Doppler Red Shifts Due to Universe Rotations

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Introduction. There are a few scientists such as Hubble's former assistant, Halton Arp, who are not inclined to believe the "genesis idea" of an expanding "big bang" universe bursting into existence exactly 13.7 billion years ago. They cite conflicting astronomical evidence – photos of gravitationally connected systems with very different red shifts [Sco05]. These skeptics of large recessional velocities [Pan05] offer alternate explanations for the large shifts toward lower, less energetic, red frequencies that light quanta coming from far distant objects display.

One such alternate interpretation is "tired light", the conjectured frequency attenuation of light from far distant outer space in passage through space by partial absorption or other influence making it appear that the object is receding [Bal05]. This would explain the linear relation Edwin Hubble discovered between red shift and distance without implying recession at greater and greater speeds the further out we look, . But "tired" light has no less clarity than presumably non-tired light from closer objects making the absorption hypothesis somewhat difficult to defend.

Another possible source of significant error are the small and large-scale rapid rotations in the universe just now being discovered. For example, astronomers have been surprised to find galaxies spinning rapidly and with rims circling as fast or faster than inner zones [Cor82]. That has lead to 95% "dark matter" estimates for galaxies to account for the fact that such fast spinning luminous systems don't flying apart. Spin is a "pivotal concept" in quantum physics according to Nobel prizing winning quantum physicist Sin-itiro Tomonaga [Sin74]. Clearly, spin is fundamental in the universe both as a macro phenomenon as well as a micro phenomenon.

Just recently a team of astronomers headed by Scott Chapman (California Institute of Technology) and Rodrigo Ibata (Observatoire Astronomique de Strasbourg) announced that Andromeda is actually three times as big as they thought, and that such huge rotating systems are hard to derive from the accretion models presently being explored. [Tin05]

Alternative solutions of A. Einstein's general field equations discovered by K. Gödel [Göd49] are "rotating universe" solutions [Hol05, p.84] albeit the universe rotates around every particle [Svi96,p.2]. But considering the imagination of many contemporary "big bang" cosmologists, string theorists and particle physicists as they try to combine quantum logic with general relativity, surely a rotating universe should not be summarily discarded based on its supposed implausibility. Perhaps all of these "centers of rotation" can be topologically gathered together as a single central position about which everything rotates, and from which energy is somehow projected in space and viewed in time. Is that any more fanciful a framework than contemporary theories?

Question: As seen from Earth how would a universe of clockwise and counter-clockwise rotating rings of galaxies be manifest in Doppler shifts? How much of the observed phenomenon of large Doppler red shift can a "rotating rings" model of the universe explain? Is it consistent with contemporary astronomic data?

Analysis (by elementary methods): Assume that large concentric rings of stars and galactic systems rotate more or less as rigid disks with constant angular velocities in opposite directions, clockwise and counter-clockwise around the same Center of Rotation.

Assuming a counter-clockwise rotation for the Earth about the Center of Rotation C, without loss of generality for determining Doppler shift, adopt a counter-clockwise rotating coordinate system in which the Earth is fixed at x = D, y = 0. The outer space object J then has angular velocity ω equal to the *difference* between the original angular velocities of Earth and the object with respect to the Center of Rotation.

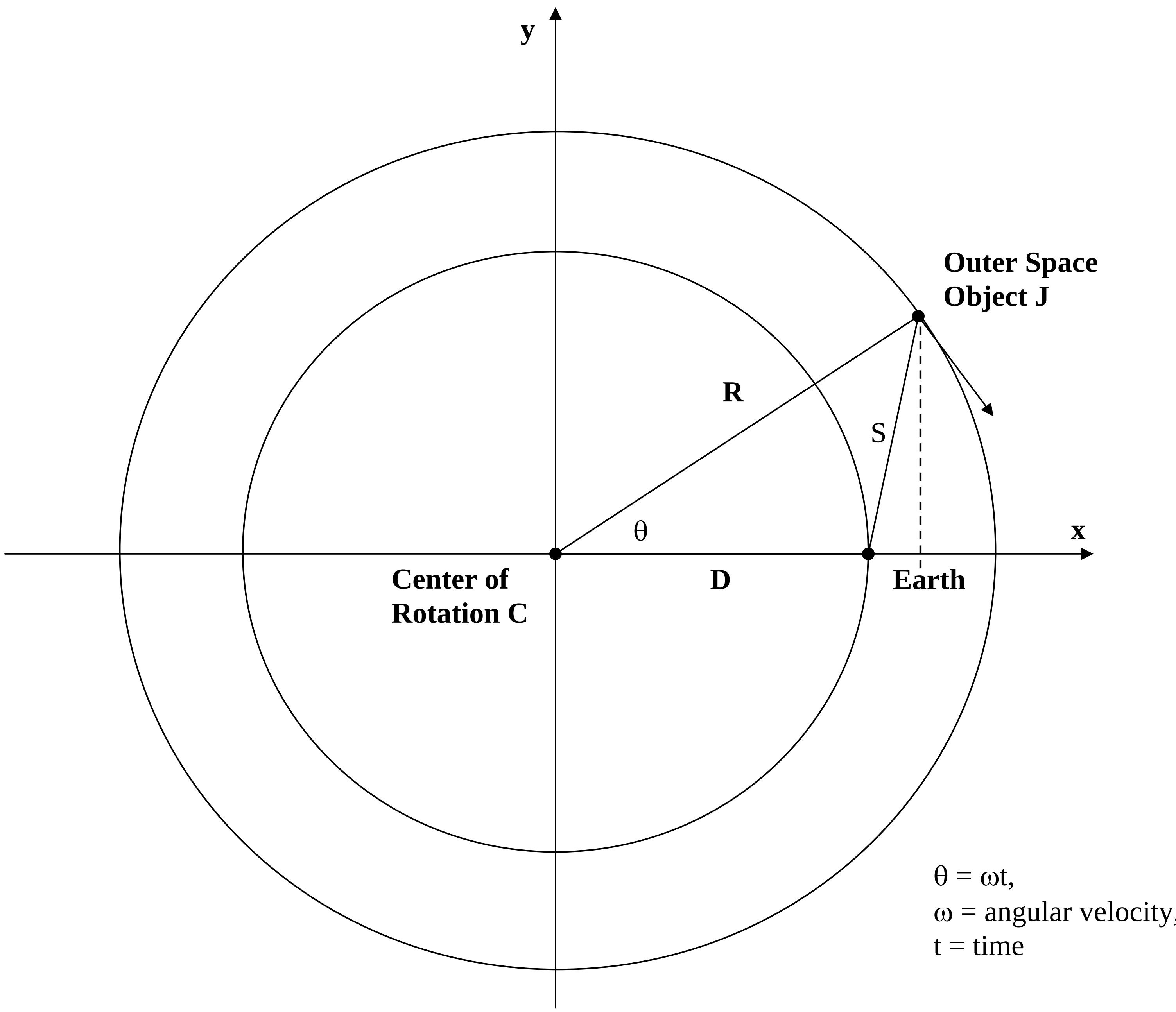


Figure 1. Rotating Universe

By the law of cosines, $S^2 = R^2 + D^2 - 2RD \cos \theta$. [This of course can be proved directly by expressing the length of the dotted line as $R \sin \theta$ and the distance from the center of rotation to the base of the dotted line as $R \cos \theta$ and then using the Pythagorean Theorem and a little trigonometry. A less elementary, vector calculus solution is also available.]

The Doppler shift is due to the change in the distance of object J as seen from the Earth as the object swings around C. This change in distance with respect to time is the first derivative dS/dt. During the rotation only θ and S change with time t although we will also want to examine dS/dt for objects of varying distances R from the Center of Rotation.

Setting $\theta = \omega t$ and taking the derivative of both sides with respect to time t yields:

$$2S\,(dS/dt) = 0 + 0 + 2RD\omega \sin(\omega t) \qquad 1)$$

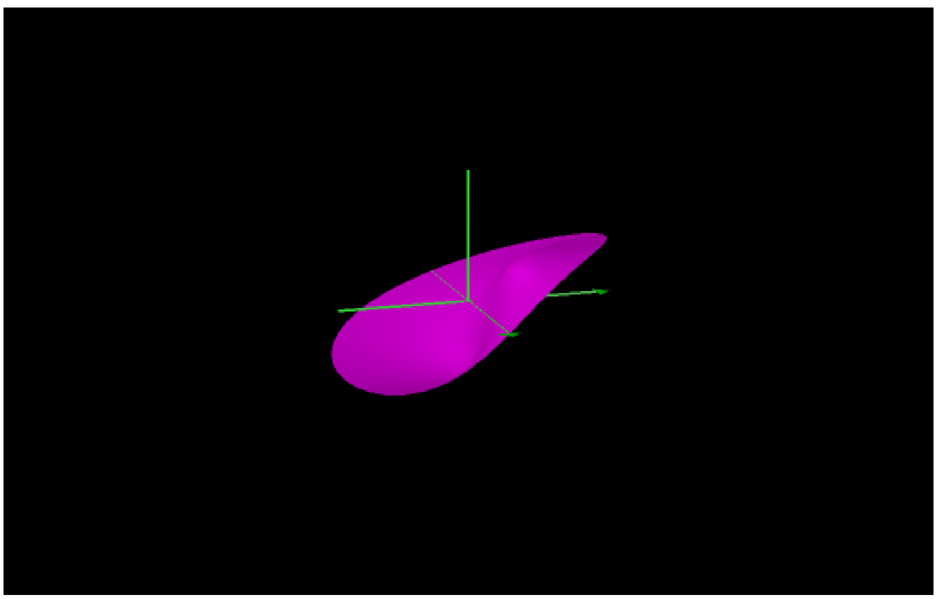
and so

$$S\,(dS/dt) = (RD\omega) \sin(\omega t) \qquad 2)$$

$$dS/dt = (RD\omega/S) \sin(\omega t) \qquad 3)$$

$$dS/dt = RD\omega \sin(\omega t)/(R^2 + D^2 - 2RD \cos \omega t)^{1/2} \qquad 4)$$

$$dS/dt = D\omega \sin(\omega t)/(1 + (D/R)^2 - 2(D/R) \cos \omega t)^{1/2} \qquad 5)$$



Graph 1. Doppler Shift, dS/dt, Due to Rotation

In terms of D, ω and R, this is the speed of recession (or approach) of J due to the assumed rotating motion. This speed will change signs when $\theta = 0$ or π because at those angles J will stop getting closer (or farther) away from Earth and start receding (or approaching) again, thus changing the sign of dS/dt.

By fixing any angle θ and letting R (and S) increase in equation 5) , (D/R) goes to zero and the Doppler shift velocity approaches D ω sin θ. That is,

$$\lim_{R \to \infty} dS/dt = D\omega \sin\theta \qquad 6)$$

which is a constant, positive or negative, depending on θ.

Notice that when $\omega t = \theta = 0$ or π there is no Doppler shift since $\sin \theta = 0$. For $\theta = \pm\pi/6$, dS/dt approaches constant $\pm D\omega/2$ as R and S approach ∞.

At $\theta = \pm\pi/2$, the Doppler shift is $dS/dt = \pm RD\omega/S = \pm RD\omega/(R^2 + D^2)^{1/2} = \pm\omega/(R/D + D/R)^{1/2}$, whose absolute value is still about ω/10 when R is 100 times D indicating that this effect can be significant.

Fixing R and D and letting θ and S vary again, the maxima and minima of this sinusoidal function dS/dt in equation 3) occur when the 2nd derivative vanishes. Taking derivatives (implicitly again) on both sides of equation 2) yields:

$$S\, d^2S/dt^2 + (dS/dt)\,(dS/dt) = (RD\omega^2) \cos(\omega t). \qquad 7)$$

So the maxima and minima must occur when

$$(dS/dt)^2 = (RD\omega^2) \cos(\omega t). \qquad 8)$$

That is, using equation 3), the maximum or minimum Doppler shift values are when

$$(RD\omega^2) \cos(\omega t) = (RD\omega/S)^2 \sin^2(\omega t) \qquad 9)$$
$$S^2 \cos(\omega t) = RD \sin^2(\omega t) \qquad 10)$$
$$(R^2 + D^2 - 2RD \cos\theta) \cos\theta = RD \sin^2\theta$$
$$(R^2 + D^2) \cos\theta - 2RD \cos^2\theta - RD \sin^2\theta = 0$$
$$(R^2 + D^2) \cos\theta - RD \cos^2\theta - RD(\cos^2\theta + \sin^2\theta) = 0$$
$$- RD \cos^2\theta + (R^2 + D^2) \cos\theta - RD = 0$$

Thus the angles θ at which dS/dt attains its maximum or minimum value satisfy

$$\cos^2\theta - (R/D + D/R) \cos\theta + 1 = 0 \qquad 11)$$

Solving this quadratic equation for cos θ yields

$$2\cos\theta = R/D + D/R \pm ((R/D + D/R)^2 - 4)^{1/2}$$

$$2RD\cos\theta = R^2 + D^2 \pm ((R^2 + D^2)^2 - 4R^2 D^2)^{1/2}$$
$$2RD\cos\theta = R^2 + D^2 \pm ((R^2)^2 + 2 R^2 D^2 + (D^2)^2 - 4R^2 D^2)^{1/2}$$

$$2RD\cos\theta = R^2 + D^2 \pm ((R^2)^2 - 2R^2D^2 + (D^2)^2)^{1/2}$$
$$2RD\cos\theta = R^2 + D^2 \pm ((R^2 - D^2)^2)^{1/2}$$
$$2RD\cos\theta = R^2 + D^2 \pm |R^2 - D^2| \qquad 12)$$

Therefore the maxima or minima dS/dt occur when

$$S^2 = R^2 + D^2 - 2RD\cos\theta = \pm|R^2 - D^2|. \qquad 13)$$

$$S^2 = \begin{Bmatrix} R^2 - D^2,\ D \le R, \\ D^2 - R^2,\ R \le D \end{Bmatrix} \qquad 14)$$

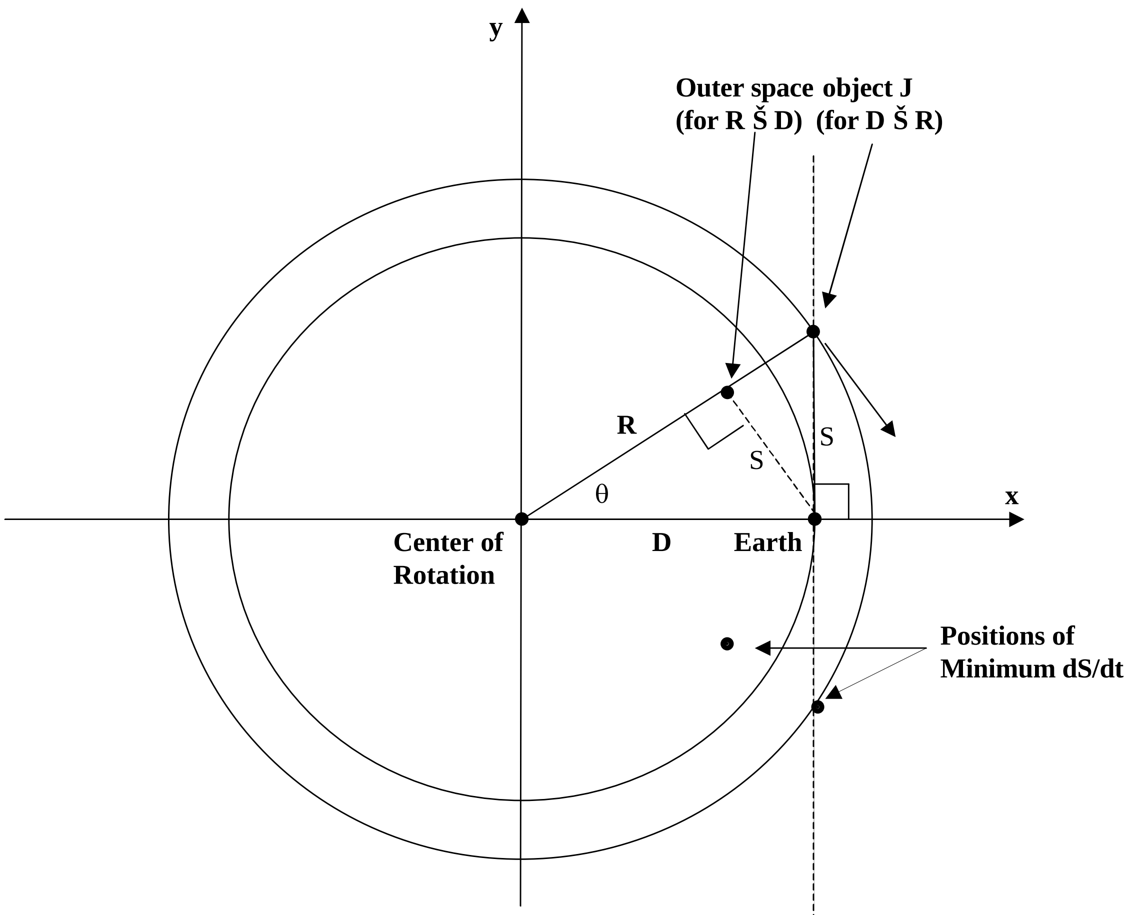


Figure 2. Angle θ and Positions of Object J of Maximum dS/dt for a given R

Objects Further from the Center of Rotation. In case $D \le R$, a circle of radius R about the Center of Rotation will intersect the vertical (dotted) line "x = D" through the Earth in two places making $D^2 + S^2 = R^2$, which is both necessary and sufficient that D, R and S form a right triangle with R as hypotenuse. So

$$\cos\theta = D/R \text{ and } \sin\theta = \pm S/R. \qquad 15)$$

Therefore the maximum and minimum dS/dt in case $D \le R$ are $dS/dt = (RD\omega/S)\sin\theta = (RD\omega/S)(\pm S/R) =$

$$dS/dt = \pm D\omega \qquad 16)$$

$D\omega$ is a constant, the distance D of Earth from the Center of Rotation C times the difference in the angular velocities of the assumed counter-clockwise and clockwise rotations of Earth and an observed object J. Therefore the net Doppler effect of such rotations is to add at most a constant red or blue frequency shift to light from an object J.

With "Up" taken in the direction perpendicular to the plane of rotation making Earth's rotation counter-clockwise, objects far out in outer space off the left edge of the Milky would have a red shift due to the rotations, and objects off the right edge of the Milky Way would have at most this constant blue shift added to their spectrums.

Multiple Motions. This might be the largest distortion among many caused by unrecognized rotations each potentially adding to others in certain astronomic periods and positions. Our time could be such a period of coordinated red shifting due to rotating motions of systems and subsystems in which Earth happens to find itself. A spinning within a circling produces Doppler peaks equal to the sum of the red (and blue) shifts of the individual rotations. Thus were Earth part of a rotation within a rotation within a rotation, and so forth, all rotating in the same counter-clockwise direction, the effect at times would be that all these red shifts would add up to a large red shift of far distant objects rotating clockwise in the opposite direction in an outer space zone beyond the local group rotating counter-clockwise. Concentric rings of galaxies, alternately rotating clockwise and counter-clockwise at varying distances from a Center of Rotation, would further complicate matters.

Objects Nearer to the Center of Rotation: In case $R \le D$, the right triangle in Figure 2 has D as hypotenuse and $S^2 + R^2 = D^2$; a circle of radius R about the Center of Rotation has two tangent lines that intersect the Earth's position and which form right triangles. One is depicted (slanted dotted line) in Figure 2. So

$$\cos\theta = R/D \text{ and } \sin\theta = \pm S/D \qquad 17)$$

Therefore the maximum and minimum dS/dt in case $R \le D$ are $dS/dt = (RD\omega/S)\sin\theta = (RD\omega/S)(\pm S/D)$. So

$$dS/dt = \pm R\omega \qquad 18)$$

This is a linear relationship akin to Hubble's law with ω as the constant of proportionality. But R is the distance from the center C, not from Earth.

Dual Solutions. For larger and larger R, the two intersections of the dotted line "x = D" with the circle of radius R about C will occur further up (or down for minimums) the dotted line, and the angle θ will approach $\pm\pi/2$. As the angle θ approaches $+\pi/2$, the two

Doppler shift maximizing values of R, one greater than D and one less than D, approach ∞ and 0 respectively. Similarly for θ approaching –π/2 and minimum values of dS/dt.

Summary of Maximum Doppler Shift. As a function of the distance R of object J from the Center C of rotation, the maximum dS/dt is given by the following equation and is depicted in Figure 3.

$$\max\frac{dS}{dt} = \begin{Bmatrix} R\omega, \ R \le D, \\ D\omega, \ D \le R \end{Bmatrix} \qquad 19)$$

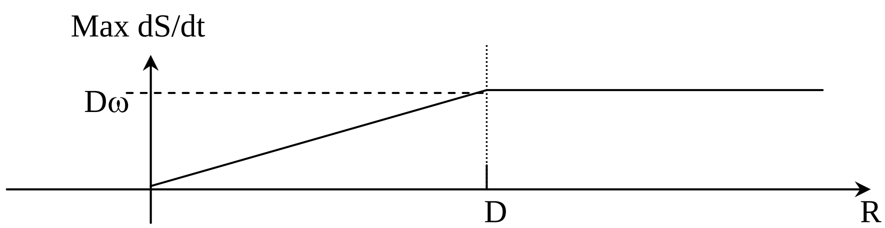


Figure 3. Maximum dS/dt

This maximum value of dS/dt occurs at

$$\theta = \begin{Bmatrix} \arcsin(S/D), \ R \le D, \\ \arcsin(S/R), \ D \le R \end{Bmatrix} \qquad 20)$$

This is the same angle for two values of R. For any given direction θ, there are two distances R, one smaller and one greater than D, which maximize dS/dt at that angle compared to other directions at those distances R.

Astronomic Data. The verification of this model as a cosmological hypothesis hinges on evidence of asymmetry in the Doppler shifts when looking in the plane of the Milky Way off one edge of the galactic disk or the other. The difference between the Doppler shifts of far distant objects off the left edge versus objects off the right edge of the Milky Way would be as much as 2Dω.

The large-scale motions of the stars are not yet known well, but the existence of a "great attractor" at the center of the local group of galaxies lends credence to the notion that unrecognized rotational motions, especially nested motions of systems and subsystems, together with reverse rotations, can partially account for the appearance of a rapidly expanding universe. If nothing else rotations magnify space-expansion Doppler effects.

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