

The Cosmic Monopole



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Penny Press

The Cosmic Monopole

is the first volume in the Time Crystal Series



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ISBN 978-1-871281-23-1

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Hidden Sacred Book Chapter 1

Cosmic Monopole

And so at last I come to you, blessed Monopole, seed of the becoming, to whom this Hidden Sacred Book is most humbly dedicated. I am dictating this to the Princess Uskabellu in total secrecy, with instructions to reveal it to no-one. This work is not just an act of homage to you, Oh glorious Monopole, but as a stimulation to my thoughts as I contemplate the mystery of your current location. For it is beyond doubt that resolving this problem is the key to the fate of the Universe.

Your story begins in the skies above the domain known as Entroilia. At that time you still took the form of a cosmic seed. During the annual mating of Her Imperial Majesty Queen Karolinda, an unidentified drone did fertilise one of her eggs with you, thereby creating the Cosmic Egg and giving impetus to the unfolding history recounted with devotion in my preceding chronicles. Once inside the living egg, you became manifest as the object later known to mankind as “the Cosmic Monopole”.

When the Egg subdivided into incompatible regions with different physical laws, as I explained in Book 1, you were trapped at the junction between three of these regions which mankind would eventually call “Universes”.

Each region obeyed different fundamental laws of physics. You must have felt as confused as a child finding itself on the disputed border of three nations, all speaking different languages and obeying mutually incompatible laws. You shared aspects of all three domains but belonged to none.

From your vantage point between these regions, no doubt you surveyed them with much distress, for clearly you were different from the swarms of other particles flickering momentarily into existence around you in the intense heat of the complex sequence of events known to mankind, in his simplicity, as “before the Big Bang”. For one thing, the lives of those particles were short whereas you, blessed Monopole, you endured over time so that even many microseconds later, when those others had settled into stable configurations, you were still obviously special and apparently unique.

For of all the particles surrounding you, Oh Cosmic Monopole – may your name forever be venerated in the minds of all living creatures – you alone possessed that magical property which mankind would later call a “magnetic charge”.

True, many of those others had “electrical charges”. Of these the commonest were the large heavy protons with their positive charges and the tiny, cloud-like electrons with their negative ones, although some particles such as the neutron had no charge at all.

And true, some of their movements resulted in the creation of small magnetic fields around them. But not one of them had the magical property of a permanent magnetic charge, the single magnetic pole which gave you the wonderful name “Monopole”.

As I have explained hitherto, as time went on the Cosmos expanded and the energy density fell to levels below which particles could no longer be created. From now on their number was more or less constant. Occasionally two of the smaller ones would collide and fuse together to make a single large unit. Sometimes large ones would split apart into several fragments, but the great age of particle creation was over. Later still the opposite charges of protons and electrons attracted them together and they stuck into tiny objects called “atoms”. The cosmos was now full of a simple atomic gas.

But none of this was of any interest to you, Oh majestic Monopole! You still hovered on the boundary between three regions, unable to decide which one should be your home.

There were magnetic fields within these domains, lines of force which reached endlessly around space in wildly gyrating coils and spirals, loops and bands. As the Cosmos expanded, these fields interacted with charged particles, both pushing them around and in turn being itself shaped by their movement. And you too were affected by these fields, Oh Monopole. Unable to maintain your position on that narrow border between the three regions, the lines of force pulled you by chance into one of them, the one which mankind would eventually call "the Universe", and henceforth you found yourself trapped therein, losing contact with the uncounted other domains in the wider Cosmos.

For a long time you drifted listlessly around your new home. Far away there appeared tiny splashes of light which men now call "galaxies". Hundreds of billions of them traced out walls and filaments around vast dark oceans of almost empty space. But for all this time, Oh Monopole, you remained isolated within one of these spaces, drifting restlessly, pulled by weak magnetic fields, as if searching for another particle like yourself.

After a billion years or so, a winding line of magnetic force drew you closer and closer to one of these glowing galaxies and finally you found yourself inside. Wandering through this island of gas, you discovered the source of the light. It contained billions of those glowing globes of plasma men call "stars". These too had magnetic fields and occasionally you would be trapped inside one of these nuclear fusion reactors, where the force of gravity was forging smaller particles together into larger ones and, almost incidentally, converting matter into radiation which seeped out as starlight.

Here, no doubt, you searched at first with great excitement, hoping to find another monopole like yourself. But when you found only the same particles you had seen in the Big Bang your disappointment must have been intense. You did, however, discover something entirely new. Occasionally one of protons around you was able to adhere to your outer surface. Although these new companions invoked in you no interest, nevertheless you began slowly to grow.

After a few million years of fusion, your star ran out of fuel and the nuclear power plant at its centre shut down. Normally a star dies quietly but your star happened to be larger than average. It exploded into a spectacular "supernova", fusing smaller particles together and creating entirely new species of heavy particles such as you had never seen before.

This must have attracted your interest, for surely you wondered whether any of these new particles had a magnetic pole, like yourself. But you had no chance to find out, for the explosion which made these particles also spewed them out into the galaxy as a shower of pollution. You too were ejected from the dying star and you continued to wander the galaxy, observing new stars forming around you from this polluted gas. Eventually these stars also died and released more heavy particles. This pollution finally became so bad that particles were able to stick together to produce grains of dust. Dust absorbs starlight and the galaxy began to grow dark from the pollution released by generations of dead stars.

For the next fourteen billion years you wandered around the galaxy, poor disconsolate Monopole, moving in and out of stars, carried along by the lines of magnetic force. An observer might have imagined you searching these clouds of dust, picking over the debris of dead stars, hoping perhaps to find another like yourself, searching among the debris for a brother or even a distant cousin with whom you could identify. But you were destined to be utterly disappointed, for the new particles created inside stars were merely larger accumulations of the protons and neutrons you already knew and despised. No doubt you felt you did not belong here, unrelated to the particles among which you found yourself, a stranger in a strange place, trapped by the galaxy's magnetic fields.

You probably did not notice that, on the surface of these grains of dust, smaller atoms were bonding together into little groups called "molecules", and so the first appearance of water in the Universe almost certainly passed without remark. But you probably did notice that your galactic prison was changing.

For the whole galaxy was drifting through space and slowly rotating. As it drifted it occasionally collided with a neighbouring galaxy, creating new showers of stars. Even more important was the effect of its

rotation. The resulting centrifugal force pushed its equatorial regions outwards while gravity pulled the northern and southern sections inwards. These forces reshaped the galaxy's structure, turning it from a large ball into a flat, plate-shaped disc with a slightly bulging centre. Henceforth new stars would form within this disc. Furthermore the new stars would be organised not at random but in several narrow bands which spiralled elegantly outwards from the central region.

These stars were created from the debris of gas and dust left over from older supernovae, the pollution which had accumulated over the aeons. When finally humans looked up into the night sky, from their position upon a tiny planet within the disc, they saw it as a thin band of glowing light smeared across the heavens. This band came to be called the "Milky Way" and eventually when astronomers worked out its true nature, it gave its name to the whole galaxy, the "Milky Way Galaxy".

Two million years ago, Oh Monopole, following a magnetic line of force, you happened to pass very close to a middle-aged star, the one later given the name "the Sun". It was surrounded by a small array of planets spread out in a flat disc around the star. At first you hardly noticed the third one out from the centre, the little rocky planet which mankind calls "Earth". Orbited by a single moon, this rocky speck in space did not at first seem very interesting. Only its beautiful blue colour and its unusual oxygen-rich atmosphere distinguished it from the millions of other planets which you had wandered past during your long life.

You had occasionally visited planets before. There were many of them scattered around in the Galaxy. Small ones such as this were mostly formed from the heavy atomic debris left over from previous supernovae, atoms such as oxygen, silicon and iron collected together in dirty little balls of rock. You had sometimes even passed through these objects, drawn in by their magnetic fields, but inside they were just as boring as everywhere else, same old particles, nothing you could call a relative.

The exact source of the line of magnetic force which drew you towards this planet has not been established with certainty. It might have been a chance configuration of the solar magnetic field. More likely it was the planet's own field, originating in its iron core, which pulled you inward. In either case, you began to descend rapidly towards the surface.

And so it was that one morning in early April you were finally swept along by the Earth's magnetic field, Oh Monopole, and approached the continent known as "Europe". Plunging down through the thin cloud you descended rapidly towards a lake trapped between two mountain ranges. You might have been curious about this lake for you had never been close to liquid water before. Water ice yes, that was common enough upon dust grains in the Galaxy, but it was rare to find a planet which was at just the right distance from its star that water would neither boil nor freeze but remain as a liquid. You might even have hoped to plunge into this exotic medium, this curving lake, to explore its properties and probe its hidden depths.

But, as you approached the end of the lake, a long finger terminating in a small city called Geneva, you were suddenly pulled off course by a local magnetic field and you swerved towards the west. As you flew rapidly over streets swarming with shoppers and traffic, over planes heading for the airport, you must surely have been surprised at the difference between this and the other planets, sterile and lifeless, which you had visited during your long existence.

Did you, perhaps, notice a silver BMW driving up the long straight road, the Route de Meyrin, along whose path you flew? Probably not, and even if you had seen it there was no way for you to know that your fate would be intimately connected with that of the occupants.

Episode 1 Arrivals

‘Don’t worry if nobody loves you.’

Ireland’s entry for the forthcoming Eurovision Song Contest, sung a semitone flat, drifted over the car’s front passenger seat.

Alone in the back of her BMW, Ambassador Brigit O’Brien stopped reading the “United Nations Commission on Sustainable Development Report of the Inter-Sessional Briefing on Sustainable Consumption and Production” and slammed the heavy document onto her lap. *How the hell can I concentrate with that bloody noise going on?* she thought.

‘And nobody seems to care.’

Brigit’s fourteen-year-old daughter Catriona was gradually singing louder as she looked at Kieran Gable’s photograph on the front of “Kiss”, the Irish teen magazine she had brought from Dublin.

In the back seat, Brigit watched her daughter’s ginger head wobbling and Sam Fitzpatrick’s fingers drumming on the steering wheel. She was about to scream at her daughter to shut up when a pleasant idea suddenly struck her. *Maybe this is the opportunity I’ve been waiting for!*

She caught a glimpse of herself in the driver’s rear-view mirror, thick blond curls above a heart-shaped face with perhaps a little too much make-up, a broad smile playing upon her ruby-red lips. She forced her expression into an angry scowl and glanced at the driver, but Sam was concentrating on the traffic and did not notice her.

‘When everyone tells you you’re ugly.’

Catriona seemed to be on stage now, singing her heart out for Ireland as if the eyes of the world were upon her. Sam drove over the brow of a hill on the outskirts of Geneva and Brigit saw a long mountain range spanning the horizon on the far side of the little valley ahead of them, their peaks sprinkled with a dusting of icing-sugar left over from last winter’s snow. At their foot on the far side of the valley a large brown dome came into view. *That must be CERN*, Brigit thought. *We’ll be there in a minute. It’s now or never.* She lifted the report level with her eye and paused to take aim.

‘Keep smiling and you’ll get your share.’

Catriona gave the somewhat lack-lustre lyrics everything she had with full throated expression. With equal passion, Brigit hurled the document viciously over the front passenger seat at the back of her daughter’s head as she screamed ‘For God’s sake Catriona, shut up!’

Catriona gave a yelp of pain mixed with alarm as the missile struck her head and exploded across the windscreen in a paper snowstorm. Unable to see the road, Sam braked sharply and the car swerved into the path of an on-coming wagon which was labouring up the hill towards them.

‘Mother you’re going to get us all killed!’ Catriona yelled as she scooped the papers away from the windscreen onto her lap. Seeing the wagon, Sam pulled the car back into his own lane.

Satisfied that her little melodrama had opened well, Brigit pulled out an exquisitely embroidered handkerchief from her ample cleavage, conveniently exposed by the low-cut jacket of her vermilion designer trouser-suit, and howled ‘I can’t do this job another minute, Sam! It’s all official reports and briefings and bureaucratic gobbledy-goo. How am I ever going to become the President of Ireland if I can’t hold down a simple Ambassador’s job? I give up!’ she howled, putting as much expression into the words as her daughter had put into the song. ‘I’m going to quit the UN and come back to Dublin with you two.’ Finally she began sobbing theatrically into the handkerchief.

For a moment the only sounds were Brigit's sobs. Then, in an astonishingly calm voice Sam said, 'No, don't do that, dearest. You don't want to resign, Bee.' The car picked up speed as they began to descend the hillside, following the stream of traffic pouring westwards along the Route de Meyrin out of Geneva. 'You're just a bit stressed out at the moment. It's natural. You've been working your socks off for the past two months. Why don't you have the rest of the week off and—'

'You've got to be kidding, Sam!' Brigit yelled. 'You don't get it, do you? My diary's packed every day and every evening for the next two months. I need help, Sam,' she wailed and once more began making the sounds of sobs.

'I think you do, Bee. Listen. Why don't Catriona and I stay here after Easter and lend you a hand?'

'Would you?' Brigit said with exaggerated enthusiasm. 'Would you really, Sammy? That would be so helpful. Oh thank you, darling.' She pushed the handkerchief back in her bra feeling elated. He had capitulated almost without a fight. She smiled at him in the mirror and even smiled at her daughter.

Beside him in the passenger seat, Catriona was staring at him too, an expression of utter disbelief on her pale oval face, but she wasn't saying anything.

'Of course we will my love,' Sam said. 'I'll phone my school and tell them I've broken a leg skiing.'

'Good idea,' Brigit said, leaning over the passenger seat and taking the papers off Catriona. 'Better make it both legs. I'm going to need you here for quite a while. And for God's sake keep quiet, Catriona. I've got to work.'

She began to rearrange the sheets in order, happily humming to herself.

'Don't worry if nobody loves you.'



Catriona stared at the balding man sitting beside her, his fingers still happily tapping the steering-wheel. 'You're not really planning to stay here are you, Sam?' she hissed. 'Surely you weren't fooled by Mother's pathetic little performance? You know what an actress she is! She can't ask you to take time off your job and me to miss out on school just because she's having some problems. She's selfish. Utterly selfish.'

He glanced at her and she saw an indulgent smile playing on his lips but she couldn't quite make out what it meant, especially when he said 'I'm sorry, Catty, but it was your idea to come here in the first place. Don't you remember?'

Oh yes, I remember it very clearly, Catriona thought, *Sam sitting at my computer reading his emails and saying 'You'd be interested in this one, Catty. Your mother's been invited to CERN. Wasn't that where your father used to work a lot of the time?'*

The idea had hit her immediately. At first it seemed so audacious it took her breath away. 'When's she going?' she had asked, trying to sound casual, thinking: *Don't want to frighten him.* 'Hmm, in the week before Easter.'

That was it, the moment when fate had stepped in and taken control of her life. 'We'll both be on holiday then!' she said, trying not to let her excitement show. 'You ever been to Switzerland, Sam?'

Oh yes I remember, she thought, *the days of nagging and begging and persuasion before you agreed to come.*

'You can't take a decision like that', Sam was saying, 'and then blame somebody else when it goes wrong.' He started to drive up the far side of the valley. 'What's the matter, don't you want to stay here?'

Catriona sighed. *He's right*, she thought. *It's my choice to be here so I have to take the consequences.* 'Listen Sam,' she said. 'I don't care what happens as long as I solve the mystery. Actually it might be quite interesting, staying here and going to finishing school. What is a finishing school, anyway? Sounds expensive, Sam. Can you afford it?'

That wiped the smile off his face, but only for a moment. 'Your mother can. But don't worry, Catty. We won't have to stay too long. She'll settle down in a week or two and we can go home. Oh look, that must be CERN,' Sam said.

As the car crested the valley, an industrial estate came into view, sprawling across the pretty Swiss landscape. Catriona began to tingle all over with excitement. *This is the moment I've been waiting for*, she thought. *Not just for two weeks but for the past six years of my life. This is the promised land.*

Even the grotesque electricity pylon standing beside the road looked majestic to her, the guardian of the secret world of science and perhaps of the mystery she was trying to resolve. Behind the pylon, a huge wooden dome bulged out of the ground like a giant football at the feet of the unmoving guardian. Everything she saw looked beautiful, especially the range of mountains filling the horizon ahead of her.

When Sam turned off the road and parked outside a building labelled "Reception" her excitement was intense, so it was an enormous disappointment when Brigit got out with Sam and told her to wait in the car. Catriona wandered round the car park, looking back towards Geneva, watching the aeroplanes taking off from the airport and wondering vaguely whether she would ever fly home or stay here forever, but not really caring either way. The city was invisible from here, the tall jet of water and the cathedral on the hill were hidden by the valley they had just—

'Francesco, may I introduce my daughter?'

Catriona spun round to see her mother standing beside a smiling, corpulent man. Even his smart blue Italian suit failed to hide the ample fat which hung about his body. 'Catriona,' Brigit went on, 'this is Professor Francesco Romani, the Director General of CERN.'

When he reached out and shook Catriona's hand, she barely managed to control her disgust as her fingers sank into his soft yielding flesh. And when he bent forward to kiss her on both cheeks the smell of his tobacco-heavy breath made her feel nauseous. His long nose dangled down towards her like a monkey's proboscis. His hair was unnaturally black for a man of his age, about sixty she guessed. *He's the ugliest man I've ever seen*, she thought.

Yet he oozed self-confidence and when he let go her hand and spoke, his heavy Italian accent was so charming Catriona began to forgive him his revolting appearance.

'I am so happy to meet you, signorina Catriona.' He made her name sound like a little melody. He turned towards a young woman who was standing beside Sam. 'May I introduce your guide for today? This is Marianne. She will answer any questions you might have about CERN.'

The young woman stepped forward, smiling and holding out her hand. Catriona shook it timidly. Marianne was as lovely as Francesco was ugly. *Beauty and the Beast*, Catriona thought. She had long dark hair with auburn highlights. Her face was almost without creases except for the two little dimples in her cheeks when she smiled, which she did often. Her skin seemed to glow with health, her cheeks pink, her forehead a lovely creamy colour, and her eyes showed merely the faintest trace of makeup.

It was only when Marianne turned to lead them across the car-park towards the road that Catriona noticed the jacket of her blue uniform hanging open below her bust, revealing a big bulge in her abdomen. Catriona had always been fascinated by pregnancy, and she walked close beside the young woman, who was about ten years older than herself, twenty-four or twenty-

five she thought, with Sam on the other side listening attentively as she answered his questions. Francesco and Brigit followed them, deep in conversation. Catriona had no interest in what Marianne was saying, technical stuff she could not understand and did not want to. But her soft voice and her beautiful accent fascinated the girl. Catriona thought she was French although she wasn't sure. She repeated Marianne's words silently to herself trying to imitate the sound.

Ze Lardge Adron Colliderr. Ze ATLAAS Detectoor.

The guide led them over the road and round the outside of the huge brown dome which towered over them, its horizontal wooden slats and thick curving legs giving it the appearance of a giant sea-urchin without the spines. Behind it lay a building with a huge painting on the outside showing some sort of machine with big brown discs and yellow gear wheels and orange pipes. That building was apparently where they were heading, but on the way Marianne took them into the wooden dome for a quick look at the exhibition.

Catriona's attention was immediately caught by the words written on the wall near the entrance.

"WHERE DO WE COME FROM?"

"WHAT ARE WE?"

"WHERE ARE WE GOING?"

Her spirits soared as she read them again. *Where do I come from? From a land of hell called Ireland. What am I? I'm a girl who wants to solve a mystery. Where am I going? I'm going to find out the truth about how my father died. That's more important than anything else in the world.*

Hidden Sacred Book Chapter 2 Into ATLAS

Beneath the rolling countryside to the west of the city of Geneva lay the sedimentary sandstones, shales and conglomerates which had eroded from the high Alpine mountains to the south millions of years ago. Drawn downwards by the line of magnetic force, Oh Primeval Monopole, you flew over the city and plunged into these soft materials. Naturally you had no trouble traversing these small obstacles. In comparison to yourself, the atoms of these rocks were merely huge thin shells of orbiting electrons surrounding a tiny central nucleus. But what you felt after penetrating only a few metres into the ground was much more surprising.

The magnetic field grew rapidly stronger, and began to slow your flight. After fifty metres your speed had reduced dramatically and when, after a further fifty metres, you emerged into an underground cavern, you were travelling slower than you had ever done before. Here you found a gigantic, barrel-shaped object, the subterranean monster known by its human minders as "ATLAS". They force-fed this ravenous beast with a constant diet of protons which they accelerated to almost the speed of light in the "Large Hadron Collider". This, the largest collaboration ever attempted between the scientists of the world, lay in a huge circular tunnel in the sediment one hundred metres deep and twenty-seven kilometres long. You caught only a glimpse of all this, Majestic Monopole, before you were swallowed by ATLAS's body, drawn in by some of the most powerful magnets ever built by mankind.

Cooled by liquid helium to almost absolute zero temperature, ATLAS's "superconducting" magnets were designed to bend the paths of particles created by proton collisions and so allow the detector to record and identify their constituents. At thirty-four minutes and twenty-three point five-eight-four-one-two seconds past nine on that memorable morning, the array of individual detectors within ATLAS began to record your silent passage.

Although designed to trace the paths of particles travelling outwards from the centre of the detector, the various sub-systems were nevertheless perfectly capable of recording the effects of your unexpected arrival. The outer detectors in the assemblage saw you first. As you traversed the "Muon Spectrometer", many of the hundreds of long, thin, high-pressure gas-filled metal tubes fired a pulse of electricity from their central high-voltage wires. These signals passed into the data processing system and the first-level electronic "triggers" took only two microseconds to decide that something extraordinary was happening. These data were stored in "readout buffers" in the underground counting room of the USA15 cavern close to ATLAS's lair, awaiting confirmation from the other sub-systems that this was a real event and not a spurious signal.

You moved downwards, Oh Monopole, bending sharply in the strong field of the "toroidal magnetic coils" as you penetrated deeper into ATLAS. Here you passed easily through the "Calorimeter's" metal plates, although collisions with the heavy nuclei of several atoms further slowed your rate of descent and triggered more data from the "scintillating plastic and liquid argon sensors".

Very soon you entered the "Inner Tracker" causing electrical pulses to fire within excited gas-filled straws and, deeper still, state-of-the-art semiconductors measured your position with exquisite accuracy while your path curved sharply in the enormous two Tesla magnetic field of the huge "central solenoid". Your final energy was spent in traversing the stainless steel and copper wall of the Large Hadron Collider's beam pipe, a narrow tube which ran through the middle of ATLAS.

At first all was quiet. There was a moment of peace, when (had you been capable of feeling emotions, Oh Marvellous but totally insensible Monopole) you would perhaps have reflected, as you drifted slowly along the beam pipe, that here at last you had found the home you had been seeking since time began. You might

have held your breath, waiting eagerly to meet your relatives in this exotic world, so different from anywhere else you had ever been and grateful for having found a magnetic field strong enough to finally bring your long journey to an end.

You did not have long to wait. Within a tiny fraction of a second your tranquillity was shattered and your hopes raised even higher as a bunch of protons came hurtling along the beam pipe like a vast school of excited children going on an outing. There were almost a trillion of them, flashing past only millimetres away from where you floated gently along the pipe. As the pack passed, some of the particles actually collided with you. The collisions did no harm and their momentum counteracted the effect of the magnetic field, pushing you back along the pipe towards the centre of the detector.

The particles, you would now have realised with a sharp sense of disappointment, were not Monopoles like yourself, but merely protons, the sort of thing you had frequently seen before, although you had never previously met so many with so much energy. And, just as they had inside stars, some of the protons adhered to you, increasing the size of your outer mantle.

Within less than a nanosecond the bunch of protons had passed you by, Oh Marvellous Monopole, and gone hurtling out of sight along the beam pipe. Alone once more you began drifting in the magnetic field but you had hardly gone a centimetre before another bunch arrived and the same thing happened. More protons fused with you and pushed you back up the beam pipe.

Surrounded by your growing mantle, you felt more at home now than ever before, but you could also sense a tension growing around you. Every proton carries something called an “electric charge” which makes it try to push away from all other protons. This produced a mutual repulsion within the particles in your mantle, which was in danger of breaking up and leaving you naked once more. Luckily a new phenomenon prevented this. Sometimes a passing particle came very close without actually fusing with you. As a result of this near-miss collision, one of the protons in your mantle acquired sufficient energy to emit a small object which scientists call a “positron”. This carried away the excess electrical charge, leaving your mantle more stable. In addition, an uncharged particle called a “neutrino” was emitted at the same time. These two particles went shooting through the beam pipe wall out into the detector.

Because it had no electrical or magnetic charge, the neutrino travelled out through the whole of ATLAS without producing any effect whatsoever. But things were very different for the positron. As soon as it hit the beam pipe wall it immediately fused with one of the particles it found there, a particle which was like its twin, identical in every way except it carried the opposite kind of electrical charge. Scientists, in their wisdom, call these two sorts of electrical charge positive and negative. The positron’s charge is said to be positive while the electron’s is negative. These opposite charges strongly attracted each other and the positron fused with the electron, with dramatic results. All the matter of these two particles was transformed into a pair of “gamma rays”, similar to light but with much higher energy. They radiated outwards through ATLAS’s sub-detectors, firing events in the “Electromagnetic Calorimeter”.

The computerised “trigger system” was designed to distinguish the few extraordinary events occurring in the beam pipe from the millions of ordinary ones which were of no interest. It had already decided that your arrival was interesting and had recorded every detail of your inward path. But that had been merely one event out of many, although with higher energy than almost any other. The computers had simply assigned the whole record a “StoreGate key”, added it to the database and moved on.

Now the hard-wired Level-1 trigger system embedded within ATLAS was observing the outward flow of gamma rays emanating from the beam pipe wall with equally close attention. The electronics easily determined that positrons were flowing out of the beam pipe and passed the data to the Level-2 Trigger System.

The Level-2 processors which analysed these events were unable to find any obvious energy source for the positrons. During the many years of planning and building ATLAS nobody had ever predicted such events.

Indeed, despite all their precautions to ensure the safety of the experiments at CERN, not one scientist had ever evaluated the possible dangers presented by a cosmic monopole.

The processors assumed that some undetectable form of energy must be flowing out of the beam pipe in the opposite direction which they labelled as “missing transverse energy”. They had been programmed to recognise this type of event as a distinct and important signature for interesting new physics. Something truly extraordinary was happening, the banks of computers agreed, and hard discs whirred as records were copied from the “Transient Data Store” and written to permanent storage.

The data flow was low at first, but as you absorbed more and more protons and your cross section grew larger over the next few minutes, so you were able to absorb even more protons and the outward flow of positrons increased dramatically. A runaway process began, with more and more gammas triggering more and more interesting events. But the Level-2 Triggers had never been designed to handle such a high rate of data flow and after three minutes the system was beginning to struggle. Initially tiny, Oh Blessed Monopole, you had now grown to macroscopic proportions, and would have been visible to the naked eye of any observer foolhardy enough to expose himself to the lethal radiation levels within the beam pipe. Henceforth you grew exponentially and a minute later the whole data storage system reached saturation point.

Episode 2 System Overflow

By nine-thirty-six Danny Schneider had finished briefing Seline Soubise, his replacement as Run Co-ordinator. He stood and stretched, peering as if through a mist at the huge brown wooden dome outside the ATLAS Control Room. After staring at the bank of computer screens on his wide curving desk and those filling the long side-wall for the past twenty-four hours, his eyes were gritty and his mind was numb. *Thank Christ that's over*, he thought. *That was the most difficult day of my life, but I did it!* Under his supervision the team had successfully restarted ATLAS after the winter shut-down. But as he lifted his green jacket off the back of his chair, little did Danny know that his problems were only just beginning.

'I'm going to see if Marianne's arrived,' he said. 'She went to the antenatal clinic this morning.' Seline glanced at him, her eyes hard and cold, nodded once then turned back to her screen.

He headed for the Control Room door, pushing through the visitors crowded around the desks of the resident scientists and engineers. The visitors had come from universities all over the world to help nurse their parts of the detector through the difficult start-up run. Many of them shook his hand and patted him on the back. Danny could feel his own palms hot and clammy, but he smiled and made self-deprecating remarks, pleased by their praise. It was for this acknowledgement that he had worked so hard. He knew he was the best engineer on the ATLAS team and it felt good to know that the scientists were finally realising his true value. But now it was time to face the other part of his life, the part where emotional doubt replaced logical certainty. He took his mobile phone from his pocket and began to search for Marianne's number as he reached the door. He had just found it when he heard a computer generated voice crackle in a monotone from the overhead speakers:

'Level Zero Alarm.'

Danny hesitated, one hand on door-handle, the other holding the phone, waiting for the second half of the message, his brain clicking back into problem-solving mode. *Level Zero?* he said to himself. *Minor fault. Shouldn't be a problem. Seline will be able to cope with that. Nice easy start to her first run. Wonder what kind of error it is, exactly?* His bleary eyes studied the image projected onto the far wall, trying to bring the digital clock into focus. He had just deciphered the numbers 09:38 when the synthetic speech droned:

'Data Storage System Overflow'

Data Storage System Overflow? Danny pondered. *Never heard of one of those.* He shielded his tired eyes from the glare of the overhead projectors as he squinted back down the long narrow room feeling dog-tired, not just from the shift he had just finished but from many weeks of twelve-hour days getting ready for last night. His bleary eyes finally brought Seline's face into focus: white pointed nose and chin sharp against severe black hair; hunched shoulders tense. Half a dozen visiting scientists were leaning over her desk, pointing at her screens, talking excitedly, but they didn't know the ATLAS Control System and could not really help. Her anxious eyes darted rapidly between screens, hands, keyboards, faces. After a few seconds she turned and scanned the room. When she saw Danny she compressed her lips, raised her hands, shook her head.

The synthetic voice was still droning, over and over. 'Level Zero Alarm. Data Storage System Overflow.'

With a slight feeling of elation, like a marathon runner finding his second wind, he dropped his phone back into his pocket, let go the door and trudged back down the room. As he approached her desk he saw the little Chinese-Irish scientist Michael Zhang push his way through the crowd behind Seline. Danny heard his high-pitched voice rising over their chatter: 'I

think there's a fault with the trigger system.' His Chinese accent was enhanced by an Irish twang, like a jig played on a bamboo flute. As usual, nobody took any notice of him. Michael was always poking his little snub nose into everyone else's business as if he knew everything about everything. The other scientists only tolerated him because he was a genius at programming the "Trigger and Data Acquisition System".

Seline grew calmer as Danny slumped into the chair beside her. 'Can you just tell me where the procedure is for handling this type of error?' she said, her long black fringe falling over one eye. 'I've never heard of it.'

'Well you could start by acknowledging it. That voice is driving me mad.'

She clicked the Acknowledge button on the Detector Control System Alarm Screen and the computer's voice fell silent. Michael Zhang was standing at her elbow. He was so short that his head was almost level with hers as she sat peering at her computers. His pink T-shirt bore the stains of several weeks wear and there was a dark smudge down one of his cheeks.

'I've never heard of a Data Storage System Overflow before either,' Danny said to Seline, disregarding Michael. 'Just do a search in the DCS Operations Layer of the ATLASTWiki.' *But the procedure probably won't be much use to you, he thought. We only really find out how to handle an error by doing it. Then we write the real procedures afterwards.* While he waited for her to run the search he read the top line of the list of alarms filling the screen. 'We must be getting a lot of events,' he said. 'The Sub-Farm Output file servers are swamped.'

'I can see that, Danny. Okay, I've found the procedure. I can handle it now.'

But he didn't move. *She's never run a shift on her own before. Can she really cope? I'm going to look pretty stupid if she makes a mess of it, after recommending her for the job.* Seline was slowly reading the on-screen instructions. Danny sighed. *It should be obvious what to do.* 'How many events are we getting out of the Event Filter?'

'Thousands,' Michael said brightly. Danny stared at him. There was a twinkle playing in Michael's heavy-lidded eyes. Danny assumed he was joking.

'I don't know,' Seline said, ignoring Michael. 'Wait a minute.' She began to type an Athena command into a console window.

Marianne must have come out of the clinic by now, Danny thought as he again took his mobile phone out of his pocket. *Wonder if the doctor managed to turn the baby? I hope she likes the name I've chosen for him. Dragomir. Precious and peaceful.* As he flipped the phone open a histogram flashed up on Seline's screen and she leaned towards it.

'He's right,' she said, astonishment chilling her voice as she glanced nervously at the two men. 'We're getting over two thousand per second.'

'Two thousand per second?' Danny said, feeling sweat break out on his back. 'Not really? But that's ten times more than the system was designed to handle!'

Episode 3 Observation Room

Danny dropped his mobile back in his jacket pocket thinking *I'll call Marianne in a minute.* 'They can't be real events,' he said. 'What kind are they supposed to be?'

'They're all missing energy events,' Michael's little voice piped as gaily as a flute leading a band.

'I don't think so,' Danny said dismissively.

Seline clicked on a menu and the histogram changed into a single bar. 'It's true,' she said.

Danny stared at her. 'ALL of them? That's not possible. There's obviously a fault with one of the sub-detectors. Can you find out which one?'

Danny wiped his sweating palms on his trouser legs as he watched her type in a little script to analyse the data, thinking *This is a disaster. Thank Christ it happened before I left.* 'Are you going to suspend the run?' he said to Seline. 'It's your call, but if I was in charge—'

'You still here? I thought you were going to see Marianne?'

'I'll stay for a minute or two. I'm really curious. I've never seen anything quite like this before. It's probably an error but... ' An idea suddenly flashed into his mind giving him a jolt like a physical blow. 'If these events are real it would mean ATLAS has found a new type of particle. Imagine how I would have felt tomorrow if I'd gone and missed all the fun!'

Suddenly everything had changed. The possibility of being present at the discovery that he and thousands of other scientists and engineers had been striving for was so exciting that his tiredness seemed to evaporate. *This could be history in the making,* he told himself.

'It's almost certainly a hardware fault in the Level 1 trigger system,' Michael said cheerfully. 'There could be noise on one of the lines coming out of the ATLAS cavern into USA15. Probably just a bad connection.'

Danny glanced at him. 'It should be easy to check if that's true. We'd need to go down into the USA15 cavern.'

'Or it could be a bug in the ROD crate processors software,' Michael said.

'That's true,' Danny said. 'We'd have to use the ROD crate workstation in USA15 to check the functionality of the crate processors. Come on.' He stood and the room began to spin. He reached out and steadied himself.

Seline glanced at him. 'You alright, Danny?'

He leaned on the chair and waited for his head to clear. 'Yeah. Just a bit tired.'

'I'll stop beam intersection,' she said. 'No point in collecting more spurious data.'

'I would very much prefer it if you could leave the beams intersecting,' Michael said.

'Why?'

Michael paused for a second then said 'We will need to check whether it's a fault in the region of interest builders or perhaps in one of the readout subsystems. If we lose the signal we won't be able to monitor their activity.'

Seline stared at him then shot Danny a questioning look.

He shrugged. 'I guess he's right. He's the expert. Come on then, Dr Zhang.'

'Okay,' she said. 'I'll leave the beams intersecting.'

'I'll just shut down my systems,' Michael said with a little smile and waddled back to his desk.

'He's an odd case,' Seline whispered so the visitors wouldn't hear. 'I've never seen him smile before. Do you think he's up to something?'

Danny went cold. 'Like what?'

'I don't know. I just don't trust him. I heard he lives in a caravan in some woods.'

'I wouldn't be surprised,' he said as Michael walked past. 'A caravan? I wonder which planet it's on?' He stood and followed the little Irishman up the room towards the door.



This is it, Catriona thought as she followed the group through a gate in a metal fence. *At last I might get a chance to find out the truth about Daddy.* On the other side was a row of buildings on the left and a row of cars on the right of a long narrow car park. She tried not to run as they walked past tall white cylinders, beneath the huge painting of a machine and through the car park and into a glass-fronted building which just looked like an office block.

Inside was a little exhibition describing something called ATLAS, and a glass wall through which they could observe people sitting at computer terminals. There were more terminals on the near side of the glass and Sam sat at one and started fiddling. Catriona stood beside him, looking through the glass wall, wondering who those people were and whether any of them had known her father. She was vaguely aware that Marianne was standing near the door talking to a handsome young man, but Catriona wasn't interested. Even his long black curly hair, his bright yellow shirt and his warm, full-lipped smile couldn't capture her attention. And she was deliberately trying to ignore Francesco's strident voice as he stood beside her, talking to mother, explaining the potential benefits of Ireland joining CERN. But all that changed when he said: '...he's from the Advanced Physics Laboratory in Dublin.'

Instantly she was lying on the bank of a pond outside the laboratory building gazing up into a star-speckled, ink-black sky. This always happened whenever anyone mentioned that place. The Advanced Physics Laboratory was where Daddy had worked, where the nightmares and flashbacks had started. For a moment she waited in terror, holding her breath, hoping it would be different this time. She saw the lighted window on the top floor of the lab and felt the warm fur of Trackaway, her huge St Bernard dog, beneath her. Then a blue light drifted over her head and her heart sank. *It's happening again*, she thought. There was a dark shadow trailing behind the light, hiding the stars as it flew towards the window. In a panic she tried to stand and shout, to change the story, to stop the disaster this time, but she couldn't move. She was frozen with terror, as she always was. Only this time there was a voice booming through the darkness. 'He's the only Irish nuclear scientist working in CERN,' Francesco said.

Nuclear scientist? Catriona thought. *Wasn't that Daddy's job too?*

The dark shape flew over her head and reached the window. A reindeer was clearly outlined against the light, the one she had stuck on her father's office window the previous Christmas.

Then she saw a second blue light flying against the black November sky and her terror grew. *I've got to stop them this time!* But still her body would not respond to her mind's commands. All she could do was lay on the bank of the pond gazing up into the night sky.

'Ah good!' Francesco boomed. 'He's coming out! I really want you should meet him.'

He's coming out! she thought. *Who's coming out? Is it Daddy? Is Daddy coming out of the lab this time instead of staying in his office like normal?* With a superhuman effort she forced her body to move, trying to see the laboratory building door. Her hand hit something hard, somebody said 'Ouch', the vision vanished and she was back in the brightly-lit Observation Room looking into Sam's eyes as he sat before the computer screen. 'What's the matter, Catty?' he said.

'Nuclear Irish scientist, Francesco?' Brigit was saying. 'That's odd. That's what my late husband was too. Which one is he?'

'Just there,' Francesco said, pointing through a glass wall into a long narrow, well-lit room. It

was full of people sitting or standing around looking at the computer terminals scattered all over the desks and even projected onto the walls. Two men were pushing their way through the crowd towards the door. The one in front was a short man with a smiling Chinese face wearing a greasy-looking pink T-shirt and blue jeans. Behind him was a tired-looking Caucasian man in a green jacket. Catriona immediately assumed he must be the Irish scientist and felt sorry for him. He looked completely exhausted as he almost staggered after the Chinese man. His pinched face was drained of colour and his hair was almost the same, with just a hint of brown. His mouth was tight-lipped, as if he was having to concentrate just to reach the door. She felt sorry for him, but he looked nothing like her father and somehow she felt terribly disappointed until Francesco's next words put doubt in her mind.

'Dr Zhang can explain to you some of the potential benefits for your economy from Ireland becoming a member of CERN.

Dr Zhang? Catriona thought. Is the Chinese one Irish?

'But what about the cost, Francesco?' Brigit said. 'You know what a state Ireland's finances are in.'

'Did you hear that?' Sam whispered in Catriona's ear, making her jump. He was standing beside her now. All she could do was nod.

'I will show you a calculation to prove that the economic benefits will far outweigh the costs,' Francesco said. 'But first I want Dr Zhang to explain the academic benefits his Laboratory has already obtained from working on ATLAS. They're going out through the side-door. I'll go and get him.'

Francesco went through a door and Brigit started checking her mobile phone.

'I wonder whether this man might have known your father?' Sam whispered. Catriona felt a shiver run down her entire body as she stared at him. They had not talked about her father for years. 'Why don't you ask him?' he said. She nodded so vigorously her ginger hair flopped into her eyes. There was nothing in the world she wanted so much as to solve the mystery surrounding her father's death and hopefully get rid of those horrible haunting memories.

Francesco came back into the Observation Room with the two men and introduced the green jacketed one as Danny Schneider, Marianne's husband, and the Chinese one as Dr Zhang. He was extremely short, not even as tall as Catriona, and his voice was as high-pitched as a child's. 'I'm sorry, Madame Ambassador,' he said to Brigit, 'but I don't have time to talk to you at the moment. I have to go underground to help fix a serious malfunction with ATLAS. Could we talk later, over lunch perhaps?'

'I'm sorry but I can't stay long,' Brigit said as she put her mobile in her yellow leather handbag and checked her wristwatch. 'I have to be at the UN by twelve.'

'Well, another day perhaps. I'm based here so I'll be glad to talk, but it's simply not possible right now.' He bowed his head and turned towards the door where Danny was in earnest conversation with Marianne. The handsome man in the yellow shirt was sitting at one of the computer terminals and Danny kept glancing down at his black curly hair with an angry look.

If I don't do something now he'll leave and I'll lose my chance, Catriona thought. *This is what I came to Switzerland for. I've got to say something.*

As he walked past her she said 'Did you happen to know my father? His name was Dr O'Brien.'

Michael Zhang immediately stopped and looked at her. 'John O'Brien? Yes indeed, I knew him well. You are his daughter?' For a long moment he stared at her, his eyes unblinking, and Catriona thought *This is it! I've found somebody who knew Daddy! It's incredible. Maybe the nightmare is nearly over.*

Then the man smiled and nodded as if he recognised her father in her face. 'I'm very sorry about the accident. You must have been quite young?'

'It was my eighth birthday,' she said quietly, barely able to speak as the memory of it flooded

over her again, washing aside everything else, and for a moment she was back in that moment of terror.



Catriona could see the unmistakable shape of a human being holding the blue light in his hands. She stared up in horror. *How can he fly like that?* She was pretty sure it was a man, not a woman. He was hovering outside the lighted window. Once more, as always when she relived this terrifying moment, she searched for some sign of a rope or a jet or something, anything, that would explain what held him up there in the night sky, but without success. She stared as he hung in the air for what seemed like hours, peering into the window.

When she had first seen him, on the night of her eighth birthday, she had wondered whether he was working with her father. *Daddy's probably helping him to fly using his beam of lectons*, she had thought. Her relief at this idea had been intense.

Her father had sometimes spoken about electrons although when she was eight she had no idea what they were. All she knew was that he sent them flying down a tube somewhere in the lab. But she imagined him now, sending the beam out of his office window and somehow holding the man up in the air.

It must be top-secret, the little girl had thought. *That's why the man's trying it out at night-time, so nobody will see him. And the blue light, that's got something to do with the lectons. Of course! It all makes sense now. That must be why Daddy's left home!*

John O'Brien had deserted the family home several months before. According to her mother he had gone to live with another woman. Catriona missed him terribly. She hated having to live just with her mother. She had made the long journey alone from her home to the lab on the evening of her eighth birthday to persuade him to come back.

Now Catriona relaxed, reliving that moment, the horror of seeing the flying man quickly fading. And then, as always, Catriona saw him take something out of his pocket with one hand and point it through the window. With a sickening lurch she realised it was a gun. She wanted to scream but her voice was silenced by the sight of something else flying rapidly and silently across the night sky towards the lighted window. It too was holding a blue light in its hands and by its light she could see that its head had two bulging eyes and its body had black and yellow stripes. *It looks like a giant bee! This has to be a joke. Somebody's in fancy-dress costume.*

It was much bigger than a real bee, even bigger than the man, and it wasn't buzzing. Its wings weren't even flapping! They were just folded up on its back and its front legs were holding a blue thing, just like the man. Real bees couldn't do that! And the gun was probably a toy. The man was having a joke with Daddy. They were having a bit of fun.

But what happened next showed it wasn't a joke. The bee swooped down towards the man and grabbed him with its rear legs. The gun went off, the window shattered and Trackaway jumped up, barking madly. Catriona went rolling down the bank and only just managed to stop herself before she reached the water. Turning towards the barking hound she saw him on the other side of the pond racing after the bee. It was carrying the man over the trees, his body hanging limp in its back legs as it flew up higher and higher into the night sky until it vanished from sight.

Episode 4 Underground

A hand gripped Catriona's shoulder and Sam's voice said 'Excuse me, Dr Zhang, but you don't happen to know anything about how he died do you?'

With a superhuman effort Catriona dragged her mind back to the Observation Room. The little Irish scientist was nodding at Sam and seemed about to reply but Danny called: 'We have to go, Dr Zhang'.

Still Michael didn't move. 'I was...I would very much like to talk to you about what happened that night,' he said quietly. 'I do not believe the whole story has yet been told.'

'No it hasn't,' Catriona said in a hoarse voice, hardly able to speak from excitement and fear. She had told them what she had seen, told Mother and Grandma and even the police, but nobody had believed her and finally she had even begun to doubt herself.

Michael put his little hand on her arm. 'I'm sorry but I really must go and help steer this ship off the rocks. We are perilously close to the shore. I will be happy to talk to you on another occasion.' He bowed again and followed Danny through the revolving door. Marianne stood watching them go and waving through the window but Danny was talking to Michael and did not notice.

'I'm sorry to hear about your father, young lady,' Francesco said.

Catriona was about to reply but Brigit butted in: 'My first husband was a scientist. He died in a horrible accident at the same laboratory.' She placed her hand on Francesco's arm. 'It's a long story.'

Francesco patted her hand sympathetically and began talking once more about the benefits of Ireland joining CERN.

'I'm certain of one thing, Sam,' Catriona whispered urgently. 'I'm not going to leave this place until I've talked to that Chinese man and found out exactly what he knows about Daddy's death. What was his name again?'

'Michael Zhang,' Sam said. 'Now listen, Catty, you can't just stay here. I've got to drive your mother back to the UN in an hour and she would kill me if I suggested leaving you here on your own.'

'But we're only a few miles away from Geneva aren't we Sam? I can easily catch the tram back into town. Just give me some money for the fare.'

'Excuse me please,' Marianne said as she tried to get past them. They moved aside and Marianne led the long-haired young man to where Francesco was still talking to Brigit. 'Professor Romani, can you spare me a moment please?'

Catriona was suddenly struck by what seemed to her like a brilliant idea. 'I could stay with Marianne! She'd make sure I got on the tram.' They both turned to look at the young woman talking to Francesco.

'...remember Count Alex Karolyi?' Marianne was saying, gesturing towards the handsome young man beside her. 'His software company wrote Mercator.'

Francesco frowned, looked at the young man, nodded then smiled and said 'Ah yes of course, you are the one with the boat,' and finally shook hands with him. There could hardly have been a bigger contrast than that between the sleek, tanned young man and the flabby old, grey-faced scientist. 'He has found something on Mercator I think you should see,' Marianne said.

'I'm very busy at the moment,' Francesco said.

'It's pretty important, Professor,' the young man Alex said. His voice was soft and gentle in the middle but with a firm edge. As soon as Catriona heard it her ears seemed to twitch. There was something about his voice which appealed to her instantly, warm as a blanket on a frosty

morning. 'There's a very unusual Mercator track,' Alex was saying. 'It occurred around the time this problem started. I tried to show it to Mr Schneider but for some reason he didn't seem very interested.' He glanced at Marianne and lifted one eyebrow with a quizzical smile. She gave him a little scowl.

'I am not surprised,' Francesco sighed. 'Michael and Danny are trying to fix a fault with ATLAS. An unusual track you say? Oh, very well, Count Karolyi, but please be quick. You might like to see this as well, Madame Ambassador. It will give you an idea of the excitement of the leading edge work we do here.'

Alex sat at the nearby computer terminal and Francesco explained to Brigit: 'Mercator is the software the scientists use to visualise events happening inside ATLAS.' Everyone clustered around Alex. Catriona could smell his musky after-shave. He clicked the mouse a few times and an image appeared on the screen. To Catriona it just looked like a strand of hairy wool, getting thinner as it curved down towards the centre of some concentric circles in the middle of the image, but Romani gasped: 'And you say Danny doesn't know about this?' he said.

'No, Professor,' Alex said. 'Look at the StoreGate record.' He clicked the mouse again and some writing came up on the screen. 'Michael Zhang and I are the only two people who have ever accessed this event.'

'Oh, well I suppose he might have told Danny.'

'Knowing Michael Zhang, I'd say he's probably kept it to himself,' Alex said.

Francesco glanced at Brigit. 'Michael has a bit of reputation as a loner,' he explained with a smile. 'How did you find this event, Count Karolyi?'

'I simply looked for the highest energy event that happened around the time this problem started,' Alex said.

'I think your husband should be told about this,' Francesco said to Marianne, then he turned to Brigit. 'Look, why don't we all go down and see them? Count Karolyi can show Danny this event and you can have a quick word with Michael at the same time. I'm sure he can spare you two minutes and I really want him to tell you exactly what benefits Ireland has already gained from his participation in the ATLAS project.'



In the damp little car park outside, Catriona's heart soared as she waited for the others to come out, not sure which way to go but very eager to be first. The Sun reflected off the ATLAS building's tall black windows as it struggled to break through the morning cloud. She gazed at it thinking: *This was exactly what I want more than anything else in the world. I'm going to see Michael again. No matter what happens I'm going to ask him what he knows about Daddy's death.*

The others came out and Francesco paused to light a cigarette, still talking to Brigit. Catriona followed Marianne as she turned left and walked towards a little door leading into a huge wooden-clad building. Sam walked beside her asking questions as she entered a code into a keypad to unlock the door. Catriona found herself waiting beside the handsome young man Alex. He asked her what her name was but when she said Catriona he said 'I will call you "Kata". It's an old Hungarian name. How do you like Geneva, Kata?'

She had never been this close to anyone so good-looking, let alone a real live Count. The smell of him and the sound of his voice made her head swim, as if she had been secretly drinking some of mother's pale cream sherry. To her own surprise she found herself saying 'I love it here.' She realised that the hope of solving this terrible mystery had transformed her whole attitude. Her

ardent desire to leave and go home had suddenly been replaced by an equally fervent determination to stay and talk to Michael, no matter how long it took. She didn't care if she never went back to Dublin as long as she got rid of these flashbacks and solved the mystery.

Light streamed into the building through windows between the roof sections, reflecting off the metal pipes and girders which covered the walls of the almost empty space inside. Marianne and Sam held the door open, waiting for the others, and Catriona walked beside Alex across the wide floor, passing the fences surrounding two huge circular holes in the ground which, he told her, led directly down to the ATLAS cavern. 'But we're not going there,' he said. 'Danny and Michael are in the cavern next door. Nobody is allowed in the ATLAS cavern while the beams are running.'

As he led her through a doorway into another building, she plucked up her courage and said: 'I'm so glad you found this Store-thing, Count. I really want to see Michael again. There's something I need to ask him. Without you I might never have got this chance.'

Alex looked at her curiously as they approached some steps leading over a pipe which lay across the path. 'What is it you want to ask him, Kata?' He said as he politely took her arm to help her up the steps. His hand seemed to burn into the skin exposed by her short-sleeved, lime-green blouse. As she stepped up she glanced into his eyes, worried in case he had some sort of fever. Her eyes were level with his now and for a long moment she stared into them, hypnotised by their beauty, embarrassed by her own brazenness but unable to tear herself away.

His deep brown pupils shimmered like pools of liquid chocolate, flecked with grey and green specks. Long, curving lashes sprouted around them like thick banks of reeds. She felt herself being sucked into that delicious pool. One moment she was falling, the next she was drowning. It was horrible and beautiful and frightening but completely exhilarating. *I never believed this kind of thing could happen*, Catriona thought, *except in trashy women's novels. But here I am and it's really happening. To me!*

Alex was staring at her with a puzzled smile playing on his broad, sensuous lips. He was obviously waiting for her to answer but she didn't speak. She would have liked to explain about the mystery surrounding her father's death but she could not utter a single word. Finally he lifted an eyebrow, releasing a sunburst smile upon her and pushed her gently up the steps and down the other side. Then he carried on walking and talking as if nothing had happened, as if the world hadn't changed, but hers had. She found herself walking beside him but literally three feet off the ground. It was extraordinary. *I still don't believe this is happening*, she thought as they rounded the corner of a little tower inside the second building.

She eventually came back down to Earth while they waited for the others to catch up. Alex began asking her about Mother. How old was she? What had she done before she became the Irish Ambassador? At first Catriona assumed he was just making polite conversation but the more questions he asked the more her doubts grew and she didn't want to tell him about her father.

Soon the others arrived and they all went into a little room at the foot of the tower. The hiss of gas echoed around them. Marianne explained that this was a sort of airlock. 'There is a lot of liquid helium down there,' she recited as if reading from a book. 'We probably have more liquid helium here in CERN than anywhere else in the Universe. If there is a fault then it might boil explosively so we keep the lift shaft at a slightly higher pressure. You will always be able to breathe here, although in an emergency you might have to walk up the stairs.'

The hiss died down, they left the airlock and put on red and yellow helmets before entering the lift. As they went down Alex stood close to Brigit, leaning towards her and talking in a confidential way, asking about the economic infrastructure in Ireland and support for entrepreneurs. To Catriona's surprise Mother was able to answer most of his questions. She didn't seem to notice Alex glancing down the front of her blouse, although it was obvious to Catriona that she liked him, otherwise she would never have let him get that close. Catriona had

a horrible feeling that Alex fancied mother.

The lift door opened into a little white corridor which Marianne reminded them was the bottom of the airlock. 'This is where you must come if there are any problems,' she said. 'You will be safe here, and the emergency stairs are down there,' she added, pointing to a little corridor that ran beside the lift. A blue door led out of the airlock into a much wider, higher, longer corridor filled with the hum of pumps and the hiss of gas. There were doors and other corridors leading off to left and right. At its far end the corridor opened into a large hall full of pipes and tanks. It was hard to believe they were in a hole a hundred metres below the ground.

Francesco Romani led them through a door on the left into a smaller room crammed full of blue metal cabinets buzzing with electronic equipment. Michael Zhang and Danny Schneider sat at the far end facing a bank of computer screens. Danny turned as they came in and when he saw the little crowd he stood up, frowning. Marianne hurried forward, took his arm and stood beside him smiling. Catriona could not understand why a beautiful woman like Marianne would marry such a man. He was a good few years older than her and miserable-looking, with completely tired eyes and lifeless hair. He continued to frown at the obviously unwelcome visitors.

'Ah Danny,' Francesco said affably. 'Count Karolyi has found something very interesting. I thought you really ought to see it. In the mean time could I just borrow Michael for a second?'

Michael stood up and walked over to Brigit while Alex stepped forward and offered Danny a scrap of paper. The frown on Danny's face deepened and he glanced at his wife before taking the paper and reading it. Then he looked at Alex. 'It's just a StoreGate key,' he said.

Alex nodded. 'This is what happened just before these missing energy events started. You ought to have a look at it. It's very unusual.'

'As a matter of fact I was about to search the StoreGate database myself,' Danny said. 'We have found no physical faults with the equipment.' He sat and typed the number into a computer. Catriona saw the same pattern appear, the one Alex had shown them earlier with a thick line like a long hairy caterpillar crawling in a huge arc towards the middle of some rings.

'Christ almighty!' Danny said and turned to Michael. 'Have you seen this, Zhang?'

Episode 5 Electronics Cavern

Michael stopped speaking to Brigit and turned to look sideways at Danny through narrowed eyes. 'It's clearly some sort of high energy cosmic particle,' he said without any sign of the alarm which was burning on Danny's face. Danny scowled at him then turned back to the screen.

'Excuse me, Michael,' Catriona said, 'but could I just ask about my fa—'

'Did you say "cosmic particle" Michael?' Brigit interrupted her daughter. 'In what sense are you using the word "cosmic"?'

Catriona fell silent and waited, determined to ask her question before she left this underground cavern.

'There are particles,' Michael said turning back to Brigit, 'millions of particles raining down upon us every second from outer space, Madam Ambassador. Most of them come from the Sun, have low energies and are consequently perfectly harmless. It is these cosmic particles which create the Northern Lights, for example. On the other hand there are some which, like the one we are honoured to witness here, have much higher energy. They come from outside the Solar System and some even arrive from outside the Galaxy. Such particles are passing through your body right now, Madam Ambassador, even this far underground.'

Brigit looked up at the ceiling with a startled expression as if she expected something to come down and hit her.

'Have no fear. There is very little risk to your health and—'

He was interrupted by Danny who had been examining the screen again and now whirled round and faced him with a strained, almost angry expression. 'You already knew these missing energy events were real when we came down here, Zhang, not faults with ATLAS at all!' His voice was trembling and Catriona noticed the tip of his nose had turned completely white. She looked at Michael, aware that he was being accused of doing something wrong, although she did not really understand what it was. There was a little smile playing on Michael's lips as he stood silently looking straight at Danny.

'Look at this!' Danny gestured viciously towards the screen beside him. 'According to the StoreGate database, you accessed this record a few minutes after the cosmic particle entered ATLAS.' Marianne stepped forward and put her hand on her husband's shoulder but he shrugged it off and stood up. 'Yet you let me waste time coming down here looking for a fault. Why?'

There was a long silence as the two men stared at each other. There seemed to be some sort of psychological battle going on between them, Catriona thought, with Michael's eyes inscrutable in the face of Danny's cold anger and, she thought, perhaps even hatred. Francesco Romani was bending over the screen now, saying 'Come now, Danny, I'm sure there's some perfectly valid explanation for all this.'

Finally Michael said 'ATLAS is the responsibility of the Run Co-ordinator, is it not Mr Schneider? And that is your position, I believe? Hence of course when you asked me to come down here to help you search for the fault I could hardly refuse, could I?'

'But it was you who first suggested there was a fault, Zhang!' Danny barked.

Francesco Romani straightened up, looking embarrassed as he glanced at Brigit then turned to Danny. 'Look, Danny, you haven't yet actually proved that this particle was the real cause of this problem. I'm still not convinced that any cosmic particle could cause all these missing energy events. What kind of particle could do that?'

'Look at the track it made when it arrived!' Danny growled, jabbing a finger at the screen. 'It obviously had enormous energy, more than any particle I've ever seen! It can't be a coincidence

that these weird events started at exactly the same time. No, what really puzzles me is why it slowed down and then stopped in the middle of ATLAS. It seems to have got trapped inside the beam pipe! I would expect a particle with that much energy to just pass straight through and out the other side.'

'The obvious explanation is often the last one that engineers can discern,' Michael said quietly. 'The postulation of hypotheses is probably best left to scientists who are trained in the field.'

Danny whirled round and stared at him as if his intelligence had been insulted but Michael continued calmly: 'In this case, for example, suppose the cosmic particle had an extremely large magnetic field. The consequence is obvious, is it not? The particle would have been trapped by the magnetic field inside ATLAS, which is precisely what we observe. Such is the power of lateral thinking.'

'A magnetic... ' Francesco sounded dazed. Beads of sweat were glistening on his forehead. 'What kind of particle could possibly have a strong enough magnetic field to be brought to rest so rapidly?'

'There is only one I can think of,' Michael said. 'I believe it must have been a magnetic monopole.'

'Eh? You've gone and lost me again there I'm afraid, Michael,' Brigit said, glancing at her watch.

Michael smiled up at her and spoke slowly as if he were talking to a rather stupid schoolgirl. 'Several different theories predict that particles with a single magnetic charge called monopoles were created in the Big Bang, Madam Ambassador. Although many people have searched for them, nobody has ever found any evidence of their existence. Until today. Therefore this particle, if it proves to be a monopole, will be the most fundamentally important object ever discovered in CERN. If we can measure its properties it will completely revolutionise the fundamental laws of physics.'

Francesco pulled a gleaming white handkerchief out of his pocket and mopped his face. 'Can you measure its magnetic charge, Michael? If you can prove that it's a monopole and measure its parameters then I would say you would almost certainly win the Nobel Prize for Ireland.'

'Hurrah!' Brigit yelled, making everyone jump. 'And if he does that then I can guarantee that Ireland will join CERN. This is a triumph for Irish science! Hurray for Ireland.' She began to dance a jig and Michael watched her with a little smile.

'And it wouldn't do your Presidential Campaign any harm either,' Sam said.

Brigit turned a smiling face on him. 'Exactly,' she said. 'Anyone here got a camera? Oh,' she said, answering her own question, 'I've got one.' She took her mobile phone out of her bag. 'Here Sam, turn this on.' She was still holding it out to him when the high-pitched wail of an alarm echoed around the little Electronics Room. Everyone went quiet and Catriona's heart sank. *Something's obviously wrong down here*, she thought and began working out how to get back to the surface. I can't remember where Marianne was pointing when she told us about the emergency stairs, she thought, panic surging in her stomach.

Muttering 'Ach Scheisse!' Danny sank into the chair and stared at the screen.

'What's the matter?' Brigit said.

'We've got a Level One Alarm.' Danny clicked the mouse on a flashing icon near the bottom of the screen. 'The beam's aborted,' he groaned, as if announcing a death in the family.

'Oh dear, what a pity,' Brigit said, putting the phone back into her bag and glancing at her watch again.

'There's been a vacuum failure in the beam pipe.' Danny was running his hands through his hair. 'This is a disaster. We'll have to dismantle ATLAS to fix this. We'll be out of operation for months.' He turned and glared at Michael as if it was his fault. 'This cannot possibly be a coincidence. It must be connected with this cosmic monopole.'

'What?' Francesco said, 'You think the monopole's punctured the beam pipe wall? No, that's

not possible. The monopole passed through the wall when it entered ATLAS without causing any damage, so why would it cause this problem now?’

Danny was staring at Michael. ‘I think he knows.’

Francesco turned to Michael who placed the palms of his hands together, saying ‘The explanation is quite simple.’ He was not smiling now. ‘Suppose the Monopole is absorbing energy from the beams. That would explain why we were getting the missing energy events we assumed were faults.’ He checked his watch. ‘This absorption has lasted for just under an hour. That would be sufficient time for the monopole to have been transformed into something else, something capable of puncturing the vacuum pipe.’

‘Transformed?’ Francesco sounded exasperated. ‘Into what?’

‘There is only one thing I can think of,’ Michael said.

‘A black hole,’ Danny whispered.

‘Precisely.’ On Michael’s lips the word almost became a song.

Catriona felt herself grow tense. She had seen black holes swallow things in movies. *But they aren’t real, are they?* she asked herself, but did not get an answer. *And all this talk is taking up so much time. I just want a chance to ask Michael some questions.*

‘A black hole?’ Francesco sounded as if he was going to explode. His heavy jowls wobbled as he shook his head. ‘No no no! Any black hole we create in CERN cannot possibly last long enough to give rise to all these missing energy events. It would immediately be eliminated by Hawking radiation.’

Catriona’s head was beginning to swim with all this technical talk. *If the scientists can’t understand it, what chance do I stand?*

‘But a black hole built around a cosmic monopole would be entirely different,’ Michael said. ‘Wells and Watts wrote a paper on the subject a few years ago. In Phys Rev Letts I believe. They predicted that if a micro black hole could contain a magnetic monopole then it might be stable for several minutes. Perhaps as long as an hour before it evaporated.’

‘A micro black hole?’ Brigit said. ‘I’ve never heard of one of those.’

‘There are two types of black hole, Madame Ambassador,’ Francesco explained, talking quickly. ‘Large ones found at the centres of galaxies and tiny little ones such as we might make here in CERN. But the Hawking radiation theory predicts that the small ones will immediately evaporate.’ He turned to Michael. ‘So you’re saying the magnetic monopole came to rest in the beam pipe, absorbed particles from the beam and was transformed into a persistent black hole?’

Michael nodded.

‘And you knew that was going to happen,’ Danny said, his voice crackling with emotion. ‘That’s why you persuaded me to leave the beams running while we came down here to investigate this supposed fault.’

‘But surely you can see, Mr Schneider,’ Michael replied calmly, ‘that this one experiment alone is worth the entire cost of ATLAS?’

Danny almost exploded. ‘But that’s crazy! Don’t you realise that if that black hole comes out of ATLAS it could endanger the whole world?’

Michael looked up at him with an inscrutable Chinese smile. ‘I don’t think that will happen, Mr Schneider. Wells and Watts showed that any such black hole would evaporate within an hour.’

‘But this one’s lasted for over an hour already,’ Francesco said.

‘Not so, Professor. For most of that time it was still merely a monopole. We do not know exactly at what point it was transformed into a black hole. What we do know is that it will evaporate within the next hour at most.’

‘The LHC is closing down,’ Danny said, looking at the computer and picking up the phone. ‘I think we’d better shut ATLAS down too.’

‘No, Mr Schneider!’ Michael said with a yelp like a frightened child. ‘Please don’t do that. I think you should leave ATLAS running.’

‘What?’ Danny said, the phone to his ear. ‘You’re crazy, Zhang!’

‘Let’s all just try to stay calm,’ Francesco said, waving his arms up and down then taking a deep breath. ‘Suppose we assume there is a black hole and let’s assume it has punctured the beam pipe. In that case it must be inside ATLAS now!’

‘That seems very possible,’ Michael said, ‘even probable. That’s precisely why I don’t want Mr Schneider to turn ATLAS off. If it keeps running we might be able to use ATLAS to track the black hole.’

‘Listen, Zhang,’ Danny snapped. ‘If there is a black hole and if it’s entered ATLAS then it’s going to burn a hole in the detector, isn’t it?’

‘So is this black hole dangerous or not?’ Brigit asked.

‘No, not at all,’ Francesco said confidently. ‘Micro black holes are very tiny. Any damage it causes will be very small.’

Catriona saw Michael glance at Francesco out of the corner of his eye then turn to Danny. ‘It will burn a hole whether ATLAS is running or not,’ he said, ‘but I agree with Professor Romani. I don’t think the damage will be huge and if you shut ATLAS down we won’t be able to collect any data. But if you leave ATLAS running I can measure some vital parameters such as its mass, its electrical charge and especially its magnetic charge.’

Danny stared at him, still holding the phone.

‘Surely you can see, Mr Schneider, that this accidental capture of a monopole has presented us with a unique opportunity to measure a black hole. Now surely we need to make the best of a bad situation and take what measurements we can.’

There was a deep silence in the little room. The only noise was from the gas moving through the thick metal pipe overhead.

‘What do you think, Professor Romani?’ Danny groaned.

‘I agree with Dr Zhang. I don’t think serious harm will come to ATLAS and this event is clearly very important. I don’t know how many of these magnetic monopoles there are in the Universe but I should think the chances of one being captured and then converted into a persistent black hole must be fairly small. It might never happen again in our lifetime. I think we should learn as much as we can while we have the chance. And anyway you will get exactly the same damage to ATLAS whether the magnetic field is on or off. But in the end the decision is down to you, and the ATLAS Executive Board, of course.’

Danny dialled and lifted the phone to his ear. ‘Seline? We think there might be a black hole inside ATLAS... Yes I know that, but this one is persistent... I haven’t got time to explain that now. I want you to leave ATLAS running and call an emergency meeting of the Executive Board...’

Meanwhile Michael had sat down at the computer and was clicking the mouse. Catriona saw images flash onto the screen. Straight black blocks, red rods and green bars organised like a child’s building blocks into rectangles, one inside the other, scattered over a pale blue background. Another image flashed up, concentric rings, mostly black but with thinner coloured circles within and without. The images flickered then zoomed and she felt as if she were falling into a pool of blue water.

Danny put the phone down. ‘We’re going to leave ATLAS running. Even if we turn it off the magnetic field will persist for over an hour so we might as well try to measure something while we’ve got the chance.’

‘Ah, here it is!’ Michael said.

The screen showed a thin red line moving slowly across one of the thick black rings.

‘It seems to have left the Silicon Detector,’ Michael said. ‘I will see if I can measure the curvature in the rho-z projection.’ The mouse clicked and the image changed back into rectangles. The red line curved across the scattered bars.

‘It’s drifting at quite a rate,’ Danny said.

‘Is that important?’ Brigit asked.

‘Of course it is! It’s accelerating in ATLAS’s magnetic field. It could reach the end of the detector before it evaporates.’

‘I’ve measured its curvature,’ Michael said. ‘I will now work out the magnetic charge.’

‘Michael, is that possible?’ Francesco said.

‘Oh yes, Professor Romani. The calculation is trivial. We know the field strength so—’

‘No, I mean is it possible for the black hole to come out of ATLAS?’

Michael paused. ‘It is possible, if it persists long enough. Wells and Watts showed that the lifetime of a black hole containing a monopole will depend on its magnetic charge.’

‘Can you work out how long it will last?’ Francesco said. ‘We need to know whether it will emerge from ATLAS or not.’ He turned to Brigit. ‘I am sorry, Your Excellency,’ he said in a very formal tone, ‘but the LHC is temporarily out of action, Dr Zhang is obviously busy so there is no further point in your remaining down here. If you would care to go with Marianne she will accompany you—’

‘It’s in the TRT endcap now,’ Danny said.

‘Oh, can’t I stay a bit longer, Francesco?’ Brigit said, peering round him at the screen. ‘I want to see what happens and you say there’s no danger so why not. I’ll just have to be late for my meeting, but I think it would be worth it.’

‘Then you remain at your own risk,’ Francesco said and turned back to the screen.

‘Don’t you think it would be safer if we left now, Bee?’ Sam said quietly.

‘What, and lose a unique publicity opportunity? Don’t be stupid, Samuel. Can’t you just see the headline? “Irish Ambassador and possible Presidential Candidate Brigit O’Brien present at discovery of insistent black hole.”’

‘I think they said “persistent”,’ Sam said.

Michael stood up. ‘According to my calculations the black hole should evaporate in the next ten minutes with a probability of ninety-nine percent.’

‘But what will happen if it doesn’t,’ Sam said, ‘and the black hole comes out of ATLAS? What would happen then, Michael?’

It was as if time stopped for a heartbeat as everyone waited for Michael to answer. He was looking at Sam but his eyes seemed to be seeing something else, something inside his head. ‘If the black hole emerged from ATLAS then its motion would depend on the net force acting upon it,’ Michael said very slowly. ‘Once outside, it would feel two forces: the Earth’s magnetic and gravitational fields. Gravity would tend to make it fall but on the other hand we know from the way it is moving in ATLAS’s field that it is a south monopole, so the Earth’s magnetic field would tend to make it rise.’

‘So which way would it move, do you think?’ Sam asked.

‘That would depend on the strength of these two forces which would in turn depend on both its mass and magnetic charge. At a guess, I would say that gravity will probably have the stronger effect, and it will fall, but I’d have to do some detailed calculations to corroborate that.’

‘And what would happen if it hit the Earth?’ Sam said.

Again there was a long silence before Michael said quietly: ‘My guess is it will have evaporated long before we get to that stage. I’m almost sure it will.’

‘But my God, Michael,’ there was a hint of panic in Brigit’s voice, ‘you mean there’s a chance it won’t? It could actually hit the Earth?’

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