



# Topical: Dark Energy, Dark Matter with Structure evolution of the Universe Dark side of Special Relativity and Space-Time

## Abstract

Space-Time and special relativity theory of matter transformation explain the universe how to origin and evaluation as well as dark energy and dark matter evaluation of the universe. A black hole formed from anti-matter, which created with the positive matter, and created positive matter (the process of  $m = E/c^2$ ) attract to the black hole make a galaxy. Inflation is the period of the first step of matter generation. Then dark energy got inflationary expansion and positive energy get compression by the speed of light ( $E/c^2 + (-E)$ ). Created matter makes neutral atoms make the HI region. The matter makes a connection with dark energy make ionized matter and make the HII region. Then nebulae created in the HII region by dark energy and positive matter. Sufficient density of matter and dark energy formed a star and make the process of  $E = mc^2$  and negated in a supernova and nova explosions. The remaining matter creates dwarfs or neutron stars. Remaining dark energy creates pulsars. This explains how galaxies and stellar formation as well as other structures evolution of the universe.

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White Paper submitted to the Decadal Survey on  
Biological and Physical Sciences (BPS) Research in Space 2023-2032

## 1. Introduction

Our universe explained as homogeneous and isotropic. This is explained by Robertson Walker metric (Mambrini, 2013).

$$s^2 = c^2 dt^2 - R^2(t) \left[ \frac{dr^2}{1 - kr^2} + r^2(d\theta^2 + \sin^2 \theta d\phi^2) \right]$$

where  $k$  is the curvature, and  $t$  is the time measured by a fundamental observer (at rest with local surroundings), and  $R$  is a time-dependent scale factor.

The General Relativity solution for the scale factor  $R$  is given by the Friedmann equation as follows (Mambrini, 2013).

$$\ddot{R} = -\frac{4\pi G}{3}R \left( \rho + \frac{3P}{c^2} \right) + \frac{\Lambda}{3}R \quad (\text{Force Equation})$$

$$\dot{R}^2 = \frac{8\pi G}{3}\rho R^2 - kc^2 + \frac{\Lambda}{3}R^2 \quad (\text{Energy Equation})$$

where  $P$  is the pressure and  $\Lambda$  is the cosmological constant,  $k$  is the curvature. Energy density changes in the universe (Fluid equation) as follows.

$$\dot{\rho} + 3\frac{\dot{R}}{R} \left( \rho + \frac{P}{c^2} \right) = 0 \quad (\text{Fluid Equation})$$

Albert Einstein's theory of special relativity that expresses the fact that mass and energy can be interchanged into each other.  $E = mc^2$ , in the equation, the kinetic energy ( $E$ ) of that body is equal to the increased relativistic mass ( $m$ ) of body times the speed of light squared ( $c^2$ ) (Bodanis, 2005). The above equations explain how the universe origin, evaluation, and how it looks likes.

## 2. Dark Energy, Dark Matter problem and origin of structures in Universe

The universe describes by  $\Lambda$  CDM (Lambda – Cold Dark Matter) model, which is the currently accepted model for explaining the universe (Silk, 2000). The present Constitution of the Universe according to the  $\Lambda$  CDM model is Baryonic matter: 24%, Dark matter: 4.6% , Dark energy: 71.4% . Also Friedmann equations use  $\Lambda$  as dark energy. But there is no clear description of the dark energy and dark matter, also the origin and evaluation of dark energy and dark matter.

The  $\Lambda$  CDM model explains the origin of the universe from Big Bang, then inflation, Big Bang Nucleosynthesis, and expanding universe (Boesgaard, 1985). The Big Bang model itself did not explain the method of structure formation. Also, it is explained as galaxies formed by gravitational collapse, not from the origin of the universe. The criterion for Gravitational collapse was explained as Jeans Criteria.

### 3. Solution of Special Relativity, Friedmann equations and Fluid equation explain origin of structures of the universe with Dark Energy, Dark Matter

Solution to the Friedmann equations, fluid equation and special relativity explains how matter and energy created. According to that matter can generated with negative energy. Matter can destroy with negative energy. The negative energy can identified as dark energy. The negative matter can identified as Dark matter.

The special relativity matter and anti-matter generation model explains how the structure formation, simply it is since the anti-matter attraction of the matter. This explain the galaxy creation, HI region, HII region, black holes, quasars, planets, stars, dwarfs, supernova, nova, neutron stars, pulsars and nebulas as growth structures of the universe.

It explains these growth structures related to matter transformation process, which govern the expansion and compression of the universe. This solve the structure origin mechanism of the Big Bang. This will provide the possible answer to how the universe work does.

### 4. Space Architecture of Energy, Matter, Dark Energy, Dark Matter

Consider an initial stage with no matter in the universe and nothing all over. Then according to the fluid equation  $(\rho) + (P = -\rho c^2)$  can be generated without effect to the equation. Then  $P = -\rho c^2$ , Which is explained as the pressure of vacuum energy, where cosmological constant dominates the universe. In the fluid equation, it was written as

$$(\rho) + ([-\rho * c^2]/c^2)$$

According to the special relativity, it explains as

- density  $\rho$  + negative density  $(-\rho) * \text{expand speed } c * \text{compressed by speed } c$
- => density  $\rho$  + dark energy  $(\Lambda = -E = -\rho c^2) * \text{compressed by speed } c$
- => density  $\rho$  + anti-matter  $(-\rho)$

The anti-matter  $(-\rho)$  can identified as dark matter. it is comparable with special relativity energy -> mass transformation.

$$\begin{aligned} 0 &= E - E && \{ \text{initially Energy and Dark Energy} \} \\ \Rightarrow 0 &= (E/c^2) * c^2 + (-E/c^2) * c^2 && \{ \text{divide by } c^2 \text{ and multiply } c^2 \} \\ \Rightarrow 0 &= \rho * c^2 + (-\rho) * c^2 && \{ E = mc^2 \Rightarrow m = E/c^2 \} \\ \Rightarrow 0 &= \rho + ([-\rho * c^2]/c^2) && \{ \text{equivalent to fluid equation, } P = -\rho c^2 \} \end{aligned}$$

It can explain as positive density can generated with negative density expand by speed of light and apply compression of speed light again. This expansion of speed of light apply, since the opposite force to compression of energy by speed of light.

It explains how the initial mass generated as positive density and dark energy compressed by the speed of light. Not the positive density expands by speed of light nor the positive mass and anti-matter. It also explains dark energy as negative pressure and universe origin as:

$$\text{density } \rho + \text{dark energy } (\Lambda = -E) * \text{compressed by speed of light}$$

Apply the initial  $\rho$  and  $P = -\rho c^2$  to Friedmann force equation, give initial  $\Lambda = -8\pi G$ . Also applying  $\Lambda = -8\pi G$  for Friedmann energy equation, give initial scale factor  $R = ct$

(initial curvature  $k=-1$  for open universe in big bang inflation). Which also comparable for the expansion of speed  $c$  given by fluid equation. Therefore inflation is start with scale factor  $R$  equals to speed of light( $c$ ). Initially generated matter gets nearly equivalent speed of light, hence generated as radiation matter. This process is the power generation process to universe to expand.



This will refuse the concept of initial high density soup, alternatively can consider origin from nothing or origin from Energy and Dark Energy soup and then it had transform to Matter and Dark Matter. This will useful for future Dark Energy and Dark mater searches as well as determine physics of Stellar and Black Holes. This will provide the possible answer to how the universe work does.

## 5. Matter and Dark Matter: Structure of Galaxies, Black Holes, Quasars and HI, HII Region

The matter will generate with equivalent anti-matter or dark energy. Dark energy is negative energy and has negative pressure. Consider the properties of anti-matter. It is with negative pressure and compresses by as matter (Dark Matter). And a black hole is like massive anti-matter, which contains all anti-matter of masses of a galaxy.

Quasar is the process of mass generation. It is observed that quasar emits radiation, which is like the generation of radiation matter (Elvis, 2000). Considering the steps of matter generation, it will generate expansion power of the speed of light to the universe by the equivalent amount of matter generation. Consider the mass generation process, which generates radiation matter with Dark Matter. Generation of radiation matter like energy is released in the form of electromagnetic radiation in a quasar.

Since the negative pressure of the massive Dark Matter of Black Hole, positive matter organizing around it and creates and evaluate Galaxies. Cloud in the interstellar medium composed of neutral atomic hydrogen called the HI region. HI region is formed by the generated matter and it contains the neutral atomics. Region of atomic hydrogen that is ionized called as HII region. This HII region is formed from the dark energy and the matter. HII region has ionized matter since the matter gets ionized by the presence of dark energy.

### 3. Special Relativity and Space Architecture of Matter transformation

According to the Einstein equation, when mass  $m$  apply speed of light, transform to the dark energy  $E$ , where  $E = mc^2$ , will get destroy with dark energy  $-E$  resulting nothing. This will happen when the dark energy presence.

Steps can be explained as follows.

$$\begin{aligned} -E \text{ (Dark Energy)} + mc^2 \text{ (with opposite compression power of } c) &= 0 \\ -E \text{ (Dark Energy)} + E \text{ (Energy)} &= 0 \end{aligned}$$

Considering the steps of mass destroying with energy, it needs matter to apply the speed (according to Einstein) or expansion of the speed of light. Possible scenarios are if the universe expanding the speed of light, the matter can get the expansion of speed of light. Also universe compress by the speed of light, then matter can be travel to the compression point by speed of  $c$ .

Also, there is an opposite force for the matter to apply the speed of light, which is the compression power of the speed of light. Therefore matter converting energy will have equivalent compression power of the speed of light to the universe. The matter destroying process is the power generation process to universe to compress.

### 4. Energy and Dark Energy: Structure of Stellar evolution

Matter converting to energy is the process of starts will generate the power for the universe to compression. For the process of mass transform to energy, there should be Dark energy exist. Then only the matter gets expansion of speed of light. Stars convert matter into energy and emit as light, which has the property of speed of light. As a result of light speed, stars generate opposite compression power of the speed of light.

According to matter-energy transformation, the process of stars needs dark energy to present. If the dark energy present, the matter will expand in the speed of light by creating light energy. Therefore, star formation mechanism is a process of matter gets companion with dark energy. Therefore, star is a special object made up of matter and dark energy. When the presence of dark energy, matter will start nuclear fusion to create energy.

The next step is the process of matter destroying with dark energy. Consider the life cycle of stars. If the star formation gets enough to matter and dark energy, according to the mass, large star or small star formed. If not sufficient dark energy, then results in brown dwarf. After the energy created by destroying mass, stars get the stage of Supernova or Nova. Supernova is a powerful and luminous stellar explosion, which results in a neutron star, a black hole, or completely destroyed. Nova is not a powerful explosion as a supernova and results in a white dwarf or black dwarf. Supernova or Nova is the stage of energy and dark energy get negate by the explosion. Therefore, supernova and nova are the energy destroying steps of matter destroying process. If the star gets the equivalent amount of matter and dark energy, then the supernova will result in nothing and completely destroyed.

If the star has more matter than dark energy, an equivalent amount of matter and dark energy gets destroy and the rest of the matter formed as a dwarf. If the matter quantity larger than the dark energy potion of a supernova stage of the star, remain matter form as a neutron star. The neutron star is very high density, composed predominantly of closely packed neutrons. After a supernova explosion, by the gravitational collapse of the remnant of a massive star, neutron stars will form. Since the nova results only white dwarf or black dwarf, nova form from a star has more matter than the dark energy.

If the dark energy portion larger than the equivalent matter quantity, then form a pulsar (not the black hole). A pulsar is a highly magnetized rotating object that emits beams of electromagnetic radiation out of its magnetic poles. It is like a quasar. Since black hole form only the center of a galaxy, remaining dark energy form as a pulsar.

## **5. Benefits to the space community**

The space time, fluid flow and special relativity process of Energy, Dark Energy, Matter and Dark Matter explain the universe how to origin and evaluation as well as how does the universe work. This will refuse the concept of initial high density soup, alternatively can consider nothing or Energy and Dark Energy soup initially and in then it had transform to Matter and Dark Matter.

Detailed study the concept also explains how galaxies and stellar formation and evolution as well as other structures origin and evolution. This will useful for future Dark Energy and Dark mater searches as well as determine physics of Stellar, Galaxies and Black Holes. This will provide the possible answer to how the universe work does.

## **6. Conclusion**

The special relativity explains how the matter transforms into energy. According to that matter can be generated with negative energy and matter can destroy with negative energy. The negative energy can be identified as dark energy. The negative matter can identified as dark matter.

Also detailed analysis of this concept with observed phenomenon of space will give picture of universe as a whole as well as Galaxy formation and Star formation mechanisms. This also explains how galaxies and stellar formation and evolution as well as other structures evolution of the universe.

## Reference

- Bodanis, D., A Biography of the World's Most Famous Equation, 2005.  
DOI: 10.1119/1.3099672
- Boesgaard, A.M., Big Bang Nucleosynthesis: Theories and Observations, Ann. Rev. Astron. Astrophys. 1985.23: 319-78, 1985.  
DOI:10.1146/23.090185.001535
- Elvis, M., A Structure for Quasars, The Astrophysical Journal, 545: 63-76, 2000.  
DOI: 10.1086/317778
- Mambrini, Y., Histories of Particles in the Dark Universe, 2013.  
[http://www.ymambrini.com/My\\_World/Physics\\_files/Universe.pdf](http://www.ymambrini.com/My_World/Physics_files/Universe.pdf)
- Silk, J., The Big Bang: Third Edition, Henry Holt and Company: New York, 2000