

## SPIRAL ARCHITECT

*“...the stuff of which we’re made is like flotsam on the cosmic ocean.”*

*- The Fabric of the Cosmos, by Brian Greene, p. 301*

Yang Lee arrived at his modest, three bedroom house in the northern outskirts of San Bernadino, near the foothills of the San Bernadino Mountains. As he got out of his car he looked over at one of the nearby mountains, with its familiar arrowhead landmark etched upon its face. Made of quartz and white sage, it was a naturally occurring image that looked like a giant arrow flint pointing straight down towards the ground. The Indians who inhabited the San Bernadino valley had believed it pointed the way to the hot springs below, or perhaps it was simply a guide, like the Israelite’s Pillar of Fire, to the spot where they were to live. Looking at it, Yang couldn’t help but make other connections for it.

He turned and walked to his letterbox, and with a sigh removed a large wad of junk mail. Holding it in his hand it felt like a large book, but not one that was filled with much wisdom. In his time here he had placed two ‘no junk mail, please’ signs on the box, but vandals (possibly junk mail deliverers) had removed them both. And so he had been resigned to continue receiving the deluge of unsolicited advertising, which he saw as a clear sign of the coming apocalypse, and how it was probably well deserved. It wasn’t even a whimsical thought; he was serious. *The Earth is a finite resource*, he thought, *yet we continue to recklessly consume it. There will come a reckoning*. Of course, there were other signs, like the existence of reality TV, but he did not care to dwell on them.

Along with a couple of honest letters, he took the junk mail inside with him (his wife enjoyed reading it).

The house interior was sparse and uncluttered, decorated along strict zen lines betraying a Japanese design aesthetic, courtesy of his wife. The walls, which were all painted white, were lined with unobtrusive cupboards and bookshelves. The furniture - chairs, couches and coffee tables - was minimalist. The only concession to modern garishness was the large flat-screen TV that hung on one of the walls. Its frame was white, designed to blend in with the walls, and it was presently not turned on.

Besides Yang, the only occupant of the lounge room was a small child, a girl of five years age, lying on the floor reading a book. Her hair was black, with short pigtails that stuck up whimsically like antennae. Upon seeing her father, she took her nose out of the book she’d been devouring and happily ran to him.

In a squeaky Californian accent she said, “Hey dad, I’ve finally worked out that puzzle!”

“Did you?” he gaped indulgently. He had given her the toy, a three-dimensional logic puzzle, the day before.

“Yeah, it wasn’t too hard, after I found the right combinations for the ball. The rest of it just...made sense.” She hunched her shoulders.

“That’s my girl!” He gave her a squeeze and a kiss, then moved on into the kitchen, where his wife Keiko was preparing the evening meal. She looked prim and proper in a fresh clean dress and apron.

Yang grabbed an apple from the fruit bowl on the dining table then walked over to his wife. He leaned over her shoulder to see what she was cooking. “Hello wife. What is it this time?”

“Hello husband,” said Keiko, raising her free hand to stroke his chin. “It’s minestrone.” At Yang’s grimace she exclaimed bossily, “You’ll take it and you’ll like it!”

“Yes, ma’am,” he grumbled, taking a bite of the apple.

“That’s right, you’ll take it and you’ll like it, daddy!” Kimmy, having come into the kitchen and seen the exchange, repeated her mother. She giggled and ran off.

“I’m outnumbered!” Yang complained good-naturedly, and kissing Keiko on the neck, escaped the kitchen.

Heading up the passageway towards his study he glanced warily at his son’s bedroom, seeing the computer screen light flickering busily against the opened door. He knew Christopher was playing some trivial computer game, when he should have been doing his homework. The flickering light suspiciously changed configuration to something more sedate as he approached.

Sticking his head in the door, he said, “Hey Chris, how’s the homework going?”

The thirteen-year old didn’t look up from the screen as he said, “Great, dad.” Hunched over the keyboard, he tapped industriously, sending a shard of letters onto the screen.

“Okay, that’s my boy.” Yang left him to it and moved on.

Once inside his study, he finally relaxed completely. The wife had allowed a certain amount of clutter in this room - and *only* this room - of the house. Not that there was much - Yang was almost as fastidious as was Keiko. One side of the room contained filing cabinets, a plush couch, large swivel chair and a small antique desk. On the other side were an upright electric piano and a violin on a stand.

He walked over to the desk, which contained a green lamp, desktop computer, printer and two framed photos. One photo contained a happy snap of Keiko and the two children, beaming out at him as if they completely approved of everything he did. The other was a photo of Albert Einstein, sticking his tongue out as if reminding him that even geniuses have their faintly ridiculous moments.

He took some papers out of his briefcase and placed them on the desk next to some other papers. Glancing over them, he pursed his lips and put some of them in the desk draw. He retained the recent printouts of the Gate energy readings he’d brought with him from the Institute. He then carried them over to the couch, where he sat. Munching on the apple, he studied the papers with interest.

He looked at the last few lines, the ones that had shown a distinct peak in energy at the point when Lina had thrown the pencil through the Gate. Just what had happened to the pencil at that point was very much open to discussion. If it turned out the Gate event horizon was a black hole then the pencil may have simply got burned to a crisp inside the quantum firewall. But that didn’t make sense, as the Gate was clearly meant to do something *useful*. And the photons and visible light coming from the event horizon seemed to rule out the black hole theory, in any case. No, Yang was certain it was something more than a *mere* black hole.

One possibility was the wormhole theory. It was a good lead, but Yang’s preferred hypothesis was that a type of matter-energy transference was taking place. He was well aware that, if he were right, the forces needed to break down the binding energy of nuclei would be enormous, but he was confident the geothermal energies accessed by the Gate could do the job. Therefore in this theory the Gate had somehow broken down the pencil’s subatomic matter into direct energy, wherein it was then sent through the Gate – but to where? In all likelihood, Yang considered it was another Gate.

The idea was very similar to the old science fiction notion of teleportation, which these days was mostly expressed through that wonderful quantum idea of *entanglement*. It was a theory based on the proven ‘spooky’ (Einstein’s word) connection between paired atoms operating at a distance, and using that connection to pass matter back and forth between them. Many physicists had seen it as a theoretically possible solution to long distance transit. There had already been successful practical teleportations of small elements such as quarks from one location to another using the theory, but nothing on a larger scale.

It was all crazy stuff. But the Gate had already displayed many unusual properties, and Yang was prepared to accept that there were even more discoveries to come. He had already invoked Bayes’ theorem:

$$P(h/e) = P(h) \frac{P(e/h)}{P(e)}$$

wherein  $P(h/e)$  denoted the probability of a hypothesis  $h$  in the light of evidence  $e$ ,  $P(e/h)$  denoted the probability to be ascribed to the evidence  $e$  on the assumption that the hypothesis  $h$  is correct,  $P(h)$  the probability ascribed to  $h$  in the absence of knowledge of  $e$ , and  $P(e)$  the probability ascribed to  $e$  in the absence of any assumption about the truth of  $h$ . Having done the ‘prior’ (the initial probabilities on both the matter/energy transfer theory and the entanglement theory) he found the outcome for both was high – more positive than negative. The new evidence  $e$  of Lina’s pencil disappearing into the event horizon was encouraging, to say the least.

He thought about it some more, and even considered putting on a set of headphones and listening to some music to gain his *fast track to focus*, but there wasn’t really time. Dinner would be ready soon. He turned off the main room light and switched on the green lamp instead. With its soft, friendly glow the room became warm and intimate. He let go of the problem and sat quietly, shutting out the noise, meditating on more important things, like his family and his ever-present Now.

He then walked over and sat at his electric piano. Playing some variations on a couple of Beethoven sonatas, he let his mind wander. He thought of a piece of music he was working on: a simple lullaby he thought his daughter Kimmy might like. He began to play around with it, altering the keys, diverting from the melody, changing the tempo. It was beginning to take shape, as he knew it would. He loved that about music and art. No matter how much you improvised, no matter how many unexpected elements you threw into the mix, it always wanted to make sense. It was just like his investigations into science and physics. The connections, the patterns were always there; you only had to be persistent and open to them. It was order from the chaos, seemingly reversing entropy’s arrow.

Dinner was, as always, held at the family dining table. All members were expected to attend, but Christopher lingered in his bedroom, still absorbed by his computer games.

“I’ll get him,” said Keiko, getting up.

“It’s all right,” said Yang. “He’ll come out soon enough.”

Keiko looked sternly at her husband. “This isn’t what we agreed on.” She left the table to retrieve her recalcitrant son. She was a person who liked order, especially in her home.

Little Kimmy sat quietly at the table, taking in her parent’s exchange and filing it away for future reference.

“I don’t know why you had to call me, I was coming out anyway,” grumbled Christopher, blinking in the bright light as he came to the table.

With the son safely installed, the meal finally began, and everyone – except Yang – enjoyed the hearty minestrone and bread.

Yang looked at the thin vegetables and wished for meat. He remembered his father, a butcher, slicing up beef and pork back in Bakersfield. He had the habit at every meal to give words of thanks to the animal being eaten, and which he more than likely killed, skinned and butchered himself. It was a habit Yang had taken up, and which he performed whenever he got the chance to eat meat. Depending on the dish, he would say quietly to himself, *Thank you, piggy*; or, *Thank you, cow* – or even *Thank you, fishies*. He did not always remember to do it, but he tried in his own small way to honor the animal. It seemed important - not just as a way of remembering his father, but of remaining in touch with the cycle of life and death.

“Mrs Keach said in class today she’ll be going away soon,” Kimmy piped up. She had learned that dinner time was a good time for talk, so she conscientiously decided to start. Anyway, Mrs Keach, her grade school teacher, whom she idolized, was always doing something interesting.

“Why is that, dear?” asked her mother. “I hope it’s nothing bad.”

“No, it’s good. She’s going to have a baby!” Kimmy smiled, delighted at the prospect.

“Oh!”

“But you know,” joined in Yang, “that means you’ll be getting a different teacher. What if it’s a man?”

“It *is* a man,” said Kimmy, unconcerned. “Mr Cortez. I’ve seen him. He’s got big teeth.”

The talk continued in this way, with Kimmy as the centre of attention, for several minutes, until Christopher decided he wanted to participate. He had some information he thought his father, in particular, might appreciate.

“Mr Whitby said in Science today that we, or...” he scrunched his eyes, trying to remember the right term, “...*normal matter*, everything we can see and touch makes up only about five percent of the universe.” He looked to his father. “Is that right?”

“That’s about right,” confirmed Yang happily. “It’s also galaxies and stars and normal electrons and protons, and everything in between. It’s good to see your Science teacher is giving you some basic Cosmology, son.”

“But what about the other, uh, ninety-five percent?”

“That’s what I was gonna say!” protested Kimmy. Her parents smiled indulgently at her.

“Mr Whitby said,” continued Christopher, “that it’s made up of some dark stuff – dark matter we can’t even see?”

“Yes,” said Yang, warming to the subject. “About twenty-five percent is what we call dark matter, and the remaining seventy is something we’re calling dark energy.”

“But how do we know it’s there?”

Yang pushed his half-empty bowl of minestrone away. “Well, the short answer is we can only infer it.”

He looked at the bowl and decided to make a demonstration from it. Waving a hand over the bowl, he said, “Think of this bowl here as the universe with everything that’s in it. We know this is supposed to be the extent of its density, but we can only detect those little vegetables that are floating around in it. That’s the five percent ordinary matter. Now, we know something’s making it float around in there, and that’s the broth which is like the dark matter that we can’t see. Then...”

He paused for a moment, beginning to realize that the analogy was probably ill-advised and confusing, yet he continued. "Then there's the dark energy, which is all the air that's left in the bowl. And we know it must be there because of the shape of the bowl, which is..."

He pointed a finger at Kimmy, who responded obediently, "The universe!"

"But here's the thing..." He paused dramatically. Pointing into the bowl, he said, "The bowl is getting bigger - or rather, all that dark energy 'air' is pushing at it and stretching it further, so that all the matter that's there - the minestrone - is getting less and less. Like when I do this." Here, he dipped his spoon into the soup and scooped out a spoonful.

"Yes, and...?" Keiko smiled and nodded her head with some amusement, encouraging her husband to empty the spoon's contents into his mouth.

Putting on a glum face, Yang made the minestrone/ordinary matter disappear into the giant black maw of his mouth.

"Like so!"

His family clapped his impromptu demonstration. Receiving it gratefully, he added, "And that's how we know something's there: it's pushing all the ordinary matter in the universe away at an accelerated pace."

While they took that all in he got up and began clearing the table. Keiko gave him an appreciative grin and helped him, while the children escaped to their various pre-bedtime activities.

"The universe as a minestrone," she said, shaking her head. "I swear, you physicists are incorrigible with your metaphors."

"The kids seemed to enjoy it. Especially Christopher." Yang was happy about that. He knew he had been somewhat distant and cold to the boy lately, but that was mostly work distractions. His son's questions about the universe and his genuine interest in the subject had given him real pleasure in that connection.

"Anyway, don't forget the green waste goes out tonight."

As she said this she bent down to pick up a napkin that had fallen on the floor. The action caused some errant strands of hair to come loose. Yang reached up his hand and brushed them away.

He looked admiringly at her. There was a proud, prematurely grey streak in her otherwise jet black hair. It reminded him vaguely of Lillian Munster, from the old *Munsters* TV show - and not meant unkindly. He thought she was kind of hot.

Acknowledging the intimate gesture, but still commanding, Keiko ordered, "And try not to be too late to bed tonight, hey?"

Yang detected a glint of suggestiveness in the advice, and heading for his study, promised not to work for too long.

She was a demanding woman, but well worth it, he thought as he entered the room. It had been a relatively short courtship. They had been students at Berkeley, and she had shown some slight interest in him. Normally he was hopeless with girls, and tended to over-think the situation, dallying when he should be taking control, and thus making things weird and missing his chances. But he knew he had a short window of opportunity with Keiko, and so for once he took the initiative. In a cafe on Telegraph Avenue, he asked her out, and she accepted.

Both were career driven, with very strong views about family and its role in society. When they married they conducted it, and then their family, as a microcosm of how they thought society should be. It was all based on a plan of control, and eliminating the unexpected as much as possible. Firstly, they didn't have the children until they knew they were ready, financially, emotionally and intellectually. And they agreed

there would only be two. After the two children were born, Yang studiously submitted to a vasectomy.

As the marriage proceeded and the family grew they quickly downshifted their lifestyle. Yang left his previous job in corporate research for the much lower paid job with the Institute, and Keiko traded down to part-time nursing. But the tradeoff was much less work hours and more time with the family, which was important to them. They could also indulge in other outside hobbies and past-times, like Yang with his music, and Keiko with her interior design. They saw success not as an increase in pay and material wealth, but in time spent with family, pursuing hobbies and gaining life interests.

This downshifting extended to other aspects of their lives, particularly in their consumption. There would be no gas guzzling family vans for the wife and kids, no McMansions and swimming pools in the back yard. They were determined to leave a small footprint.

But parenthood and family life, of course, inevitably threw up its unpredictable elements. They found they could not control everything, especially the way the children developed. This unpredictability was something Yang welcomed. He felt they had been over-controlling and they needed to balance this out by letting go sometimes. In the case of his son, it had not always been easy to watch, or to stand by and let it happen, but he felt it was the right thing to do. Chaos must, at times, assert itself. With careful supervision, he was confident things would work out in the end.

Back in his study, Yang placed a comfortable set of headphones on his head, turned on his *Heavy Metal* playlist (sourced by an aficionado friend) from the computer and began his *fast track to focus*. He hated the music, but (because it was like a kind of white noise to him) it was the only sound that helped him to zero in on any problem, free of distractions. He looked again at the two printouts of the *Bob* and *Alice* detector readings that represented the event horizon's energy output.

While in his headphones the heavy metal band Slayer were exhorting him to spill 'the pure virgin blood', Yang found himself thinking about Kimmy, amongst all the data. Her birthday was coming up, and he was thinking of presents to get her. It almost threw off his concentration.

Letting the music wash over him, he regained his focus and tuned in to the information before him. There was definitely something going on in the data that was intriguing him. He looked at the lines for the *Alice* energy stream. The peak had occurred very near the 24 electron-volt mark. It was a relatively small energy signal, but it was highly suggestive of large forces at work on the other side.

As the music in his headphones changed to the crushing death metal tones of Morbid Angel, Yang began to wonder about wave function collapse. Since nothing of the event horizon had been measured, apart from the weakling photon stream, he reasoned that it must be positively awash with un-collapsed phenomena in there still in their superpositioned quantum states. Whether it was entangled particles doing their merry dance, or the mysteries of matter/energy conversion, their observation (and thus, the wave function collapse) was denied, cloaked like Schrodinger's Cat in its box. And this was intentional. The act of measurement was thwarted so that the Gate could be free to do its job. It was programmed for quantum autonomy. But how was it programmed, what exotic or elusive element could mediate between the quantum and classical worlds and stave off the collapse? What was out there that the Gate could usefully collect, apart from geothermal heat and ordinary matter? Radiation? Neutrons? Neutrinos?

The music in his headphones suddenly changed and Yang couldn't help but listen along. Evocative acoustic guitar arpeggios of some delicacy were played. And then a thunderous introduction including what sounded like orchestral strings swept him up in its glory. Was this really heavy metal music? The lyrics, when they came, were nonsensical and disparate – something about sorcerers selling time. He tried to block them out while he continued on the problem. But instead, he found himself thinking of the 'minestrone' explanation he'd given of the universe at the dinner table, of the ordinary matter, the dark matter and the dark energy.

And then it came to him...

What if the secret ingredient was found within the dark matter, or possibly the dark energy, the other ninety-five percent of the universe?

Disoriented, he suddenly took off his headphones and looked away from the screen. Ozzy Osbourne of Black Sabbath could faintly be heard proclaiming tinnily within the abandoned headphones: *'Silver ships on plasmic oceans in disguise'*.

Yang gasped with excitement. He looked back at the computer screen before him and it was a blur. He breathed in deeply, and settled himself. Nothing was proved. He had no more than another crazy hypothesis, a new direction to take. It was enough. Yang well knew that by these theoretical constructs he was pulling several quantum rabbits out of a quantum hat, but in the world of theoretical physics this was perfectly valid.

He experienced a familiar feeling of satisfaction that often happened when he was working on a problem. As always, the patterns – the music – had wanted to make sense.

Outside, by the garage, the green waste bin stood neglected by Yang in all his excitement. Above the house, as seen from a certain angle, the old landmark of the Arrowhead sat on its mountain, pointing down toward the scene of Yang Lee's new direction.