

Isaac Newton's universal law of gravitation states that the attractive gravitational force between two masses is proportional to the product of the masses and inversely proportional to the square of their separation. Newton used the law to explain the ocean tides, caused by the gravitational influence of the Moon. In the open seas there are two tides a day. On the side of the Earth facing the Moon the water is nearest to the Moon and pulled towards it most. Being able to move, the water bulges out to make a tide. On the opposite side, being farther from the Moon, the water is pulled less strongly and so is 'left behind' by the Earth, bulging out to make the second tide. These relatively weak tidal forces move the water by no more than a few metres. But when the orbit of a star brings it close to a supermassive black hole, tidal forces can rip the whole star apart. If a star wanders too close to a black hole, tidal forces deform the star's facing surface strongly, causing it to bulge out towards the black hole, and elongating it into a cigar shape. Once the stellar material protrudes outside the Roche lobe, it can be captured by the black hole. The material then further elongates, eventually forming a filament winding around the hole. The filament fragments into separate pieces which fall into the hole producing a string of observable transient radio, optical, X-ray, and gamma-ray flares. This star-shredding process is a tidal disruption event, and many are seen in surveys. A classic nearby and small-scale example of this fragmentation process took place in 1992 when Comet Shoemaker-Levy 9 passed so close to Jupiter that the planet's tidal forces tore it apart, forming a line of cometary pieces, all of which subsequently fell into the giant planet. One of the most mysterious and terrifying objects in the Universe Magnetars are the most highly magnetized objects known in the cosmos and generate powerful outbursts of X-rays and gamma rays. The details of how magnetars form are not understood but, like pulsars, they are thought to be produced in the collapsing cores of massive stars in supernovae. The enormous magnetic fields are likely to arise from a magnetic-line winding-up process, in which accretion from a companion is combined with rotation. A magnetar has a magnetic field strength of a quadrillion (10^{15}) gauss. To put this in perspective, the Earth's field is about 0.5 gauss, a common refrigerator magnet has around 100 gauss, in a pulsar the field strength is 1 trillion gauss, but in a magnetar it is 1,000 times stronger still. Near to a magnetar the field is so strong that it can distort matter by tearing molecules apart and stretching atoms into rod-like shapes called pencils. Even if you were 1,000 km from a magnetar, its magnetic field would distort the atoms in your body

.(an excerpt from Geoff Cottrell's *Observational astronomy*)

Maria reverted to the standard clock rate, and a macroscopic view of her twenty-one Petri dishes—just as a message popped up in the foreground:

JSN regrets to advise you that your resources have been diverted to a higher bidder. A snapshot of your task has been preserved in mass storage, and will be available to you when you next log on. Thank you for using our services.

Maria sat and swore angrily for half a minute—then stopped abruptly, and buried her face in her hands. She shouldn't have been logged on in the first place. It was insane, squandering her savings playing around with mutant A. lamberti—but she kept on doing it. The Autoverse was so seductive, so hypnotic . . . so addictive.

Whoever had elbowed her off the network had done her a favor—and she'd even have her fifty-dollar log-on fee refunded, since she'd been thrown right out, not merely slowed down to a snail's pace. Curious to discover the identity of her unintentional benefactor, she logged on directly to the QIPS Exchange—the marketplace where processing power was bought and sold. The connection to JSN had passed through the Exchange, transparently; her terminal was programmed to bid at the market rate automatically, up to a certain ceiling. Right now, though, some outfit calling itself Operation Butterfly was buying QIPS—quadrillions of instructions per second—at six hundred times that ceiling, and had managed to acquire one hundred percent of the planet's traded computing power.

Maria was stunned; she'd never seen anything like it. The pie chart of successful bidders—normally a flickering kaleidoscope of thousands of needle-thin slices—was a solid, static disk of blue. Aircraft would not be dropping out of the sky, world commerce would not have ground to a halt. . . but tens of thousands of academic and industrial researchers relied on the Exchange every day for tasks it wasn't worth owning the power to perform in-house. Not to mention a few thousand Copies. For one user to muscle in and outbid everyone else was unprecedented. Who needed that much computing power? Big business, big science, the military? All had their own private hardware—usually in excess of their requirements. If they traded at all, it was to sell their surplus capacity.

Operation Butterfly? The name sounded vaguely familiar. Maria logged on to a news system and searched for reports which mentioned the phrase.

.(an excerpt from Greg Egan's novel *Permutation city*)