



## → **PATHS IN THE UNIVERSE**

This Article-work serie called “PATHS IN THE UNIVERSE”, have 3 titles or parts:

- Matter dynamic in the Universe.
- New models about Expansion of the Universe.
- Navier Stokes equations in the Universe.

### **MATTER DYNAMIC IN THE UNIVERSE**

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#### **ABSTRACT**

If you want to explain how the Universe works, it is necessary to know how the clusters of matter that originate the galaxies and the clusters of galaxies that originate the large-scale geometry of the Universe are formed. On the other hand, it is also necessary to know the mechanisms by which galaxies evolve and interact among them, and also, what the process for mater aggregation are. Finally, it is also necessary, therefore, an explanation of dark matter in terms of properties and not its composition, since it is a majority part of the matter of the Universe. A series of mechanisms and numerical models are established, which explain all this.

#### **1. INTRODUCTION**

The Background Microwave Cosmic (BMC), is a map of density variation in a distribution of mass in early universe (the red color, means barionic matter – “high” temperature or density):

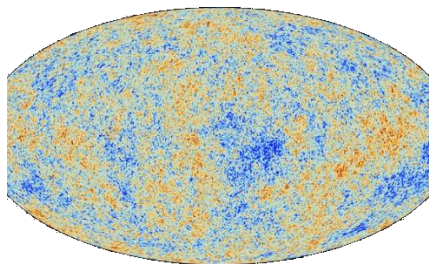


Fig. 1: Background Microwave Cosmic (BMC).

Why this distribution? This special distribution of zones with more and less density, is normal in the nature. All explosions for example, not have an equal matter, fragments distribution, density or temperature (sun surface, supernovas, atomic bomb, nebulae, etc...):



Fig. 2: Explosion sun surface, supernovas, atomic bomb, nebulae.

These densities variations, origin in the future, the different galaxies cluster and matter distribution in large scale. In fact, from this BMC as a boundary condition, is possible simulate the evolution of universe: the result is very similar to universe observable today:

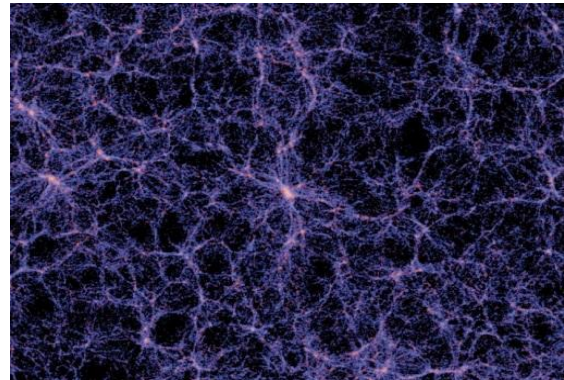


Fig. 3: Matter distribution in universe today.

The gravity (dark matter, dust, density waves, etc...) is very important in order to create the actual and special matter distribution, but also the Viscosity and other thinks those are define in this article (matter distribution, galaxies (creation, arms, interaction), universe, planet atmospheres, paths, large scale, but the gravity, not is the goal of this Article (minimum mentions).



## 2. DEFINITIONS

### 2.1. DENSITY

Density " $\rho$ " is defined as the number of particles per unit volume or time interval. Density is defined as the quotient between the number of particles enclosed in a ball of determined radius and center of particle, and the volume of the ball. This definition is extended to " $n$ " dimensions, defining the volume of a ball of " $n$ " dimensions as:

$$\frac{\pi^{n/2} R^n}{\Gamma(n/2 + 1)} \quad \text{Eq. (1)}$$

" $z$ " is an integer and " $\Gamma$ " being the Gamma function:

$$\Gamma(z) = \int_0^{\infty} t^{z-1} e^{-t} dt \quad \text{Eq. (2)}$$

Also is possible to define this value, as an average density. In the Articles, the Density is density matter barionic + density radiations + density cosmological expansion energy (energy density, in general).

### 2.2. PRESSURE

Is a concept, very similar to Density, or better, is a consequence of her. Obviously, if the density is greater, the pressure also. First, we can think about pressure as a definition in Kinetic theory of gases (proportional to " $m$ " total mass particles, " $1/Vol$ " volume and " $u$ " average velocity of particles, impulse ( $m \cdot u$ ) and " $N$ " number particles); " $\rho$ " is a local value, that is: around a point, " $cte$ " is a constant):

$$P = cte \frac{mN u^2}{Vol} = cte * \rho * u^2 * N \approx \rho u^2 \quad \text{Eq. (3)}$$

In fact, is common work with the Lift Force in Aerodynamics, as (" $A$ " area and " $C$ " a coefficient); very similar to (Eq.3) (pressure = Force / Surface):

$$Force(lift) = \rho u^2 \frac{1}{2} AC$$

This concept, is very important in galaxies formation and evolution or in general in cosmology. In this case, " $P$ " is called "Ram Pressure", and very similar, to Einstein equation  $E=mc^2$ . In fact, the Pressure is the Energy; this concept of Pressure as Energy, is essential in order to define a new procedure for create a CFD code:

$$E = m c^2 = \frac{m}{vol} c^2 Vol \approx P * Vol \quad \text{Eq. (4)}$$

We can have a fluid with compressibility but is necessary to know the velocity for this compression or expansion. This value, is the divergence of velocity; that is: the variation of volume, and may be positive (universe in expansion) or negative (universe in compression).

### 2.3. TEMPERATURE

In the expression before about Pressure, we calculate it for a 1 mol; then (" $N_A$  is Avogadro number, " $M$ " molecular mass, " $cte1$ " and " $cte$ " are constants):

$$P * Vol = m u^2 N_A = R * T \quad \text{Eq. (5)}$$

$$T = cte1 * M * u^2 \approx cte * u^2$$

From (Eq.3) and (Eq.5) (is very know this relation):

$$P \approx \rho T \quad \text{Eq. (6)}$$

About the Brownian movement, the particles vibrating (Temperature), produce a variation of position, and this position unpredictable, produce an evolution unpredictable.

### 2.4. VISCOSITY

When starting a car when the traffic lights turn green, it does so after some time after the car that precedes it moves (this causes a wave that is called Soliton). It also happens when the price of oil changes due to the index variation of the New York Stock Exchange-Market; it does not do it immediately. The invers of his time delay " $Td$ " is defined as Viscosity " $\mu$ ". In fact, Viscosity is defined, as said delay time:  $\mu = (1 / Td)$ .

If  $\mu = 0$ , if and only if,  $\rho = \text{Constant}$ .

The density of a fluid formed by particles depends directly on the compressibility and vice versa; Compressibility is defined as the force applied to 2 particles to bring them closer together. Be a closed box full of billiard balls; if you try to move the balls, it will be absolutely impossible. But if there is some kind of compressibility, the balls will tend to move and pass one another.... (Tennis ball, for example). This Viscosity, seem the "Friction", which in my opinion, is the mother of all properties. Viscosity = 1 / delay time between molecules in a fluid, in order to transmit the sound = (1 /  $\mu_G$ ) It is a way to classify different fluids. In the

representation of evolution of model “prey and predator”, we can understand perfectly, what is this new value for the Viscosity, as delay between input and output:

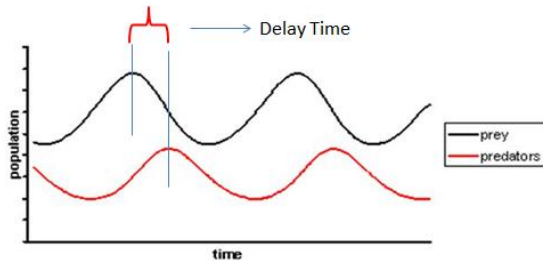


Figure 4: Viscosity as a delay between input and output signal.

Calculate now, the reaction time between 2 molecules of a fluid, for transmit a sound wave: "C" is the speed of sound (wave shock) in a fluid, "R" is the gas constant, "x" is the average displacement of molecules, "t" is time and "N<sub>m</sub>" the number molecules in 1 lineal meter: the gas viscosity ( $\mu_G = Td$ ):

$$\mu_G = \frac{1/C}{N_m} = \frac{1}{C^3 \sqrt{\frac{P}{RT} N_A}} = \frac{1}{C^3 \sqrt{\rho N_A}}$$

Eq. (7)

Einstein viscosity value is:

$$\mu_E = \frac{RT}{N_A} \frac{1}{6\pi D r} / x^2 \propto Dt \quad \text{Eq. (8)}$$

“D” is Diffusivity and “r” radio molecules or particles. So:

$$\mu_G = \sqrt[3]{\frac{\mu_E 6\pi D r}{P C^3}} \quad \text{Eq. (9)}$$

From another point of view, we have a particles group and between them, there is a spring between particles (or full fluid volume) with a constant “K”; from Hookes law, we are:

$$F = Kx = m \frac{u}{t}$$

$$K = \frac{m C^2}{N_A \mu_G} \propto \frac{m}{\mu_G} \quad \text{Eq. (10)}$$

In space, the viscosity is easier: = 1 / light-time; and this value, is a local property (one for every relation between two objects). Also, is possible think about the viscosity, as a damper or even, cohesion force. In gasses, if the temperature is greater, the viscosity is greater and sound speed is less, but in liquids, the viscosity is less. That is because the gasses, are more compressible.

Is possible that exist a control volume expansion velocity. That is the “bulk or volume viscosity”. In fact even, this expression corresponds to an “inertor” damper force ( $F_{Bv}$ ) (“f<sub>v</sub>” is a factor volume variation and “V” velocity vector):

$$F_{Bv} = f_{vv} \nabla V \quad \text{Eq. (11)}$$

If there is a delay time between movement molecules, smaller, the viscosity is bigger; that is the case for a Lava, through a channel:

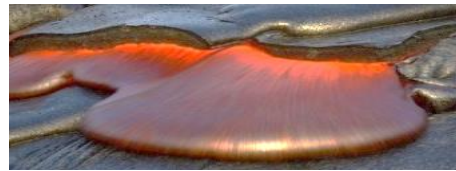


Figure 5: Lava in a channel.

In the end of the “filaments or channels”, it can see a parabolic velocity profile....It can see this “parabolic” velocity profile, in a people group walking in street (there are boundary layer in lateral walls):

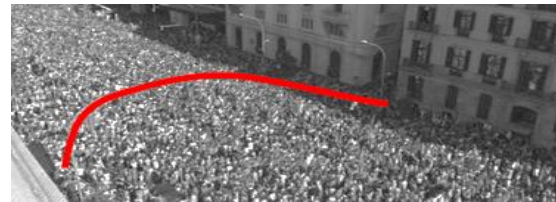


Figure 6: Velocity profile section in a street.

What is the Diffusivity “D” as a fluid property? Is the tendency to fade. If it have a spherical particles group (“r” radio, “cte” is a constant). When the viscosity and radio particles is greater, the diffusivity is less, if “T” is greater the diffusivity also; that is:

$$D = cte * \frac{T}{\mu r} \quad \text{Eq. (12)}$$

Comparing this (Eq.12), with the Einstein relation for diffusivity (“K<sub>B</sub>” is a Boltzmann constant) (very similar):

$$D = \frac{K_B T}{6\pi\mu r} \quad \text{Eq. (13)}$$

### 3. CLUSTER MATTER AND MATTER AGGREGATION BY VISCOSITY

It can see the accumulation of dust and lint at home, in a dispersion of tree leaf by the wind, in an accumulation of drop water in a flat plate, in clouds or plastics in sea:



Fig. 7: Dust and lint, tree leaf, drop water, clouds and plastics.

The friction between particles is the responsible of these accumulations: that is: the Viscosity.

In fact, the responsible of this accumulations, are the Density and the Viscosity: both properties are very important in this effect; is possible create so, a new force-parameter “ $V_d$ ”:

$$V_d = f(\rho, \mu) \quad \text{Eq. (14)}$$

Is possible to see this effect, also in other's phenomenon in nature:

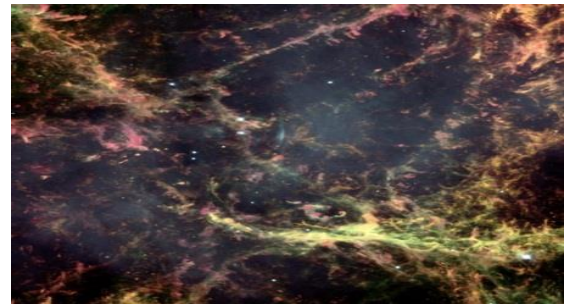


Fig. 8: Fall water (filaments and other's structures), also in Crank Nebula.

The matter, tend to join to other's particles each and other.

This union, may be produced by 3 factors (obviously also the gravity but in this serie, don't comment gravity effects practically):

- By the particles: density and viscosity.
- By the environmental or context:

The environmental have the conditions ideals for accumulations of people; may be that this accumulation is due to the same feelings, but that, it will analyze in other Article. The environmental may to be the low pressure tube, as it show in Galaxy formation in this Article.



Fig. 9: People “group” in the beach.

The particles with the same or similar viscosity, tend to join (that occur also in humans....).

In the case of flock’s birds, the friction force or Viscosity, work as a feelings:

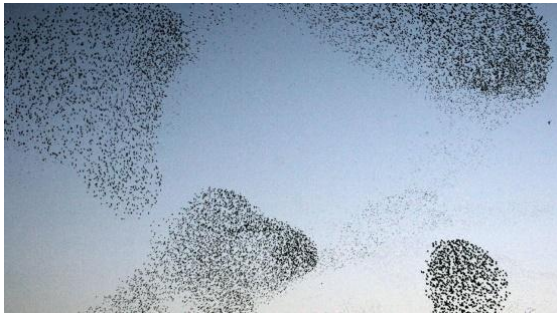


Fig. 10: Bird flocks.

- Combination between both:

For example, in a discotheque (or beach before), the people is there because they to have a good time, and the place, is the right one for it.

Is possible show the next images, about interfaces between fluids of different viscosity (sea water), creating filaments, accumulations or aggregations; this densities and viscosities different, may be produced by different temperature, salinity, etc.....:



Fig. 11: Filaments or interface lines in sea water.

- ➔ Test for validation and analysis: make in CFD software:

Main goal: Analyze the aggregation-mix-evolution of fluids particles.

In a box with 2 or more fluids (without chemical reaction between if there are more than 1 fluid), generate a movement during a time period, and stop the movement. See the aggregation and evolution of fluids.

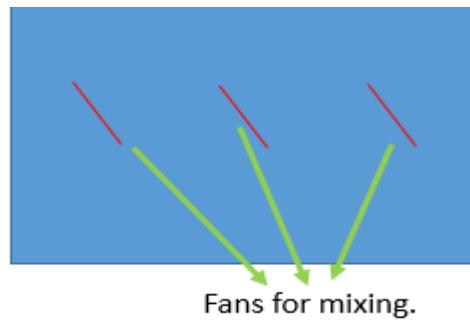


Fig-test-1.

Calculate and see, the density map of mix.

May be change densities, viscosities, temperatures, pressures, velocities of movement and amounts.

Is possible start this analysis in only 2 dimensions.

## \* Results and Analysis:

### 4. GALAXIES

5 aspects to study:

#### 4.1. Formation: vortices:

When a particle move, his path is a depression path; all particles behind or around her, rotate around the depression tube, producing vortices:

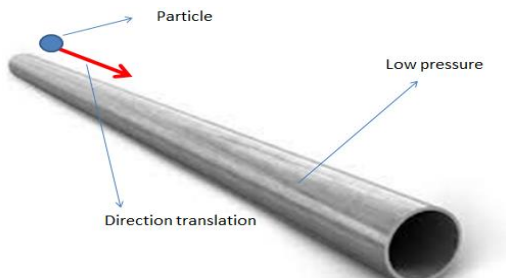


Fig. 12: Depression tube and samples of that.

These “paths” of low pressure or density, can help matter particles, to aggregate each and other, producing, in the future, stars, black holes, etc. That is: the galaxy seed. Also, these paths, allow and help other’s galaxies behind to follow the first galaxy.

→ Test for validation and analysis: make in CFD software:

Main goal: Create a path low pressure and analyze the particle dynamic around.

For creating the low pressure tubes, is possible work in 2 ways or methods:

- On a flat plate:

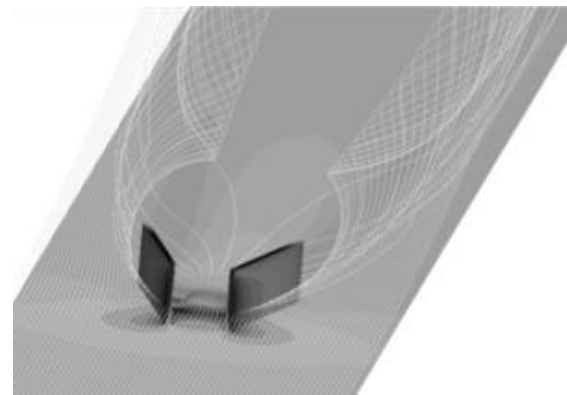


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- In 3 dimensions, from a wing:

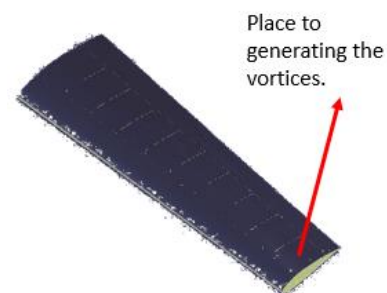
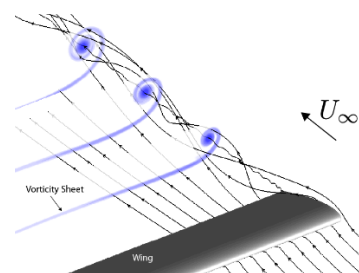


Fig-test-3.



Box with only 1 fluid.

May be changes velocity of creation low pressure tube, density, viscosity, temperature and pressure of fluid

## \*Results and Analysis:

### 4.2. Galaxies creation and rotation:

4.2.1. Initial black hole (black hole “primordial”, create just after bing bang. Around it, pull matter and matter. Rotating the black hole, it create the galaxy, arms, etc.... Why rotate in this case? because is the most probable.

The same explanation it have for a water sink: the rotation direction (without Coriolis and more), is aleatory:



Fig. 13: Rotation water sink.

4.2.2. Initial aggregation of matter, creating the galaxy. May be, sure...., in the galaxy center, it create a black hole. Around depression tube? may be.... Or from initial disturbance. Why rotate in this case? because there are a rotational moment, for every star which is pull.



Fig. 14: Black hole in the galaxy center.

The rotation of black hole, help galaxy in its evolution (also bend the light....).

### 4.3. Velocity profile rotation:

The velocity radial in a galaxy is different if it suppose the rotation with the Kepler laws; the velocity “real” is greater:

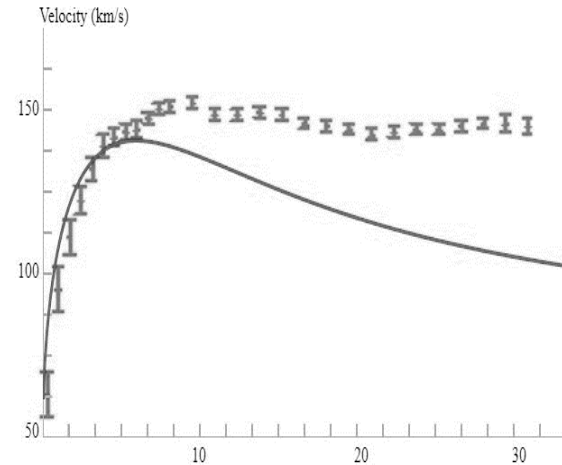


Fig. 15: Solid line is a velocity by Kepler rules, and star line, velocity “real”.

In order to create a model for galaxy matter, which its velocity profile is the correct, is possible change galaxy density and/or viscosity.

- Density:

The existence of dark matter becomes necessary:

The velocity “V” in a point with “r” distance to galaxy center is (“G” gravitational constant, “m” mass of particle-point):

$$V^2 = \frac{Gm}{r} \quad \text{Eq. (15)}$$

The variation of velocity “real” with the Kepler hypothesis, is suppose that m/r, change in a special form (constant); so: (“cte” is more or less constant: is possible calculate a Density in every point, or full galaxy):

$$\frac{m}{r} = cte \quad \text{Eq. (16)}$$

$$2V\partial V r^2 = G(r\partial m - m\partial r)$$

Adding this “new” matter to galaxy, is possible obtain the good velocity profile.

- Viscosity:

In a galaxy, “a” star radio, “r” distance star to galaxy center, “m” the galaxy mass (inner part) and “μ” the viscosity: the velocity “V” is proportional to “a” and “r” and proportional to “1/m”; “μ” is the proportional constant (more or less: is possible calculate a Viscosity in every point, or full galaxy) or factor:

$$V = \mu_1 \frac{ar}{m} \quad \text{Eq. (17)}$$

$$\mu_1 = \mu 6\pi$$

Is possible so, to know the viscosity, for having a velocity.

- Density and viscosity (together):

Combining and substituting the mass for density\*Volume (Vol), is possible change density and viscosity, in order to have the profile velocity “real” (“Vol” is the galaxy volume inner part, “K” constant more or less): is possible calculate a Density and Viscosity in every point, or full galaxy): (the Viscosity is more important than Density):

$$\sqrt{\frac{Gm}{r}} = 6\pi \frac{a}{m} \mu r$$

$$m = \rho * Vol$$

$$\rightarrow \frac{\rho}{\mu} \approx K \quad \text{Eq. (18)}$$

In the 3 cases, is possible create the real profile:

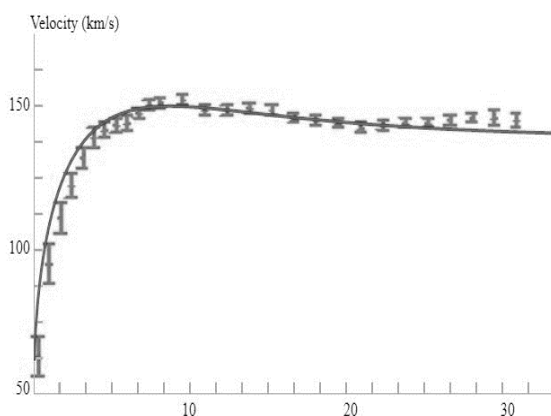


Fig. 16: Solid line is a velocity by Kepler rules, and star line, velocity “real”.

#### 4.4. Arms formation:

First of all, and obviously, is possible appreciate the similarity with any real galaxy (geometry pattern – typical in mathematical or physical models):

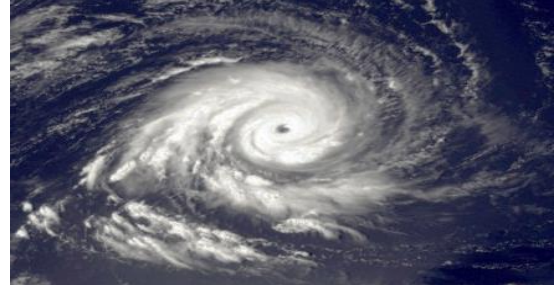


Fig. 17: Typical galaxy in spiral.

Is possible so, apply fluids theory to galaxy formation, evolution and interaction? May be....

When the galaxy is created (last point), maybe some front of fluid, with different viscosity and/or density (interface between 2 fluids):

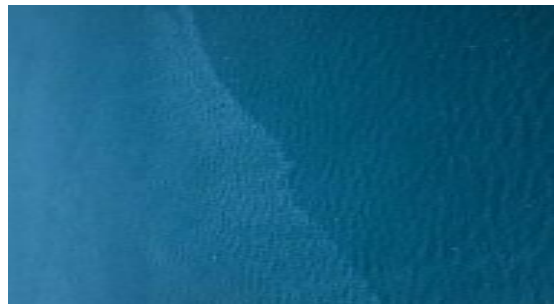


Fig. 18: Interface between 2 fluids.

If the galaxy is rotating or tend to rotate, this interface begins to divide into “fingers” moving forward. These “fingers”, produce the arms, with also the centrifugal force:



Fig. 19: Fingers generation advancing the interface.

A rotating fluid in other or not, fluid (different viscosities and densities), generate arms, as a density contours (café, as example).



Other explanation, is more accurate and “real”, but complementary to these before: around a galaxy, there are a lot of matter in different forms (in fact, the galaxies, swing in Dark Matter): traditional or visible, dark matter, may be etc.... that is: the density and also the viscosity, around and into a galaxy, is big.

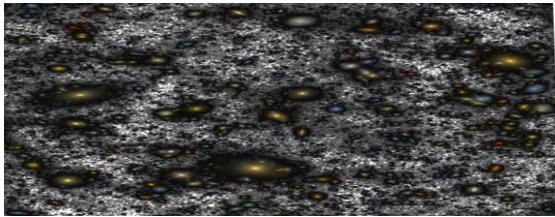
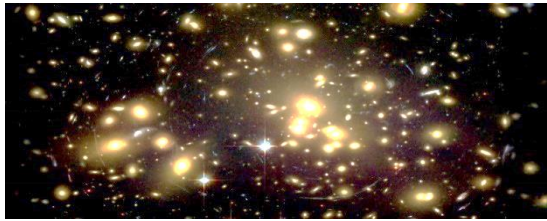


Fig. 20: “Extra” Matter no visible and visible, in the universe, around galaxies and galaxies clusters.

Imagine now, that it have a cloth and a cylinder placed in the central part which rotate, creating a special pattern:

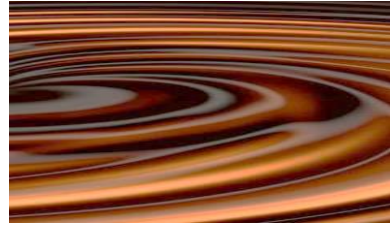
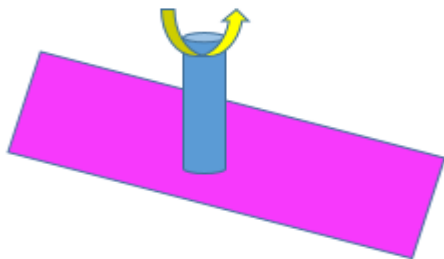


Fig. 21: Zones of creation of galaxy arms; the same phenomenon in a whirl water. Also is possible generate these “arms” in chocolate rotating.

These waves, are zones low pressure and other’s high pressure. In the zones of high pressure, so with high density, it create the stars, so the arms (with the help, as always, of the gravity):

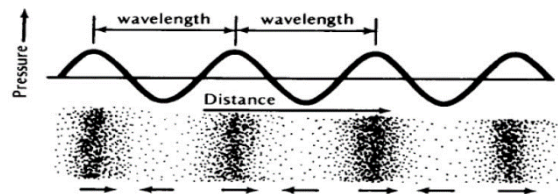


Fig. 22: High pressure and low pressure in waves.

These waves, are density waves. Why a lot of shapes types of galaxies? Depend of initial matter distribution, including amount, velocity rotation black hole, dimensions of black hole or disturbance zone, etc....

The stars matter, may be composed by barionic matter but also may be, by Dark Matter transformed in barionic matter....

Is possible see the arms, through a density map or viscosity map-field generation (café or chocolate for example – is very complicate to see these densities variation or height variation - waves).

Validation; different theoric phenomenon’s (must to be true):

a)

From this point of view, the galaxy matter in rotation, interaction with other matter, producing big greater densities zones. So, is possible to think, that if a

galaxy have a greater rotation velocity, the interaction with the matter, also is bigger, so more stars zones formation. So finally, if a galaxy have a greater rotation velocity, its luminosity will may be bigger. And that is true:

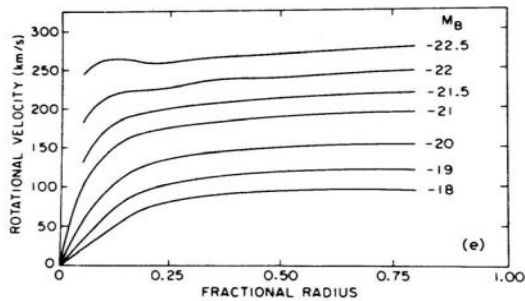


Fig. 23: Classification galaxies luminosity, against rotation velocity; Rubin in 1983.

b)

But, if a galaxy have more luminosity, will must to be more arms. And that, also is true:



Fig. 24: Classification galaxies Sa, Sb and Sc.

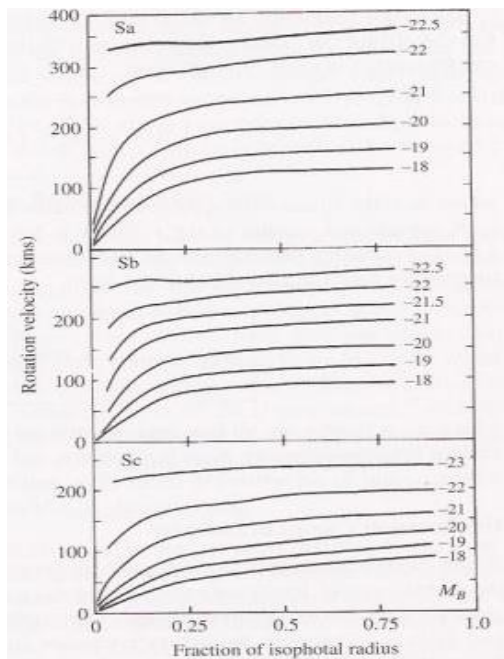


Fig. 25: Rotation velocity Sa, Sb and Sc galaxies.

c)

The galaxies for example, in its way, have a tail, with itself matter but also by other's matter "activate-excited" by interaction between galaxy and environmental, basically Dark Matter:

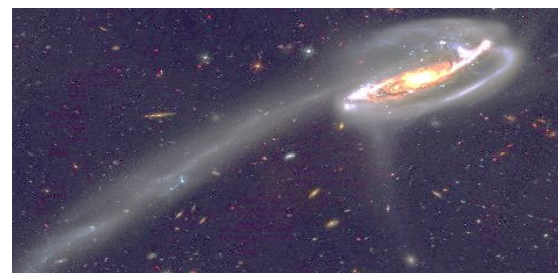


Fig. 26: Galaxy tails.

d)

If there are few dark matter, the galaxy have less arms.

**\* Search for validate this affirmation.**

e)

In the past (more density), a galaxy have more luminosity with less rotation velocity than today.

**\* Search for validate this affirmation.**

➔ Test for validation and analysis: make in CFD software:

Main goal: Analyze the galaxies formation from a black hole and Dark Matter.

In a box with 2 fluids (not chemical reacting) with different densities and viscosities, place a rotating cylinder:

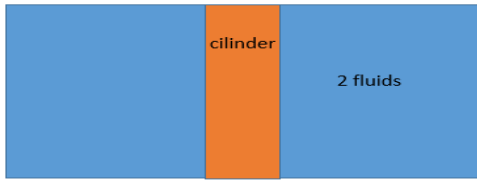


Fig-test-4.

In a walls of box, symmetry as a condition. Walls cylinder, with roughness. Fluids without chemistry reaction. Is possible start this test, with only 1 fluid.

In this simulation, is possible to change:

- Density, pressure, viscosity and temperature of fluids.
- Rotation velocity of cylinder.
- Dimensions box and cylinder.

Other test very interesting, is:

In a box, place two fluids: 1 of the as a Dark Matter (Viscosity and density particular). Generate a vortices with fluid (not Dark Matter), and generate a law as that: if the Dar Matter have a pressure particular, this Dar Matter transform in Barionic Matter.

## \*Results and Analysis:

### 4.5. Interaction between:

In the sky, is possible to see, a lot samples of collisions:

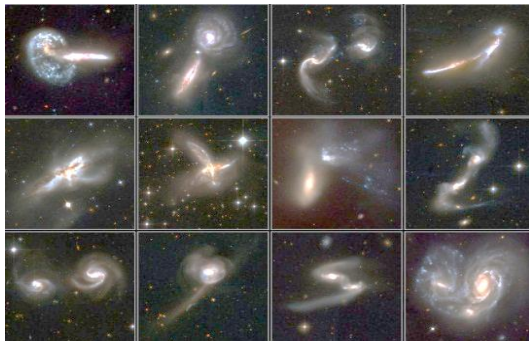


Fig. 27: Some galaxies colliding.

When two galaxies collide, collide also the dark matter.

As always in this Article, is possible to see the same between hurricanes (analogy with fluid theory or geometries patterns):

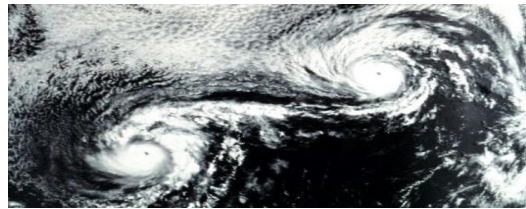
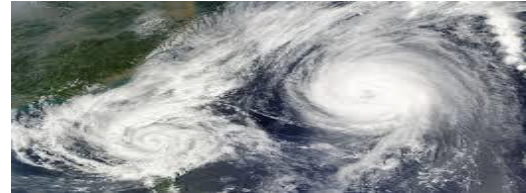


Fig. 28: Some hurricanes colliding.

So, it can think about (evolution and combination), as an interaction between fluids vortex.

The interaction between vortices, is some think very important and complicate:

These unions or alteration, depending of intensity (vorticity) of vortex; if there is one vortex, bigger than other vortex (red and green), can produce that: (each horizontal line correspond one context or size):

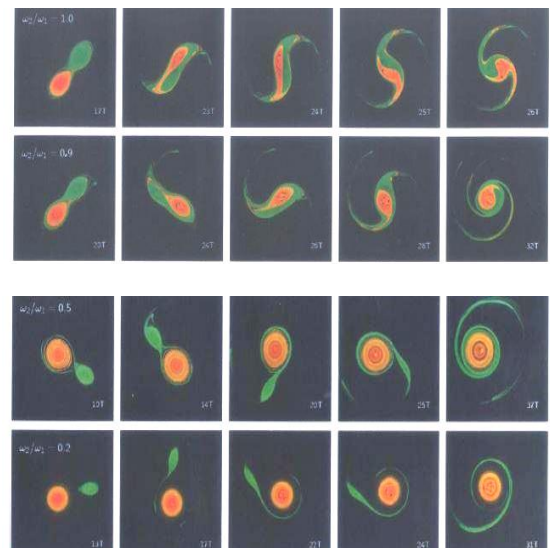


Fig. 29: Interaction between 2 air vortices of 2 cm diameter....

Also depend of densities, viscosities, temperatures, rotation direction, velocity rotation, size, etc.... and other's paths as a way of other galaxies (depression tubes).

The study of these interactions between vortices, is typical in aerodynamic work about Race Cars; is important create vortices, but is more important, their interactions:

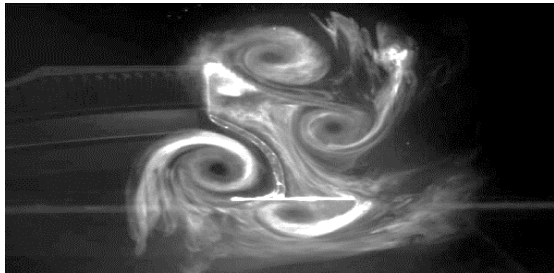


Fig. 30: Vortices in front wing race car Formula 1.

In fact: → ““J. H. Lee et al. “Galaxy Rotation Coherent with the Motions of Neighbors: Discovery of Observational Evidence”. The Astrophysical Journal, 2019:

The sense of rotation of a galaxy is influenced by the movement of its companions, even the farthest. This is revealed by the CALIFA galactic survey data used by a group of astronomers to carry out the study.

In principle, distant companions, located millions of light years away, should show little influence on the shape and rotation of the central galaxy, but a recent study indicates that the direction of rotation of a given galaxy depends, in effect, on the average movement of its neighbors, including those located at long distances.””

It can see another very illustrative effect of the importance of the density and viscosity and this last Article.

Let's think of a submerged pendulum. It make it swing.



Fig. 31: 1 pendulum.

It will be able to see that the pendulum will stop oscillating almost immediately. This is due to the opposition of the water molecules which act on it. In fact, the more density/viscosity the fluid has (less compressibility), the less time the initial oscillation will take to stop.

Now, let's think of two identical pendulums immersed in a fluid and with opposed oscillations.

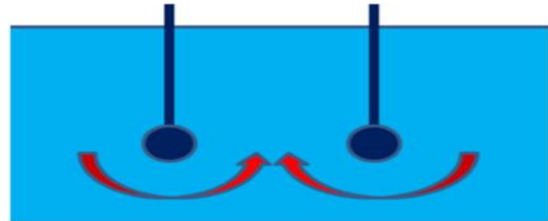


Fig. 32: 2 pendulums.

After a short time, both pendulums will oscillate in the same direction and with the same frequency!!!

Why does this fact happen?

Because the density/viscosity of the fluid, because its variations and the forces transmission trough the molecules. On the moon, this wouldn't happen, due to the air (fluid in general) absence.

→ Test for validation and analysis: make in CFD software:

Main goal: Analyze the galaxies interaction between.

Create 2 or more vortex in different positions in a box with 1 fluid, and analyze the interaction between them, against positions, velocities rotation and translation, densities and viscosities, sizes.

2 ways or tests types:

- Create 2 or more vortices and analyze the interactions: box with 1 fluid.
- Create 2 or more vortices and analyze the interactions: box with 2 fluids (not chemical reacting): 1 fluid for vortices.

It would be possible, change and so, analyze:

- Size and rotation/translation velocity of vortices.
- Density, pressure, temperature and viscosity fluids.
- Position of vortices.

# \*Results and Analysis:

## 5. GASEOUS PLANETS

### 5.3. Perturbation of Kelvin-Helmholtz.

The Kelvin-Helmholtz effect, cause a little variation between different layers of fluid. These variations change in time, producing turbulences.

The variation may be caused by gravity or random movement of molecules (Brownian movement of molecules). On a moving surface, the boundary interface produces a fluid brake, because there are different velocities and may be densities and/or viscosities.



Fig. 33: Typical structure of these disturbances.

The origin of these geometries, is simple: start from a little perturbation:

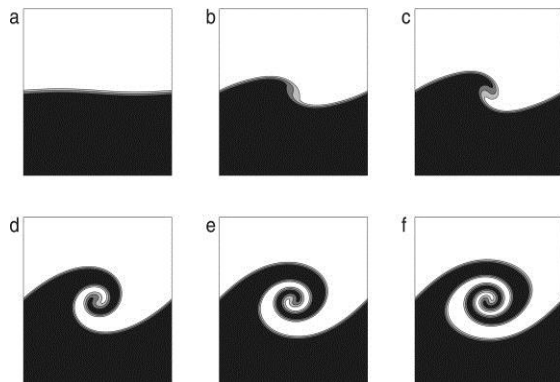


Fig. 34: Dynamic process of Kelvin-Helmholtz disturbance.

Also, is possible that from this specials geometries, create the galaxies arms.

So if that disturbance does not exist, it is necessary that the 2 bands circulate fully parallel. But it is more probably that not circulate parallel. In this way, disturbance occurs.

If two fluids bands are different density or/and viscosities and velocities, will be a disturbance: the fluid with more velocity, tend to fill the low pressure in a fluid with less velocity. This low pressure zone, is originate by:

- Gap time of reaction between molecules; that is: different viscosity.
- Density lower.
- Gravity, if exist.
- Rayleigh-Taylor:

This last effect, occur when a fluid with more density, interaction with other fluid:

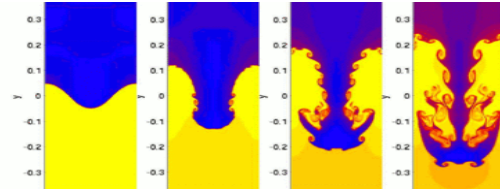


Fig. 35: Rayleigh-Taylor effect.

Considering the origin of turbulence in terms of small initial disturbances, one case where we can see and observe the creation of turbulences is the curtains of most rural houses. We all have seen this curtains which are placed on the door to prevent the entry of mosquitoes. If it's windy, we will see that the curtain starts to ripple. Originally, the curtain doesn't move, but with a slight alteration, the wave starts:



Fig. 36: Curtain oscillation.

Perturbation of Kelvin-Helmholtz also in other's structures bigger, as Orion Nebula or even in the Sun:

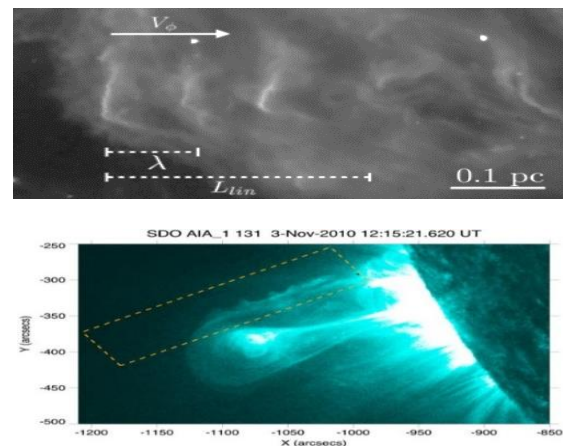


Fig. 37: Kelvin-Helmholtz perturbation in Orion nebula and Sun.

These perturbations or disturbances, also can be the origin of galaxy arms.... This perturbation of Kelvin-Helmholtz, are very spectacular; we can think about this disturbance, as a brake wave, more or less:



Fig. 38: Some examples for Kelvin-Helmholtz disturbances, in clouds.

Is possible to see these specials geometries in stones; the origin, is the same: little disturbance.



Fig. 39: Kelvin-Helmholtz disturbances in stones or mountains.

As a Viscosity before, there are time gap between 2 particles. This gap can produce vortex as geometry: 1 particle want follow other particle with different directions; the geometry path, can be a Vortex or turbulence:

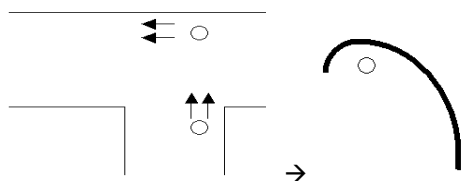


Fig. 40: Turbulence generation, by gap time.

→ Tests for validation: make in CFD software:

Main goal: analyze the creation of Kelvin-Helmholtz disturbances in 2 fluid bands.

Rectangular region with 2 fluids bands (blue, green) (not chemical reaction). Is possible to change:

- Viscosity, density, pressure, temperature of fluids
- Chemical composition.
- Velocity of fluids translation.

Is possible start this analysis in 2D, and after, in 3D (other dimension very important - Rayleigh-Taylor effect).



Fig-test-5.

## \*Results and Analysis:

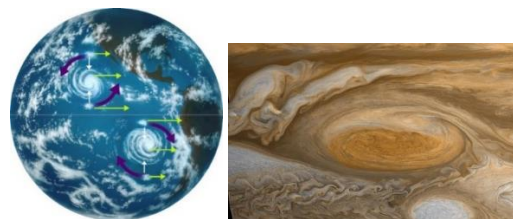
### 5.4. Atmosphere dynamic in gaseous planets.

Having a gaseous planet with bands already formed, the dynamics that occur is quite simple: from a Kelvin-Helmholtz disturbance, more and more disturbances arise, producing those magnificent images for example of Jupiter; obviously, other's factors are very important also: convection, solar heating, condensation and may be other's factors.



Fig. 41: Turbulences in Jupiter

The Coriolis effect, produce in these alterations a rotation, producing spots, hurricanes, etc....:



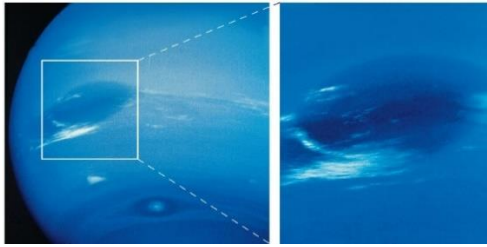


Fig. 42: Spot in Jupiter and Neptune.

It is therefore sufficient to establish the bases by which the bands originate.

- The centrifugal force tends to "classify" the fluids in bands, depending on the density.
- Fluids with the same viscosity tend to join.

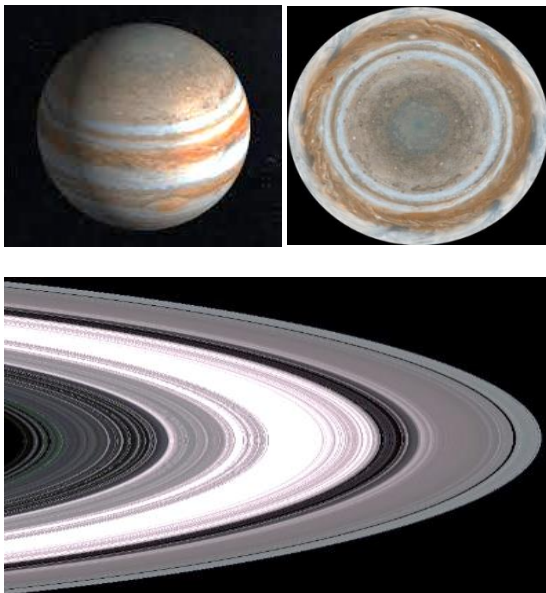


Fig. 43: Bands in Jupiter and Saturn belt.

→ Test for validation: make in CFD software:

Main goal: Analyze the bands formation in a mix of fluids in rotation.

Cylinder with two fluids (not chemical reacting), in rotation. Obviously, with possibility of change temperature, density, viscosity and pressure of fluids.

The cylinder rotate with a velocity particular. Obviously is possible to change this velocity. The cylinder wall have the property of simetry (not energy loss). Is possible start this test, in 2 Dimensions:



Fig-test-6.

## \*Results and Analysis:

### 6. PATHS IN THE UNIVERSE

Different methods or ways, for generating paths.

#### 6.1. Low pressure tube, and Viscosity:

See points in Galaxy formation.

#### 6.2. Low pressure:

First, one particle, tend to go where the Pressure is less (without external forces and viscosity). But the direction and acceleration or velocity, may be also depend of other's forces as a gravity ("g") (external force): if the gravity pull more than pressure, the particle, change its direction. So one particle, tend to go with the direction of the next value (acceleration):

$$\frac{P}{\rho} + g \quad \text{Eq. (18)}$$

Is incredible, but this expression and concept, is the origin of Navier-Stokes equations, that will be the objective in Article "NAVIER STOKES EQUATIONS IN THE UNIVERSE".

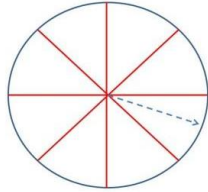
A system of particles tends to disorder, because it is simply the most likely: a book is thrown in the air completely undone in individual sheets: it will reach the floor in the form of a book completely ordered page by page?: it is not probable ....

It need an energy definition. It can define this Energy, as a Pressure:

The path of one particle, is the path with the minimum pressure. Also, the pressure work as a density; one particle will be where there is less density. So is

possible create algorithms in order to create the path for any particle.

Give a particle and give “sectors” in a sphere with center the particle:



$$u^{n+1} = u^n - \frac{1}{\rho} \nabla p$$

Eq. (19)

Fig. 44: Possible paths from a particle in center.

The particle will move toward the bisectriz (half angle line) of sector, with the least density; this movement, with a delay time (viscosity) (step by step).

Let  $P=u^2\rho$  ; “u” and “ρ” depend of 3 variables (x,y,z). But now, work only in “x” variable.

$$\begin{aligned} \frac{\partial P}{\partial x} &= 2u \frac{\partial u}{\partial x} \rho + u^2 \frac{\partial \rho}{\partial x} \\ \frac{\partial P}{\partial x} &= 0 \rightarrow \frac{\partial u}{\partial x} \rho = -\frac{1}{2} \frac{\partial P}{\partial x} \\ \frac{\partial P}{\partial u} &= -2\rho \end{aligned}$$

Eq. (20)

So if velocity is greater, then the density is smaller.

It need to know what is the direction of particle movement “X1”, if we know the direction of particles “X2”, “X3” and “X4”:

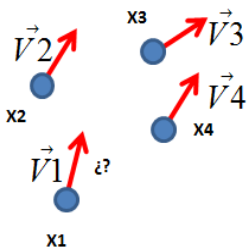


Fig. 45: Directions particles in a group.

$$\vec{V}_1 = \frac{\vec{V}_2 + \vec{V}_3 + \vec{V}_4}{3}$$

Eq. (21)

→ Test for validation: make in Matlab, Mathcad, C++ or similar (programation):

Main goal: Create CFD code, from “low pressure” direction of movement.

Particles set in a box (start in 2 dimensions), and apply “low pressure” movement as a condition.

## \*Results and Analysis:

### 6.3. Minimum energy:

Any particle, tend to walk with the minimum energy “E” (Kinetic Energy ( $E_K$ ), Potential Energy ( $E_P$ )):

$$E = E_K - E_P \quad \text{Eq. (22)}$$

In the particular case about a particle in orbit with “n” masses: (“V” velocity, “M” and “m” masses, “G” constant gravitation, “r” vector between the 2 masses):

$$\frac{1}{2} m V^2 + \sum_{i=1}^n \frac{GM m_i}{r} = \text{minimum} \quad \text{Eq. (23)}$$

But, the gravitation action (potential energy), is not an action with velocity infinite: the speed of gravitation is the speed of light. This value is the “gap time action” (viscosity).

In this Potential Energy, in order to have more accuracy (real so), is necessary to add the Viscosity force (as a magnetic force or similar) and other’s forces.

### 6.4. Brownian and DLA movement:

When a particle comes in contact with another particle, it remains attached to it. If the particles reach the seed particle describing random walks, it is called DLA or movement of aggregates by limited diffusion:

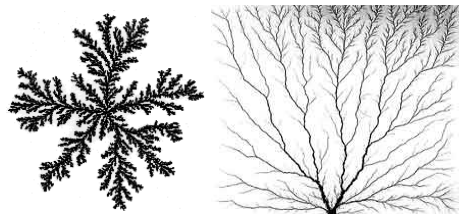


Fig. 46: DLA: Ice and lightning.

What is this factor-attraction between particles? The Viscosity (and the gravity). That is the



same applied to humans and feelings. Is a combination between Brownian movement and Viscosity.

About Brownian movement:

Brownian and not Brownian motion (very sensible to random motion limits); is practically impossible, to have a Brownian fully aleatory.

```

x1 := 0 y1 := 0    i := 1..100000
alea1i := if(mrd(1) < 0.5, -0.1, 0.1)
alea2i := if(mrd(1) < 0.5, -0.1, 0.1)
xi+1 := xi + alea1i
yi+1 := yi + alea2i

```

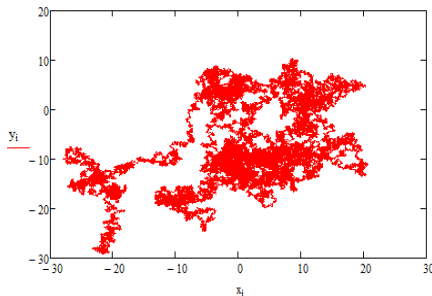


Fig. 47: Brownian movement typical.

```

x1 := 0 y1 := 0    i := 1..100000
alea1i := if(mrd(1) < 0.505, -0.1, 0.1)
alea2i := if(mrd(1) < 0.505, -0.1, 0.1)
xi+1 := xi + alea1i
yi+1 := yi + alea2i

```

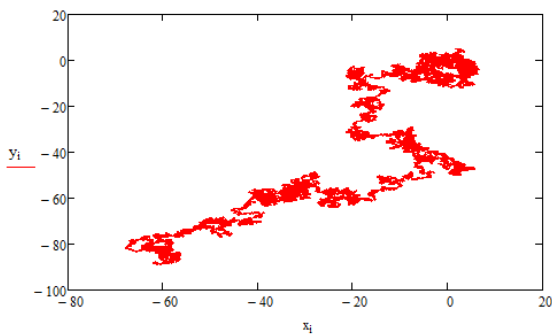


Fig. 48: Brownian movement conditioned (only 0.5%). Very good "filament"....

The Brownian movement full aleatory, is less probable.

This is the easiest method to decide: do not worry about the decisions of your environment.

Decide for yourself, with or without weights in some decisions. The path produced by this movement, is a tube of low pressure (see formation Galaxy point), so the matter, tend to aggregate in this zone-tube.

**6.5. Navier Stokes equations:**

See third Article.

➔ Test for validation: make in CFD software.

Main goal: Create Cosmic web.

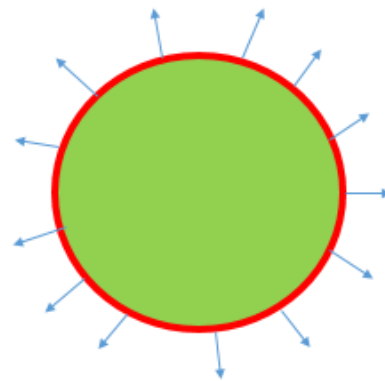


Fig-test-7.

From a matter distribution initial in center (Background Cosmic Microwaves), expand this distribution from vacuum pressure in red line, applying Navier Stokes equations and low pressure movement (without gravity), with 2 fluids (main fluid in sphere and other fluid as a fluid-evolution seed).

Changing density, viscosity, temperature, pressure of fluid, and pressure suction.

**\*Results and Analysis:**

**7. LARGE SCALE MATTER DISTRIBUTION**

Today, there are a lot simulations in order to create the matter distribution in the universe in large scale (filaments), from Distribution matter in Background cosmic microwave. And the accuracy is very good.

There are a lot similarities or patterns, between Cosmic Web and other's phenomenon as a Neurons, but also in Brownian and DLA movement, etc....:

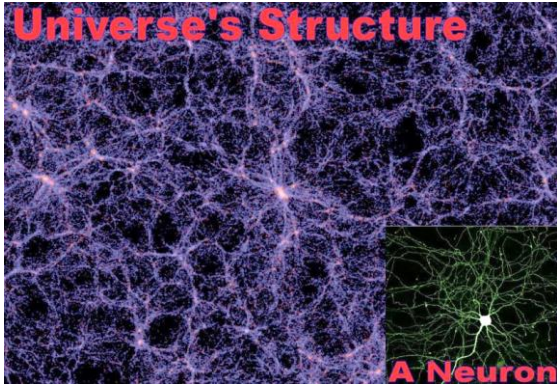


Fig. 49: Pattern between cosmic web and neuron and Lights in Europe.

Why? Because the dynamic or generation laws are the same or very very similar.

In point before, it show all methods or principles, that from the, is possible generate the cosmic web (obviously plus gravity, but that, is possible to add in Navier Stokes equations).

The basic structure in universe as a skeleton, is a dark matter: there are a different viscosity and density between "normal" matter and dark matter, and that, generate the paths.

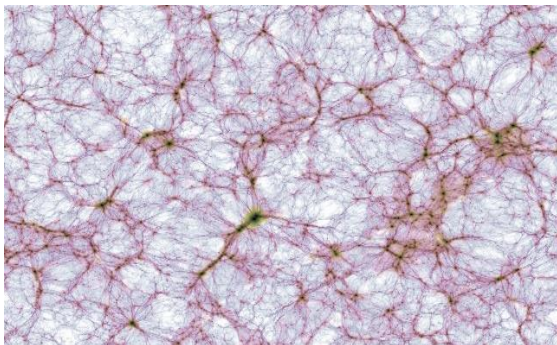


Fig. 50: Large scale matter distribution.

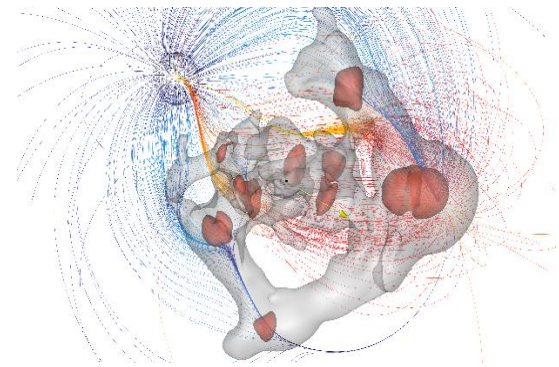
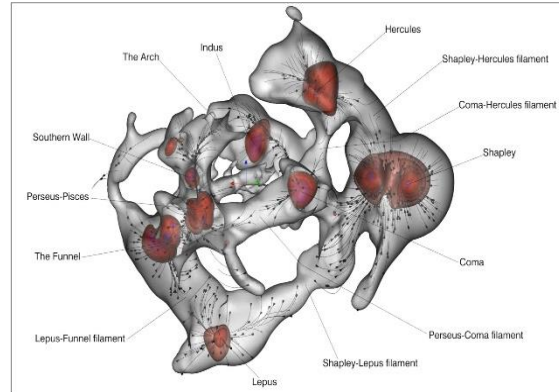


Fig. 51: Paths in and over skeleton-dark matter.

➔ Test for validation: make in CFD software.

Main goal: Create Cosmic web.

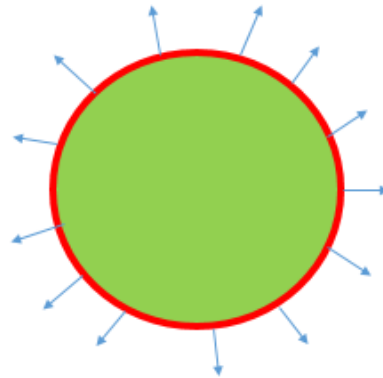


Fig-test-8.

From a matter distribution initial in center (Background Cosmic Microwaves), expand this distribution from vacuum pressure in red line, applying Navier Stokes equations and low pressure movement (with gravity), with 2 fluids (main fluid in sphere and other fluid as a fluid-evolution seed or dark matter).



Changing density, viscosity, temperature, pressure of fluid, and pressure suction.

## **\*Results and Analysis:**

### **8. CONCLUSIONS**

It now so, how the matter work, for aggregating between them. The gravity is important, but also the pressure, density, temperature and viscosity.

### **9. ACKNOWLEDGMENTS**

All my family, for its patient and love.

### **10. I'M LOOKING FOR**

I'm looking for a University in order to allow time for researching, teaching and publishing.

### **11. FUTURE WORKS**

This Article, is the first of a Serie called "Paths in the Universe". Is a new theory able to simulate from Expansion Universe, to Stock Market evolution, or Formation and Dynamic of Galaxies, matter distribution, even feels humans. It is necessary to explain a general behavior in future, not a particular. All dynamic event in the cosmos, are a wave.... And as a wave, is necessary to study it. It is necessary to detect patterns in numeric models that describe the events, and then, it will be easier to detect patterns between events: finding similarities between phenomenon's and numeric models.

Next Article: "NEW MODELS ABOUT EXPANSION OF THE UNIVERSE"; second Article of Serie: "PATHS IN THE UNIVERSE".

## NEW MODELS ABOUT EXPANSION OF UNIVERSE

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### ABSTRACT

There are several numerical models, to explain how is the expansion dynamics, like the equations of Friedmann-Lemaître-Robertson-Walker. But it is a model that is very simple to explain, for example, the variation of pressure or density, and other important values, and more: is only possible an acceleration negative. In this article new concepts and new procedures are defined, to obtain a more useful numerical models that are able to describe the dynamics of the Expansion of the Universe (positive or negative), as well as the evolution of diverse variables that participate in the phenomenon, as a variation density and pressure, and even the acceleration. In these new created numerical models, expressions are established to calculate certain values of the intergalactic medium (such as density, viscosity, pressure, force), considering it as a fluid, which will be very useful in later articles, to know the evolution and interaction of matter in the Universe. And other think more important: is possible other vision about Dark Energy, as force, not as a matter or particle. It describe expansion Universe model as a spring damper set, as energy from vacuum or low pressure and also and finally, from Navier Stokes equations.

This Article serie called "PATHS IN THE UNIVERSE", have 3 titles:

- Matter dynamic in the Universe.
- New models about Expansion of the Universe.
- Navier Stokes equations in the Universe.

### 1. INTRODUCTION

If you look at the distances that separate us from the galaxies that are not in our local group, you will see that they are moving away from us. That is to say: the Universe is expanding. Edwin Hubble already validated this fact experimentally by measuring the distances and speeds of many galaxies, and created a numerical model that expressed the linearity between distance and speed, whose constant is called the Hubble constant. Recent observations have shown that this relationship is not linear, and some more important: the Universe is

expanding with acceleration ( $H=H(t)$ ). Why is it expanding and how? This expansion, will be end? They are 3 very important questions that currently, do not have totally satisfactory or real answer. All explanations are hypothesis, which as such, must be demonstrated, and explain the reality. One of the most accepted but not validate, is that there is a kind of dark energy, which works as the opposite of gravity, that is: repelling instead of attracting. In fact, the evolution of length parameter ("a") in axis vertical, from big bang, against universe time in axis horizontal, from now: is possible see that from end inflation period to more or less 7500 million years, there are an acceleration negative, because the density was bigger than expansion force. From this date to actuality, surprise and Nobel prize so, there are acceleration positive (the gravity force was less than "dark force-energy"):

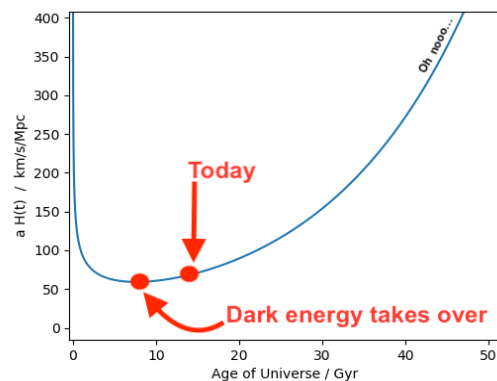


Figure 1: "H" against Universe time in Gyr.

### 2. HYPOTHESIS

Hypothesis 1: Non Homogeneous Universe.

Hypothesis 2: Non Isotropic Universe.

### 3. VELOCITY AGAINST DISTANCE EXPANSION MODEL

In a city traffic, when the speed of cars is bigger, the separation between the, also in bigger:



Figure 2: Separation vehicles with low and high speed.

Today, we know that in Hubble expression ( $V=Hx$ ), (wrong may be??),  $H=H(t)$ ; that is: there are an accelerate expansion of Universe.

But, the “Expansion Velocity” depend of Pressure and Density also (“x” space length), (nomenclature from first Article in this serie) (“a” and “b” > 0):

$$V_E = function(x, P, \rho) \quad \text{Eq. (1)}$$

$$V_E \propto \frac{1}{\rho^a P^b} \quad \text{Eq. (2)}$$

$$V_E = H \frac{1}{\rho^a P^b} x$$

#### 4. VACUUM ACCELERATION EXPANSION

Between 2 zones with different pressure, there is pressure difference which produce an acceleration “a” (high to low pressure): pulling with an acceleration “a”:

$$a = \frac{1}{\rho} \frac{\partial P}{\partial x} \quad \text{Eq. (3)}$$

What is the origin of this Acceleration – Suction, as a Dark Energy action? It know perfectly, that the Bing Bang, is not an explosion or blast (is a space expansion). But, is perfectly possible to assign it an analogy with a wave-shock. In any wave shock produce by a blast (big bang for example), there are a zone of high pressure (wave front) and after, other wave or zone of low pressure. This zone, produce (without any drag) one acceleration: next images about wave explosion propagation with simulation CFD techniques (test made with Star CCM+ as a CFD code: simulation in 3D (cut plane view), 10 km diameter sphere, 14.5 million mesh cells, explosion of dynamite into air dry, K-epsilon turbulence model):

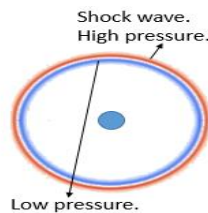


Figure 3: Pressure contour of wave blast.

The front-shock wave, have only 2 brakes (drag): viscosity and mass (gravity).

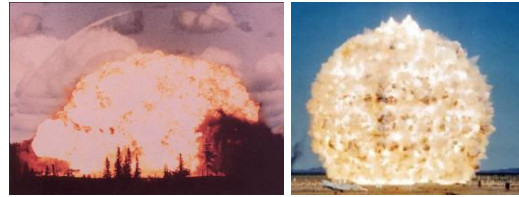


Figure 4: Explosions and wave shock.

It can see the low pressure rear in any car (any wave shock) (simulation CFD techniques (test made with Star CCM+ as a CFD code: simulation in 3D about Pikes Peak race car, 11 million mesh cells, air dry, K-epsilon turbulence model, wheels and ground moving, 250 km/h speed):

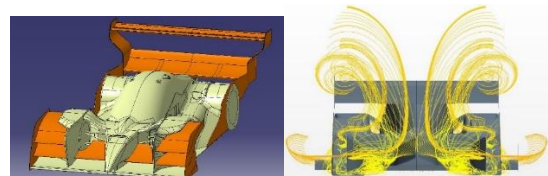


Figure 5: Low pressure in rear car zone.

The pressure profile in any blast wave is (the wave may to be an oscillations (positives and negatives) in time):

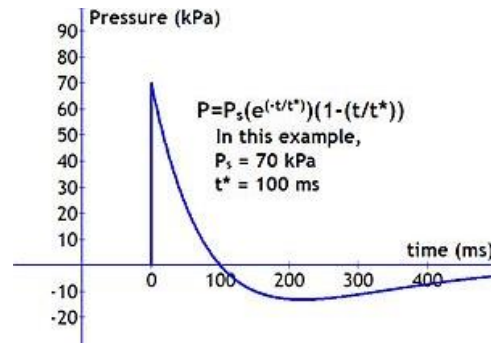


Figure 6: Friedlander waveform sample for any explosion.

The zone or zones, with negative pressure, the “dark energy”, work (the dark energy change in time), producing acceleration-suction (with positive pressure, work but pushing).

Even, is possible combine (Fig. 1) and (Fig. 6): is possible that in the future, there are variations positives and negatives in dark energy:

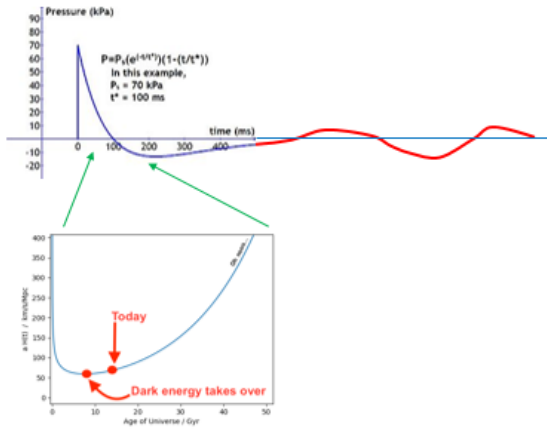


Figure 7: Evolution Dark Energy force.

5. SPRING – DAMPER EXPANSION MODEL

Considering that the viscosity of universe work as a damper; also, the mass (gravity) and density so, work as a spring. So (“Ks” is a value of spring constant, and “Kd” diffusivity of Damper) (is possible that “Ks” and “Kd” non-constants) (Vacuum(Force)=Fv):

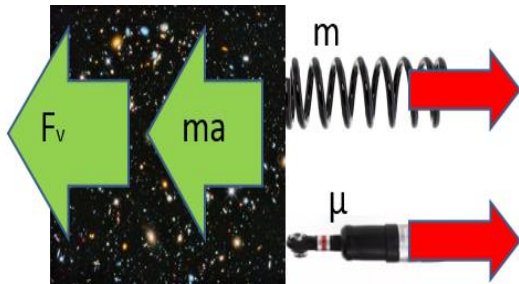


Figure 8: Spring-Damper model representation.

$$F_v - K_s x - K_D \frac{\partial x}{\partial t} = ma \quad \text{Eq. (4)}$$

About the constants (in general form):

$$K_s = \text{function}(\text{mass}, x) = f(m, x)$$

$$K_D = \text{function}(\text{viscosity}, x) = g(\mu, x)$$

Eq. (5)

Is possible suppose that (reasonable option):

$$K_s = x$$

$$K_D = \text{Velocity} = V \quad \text{Eq. (6)}$$

Kinetic energy + Potential energy, is constant  
“K”:

$$V^2 - \frac{2Gm}{x} = K1 * \frac{2}{m} = \frac{K}{m} \quad \text{Eq. (7)}$$

Is possible calculate the Critical Density (V=0):

$$* \quad \text{Eq. (8)}$$

Finally, is possible to know the conditions for Universe in contraction or expansion:

$$* \quad \text{Eq. (9)}$$

Finally:

$$K_D \frac{\partial x}{\partial t} = K_D V = F_{viscous} \quad \text{Eq. (10)}$$

$$K_S x = \text{Force(Gravitational)}$$

**\*Numerical-values analysis:**

6. NAVIER STOKES DYNAMIC-EXPANSION MODEL

It create a numerical model, from equation analyzed in Article “NAVIER STOKES EQUATION IN THE UNIVERSE”, based in Navier Stokes equations, with Continuity equation:

$$\rho \left( \frac{\partial \vec{V}}{\partial t} + \vec{V} \nabla \vec{V} \right) = -\nabla P + \rho \vec{g} + \beta \nabla \vec{V} + \mu \nabla^2 \vec{V}$$

$$\frac{\partial \rho}{\partial t} + \nabla \vec{V} = 0$$

$$\beta \nabla \vec{V} \quad \text{Eq. (11)}$$

Is the “Cosmological acceleration factor” and “β” the Coefficient. In this case, is possible to work in one dimension (universe is a sphere); so (“g” gravity



acceleration, “a” is a scale factor – traditional nomenclature in Cosmology, “G” constant gravitational), the Navier Stokes equation, are:

$$\rho \left( \frac{\partial V}{\partial t} + V \frac{\partial V}{\partial x} \right) = -\frac{\partial P}{\partial x} + \rho g + \mu \frac{\partial^2 V}{\partial x^2} + \beta \frac{\partial V}{\partial x}$$

Eq. (12)

$$\begin{aligned} \frac{a}{a} &= H(t) & m &= \rho \frac{4}{3} \pi a^3 \\ g &= \frac{Gm}{a^2} \end{aligned}$$

$$a + H^2 a = -\frac{1}{\rho} \frac{\partial P}{\partial a} + \frac{Gm}{a^2} - \frac{\mu H}{\rho a} + \frac{\beta}{\rho} H$$

Eq. (13)

If Acceleration is 0:

$$H^2 = \frac{4\pi G}{3} \rho - \frac{\mu H}{\rho a^2} + \frac{\beta}{\rho a} H$$

Eq. (14)

Is possible to derivate this expression:

$$* \quad \text{Eq. (15)}$$

The Friedman equation is (“c” speed of light, “ρ” density universe, “K” curvature Universe, “Λ” Cosmological constant):

$$H^2 = \frac{8\pi G}{3} \rho - \frac{K C^2}{a^2} + \frac{\Lambda}{3} C^2$$

Eq. (16)

$$-\frac{\mu H}{\rho a^2} + k1 \frac{4\pi G}{3} \rho = \frac{-K C^2}{a^2}$$

$$\frac{\beta}{\rho a} + k2 \frac{4\pi G}{3} \rho = \frac{\Lambda}{3} C^2$$

Eq. (17)

$$0 \leq (k1, k2) \leq 2$$

$$k1 + k2 = 2$$

Is possible calculate the critical density:

$$\rho_{critical} = \frac{3H^2}{4\pi G}$$

Eq. (18)

This Critical density from Navier Stokes, is double than critical density from Friedman. So, may be:

$$H_{new} = \frac{H}{\sqrt{2}} \quad \text{Eq. (19)}$$

Finally, is possible to know the conditions for Universe in contraction or expansion:

$$* \quad \text{Eq. (20)}$$

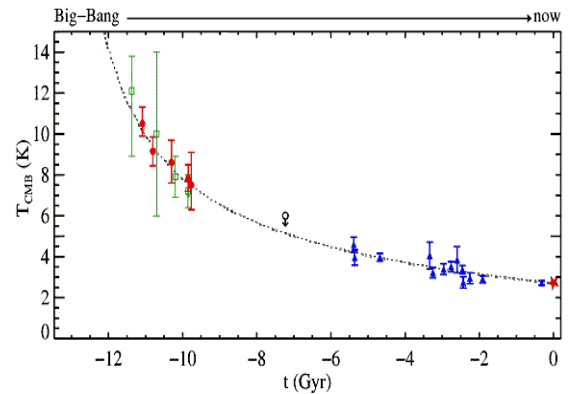
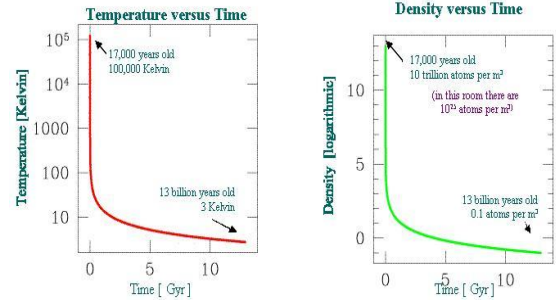
## \*Numerical-values analysis:

### 7. DATAS FOR VALIDATING THE MODEL WITH THE TEMPERATURE

Is very interesting including Temperature in this study or model.

$$\rho V^2 = P \propto \rho T$$

About Density and Temperature in Universe history or evolution from big bang:





$$\rho_{mass} = (0.5 GeV / m^3) \left[ \frac{T}{2.7K} \right]^3$$

$$T(t) \approx 10^{10} K \left( \frac{t}{1 s} \right)^{-1/2}$$

$$t_{exp} \approx \frac{4 \times 10^{20} s K^2}{T^2}$$

## **\*Study, Analyze and Validate the model:**

### **8. CONCLUSIONS**

Now, it show two special models about Expansion of the Universe from spring-damper and Navier Stokes equations. Two models with specials variables as a pressure, density, velocity, acceleration and eve, Cosmological constant. Even, it show the analogy between Friedman equations as a traditional equations for a Cosmology, between model from Navier Stokes equations. And finally, it show a new concept about dark energy, as a force and acceleration, produced by low pressure-vacuum.

### **9. ACKNOWLEDGMENTS**

All my family, for its patient and love.

### **10. I'M LOOKING FOR**

I'm looking for a University in order to allow time for researching, teaching and publishing.

### **11. FUTURE WORKS**

Next Article: "NAVIER-STOKES EQUATIONS IN THE UNIVERSE"; third Article of Serie: "PATHS IN THE UNIVERSE".



## NAVIER STOKES EQUATIONS IN THE UNIVERSE

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### ABSTRACT

Is necessary to detect patterns in numeric models that describe the events, and then, it will be easier to detect patterns between events: I find similarities between phenomenon's and numeric models.

It try to create a theory for explaining the distribution and evolution of matter in the Universe in large scale, galaxies dynamic, Universe expansion, Dark matter and dark energy, etc.

But also is possible to apply this theory, in others fields as economy, human's relations, people flocks, stock market, feelings human, etc....

It try to explain a general behavior in future, not a particular. All dynamic event in the cosmos, are a wave.... And as a wave, is necessary to study it.

Richard Feynman:

- "MATHEMATICS. To those who do not know mathematics it is difficult to get across a real feeling as to the beauty, the deepest beauty, of nature. If you want to learn about nature, to appreciate nature, it is necessary to understand the language that she speaks in."
- "A theory for a scientist, even it is your most desired wish, even if you have invested a lot of time, even if you have married, if not explain the reality, the theory is wrong".

Albert Einstein:

- "Look deep into nature, and then you will understand everything better."

A perfect and full description and analysis of Navier Stokes equations, is essential and necessary so.

This Article serie called "PATHS IN THE UNIVERSE", have 3 titles:

- Matter dynamic in the Universe.
- New models about Expansion of the Universe.

- Navier Stokes equations in the Universe.

### 1. INTRODUCTION

The main goal for any mathematician is create numeric models about nature phenomenon. For that, is necessary discovery (or create) patterns, and if is possible lineally, but that, is not easy, and normally not real. Maybe, that the phenomenon witch is studied (numeric model), have more laws or different laws or even more or less laws, but our numeric model, explain the phenomenon; a typical case of atoms and electrons in circulars orbits.

As a writer, a mathematician thinks with a language and as all language have their rules, their pretty rules....

Is very nice is front a white paper and write ideas and translating dreams....

The fact of call one event as unpredictable is to assume ignorance. Our goal so, is know the evolution (temporal or spatial) of any object or event, from similarities. In the nature, there are a lot of think very estranges, about patterns:

- Benford law, applied for example, in distances of galaxies (distribution in space) (Timoteo Briet Blanes – 2017): (brown=Benford, yellow=data 4.000 galaxies):

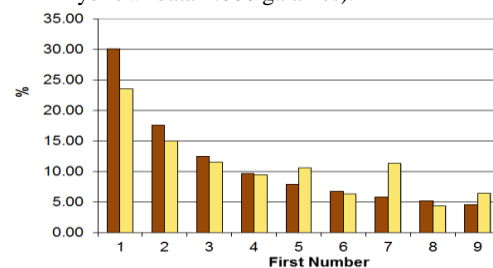


Fig. 1: Benford diagram galaxies distances.

Generation on Lissajous curves from different cases: electronic control, lift or downforce against position in a vibrating wing, etc... (Timoteo Briet Blanes – Thesis Doctor "Aero Post Rig Analysis"):

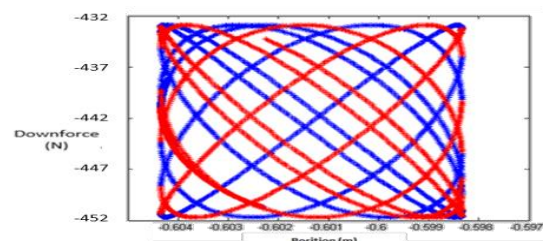


Fig. 2: Lissajous curves in flapping wing.

Input-output signals, with delay, generate Lissajous.

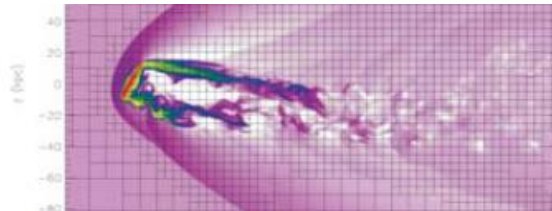


Fig. 3: Vortex Karman street, in different scales as a turbulences in cylinders, atmospherics events, tail in striped galaxies, etc....:

Is possible to see the vortices-disturbances created from the Kelvin-Helmholtz effect, also in different scales: clouds, Orion Nebula:

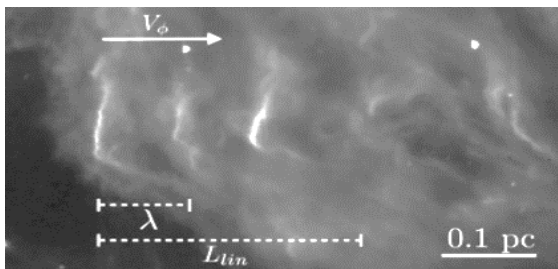


Fig. 4: Turbulences in clouds and Orion nebula.

Also, in a lot cases, is not possible to see some pattern or some think as that, but is possible analyze the phenomenon in order to find a pattern.

For example, in a Meteorites rain (Quadrantides - Josep Maria Trigo - temporal data January 1992), is possible to create a graphic, with “d<sub>i</sub>” the detection instant of meteorite “i”, d<sub>i</sub> – d<sub>i-1</sub> against d<sub>i-1</sub> – d<sub>i-2</sub>. Is possible detect and analyze one geometry multifractal (may be because there is a random variable....) (Vicent Martínez García - University Valencia - Spain) on this graphic (Timoteo Briet Blanes - 1993).

And more: is possible to see some phenomenon or properties about fluid mechanic, in objects or particles dynamic.

For example, Bernoulli principle in accumulation or exit of people from sport stadium, also sheep out of a stable, even is possible apply fluids theories in vehicles traffic in cities, etc....

About the phenomenon prediction, if there are few laws which define him, it will be more complicated know the evolution (chaos essence).

From all that is necessary to ask us, if there some think common for all these cases, some law able to means these examples.

That is the main goal for me and this article: know how the nature think and decides, and create language mathematics, pretty and simple, in order to explain any event, as a fluid. For example, get a fluid with density “ρ” constant; get a space in 2D and get u<sub>i,j</sub> velocity horizontal in point (i,j) and v<sub>i,j</sub> vertical velocity in the same point:

$$A = u_{i+1,j} - u_{i,j} + v_{i,j+1} - v_{i,j}$$

So A=0, or the same: variation zero of the mass:

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0$$

: Continuity equation or divergence zero; that is, with language mathematic is possible explain the nature.

To know the evolution of any event means the introduction may be of a probability of to be or not to be (Multifractal geometry in meteorites rain). That is very important.

Can you fight the flow of a brave river trying to reach the edge? Surely it will be useless, but you can try.... Every person has his own will and is able to choose

his destiny or movement as a decision or choice, but the group dilutes that will; It might even alter your environment, but only the environment .... A person solitary, is unlikely to originate or produce a "different" evolution of the whole; but it will be able to do so, only in the case of being able to generate a great impact that affects many people: the union, it makes force.

When one speaks of "power," power is the ability to influence large numbers of people. The birds, don't know what is the geometry of a flock, but hi flights and moves....

Who, when a very dear one has died, has not thought that the world is going to stop, that the sun will not come out any more, or that everything will change, or that he will telephone on your birthday to congratulate you. Really the sun does not come out the same way and with the same beauty, but the world follows, and despite what happened, everything remains the same.... and never phone....

I need understand the cosmos, but I and my actions, are very and quite insignificants....

There is a special relation between sloth or minimum energy principle and fluid dynamics. If I must to go from here to there, yes; I will go. But, with the minimum energy,,,, If it ask question about universe, it would be able to understand it....

## 2. GEOMETRIES SIMILARS IN THE NATURE

Some similarities between fluids and others phenomenon's in the nature:

### a. COANDA EFFECT / VISCOSITY / BOUNDARY LAYER:

Street laterals, people manifestation:



Fig. 5: People manifestation in street.

### b. BERNOULLI EFFECT:

Sheeps:

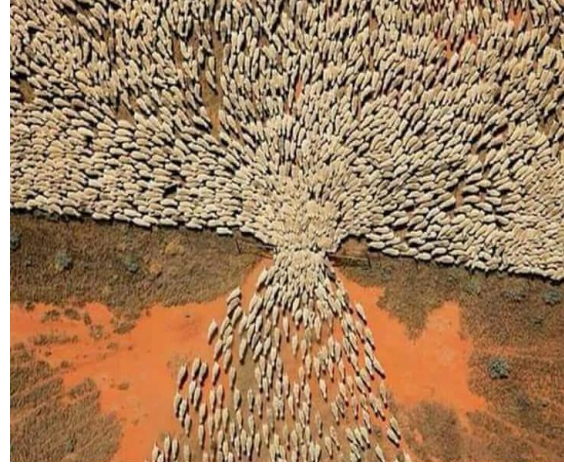


Fig. 6: Opening "box" with sheeps.

This geometry is very similar to nozzle exhaust; and not only the geometry, also the density or pressure field:

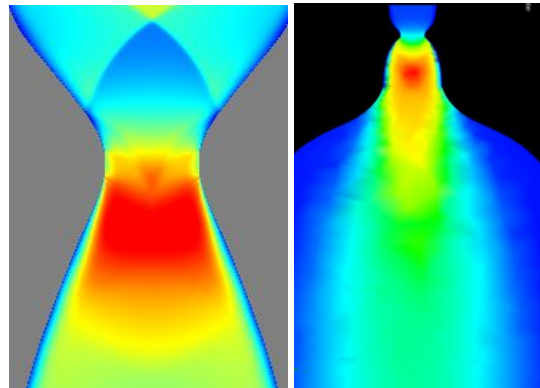


Fig. 7: Nozzles and sheeps.

3. NUMERICAL MODEL SIMILARS IN THE NATURE

a. PREY AND DEPREDATOR NUMERIC MODEL:

“x” number prey and “y” number predator:

$$\frac{dx}{dt} = ax - bxy$$

$$\frac{dy}{dt} = -cy + dxy$$

Eq. (1)

Is a model very simple with “x” and “y” initials, and point fix (a/b, c/d):

$$\frac{dy}{dx} = -\frac{y}{x} \frac{dx - c}{by - a}$$

Phase space:

$$V = dx - c \ln(x) + by - a \ln(y)$$

Some images with different “x” and “y” initials, and “a”, “b”, “c” and “d”:

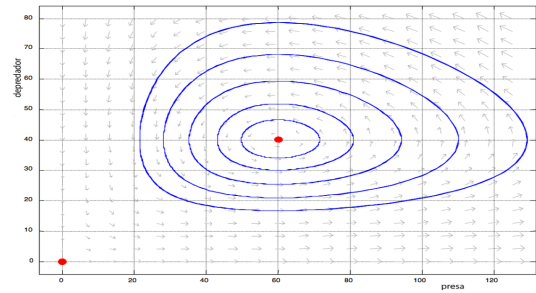
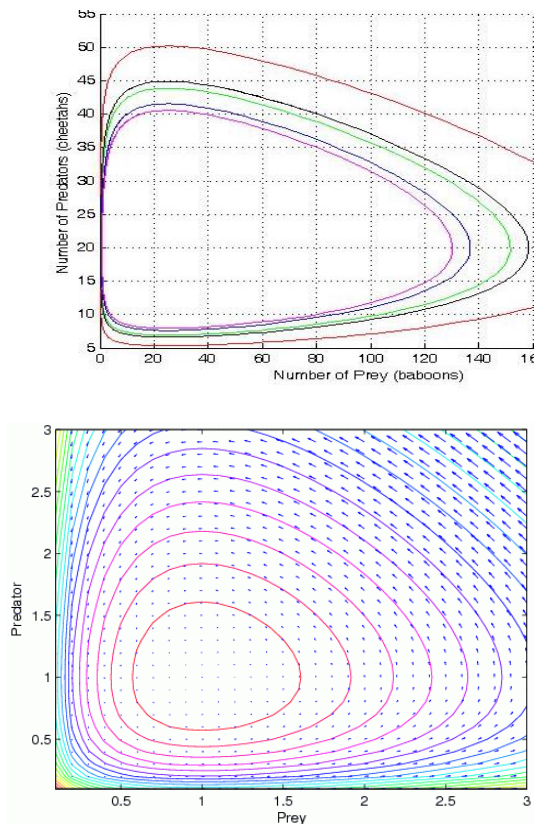


Fig. 8: Representations with different initial values.

This geometry concept is very similar to:

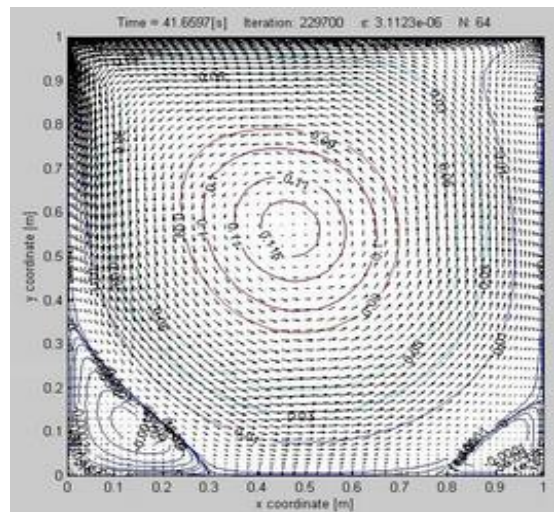
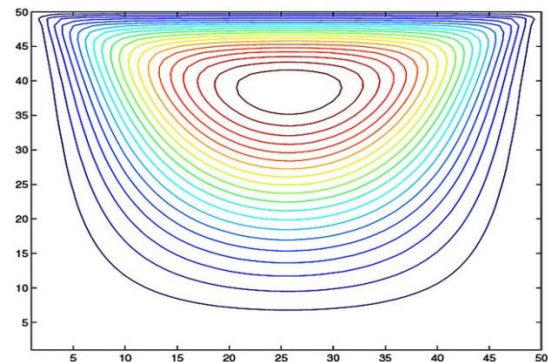


Fig. 9: Typical Cavity problem fluids.

In the 2 last images, they are the representations of pressure lines in a cavity with a fluid in movement.

Geometries very similar, numeric model, so, must to be also similar....

In these representation of space phases, is possible to change the orientation and scale, of axis. In the next image, we can see the movement of a flock-group of

sheep, in particular, in corner left down (and the zoom of this zone):



Fig. 10: Sheeps.

Is possible to know the vortex center in these models? yes. When the variation of each variable (axis) is zero.

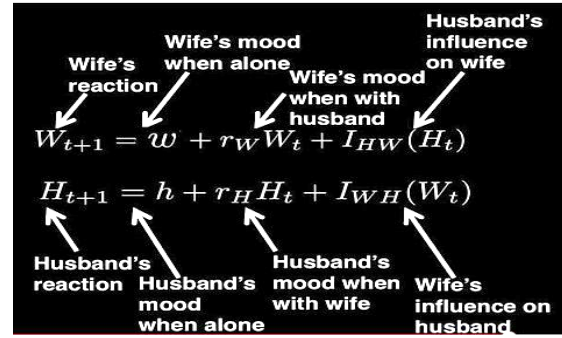
**b. ROMEO AND JULIET MODEL:**

The same happens in a love equations between two peoples (Romeo and Juliet model); I love more a girl (H) if the girl (M) love me:

$$\begin{aligned} \frac{dH(t)}{dt} &= aM(t) \\ \frac{dM(t)}{dt} &= -bH(t) \end{aligned} \quad \text{Eq. (2)}$$

That is: the variation of my love to you, depend of your love to me.

There are other's equation of love, one bit more complicate (Hannah Fry), but basically, are the same:



Eq. (3)

**c. LANCHESTER MODELS:**

And finally, in the second world war, the Lanchester equations, for predicting an air combat ("A" and "B", number aircraft:

$$\begin{aligned} \frac{dA(t)}{dt} &= -bB(t) \\ \frac{dB(t)}{dt} &= -aA(t) \end{aligned} \quad \text{Eq. (4)}$$

So, are the Prey and Lanchester equations, some similarities as a phenomenon? Are the Prey, Lanchester and Love, events similar? There are also, equations for war "guerrillas":

$$\begin{aligned} \frac{dA(t)}{dt} &= -bA(t)B(t) \\ \frac{dB(t)}{dt} &= -aA(t)B(t) \end{aligned} \quad \text{Eq. (5)}$$

If the phenomenon is the "same", the numeric model also, but vice versa, is not necessary....

- In the Lanchester case eat aircrafts, and in the Prey case, eat animals, and if one go up, the other go down, with a gap or delay time.

- Basically, prey model and Lanchester model, are the same. It can transform:

$$ax - bxy \rightarrow x(a - by)$$

**4. NAVIER STOKES EQUATIONS**

The "traditional Navier Stokes equations, are:

$$\rho \left( \frac{\partial \vec{V}}{\partial t} + \vec{V} \cdot \nabla \vec{V} \right) = \nabla P + \rho \vec{g} + \mu \nabla^2 \vec{V}$$

**MASS**  
 Density of the fluid  
 $\rho$

**ACCELERATION**  
 How velocity experienced by a particle changes with time  
 $\frac{\partial \vec{V}}{\partial t} + \vec{V} \cdot \nabla \vec{V}$

**FORCE**  
 All the forces that are acting on the fluid  
 $\nabla P + \rho \vec{g} + \mu \nabla^2 \vec{V}$

$\nabla P$ : Internal pressure gradient of the fluid (the change in pressure)  
 $\rho \vec{g}$ : External forces acting on the fluid (such as gravity)  
 $\mu \nabla^2 \vec{V}$ : Internal stress forces acting on the fluid (taking into consideration viscous effects)

**Navier-Stokes Equations**  
 Describe the flow of incompressible fluids.

Eq. (6)

In the case of compressible flow, is necessary to add the Bulk Viscosity (“ $\beta$ ” Bulk Viscosity factor, “ $\vec{V}$ ” vector velocity, “ $\vec{g}$ ” gravity acceleration, “ $\mu$ ” viscosity, “ $P$ ” pressure and “ $t$ ” time):

$$\rho \left( \frac{\partial \vec{V}}{\partial t} + \vec{V} \cdot \nabla \vec{V} \right) = \nabla P + \rho \vec{g} + \beta \nabla \vec{V} + \mu \nabla^2 \vec{V}$$

Eq. (7)

Other form of the same expression is:

$$a = \frac{D\vec{V}}{Dt} = \frac{\nabla P}{\rho} + \vec{g} + \frac{\beta}{\rho} \nabla \vec{V} + \frac{\mu}{\rho} \nabla^2 \vec{V}$$

Eq. (8)

5. **SIMILARITIES WITH NAVIER STOKES EQUATIONS MODELS**

- a. In Research Article, Modelling Adopter Behaviour Based on the Navier Stokes Equation, Kazunori Shinohara and Serban Georgescu, simulate the paths of a crown people in an aquarium.

As a viscosity, work, in this Article, as an attractive force between people:

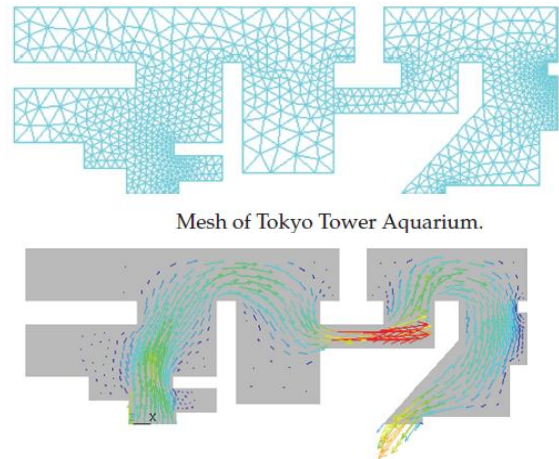
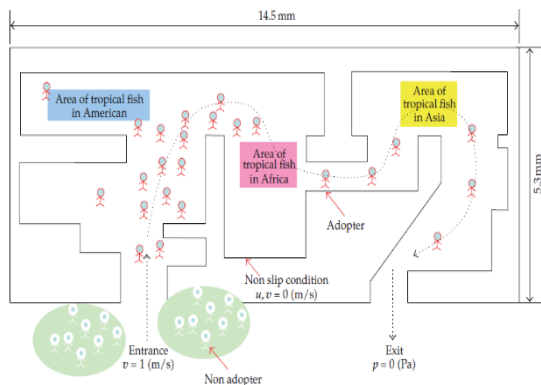


Fig. 11: Evacuation people process in CFD.

b. **BLACK-SCHOLES MODEL:**

Is a model for analyze the behavior of Stock Market (sell and call), and predict some prices in the future. The expression is very similar to Navier Stokes equations:

$$\frac{1}{2} \sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} + rS \frac{\partial V}{\partial S} + \frac{\partial V}{\partial t} - rV = 0$$

rate of change of rate of change  
 volatility  
 price of financial derivative  
 rate of change  
 price of commodity  
 with respect to  
 time  
 risk-free interest rate

Eq. (6)

Even, from this special equation, is possible create a Heat equation expression:

$$\frac{\partial u}{\partial t} = \frac{1}{2} \sigma^2 \frac{\partial^2 u}{\partial x^2}$$

c. **TRAFFIC OF PEOPLE:**

Is possible to simulate the car traffic or even the group or flocks of peoples in a city, working with fluids equations (streets as a tubes, semaphore as a valve, etc....).

From the Brownian movement in which the particles move without restriction, passing through aggregates of limited diffusion (DLA) where there is only one restriction or condition of movement, following the movement of planets, all the dynamics obey rules of movement between the particles that they make up the

group, extremely simple and easy: flocks of birds or pedestrians, are clear examples of this fact:



Fig. 12: Bird flock and peoples accumulation.

In both latter cases, the study of their dynamics allows the optimal design of evacuation systems for sports stadiums and risk protocols, for example.

d. **SCHRÖEDINGER EQUATION:**

$$i\hbar \frac{\partial}{\partial t} \psi(\mathbf{r}, t) = -\frac{\hbar^2}{2m} \nabla^2 \psi(\mathbf{r}, t) + V(\mathbf{r}, t) \psi(\mathbf{r}, t)$$

Eq. (7)

It can work so or considerer as a wave, all event in the universe.

$$\Psi(x, t) = Ae^{i(kx - \omega t)} = A[\cos(kx - \omega t) + i \sin(kx - \omega t)]$$

e. **ALAN TURING BIOLOGY EVOLUTION:**

Is a numeric model in order to predict the formation of patterns in the nature:



Fig. 13: Patterns in animal skin and evolution in chemical reactions:

$$\begin{aligned} \frac{\partial u}{\partial t} &= D_u \frac{\partial^2 u}{\partial x^2} + f(u, v) \\ \frac{\partial v}{\partial t} &= D_v \frac{\partial^2 v}{\partial x^2} + g(u, v) \end{aligned}$$

Eq. (8)

“u” and “v” are the concentrations of 2 axis. “Du” and “Dv” are the coefficients of diffusion of “u” and “v”, and “f” and “g” the reaction between.

We can see perfectly, the heat equation (diffusion), into Alan Turing equations.

We can see also this evolution is Voronoi schemes (the evolution of “point”, may be a reaction in function of time and also metric-distance):

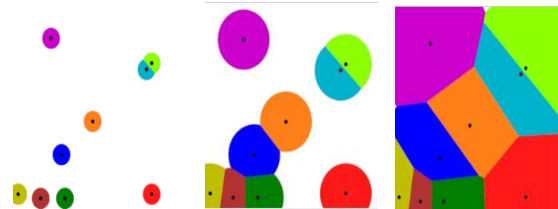


Fig. 14: Some Voronoi schemes evolution.

f. **SOME CONCLUSION ABOUT THESE MODELS:**

In these models before, the numerical models are very similar, so the phenomenon must to be also (may be....).

??¿ Schrödinger , Black-Scholes, Alan Turing:

In these 3 equations, we can see the diffusion equation (heat equation). This diffusion part, also is in Navier Stokes equations. If in Navier Stokes equations, the extern forces are zero, is possible create the Alan Turing model.

6. **EVENT**

Any concept, dependent of time; that is: dynamic. For example: ball position, aircraft velocity, economics values, temperature, petroleum price, etc....

7. **DEPENDENCE OR NOT, BETWEEN EVENTS**

A coin is thrown: what is the probability that it comes out face? The answer seems pretty obvious. But, and if it is known that previously the same coin has been

launched 50 times and has always has face? The answer is no longer so simple, besides that there are some explanations mathematically (Markov chain, etc....). Also analyze Bayes, Pascal and Anchenwall.

Does it therefore influence what is known a priori of an event in order to predict it? Does knowledge influence? Yes that influences, indeed: if you ask us if it's going to rain an hour, just look at the sky and know if there are many clouds....

Be 2 events; it is assumed that one of them varies and it is observed that the other event also varies or responds to the variation of the first. Are both events therefore dependents?

One could say yes, as long as these mutual variations are known over a suitably long time, since, perhaps, the second event varies "coincidentally"....

## 8. EVENTS REPRESENTATION

An event or a group of events, can be represented between them in the following ways:

- Through springs, dampers or shock absorbers and bars:

- Fixed bar (positive or negative): one event moves in the same proportion as another to the same direction.
- Spring: it is defined analogously to the bar, but with a force of repulsion or attraction, as a spring.
- Damper: it is a displacement damper, applicable to bars and springs. Is a try to enter the variable "time".
- Inerter. Is a try also, to enter the variable "time".

It is possible to apply "mass" to the event, in the form of "importance" or "transcendence", and others systems as damper inerter.

The options, therefore, of connections between events, are endless. All these relationships can work under linear and non-linear functions.

- An event is represented according to different "Coordinates", which are the variables on which the Event depends. The "Dimension" of the event is defined as the number of variables on which it is possible to represent it:

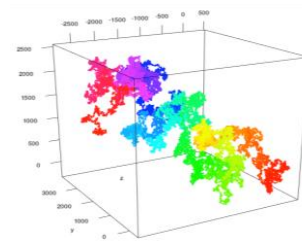


Fig. 15: Representation of some events in 3D.

The glass, is a material called "Amorphous":

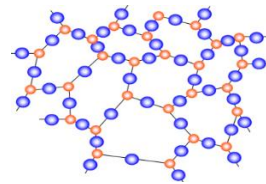


Fig. 16: Molecules in Amorphous object.

This material have the property of not transmit normally, a vibration. In fact, is possible think about the glass, as a material with a viscosity very high.

## 9. COMMENTS, IDEAS, HYPOTHESIS

### a. ECONOMIC MEASURES / SOFT MEASURES:

Front bulb in ship:



Fig. 17: Front bulb of a ship.

An economic measure is necessary that softens subsequent measures in order to mitigate the effects.

### b. DYNAMIC SLOTH:

The universe cools; less energy and more laziness; despite this principle the galaxies are moving away from each other, and increasingly faster ....

Suppose a spiral pipe; at the extreme, the fluid will leave with a tendency to follow a spiral path; but, the fluid, "hardly" will take anything to follow a straight path.



To the dynamics of the fluid, it does not cost him anything to become dissatisfied with a certain dynamic that "forces" him to "something".

An economic measure, will remain in time (its effects), if the means are put periodically, so that it lasts or remains.

If it want to divert a flow of fluid to a very "far" point, we have to place several "corrective" devices or adapters "along the trajectory, to reach our final objective, not just a device (or corrector) initially.

**c. CONSIDERATIONS ON THE WORLD CRISES:**

In the face of the evolution of an economic crisis, it always ask ourselves: "Even when?"

It do not know at all, when it will stop downloading, or when it will stop uploading in your case; but one thing is clear: at some point it will stop going down.

There is nothing that goes up or down forever; like a diver, no matter how deep the waters you dive, "always" there will be a time when you touch the bottom or reach your maximum depth.

To say that the economy rises and falls alternately, like a sawtooth, is to admit our ignorance of how it evolves; Besides, if he did not do it, it would be absolutely incredible to go up or down constantly ... Sure it would be surprised.

And another question:

Is there any merit in "leaving" that some stones, thrown into the sea, reach the bottom, is there merit in saying that they will reach the bottom?

Imagine a pool like an ocean; if we open the drain, sooner or later, it will empty...

The question always arises: "What to do".

All governments "try" to mitigate the effects of the crisis, "doing things" under the options and criteria, more or less successful, that mark or govern their ideologies.

But also, we can all verify, that these actions either have no appreciable effect, or are slightly appreciable in the very long term. If indeed it can see some effect, it is simply because the previous diver was already close to the bottom....

The world economy or global dynamics is the one that always prevails; it's like wanting to empty the sea, from glass to glass.

It is true that before a small action, as it is to cover the drain of the ocean, we make it never empty; but we will know that it is not going to be emptied, in a very long time. It is more: there are actions that do not affect "absolutely" in anything; therefore, it have 3 possibilities:

1. Do something and see its possible consequences in many many years.
2. Do something that does not affect anything (and people see that something is done).
3. Let the global dynamics prevail and flow...

The best choice? The 3; At least, let's dedicate ourselves to enjoyment and that other rights are not affected.

Sup "A" fixed; then if "C" moves, "B" will move; but the greater "b" and the smaller "c", keeping "a" constant, the movement of "B" will be less.

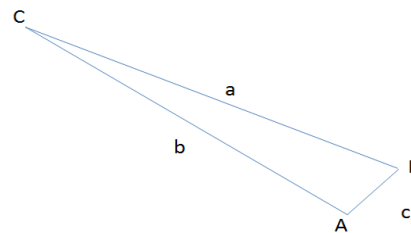


Fig. 18: Relations between 3 events.

It is an example to observe that although we have 3 dependent events, certain movements of one of them, may have very little importance on the others. Any government that takes credit for taking a country out of a crisis lies: it simply has been lucky to be at the right time.

**d. TIME: COMMENTS ABOUT:**

It can define "being alive" to that substance that is able to have notion or consciousness of the passage of time.

It is possible to perceive time in a different way; in fact, when it are sleeping or when it are older, it do so. Is time the necessary variable for there to be a dynamic? if everything were causal, the existence of time would not be necessary, since "everything" would already be defined and marked until eternity. It is also true that, as we have already seen, in the dynamics of a set of phenomena, only one of them lacks the power to



modify fully; it is the randomness that marks this effect or influence.

Randomness is necessary in the universe, for whatever reason, but it is necessary ... In fact, let's think of 2 different phenomena (water flow and galaxy formation): time scales and time are different. It is as if the dynamics of the universe invite us or force us to standardize time and its scale, in order to be able to compare.

### 10. NAVIER STOKES EQUATIONS ANALYSIS

Analyzing very deep the Navier Stokes equations, is possible to know the knowledge basic for working with these equations. The discretization is a method very efficient for reaching that.

The first model of Navier Stokes equations, are in 2D (without pressure and extern forces):

$$\frac{\partial u}{\partial t} + u \frac{\partial u}{\partial x} + v \frac{\partial u}{\partial y} = \nu \left( \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} \right)$$

$$\frac{\partial v}{\partial t} + u \frac{\partial v}{\partial x} + v \frac{\partial v}{\partial y} = \nu \left( \frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} \right)$$

Eq. (9)

a. **ADVECTION EQUATION (TRANSPORT VELOCITY "c")** IN **LINEAL 1-D WITH**

$$\frac{\partial u}{\partial t} + c \frac{\partial u}{\partial x} = 0$$

Eq. (10)

$$u_i^{n+1} = u_i^n - c \frac{\Delta t}{\Delta x} (u_i^n - u_{i-1}^n) \quad \text{Eq. (11)}$$

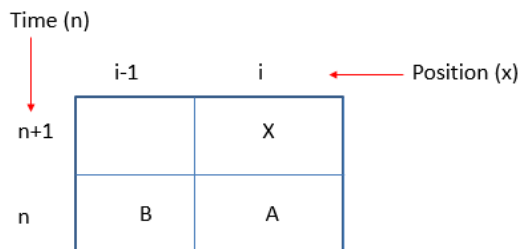


Fig. 19: Numeric scheme 1.

$$X = A - c \frac{\Delta t}{\Delta x} (A - B) \quad \text{Eq. (12)}$$

- If  $A > B$ , then  $x < A$ , independently of what scheme work for finites differences (forward, backward, central, etc....).
- $X$  is "A" plus a value, function of a variation (plus or minus).
- If  $\Delta t$  is bigger, the variation is more important (more incorrect) (bigger). That is the basic concept for interpolating and extrapolating.
- If  $\Delta x$  is bigger, the variation is smaller.
- "c" is the "risc factor"; if "c" is smaller, the variation is smaller.

Sample (money invest for a "i" and "i-1" people):

Year	i-1	i
2018		X
2017	55	50

$$X = 50 - \frac{1}{10} \frac{10}{1} (50 - 55) = 55$$

$$X = 50 - \frac{1}{10} \frac{10}{5} (50 - 55) = 50$$

c=0.1

In the first case, "x-1" is a good friend of "x" ( $\Delta x=1$ ). In the second case, is a friend not close ( $\Delta x=5$ ).

**\*Study and Analyze, more Navier Stokes equations cases:**

### 11. APPLICATIONS AND SAMPLES



### 12. CONCLUSIONS



A new model for the Navier Stokes equations has been described, analyzing multiple applications to everyday phenomena. It has been found that these equations can control a large part, and even most, of dynamic phenomena in Nature.

### ***13. ACKNOWLEDGMENTS***

All my family, for its patient and love.

### ***14. I'M LOOKING FOR***

I'm looking for a University in order to allow time for researching, teaching and publishing.

### ***15. FUTURE WORKS***

Generate all samples in CFD basically, in these 3 Articles, in order to validate the models and also, generate numeric values. (\* it means that: activities to work, basically, generate equations and generate CFD simulations).



# PRESENTATION PPT, ABOUT THESE 3 ARTICLES:

## PATHS IN THE UNIVERSE

Not Isotropic. Not Homogenous.

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### Searching Patterns

Similar Patterns in events: Similar Numerical models.

Similar Patterns in Numerical models: Similar events.

Richard Feynman

A numerical model is composed of:

- A set of governing equations
- A specified domain
- A set of numerical methods
- A set of parameterizations
- Initial conditions and boundary conditions

→ DIVULGATION

→ INVESTIGATION

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PATHS IN THE UNIVERSE: → COSMOLOGY → ASTROPHYSICS

MATTER DYNAMIC IN THE UNIVERSE  
EXPANSION OF UNIVERSE  
NAVIER STOKES EQUATIONS IN THE UNIVERSE

→

## Fluids theory

What is?

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What is?

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Geometric evolution

Nozzle

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Nozzle

Geometric evolution

What happened if opens the door? (1)

Hormones

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### Women's Hormone Equations

$$\frac{dX_i}{dt} = a_i X_i - b_i X_i - M_{i,j}(X_i - X_j) + \dots$$

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### Men's Hormone Equations

$$\frac{dX_i}{dt} = a_i X_i - b_i X_i - M_{i,j}(X_i - X_j) + \dots$$

Numerical models

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SAME MODEL	ROBERT AND JULIA	LAURENTER
$\frac{dx}{dt} = ax - bxy$ $\frac{dy}{dt} = -cy + dxy$	$\frac{dH(t)}{dt} = aM(t)$ $\frac{dM(t)}{dt} = -bH(t)$	$\frac{dA(t)}{dt} = -bB(t)$ $\frac{dB(t)}{dt} = -aA(t)$
BLACK HOLES	SCHROEDINGER EQUATION	ALAN TURING BIOLOGY
<p style="font-size: 0.8em;">N-S:</p> <p style="font-size: 0.7em;">rate of change of rate of change</p> $\frac{1}{2} \rho \frac{\partial^2 v}{\partial t^2} + \rho S \frac{\partial v}{\partial t} - \rho V = 0$ <p style="font-size: 0.7em;">price of commodity with respect to time</p> <p style="font-size: 0.7em;">this has been learned table</p>	$\hbar \frac{\partial}{\partial t} \psi(r,t) = -\frac{\hbar^2}{2m} \nabla^2 \psi(r,t) + V(r,t) \psi(r,t)$ <p style="font-size: 0.7em;">WHAT ARE THESE PLATES FOR AND WHY SHOULD I CARE FOR THEM?</p>	$\frac{\partial u}{\partial t} = D_u \frac{\partial^2 u}{\partial x^2} + f(u, v)$ $\frac{\partial v}{\partial t} = D_v \frac{\partial^2 v}{\partial x^2} + g(u, v)$ <p style="text-align: right;">Matter voids</p>

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MATTER AGGREGATE - VISCOSITY / LOW PRESSURE

Dark Matter

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### DARK MATTER

### DARK MATTER

Kepler laws:  

$$F = \frac{GM_{\odot}m}{r^2} = \frac{mv^2}{r}$$

$$v = \sqrt{\left(\frac{GM_{\odot}}{r}\right)}$$

Visc. Dens.

DENSITY

VISCOSITY

$$V^2 = \frac{Gm}{r}$$

$$V = \mu_1 \frac{ar}{m}$$

$$\mu_1 = \mu_0 \pi$$

DENSITY + VISCOSITY

$$\sqrt{\frac{Gm}{r}} = 6\pi \frac{a}{m} \mu r$$

$$m = \rho * Vol$$

$$\frac{\rho}{\mu} \approx K$$

Dark Matter pictures

RAM Pressure Stripping

$$P = \rho u^2$$

Galaxies Origin

### GALAXIES ORIGIN / ROTATION

Origin ?  
 → Primordial Black hole (created in Inflation period) + Matter Accumulation.  
 → Matter accumulation from disturbance + Black Hole creation.  
 → Low pressure tube.

Rotate ?  
 → IS THE MOST PROBABLE  
 → Rotational moment, by accumulation stars and matter.

Arms.

### GALAXIES ARMS AND SHAPE

Degree of matter distribution and its radius, rotation velocity (measured and black holes) etc...

Stars: possible dark matter in compression.

Waves

Arms formation.  
 Density waves: stars creation in high pressure zones.

VALIDATION

### VALIDATION ????

Galaxies types arms

More arms. More luminosity.

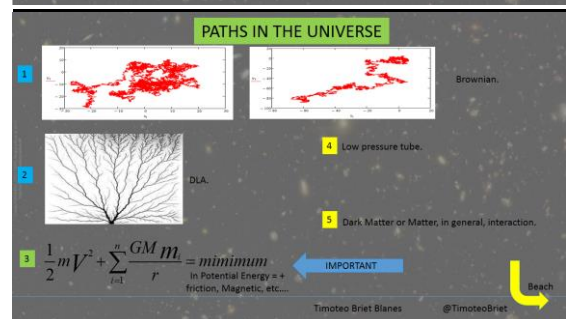
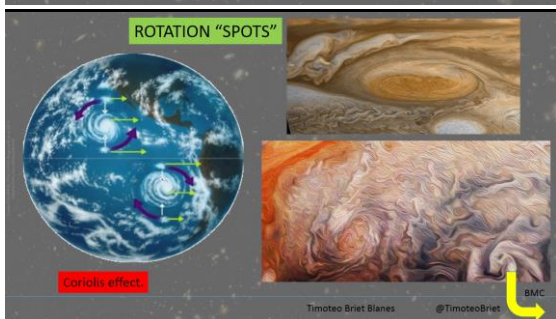
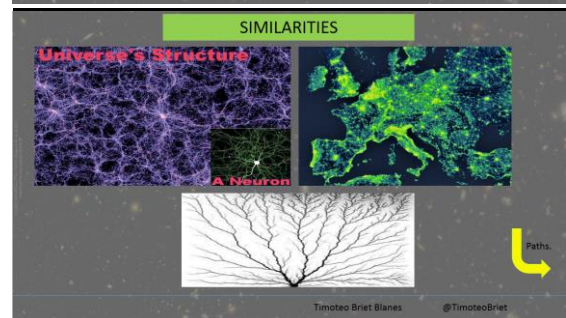
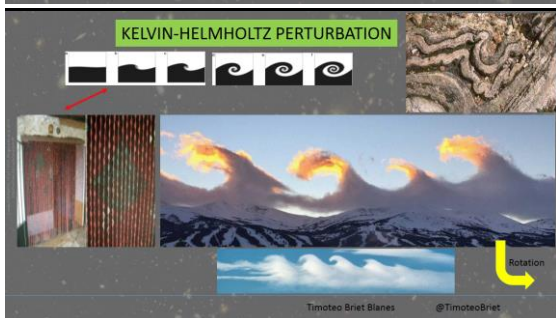
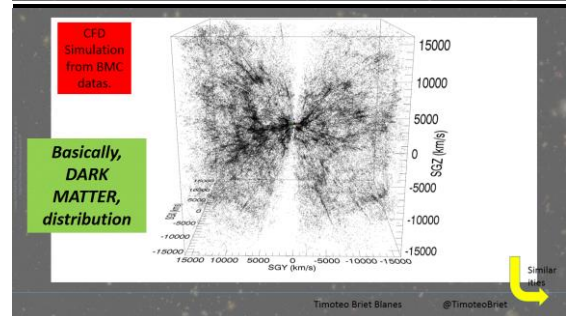
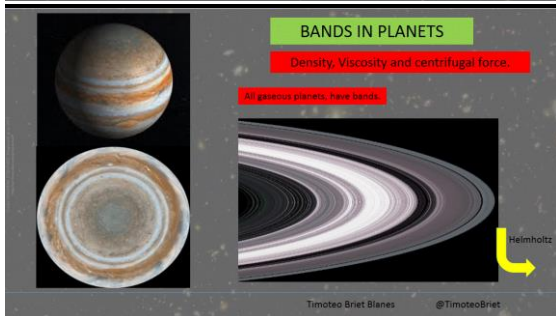
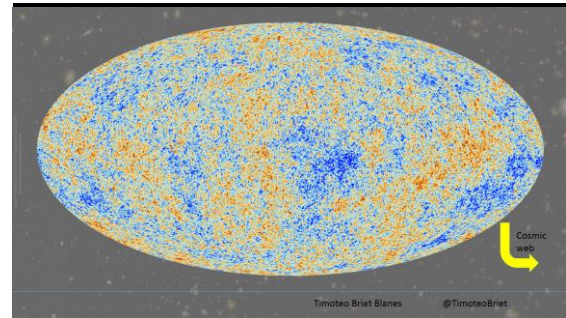
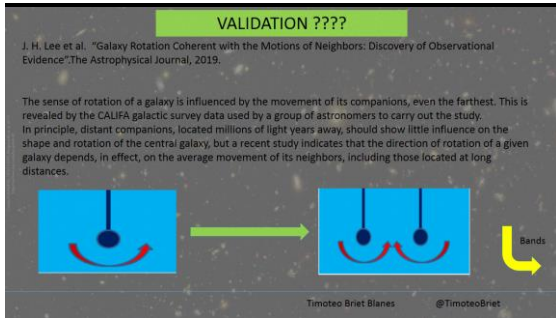
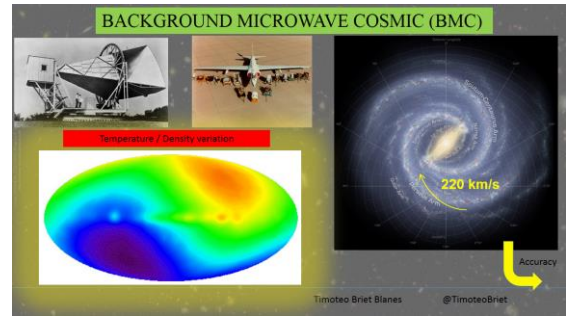
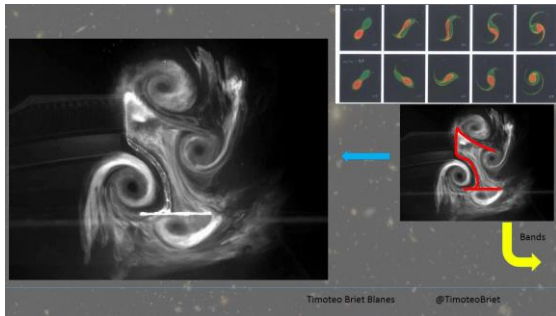
3 in the past (more density), a galaxy have more luminosity with less rotation velocity than today.

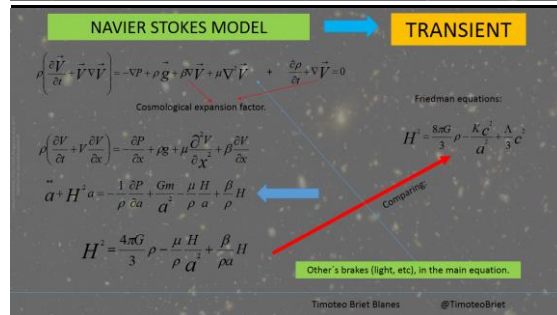
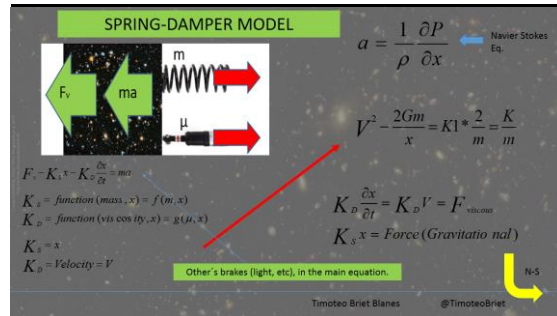
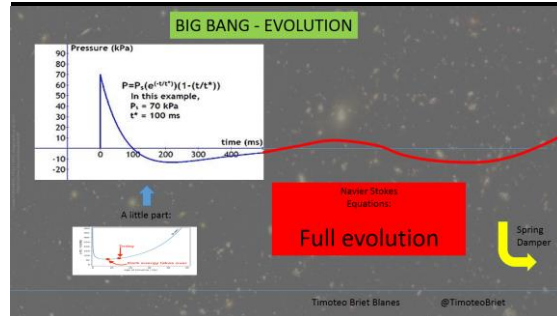
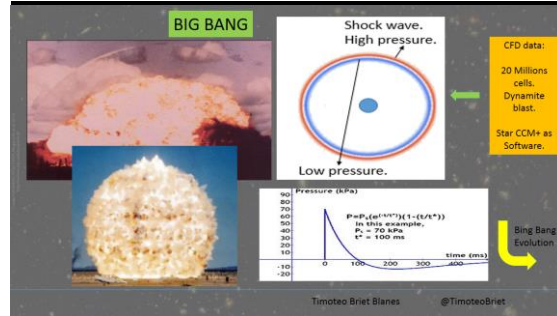
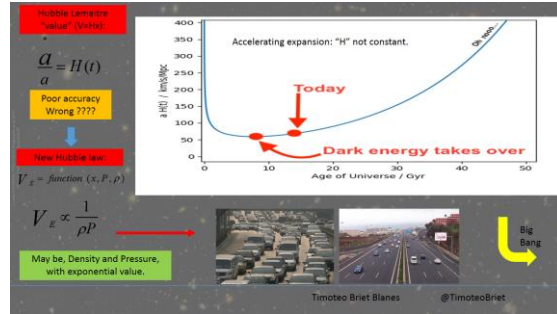
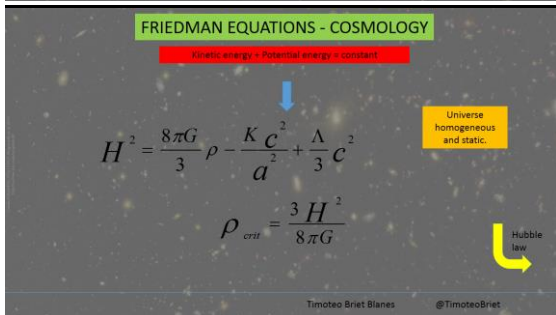
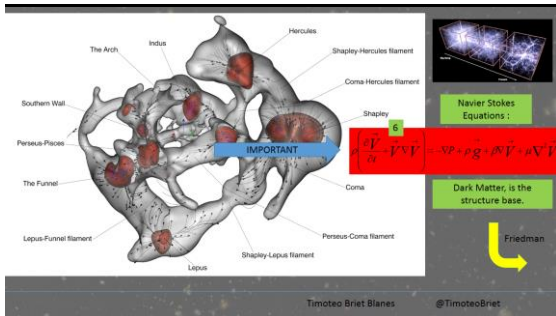
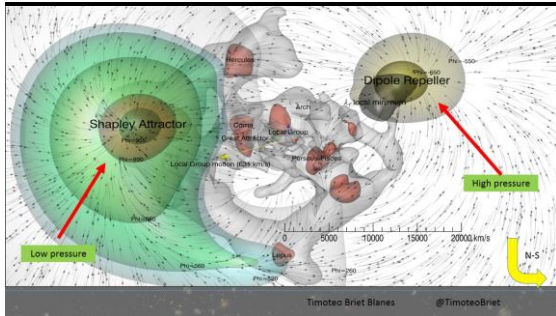
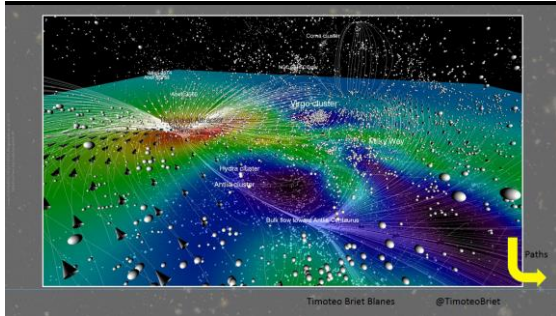
4 Less arms, with less dark matter.

Colliding

### GALAXIES COLLIDING ANALYSIS

Vortices








**CRITICAL DENSITY**

$$\rho = \frac{3H^2}{4\pi G}$$

Critical density (Friedman) = 0,5 \* Critical Density (Navier Stokes)


$$\rho_{crit} = \frac{3H^2}{8\pi G}$$

Friedman:  $???? H = H/(2^{0,5})$

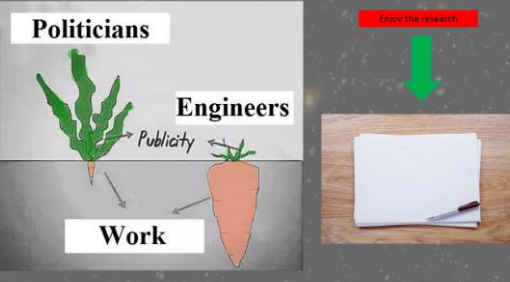
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**Politicians**

**Engineers**

Publicity

**Work**



Once the research

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