CRANK ASTRONOMY AS A TEACHING TOOL. II.

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1. A Changing Speed of Light?

Level: Basic Calculus

Consider the possibility that the speed of light was much higher in the past. This would enable light from distant stars to reach the Earth even if the Universe were very young. This idea is popular among some young-Earth creationists. But is that the *only* implication?

Consider a simple model for a changing speed of light:

(1) Choose a simple model for a varying speed-of-light: $c = 1+ke^{-at}$ or $c = 1+k(t-\tau)^2$, where t is time and the speed of light is in units such that the present-day value is unity. The primary constraint is the speed should be very close to unity for $t = 10,000$ years and much greater than unity for $t = 0$. The values of k, τ and a will be determined in a later step.

(2) Integrate the equation to compute the distance of light travel, $s(t_1, t_2)$, between any two times, t_1 and t_2.

(3) Choose variables, such as k, τ, a above, so between the values of $t = 0$ (defining the moment of creation) to $t = 10,000$ years correspond to a travel distance of about 13,700,000 light years.

(4) Derive the Hubble Law for this configuration. For an object at some distance d, emitting light of some wavelength, λ_0, compute the change in wavelength on arrival at the Earth, λ. Consider the problem as tracking two wave crests as they leave the emitting object to when they arrive at the observer. Then compute redshift, $z = (\lambda/\lambda_0) - 1$. Examine the expected behavior of this Hubble law by comparing measured d and z for some nearby galaxies, preferably nearer galaxies with distances determined by Cepheid variables. Are the distances and redshifts consistent?

2. Electrically-Powered Stars

Level: Basic dynamics and electromagnetism.

A large segment of astronomical pseudoscience is any derivative of the "Electric Universe," which posits that everything in the Universe is electrical and acts and reacts because of electrical interactions and that these are far more powerful than the gravitational interactions. Included in that is the Sun and, by extension, all stars.

Consider two possible configuration for stars powered by external electrical currents.

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Resistor Model: A star as a ball of gas along an electric current stream, similar to a resistor on a wire.

Spherical Capacitor Model: A star functions like a spherical capacitor, with the anode (source of protons) at the photosphere and the cathode (source of electrons) at the heliopause.

Now examine some implications of these two configurations:

(1) Compute necessary electron energies & fluxes of sufficient energy to produce solar luminosity for the two configurations described.
(2) For the 'resistor' model, compute the magnetic field of the current stream (magnitude & direction) by treating it as a long wire.
(3) For the 'spherical capacitor' model, compute the average inbound electron and outbound ion fluxes you would expect to measure at the orbit of the Earth, using particle conservation.
(4) For a more advanced class, consider the possibility that an electric voltage difference exists between the stellar photosphere and the heliopause, perhaps driven by a net charge on the star. Apply conservation of energy to determine the energy the electrons and ions would have at the orbit of the Earth.
(5) Compare results to publicly available data, such as solar wind speed, density, and magnetic field strength available at http://www.spaceweather.com
(6) Can you identify other testable problems with these models?

3. Planet X

Level: High-School students, algebra

A popular meme for the last 100 years has been the idea of a"Planet X" that lurks "out there" in the solar system. This has taken on numerous forms, perhaps best popularized most recently by Zecharia Sitchin or by the general 2012 paranoia. Could an unknown planet 'sneak up on the Earth from the far side of the Sun without astronomers (professional AND amateur) seeing it?

(1) What are the orbit dimensions for a planet with a claimed orbital period of 3600 years?
(2) How would a massive object on a radically different orbit affect the other planets, or asteroids (hints: occultation timing, discovery of Neptune).
(3) Could such a planet approach undetected from the direction of the South Pole? How about from opposite the Sun? How much of the sky can you see over the course of a night, a month, a season, a year?

For more information:

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