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The Friedmann Equation for the Spinning Universe

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Abstract

While reporting that the Universe originated from the collapse of one of the densest objects in a previous-aeon black hole, we found that the Universe has been spinning clockwise. However, the spin of the Universe has never been included in the standard theories of cosmology. In this report, we propose a modified Friedmann equation for the spinning Universe: $H_S^2(t) = H^2(t) - \omega^2(t)$, where $\omega(t)$ is the angular speed of the Universe, and $H_S(t)$, $H(t)$ are the Hubble parameter with and without spinning, respectively. The significant change of the Hubble constant can only be observed when the scale factor $a < 0.01$. We also found that the Universe has spun ca. 41° since photon decoupling. Using the modified Friedmann equation, the theoretical angle is 41.8°, indicating that our proposed model of the Universe is correct.

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Introduction

By analyzing Gurzadyan and Penrose's anisotropic distribution of concentric low-variance circles (LVCs) [1–3] with the Planck Collaboration's large-scale temperature extrema [4,5] in the CMB, we propose a mechanism initiating the Big Bang: the Universe would emerge from the collapse of the densest object in a previous-aeon black hole [6]. Where the collapse occurred, or the Center of this Universe, would currently be about 30 billion light years away from us and around Galactic coordinates $(l, b) = (279°, -47°)$. If we look from where we are, i.e. the Local Supercluster (LS), to the Center, the Universe would spin clockwise.

In this report, we provide the Friedmann equation for the spinning Universe, and then use it to study the Hubble tension, and to calculate the angle that the Universe has spun since photon decoupling.

Theory

Newtonian mechanics has proven to be valid for the study of most of the aspects of the Friedmann Equation [7]. Suppose a homogeneous sphere of matter that is rotating about its center and is expanding with time, for a test mass m at the surface of the equator of the sphere, a centrifugal force will be experienced:

$$\mathbf{F}_c = m\omega^2(t)r(t)\hat{\mathbf{r}} \tag{1}$$

Therefore, the total force will be:

$$\mathbf{F} = -\frac{GMm\hat{\mathbf{r}}}{r^2(t)} + m\omega^2(t)r(t)\hat{\mathbf{r}} \tag{2}$$

By writing the radius in the form: $r(t) = a(t)r$, we have

$$\ddot{a}(t) = -\frac{GM}{a^2(t)r^3} + \omega^2(t)a(t) \tag{3}$$

Assuming that the angular momentum is conserved (after photon decoupling, the Universe was large enough, and hence would not be significantly affected by its surroundings):

$$\omega(t)a^2(t) = C \tag{4}$$

Therefore,

$$\ddot{a}(t) = -\frac{GM}{a^2(t)r^3} + \frac{C^2}{a^3(t)} \qquad (5)$$

Multiply by $\dot{a}(t)$ and integrate:

$$\frac{1}{2}\dot{a}^2(t) = \frac{GM}{a(t)r^3} - \frac{1}{2}\frac{C^2}{a^2(t)} + U \qquad (6)$$

For a perfectly flat Universe, the integration constant $U = 0$ [7]. As the sphere is homogeneous: $M = \frac{4\pi}{3}a^3(t)r^3\rho(t)$, we have:

$$\dot{a}^2(t) = \frac{8\pi G}{3}\rho(t)a^2(t) - \omega^2(t)a^2(t) \qquad (7)$$

Thus we have a modified Friedmann equation for a flat Universe with spin in the mass-dominated era:

$$H_S^2(t) \equiv \frac{\dot{a}^2(t)}{a^2(t)} = \frac{8\pi G}{3}\rho(t) - \omega^2(t) \qquad (8)$$

where $H_S(t)$ is the Hubble parameter for a spinning Universe. If $\omega(t) = 0$, then the Friedmann equation for a non-spinning Universe is:

$$H^2(t) = \frac{8\pi G}{3}\rho(t) \qquad (9)$$

Therefore, for the spinning Universe, we have:

$$H_S^2(t) = H^2(t) - \omega^2(t) \qquad (10)$$

The Universe at present is large enough that $\omega(t_0) \rightarrow 0$; hence the Hubble parameter that we measure locally can be regarded as the non-spinning Hubble parameter. Traditionally, we report it as the Hubble constant: $H_0 \equiv H(t_0) = 73.04\ \mathrm{km\ s^{-1}\ Mpc^{-1}}$ [8]. Note that the non-spinning Hubble constant H_0 is a constant during the course of expansion, as the standard theories of cosmology assume. We can also measure the Hubble parameter $H_S(t_{\mathrm{CMB}})$ for the spinning Universe at photon decoupling and report it as the Hubble constant $H_{0,S}(t_{\mathrm{CMB}}) = 67.4\ \mathrm{km\ s^{-1}\ Mpc^{-1}}$ [9]. Since the spinning is invisible, we cannot directly measure the angular speed $\omega(t)$.

To know the angular speed, we first calculate an equivalent angular speed:

$$\omega_0(t) = \sqrt{H_0^2 - H_{0,S}^2(t)} \qquad (11)$$

and then use the Friedmann equation for the spinning Universe to convert it into $\omega(t)$. Dividing by H_0^2, equation (8) provides the ratio:

$$\frac{\omega^2(t)}{\omega_0^2(t)} = \frac{H_S^2(t)}{H_0^2} = \frac{\Omega_{m,0}}{a^3(t)} - \frac{\omega^2(t)}{H_0^2} \qquad (12)$$

Note that the ratio also depends on the angular speed. By rearranging, we have the angular speed:

$$\omega(t) = \sqrt{\frac{\Omega_{m,0}}{a^3(t)} \cdot \frac{\omega_0^2(t)H_0^2}{\omega_0^2(t)+H_0^2}} \qquad (13)$$

Combining equations (12) and (4), we have:

$$\omega_0^2(t) = \frac{C^2H_0^2}{\Omega_{m,0}H_0^2a(t) - C^2} \qquad (14)$$

Therefore, the observable Hubble constant $H_{0,S}$ with respect to the size $a(t)$ of the Universe is:

$$H_{0,S}(t) = \sqrt{H_0^2 - \omega_0^2(t)} = H_0\sqrt{\frac{\Omega_{m,0}H_0^2a(t) - 2C^2}{\Omega_{m,0}H_0^2a(t) - C^2}} \qquad (15)$$

Results

The Rotational Center of the Universe

For us (the observer) in the LS, the Rotational Center of the Universe is at the intersection of the rotational plain that is parallel to the equator of the Universe:

$$z = -0.71x - 0.06y \qquad (16)$$

and the axis of spin is:

$$(x, y, z) = (0.07r_{\mathrm{SLS}}, -0.45r_{\mathrm{SLS}}, -0.49r_{\mathrm{SLS}}) + (0.71, 0.06, 1.00)t \qquad (17)$$

So the Rotational Center is at 0.55 times the radius of the surface of last scattering away from the LS and at Galactic coordinates $(l, b) = (304°, -19°)$.

Angular Speed of the Universe

For the CMB, $\omega_0(t_{\mathrm{CMB}}) = \sqrt{H_0^2 - H_{0,S}^2(t_{\mathrm{CMB}})} = 28.1\ \mathrm{km\ s^{-1}\ Mpc^{-1}}$. Since $\Omega_{m,0} = 0.315$ and $a(t_{\mathrm{CMB}}) = 1/1100$, the angular speed of the Universe at photon decoupling is:

$$\omega(t_{\mathrm{CMB}}) = 1.74 \times 10^{-14}\ \mathrm{sec} \tag{18}$$

and the constant is:

$$C = \omega(t_{\mathrm{CMB}}) a^2(t_{\mathrm{CMB}}) = 1.44 \times 10^{-20}\ \mathrm{sec} \tag{19}$$

The Hubble Tension

Based on equation (15), we plot the Hubble constant that we can observe at different sizes of the spinning Universe (Figures 1-3). The Hubble constant is quite stable as long as the scale factor $a > 0.02$. The most significant change occurs when $a < 0.01$.

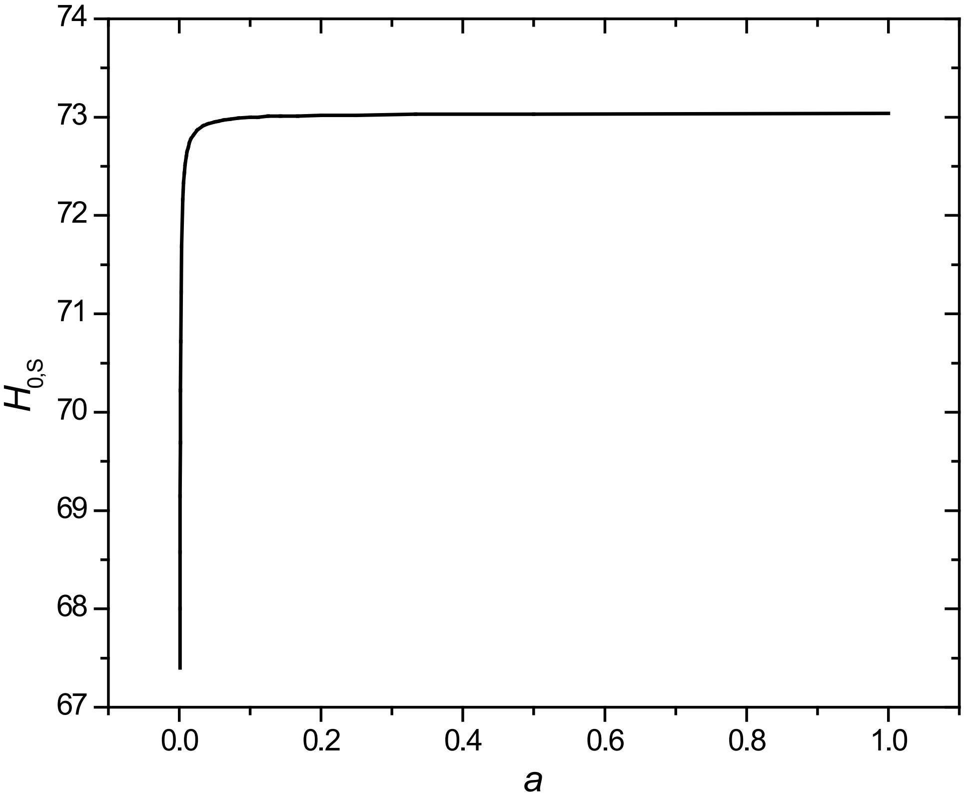

Figure 1. The observable Hubble constant with respect to the scale factor ($a = 0 \sim 1$) of the spinning Universe.

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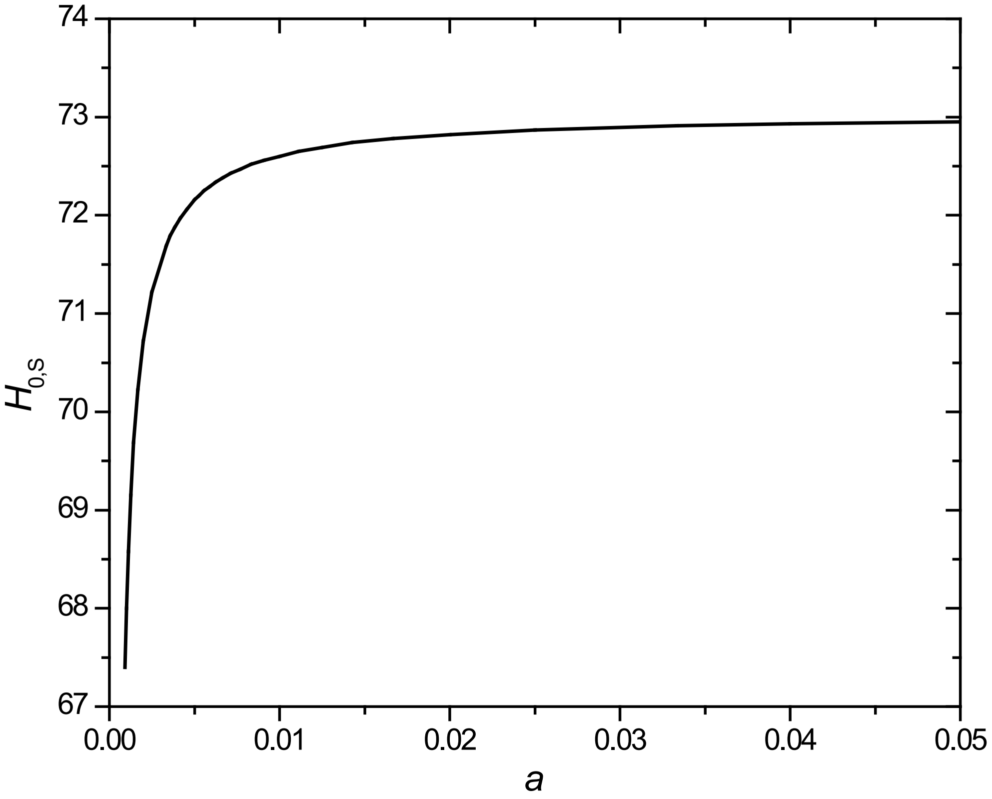

Figure 2. The observable Hubble constant with respect to the scale factor ($a = 0 \sim 0.05$) of the spinning Universe.

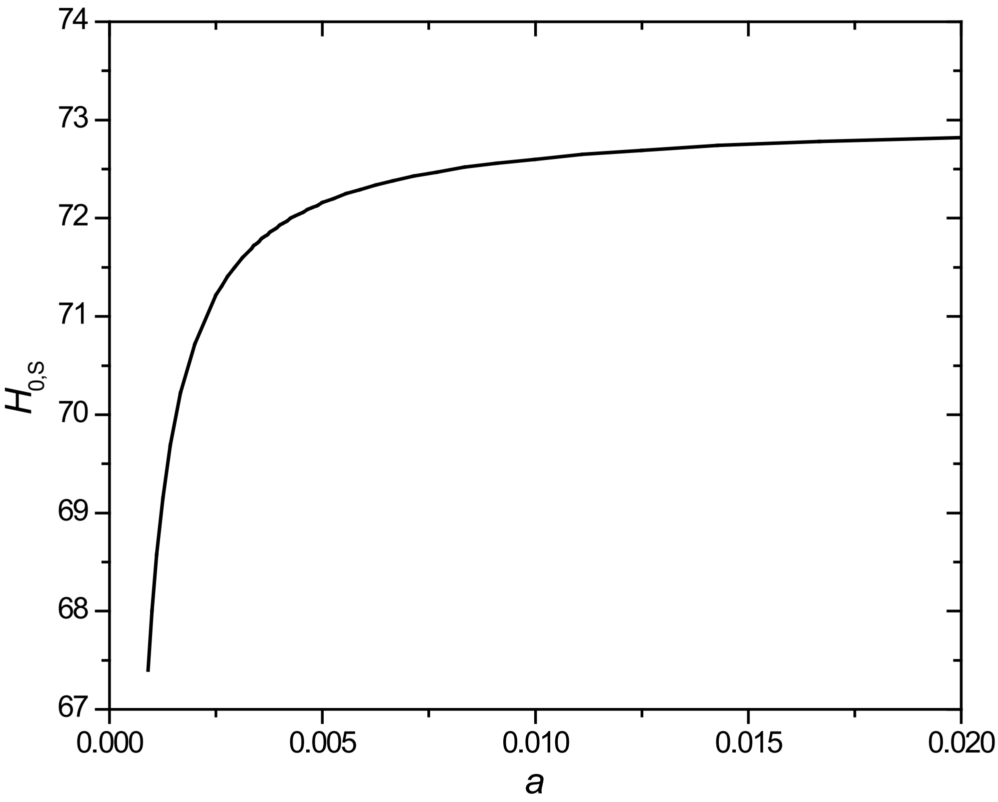

Figure. 3. The observable Hubble constant with respect to the scale factor ($a = 0 \sim 0.02$) of the spinning Universe.

The JWST can observe objects with redshifts up to $z = 20$, corresponding to $a = 1/(1+z) = 0.048$, $\omega = C/a^2 = 6.35 \times 10^{-18}$ sec, $\omega_0 = 3.63\ \mathrm{km\ s^{-1}\ Mpc^{-1}}$, and $H_{0,\mathrm{S}} = 72.95\ \mathrm{km\ s^{-1}\ Mpc^{-1}}$. Since the difference: $H_0 - H_{0,\mathrm{S}} = 0.09\ \mathrm{km\ s^{-1}\ Mpc^{-1}}$ is much smaller than the error bar of $H_0 = 73.04 \pm 1.04\ \mathrm{km\ s^{-1}\ Mpc^{-1}}$, the JWST confirms the Hubble constant measured locally [10].

In conclusion, the Hubble tension [8,9] is caused by the invisible spinning of the Universe. With the spinning, the Universe is not perfectly isotropic and homogeneous.

The Angle that the Universe has Spun Since Photon Decoupling

Since photon decoupling, the Universe has experienced two eras. In the matter-dominated era, the Universe has expanded [7]:

$$a(t) \approx \left(\frac{3}{2}\sqrt{\Omega_{m,0}}H_0 t\right)^{2/3} \qquad (20)$$

Therefore we can calculate the angle that the Universe has rotated:

$$\int_{t_{\mathrm{CMB}}}^{t_{\mathrm{m}\Lambda}} \omega(t)\,dt = \left.\frac{3C}{\left(\frac{3}{2}\sqrt{\Omega_{m,0}}H_0\right)^{4/3} t^{1/3}}\right|_{t_{\mathrm{m}\Lambda}}^{t_{\mathrm{CMB}}} = 41.7° \qquad (21)$$

In the cosmological-constant-dominated era, the Universe spins very slowly: at the matter-lambda equality, $\omega(t_{\mathrm{m}\Lambda}) = 2.56 \times 10^{-20}$ sec ; at present, $\omega(t_0) = C = 1.44 \times 10^{-20}$ sec . Approximately,

$$\int_{t_{\mathrm{m}\Lambda}}^{t_0} \omega(t)\,dt \approx \frac{1}{2}\left[\omega(t_{\mathrm{m}\Lambda}) + \omega(t_0)\right] \cdot (t_0 - t_{\mathrm{m}\Lambda}) = 0.12° \qquad (22)$$

In total, the angle that the Universe has spun since photon decoupling is:

$$\theta = \int_{t_{\mathrm{CMB}}}^{t_{\mathrm{m}\Lambda}} \omega(t)\,dt + \int_{t_{\mathrm{m}\Lambda}}^{t_0} \omega(t)\,dt = 41.8° \qquad (23)$$

By investigating region W in Gurzadyan and Penrose's LVC map [1–3,6], which can be divided, roughly in the middle of the region, into one half with higher temperatures and the other half with lower temperatures. This characteristic pattern could only be seen when an observer was in the middle of LVC region W (i.e. $J = 41°$ [6]) at photon decoupling. Interestingly, we at present at $J = 0°$ are able to observe it, meaning that the Universe has rotated an angle of 41° since photon decoupling. Thus we have a perfect match between the theoretical value and the observed value.

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