Of Protons and Gravity (An Epic Tale of the Universe)
By Chris Nagele

It is well known that Protons are solitary creatures. A Proton is happiest when sitting in some intergalactic void, minding its own business, and watching the flow of light, neutrinos, and the occasional relativistic particle. For a free Proton, there is no worse fate than being bound to another. Any good Proton shivers at the thought as it repels its neighbor Protons with the Electromagnetic Force.

That is why, when Protons came into existence--- as they took their first steps on the cosmic plane--- they were horrified to discover their collective proximity. Everywhere they looked, waves and waves of protons covered the plane, and some protons were given to panic, fearful that they would never rise above the sea and take their first breath. But then, from a state of near asphyxiation, light emerged (or rather dimmed), as the First Hero of the Protons made effort to alleviate their condition.

Radiation, wielding in her and in her right hand a photon and in her left a photon and a neutrino, lent her strength to the plight of the Protons and slowly, ever so slowly, forced the universe to expand, thus creating more and more space for each Proton. For many days and nights, the strength of Radiation neither wavered nor waned, and so the expansion of the universe quickened, propelled by Radiation's brawn.

Eventually the Protons rejoiced! Even as the strength of Radiation began to fade, the Protons understood that cosmic expansion, once started would not stop, and they anticipated a future of existence infinitely far away from other Protons. But suddenly, an almost imperceptible tug materialized in the gut of each Proton, and with it the realization of despair. Gravity, the villain of this tale, had made her presence known. With her wayward pull, she sought to bind every Proton to every other, a most diabolical aim in the view of the introverted Protons.

Time passed as the Protons were dragged, slowly but inexorably, closer together. As dense clouds of Protons were formed by Gravity, their distaste for the proximity of their kin was a secondary concern to their fear of the next stage of Gravity's fell plan; every young Proton knew the fate of those captured within the heart of a Star. First, the Protons would be forced closer and closer together, until the Protons would collide with each other so frequently that half of them would lose their identity (and their charge) and become neutrons. But worse still, the other half would be bound to those neutrons for eternity in that horrible isotope, Helium 4.

However, as the Protons contemplated their impending imprisonment, the second Hero of the Protons showed his face. Angular Momentum, wielding a circumstellar disk as a shield, and wearing armor made of interlocking barred galaxies, struck a mighty blow at the heart of Gravity's design. Taking up the Sword of Conservation--- a weapon which will make many an appearance in this tale--- he cleaved the collapsing cloud of Protons so that many of the Protons were freed and many others avoided falling into the Star. The Protons had won a great victory that day, as scores of them would avoid the certain imprisonment of the Star.

Even as the Protons celebrated their victory, thoughts turned to their less fortunate brethren who had been trapped in the heart of the Star. There, the anticipated cruelties did indeed come to pass. Once the Protons were chained into Helium 4, they were then forced into larger and larger configurations. First, Carbon 12, then Oxygen 16, and soon after, Nitrogen 20.

With each step, the Protons were bound to more and more of their kin, and some feared this was the beginning of the end, that they would eventually end up in one giant molecule of Protons.

But then, Gravity misstepped. When Silicon 28 was produced, instead of making Sulfur 32, Gravity instead decided to combine two Silicons to make Iron 56. Gravity reasoned that this near doubling of the number of Protons would make an isotope so stable that no Proton would ever escape. Filled with glee, she observed the fear and suffering of the Protons bound in the Iron 56 isotope, but as she attempted to add even more Protons to this wicked configuration, her mirth ceased. Gravity tried innumerable ways of adding Protons to Iron 56, but each way was met with failure. Gravity felt a mounting fear; if she could not produce anything with this Iron, then she could not increase the temperature of the Star and it would collapse! The Protons, for all their apparent helplessness, had finally found a way to fight back, by using the force of Gravity herself.

Gravity howled in rage, distraught that she would no longer be able to torment the Protons, but her anger faded quickly. She would miss her tinkering, but what awaited on the other side of a marginally stable Iron core was her ultimate goal, a black hole. Inside a black hole, Protons (if they can even exist in such a place), would be confined to a single point in space; a tiny prison, the size of nothing.

Her emotion passed, Gravity set her expression and turned towards the core of the Star. As the core began to collapse, however, she felt a presence she had thought diminished. Radiation, the First Hero of the Protons, had reemerged.

Concern tugged at Gravity as she watched the Hero go to work. Radiation used the energy produced by the collapsing core to hurl bolts of light at the Iron 56 atoms, and so powerful were her strikes that she shattered those terrible isotopes, freeing the Protons. Gravity smirked when she saw this.

So what if the Protons had a few extra moments of freedom? They would all end up in her Black Hole, soon enough.

So smug was she that she missed the entrance of the Third Hero of the Protons. Principled Quantum Mechanics slipped into the core of the star. He wandered amongst the Protons for a time, offering words of encouragement and solidarity. He knew the coming task would be difficult.

Moments later, the brave Protons of the Core put their plan into motion. Electrons flew around the core at ever more frightening speeds, but Quantum Mechanics is deft, and he plucked an electron from the morass and combined it with one of the Protons, turning it into a neutron. Again and again, he seized Proton and electron and forced them together. A tremor ran through the ranks of the Protons as they observed the sacrifice of their brethren, but they stood firm, their thoughts resting on their brethren above.

By the time Gravity realized her Protons were disappearing, it was too late for her to do anything about it. She watched in horror as nearly the entire Core was converted from Protons to neutrons, but she did not yet grasp the Heroes' design.

It was no matter, she thought. Proton or neutron, they would all end up trapped for eternity.

Quantum Mechanics, his grim work finished, let Radiation take the stage. Each of the Protons which had sacrificed themselves had left behind not only a neutron, but also a neutrino. Radiation marshaled these neutrinos, sembled them into rank, and directed them against the enemy. Radiation led the charge, and with her left hand she struck a mighty blow against Gravity.

Gravity reeled.

Nothing should be able to stop the collapse of the Star, but somehow Radiation and her neutrinos were pushing back. All waited with breath held close as the struggle between Radiation and Gravity came to a standstill. One milli-second passed, then ten, then a hundred and finally with a piercing cry, Gravity was shoved aside and the Star exploded in a Core Collapse Supernova.

The Protons in the outer layers of the Star could not believe their eyes. Moments before, they had been destined for a Black Hole, but now they were being carried away, awash in the twin glows of euphoria and 10^{58} neutrinos.

Gravity's wrath was great as she surveyed what remained of the Star. The core had been converted into neutrons, with but a few Protons hiding in the wings. She channeled her fury into collapsing that core ever further, until it was supported only by the laws of Quantum Mechanics, who dallied on the scene despite Gravity's ire. In the center of this newly formed Neutron Star, Protons were pushed together as close as was allowed by the Pauli Exclusion Principle and although this proximity brought untold agony, they still found voice to snicker at the failure of Gravity. 'Gravity couldn't make a Black Hole, does she even know about General Relativity,' one jibed. Another took up the beat, 'Is it possible that Gravity is actually weaker than the Weak Force?'

Gravity listened from afar, but unbeknownst to the sarcastic Protons, she had a backup plan. This particular Star was not the only star, and in fact, it had a companion star which had also undergone a Core Collapse Supernova, leaving behind another Neutron Star. Now these two Neutron Stars circled each other, and had the Protons understood General Relativity themselves, they would have had great cause for alarm.

Neutron Stars are in most cases, unscrupulous narcissists, and since all Neutron Stars are of the same cut, they tend to be quite affectionate amongst themselves. This situation will often lead to two Neutron Stars chasing each other round in circles, as was the case in this small slice of the Universe. The Neutron Stars circled each other, each yearning for contact with its companion, but they understood that they must obey the edicts of Angular Momentum, the First Hero of the Protons, lest one of them be ejected into interstellar space. As they followed each other round and round, they broadcast their sad tale to the rest of the universe in the form of gravitational waves.

Gravity is a clever antagonist and she recognized that these gravitational waves carried with them an opportunity. They required energy to produce and she took up the Sword of Conservation and struck clean and fast. With each gravitational wave created, the two Neutron Stars were forced by Gravity's strike to edge closer to each other, reducing the energy of the system.

After many years, the Neutron Stars were so close they almost touched, and the gravitational waves they produced were fierce to behold. What Protons remained, finally

cognizant of their impending doom, cried out in terror as the two Neutron Stars collided. I will not speak of the horror of that event, but it was clear to all that Gravity had finally constructed her black hole. From her ever falling throne, with tilted head she listened, but the sarcastic Protons would never again be heard. A slight smile graced her face as she considered that nothing could now stop her. Eventually, all Protons would become ensconced in her eternal prisons.

Protons everywhere quailed at the fate of their brethren, and what they now understood must be the fate of every one of them. Despite the bravery of their Heroes and the sacrifice of their kin, they had been unable to foil Gravity.

Principled Quantum Mechanics looked upon the grief of the Protons and was greatly moved. He resolved to do whatever it took to once again offer hope to the brave particles.

Cautiously, he approached the edge of Black Hole. Gravity lifted an eyebrow invitingly, but Quantum Mechanics continued his careful inspection. There it was. A flash! There, another one!

Quantum Mechanics kept his expression neutral as he reached for the Sword of Conservation. The flashes were from Quantum fluctuations which produced particle antiparticle pairs. Deft Quantum Mechanics waited with the Sword of Conservation held at the ready.

Gravity noticed him, but paid him no heed. He could swipe at her Black Hole all he wanted with his tiny sword. What could he hope to achieve?

The Hero saw what he had been waiting for: a Proton just outside the Black Hole with its partner antiproton just inside. The antiproton was immediately sucked into the center of the black hole and acquired a huge negative energy. Quantum Mechanics struck, dictating that the energy the antiproton had lost must go to the newborn Proton, which sped away from the Black Hole in terror. The struggle against Gravity would be carried on.

Hope springs eternal, although the Protons are not quite sure from where.