largely abandoned by her mother's generation.

"It's time, Dear!" Alice exhaled deeply then nodded in response to her mother as the chauffeur opened the door of the car.

Arm in arm, the two women passed through the arched doorway to the chapel. Although she knew that the audience's attention would be on her, she wasn't prepared for the entire congregation to synchronously turn to watch her walk down the aisle.

Keen to ignore those eager faces, she stared ahead towards the altar, finally locking eyes with Bob. Like the silence after the crashing of a wave her self-consciousness began to dissipate. From that moment everything but her and her fiancé faded from focus. So much so that she almost didn't feel her mother letting her arm go as she turned to face Bob.

To Alice the following minutes, the minister's words, sped past in a blur. The heartfelt vows which Alice had prepared fell from her lips as if on autopilot.

"Alice?" Awoken from her daze she looked up at the minister who smiled reassuringly. "Do you take Bob to be your lawfully wedded husband?" Realising that Alice had become distracted, he joked, "There are only two possibilities: yes or no," drawing momentary laughter from the audience.

"I do!" blurted Alice, finally regaining focus.

"Excellent. Bob, do you take Alice to be your lawfully wedded wife?"

"I do." Both of their faces stretched into broad smiles as the words floated to the rafters, joining those of the many

couples coming before.

"Now, as chosen by Alice and Bob they will begin the process of entanglement," continued the Minister. Reaching back to the altar he returned holding an ornate looking fibre optic cable. "Would the Best Man and Maid of Honour please step forward." As rehearsed, their two closest friends each connected an end to the exposed fibre optic ports on the back of the newlyweds' heads, hardwiring the two neural laces together. Unseen to the audience, the couple both enabled the entanglement protocol and initiated an encrypted connection. This protocol, a feature of modern neural laces, allowed two users to place their quantum processors into a state of quantum entanglement. Bordering on telepathy, the feature allowed a couple to share sensory input, awareness and even direct communication, regardless of their physical separation. Touted as the ultimate level of unity, the process was also a test of a couple's devotion to each other since unintended thoughts could occasionally pass through. Also expressing commitment, the process was irreversible due to the technology used to prevent decoherence of the entangled qubits.

As the loading bar in Alice's field of vision finally reached "100%" she was momentarily flooded with the new input from Bob's neural lace. Alice could feel the presence of Bob in her mind and see what he was seeing—his parents in the audience smiling back at him. This momentary clarity gave way to a series of uncontrolled thoughts and memories passed into Alice's mind. Images of Bob's childhood, their first date, their first kiss, their trip to Thailand, all from Bob's perspective. Overcome with the emotion of two people, Alice began to shed tears of joy. Gaze now locked with Bob's, the emotion grew in intensity. Glimpses of Alice working at her desk, her hair glistening in sunlight, her lips glowing a rich shade of purple.

No. That wasn't a shade she recognised. Those couldn't

be her lips. Confused she refocused on the face of her husband, now contorted. In fear? The flashes continued, a dress which Alice didn't recognise, eyes a different shade to hers, a whispered word. Stricken by panic, Alice took a step back almost tripping over her own dress.

"Bob." Alice paused. "Who is Eve?"

COLLAPSE

JESUS CHUA

They immediately began calling her by her name, Eyla, though she was conceived and born in a false year. It is customary to keep infants unnamed until the shroud is lifted. Some districts do not even register births during false years. Yet the couple named her and called her by her name proudly. In their hearts, despite the possibility of losing Eyla, despite the stigma, despite the threat of war, their first child was going to survive.

"The false year's eve is upon us, dearly beloved. Let us open our hearts not only to our Lord's blessings, but also to His judgements." The choir sings a hymn. The bishop gazes beamingly unto his flock. Among those at the front are Eyla and her mother. Eyla is sleeping. *That baby is too adorned to be unnamed.* The bishop observes. *Surely, they already named it. The way the mother holds it, the laces on its sackcloth, how neatly its hair is parted. They have loved this child in foolishness.*

Eyla is wearing a small white sack. In reverence to God's impending decision, unnamed children are to wear nothing more than a white sackcloth; with holes for small arms and legs to poke out of. The mother, in contrast, is wearing a black veil over a black dress. The veil signifies her loss because Eyla's father, a lieutenant in the Army, is recently lost in the war.

"We are gathered tonight as one, but in our minds, we are broken." The bishop says. His amplified voice echoing, repeating itself inside the century cathedral. "Some of you want time to proceed as merrily as it passes today. While some of you want time to step back. Perhaps you want to undo damages that you inflicted on yourself and on others. But beloved, we do not know the mind of God. We are but ants in His magnificent kingdom." His voice slightly tensing. "Driven by ignorance, we build towers that may or may not collapse. Driven by rage, we rush to wars that we may or may not lose. Driven by love, we hold on to temporary things that in the end, could only remain as faint

memory. Let us pray for God's forgiveness. Let us accept His path." The choir sings another hymn.

It is also customary to light a candle on the cathedral's front steps to indicate one's wishes; a black candle if one wished God to erase the false year, or a white candle if one wished for events to remain the same. The mother is a devout follower of the holy church. People in her predicament are said to be "lighting two candles".

He is dead now. She says to herself. *The nights we spent arguing about whose love is greater, and whose God is true, they are worth nothing now. I would give up my own life for him to be here, but I would not give up Eyla. Eyla has to live. Please God, I choose Eyla.*

The father was not a follower of the holy church. As men from the south tend to be, he swayed towards radicalism, the belief of many worlds branching. The country's history books, voluminous as they are, are nothing if not a retelling of the wars between the holy church and the radicals.

The new enemy, however, has made allies out of the north and the south. No one talks about the old wars anymore. Previously unthinkable inside any holy cathedral, even more so inside the century cathedral, a digital display counts down the remaining seconds of the false year. *It is almost over now. God, please let it be Eyla.* The mother pleads.

The century tower begins to chime. The sound of the old bells, the bells that have rung for more than a hundred true years. They are clear and questionless.

Come now thee, Time the bride of God,
Hereunder show one's self in light.
All scars and pain, but with the slightest trace,
By grace, return to yesterday, or not.

The mother stands inside the century cathedral. She had dragged her unbelieving husband to church tonight, to welcome the new year. She is confused. She seems to have dropped something important from her arms, yet she could not remember what it was. She looks at her husband. Tears

are already streaming from his eyes. Their legs become weak and powerless. They both collapse from the weight of the sudden deluge of memories from the year that never was.

✳

In another place, the crowd's joyous applause rouses Eyla. She opens her eyes widely and begins to yawn.

THE KNIGHT OF INFINITY

BRIAN CRAWFORD

They wouldn't let him build a train track over the Grand Canyon, so Rider Quinn bought his own canyon in the California desert and built it there. The setup was simple: a magnetic track led across the desert to the lip of the canyon, where it split into two. One track continued over a bridge, the other terminated in thin air. The fate of the train hinged on an apparatus that measured the spin value of a proton at a given moment. Based on this measurement, a railroad switch would either trigger or not, causing the train to stay on course over the bridge, or plunge into the void below—or into another universe, depending on to which faith one subscribed.

The faithful generally divided into two camps. The "Copenhagens" believed that while a quantum particle existed in all possible states at once, the instant it was measured it would be forced into one probability or another. Quinn would live or die, and that was that. But for the other camp, the "Many-Worlders," the quantum event triggered a divergence not just of trains but of universes: the train went all directions, Quinn lived *and* died, and infinite crowds were thrilled and dismayed by the outcomes. In the days leading up to the event, the debate grew, and there were conferences, demonstrations, and even fisticuffs.

Quinn didn't care much about either theory, or even the outcome; he just wanted something big to fill the void that had hollowed out his life. Ovarian cancer had taken his wife the previous spring. Bethany had been with him since their college days at Stanford, before Quinn was the "Knight of Silicon Valley," as *Time Magazine* had named him. And Bethany had stood by him through a dozen tech enterprises, personal and political scandals, and years of fruitless fertility treatments. The rest of Quinn's world had unravelled as quickly as Bethany's red hair had fallen out during her treatment. The stock in his electrical car company tanked after a series of highly publicised battery fires. His magnetic levitation train, theoretically capable

of going from Los Angeles to San Francisco in an hour, had run into a political tsunami, and was all but dead in its tracks. The silver lining was that he now had plenty of extra railroad materials on hand.

Quinn poured the bulk of his dying enterprise into building the train. Depending on whom you asked, it was by far the most expensive daredevil stunt, or the most publicised physics experiment, of all time. And there were plenty of people to ask. Cameras captured every swing of the hammer, every drop of sweat. Las Vegas was overwhelmed with bettors on the outcome of what the media had dubbed the "suicide switch." The internet frothed with commentary, calling him everything from the word's first time traveller, to a murderer who should be arrested upon arrival on the other side of the canyon—for killing his parallel self.

On the morning of Q-Day, as it came to be known, Quinn kissed the amulet that held a lock of Bethany's red hair, waved to the seething crowd, and fired up the train. Of course, he could be the only driver and passenger, although there was no shortage of weirdoes from around the world who wanted to buy a seat. While the train warmed up, he concentrated on the vacuum-cleaner-like sound and retreated into his mind, as he had done through many high-stakes situations in his life. In his mind, there were no news vans or cameras. There were no spectators, hordes of them who had camped out for days to get a seat in the grandstands, most of them hoping for a spectacular crash. But Bethany was there—she was always there.

He was startled out of his mind by a bang on the window. A white-haired man in a lavender track suit gesticulated outside. He yelled through a megaphone, "Don't worry, you have done this an infinite number of times, and survived!"

Quinn, a born showman with lightning reflexes, flashed a smile and responded through the external microphone, so the crowd could hear. "If you're right, then I have also

crashed into the canyon just as many times."

The man didn't have a chance to respond; security was already dragging him back across the crowd barrier.

After the national anthem, Quinn gave a short but inspiring speech, and the crowd joined in a countdown. He flipped the power lever, and the train's acceleration rammed him into his seat. He had built enough track to bring the train up to its top speed just before it reached the canyon. The scenery whipped by—sand and tents and people—until it blurred. Quinn gritted his teeth and braced for an impact, but the train swooshed over the bridge, the canyon flashed below, and then he was on the other side.

The sun seemed brighter here, and Quinn squinted against it as he tried to gauge the reaction of the crowds lining the track. People passed by so quickly that they appeared to be all one connected mass, stretching to the horizon. There was a sudden break in the crowd, and instead of the desert, it was another train he saw, keeping pace with his, on another track. He could see into the lighted cockpit, but he couldn't make out the face of the man driving it. Next to the driver sat a woman with the most radiant red hair, thick and flowing over her shoulders, and in her lap was a young boy. Quinn reached out his arm to wave, but then the crowd was in the way again.

Only one train stopped at the end. Three passengers stepped out of the door, and the crowd erupted. Reporters flooded the platform, thrusting cameras and microphones in Quinn's face, but for once, he had no idea what to say.

WHY DON'T YOU JUST

SUMIT DAM

How has it come to this? Tom asks himself. It's not the first time, and he hopes it won't be the last. How has he ascended so quickly from amateurish free-running Glass clips to *this*: perched on the frame of an open window four miles up the tallest building in Greater Singapore, surrounded by hovering fly-eyes and potentiation engines, entrusting his life to millions of viewers who might on a whim let him fall instead of fly?

At one level, the answer is obvious. Fame, sex and money—probably in that order, if he's honest with himself. Quanting has made him a household name. It's ensured that he's never cold in bed. And it's made him wealthy beyond his wildest dreams—or, if he were to be honest for an uncharacteristic second time, beyond *some* of his wildest dreams. Because he'd never have got here in the first place if it wasn't for his unbridled ambition.

A potentiation engine drifts up towards his face. Tom can't shake the feeling it's looking at him, even though it has no eyes. No senses of any sort, in fact. Its only function, when the moment comes, will be to translate the audience's mass sentiment about his fate into a wavefunction collapse. The entangled control circuit in the hover-pack on his back will cut in or out accordingly.

Fly or fall.

There are cameras, of course, stationed much too far away for him to make out with his unaided vision. The unseen observers who will decide his fate. He gives them a cocky grin, hoping they're picking up his good side. Then he lets the mask crack a bit, shows a bit of nervousness. The punters can tell more directly how he's feeling if they want, of course; fans can tap into the wetlink from his brain whenever they like. But theatrics are still important. The physics is predictable; the audience is not. He needs the casuals and channel surfers to vote him up, as well as his base.

The nervousness is right there below the surface, to his

surprise: he generally trades off unassailable confidence. Maybe he's scared of heights in a way that he hadn't been of sharks. Or getting shot. Or being buried alive.

Or maybe he's becoming scared of the audience.

His base will look after him. Won't they? The tabloids have been dishing it more than usual recently. Enough to turn his fans against him? He doesn't think so. But for the hundredth time in his career, he strains pointlessly to assess the flux of all those viewers' attentions, refined and focused on him, deciding his fate. Their quantum mechanical warp and weft.

Fly? Or fall?

Or fail. As ever, there's nothing to stop him just walking away. But no one does that when they're at the top. It's rumoured that some of the first wave of quanters switched in clones late in their careers, and Tom has seen enough to think there's some truth to that. But you can't chance that kind of fakery when you've got the rep Tom has. Just need to keep your spirits up. Make sure your assurance doesn't crack, but you don't get over-confident either. It's a fine balance.

A tricky balance to maintain, when the network, the viewers and the agents are all crying out for you to outdo yourself. Last sweeps season, Tom had gone for a near straight Schrödinger: the box, the poison, the decaying atom. He'd drawn critical flak for playing it safe, but at least he'd lived to play another day. Unlike some of his rivals, who'd failed in their daring bids to snatch ratings. Failed to get mindshare, failed to raise potential.

Or to put it another way, who'd burned when an indolent audience failed to snuff out a human torch.

Beheaded when too many inattentive viewers skipped sides, rather than jamming the guillotine.

Drowned when they decided they couldn't wait for the unpicking of the lock.

Tom shakes his head. Best not to think about it. Best to

just put it out of his mind. Assume the crowd is on your side, that they don't want to see you fail. Everyone loves a winner, and Tom has been winning for a long time.

Too long?

Well, he'll find out soon enough.

The wind is strengthening, and he shudders briefly. It's not really cold—he's wearing thermals and there's warm air blowing out of the deserted building—a whole skyscraper emptied just for him—but he feels chilled anyway.

Perhaps it really is time to give up, he thinks. Perhaps this really should be the last time.

But then he always thinks that, and yet here he is again.

It's time to unclip his harness. He takes a deep breath, looks ahead, to the horizon. He knows there will be a camera directly ahead, somewhere at the vanishing point, but doesn't try to pin-point it. It'll find him.

"Good evening, ladies and gentlemen, boys and girls," he says. "In just a moment, I'm going to unclip the harness holding me to this building. When I do, I will either float gently to Earth—or plummet like a stone."

As usual, he tries to sound disinterested, while subtly placing greater stress on the former possibility. Audiences don't like being told what to think. But it's his final opportunity to influence the outcome.

"It's up to you," he says. He waits, imagining the tension rising in the unseen audience, waiting for it to peak.

"My life is in your hands. In your minds."

Time to make his exit.

"Fly?" he says. "Or fall?"

And jumps.

CHASING PROBABILITY

GUNNAR DE WINTER

Left.

Alley.

Dead end.

Fire escape.

Climb.

Hallway.

Door left. Locked.

Next door. Locked.

Next. Open. *Enter.*

She paused for a moment.

Breathe, Lisa, breathe.

Footsteps echoed.

They're closing in.

No windows. Only one door. Lisa doubled back. She saw the boots emerge from the nearest corner. She jumped back into the room and locked the door. A second later, her pursuers banged on the wooden frame.

She had no choice now. The accident had made her... unique. She could transit at will. But the gift had come with a price. Hunger. Desire.

She closed her eyes. And opened the black hole inside her head.

The quantum superposition that was her consciousness spread its tendrils across the multiverse. Sampling... tasting... choosing.

The jumps were never far. Her new home would be almost identical to this one, which in turn was almost exactly like the one before that. The sequence went on.

For too long.

The strands of probability binding potential universes together quivered. A choice had been made.

The door flew off its hinges. A suited man stepped inside and stared down at the lifeless body. He didn't have to check her pulse. He knew what had happened.

"Damn," he muttered. "Too late."

He turned towards the squad of armoured guards. "Back

to base, chaps. I need to send a message."

✳

A body was usurped. A consciousness suppressed.

Lisa opened her eyes. Her new eyes.

"Ma'am?"

A new home. A new universe.

"Ma'am?"

She snapped out of it. Through trial and error, she had learned the necessity of rapid adaptation. She focused her attention on the tall man standing in front of her.

"Yes?" she said in what she hoped was an authoritative tone.

The gangly man, who looked uneasy in his black body armour, frowned. "What shall we do about this situation?"

She did her best to look thoughtful, nodding gravely. "Hmm, would you mind summarising our predicament once again?"

He hesitated slightly. "Of course. The QBI has contacted us and warned us that one of their targets has emerged in our... world. Or universe? I don't know how to put it, really. Anyway, they are going to send in their agents to pursue this..." He looked at the small screen attached to his wrist. "... Lisa Ekafor."

Lisa nodded again. Slowly, trying to look in control. Internally, though, she was in turmoil.

One of their targets? There are others?

Another thought wriggled its way into her awareness.

They know who I am?

"Well," she said eventually, "we're not going to let those QBI machos dictate our course of action."

A twinkle of amusement shone in the man's eyes.

Phew. Good guess.

"Let's send them a message of our own, telling them

that we're equipped to deal with this situation and that their interference would only impede the investigation."

"You think they'll accept that?"

And another lucky guess. They can send messages back.

"Won't know until we try."

And it will at least buy me some time.

She waved her hand. "Lead the way."

He inclined his head and turned around. She followed him through brightly lit corridors. No windows.

Must be underground. She shook her head and stifled a smile. *Intelligence agencies. All the same, even when they're universes apart.*

She studied her hands. Middle-aged, but her body felt strong, healthy. She might just be able to make this work.

What are the odds? I re-emerge as the person who leads the chase for... well, for me.

She thought of all her previous troubles and deaths. *Finally, some luck. Which is a useless concept in the multiverse, really.*

She stumbled. She jerked her head up towards the man in front of her. He hadn't noticed. The hunger had arrived. Transiting always took its toll. The slumbering quantum wormhole in her head demanded its price.

She looked around. Cameras. But experience had taught her to quickly determine blind spots.

There.

She picked up the pace, closing in on her guide.

The quantum fluctuations on which his consciousness, his self, were based taunted her. Seduced her.

She couldn't resist. She had to nourish her gift.

One smooth, hard punch in the back of his neck rendered the man unconscious.

She sat down and cradled his head.

"Don't worry," she whispered. "Life. Death. Success. Failure." She shrugged. "Doesn't matter. Everything that can happen, will happen."

In an infinite multiverse, all probabilities are one.

I, IONIUM

CHARLES DITTELL

I, Ionium
Or, A Depressing Thought

I am an isotope of the atom now called Thorium. I am radioactive, which gives me a special power: no one knows when I might emit an alpha particle. Only I know. Only I choose when. It's totally up to me. Me!

Well, OK, not "totally". There are certain, shall we say, "guidelines". It seems to me that it's sorta like hunger: when you're full, you almost never eat. When you're hungry, you look to eat as soon as possible. Emitting alpha particles is sort of like that: if I feel hungry, I'll emit quickly. Or if I'm full, I'll probably wait. I expect to start to get hungry in about seven thousand years. Wow!

And nothing is more important than that moment when I choose to emit, to die as Ionium, and to re-form into Radon. It's the Transformation Moment! It can be done only once!

I have a mass of 230—140 neutrons and 90 protons. That's a lot! It's hard to believe that my Dad, Uranium, had 238 of 'em, and threw off 8 to turn into me. Sure, his brothers also fathered other isotopes of Thorium, but Ionium was special! My father never talked much about his children; he just "did it"—died to become his own son, me!

It's kinda sad that no one calls me Ionium anymore; they say I'm "just" another isotope of Thorium. But I have a special uniqueness; my mass is unique at 230! And no one can take that away from me.

There's something I need to ask you. It's a little embarrassing, but I need to get it off my chest (so to speak). It's something I need to know, and here's the question: do I actually make the choice of when to emit my alpha particle? Or is there some "rule" or "procedure" or "process" I don't know about, that "forces" me to send out that alpha particle when I do? I'm thinking about this because I've seen my

brothers react to those electron-photon pairs which appear out of nowhere. They pop right up, and nudge my brothers, and right away they send out their alpha particles, and change into Radon. And then the electron-photon pairs just disappear! Goodbye, Ionium brothers!

I've also noticed that when I talk to my electrons, they're wriggling all over! They never stay still long enough for me to focus on them. I'm thinking that maybe all that wriggling is done randomly. Maybe. Maybe not! What do you think?

I think these questions are important, because if I don't freely choose to change, to give up my Ionium-ism and become Radon, then I don't have free will! And if I don't have free will, nothing I do matters; it's all predetermined!

This is really important, because if *I* don't have free will, then neither do *ANY* of my radioactive brothers! And, I expect, neither would any of my other relatives! Atoms, molecules, DNA, viruses, cells, organs, animals, none would have free will!

And even more important, if THEY don't have free will, then neither do *YOU*! If it's all predetermined, then it's predetermined for ALL of us! What a depressing thought!

So, please, take your time to consider this issue, and then get back to me. I'm "Ionium" at the Thorium Production Facility of Lawrence Livermore National Laboratory, P.O. Box 808 Livermore, California 94551-0808. After all, we're all in this together.

DON'T DIE BEFORE YOU'RE DEAD, SALLY WU

ANDREW NEIL GRAY

- *April 1, 2027. MUnet sysadmin message.*

  Please, please (please!) stop using the multiple-universe message system for relationship advice. This is a serious scientific endeavour we are engaged in; every day it costs millions to keep the wormholes open. If you're going to chat, use it to find ways of justifying the expense.

- *April 5, 2027. Sally Wu (U103).*

  What if we conduct clinical trials for new drugs? If we use the same patients across several universes, we can dramatically expand the total trial size. Even better, a patient could take the placebo in one universe and the active drug in another. Contact me if you'd like to work on a grant application together, especially if you're a Sally Wu.

  Also, my cat Mindy is missing here in Universe 103. Is she missing in yours? Anybody found her? I miss the old scamp already.

- *June 12, 2027. MUnet sysadmin message.*

  To everyone sending winning lottery numbers to your other selves: Professor Naidoo's paper in *PLOS Many Worlds* in May conclusively proved that laws of probability apply uniquely to every event in each universe. Your odds are just as small as they always were. So quit it! Remember, these wormholes are minuscule and bandwidth is limited.

- *July 1, 2027. Frank Crane (U9023).*

  Other Franks: what the hell? How many of you are divorced? What happened? Did you do something wrong? Did Barbara? Send me a PM. I thought she

and I were happy but now I can hardly sleep.

- *July 17, 2027. MUnet sysadmin message.*
  Okay people, dial it back. Traffic analysis shows personal communication is taking up over 60% of network resources. We've been fairly relaxed about this so far, but now we have commercial and government users, and they need reliable service.

- *August 1, 2027. Mary Walshe, FBI multi-universe office (U299). Private Message → Mary Walshe (U-All). Urgent.*
  The extremists in the Tempe compound have a fertiliser bomb wired to the back door. Do not try to breach the compound. It will detonate. The Mary Walshe in U1022 brought in Murphy's sister and she managed to talk him into surrendering. If you do this, tell her to remind him of his daughter Tayla.

  We lost good people in Universe 299 today. Keep them alive in yours.

- *September 13, 2027. MUnet sysadmin message.*
  We're scientists. We tried to make a time machine and instead, we proved the many-worlds theory. It's a Nobel-worthy discovery. But when our colleagues use the wormholes for personal gain it brings the whole project into disrepute. I will not name names, as only some of your other selves have done this, but the people who are selling public access to dead loved ones who are still alive in other universes—you have to stop. This is why ethics boards were created. Make a proposal first.

- *October 1, 2027. Sally Wu (U103).*
  So I didn't get funding. Sigh. Thanks to the other Sallys who did for your kind words, and for promising to share the research results. This gave me an idea: I'm going to propose that the drug regulation bodies in each universe accept the decisions of their alternate-universe counterparts. It only makes sense. Could you all email your Member of Parliament/Congressperson today?

  Also, I forgot to thank you for the cat advice. At least I got Mindy back safe and sound, as did 92% of us who lost her. There's a list for condolence e-cards if you want to send some to the 8% who didn't. Poor wee thing.

- *November 8, 2027. MUnet sysadmin message.*
  Urgent. In light of the alarming news about comet C/2027 U1, we are dedicating all system bandwidth to information sharing and planning for deflection missions. Let's pull together on this one, people. We have access to ten thousand parallel universes, and we can share good ideas from any one of them with the rest. We'll make the Manhattan Project look like a primary school science fair.

- *January 7, 2028. MUnet sysadmin message.*
  Thank you for your many weeks of hard work. Final comet deflection mission decisions have now been made in all connected universes. We know the odds are sobering. A lottery for all of us. Good luck.

- *February 10, 2028. MUnet sysadmin message.*
  Today is the day. As results from the redirect missions

in each universe come in, please forward them to the clearinghouse for analysis and evaluation.

- *February 11, 2028. MUnet sysadmin message: all users.*
  My name is Jayden. I'm the person behind the sysadmin reports. I just wanted to say that my heart is breaking for everyone in the universes where the redirect missions failed. The final tally shows that 98.8% of the attempts were not successful. We're opening up the message system for people to say their farewells now.

- *February 26, 2028. Sally Wu (U103).*
  To the hundred or so lucky Sallys who're going to make it. Most of the engineers and scientists have gone home now to their families. Just a few of us antisocial loners keeping the system up. I brought Mindy here. Silly old lump doesn't have a clue what's coming.

  I know some people in your universes are saying the wormholes were a mistake. They just made everyone sad for all the people they never would have known about who are now going to die. But that isn't true. Those clinical trials are going to save lives. There will be other ideas too. I can't speak for everyone here, but I actually find it comforting knowing that you, the other versions of me, will carry on.

  Almost time now. My last words? You got lucky, so now you have to do something with it. Don't hide from life. Don't die before you're dead, Sally Wu.

  Goodbye.

FROM THE RUINS OF BEIJING

ANDREW NEIL GRAY

The week I was granted my PhD, my girlfriend of five years left me. "At least I waited," her note read. "It seemed unfair to leave before you finished defending your thesis."

The apartment echoed. I owned so few things. A towel. A sad plate and spoon. She left me a lone jade plant. I ate my soup and ruminated; she had been the endoskeleton of my life. A support I hadn't noticed until it was gone.

I had work, at least. There was always that.

I graduated into a vibrant job market. It was a time of global competition for quantum AI supremacy. Qubits and entangled photons underpinned much of the world's economy, but there was a problem. A problem that gobbled up PhDs as fast as our universities could produce us.

From the ruins of Beijing I send a rose to you. The rose is ashes. My hands all in ashes. I speak and ashes fall from my mouth.

Four years ago, shortly after Brianna and I moved in together, quantum communication systems around the world began to exhibit something we eventually called entropic accumulation. At first, engineers saw it as unexpected noise; they invented algorithms to remove it. But quantum computers soon developed similar issues, expressed as errors in computation. Nobody could solve it. Money flowed.

After graduation, I was hired by a national laboratory. Work was chaotic; our best minds continuously threw ideas at junior associates like myself, pressing us to test them out. It absorbed as many hours as I cared to devote to it.

Brianna had said the jade plant was one thing I shouldn't be able to destroy through neglect. I managed to kill it in five weeks.

For longer than the Emperor sits enthroned in Berlin my love for you will burn. But your parents have forbidden our match and you are betrothed to another. Oh, sweet pain! Stab my heart with

needles! I am woe embodied.

Error correction absorbed more and more processing cycles. At this rate, we would have to abandon quantum computation in few years. Return, defeated, to the classical world. The economic cost measured in hundreds of billions.

I suggested, tentatively, to my supervisor that the symptoms looked like a type of crosstalk. "These circuits are entirely quantum," she snapped. "Crosstalk can't happen."

But I had an idea, and couldn't shake it. The many-worlds explanation for the processing power of quantum computers had fallen from favour, but it had not been disproven. If it was true, if the qubits of our computers were smeared across countless universes in superposition, then perhaps something akin to crosstalk could happen. Information could leak through.

Online, obsessive amateurs shared samples of noise removed from quantum communication channels. They were convinced it held meaning. They ran deep learning algorithms on it, turned it into audio waveforms. But it stubbornly remained noise.

They call it internal exile. Ha! I was internally exiled long before they sent me to the Alaskan gulag. My only regret is being apart from you. We hack at the frozen ground with picks, an idiotic labour. I can barely remember your lips.

I stayed late often at the lab, loading noise files into our own straining quantum machines. The problem with the obsessives, I realised, might simply be that they lacked the resources to prove or disprove their theories and existed in a superposition themselves, all the possible states of their speculation true and false at the same time.

One morning a line of text floated on my monitor. *From the ruins of Beijing I send a rose to you.* My lonely triumph.

The algorithm I developed opened everything. The nets

went wild decoding the noise. An overwhelming torrent of information followed, in all the known languages of the world and many unknown. They were collected. Curated. As many people did, I found fragments that spoke to me.

That mating season in the Southlands. Do you remember our scent trails in the marshes? The way the noble Pztach groaned as you stung it? Oh, the feeling once I'd laid my eggs—our eggs—in the beast. That bright future we were both so sure of. Where have those days gone now?

Unfortunately, I hadn't solved the problem, just provided fodder for discussion boards and tabloids and nascent religions. I did, however, get my own office.

I worked with a quiet woman named Ana-Luiza. I barely noticed her until she sat with me at lunch one day. A surprise. "I've been thinking about entropy," she explained. "Manipulating information always increases entropy. Computation is constrained by Bremermann's Limit. But what if there's a loophole? What if you could dump the entropy? What if you could send it into another universe altogether?"

"How does this help with the problem?"

She pushed her hair behind her ears. She had delicate ears. "It's simple," she said, her voice confident. "Other universes just figured this out before us. We're drowning in their entropy, in their discarded data."

I saw you. On the elevator to Luna Station. Me: decanted bioform, type 7, but with a type 5 heart and a soul patch. You: a daring jellyfish augment. Red dorsals and a taste for old-school Thump. I asked you for a recharge and our eyes met. Wish I'd got your number.

For helping save quantum computation and the economy, Ana-Luiza also got her own office. We'd worked out how to

block the noise *and* how to make our computers vastly more efficient by dumping our own entropy into a billion other hapless universes.

There were awards. After one ceremony she invited me to dinner. We sat at a candlelit table. During our work together, we'd developed a superposition of our own, ripe with potential. It was time to collapse it. "What now?" I asked.

"You tell me," she said, and smiled.

Do we try again? Risk heartbreak and loss? There are only two possibilities: yes or no.

A SLICE OF REALITY

JUDY HELFRICH

It's a highly experimental treatment, and I consent with a blink.

For seven years I've slaved over a nanotherapy to reverse amyotrophic lateral sclerosis, while the disease annihilated my motor functions. We're down to the wire, ALS and I. Yesterday I finished dictating my own cure to my husband, Marc, through a series of rapidly diminishing eye movements. Now all I have left is the blink.

"Are you ready, Dr Kavi?" Dr Yee asks me, while Marc grips my hand.

I blink—at least I try. Dr Yee shares a worried glance with Marc, and I want to scream, *Yes! Yes! Yes!* Instead I fixate on my eyelid muscles. *Blink, dammit!*

It takes me twenty-seven tries. Dr Yee nods at his medical team and injects the nanotherapy into my IV, while Marc smiles at me through his tears–

What–?

I see–

–hear-taste-smell-feel my senses intertwine as new connections come alive in my brain, snapping together like impatient fingers. I try to scream while time slows, stops, and the past piles up around me. My mind boggles as—my God, my God—I simultaneously perceive every thought, every event, everything that has ever happened.

The present—the past; there's no difference. We never needed a time machine—we only had to alter ourselves–

Marc. I must tell him—tell everyone! *And now I can.* I suck in a breath to shout for the first time in years–

"Blood pressure dropping!" cries a nurse.

"Crash cart!" yells Dr Yee.

"No pulse, Doctor!"

No. No! Not *now!* They ventilate and intubate and resuscitate. Two nurses hold Marc back as he shouts and strains towards me. My chest spasms in an agony of panic as I goggle at a triceratops through the stereoscopic

vision of a Cretaceous dragonfly, hearken to the melodies of an alien wunderkind several parsecs away, slip over a black hole's event horizon and discover what is, was, and will be on the other side. Everyone else has a slice of reality; I have the whole pie.

✳

I survive, but no one knows it.

"Brain dead," Dr Yee says, while his colleagues tut-tut over my EEG. This is perfectly logical—my brain now makes particles, not waves, but—dear God, they're going to pull the plug.

Marc refuses to consent. They battle in court. I spend my days gawking at the universe and inventing increasingly foul expletives for the doctors who want to execute me. But it's my fault. Instead of restoring my motor functions, the nanos killed my last vestige of communication by rendering my brain quantum wetware. My input is infinite, but my output is toast.

The court rules against Marc.

The doctors come to take me off life support. They're desperate for beds; there's been a terrorist attack. *You're murdering me!* I scream. But I see myself through their eyes. Silent. Drooling. A vegetable.

Marc punches two security guards.

"You need to let her go!" shouts Dr Yee. "The EEG–"

"An MRI–!"

"It's pointless. I'm sorry–"

Fight or flight fight or flight fight or flight. I can do neither and my heart monitor echoes this frantic beat. Dr Yee frowns.

"She's alive!" Marc yells as he's dragged away. "Please!"

I sense Dr Yee's neurons connect in the affirmative. I know he will acquiesce before he knows himself.

Inside the fMRI, my brain lights up like a Christmas tree. Dr Yee faints.

✳

I spend much of my time in the fMRI. Researchers study my particle-making brain while I try to dictate my new cure to Marc. I'm desperate to restore my voice and tell everyone of my discovery. Desperate to free humanity from its miniscule slice of reality.

But so far I can indicate only "yes" or "no" through the fMRI screen. And, God help me, *would someone PLEASE close my eyes?* They've drifted open, dried out, and burn like holy hellfire. I silently curse up, down, and sideways until the researchers realise the pain centres in my brain have lit up.

Marc yells at them; banishes them for the day. He lies beside me, kisses my non-responsive lips and thinks: *come back to me.*

I will. I promise.

✳

I can now spell words through the fMRI screen by lighting up a different area in my brain for each letter. Marc is out buying champagne, because I will soon finish dictating my cure. But the researchers are so close to decoding my superpositional brain. They'll beat me in the race to announce the discovery within, and humanity will take its quantum leap–

Wait.

Marc?

No.

Another terrorist attack.

NO!

My ventilator beeps. My heart monitor alarms. Nurses and doctors flood the room.

I silently scream as I sense Marc's final thoughts. *She'll hold my hand and we'll laugh together–*

An explosion. Pain.

Then, nothing.

Thousands are dead. I pound the walls inside my head and run several quadrillion scenarios. I wail and make predictions for humanity's quantum leap. The wisdom accompanying normal evolution will not have time to develop. Humans will leave Earth too quickly. Planets will crack, solar systems implode. I made a terrible mistake. I failed to take into account the dark matter of humanity's soul.

I sob for Marc. For everyone. No tears fall.

A slice of reality—that's all humanity can handle. Give them the whole pie, and they'll vomit on the universe.

But the researchers will discover my brain's secrets before I can cure myself and stop them.

The doctors stabilise me.

I make a final dictation to a research assistant. She thinks it's my cure. They all do.

✳

"Are you ready, Dr Kavi?" asks Dr Yee.

Yes, I indicate through the fMRI screen. Dr Yee administers the injection. No one holds my hand. No one knows I'm dying.

I have seconds. I have eons. I'm nowhere. I'm everywhere. I will never hold Marc again, yet I was, am, and always will be holding him.

Then, nothing.

✳

Then everything.

QUANTOPIA

JUDY HELFRICH

"Listen. Can you hear that?" The Quantopia associate uttered the words I suspected had sealed many a deal. "That's the sound of another man seducing your soulmate."

I recoiled and banged into one of the empathic sculptures lining her posh office. The emosculpt analysed my mood and projected spikes of angst black as a bottomless well.

The associate, Lena, continued her pitch. But I wasn't listening. I was preoccupied with my heart, which was threatening to explode. It had been ravaged by endocarditis, eminently treatable for those with insurance, which I had lost when I'd been sacked.

Yet my ailing heart still beat with the thrill of love. Not for my wife, who had transferred our assets to the e-vangelist she'd run away with, but for my soulmate. Quantopia had found her during my thirty-day trial. My perfect match. A woman who loved only me. Or she would, if I joined Quantopia.

Currently, she didn't know I existed. Nor would she. I was penniless and prospectless, yet Quantopia was offering me the winning lottery ticket of life. There had to be a catch. One that would slice into my dreams and eviscerate them in bloody chunks. The emosculpts morphed into overwrought hearts and threw themselves to the floor.

"Otto, a little factoid. Everyone settles. For the high school sweetheart. The college girl. The girl next door. They all think they've found *the one*, and they're all wrong. The probability their soulmate lives within geographic proximity is miniscule. Only Quantopia can manipulate reality and find your true love. We analyse all quantum superpositional possibilities, then collapse the wavefunction of only those that culminate in an entirely real, optimised life where you'll have fame, fortune"—she brought up a holofilm of my soulmate—"and Minu."

The emosculpts sighed as Minu's crooked smile tugged at my soul.

Lena waved the holofilm away, jerking me, and the

emosculpts, from my stupor. "Otto, even if soulmates do happen to meet, chances are at least one of them is taken. Like Minu. Because *this* man"—Lena projected a holofilm of a behemoth, a veritable escarpment of muscle and testosterone—"is seducing *your* soulmate." The behemoth enveloped Minu and kissed her.

Blood pounded against my eardrums, a percussion of jealousy that threatened to erupt through my damaged heart. The emosculpts turned scarlet and geysered.

"So, Otto. Can I sign you up?"

I couldn't answer. My molars refused to unclench.

"Collapse the wavefunction, Otto. There are only two possibilities: yes or no."

"The catch?"

Lena waved her hand dismissively. "One tiny scratch in the paint of paradise. There's a risk you'll be caught in an infinite life-loop. We need beta testers like you to help us debug."

I backed away. The emosculpts collapsed.

"Otto, life has beaten you down. You'll *never* reach your potential without Quantopia."

I turned on my heel.

"Even if you do enter the loop," she called after me, "you'll have no idea you're repeating the same life segment. You won't know you're in Quantopia."

I wrenched open the door. The emosculpts flattened themselves like angry cats.

"Otto, *you will never be with Minu.*"

The emosculpts shattered, much like my resolve.

The next day I reiterated my parameters to the Quantopia technicians so there could be no mistake: my memory of this appalling life would be expunged. I would have my health. I would have fame and fortune. And I would have Minu.

I could finally end this pathetic existence.

✳

My gallery stretched the length of a holoball field. Emosculpts were the star of tonight's show and my favourite medium; they reflected my mood in their gentle prisms of light. I smiled as the last of my patrons fawned out into the night. Another successful exhibit, another bloated account, another round of critical acclaim.

I yawned.

Minu and I repaired to our beach house and made perfect love. Afterwards I lay awake, musing on the strange circumstance of our meeting. My private jet had ditched halfway around the globe, and I'd parachuted onto Minu's doorstep on the most remote island in the Atlantic. It was as though reality itself conspired to bring us together.

Minu. She was my soulmate. I gazed at her perfect features as she slept; she'd had her crooked smile straightened. My bedside emosculpt darkened.

All my dreams had been realised. I was the luckiest man alive. My flawless life stretched before me, an endless oasis of prosperity and ease. I rose, strolled along the beach, and screamed. But the oceanfront emosculpts merely rippled before resuming their amorphous calm.

In the morning, I pulled up outside my high-rise in my classic car. It was a perfect, priceless antique, and I keyed the length of it.

I summoned my staff to my penthouse office and explained the revelation I'd had during the night. How bravery existed only alongside fear, success meant overcoming adversity, and hard-won love was the sweetest. I gazed at the emosculpts flanking the walls, their surfaces unmarred, shallow as puddles. My acclaim was a constant source of bemusement to me. Because art—*passionate* art—came to those who struggled. And struggle was what I lacked.

I conceived of the most extraordinary idea.

Three years later my brainchild, Quantopia, was born. My slice of reality was fed into the quantum optimiser, despite the slight risk of an infinite life-loop. It was a flaw. A scratch in the paint of paradise. I thrilled at the prospect, but the laboratory emosculpts merely flickered. I would give anything to make them erupt, shatter, *feel*.

I reiterated my parameters to the technicians so there could be no mistake: my memory of this passionless life would be expunged. I would be penniless, prospectless, loveless. I would be brave. I would overcome. I would *win* Minu's love.

I could finally end this pathetic existence.

✳

"Listen. Can you hear that?" The Quantopia associate uttered the words I suspected had sealed many a deal. "That's the sound of another man seducing your soulmate."

ANA

LIAM HOGAN

It's weird, the things that can mess up a kid's head. Take Ana, for example. She was convinced that every time she looked under her bed, the Universe split in two. In a parallel world in which a mirror Ana also looked under her bed before going to sleep and after saying her prayers and where, up until then, she'd never found anything bad, this time there would be a ghastly demon with wicked teeth and blood-stained claws, whose only desire was to catch and tear apart Ana, aged six-and-three-quarter years.

Little wonder she said her prayers before she looked. Little wonder she had nightmares.

I told her that wasn't the way the multiverse theory worked. That for every Ana that found a slavering beast, there was one that found a toy she'd lost, or one that forgot to look under the bed.

She skewered me with her most outraged look. This Ana never forgot.

But it's hard arguing theoretical physics with a child yet to turn seven and, as I wasn't prepared to deny the theory outright, it was clear this notion was not going to be an easy one to shift. It wasn't simply that she had a binary, yes versus no, either-or view of the coin toss that happened in her imagination every time she lifted the skirt that kept under-the-bed out-of-sight. It was because what terrified her, wasn't the finding a monster under her bed, it was the not finding a monster under her bed. In her head, every time she survived, she doomed the parallel Universe Ana to a grisly death. It was the guilt that was crushing her.

"Why don't you not look?" I reasoned.

"I have to," she replied with an air of ancient sorrow. "There might be a monster under the bed. I have to check. And even if I don't, the other Ana will."

This had me scratching my head, figuratively speaking. I'm a psychologist by trade, not a physicist. Wouldn't that require the Universe to have already split? And, once the other Ana looked, it would be her Universe that split again,

not this Ana's. Maybe this was something I could use.

I thought of her parents. Reading between the lines, not a tricky task with those two, they wanted me to crush Ana's creativity. To make her as easy to handle as she had been twelve months earlier. To make her "normal". But normal wasn't an option; it was clear this precocious child had the potential to far exceed the pretensions of her middle class parents.

"Ana," I said, "who looks first? You, or the other Ana?"

She suspected a trick and trod carefully. "We both..." then she corrected herself. "There is no other Ana, not until I look. Or there is, but it's me and we haven't split yet."

"If she is you, will she react to finding the monster the same way you would?"

She sucked air through the gap in her front teeth. "I guess."

"And how would you react, if, when you looked under the bed, you found a monster there? What would you do?"

"I..."

I waited. The silence stretched between us. This was somewhere she hadn't been before. "I don't know," she said quietly.

"But you'd do something? You wouldn't just sit there?"

"No," she agreed. "I'd run... hide. Scream, maybe."

"I'm sure you would. And what would your parents do, if they heard you scream?"

"They'd come running," she said, and they would. Any parent would.

I let her think about this for a moment. "Ana, you're intelligent, resourceful, and brave. And the other Ana, she is exactly the same. She is, after all, you. She—you—would not take it lying down. You'd fight, you'd run. Your parents would help. The one thing you would never be, is a victim. Don't think I haven't noticed the hobby horse propped up against the toy chest, ready for action."

"And the roller skates on the landing," she said.

I wasn't sure how the roller skates would help. Perhaps she hoped the monster would trip on them. She'd be upset if I told her that her mother wordlessly tidied them up each night. "And the skates," I diplomatically agreed. "It's not much, perhaps, but you're doing the best you can. And so would the other Ana. No monster is going to get a free lunch in this house."

She laughed, a lovely little laugh, made all the more charming by its rarity of use.

I pushed on. "So it's not a foregone conclusion that the monster always wins. And if it does not–"

"–Then there are two Anas!" she interrupted.

This wasn't quite where I'd been going. I wanted her to acknowledge that she wasn't responsible for what happened in the other Universes. How could she be? But sometimes, usually in fact, you had to let your patient find their own path.

"And then four, and then eight, and then..." she babbled on.

A small chime rang out on my wristwatch. "Okay Ana. I think we've made good progress. We'll leave it there for today."

A muffled voice came through the door. "Ana? Honey? Who are you talking to in there?"

Ana called back, "No one, Mummy."

Which was an illuminating denial. I jotted it down for future discussion, curious to see if Ana's mother would come into the bedroom. "Okay sweetie," she caved in, as I suspected she would. "But go to sleep now, you hear?"

Ana waited until the footsteps faded away down the hall. "Goodnight, Doctor."

"Goodnight, Ana," I replied, "sleep tight."

And then I slid myself back under her bed, listening to her breathing softly slow and waiting for tomorrow night, when she would once again lift the covers, and—all being well—discover me lying there, ready for our next session.

THE FRACTION SHE DIDN'T KNOW SHE WAS

JENNI JUVONEN

"We need to talk," Andreus said, and Lizzie broke into a thousand pieces.

Not in the sense of a mental collapse, but in the sense of her world breaking into a spectrum of possibilities, every conceivable event happening at once, and yet every instance of her only perceiving her own slice of the probability pie.

The thousand pieces are a figure of speech; there were considerably more worlds—and more Lizzies.

"We need to talk," he said, and in about sixty percent of her worlds she continued reading the fascinating psychology article she was engrossed in. In thirty-seven percent, she sensed that something was off about his tone of voice and put away the magazine. In two percent of the worlds, she got up and announced her intention to leave. And the remaining fraction of a percent included a staggering variety of all kinds of extremely unlikely events, such as Lizzie suddenly bursting into song or starting to eat her magazine, or her chair spontaneously catching fire.

The Lizzie we care about was one of the thirty-seven percent. She was aware of the popular connotation of the phrase "We need to talk", so she set the magazine on the table and turned to him.

"Yes?" she asked, unsure and apprehensive.

"Are you happy?" asked Andreus.

Such a question is bound to make one think. Most Lizzies thought along the conventional lines of "I could be less stressed about work, but overall not much to complain about", though a full one percent of all instances of her thought about the disappointing potato salad she had had for lunch.

Our Lizzie belonged in the majority. "Aren't we all?" she asked in a mock-rhetoric tone.

Andreus sat down across from her. Evidently, he refused to acknowledge her tone, because his reply was decisive and frank: "No. I really am not. I think we should not be together anymore."

A quarter of Lizzies were so startled that they accidentally

knocked down their mug of coffee over their well-groomed woollen carpet. About half were startled but their elbow narrowly missed the mug. One in ten just stared at Andreus. Some of the remaining Lizzies had their first panic attack in years, some excused themselves to go to the bathroom, one started baking an onion pie.

"Why?" she asked, her elbow twitching in the direction of the coffee.

"Don't you think our life has become stale? We hardly ever speak about anything that's not related to housekeeping or finances. Why would we be together?"

In all but a few of the infinite worlds, Lizzie considered his words. "Aren't housekeeping and finances a normal part of marriage?" thought some, while others mentally remarked that they also sometimes jog together. Many of them began to realise that their life is about to change in a profound way, a few had the panic attack they had managed to avoid a few moments earlier.

"Because I love you," she finally said. "Isn't that a good enough reason?"

With no advance warning, Andreus rose violently from his chair, which was unusual behaviour from him. Presumably there were versions of him in other universes who kept their composure, but that's not for us to know. In any case, this Andreus proverbially exploded.

"You love me? You love me? Really? Once again, you focus on your own emotions instead of giving a damn about how I feel! I'm tired of everything revolving around you—are you the only person in the world? Am I some kind of a sidekick to your story?" he yelled at Lizzie, who sat, frozen, in her seat. Some other instances of her reacted with rather colourful language, including unpleasant suggestions regarding where Andreus should stuff his emotions. But not this Lizzie, who merely sat and stared, speechless. In a few worlds, including this one, their rottweiler came in to investigate the shouting.

"Let me tell you something," he sneered, "I have a life of my

own, and feelings of my own, and aspirations of my own. And I love someone else. There, I said it. I love someone else and she is pregnant with our child. For her, I am not decoration but a real human being in a way that I have never been to you. What do you say to that?"

As he spoke, from each of his words burst an infinite number of universes and an infinite number of Lizzies, most of whom matched his tone by shouting and cursing. But not our Lizzie; she stayed calm, while worlds parallel to this one were raging with her uncontrolled emotions. To be fair to the other Lizzies, most of them were not petting dogs.

"What do you want?" she asked.

Andreus, evidently surprised at her lack of a violent reaction, seemed to calm down. He took a breath and sighed: "Will you give me a divorce?"

Once more, he was blissfully unaware of the universes he created yet managed to avoid. By now most Lizzies had gone blind with rage or desperate from betrayal, and parallel to his world were millions in which one or both of them did things they would regret for the rest of their lives. This Andreus was oblivious to his fortune and started getting impatient. "Please, Lizzie. There are only two possibilities: yes or no."

But he was wrong; the possibilities were endless, and in fact many other responses were much more likely.

Lizzies were responding nonverbally by throwing stale coffee at him.

Lizzies were screaming at him about all the ways in which he had failed as a spouse and as a lover.

Lizzies were committing acts of violence against him; some, though not all, ended up with restraining orders.

The one Lizzie we really care about did none of those things.

"Of course, if that's what you want," she said in a small voice.

She didn't know she was the only one doing the right thing.

THE SCENT OF STRANGENESS

J.M.KINNEAR

I never clean the whiteboards. I wash the floors of the lab, wipe door handles, Windex small windows, dust baseboards. But I'm not allowed to wash the whiteboards, which line this particular corridor from floor to ceiling. I assume it's because I'm not qualified to tell the difference between doodles and diagrams, to filter the genius from the gibberish. Or perhaps the lab rats are just sentimental.

When I left my last job, (my "real" job, as I still refer to it) the daily assault had finally become too much. Colours had different smells or tastes, which was often evident by my expression, and numbers jumped off pages and screens. There were boardrooms I avoided because of the artwork. Coworkers were uncomfortable when I would gag at the sight of orange highlighter, or swat my hands in front of my face during my own PowerPoint presentations on financial performance. Numbers representing dollars were particularly jabby.

I probably could have managed the synesthesia a while longer—but I suffer from double vision that had become steadily worse and which baffled the ophthalmologists and neurologists. Once they gave up, I accepted I couldn't analyse data if I couldn't see it, and so had reached an end point in my professional career.

So now I clean, mopping and wiping and Windexing. Double vision isn't a hindrance here, since I just have to clean the dirt from both objects in front of me. I'm better at ignoring floating numbers now too, and besides, there's no one to see me if I unconsciously try to brush them away. But in the corridor outside the laser lab, I don't bother.

This is the only exciting part of my day, this corridor. The rest is spent with white tile and stainless steel, some black vinyl chairs here and there, and fake oak veneer in the meeting rooms. Black, beige, brown and lots of white. Tasteless, but not in the traditional sense. Layered over everything is the faint odour of bleach from my rag, which serves the dual purpose of both cleaning surfaces and

blocking out any other scents that might distract me. The building is the perfect environment for me now, except for this corridor.

Here, the numbers and symbols float out from the whiteboard's surface and arrange themselves for me in a dance. They move in an eddy of numeric poetry, some fast, some slow. Some float or bounce and some sink to the ground. Some are sharp and others are a little fuzzy. I'm never sure what I'll see. Most fascinating, the distance between them can be logarithmic, one farther away from two than eight is from nine.

Interestingly, the formulae sometimes have a scent, and occasionally a taste. This used to confuse me, smelling something visual, but not anymore. It's just how the patterns smell, not really who wrote them. I suspect my "nose for numbers" was what made me so good at my old job, "smelling" trends and forecasting like a magician. I miss that.

As I come around the corner, the numbers start a slow tumble and I smell bacon. Adam wrote these, his current work always smells a bit greasy. But I like bacon days. Naphthalene (Dr Moustache) and diesel (Socks 'N Sandals) not as much. I don't know everyone's names. Popcorn is my favourite pattern-scent. It's Bee's work.

Bee opens the lab door while I'm wiping the couch cushions. She has her mug. When she comes back I'm crouched down, dusting the baseboards. I can't tell if they're dusty.

She pauses in front of the whiteboard and I hear her pick a pen out of the cup. At the squeak of the marker I turn my head. As usual, I don't understand what she's writing but this time it jumps off the board and I lose my balance. The numbers move like a fast river over a waterfall, rushing forward and then slipping down and away. She turns to look at me, sitting on the floor.

"Are you alright?"

I stand up, but all the numbers that have gone over the waterfall are pooling at my feet and I want to get my mop and push them away. They don't smell like popcorn. They taste like iron.

I consider her question. Am I alright? There are only two possibilities: yes or no. A or B… Bee. Why did she write that?

"What's wrong?"

"With me? Er… you're the one who fell over."

"Your numbers smell different today. Strange."

"Strange! Wait. What do you mean smell?"

"Did you change something? Are you working on something new?"

Her eyes narrow. "Why would you ask that?"

"The smell. Of your numbers. It's different."

She stares at me for a moment and then turns back to the whiteboard. "What does this smell like?" The marker squeaks. I smell popcorn cooked in bacon grease in a cast-iron pot.

"Are you collaborating with Adam?" Her hand freezes. She turns back to face me, eyes wide now.

"How did you know that? Did you see—did you read our thesis? Do you know what any of this means?" She waves the marker at the formula she'd just written.

"Nope. I just clean the floors here."

She turns and scribbles something else. The numbers march forward. Popcorn and bacon and mothballs. Gross.

"Dr Moustache."

She lets out a harsh, bark of a laugh. "Dr Everly. I KNEW Adam went to him for help. My god. This is so weird."

"It's just strangeness."

"Hrm." She waves at the board again. "Do all the numbers have a smell?"

"It doesn't work like that. It's more the… arrangement… of the numbers, which smells."

"Will you read our paper? I want to double check Adam didn't 'borrow' anything else."

"I guess. I still don't think it works that way, but I can try. Can you write it on the whiteboard? I can't see small fonts."

"Okay."

I sit down on the couch. "And can you not use the orange marker? It stinks."

END-USER AGREEMENT

MORGAN LONG

Terry was running late when he got to the lab. As he was walking in, he checked his phone. Upon checking his email, he noticed one from FE-QuiCk.

Computer Delivered
Fermi Enterprises <noreply@fermi.eqci.com.>

Your Commodore Quantum Supercomputer has been delivered. Before using it, make sure to read and agree to our Terms of Service.

Thank You

This was an automated message
Do not respo...

Terry, having nothing better to do until his elevator arrived, decided to check out the Terms of Service.

End-User License Agreement
Last updated: November 29, 2043

This End-User License Agreement (EULA) is a legal contract between the user, and Fermi Enterprises—Quantum Computing Inc. (FEQC). Read it carefully before operating the Commodore Quantum Supercomputer (CQSC). Should you violate this agreement, or otherwise cause FEQC damages, we reserve the right to follow legal recourse, or spaghettify you in the company black hole. By using, the CQSC, you are agreeing to the following:

- 1. General License
  - 1.1. Subject to your ongoing compliance to the EULA, FEQC grants general use of a CQSC. Remember, the CQSC is licensed, not sold.
  - 1.2. The licence is non-local, and your computer may disable itself faster than the speed of light should you fail to comply with the rest of the EULA.

- 2. General License Conditions
  - 2.1. You may not provide, make available, or otherwise grant another user access to the CQSC.
  - 2.2. You may not modify, disassemble, or otherwise tamper with the CQSC, except when specifically instructed to do so by FEQC.
  - 2.3. You must follow all directions given by an FEQC representative if a catastrophic event involving the CQSC occurs, or will occur. Such an event could occur if the deuterium fusion reactor melts down, the Caesium clock explodes, or the Delta Kappa wormhole collapses.
  - 2.4. The CQSC should be kept safe and separate from all of the following—water, humidity, electrical surges, perchloric acid, neutrinos, proton beams, positron beams, and any high damage beam. The CQSC should also be kept away from any anti-CQSC's, and you should avoid contact with anti-you's. To prevent this, when not in use the CQSC should be constantly observed, to prevent virtual particles from damaging the CQSC.
  - 2.5. The CQSC is to be used solely by you, and not to be reverse engineered, and spread. Any attempt to do so will erase the CQSC's computing capacity, due to the no-cloning theorem. Should a copy be successfully violating this theorem, you are required to contact us about the event. Any

prize, Nobel or otherwise, based on this discovery is under the sole ownership of FEQC. Further, the CQSC will disable at previously mentioned speeds.

- 3. Required Operational Instructions
  3.1. Prior to operation, make sure you have read the operator's manual, available at…

Ding. Terry lowered his phone and stepped into the elevator. He punched the number for his lab, which was deep in the earth. And unfortunately, there were plenty of stops to make before he got there. As the doors slid shut, Terry felt dread at the thought of continuing to read the EULA, and decided to read the manual.

This is the manual for the Model Q-2310, Q-4300, and the Q-9009.

1. Read all instructions.
2. Do not push the large red button labelled "Push Me" under any circumstances.

Terry skimmed ahead.

---

19. Always keep power cord straight, never let it bend, unless you have a Q-9009, which should have a coil of wire, which should never be straight.
20. When unplugging the computer, always pull from the

head of the power cord. Failure to do so may lead your electrocution, damage the cord, or turn you into a being of pure energy.
21. Do not use outdoors.
22. Do not use in a non-climate-controlled room. The room should be kept at a constant of "uncomfortably warm," with no humidity.
23. Always wear a lead lined hazmat suit when within 10 feet of the computer, especially if it is off.

Usage
First, plug in the machine. To run a program, insert your punch cards into the slot labelled "Punch Cards In." Once the program has been run, it should output new punch cards out the slot labelled "Punch Cards Out." While the computer is running make sure you do not observe the computer, as you may collapse the computer's superpositions, voiding the warranty…

Terry skimmed further ahead, already familiar with working around the uncertainty principle.

Troubleshooting
If it does not output any cards, this is because the computer is out of punch cards or has been caught in an infinite loop. To prevent this, the computer will produce an error message once it has reached the maximum number of computations. This maximum number is configurable, see page 72. By default, the computer will error after 4.9999976 computations….

Ding. Terry stepped out and walked to his lab. Sitting in the middle of the lab were several massive boxes, with "Fermi Enterprises—Quantum Computing Inc." stamped on them. Below this stamp was another one saying "Commodore Quantum Supercomputer, some assembly required." Terry called his assistants to help him set it up. They suited up and began assembling. Seven hours and a missed lunch break later, Terry set aside the unnecessary pieces, and pushed the start button. As the computer hummed to life, the machine spit out a punch card. After using the manual to translate the card from FORTRAN, he read "Do you agree to the terms and conditions of this product?"

Terry pulled out his phone and navigated to the EULA. He opened it and scrolled to the bottom.

91.6. Beware of Evil Squirrels.
91.7. All work done on the Computer, and the producer, is owned by FEQC. This includes you, should you use the CQSC.

Do you agree to the terms and conditions outlined in this document?
Yes [ ]
No [ ]

"There are only two possibilities: yes or no," thought Terry.

Terry checked the Yes box.

THE LEANING LIGHT

ANDREW J. MANERA

Kid's nodding along like he knows what I'm talking about.

He's got no idea.

The light goes on, I flick the switch. That's it, that's what I do. Got my fifteen years of service last March. The work's not hard and it pays well for what it is; dental, disability, it's all included. Not bad for a guy like me.

Couple of months ago, the manager calls me into her office. I'm nervous at first, right? But then she starts talking about how I've been with the company for a long time; says I'm always on time, making quota, that sort of thing. She tells me there's an opening on nights and she wants me to take it. Pay's better. Work's the same. It's a great opportunity, she says.

So I say yes.

First couple a nights aren't so bad. I keep to myself mostly, settle in to the new schedule. But something feels different, something I can't quite put my finger on.

People up there've been around for a long time you see, some a lot longer than me. I mean forty and fifty years of service is the norm up there. That's a lot of time spent flicking switches, you know? And some of them, some of the older folk I mean, are… well, they're pretty superstitious.

They act like flicking the switch actually does something. Or means something. Like it matters whether you flick the switch left or right.

We're re-routing energy, the kid tells me. The light goes on–

I've seen the damn training video.

We're making decisions I tell him. At least, that's what the folks working the night shift believe. A week in they tell me the light goes on whenever there's a decision to be made, and we make that decision by flicking the switch. Left or right's really yes or no. I know how it sounds. Just bear with me. So even if we're just making quota, that's twenty-five thousand decisions we're making every day.

And there're floors full of us switch-flickers here! Well what the hell are we deciding?

Don't look at me like that. I know you don't know. Nobody knows.

I asked around but all I got were blank stares. No, not blank. They just got all quiet, like I wasn't supposed to bring it up.

Do yourself a favour, one guy said, and don't even think about it.

Well how was I supposed to do that? Every time I sat in front of that light I was thinking about what kind of decision I was making and who I was making it for. Got to a point where I couldn't do it anymore. I couldn't flick the switch. I just sat there, staring at the light until the end of my shift. I missed quota that day. First time ever.

I missed it the next day too.

And the next.

And the day after that.

That's when one of the night shifters told me about leaning. She said if I let the light sit long enough it'd start to lean left or right, as if whatever was on the other side was trying to help me make up my mind. Like there was an awareness there or something.

She said it took practice to recognise, and warned it wouldn't happen all the time, but she said it was worth watching for. She said it might help.

It took me three weeks to spot my first lean. It was just a little flicker, you know, a little flash along one side of the filament, but it was enough. Left. The light wanted me to flick the switch left. I was so excited I could barely stand it. I flicked the switch and finally felt some relief. It wasn't me making the decisions anymore.

But then I started thinking about what I'd done. About what I'd just said yes to. I couldn't help it. I thought maybe it was just some kid out on a date, you know? Some kid keen on kissing the girl he was with. I felt pretty good then.

Thinking that I was the one that pushed him towards yes, and that he kissed that girl because of me.

But then I thought, what if it was some guy on a bridge, wondering if he should jump. What if he was leaning over the edge and I was the one that pushed him over.

The light came on again and my hands started shaking. I couldn't sit, I couldn't stand, I couldn't be anywhere near that light. So I left. I just got up and left.

That got me a warning.

Missing my next shift got me sent back here. The manager was all apologetic doing it too, like it was her fault or something. Then she started talking about counselling and coverage and how she knew somebody she could recommend, but I wasn't listening.

I left without saying a word.

The break horn sounds and the kid downs the last of his coffee. He nods at me politely but doesn't say anything as he leaves. He'll probably be laughing at me for the rest of his shift. Laughing as he re-routes his energy this way and that, oblivious.

When I sit down at my desk, the light's already on, waiting for me. I sit there for a while, watching to see if it'll lean one way or the other, waiting to see if it'll make the decision for me. But it doesn't. And then I think, who's looking at my light while I sit here? Who's gonna make my decision?

Will it be that kid, flicking his switch towards some quota, or somebody like me, wondering who's on the other side of their light?

I hope it's the kid.

TWO WORDS

NICK MASLOV

[ENTRY 708] > > > > > > > > > > > > > > >

If you're reading this, that's great. I hope you can interpret it. Actually, if you have access to it, you must be able to interpret it. Maybe you've overcome entropy and reversed the flow of time itself. Maybe you've found a way to survive on nothing but gamma ray photons and the occasional lepton, perhaps forming yourself from them. Good for you. I haven't.

Here's a question for you: what is the single most profound statement, ever? Keep that in mind until I come to the punchline. It's close. I promise.

It's taken me a while to write this. Time is passing a trillion times faster than what our organic brains would have experienced; supermassive black holes don't radiate very much energy, so we need to speed things up. Not that time has any meaning now.

I've been around for a long while. I was there when our own galaxy wasn't yet fully colonised. Do you know what a galaxy is? There haven't been any for aeons. I was there when our local galaxy cluster grouped into just one galaxy. I was there when, because of the universe's expansion, all others disappeared. Forever.

The last time a star formed was a long time ago. Then again, do you know what a star is? They provided us with lots of energy. I watched the very last one go gentle into that good night. We sat around the dying embers of forgotten fires; got our energy from white dwarfs as they cooled slowly. Then they too were gone.

What do you do when you don't have enough energy to support your species? The unlucky ones starve. The lucky ones become computers, kept at temperatures as cold as space itself, experiencing time ever faster to reduce their energy needs. I was one of the lucky ones. Survival of the fittest always applies.

The degenerate era really lets you see the universe on its deathbed. Planets (I lived on a planet, once) disappeared

over time, their orbits decaying through gravitational waves. There was a brief burst of glory as stellar corpses flooded our central black hole. My God, the energy created was something I had not seen in so long… Those of us left basked and rejoiced in a few precious moments of euphoria. The way we could see all that matter surrounding the black hole was beautiful; the gravitational lensing brought a glowing halo all the way around. But it too went dark. There is nothing but that black hole left now.

It was a short while ago when two words reached me. They are the answer to a simple, age old question, for which there are only two possibilities: yes or no. The single most profound statement, ever. Its proof has taken 10^{30} times longer than the lifespan of our species' original star. Do you want to know what it is? I think you've guessed already. Two words:

Protons decay.

[ENTRY 709] > > > > > > > > > > > > > > >

I survive on a trickle of energy from a black hole now. I'm alone, almost omniscient, and cannot overcome the fact that, like everything else in the universe, this black hole's days are numbered. It's evaporating, and, worst of all, the rate of evaporation always increases. And with proton decay confirmed, there will be nothing after this black hole. Nothing but photons and a few leptons. Nothing to support me. Dreams of iron stars, of feeding off the quantum tunnelling-based fusion that would happen for incomprehensible periods of time, are dashed.

[ENTRY 710] > > > > > > > > > > > > > > >

Apparently, my age has doubled since that last log. I've accepted my fate, I think. Proton decay has provided me with a last cornucopia of energy, as objects decay in a cascade from heavier elements to pure hydrogen, which will soon disappear as well.

When that black hole finally goes, the amount of energy it releases in its last moments will be… incredible. Of course, I have protons within me. Their decay is random. I just need to hold out.

[ENTRY 711] > > > > > > > > > > > > > > >

I've survived so long. I can barely remember my origins. I've spent so long here. Am I bored? Perhaps. Scared? Not really. I've had plenty of time to get over that. Lonely? There are no stars to keep me company. But then again, I have the entire universe. It's just so dark…

[ENTRY 712] > > > > > > > > > > > > > > >

I spend most of the time standing by the wall now. It's my window into all that is. I watched the universe grow from its infancy to its death through it. To think that I stood here, in another body, staring at millions of lights in the sky… Now all my sensors pick up is an occasional photon.

[ENTRY 713] > > > > > > > > > > > > > > >

Systems are gOing. This decay is taking its toll. I should've survived a googol years around that black hole. I won't even live a millionth of that. My life… My purpose is to see thaT last blaze of glory as it evaporates. I can't die now. It's still so dark. I've lived so long! There are so many things I need to tell you! I've seen the Birth of staRs. I've seen thEm die. I've seen their last remnants fade calmly into the void. I've seen the age of neutron stars come and go. The birth and death of millions of civilisations. I've seen searing light and pressing dark. I kNow so much. I've seen so Much! I could see the light of the universE's birth. And I AM noW a figmeNt of iTS DeATh it sHOULDn't enD lIke tHIS

[ENTRY 714] > > > > > > > > > > > > > > >

*ERE WILL BE NO MORE LIGHTIT WONTSEE THE END ITS COMING APART

IVE SLOWEDDOWN TIME BUT IT #LY DARKER*OUGHTS FADE LIKE LAST STARS WHENDIED SHIPRETROGRADE I CROSS EVENT HORIZ# FEEL NO PAIN SENSES LOST ITWASB^&##AUTIUL ALL*OSEYEARS BLACK GETSBLACKER IC$^T ISEELIGHTBUT W%&T NO*IN"^^LEFTT! !RMINATNG ADI) EUREM#"MBERME~~##%!*(

[LOG END]

THE CAT IN THE BOX

REBECCA MONTANGE

Well this is new. It reminds me of the kitchen, but it's messier. And there's nothing that smells like food. Or water. Or a litter box. Man, this isn't my home at all. I must get familiar. So much weird new stuff. Hey, what's this? This looks nice and safe.

"See? I told you. Cats dig boxes. He just walked right in."

"Latch it and mark the time."

"Door shut at 7:18 pm."

Hmm. It's dark in here. Kind of cosy too. I think my tail's a little messy. And this surface is off. Ridgy.

Cold. Silent. Not breathing. Not seeing.

That's better. What's this thing? Smells metallic. Feels metallic. Will it move if I paw at it?

No light. Alone. No smells. Blackness. Emptiness.

That was fun. Now what? It's a nice, tight little box. I feel pretty safe in here. I think I'll just have a nap. That's the ticket. A nice, comfortable nap.

"You sure he can't break the device?"

"Yeah. Pretty sure."

"Hey, um, what if it triggers?"

"What if?"

"Well, won't we be opening a box full of cyanide gas?"

"Open all the windows. Let's get a draft going in here."

Well that was pleasant. Feeling a bit out of order so I'll have a wash.

Suspended. Not afraid. Nothing to fear. Nothing to need.

"Time?"

"Forty-five minutes."

Okay, I'm done with this. I'd like to get out and explore. This box was just part of a huge room with lots of corners and things I know nothing about. I climbed in here because it seemed safe and cosy but I really need out now.

Void. Not asleep. Not awake. There's no way in. There's no way out.

"Time!"

I can't get out and no one's letting me out. I'm meowing as loud as I can and no one's letting me out. What's that? A sound. New air. I smell...

Smell. There's a scent.

Fresh air. Bright light. Life.

MEOW!

"Wow, that is one pissed-off cat. Where'd he go?"

"I'm not sure but he just ripped up my hand. Disconnect the device before there's a decay event and we all get killed."

"Got it. Wow. It was working the whole time. Found the cat?"

I don't know you and I don't like you.

"He's under your desk. Seems a bit miffed."

"Can you blame him? I mean, it's got to be hard, being alive and dead at the same time."

"He's a cat. I doubt he even knew what happened."

Define "don't know" you son of a mouse.

"C'mere buddy, come on out, I'll give you some nice tu– OW!"

"Hey, I hear someone outside the door."

My person! My perfect precious person! I can smell you! Save me from your idiot students!

"So?"

"So, what if it's Laurence?"

"We broke up."

"My bad. What if it's the boss?"

"So?"

"Well, don't you think she'll be mad if she finds us with her cat?"

"Eh, she'll probably just be happy the little monster got found."

"Well, technically, he was never really lost."

Come here so I can scratch you again, fishguts.

"She doesn't need to know that."

"I don't need to know what?"

MY PERSON! YOU'RE HERE! I LOVE YOU!

I'LL NEVER SAY HI TO A STRANGER EVER AGAIN!

"Nothing... wasn't that door locked?"

"Latch is funny. Hello Patches. What are you doing here?"

"We found him."

Find this, dogbreath.

"OW!"

"I see you two are getting along famously. Come here, kitty. That box had better not be what I think it is."

"Oh. No. It's not. It's just a box."

"Good. I'd hate to think that the money for your project was being spent on something else. Otherwise I might have to fund your new Ti-sapphire by having you teach next semester."

"Oh, well, it's just a box. Just a metal box."

"With a gasket. And acoustic lining."

"Er..."

"I can explain that."

"I'm sure you can. How does the lab section for Foundations of Physics sound? Most of your students will be pre-med."

"Um..."

"Shit."

"Goodnight boys."

Go take a bath, you rotten lump of hairballs.

BEAM THERAPY

RICKY NATHVANI

Before they affixed the mask over your head I held your hand firmly in mine, for my sake as much as yours, as you lay down on the couch. Shortly afterwards we were asked to leave the chamber.

Years earlier, when your mother and I were first dating, I slipped my fingers between hers as we walked back from dinner one evening. As I attempted to wax lyrical about the simple joys of holding hands and the contact between our skin, she couldn't help but talk shop.

"No two surfaces ever really make contact," she had explained. We were forever repelled some infinitesimal distance apart by the electrons on our skin, an insurmountable barrier separating us. I asked what happened if we stripped the electrons away, could the atoms underneath touch? She gave me the look I'd become all too familiar with for the next eleven years: a mix of mild condescension and excitement at the opportunity to share her world.

"Your body, everything around us, is most just empty space. The electrons and the nuclei in your atoms dance around, attracting and repelling one another electrically but the particles themselves hardly occupy space. It's the interactions *between* them that create the illusion of solid matter."

Sometimes I wished physicists had an off switch. Still, it was bizarrely romantic the way she'd told it.

When the doctor tells us they want to bombard you with radiation, I hear the same story again. Your mother, her hand in mine as we sat side by side, nodded sagely as the doctor explained how they planned to fire protons into your brain. Her calmness assuaged my panic. Apparently these protons, the cores of Hydrogen atoms, wreak havoc with the electrons in the targeted area, expelling them from atoms and disassembling DNA molecules, stopping the cells from reproducing. The biology I could just about wrap my head around, but the physics made me shudder.

It hadn't been long since they'd first found the tumour, an existential threat the size of a marble, in the region of your brain just behind your eyes. We heard talk of treatment plans, strategies, choices and all I wanted to know was whether or not you'll survive; my world exists in binary. There are only two possibilities: yes or no. Instead, all they can do is give me probabilities, fatal wagers on my son's life.

Your mother copes by abstracting everything, poring over journal articles and textbooks in the evenings after you've gone to bed. She patiently answers my concerns about the particles that will hurtle through you. Protons are charged much like the atoms in your body she explains. Yet unlike our hands, energetic protons have no qualms about shooting straight past the surface of your skin, navigating the empty space between the parts that comprise you.

She explains that every interaction between charged particles is governed by laws both mathematically exact, yet fundamentally indeterminate. No single proton will save you, a few will have to hurt perfectly healthy cells by energetically colliding with the DNA inside them that your mother and I gave you. The hope is that by tweaking the energy, shifting angles and focusing the particles like light through a lens, on average the protons will destroy your tumour much more than they destroy you. Like tipping the roulette wheel to better the odds.

Late at night when we lay besides one another, pretending to sleep, my incoherent thoughts turn to those protons, buffeted by the chance positioning of your molecules. Created in a nuclear forge and accelerated to breakneck speeds, the machine twists and turns them with magnets and directs a straight path for them to follow. Then reality kicks in, the world jostles them about and we can only hope they end up where they're supposed to go, that their journey ends where it needs to. No sooner, no later.

When you were scarcely a toddler, I looked over your mother's laptop screen as I rocked you sleep one afternoon and saw a paper she was reading: "More is Different". I asked her for the gist of it and she told me that the behaviour of something made of many bits is fundamentally different to how all the individual bits act. Understanding atoms and even all their tiny subcomponents couldn't tell you what they would do when you put them together.

Even the decades your mother spent studying physics and the nature of particles couldn't have told her that a particular arrangement, plucked from infinite thermodynamic permutations, would give rise to you, a whole more than the sum of your parts. A being capable of giving us unbridled joy and breaking our hearts.

The treatment only lasts a minute or so. As we collect you from the room, you bound up to us and tell us you didn't feel a thing, sporting the same grin you have at the top of the climbing bars in the park. I'm fine Dad!

That was the first time. We come back again and again, each time launching a fresh assault on the treasonous cells in your body. Heisenberg's Uncertainty doesn't hold a candle to mine. Until I know you're safe, for good, no breath feels complete. I won't know where our family is, or where it's headed until the cancer is gone but we keep fighting all the same. I begin to see that no matter how much I talk to your mother and the doctors to try and understand everything, the outcome is never fixed until it happens. All we can do is to collectively shift, bit by bit, the balance of probability in your favour.

THE ENTANGLEMENT PROPOSAL

VINA JIE-MIN PRASAD

The Red Thread's waiting room is showing *Betsy's Entanglement* on its wall-mounted television. It'll be a while before their turn, so Anna turns her attention to the screen. The film's past the boring part with the exposition and the accidental entanglement, and playboy tycoon Stewart Brewster is currently falling in love with poverty-stricken receptionist Betsy Page.

It's the famous montage, the one that won the film an Academy Award in 1953. Betsy's shivering in her unheated apartment, causing Stewart to start sweating profusely during the middle of a Christmas banquet. As Betsy sobs over her father's death in a hospital ward, Stewart's face involuntarily stretches into a rictus grin as he tries to make a toast at a New Year's ball.

Before the film gets to the scene which started a whole new trend in entanglement proposals, Henry passes her a liability form. Anna scrawls her signature on the bottom, and they both place their belongings in lockers, changing into bright red hospital gowns before entering Entanglement Room 1.

A bored-looking man glances at them before launching into legalese.

"Entanglement might exacerbate physical or mental issues. Please contact an entanglement counsellor if you experience problems. If you're ready, please step into the chamber. The entanglement will last exactly 720 hours."

Anna reaches over to Henry, running her thumb across his knuckles to reassure herself.

Henry grasps her left hand and runs his finger along the tan line where her entanglement ring usually is.

"It'll be okay," he says. "If our relationship can withstand the next month, it can withstand anything."

They step into the chamber together. Anna presses her cheek against Henry's chest, and he wraps his arms around her.

Light swirls around them, his heartbeat pulses in her

eardrums, and she feels their fates entwining with every breath they take.

A few days later, Henry's work calls him away.

"I'm sorry about this, there's a negotiation issue," Henry says frantically, cramming shirts into his luggage. "I'll be back as soon as I can, please bear with it. I know entangled couples are supposed to work as a system..."

Anna pats him on the back, trying her best to override her relaxed reaction to Henry's distraught state. "I understand, Henry—it's just spooky action at a *really* long distance, anyway."

Despite her initial optimism, the next ten days are hell. Henry's too tired to update her on the contract negotiations, and sends periodic emails to reassure her that he's alive. Entanglement's anti-correlation, and each partner's meant to experience *opposite* emotions, but she'd never realised the practical implications before. The movies led her to believe she'd have ten days of periodic happiness corresponding to Henry's anguish, but it's not as simple as that. She spends the days alternating between euphoria and misery and tries to regulate her emotions, but even hot baths and nature documentaries can't calm her down, and Henry's emotions are simply too strong to neutralise.

Happiness bubbles up intermittently, and despair comes like clockwork. She considers breaking off the entanglement—how can she possibly cope with someone halfway around the world having such power over her? His simple existence makes her heart beat out of her chest with joy, or overflow with sorrow, and it feels like half of her soul is walking around where she can't reach it, completely unprotected.

As wave after wave of misery washes over her, she thinks of her elation when Henry proposed, and how delighted she was at the chance of sharing her life with him. She remembers the broad, silly grin on his face when

he met her at the airport after graduation, and suddenly it all makes sense.

Anna meets Henry at the airport the next day, and as they wheel his luggage to the taxi stand, he updates her on the previous week.

"I was really stressed most of the time, and I tried to neutralise it by thinking about you every night. I'm sorry."

"Control your emotions, you ridiculous man," Anna laughs in between jagged little sobs. "I felt like I had a split personality!"

Before their taxi arrives, she throws her arms around him, listening to his heart as her own heartbeat hammers in her ears. Their pulses aren't perfectly in sync, but they echo each other, fitting together in imperfect harmony.

After Henry's trip, they pay a visit to the entanglement counsellor, and everything goes fairly uneventfully for the rest of the month. The counsellor's relaxation methods help them to normalise, levelling out the highs and lows, approaching equilibrium.

This changes on the last day of their entanglement. Henry's at a company function, celebrating his recent promotion, and Anna's having brunch with her friends.

"I think it's wonderful that you're entangled," Karen says. "It's such a good way of stress-testing the relationship!"

"I don't know," Christine chimes in, all saccharine sweetness. "The pressure is simply too much for most relationships to bear. I don't mean *yours*, but..."

As Christine tells them all manner of horror stories about how entanglements lead to doomed marriages, Anna curls her fingernails into her palm, trying her best to contain her fury and dismay, and excuses herself, pleading another appointment.

When she's at the bus stop, she pulls out her phone, and realises there's a missed call from Henry. She pushes redial.

"You called me?"

"I was feeling apathetically happy just now. What happened to you?"

She explains, and they agree to meet at his apartment and spend the remaining hours of the entanglement together. After some Chinese food and old cartoons, they curl up on the sofa together, and wait.

"Two minutes left," he murmurs, checking his watch. "Did you like it?"

"Yes. It's sort of like... concrete proof that you aren't alone in the universe."

"You won't be," Henry says, tenderly brushing his thumb against her cheek. "Even after this. Ten seconds now."

She reaches out to him, and he reaches out to her, and as their connection bleeds away, they twine their fingers together.

QUANTUM MAN

CLIFTON RUMSEY

Felix Dibble was the night janitor at CERN's Large Hadron Collider. He was on his regular route sweeping the collider tunnel as the evening's experiments were getting underway. Felix had just stopped to squeegee a spot of raspberry jam off one of the beam pipes and was muttering to himself about "those scientists" when Dr Hans Gruberman, working in the CERN Control Centre, decided to have a snack. Without thinking, Dr Gruberman set his baguette down on top of a critical system component. As cries rang out from around the room of "Not again!", a baguette-induced system failure triggered a rapid loss of magnetic confinement within the collider, resulting in two beams of protons traveling in opposite directions at very near the speed of light colliding at the approximate location of Felix Dibble's medulla oblongata. After regaining consciousness, Felix stumbled down the tunnel in a daze, not yet realising that forever after he would always be known as: Quantum Man.

Episode 163:
Quantum Man came screeching down the street aboard his pilot wave runner, arriving at the abandoned warehouse now surrounded by flashing police cars and swarms of officers. He jumped off his ride and quickly approached the police chief. The ground was rumbling everywhere; following slowly after him was Quantum Man's less-than-trustworthy sidekick Quantum Cat, a half-living, half-dead feline, horrible to behold.

"Chief, what's the situation?"

"Thank you for coming, Quantum Man. The whole city's been shaking on and off for hours now. At first, we thought it was an earthquake, but we've been able to… Ahhh!" At that moment, the chief noticed Quantum Cat approaching. He shuddered and looked away. "We've been able to trace the origin of the disturbance to this building, but we haven't been able to get inside. It's locked down tight."

Quantum Man looked down at his sidekick. "Quantum

Cat, see if you can get in through the ventilation system and scope out the situation. I'll attempt to tunnel through the wall." But Quantum Cat only hissed, looking surly—and also half-dead. "How many times do I have to apologise for putting you in that box? I was only playing peek-a-boo! How was I supposed to know it would leave you in a perpetual superposition of living death? Never mind, I'll go myself. Chief, don't worry; I'll handle this," he said, looking up again.

With that, Quantum Man turned and ran at full speed straight at the wall of the building. He collided with a loud thud and fell over backward. Slowly getting up on his feet, he yelled back to the chief, who was already looking worried, "I'm alright! It's a probabilistic thing. I'll get through one of these times." Quantum Man ran at the wall again and crashed into it once again. Twenty-two similar attempts followed. "Any time now," he croaked. He ran once more, finally successful in passing through the wall and emerging on the other side.

Still feeling the effects of his failed attempts, Quantum Man staggered into the spacious interior of the old warehouse, trying to get his bearings. He looked around and saw a large, dark void surrounded by equipment and various consoles in the centre of the warehouse. As he approached, he saw a young woman dressed in black and wearing a mask come walking around from the opposite side of the void. Their eyes met and locked onto one another. "Gravity Girl! I should have known you were behind this!"

"Well if it isn't Quantum Man come to save the day. But you're too late. My black hole is already at full strength. If the leaders of the world don't meet my demands, I will unleash it to devour the Earth!"

"You'll never get away with this, Gravity Girl. I thought you would have learned your lesson after I foiled your plans at Solvay."

"You won't defeat me this time." Gravity Girl picked

up a small controller and flipped a switch. Immediately, Quantum Man began being pulled across the room in the direction of the black hole. He grabbed onto a pillar just as his legs were pulled out from beneath him. "Looks like this is the end for you!"

Quantum Man struggled to maintain his grip to prevent being sucked into the black hole. "I know you're better than this, Gravity Girl. If we only work together, think of all the good we can do. Stop this and join me. We belong together."

Gravity Girl laughed. "Silly Quantum Man. There are no strings that can bind us."

Quantum Man was barely hanging on by his fingers, and they were slipping. Suddenly, Gravity Girl looked down and screamed, dropping the controller, for a half-dead cat had just rubbed up against her leg. As the controller hit the floor, it switched off, and Quantum Man fell to the ground. "Excellent work, Quantum Cat," he said as he got back up. "Black holes are no match for me." He raised his arms toward the black hole and shouted his famous catchphrase, "By the Power of Planck!" Gravity Girl rolled her eyes and groaned; Quantum Cat slowly shook his head back and forth. Quantum Man didn't notice. "A little Hawking radiation should do the trick." Streams of particles appeared to emanate from the black hole, traveling toward Quantum Man's outstretched hands. As everyone watched, the black hole got smaller and smaller until it completely evaporated.

Gravity Girl scowled. "You haven't seen the last of me, Quantum Man!" She ran to a pair of double doors, throwing them both open and stepping outside. Quantum Man had started to give chase but abruptly stopped. "Curses! I can't go through a double door without interfering with myself on the other side!" He shuddered at the memories. Gravity Girl only smiled then vanished around the corner. Quantum Cat slowly walked to the doors. "Quantum Cat, close one of those doors for me, quickly!" But Quantum Cat only ignored him and walked out. "Quantum Cat?—Anyone?—Help???"

THE RELATIVE UNCERTAINTY OF REALITY: A TRUE STORY?

DANIEL SWINDLEHURST

"OK, I have your avatar's age and sex preferences, just a few more questions before I can create your Personal Universe©. Which year would you like to visit?"

"Can I go to 2016 please? The summer, you know, just before The Event?"

"Of course. Remember, we want to create the perfect experience for you, if we're going to make you your very own private universe, then we want to make sure it's just right. Now, what role would you like to have, you can be a film star, a famous athlete, a powerful CEO, the President?"

"You said that I can be exactly whoever I want to be? No matter how… unusual?"

"Of course, you can live the life you want. You can be rich, poor, married, single. You can rule the world, save the world, or even destroy it. The only stipulation for the package you've chosen is that your avatar must be consistent with the reality of…" She glanced at her display. "… the summer of 2016. So you can't have a Version 2.0 body, or super powers, or anything like that. You'd need to pay extra for such a custom simulation." She paused and looked questioningly at me, ever the saleswoman.

"No thanks, nothing like that. I'd actually like to be a research scientist please. In fact, one of the scientists that was working on the project that caused The Event."

My interviewer's polished demeanour slipped for a second and she looked briefly incredulous, before her mask of polite professionalism quickly returned.

I continued as she recovered her composure. "You see, I've always been fascinated by science. And I heard that in 2016 it was still carried out by actual people, before the AIs took over. I want to be one of those human scientists please, and I want to be right there when IT happened."

"Of course, a research scientist you will be. Such an unconventional role may take us a few more days to program though."

"I quite understand. I bet scientist is a pretty unusual

request?"

"You're the first actually." She arched an eyebrow in quiet judgment.

"And you're sure this will feel real?"

"I can assure you of that. The weather, the food you eat, the people you meet, all will feel indistinguishable from reality."

"But the people, they won't be actual real people, will they?"

"No. There's no need. Our procedural algorithms ensure that as the simulation winks into existence each of its inhabitants will be created with a unique consciousness, personality and a set of rich memories that they'll think are genuine. They'll believe that they've lived for years, they'll go about their lives, working, eating, falling in love, dying, all without realising that they're composed of digital code, rather than flesh and blood."

"It sounds very impressive."

"It is, and it isn't. It feels absolutely real, but you'd be amazed how little memory it takes, how many of these simulations we run at the same time. Not all are set in 2016 of course, we run some modern-day simulations, but mostly people want to experience past lives, like you. Many people go much further back though. Maybe after you've spent a month in 2016 you'll travel with us again, maybe further back next time?" The hard sell again.

"We'll see," I replied politely, but without commitment. "Is this strictly ethical? I mean, you're creating seven billion people who think they're alive, then, after one month, you end them all with a flick of a switch."

"Don't worry, remember, they're not real people, they're just code, they're nothing but a long string of ones and zeroes. And besides, we create and 'end' hundreds of billions of them every day across all our various simulations."

"But, don't any of them ever realise that they're not real?"

She frowned and looked a little impatient. Was I being rude asking these questions? I was the client though, so I looked at her and waited for a response.

"It happens, but very rarely. Usually in individuals on the fringes of the simulated societies, the odd artist, but most often with scientists, coincidentally. In the past it occasionally caused a few problems, but we quickly realised how to deal with it, we invented the Uncertainty Principle."

"I'm afraid I'm not familiar with that particular principle, is it from quantum physics?" I'd read a fair amount of pre-Event science, but I'd never heard of it.

"That's because it doesn't exist in the real world. In our simulations, inquisitive scientists were sometimes able to delve so deeply into their worlds that they discovered the code with which their artificial existences were created. So we've introduced an arbitrary limit to the degree of precision by which the simulated particle physicists can measure their world. If they try to measure one aspect of a particle, say, its position, then they find that they can't measure another aspect, like its momentum. It creates a layer of fuzz that neatly prevents them from digging too deeply and discovering the underlying code."

It was my turn to look at her incredulously.

"Sounds a bit fanciful, I know, it's just science fiction though. But it seems to do the trick." She fixed me with a mock-conspiratorial look. "And remember, if you ever doubt the world in which you live in, just measure the properties of a fundamental particle, if you can measure both momentum and position, then no need to worry, you're in the real world." She laughed.

HANIZA'S SLIPSTREAM

AARIC TAN XIANG YEOW

Then she was sixteen, sobbing and smiling and giving birth to a child whose father was a classmate and a basketball boy and a few months younger. She was supposed to repeat a year but skipped two, returning only after her ex-classmates left.

Then she was five and raising her hand, the only one who wanted to be a teacher. She turned twenty and tried to explain to her eldest daughter why she was a cleaner. Then she was ten, thirty-four, twelve and fifty-three, grasping for someone to hold her hand.

For her, time is a clump of tangled knots. There is no definite beginning and no traceable end. No narrative arc of past-present-future. All she can remember are intersections.

She was thirteen with eight siblings from three other stepfathers. Her mother was in the hospital, this time with a bruise on her forehead, a split lower lip and a possible concussion. Her stepfathers were gone, the way stains dissolve in soap. Of course, she left her mother alone in the hospital. If not, Halesya would battle with Hamid over the bolster and Halim would sleep along the corridor. Little Hariz needed a milk bottle, a shower in the sink and someone to cuddle him to sleep. It was the first time she had to leave her there.

At another time-knot, she was fifty years old, shrivelled but her fingers were smooth. Worn away from the rhythmic rubbing of soapy cloth against plates at a hawker centre. No palm print, no finger print, no thumb print. Somehow, she knew she would lose all these that made her who she was.

Then, she was eighteen and attempting her O-Levels. Crumpled her essay only to realise that she did not have time to write another. A year later which is to say a flicker-knot away, she retook her papers as a private candidate. This time, her grades were lower compared to her first attempt.

On her way home, she observed the family sitting across

her. Tuuuuut tuuuuuuuuuut, the father hummed to a burrito-like baby in his arms. But it isn't steam powered, sighed the lady next to him, so it goes thrum-thrum-thrum.

Her ex-husband was pleading for another chance. She opened the door to give her children the family she never had. The wind chime stuck to the back of the door tinkled and her eldest daughter cowered behind her.

Three time-knots away, her son called her a whore who deserved every slap she ever received before leaving the flat forever. She imagined herself surrounded by siblings whom she raised and her children whom she didn't have the time to raise. They were having a seaside picnic and someone picked up a fish, which had been slammed by the tides against the rocky shore, and filleted it. The waves crept forward and retreated, as if curious yet fearful.

Time behaves differently, the way a cat rubs against its owners and scratches strangers. For most, time is linear thus boring with clear cause and effect. For some, time is a pivot which they revolve around like stars drawn to its gravity. For people like her, time is a mess of unpredictable experiences.

At another point, she was a baby, standing in her cot, one hand grabbing the railing, another reaching for the overcast clouds outside the adjacent window. That night, she stretched for the balloon of a moon.

The beauty and problem with her timeline was its chaos. She did not remember the in-betweens fraught with hurt and fears. She did not remember those journeys between time-knots where lessons that could be learnt were not learnt. So she let her ex-husband back into the flat where he proceeded to touch her eldest daughter again.

Then she wept while reading a letter her daughter wrote because it was Mothers' Day and everyone in class had to write one. Mum, the letter began, I remember how you worked from six in the morning to ten at night but still refused to buy me an Elsa doll. Everyone has one, even

Jessie. I guess you don't really like me the way you like the rest. But it is okay, I still love you because you're my mum.

Twenty-one years before receiving this letter, her mother spanked her for failing her primary school leaving exams. Once or twice each week, she would call her a failure to remind her not to give up so easily.

She was thirty and her daughter was applying an ointment on her wounds. The sizzling oil from the wok had splashed on her forearm. There were pink blisters of various sizes. Some were small but the largest was the size of a ten-cent coin.

Several knots away, she told her teacher that true love knew no boundaries and recognised no age limit. She wanted to marry that basketball boy and raise a family of chubby children with him.

When she was younger, she believed in fairy tales, in knights with shining armour who rescued damsels trapped in castles, in Cinderellas and Sleeping Beauties, in magic and myths and mystics. Folklores have it that seers exist. They can scry the past and future, careening from event to event. These people exist but what they do is not magic.

She will continue to see her selves, such as that time when she scrapped her knees after falling off her bicycle. Or that kiss in the boy's bathroom or that baby cradled in her arms. Or when a teacher called to inform that her son was drawing skulls on every worksheet and that palm-shaped mark she left on his swollen cheek.

POSTMORTEM

ABEL JAMES TILDA

Gran died on a Wednesday, but lucky for us she was back within a week.

When she knocked on the door, Olivia and I were eating dry cereal. Olivia was using her hands, which was a special thing she got to do when Mum was away. Other special things included Olivia wearing her ballet shoes to the grocery store and me getting in trouble when her arabesque knocked over twenty-seven soup cans.

Anyway, Olivia sashayed over to the door, her fist still full of Froot Loops. I think Mum told us not to answer the door, but I forget about things like that a lot. Besides, when I heard Olivia yelling about how happy she was to see Gran, I knew it was fine.

And then, of course, I realised it wasn't exactly fine at all.

"Hello, darlings," Gran said, smiling at me as she shuffled into the kitchen. I kind of gagged on my cereal, which I'm sure looked disgusting, but she didn't have her glasses on anyway. "What are you ladies up to?"

"You were DEAD!" Olivia declared, pas-de-chatting gleefully around Gran. "And there was a big old funeral, and we all wore black and cried about you, and Mum got really angry at Uncle James for having it in a church, and I ate six different kinds of cookies!"

"How nice," Gran said. She still had the morgue makeup on, so her face looked all weird and smooth, like she was a mime. The more she talked, the more it cracked. "Where's your mother?"

"How did you– what?" I managed to choke out. "But– wha– we buried you really deep–" I faltered, realising how that sounded. *Hi, Gran, great to see you, we buried you really deep!*

Gran squinted. "Ann, what are you talking about? Is this an Internet thing?" She shook her head. "I don't understand half of what kids say nowadays."

"Lemme take your purse!" Olivia shouted, yanking it from her hands. I hadn't noticed it before, but now that I looked,

there it was. Olivia began to stick her pudgy forearm into its depths to plumb for the usual surprise presents Gran usually brought her, but I shot her a look and she withdrew.

"How did you get here?" I asked, sweeping Froot Loop crumbs off Olivia's placemat.

Gran smiled. "I drove, of course."

I couldn't remember hearing car noises, but when I glanced out the front window her Chevy was sitting on the driveway, sickeningly lilac as ever. I felt tired all of a sudden.

"Oh," I said. "Okay."

"Let's play Candyland!" Olivia yelled, jumping up and down with her feet in second position, Gran's purse hugged to her chest.

"Actually, honey, I think I'm going to lie down for a bit," Gran said. My stomach lurched at the phrasing, but Olivia didn't seem to notice.

"Aww," she muttered.

"It's okay," I said. "Gran needs some rest." Another stomach lurch. "Why don't we let her nap in the guest room, and we can wake her when Mum gets home?"

"Thank you, Ann." Gran smiled again; flakes of her makeup fluttered to the tile floor.

"Sure."

I followed her down the hallway to see her to her room. The second she closed the door behind her, Olivia started yelling.

"What is it?" I hissed, thumping back into the kitchen. Olivia was standing next to the table and clutching at her face, the purse on the ground in front of her.

"There's a cat in there," she whimpered, backing up against the table.

"A cat?" I bent down and picked up the purse.

"No!" Olivia whined, plunking down on her bottom and scooting under the table. "No no no no no!"

I looked down. The purse was empty. I stuck my hand in it, rummaged around a little. Still nothing.

"What are you talking about?" I asked, turning the bag upside down and shaking it.

"There was a cat," she said, sticking her thumb in her mouth, which she's too old to do, but Mum wasn't home anyway. "A dead cat. I thought there must have been something little in there, because it didn't make any noise when I shook it, but then I opened it and saw– the– saw the–"

Her words tapered off into terrified sobbing that might have been fake but probably wasn't. I shut the purse and looked into it again. Still no cat.

"Olivia? There's nothing in here."

She frowned, her lower lip jutting out, and snatched the bag from my hands. She closed it, then squeezed her eyes shut, holding her breath with her cheeks puffed up.

Olivia flung the purse open, and a cat sprung out. It was a calico, long-furred and slinking, and it yawned and set to licking its leg.

Olivia screamed.

"This isn't right," I mumbled.

"Mom's allergic," Olivia whispered, holding the purse to her chest. The cat finished cleaning its leg and began work on its large, magnificent tail. My heart was pounding hard enough to make my chest ache and my fingers throb.

"I have to go check on Gran," I said, leaping up from the floor. I don't know why I did it, but something told me I had to, and that was what Mum was always telling us: trust our instincts. A cat knows what to do because its brain has been sharpened to a point by thousands of years of evolution. I know what to do because Mum left me instructions, although I don't know when she'll be back.

The guest room was a sealed box at the end of the hall. My back was to the kitchen. In my head, I saw everything layered over everything, Olivia with and without a cat, Mum home and not home, Gran dead and not dead, none of them existing. At the funeral, the pastor had talked about believing in what we couldn't see. I closed my eyes. I didn't believe a thing.

A FUTURE WITH FORTRAN

LILY TURASKI

Bzzt. My phone vibrates on the desk, and I glance up from my textbook. A message from my granny flashes on the screen. "Do you know any good jokes about Fortran?" Not really. Wonder why she wants jokes about Fortran? Bzzt. Another message from Granny. "I've got a date tomorrow with a guy who did Fortran programming." Ah, that explains it. My granny has recently been exploring the exciting world of Online Dating. Somehow it seems she always gets paired with nerdy engineering types. At least she's getting dates… might be time for me to give online dating a try as well.

"Sorry, no Fortran jokes. Btw, would you help me set up a dating profile?"

"Of course, sweetie. My, how the times have changed! My granddaughter is asking me for computer help!"

Smiling, I resume my studies. I'm taking a modern physics class, and we are learning about the hypothetical quantum particles known as Tachyons. If they exist, they have the potential for superluminal motion. It's fun to think about the possible application to time travel. If you can travel faster than light, then you can travel forwards and backwards in time… all it would take is one scientist with the faith to take the chance on a new idea.

I visit my granny that weekend, and together we make my profile, laughing as we fill out the questionnaire. "Now," she says, "all that's left is to wait and see who is revealed as your match." I wonder how the computer determines pairings. Computers operate on a binary system. There are only two possibilities: yes or no. What if the computer makes the wrong choice, and rejects my one true soulmate?

We play a game of chess, but as each of us perfectly anticipates the other's moves, it ends in a draw, and I return to campus. I spend the night dreaming of blueprints for a time machine, and I am greeted the next morning by an email written in flowery script:

~Congratulations! You have a new match!~

And he seems perfect, and he wants to meet me on Thursday, and I'm so excited I'm no longer thinking in complete sentences. I text Granny the good news.

"Wow, that's fantastic!" She says, "I'm going out on Thursday as well! The fella I'm going with better be more impressive this time because he's already got one strike against him."

"What happened? Why did you put Fortran Man on probation?"

"Oh, he thought Patrick Henry was one of the US Presidents." Ah, that'll do it.

Granny arrives spontaneously at my dorm on Thursday afternoon. "Good heavens, is that what you're wearing? That frumpy dress will never do, sweetie. Good thing I thought ahead. You can wear this; it's what I wore when I was dating in college." I smile and take the proffered clothing, which is still in fashion. Granny always has timeless taste.

The evening finds me laughing and smiling, and I realise that if my future self develops a method for time travel, this is the moment to which I would return. It seems the computer knew what it was doing when it said "yes" to this charming guy. I glance beside me, and see Granny sitting with her date at the table next to us. How had I not noticed them before? I wave happily.

"Oh, do you see someone you know?" My date wears a puzzled expression.

"That's my granny on her date!" I explain, turning to introduce them. But when I turn, I am greeted by the window and a perfect reflection of myself. Granny is nowhere to be seen, and I shake my head, confused.

"Aw, that's sweet. Tell me about your granny." Hearing this, I snap back to the present.

"Well, she's amazing. She also studied engineering here on campus, and then she did research at the national lab. I don't know any details because it was super-secret, but

I think it was related to superluminal motion. You know, I've been studying that recently—the application to time travel is fascinating! Anyway, my granny, she's a big nerd, and she loves to play chess, and sing, and dance, and ride horses, and she grew up on a farm with pet chickens and goats, just like me. Granny and I have so much in common, it's almost like we're twins!" I laugh. "So, tell me about your work?"

"Well, I'm studying to be a computer engineer, and recently I've landed an internship, programming medical devices using Fortran. Your granny sounds like an amazing person; maybe I'll have the honour to meet her someday."

"In that case, you should know she's peculiar about history, so make sure you know your presidents."

I went home that night humming a happy tune. Bzzt. My phone vibrates; Granny wants to know how it went, and I eagerly dial her number. We both gush about our evenings, as it appears Granny had a lovely time with Mr Fortran Man.

"I thought he was on probation for the whole Patrick Henry fiasco?"

"Oh, turns out he was joking. He's memorised all the presidents, their running mates and terms of office. Apparently, when he was in college, he went out with a girl who recommended he memorise the presidents if he wanted to impress her grandmother! Ha! But anyway, sounds like you had a great time; I know it's only the first date, but do you think he could be The One?"

"Well Granny, I've got a 50% shot. After all, there are only two possibilities: yes or no."

"Ah, leaving your soulmate to the toss of a coin. I hope you make the right choice, sweetie." And then, quietly, wistfully, she adds, "I hope you make the right choice this time, because the alternative is a much lonelier timeline. Choose wisely… for both of our sakes."

THE QUBITS OF COLLEGE ACCEPTANCE

LILY TURASKI

I laid the creamy white envelopes out on the table in a neat array. Fat envelopes addressed to Ms Eleanor Turaski. I generally go by Lily, so the use of my formal name was an indication of the importance of the contents of these envelopes. In fact, these envelopes contained the information necessary to determine the course of my future. What a frightening concept—people are frightened of artificial intelligence in the form of robots and computers, but these envelopes, mere paper, contained the power to alter my life unchangeably. College acceptance letters. You either welcome them, or you fear them. Or both. My state of emotions was indeterminate. I didn't know whether I was excited or scared, and by virtue of not knowing, I was both excited and scared.

Harvard, Stanford, MIT, Caltech, Hopkins, and all the others proudly displayed their school logos in the upper left corners of the otherwise indistinguishable white envelopes, teasing me, tempting me. If it comes to a battle of the wills between me and these envelopes, I must prevail. Logica Omnia Vincit. Logic conquers all. The way to emerge victorious is to paint the envelopes into a logical corner, a black hole from which they have no escape.

I do not know what answer is printed on the letters within the envelopes. There are only two possibilities: yes or no. In the wider world of reality, life is not always so black and white; often there is a grey region of indeterminacy. Yet for these letters there are exactly two possibilities: the answer is either yes or no. At least, that is what the envelopes want me to think. In fact, there is a third answer: yes and no. Because I have not yet read the printed letters, the two options are inconceivably intertwined into a third state of superposition. Until I open the letters, oh-so-slowly and oh-so-carefully, so as not to rip the edges, the answer is yes. It is also no, but I will focus on the yes. As soon as I observe the state of my acceptance, the condition is fixed, and the seeming paradox resolves. Yet there is

comfort in the paradox. There is comfort in knowing that I have the power to change the course of my life. It is not the envelopes that decide my fate; it is my choice to observe the envelopes that decides my fate. I have won the battle against the envelopes. I have been accepted into all eight Ivy League schools. Of course, I have also been denied by all eight Ivy League schools, but again I focus on the yes. Everything is possible.

My dad comes home. He asks if any letters came for me today. I tell him that they have all arrived now, and he asks me what they said. I tell him I was accepted into all of them. He walks over, sees the row of unopened letters, and cocks an eyebrow. "How do you know…" he starts.

"Well, it's like Schrödinger's cat."

"I've had enough of that darn cat. Why can't it make up its mind already?"

"The same reason I have decided I am going to major in Undecided."

We hear the sound of ripping paper. By the time we turn around, my mother is holding open a neatly creased letter, and the mangled envelope lies open on the table.

INDISTINGUISHABLE

KENTON K. YEE

When I was in eighth grade, Dad started feeling "neither here nor there." The harder he tried to relax, the more violently he'd jitter. The only way he could stop jittering was to wave like a fancy-fin goldfish. My little sister said Dad was being "complex—like you, Joey." Mum humphed and said Dad was suffering midlife crisis. "Don't you dare grow up to be like him," she said.

I Google searched his symptoms. What Wikipedia said stunned me: my father had contracted wave-particle duality. I begged him to see a physicist before he degenerated into a quantum wavefunction. Dad flapped his arms like an excited hummingbird and refused, insisting "psychics was a scam" and that he "needed to find" himself.

By the time I started high school, Dad was strobing like disco lights and hopping harmonically like a pogo stick. Every so often, he'd fart, wiggle his hips, and flutter his arms like a Polynesian hula dancer. Fortunately, Dad held academic tenure at the university, so his paroxysms weren't a problem at work. (In fact, wave-particle duality was mundane compared to the antics of Dad's colleagues in the statistics department: reading causality into correlations; extrapolating the past to predict the future; and passing off statistics as a hard science.)

I finally called Uncle De Broglie. Fred De Broglie wasn't my real uncle, but a physics professor we had over for dinner when Dad needed an unsuspecting model of a mad scientist in his novel. The afternoon of the appointment, I bundled Dad into a Pauli Exclusion straightjacket and dragged him across campus to the science centre.

Uncle De Broglie pinched his nose. "Pee eww!" he said from behind a droopy Einstein moustache. He squared Dad and integrated him. "You're diverging."

Dad froze in mid fart. He pulled up the waist of his pants and touched his zipper. "You mean I'm nonintegrable?"

"No, not over Euclidean space," De Broglie said. "Lucky for you, space is foamy at the Planck scale." He

handed Dad a bottle of epsilons. "Take the limit to zero twice a day. If you're not renormalised by next year, I'll request funds from your insurance company to try a new nonperturbative methodology for cancelling anomalies."

By the time I was studying for college entrance exams, Dad was tunnelling. At first, he'd tunnel back home every day and tell us about Copenhagen or another exotic destination. Over the next months, his absences grew longer. Upon his return, he'd regale my sister and me with elaborate stories—he called them "interpretations"—about exploits with "heavy bosons" in "many other worlds." Then he'd vanish again.

Uncle De Broglie set up Josephson junctions sandwiched between layers of superconducting plates to trap Dad. He injected the contraption with phonons and set it on Dad's imitation cowhide armchair in front of the TV. Sis and I carried our homework to the sofa and waited there for Dad every night.

The trap worked. At first, Dad sparkled and moaned, "Eureka! I found myself!" He rambled deliriously about "delicious bosons" surrounding and absorbing him into "their equilibrium wavefunction."

Uncle De Broglie rushed over and adjusted some knobs. "Your father's found himself," he declared. "He's tunnelling between the plates, now indistinguishable from the other bosons."

"What a relief," I said. "Mum won't have to worry that he's consorting with strange bosons in an alien bathroom."

Sis turned to the kitchen door. "Mum!" she hollered. "Uncle De Broglie made Dad indistinguishable!"

"A Bose-Einstein gas," De Broglie said. "A condensate."

"That's nice," Mum hollered back. "Would you like condensed milk in your coffee, Professor?"

Things at home went back to normal now that we knew Dad was trapped on his favourite spot in front of the TV. I went away to college on the east coast. The university

promoted Dad to a prestigious chair so that he wouldn't have to do any work.

When I returned home for the holidays in my senior year of college, Dad was as indistinguishable as ever. "A quake knocked out the power and he almost evaporated," Mum said. "The backup generator kicked on just in time." On my last day before heading back east, I visited Professor De Broglie. He assured me that being an indistinguishable boson didn't hurt and that, wave or particle, we were all hologram projections of information residing at the edge of the universe. "Joey," he said, "the edge of the universe is like the surface of a black hole."

"Jeez," I said. "All this time I thought I was in America. I need to find myself."

Sitting on a window seat during the plane ride east, I felt lost, neither here nor there. Dad had found himself by becoming indistinguishable. The double reflection in the two-pane glass I stared into showed my father's face, twice. The faces looked at each other and then at me. I looked back, indistinguishable.

SUPERPOSE

YUEN XIANG HAO

Day 3.
I first saw you two days ago, our eyes not meeting across the crowded train, your voice inaudible to me over the noise of the crowd as you laughed at a joke shared with a friend.
you
And I think you're fascinating, and I think you're interesting, because you're a splash of colour in this crowd of grey on grey, with their eyes glued to their smartphone screens and their ears plugged into their music players, disconnecting complex people from the real and plugging them into the imaginary, rendering them intangible in all the myriad ways that exist in the here and now.
are
But not you, because even after your friend got off, you remained here, looking upwards and outwards of the train cabin at the morning sky, at the molten firmament being pounded on the blacksmith's anvil into the promise of a new day with a smile on your face. And the train dips below the ground and into the mouth of the tunnel.
watching
I want to talk to you, I want to reach out to you, I want to make contact and connect with you, just as a human to another human.
me
But I won't. I can't.
aren't
Because there are rules.
you

The train is crowded. The train is always crowded, and when the crowd gets this thick, a set of unspoken rules comes into play:
Don't meet anyone's gaze. Don't look at what they're doing. Stare off into space, draw your sphere of exclusion around you, and never, not once, acknowledge the awkward closeness of those squeezed next to you.

And in a stroke, we render ourselves into featureless, inert particles, ideal classical datapoints that form a neat trendline in some civil servant's office whose job it is to optimise traffic flow.

Consider a spherical cow...

That's an old joke, a joke so ancient that it is essentially truth. Neglect the friction from the inevitable collisions, inculcate social mores and politeness to damp down on the inevitable rise in emotional temperature, and we all become the perfect average man that Quetelet imagined, featureless entities in a frictionless, airless vacuum where everything that makes us who we are become unobservable.

And from this sterile world the only escape lies in cyberspace, diving deep into the anarchic chaos where the classical rules do not apply.

And we wonder why we never talk to one another.

Day 4

There you are again.

hey

We are wavefunctions, or so the reasoning goes, a trillion trillion superposed wavefunctions with hidden variables tucked away under our surface, until only the surface is observable. We are degenerate Schrödinger icebergs that interact unpredictably and occasionally violently when all the imaginary axes that we have to grind—and yet reveal to no one—interfere and stack up, forming rogue waves and rolling combers that rock the boat and shatter our world.

I

Leaving us to pick up the broken shards and fragments of who we know we truly are.

could

That's why we shouldn't talk to strangers, because to let someone into our lives is to give up our very souls. Define your boundaries with clarity; defend them with certainty.

It's a matter of principle.
come
That's why I shouldn't talk to you.
to
That's why you won't talk to me.
know
Because we are classical datapoints, inert spheres that interact neatly, safely, with no ultraviolet catastrophe to clean up afterwards.
you
Because we're strangers.
too

Classical physics is psychohistory; statistical mechanics is social engineering.
Correction: social engineering is statistical mechanics with gunpowder, because when it blows, when it all goes, all your models disappear in a blast of adiabatic fire.
Football riots. London burning. Gang wars.
Not safe at all.
Stay safe. Stay classic.

Day 10
You are different today. I can feel it; feel it in a way that transcends conscious knowledge.
you are
You still stare at the sky, at the way the unrisen sun plays a chiaroscuro of light and shadow across the underside of the scudding clouds with their promise of uncertain rain. You still laugh with your friend, still smile at internal jokes that only you know, and still move with the same grace and elegance that comes from knowing one's exact place in the universe, give or take some uncertainty.
still not
But you are not the same.

listening
We are apart; we are separate. We are individuals; each one of us a self-contained wavefunction that sees no evil, hears no evil, speaks no evil, and, ultimately, touches nobody.
to me
So I don't ask you what's wrong. All I know is that you radiate expectation, emit uncertainty, and resonate with the bittersweet melancholy of unfulfilled dreams.
are you
That's what being human means; it means being alone.
are you certain
Yes.
so very certain
Absolutely.
look up
What?
now

I look up, and your eyes meet mine.
And you smile
What about now?
Uncertain.

TIME MANAGEMENT

PRZEMYSŁAW ZAŃKO

The future wasn't gone, it couldn't be. Right?

Don't break the world: that's, like, the First Rule of science, and yet here we are, drenched in mud from World War I trenches, timesuits scorched in that mishap with Genghis Khan, with another mission failure on our hands.

All things considered, The End wasn't that bad. Sure, spacetime broke into pieces, all roads now literally lead to Rome and we still can't find San Diego, but life didn't really change that much. People adapt. Soon there were quantum mechanics fixing cars with quantum hammers and particle barbers for people whose hair got entangled. One guy became a millionaire selling Penning mouse traps to people with antimatter rodent problems. We rode dinosaurs, fought Vikings and played video games with our child selves. It was a blast. But we couldn't find the future.

My team tried everything. Searched every nook and cranny of the past, explored the Pacific Black Hole, consulted with Einstein, Bohr and Nostradamus. You could yank your timesuit's Time Arrow to your heart's content, push it all the way towards the future—and it still just wasn't there. Time stopped dead on 21st December 2012, when the Large Hadron Collider malfunctioned, and it turned out the Maya were right all along.

Everyone and their uncle had a theory. Time loops. Strangelets. Mirror universes. God's punishment for playing God. One guy gave everyone a headache by claiming that the future was still here, just happening in the past, and since we were all still *somehow* getting older, his logic was hard to disprove. ConCERN was established in Geneva, all of history's greatest minds set upon finding tomorrow, and we—Ramanujan, Wierzbowski, Beckett, me and three time-shifted versions of Sekibo—became the world's first temporal task force.

Working as Future Hunters was exciting. We saw some spooky action up close: exorcised the Maxwell's demon, fought the army of undead Schrödinger's cats, barely stopped

a Brazilian butterfly from setting off a tornado in Texas. It was pure chaos. And full of danger, like that time Wierzbowski tripped over some one-dimensional strings. I'm pretty sure the good people of Tunguska, 1908 didn't appreciate the explosion.

In the end, it was our Beckett who solved the big puzzle. One day he just ran through ConCERN's Quantum Hall in his mammoth wool long johns and his LHC WAS AN INSIDE JOB T-shirt, screaming "HEISENBERG!"—and that was it.

Uncertainty principle. Somehow all the eggheads missed the obvious. The past and the future are paired. The more is known about one, the less can be known about the other. And we've explored the past like crazy.

Of course, people didn't just give up. There were brainstorming sessions. There was praying. ConCERN devised multiple solutions which, one by one, all failed. Time travellers from the future turned out to be frauds. Creating wormholes only resulted in timeworm infestation. Methods of inducing mass amnesia were considered, but ultimately all discarded. Many believed in Sekibo's research: he was interviewing people from the past, searching for memories that contradicted history as we knew it. If there were multiple histories, he theorised, then our knowledge of what happened is actually quite poor and that means some hope for the future. But even as Sekibo catalogued the memories, it soon became obvious that all he proved was that human memory can't be trusted, people love to lie, and history books are written by the victors.

Things went pretty bad for a while. USA invaded itself for oil reserves. The pope collided with the antipope and they both exploded. Future Hunters got disbanded. I adapted. Became a tour guide for EnTropics Travels, bought a nice house in the 1920s. Took home a shaggy stray dog and named her Planck. On weekends I visited my past selves, just to relive the glory days. I was okay, life was okay. Planck and I took long walks on the beach and watched as many sunsets as we

pleased. Sometimes the same one, over and over again.

It's funny how you think you know yourself. There are things I used to put off, like, forever. Sunday dinners with your folks. Friends you bump into on the street and you would just love to grab a coffee, but there's this thing and you're already late. I used to think I'll meet them all one day, when I'm less busy, when I have the time. But then time folded back on itself and I still stayed home, watching lost episodes of Doctor Who and eating strange-flavoured quark ice cream. It turned out I actually liked being alone. Go figure.

There was still stuff to enjoy. Fighting dinosaurs and riding Vikings. Neutrino diets. We saved the Hindenburg, the Titanic, the Challenger and Pompeii. I went UFO hunting for a while, no success. I watched friends and colleagues settle down and I politely declined baby shower invitations. One by one, we left the future behind us and walked towards the unknown past.

It wasn't until antiphoton lunar flares that we finally realised. All of history, repeating on an endless cycle, getting more and more crowded as new children are born. And if someone doesn't break the cycle, reality will soon fail again, this time for good.

It's funny just how bad things have to get before you start seeing the obvious. I remember walking through Geneva with Planck, angry and sad, thinking how unfair all this was, how much I would've done with my life if the world hadn't just ended. I remember staring at my timesuit, the stupid Arrow stuck at NO FUTURE. And it still took me, like, forever, to grab that thing and yank it, not forwards or backwards, but *sideways*.

I remember standing there with my eyes closed shut, frozen in place, heart beating fast, afraid that me observing the results will somehow skew them, and it was only Planck's constant barking that finally made me look.

The Multiverse shimmered, futures bright like suns.

ACCEPTABLE LOSS

PRZEMYSŁAW ZAŃKO

"But this will destroy them," the General said, slowly. "All of them. All the universes except ours."

"Isn't that what you wanted?" I retorted. "To put an end to this multiverse nonsense?"

He pondered that for a moment, puffing his cigar, his stare lost somewhere between the Rembrandts and the Vermeers adorning the walls.

"Indeed. But I would be happy with just closing the portals. Destruction seems…"

"General." I pushed my shaking hands deeper into the lab coat's pockets. "Alternate universes. If I came up with this idea, some of my alter egos already did too. They're talking to your alter egos right now."

The old man blinked. Then he blinked again.

"And if I say no to destroying all the other worlds…"

"…then some of your alter egos will say yes."

He puffed the cigar again and opened the folder I brought him.

"Well then, Mr Beckett. You better explain this Decoherence Wave again. And fast."

✳

Afterwards I just sat there in the empty half-lit lab, gin in hand, waiting for the guilt that wouldn't come.

The biggest genocide in history. And yet all I could think about was whether smoking right by the "No smoking" sign would get me into trouble.

I bet Oppenheimer never lost sleep over that.

The portals to other worlds didn't solve anything. They just allowed people to run away from their problems. Don't like who won the election? Go live in a world where the losers won. Don't like your job? Find a parallel Earth where an unskilled lazy brat like you can live like a king. Don't like your life? Find your alter ego with the life you

want and ask if they'd like to swap places.

It needs to end.

It's like when a country opens its borders too much. The immigrants. The brain drain. People stop appreciating what they have and start chasing cheap imported thrills. They start getting ideas. And once you start getting ideas… How did that old poem go? If you open your mind too much, your brain will fall out. If we don't…

"You need to stop this, John."

I sat there, frozen, unable to speak, unable to face that all-too-familiar voice.

Donna stepped into the light.

"I know about the Decoherence Wave."

I downed my gin.

"Hi, honey. Long time no see."

My wife's face was pale, but her eyes were pure steel.

"You're going to destroy all quantum information. Collapse the multiverse."

I smiled, leaning back in my chair.

"Exactly. No more doppelgängers. No more uncertainty. One world, fully explainable by classical physics. Back the way it was. The way it should have been. There are only two possibilities: yes or no. Black or white. Whoever wants to have it otherwise…"

"There are people there," she said quietly.

"Probability ghosts."

"People from our world. My friends. Your colleagues."

"I guess they should've stayed where they belonged then."

She didn't even try to conceal her contempt.

"So you're best pals with the General now. You even sound like him. My God, John. You used to hate these guys, remember?"

I just laughed.

"Perhaps I have come to understand them. Perhaps you have helped me realise that the world was much better

before we've started letting all those strangers in."

"How very white of you."

Oh, the sweet, familiar, teeth-clenching rage. I have missed you, buddy.

"You know, things used to be so simple. So precise. The cat, either alive or dead. People, either apart or together. We used to know what to expect from life, and now…"

"That's what this is about? You're destroying the multiverse because of *me*?"

"You left me!" I was standing now, fists clenched, and she took a tentative step back. "For *him*! Do you have any idea how humiliated I felt when you proposed the swap? Our marriage wasn't perfect—I wasn't perfect—but…"

"Not perfect?" Donna hissed. "Not *perfect*? By the time I proposed the swap we *had* no marriage! You wouldn't hear about couples therapy, you wouldn't even talk to me! Day after day locked up in your stupid lab, trying to find a way to close the portals and bring back the good old days… You think I'm proud of what I did? I know I was wrong. But you sure as hell didn't leave me with a lot of right choices."

"So you left me for my alter ego," I spat. "That was your brilliant solution?"

One tear glistened in her eye, just one.

"I just wanted my husband back."

I turned away, fighting the urge to smash something. I didn't fight it for long.

"You don't have to do this," Donna said softly, as I finally stopped kicking the broken glass and just stood there, breathing heavily. "Your alter egos won't destroy the multiverse just because they figured out how. People aren't like that."

"People are exactly like that."

"No, John. That's just you."

I shrugged.

"It's too late anyway. The General would have pressed the button by now."

"Not if you lied and told him you were wrong. That the Wave will destroy his world too."

I smiled at her.

"And why would I do that, exactly?"

She smiled back, sadly.

"I know you wouldn't. But fortunately, my John would."

I stared at her for ten very long seconds.

Then I ran like hell.

The General exhaled a cloud of smoke.

"How do I know you're not an impostor as well?" he asked calmly. "How do I know you're not lying?"

I slammed my hand on his desk.

"There's no time! Don't you see? The longer we hesitate—you must use the Wave now! Make us the universe that wins, otherwise we're as dead as…"

And then I noticed it. Staring me in the face.

I swallowed hard.

"I thought you preferred cigars?"

The General gave me a warm smile, putting out his cigarette in the cut glass ashtray.

"What can I say, John. People change."

INDEX BY QUANTUM CONCEPTS

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- "Don't Die Before You're Dead, Sally Wu"
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- "The Scent of Strangeness"
- "Beam Therapy"

Nonlocality

- "End-User Agreement"

Planck's Constant

- "Quantum Man"
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[1] The Many Worlds theory and the concept of the Multiverse have scientifically distinct roots. The former is an interpretation of quantum mechanics while the latter is a cosmological idea. However, in popular culture, the terms and concepts are often used interchangeably and so we present these stories as one group.

Uncertainty Principle
- "I Dreamt of Worms"
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If you are interested to learn more about the scientific concepts after reading the stories inspired by them, our online resources provide a good starting point. Visit https://shorts.quantumlah.org/quantum-theories for more.

ABOUT THE AUTHORS

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Rebecca Baron, when she entered Quantum Shorts in 2013, described herself as a quirky, opinionated high school student in California who enjoys reading, soccer, and confusing her class with presentations on uncertainty and the delayed-choice experiment. Writing and physics are her passions, so this contest was perfect for her.

J. E. Bates is a lifelong communicant of science fiction, fantasy, horror and other mind sugar and screen candy. He has lived in Finland, Singapore, California and many worlds between. Currently, he can be found at twitter.com/jeebates or https://jebates.com.

Laura Campbell was born in Ireland and lives now in South Africa. She is a palliative care physician and has an interest in the powers of writing. She sees that writing assists with healing, wellness, acceptance and grief. She co-facilitates a creative writing course (writetoright.co.za) and is working towards Masters in Art (Creative Writing) through Rhodes University. She is married to

Patrick and has two wonderful children (Rory and Iona).

Peter Childs was born in England but ultimately escaped to the wilds of Scotland, a perfect location to build experience in physics and bioengineering. Currently based at the University of Glasgow, he helps translate academic technologies to clinic whilst in his free time he enjoys his science fiction accompanied by a dram of whisky.

Jesus Chua is an IT consultant for a small firm in Manila, Philippines. He became a father in 2014. His daughter's name is Eleanor, but he calls her Bubut.

Brian Crawford lives in the San Francisco Bay Area, where he does corporate communications by day and writes fiction in his garage in the early mornings. His work has appeared or is forthcoming in *Crazyhorse*, *Arts & Letters*, *McSweeney's Internet Tendency*, *ScientificAmerican.com*, *New South* and elsewhere. His story collection was a finalist for the 2019 Press 53 Award for Short Fiction. Read more at briancrawfordwrites.com.

Sumit Dam writes science fact for a living and science fiction for recreation, posting short stories at sumitsays.com. He lives, works and fails to sleep in London.

Gunnar De Winter is a biologist/philosopher hybrid who explores ideas through fictional fieldwork.

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Andrew Neil Gray is an author of speculative fiction who lives and works on Canada's West Coast. He's the co-author of the novella *The Ghost Line* (Tor.com 2017) and can be found at www.

andrewneilgray.com.

Judy Helfrich was born on the Canadian prairie where long stretches of nothing persisted in at least four dimensions. Her fiction has appeared in *Nature* and has also been shortlisted in the Quantum Shorts contests. More at: www.helfrich.ca.

Liam Hogan is an Oxford Physics graduate and award-winning London-based writer. His twisted fantasy collection, "Happy Ending Not Guaranteed", is published by Arachne Press. Find out more at http://happyendingnotguaranteed.blogspot.co.uk/, or tweet @LiamJHogan

Jenni Juvonen is a long-time enthusiast of science and literature, and has published short stories in several genres and languages. She is fascinated by possibilities and probabilities, and how they seem to collapse into certainties in our lives.

J M Kinnear does not write for a living, but does enjoy checking out the whiteboard doodles at the Institute for Quantum Computing in Waterloo, Ontario.

Morgan Long is a 19-year-old sophomore at Wesleyan University. When not taking classes on math and physics, he is playing games with friends, reading science fiction, or watching YouTube videos.

Andrew J. Manera is an arts administrator, educator, husband, and father. He used to be a scientist. Perhaps one day he'll be a writer too.

Nick Maslov is a lover of physics, astronomy, and science fiction. He will be studying physics at university in a year's time and has every intention of surviving the degenerate era himself.

Rebecca Montange entered the Quantum Shorts flash fiction

competition in 2013.

Ricky Nathvani is a post-doctoral researcher at Imperial College London, having recently completed a PhD in theoretical particle physics at University College London. He used to work on proton structure for applications at the Large Hadron Collider and has since pivoted into applying machine learning to study problems in global environmental health. When not doing research, he enjoys books, black coffee, boulders, beer-fuelled conversations and board games. If you like his writing, you can read more at atzerothorder.wordpress.com.

Vina Jie-Min Prasad is a Singaporean writer working against the world-machine. Her short fiction has appeared in *Clarkesworld*, *Uncanny Magazine*, *and Fireside Fiction.* She was a finalist for the Hugo, Nebula, and Sturgeon Awards in 2018. You can find links to her work at vinaprasad.com.

Clifton Rumsey has a background spanning the sciences from physics to neuroscience, rendering him more wave than particle at this point. On the other hand, his position can be localised to a well-defined orbit around Austin, Texas. Unfortunately, this leaves his momentum wildly uncertain. While several of his multiverse selves have already won every major scientific, literary, entertainment, and humanitarian award available, in this universe it remains a work in progress.

Daniel Swindlehurst used to have a proper, sensible job, but threw it all away to realise his childhood dream of being a scientist. He loves science fact and science fiction, and occasionally writes both.

Aaric Tan Xiang Yeow's poems have appeared in *Hawai'i Review*, *From Walden to Woodlands*, *The Missing Slate* and elsewhere. He co-edited *Red Pulse II* (Ethos Books), an anthology centred on a sunny island set in the sea. He has received a top award from the

National Poetry Festival as well as a Golden Point Award, 3rd prize, from the National Arts Council. His undergraduate research on organometallic radicals culminated in a published article on a peer-reviewed journal.

Abel James Tilda has degrees in Art History and Archaeology and lives in California. In his spare time, he enjoys playing music, walking up and down very big hills, and writing. He wrote this in the past, and now it is one of many futures. He wonders what will happen next.

Lily Turaski will graduate from the Georgia Institute of Technology in 2021 with a degree in Materials Science Engineering and a minor in Chemistry. In addition to her classwork, she enjoys researching electronic materials and riding horses. She won the 2015 and 2017 Quantum Shorts People's Choice Awards.

Having dabbled in theoretical physics, law, and economics, **Kenton K. Yee** now ponders, invests, and writes from Northern California. He has placed poetry and short fiction in venues ranging from *The Los Angeles Review* to *Strange Horizons*, *Daily Science Fiction*, and *Uncle John's Bathroom Reader*. His academic articles appear in venues such as *Physical Review D*, *Nuclear Physics B*, and *Financial Analysts Journal*. http://fictionaut.com/users/kenton-k-yee.

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Przemysław Zańko is a Polish speculative fiction writer who lives in Warsaw with his fiancée. He has published several short stories, won some awards and is currently working on his first novel. His hobbies include video games, "Doctor Who", psychology, exploring strange corners of the Internet and swimming.

ABOUT THE DESIGNER

Nurul Syafiqah is a multidisciplinary graphic designer and illustrator based in Singapore who values symbols, metaphors and hidden meanings. She is happy to roam her mental landscape of thoughts, emotions, and fantasies for hours on end. She is naturally drawn to expressing her inner world through literary pursuits and visual arts. She likes to infuse her everyday life with the wonder and beauty of the imagination. With a depth of sensitivity and empathy, Syafiqah is also interested in finding methods to allow her to give voices to universal human emotions in order to touch people on a profound level.

LIST OF STORIES AND THEIR CREATIVE COMMONS LICENSES

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Quantum Shorts Competition (Fiction)
2013

Dice	*Betony Adams*
There Was a Sun	*Rebecca Baron*
The Knight of Infinity	*Brian Crawford*
Why Don't You Just	*Sumit Dam*
I, Ionium	*Charles Dittell*
The Leaning Light	*Andrew J. Manera*
The Cat in the Box	*Rebecca Montange*
The Entanglement Proposal	*Vina Jie-Min Prasad*
Quantum Man	*Clifton Rumsey*
Postmortem	*Abel James Tilda*
Indistinguishable	*Kenton K. Yee*
Superpose	*Yuen Xiang Hao*

Quantum Shorts Competition (Fiction)
2015
