

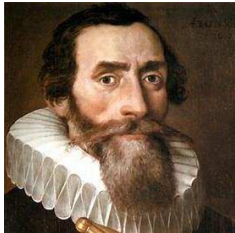
TURTLES ALL THE WAY DOWN

S.Smith February 2018

ABSTRACT

There is a mythical saying that the Earth rests upon the back of a turtle and when asked what supports the turtle, the response is “its turtles all the way down”, being an example of infinite regression which seems to be somewhat representative of modern cosmology. The only difference between this mythological world view and modern cosmology is that cosmologists have reversed the process and are busy creating a tower of turtles. The reason that this appears to be the case is that the core theories of cosmology are in reality very simple and are based upon just four equations. Combinations of these four equations are used over and over again often becoming unrecognizable as Greek symbols and acronyms are introduced as is common in modern physics. The mathematical aspect of modern cosmology adds yet another layer of complexity, using additional mathematical methods and symbols to represent different concepts. The underlying theory however almost always comes down to a combination of these four basic equations.

Johannes Kepler



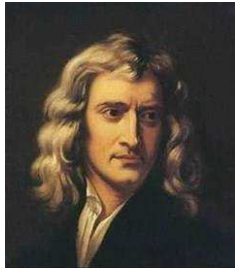
The story begins around 1609 with a German mathematics teacher Johannes Kepler. He became an assistant to the astronomer Tycho Brahe in Prague and eventually became the imperial mathematician to the Emperor Rudolf II. Following many years of observations and using the observational archives of Brahe he discovered a relationship between the planets orbits and their distances from the sun. When his work was published it became collectively known in recent times as Kepler’s laws of planetary motion. These laws are considered by the scientific community to be to be generic and valid throughout the Universe, becoming the very foundation of modern cosmology as we know it.

$$\frac{L^3}{MT^2}$$

Kepler’s third law of planetary motion shown above, where L represents the radius, M the mass of the object at the center and T the period of rotation or the orbiting body.

Isaac Newton

Some seventy years later an English mathematician Isaac Newton completed his paper on celestial mechanics using Kepler's third law to describe gravity and its effect on the orbits of planets and producing his equation representing the force of gravity and its relation to mass and radius shown below;



$$f = \frac{GMm}{r^2} m^3 kg^{-1} s^{-2}$$

One of the most important values used by almost every cosmologist to the current day was Newton's gravitational constant "G" however he neglected to explain how he arrived at the value of this elusive constant. Since that time the value of G has been assumed to be a constant throughout the Universe, essentially a fixed value which could only be measured and not calculated as such. This view is still prevalent today, and there is a great movement in the scientific community to improve the accuracy of measurement of its value. The reality however is that G is not a constant at all, but is simply Kepler's third law in disguise;

$$G = \frac{4\pi^2 r^3}{MT^2}$$

By simply inserting the mass of the Sun and its distance from the Earth into Kepler's third law, Newton established his parameter G which is a ratio of proportionality. Likewise, entering the mass of the Earth and its distance from the moon he produced exactly the same number showing him that indeed his theory was correct, a result of this it can now clearly be seen that Newton's G is not actually a constant but rather a ratio being nothing more than Kepler's equation taken from his third law.

Karl Schwarzschild

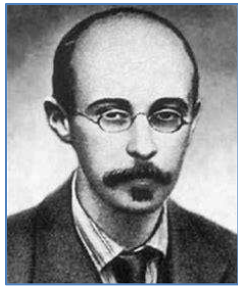
The next advance in the history of cosmology came from yet another German mathematician by the name of Karl Schwarzschild in 1916. By looking at Newton's work, much as was theorized by Newton himself, he realized that he could combine the laws of motion and Gravity to produce a simple equation to calculate escape velocity;



$$v_e^2 = \frac{2GM}{r}$$

Escape velocity being the actual speed required for cannonballs and rockets to escape the gravitational pull of the Earth, used on a regular basis by space agencies throughout the world to put satellites into orbit. The Schwarzschild escape velocity equation can also be produced directly from Newton's equations using nothing more than simple calculus.

Alexander Friedmann



In 1924 a Russian mathematician Alexander Friedmann, who was not well known in the west until more recent times, produced his energy, and acceleration equations which have become somewhat ubiquitous in modern cosmology. Friedmann's equations are used to support the theories of such things as the expansion of the Universe and Black Holes and even the Big Bang. It is assumed that these equations are derived from Einstein's General Relativity and much as with the Schwarzschild equation requires complex mathematical manipulation to arrive at the final equation.

$$v_e^2 = \frac{8\pi G r^2 \rho}{3}$$

It is not a coincidence that the Friedmann equation, shown above, looks very similar to the Schwarzschild equation as it is essentially equivalent. The only difference being that the mass is replaced with density and volume. Equally so, the Friedmann equations can also be realized in a much simpler manner directly from Schwarzschild's equation for escape velocity, again requiring only a couple of lines of high-school calculus to achieve the equation.

Edwin Hubble



relationship between the distance of remote galaxies and the red-shift of the light emitted from them. The red-shift relationship being that the light from a distant galaxy appears redder the further away it is from the observer on the Earth. Almost immediately, mathematicians suggested that this must therefore be an indication that the farther away the distant object was from the Earth, the faster it was receding and the theory of the expanding Universe and the Big

Bang was came into existence. The Hubble equation is shown below which is used to calculate the density of the Universe, the only difference between this and the Schwarzschild/Friedmann equation is that the velocity is assumed to be recession velocity rather than escape velocity.

$$v_r^2 = \frac{8\pi G r^2 \rho}{3}$$

Hubble was skeptical of this interpretation however and never fully accepted that this was necessarily the case. It is indeed ironic that Hubble was right and what has now become known as the Hubble constant does not represent recessional velocity and being nothing more than the Friedmann equation which was derived from Schwarzschild's equation for escape velocity

Modern Cosmology

This brings us to the present day whereby literally, all of the current cosmological theories are based upon these four basic equations from Kepler, Newton, Schwarzschild and Friedmann. The four equations can clearly be seen to be a natural progression, whereas most of the modern exotic cosmological theories from describing the orbits of planets and galaxies, black holes, Dark Matter, Dark Energy and even the Big Bang seem to be based upon mathematical abstractions and models. When these current theories are analyzed, it is found that they are all based upon just one single premise, that Hubble's red-shift is a measure of recession velocity, when in fact it is nothing more than Schwarzschild's escape velocity. Maybe, just maybe, is not turtles all the way down and the Universe is indeed much simpler than it appears and a return to classical physics is all that is needed.

Steve Smith