Can fluid dynamics describe the behavior of vacuum space?

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Abstract

Fluid dynamics is valid to describe the behavior of vacuum space only if vacuum space contains some type of fluid. An important parameter in fluid dynamics is the viscosity of the fluid. Currently, the viscosity of vacuum space is unknown. Theoretical work, done by others, results in both high values and low values of the vacuum space viscosity.

I argue that these conflicting values of viscosity are possible if the viscosity of space varies and is dependent on the location it is measured. To this end I first describe the structure of the Pivot universe, relying on general relativity and Newton's theories. Then I relate to the vacuum space as described in fluid dynamics.

General

The existence of the ether that ruled for centuries was discarded at the beginning of the 20th century. The rejection was based on observations and experiments. However, I argue in paper [**1**] that the ether (or– the vacuum space) exists. I explain observations such as stellar aberration and the Michelson- Morley experiment. General relativity claims that space is dragged by any celestial spinning body. Space dragging was verified by an experiment Gravity probe B. This experiment was done near Earth so the measured values of frame dragging are minuscule. But around massive bodies such as a neutron star or a black hole, the frame-dragging is significant. A reasonable conclusion is that if vacuum space can be dragged then it cannot be a total void but must have a physical property- viscosity.

In addition, quantum physics teaches, that vacuum space is not a void but is rather filled with various fields of energy. From these fields of energy pairs of virtual particles constantly pop in the vacuum and immediately annihilate each other. Thus, the exitance of virtual particles in space is permanent. Paul Dirac claimed that quantum physics' description of the vacuum space can be the equivalent of Newton's ether.

Structure of the Pivot universe.

To explain how fluid mechanics can describe the behavior of vacuum space, I need first to describe my hypothesis of the structure of the entire universe.

To that end, I refer to Newton's hypothesis. Newton claimed that the matter universe is a finite and isolated island in space. Space, on the other hand, is infinite, eternal, immovable, homogeneous, and permeates everywhere. He also claimed that space is filled with some kind of fluid he called the ether. However, Newton did not define what is the nature of the ether. According to Newton all celestial bodies that are part of the matter universe, move in the immovable ether that he considered an absolute reference frame. Newton's hypothesis was the prevailing one, until the beginning of the 20th century. Then an experiment that was done by Michelon-Morley showed that there is no ether. After that Newton's entire hypothesis on space, ether, and matter universe was discarded. It was replaced by Einstein's relativity theories.

The following is my hypothesis on the size and shape of the matter universe. The hypothesis is based on Newton's and Einstein's theories. The ether has been replaced by vacuum space, which is defined and verified by quantum physics. Space is not a total void, but is filled with fluctuating fields of energy. From these fluctuating fields, pairs of virtual particles constantly pop in and pop out in space, thus virtual particles fill the vacuum space all the time. These pairs of virtual particles that are defined by modern quantum physics, are the old ether.

Fig.1 is the picture of the Sombrero galaxy, taken jointly by Hubble's and Spitzer's telescopes.

Fig. 1 – Picture of the Sombrero galaxy

I claim that the shape of our matter universe, which I designate the Pivot universe, resembles the shape of the Sombrero galaxy, except for a huge difference in mass and size. Our visible universe resides in the flat disk of the Pivot universe. The flat disk orbits an invisible black hole at its center. I argue that the black hole at the center of our matter universe is a huge neutron star. I designate this black hole/neutron star the Pivot. I argue that the origin of the Pivot and the visible universe is a primordial neutron star that originated from the virtual particles of the infinite vacuum space. The primordial spinning neutron star gradually grew until it reached a physical limit and then exploded into two distinct parts. The first is the Pivot that stayed at the location of the primordial neutron star and the second is the visible universe in the shape of a flat disk that orbits the Pivot.

The following remark is a logical one. It is observed in the universe that the majority of celestial body systems are organized in a pattern that includes a central massive body at their center and significantly less massive bodies that orbit this central body. This applies to galaxies, solar systems, and maybe also the structure of the atom. So, is it not possible, that our matter universe is arranged as galaxies or solar systems, namely it is composed of a massive central body and significantly less massive orbiting celestial bodies? Unfortunately, this is merely a logical claim. Logic, cannot be considered scientific proof. To be considered a scientific theory, it must include a mathematical model and observations that can be explained by this model.

Fig. 2 shows the shape of the Pivot universe immersed in the infinite stationary vacuum space. At the center of the Pivot universe is the Pivot which cannot be seen by an observer that is located in the flat disk, because it resides inside the event horizon of the Pivot. The shape and sizes of the Pivot universe are derived from general relativity and Newton's theory.

In addition, the Pivot spins on its axis, and because of the frame-dragging phenomenon, that is described by general relativity, drags vacuum space around it. [**2**]

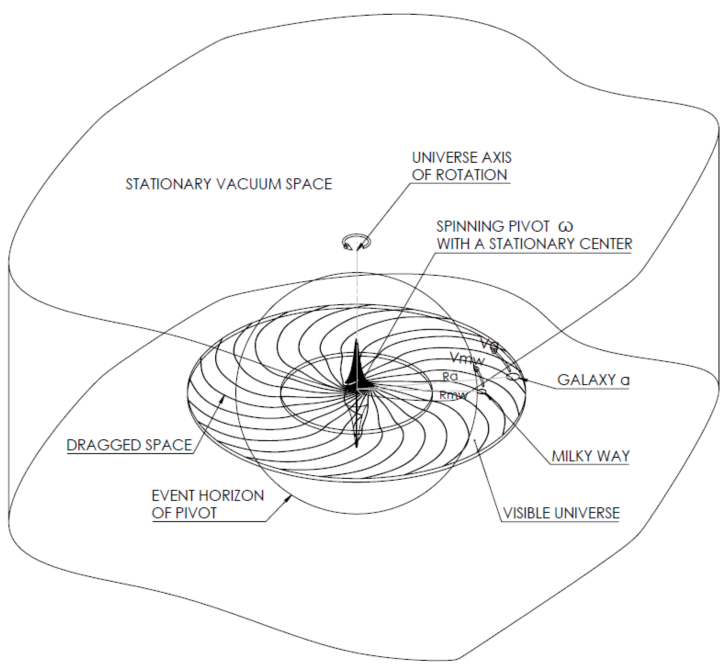

Fig. 2 – The Pivot universe immersed in stationary vacuum space

Fig. 3 is a cross-section of the Pivot universe. It includes additional details on the Pivot universe structure. The flat shape of the visible universe is shown. The visible universe can exist only outside the event horizon of the Pivot and in the volume of dragged space. The main dimensions of the Pivot universe are shown including the event horizon of the Pivot, the inner radius, the outside radius, and the width of the visible universe.

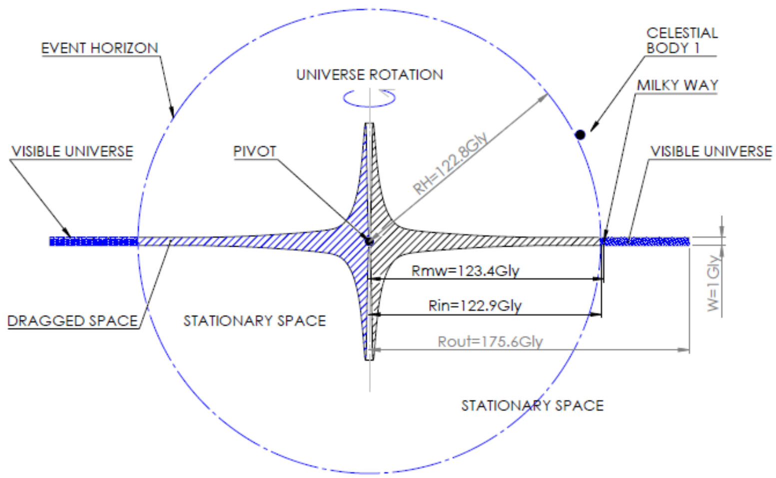

Fig. 3 – Cross section of the Pivot universe

I argue that this model of the Pivot universe can explain profound observations in cosmology that currently are not resolved by the BB theory, such as the shape of spiral galaxies, dark matter, the Michelson-Morley experiment, and other issues. To delve into the structure of the universe, including the dimensions of our matter universe, see [**3**].

Fluid dynamics

In the previous chapter, I described how the structure of the entire Pivot universe can be explained by general relativity and Newton's mechanics.

It was suggested by others that there is a connection between general relativity and fluid dynamics. T. Padmanabhan proposed that the gravitational field equations, particularly those governing Einstein's general relativity, can be interpreted in terms of thermodynamic quantities. He notably drew parallels between these equations and the Navier-Stokes equations of fluid mechanics, describing a viscous behavior of spacetime near horizons, such as black holes and the cosmological horizon of the universe.

Franck Delplace accepts Padmanabhan's hypothesis. According to his calculations, the dynamic viscosity of spacetime, based on general relativity, is estimated to be high, around 0.21×10^9 Pa·s, which is comparable to the viscosity of materials like bitumen. [**4**]

On the other hand, C. Eling [**5**] tried to calculate space-time viscosity and he found that this value should be very low. There is a substantial discrepancy in the values of viscosity between Delplace and Eiling.

In this paragraph, I suggest a way to reconcile between these two values.

Fig. 4 -is a computational fluid dynamics (CFD) simulation around a solid sphere, one meter in diameter, but the same shape is true for any other size of the sphere. When a solid sphere is rotated slowly in a viscous fluid, the flow is considered laminar and Stokes flow (which is a special case of the Navier-Stokes flow) can be used. The velocity of the fluid adjacent to its surface is forced to match the sphere's tangential velocity due to the no-slip boundary condition. This causes the fluid velocity to vary from zero at the surface (the no-slip condition) to the undisturbed flow velocity further away from the sphere.

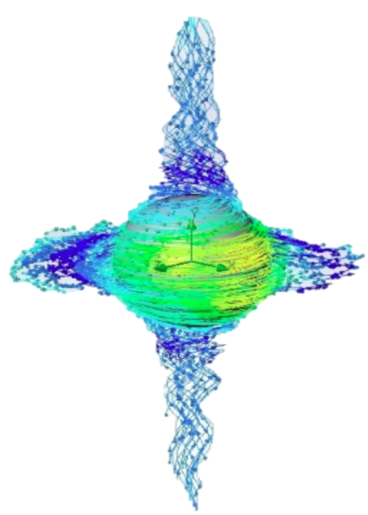

Fig. 4 – Stokes flow of a viscous fluid dragged by any spinning sphere

The similarity of Fig. 4 derived from Stokes flow, to the shape of vacuum space around the celestial body, derived from general relativity (Fig. 2 and Fig. 3) is clear. In both cases, the dragged space is a flat disk on the equatorial plane and spirals out at both poles. It is to be noted that general relativity takes into account additional phenomena such as the event horizon of the celestial body and also other parameters, such as gravity that is changed considerably. Gravity is high on the surface of a celestial body and then reduced to the minute value far away from the celestial body.

The Navier-Stokes equations describe the behavior of any type of fluid. In addition, the equations cover a wide range of fluid behavior. This range can be divided into regimes. The regimes are defined mathematically by the Reynolds number which is a dimensionless number. Generally, Reynolds number is defined as $Re = \frac{\text{inertia forces}}{\text{viscous forces}}$.

Low Reynolds numbers (Re<2000) indicate laminar flow (smooth and orderly).

On the other hand, high Reynolds numbers indicate turbulent flow (chaotic and irregular).

Stokes flow, which is a simplification of Navier-Stokes flow, describes the fluid flow at low Reynolds numbers, where viscous forces dominate over inertial forces. I argue, and I will prove later in this paper, that the behavior of all subatomic and cosmological systems in the matter universe including the entire matter universe is laminar, and therefore Stokes flow can be used.

Stokes flow is a well-known area of fluid mechanics. An example, of an analytical solution of a slow-rotating sphere in a viscous fluid is given by Dominik Beck [**6**].

The first step in the following calculations is to show that the flow around a spinning celestial body can be considered a laminar flow. In other words, if Stokes flow is applicable, it must be shown that the inertial angular momentum of the celestial body sphere $J_{\text{cb}\_inertial}$ is negligible compared to viscous angular momentum $J_{cb\_vis\cos}$. The total intrinsic angular momentum of a celestial body must be equal to the inertial angular momentum of the solid sphere + the viscous angular momentum of the vacuum space dragged by the spinning body. It was shown by Muradian [7] and [**8**] that the total intrinsic angular moment of any celestial body can be derived from the equation (1)

$$J_{cb\_total} = h_p \cdot \left(\frac{M_{cb}}{m_{neutron}}\right)^{1+1/n} \quad (1)$$

Where:

$h_p = 1.054571 \cdot 10^{-34} J \cdot s$ ...Reduced Planck's constant
M_{cb} ...Mass of celestial body
$m_{neutron}$ ...Mass of neutron
n ...coefficint: for hadron n=1,
...for disk (galaxy) n=2, and for ball (star) n=3.

Note: I use the neutron mass ($m_{neutron}$) rather than proton mass (m_{proton}) as suggested by Muradian because I argue that the Pivot is a neutron star. However, $m_{neutron} =\sim m_{proton}$.

From mechanics, the inertial angular momentum of the spinning solid celestial body sphere is:

$$J_{\mathrm{cb}\_inertial} = \frac{2}{5} \cdot M_{cb} \cdot R_{cb}{}^{2} \cdot \Omega(R_{cb}) \qquad (2)$$

Where:

M_{cb} ...Mass of celestial body
R_{cb} ...Solid sphere radius of celestial body
$\Omega(\mathrm{R}_{cb})$ ...Angular velocity of celestial body

Therefore, the viscous angular momentum $J_{cb\_vis\cos}$ is:

$$J_{cb\_vis\cos} = J_{cb\_total} - J_{cb\_inertial} \qquad (3)$$

So that Stokes flow applies to the matter universe, $J_{cb\_viscous} >> J_{cb\_\mathrm{inertial}}$.

As the vacuum space is identical on all scales, (i.e., cosmological as well as subatomic) the shape of dragged space around any spinning body (proton, Sun, black hole, the Pivot universe, etc,) has the same shape as shown in Fig. 4.

Solving the Stokes flow, the dynamic viscosity of vacuum space around a celestial body can be found. The torque $T(r)$ at a distance of r from the center of the celestial body is:

$$T(r) = 8 \cdot \pi \cdot \mu_{space}(r) \cdot r^3 \cdot \Omega\ (r) \qquad (4)$$

where

$\mu_{space}(r)$ ...is the dynamic viscosity of the vacuum space

$\Omega(r)$ ... angular velocity at distance r

r ...distance from the celestial body center

But there is also a relation:

$$T(r) = J_{cb} \cdot \Omega_{cs}(r) \qquad (5)$$

Where the angular momentum J_{cb} is constant. Therefore, the dynamic viscosity of space $\mu_{space}(r)$ can be calculated from (4) and (5):

$$\mu_{space}(r) = \frac{J_{cb}}{8 \cdot \pi \cdot r^3} \qquad (6)$$

The analysis is done for three cases: The Pivot universe, the Sun, and the proton.

Viscosity in the Pivot Universe

Given from reference [3]

$M_{pivot} = 7.824 \cdot 10^{53} \cdot kg$ ...Mass of Pivot eq. (4.2)

$R_{pivot} = 6.027 \cdot 10^{8} \cdot km$ ...Radius of Pivot eq. (4.11)

$R_{in} = 122.88 \cdot Gly$ ... Inner radius of disk eq. (4.4)

$R_{out} = 175.57 \cdot Gly$ ...Outer radius of disk eq. (4.10)

$R_{\max} = 100 \cdot R_{out} \cong 17500 \cdot Gly$ ...Arbitrary radius

$m_{neutron} = 1.67492 \cdot 10^{-27} \cdot kg$ ...Mass of neutron

$J_{pivot} = h_p \cdot (\frac{M_{pivot}}{m_{neutron}})^{3/2} = 1.06 \cdot 10^{87} J \cdot s$ ...Angular momentum eq. (1)

$R_{H\_pivot} = 2 \cdot G \cdot \frac{M_{pivot}}{C^2} = 122.75 \cdot Gly$ ...Schwarzchild radius

$$\alpha_{pivot} = \frac{J_{pivot}}{M_{pivot} \cdot C} = 0.48 \cdot Gly$$

$\Omega_{pivot}(\mathrm{r}) = \frac{R_{H\_pivot} \cdot \alpha_{pivot} \cdot C}{r^3 + \alpha_{pivot}{}^2 \cdot r + R_{H\_pivot} \cdot \alpha_{pivot}{}^2}$ ... Angular velocity, reference [3] eq. (4.8)

$$J_{pivot\_inertial} = \frac{2}{5} \cdot M_{pivot} \cdot R_{pivot}{}^2 \cdot \Omega_{pivot}(R_{pivot}) = 7.96 \cdot 10^{60} J \cdot \sec$$

Finding flow regime:

$\frac{J_{pivot\_inertial}}{J_{pivot} - J_{pivot\_inertial}} = 3.8 \cdot 10^{-27}$ $\Rightarrow$ Flow is laminar

Finding viscosity in the universe:

$\mu_{pivot}(r) = \frac{J_{pivot}}{8 \cdot \pi \cdot r^3}$ ...eq. [6]

$$\mu_{pivot}(R_{pivot}) = 1.77 \cdot 10^{50} \cdot Pa \cdot s$$

$$\mu_{pivot}(R_{in}) = 2.69 \cdot 10^{4} \cdot Pa \cdot s$$

$$\mu_{pivot}(R_{out}) = 9.24 \cdot 10^{3} \cdot Pa \cdot s$$

$$\mu_{pivot}(R_{\max}) = 9.36 \cdot 10^{-3} \cdot Pa \cdot s$$

Viscosity in the solar system

$M_{sun} = 2 \cdot 10^{30} \cdot kg$ ...Mass of Sun

$R_{sun} = 7 \cdot 10^{5} \cdot km$ ...Radius of Sun

$R_{solar\_disk} = 4.5 \cdot 10^{9} \cdot \mathrm{km}$ ...Radius of solar disk

$R_{\mathrm{sun\_max}} = 4.5 \cdot 10^{11} \cdot \mathrm{km}$ ...Arbitrary radius

$J_{sun} = h_p \cdot \left(\frac{M_{sun}}{m_{neutron}}\right)^{4/3} = 1.34 \cdot 10^{42}\, J \cdot s$ ...Angular momentum of Sun eq. (1)

$R_{H\mathrm{\_sun}} = 2 \cdot G \cdot \frac{M_{sun}}{C^2} = 2.97 \cdot km$ ....Schwarzchild radius

$\alpha_{sun} = \frac{J_{sun}}{M_{sun} \cdot C} = 2.29 \cdot km$

$\Omega_{sun}(\mathrm{r}) = \frac{R_{H\mathrm{\_sun}} \cdot \alpha_{sun} \cdot C}{r^3 + \alpha_{sun}{}^2 \cdot r + R_{H\mathrm{\_sun}} \cdot \alpha_{sun}{}^2}$ ... Angular velocity, reference [3] eq. (4.8)

$J_{\mathrm{sun}\_inertial} = \frac{2}{5} \cdot M_{sun} \cdot R_{sun}{}^2 \cdot \Omega_{sun}(R_{sun}) = 2.27 \cdot 10^{36}\, J \cdot \mathrm{sec}$

Finding flow regime:

$\frac{J_{\mathrm{sun}\_inertial}}{J_{sun} - J_{\mathrm{sun}\_inertial}} = 1.7 \cdot 10^{-6}$ $\Rightarrow$ Flow is laminar

Finding viscosity in the solar system:

$\mu_{sun}(r) = \frac{J_{sun}}{8 \cdot \pi \cdot r^3}$ ...eq. (6)

$\mu_{sun}(R_{sun}) = 1.55 \cdot 10^{14} \cdot Pa \cdot s$

$\mu_{pivot}(R_{sun\mathrm{\_max}}) = 5.7 \cdot 10^{-4} \cdot Pa \cdot s$

Viscosity in the proton system

$M_{proton} = 1.67 \cdot 10^{-27} \cdot kg$ ...Mass of proton

$R_{proton} = 0.86 \cdot 10^{-15} \cdot m$ ...Radius of proton

$R_{hydrogen} = 0.529 \cdot 10^{-11} \cdot \mathrm{m}$ ...Radius of hydrogen atom

$R_{\mathrm{proton\_max}} = 5.3 \cdot 10^{-11} \cdot \mathrm{m}$ ...Arbitrary radius (10 times hydrogen radius)

$J_{proton} = h_p \cdot (\frac{M_{proton}}{m_{neutron}})^2 = 1.0545 \cdot 10^{-34} J \cdot s$ ...Angular momentum of proton eq. (1)

$R_{H\mathrm{\_proton}} = 2 \cdot G \cdot \frac{M_{proton}}{C^2} = 2.48 \cdot 10^{-54} \cdot m$ ...Schwarzchild radius

$\alpha_{proton} = \frac{J_{proton}}{M_{proton} \cdot C} = 2.1 \cdot 10^{-16} \cdot m$

$\Omega_{proton}(\mathrm{r}) = \frac{R_{H\mathrm{\_proton}} \cdot \alpha_{proton} \cdot C}{r^3 + \alpha_{proton}{}^2 \cdot r + R_{H\mathrm{\_proton}} \cdot \alpha_{proton}{}^2}$ ...Angular velocity Reference [3] eq. (4.8)

$J_{\mathrm{proton\_}inertial} = \frac{2}{5} \cdot M_{proton} \cdot R_{proton}{}^2 \cdot \Omega_{proton}(R_{proton}) = 4.36 \cdot 10^{-153} J \cdot \mathrm{sec}$

Finding flow regime:

$\frac{J_{\mathrm{proton\_}inertial}}{J_{proton} - J_{\mathrm{proton\_}inertial}} = 4.14 \cdot 10^{-119}$ $\Rightarrow$ Flow is laminar

Finding viscosity around proton:

$\mu_{proton}(r) = \frac{J_{proton}}{8 \cdot \pi \cdot r^3}$ ...eq. (6)

$\mu_{proton}(R_{proton}) = 6.6 \cdot 10^{9} \cdot Pa \cdot s$

$\mu_{proton}(R_{\mathrm{proton\_max}}) = 2.83 \cdot 10^{-5} \cdot Pa \cdot s$

Summary

Franck Delplace and C. Eiling calculated the dynamic viscosity of spacetime and found two contradictory values. I claim that there is a way to reconcile these contradictory results by assuming that the vacuum space viscosity varies substantially in the matter universe. The high viscosity of the ether on the solid sphere surface of any celestial body means that the ether adheres strongly to their surfaces. In the entire matter universe, the viscosity varies sharply as a function of distance from the Pivot's center. In the disk of the visible universe (defined from the range 122.9Gly to 175.6Gly as shown in Fig. 3), the average viscosity is $1.8*10^4$ Pa*s which is comparable to the viscosity of materials like Lava, and asphalt. The viscosity of space far away from the Pivot, say at a distance R_{max}=17500Gly, (=~ 100*Outside radius of the disk) is $9.3*10^{-3}$ Pa*s comparable to the viscosity of water.

The above description answers to the following profound issues:

1. Why celestial bodies do not lose energy while moving through vacuum space? – The answer is that the celestial bodies do not move about the stationary vacuum space but rather are dragged by space. The celestial body does not lose energy to overcome the friction of the vacuum space. An example of such a motion is the motion of a boat in a river. The boat will move with the river as long the river flows.

2. Why do all celestial bodies spin? – Rather than explain this phenomenon analytically the reader is referred to an experiment of Stokes flow by Taylor. This is shown in a video by NSF (start time: 3:38 min) [**9**]. Galaxies and other celestial bodies are dragged by the vacuum space and simultaneously spin around their axis.

3. Is our matter universe stable? – I argue that generally, the answer is yes. The motion of all celestial bodies is in the laminar flow regime i.e., smooth and orderly. This motion will continue as long as the Pivot exists.

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CREEPING FLOW

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