

Thoughts about Gravity, Dark Energy and Dark Matter

The Rock-Star Astronomer Brian Cox, in one of his recent shows, made the comment: we live in exciting times, never before was so much new development and understanding going on in astronomy!

I can feel with him, but discoveries and understanding always seem to come in leaps and bounds, right back to the time of Copernicus, Kepler and Newton. Then in the early 1900s, with Planck, Einstein and Hubble, then Hoyle and the Big Bang, the Microwave Background Radiation, the Hubble Space Telescope and the flood of EXO-Planets.

Gravity has been under scrutiny for some time now, but lately, with Dark Matter and Dark Energy proposals, a new urgency arose to define what we understand by gravitational attraction. **Mordehai Milgrom** tried to solve the Dark Matter problem by proposing a Modified Newtonian Dynamic (MOND) theory (see below), and **Erik Verlinde** now argues that there is an additional entropy distributed throughout space, causing both the Dark Matter and Dark Energy symptoms, and questioning the Big Bang Hypothesis.



Brian Edward Cox, English Particle Physicist, born 3 March 1968 in Lancashire, England

Now that stirred a lot of memories in me and I would like to share some of my thoughts on the subject with you here: According to Wikipedia, Newton's law of universal gravitation states:

*A particle attracts every other particle in the universe using a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres. This is a general physical law derived from empirical observations by what **Isaac Newton** called inductive reasoning.*

Nota bene, **Empirical observations and inductive reasoning** also created today's ubiquitous Dark Matter and Dark Energy. Again, something was needed to let what we see and measure make sense, even if that something by itself makes no sense at all. We have no concept of Gravity, nor Dark Energy or Dark Matter. Here is the story of my struggle with the problem, which goes back quite a few years. My apologies if you have heard it before.

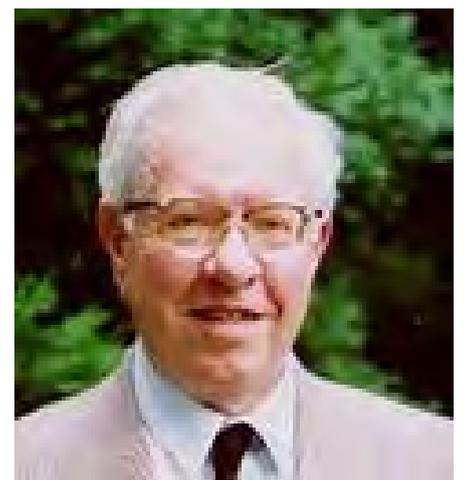
It was Fred Hoyle (with Gold and Bondi) who, with his Steady State Theory in the 1950s first fired my fascination with astronomy and cosmology. He was, as we all know, later shot down with what he himself termed the Big Bang theory and the Microwave Background Radiation. It had greater public appeal and, unfortunately, much of today's cosmology is still centred around it.

I could never get enthusiastic about a "big bang creation". After all, why would something want to explode/expand if it was in equilibrium within itself (no matter how hot or cold it was) and there was no empty space it could expand (explode) into? And where did all that "Bang" stuff come from? It never made any sense to me.

As we (I) understand today, the world around us consists basically of two fundamental concepts: Energy (Matter) /Charge on the one hand and Space/Time on the other, as well as the four forces: The Strong Force, the Weak Force, the Electromagnetic Force and Gravity.

Another given concept seems to allow matter and energy to morph from one to the other, and probably the same happens between

space and time. One more "given" fact is that particles (matter) can only be created in pairs: particle and anti-particle. This fact is a philosophical problem that goes way back to the act of creation (Big Bang): if particles can only be created in pairs, what happened to all the antiparticles created in the 13 billion years since creation? Ever since the process has been proven in physics laboratories, countless astronomers and researchers have been looking for them without success. The accepted explanation for this discrepancy is that for some "unknown reason (bias)" more particles were created in the Big Bang than antiparticles, and that the antiparticles that were then created merged with their partner particles causing the giant fiery flash, which we see today as the Microwave Background Radiation. The left-over particles then formed all the detectable matter in our universe, including you and me; **empirical observations and inductive reasoning again!**



Sir Fred Hoyle (1915 – 2001) was an English astronomer noted primarily for the theory of Stellar Nucleosynthesis and the Steady State Theory of Cosmology.

My suggestion is, that both particles, when creation in Nature and left alone (not in Synchrotron Experiments), morph into new identities. The particle turns into matter/charge and the antiparticle turns into – space/time. It is an ongoing process, for ever and ever, reminiscent of Fred Hoyle's Steady State Theory. **Space is part of a continuous creation. Each time a particle is created an equivalent amount of space is created, forcing space to expand in all directions.** Where and why the particles come is of course a different matter. This is one of the four aspects of Nature that our human mind finds incomprehensible. We have no concept of Infinity or Eternity, nor a Beginning or End of the world. Even the much acclaimed Big Bang theory is silent on what was before the bang, or where did all the stuff come from. I do sincerely hope that one day the human mind will comprehend their meaning. And there is hope, as I understand in ancient times humans had no concept of Zero, even calendars did not have year nought, as that did not make sense. To get born you need a parent!

Erik Verlinde in his new theory of Gravity of 2016, argues that there is an additional entropy distributed throughout space, introducing residual forces similar to the empirical relationship between Dark Matter and the Hubble constant. Following his lead I took the plunge and gave my space/time the property of having the same density everywhere, and allowing this process to exert pressure on suspended masses, pushing them together so they use the least possible space, proportional to the product of their masses and inversely proportional to the square of the distance between them! This inherent structure of space and its active tendencies is behind what we see and measure as the mysterious force of Gravity!

Albert Einstein, in proposing a curved space causing planets to orbits around celestial bodies, was almost there. But now, by realising that the curvature of space is actually a pressure gradient (like a contour map around a mountain) the curve (orbit) is naturally determined by the mass and momentum of the relative bodies, and the pressure of space to contain it.

The mystery of excess speed in outlying components of galaxies and clusters of galaxies first noted by **Fritz Zwicky** in 1933, could not be explained by Newtonian Gravity. "Dunkle Materie" Dark Matter was invented to account for the "missing mass". The Israeli physicist **Mordehai Milgrom** tried to solve the problem by proposing a Modified Newtonian Dynamic (MOND) theory.

I am proposing instead that the vast empty space around a galaxy causes greater pressure on the outer perimeter components of that galaxy compared to the pressure in the matter populated environment closer to the centre of the galaxy. This leads naturally to the same effect.

A similar case can be made for the apparent clustering of matter (galaxies and clusters of galaxies) around giant empty voids in space, normally referred to as 'bubbles' in deep sky surveys. Here again the great empty spaces clearly demonstrate the tendency of space to push matter away and compress it as much as physically possible according to its density, so it uses up the least space.

I can even visualize those very same tendencies of space as a possible source of the mysterious Strong Force in particle physics. The fundamental particle, whatever it may be, is the most dense object we know and as such will experience the maximum force space is capable of, that is 10^{38} times the gravitational force (the energy level just below what is needed to creating new particles) which helps neutrons and protons to form in the atomic nuclei.

AK, with Wikipedia Notes



Erik Peter Verlinde; born 21 January 1962 is a Dutch theoretical physicist. His research deals with string theory, gravity, black holes and cosmology. Verlinde's approach to explaining gravity leads naturally to the observed strength of Dark Energy.



Mordehai Milgrom born in 1946 in Rumania is an Israeli physicist and professor in the department of Particle and Astrophysics at the Weizmann Institute in Rehovot, Israel. He is best known for his 1981 proposal of Modified Newtonian Dynamics (MOND).