RADIUS OF STABLE GALAXY

According to 'MATTER (Re-examined)'

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Abstract: An evolving galactic cloud, depending on its parameters, may attain stable state for brief period. Total matter-content, spin speed and diameter of spinning galactic cloud determine duration of stable period. This article proposes mutual relation, between these factors, required for a galactic cloud during its life as a stable galaxy.

Keywords: Galaxy, radius of stable galaxy.

Depending on its parameters, it is possible for a galactic cloud to become stable galaxy for brief period during in its life. As magnitude of angular speed or radius of a galactic cloud increases, inward radial motion of its 3D matter-particles (due to gravitational collapse) becomes too less to compensate for their outward displacement due to centrifugal action. Matter-contents of galactic cloud continue to spread outwards in planes of its spin. Halo, formed around spinning galactic cloud, tends to arrest whole-body linear displacements of galactic cloud towards any other similar galactic cloud and keep it steady in space, to form a stable galaxy and for further inner developments.

Galactic stability, which is related to translational motion of one galaxy towards another, is a short-lived phenomenon. Except for temporary arrest in its translational motion, a galactic cloud never reaches stable state. However, a galactic cloud that can keep its absolute place in space and has no relative translational motion with respect to similar galactic clouds may be considered as stable galaxy.

A galaxy is a combined macro body, whose constituent macro bodies continuously move and evolve, within. Galaxy, itself, changes its parameters continuously, until either whole of its matter-content is disbursed / reverted into universal medium or it condenses into a single macro body. This is the death and ultimate fate of all galaxies. Smaller galaxies or galactic clouds (before their development into stable galaxies) may approach each other under gravitational attraction to collide and integrate into single rotating group of macro bodies. Depending on magnitude and direction of their spin motions, this type of collisions may help to form super-galaxies or cause total disintegration of both galaxies.

There are no rigid macro bodies. Macro bodies of high viscosity are usually in solid state. They tend to maintain their integrity and shape. Near larger macro bodies, fluid macro bodies tend to adopt shape of its container. In free space, all fluid macro bodies tend to form spheres. Clouds and debris in deep space gather, under mutual gravitational attraction, to form very large macro bodies. They are mainly gaseous with few solid macro bodies in them. Generally, they can be considered as of fluid nature.

A fluid macro body has lower viscosity. Gravitational attractions between 3D matter-particles provide adhesion between its constituents. Action by gravitational attraction to reduce its size is fluid macro body's gravitational collapse. In the course of their formation, due to uneven gravitational collapse, they acquire spin motion. Outer regions of fluid macro body attain greater spin speed about spin axis, compared to inner regions. If efforts, causing gravitational collapse and moulding fluid macro body into a sphere are uniform throughout, the fluid macro body will not gain spin motion at all.

It is quite improbable that radial motions (due to gravitational collapse) of components of such a large fluid macro body of diverse contents are uniform in all directions. Uneven radial motions of different components of fluid macro body induce its accelerating spin motion. Due to low viscosity, centripetal action (provided by mutual gravitational attraction between constituent macro bodies) is very low. Hence, during spin motion, fluid macro bodies in free space (not restricted by a container) spread outwards from spin axis.

With the help of mutual gravitational attractions between its constituents, a fluid macro body should continue to rotate at accelerating angular motion. However, changes in its parameters are bound to affect fluid macro body's state of rotary motion. As spinning-fluid macro body expands in diameter, 3D matter-particles at its equatorial periphery keep moving away from centre of rotation. If fluid macro body has to maintain its original angular acceleration, constituent 3D matter-particles near periphery have to move at faster linear speed in their circular paths. If no additional work is supplied, this cannot be accomplished. Additional work with each 3D matter-particle remaining (more or less) steady, their angular speeds with respect to centre of fluid macro body reduce as they move away from centre of rotation, with corresponding reduction in angular speed of fluid macro body.

Outward displacements of 3D matter-particles continue until sufficient centripetal action can be provided to arrest their outward displacements. As total matter-content of fluid macro body does not change and its radial size increases, centripetal actions on 3D matter-particles can only reduce, rather than increase. Tendency of expansion acts in direct opposition to actions of gravitational collapse of fluid macro body. Every 3D matter-particle tends move away from centre of rotation of fluid macro body due to angular motion. Centripetal action, provided by gravitational collapse tends to move them towards centre of rotation. Balance between these actions determines future formation of fluid macro body.

Magnitude of 'centripetal force', F_c, required for a 3D matter-particle (situated at outer periphery) of spinning fluid macro body, to maintain its linear motion in a circular path;

$F_c = 4mv\,\text{Tan}\,\omega$ Refer equation (5/9) in the book 'MATTER (Re-examined)' **(1)**

where m is rest mass, v is instantaneous linear velocity and ω is angular speed of 3D matter-particle.

This effort is provided mainly by adhesion due to gravitational attraction between 3D matter-particle and rest of spinning-fluid macro body. By using inverse square law for approximate magnitude of gravitational attraction, F_g;

$$F_g = \frac{MmG}{R^2} \qquad \textbf{(2)}$$

Where 'm' is rest mass of 3D matter-particle, 'M' is rest mass of rest of fluid macro body, 'G' is gravitational constant in 3D spatial system and 'R' is radius of fluid macro body, taken as average distance between 3D matter-particle and rest of all constituent 3D matter-particles of fluid macro body.

For stable radial size of fluid macro body, its component 3D matter-particles (on an average) should move in circular paths. This can be achieved only when magnitudes of 'centripetal force', F_c, on them should be as given by equation (1). Hence, a spinning fluid macro body can maintain its radial size constant, only when gravitational attraction, F_g, on a 3D matter-particle (moving at periphery of a spinning fluid macro body) is equal to required 'centripetal force', F_c, on it.

Hence, $\frac{MmG}{R^2} = 4mv\,\text{Tan}\,\omega$, $\frac{MG}{R^2} = 4R\omega\,\text{Tan}\,\omega$, $\frac{MG}{4R^3} = \omega\,\text{Tan}\,\omega$

$$\left(\frac{MG}{4}\right)\frac{1}{R^3} = \omega\,\text{Tan}\,\omega \qquad \textbf{(3)}$$

For critical equilibrium of radial size of fluid macro body in the plane of its spin, equation (3) has to be satisfied. In equation (3), ω is fluid macro body's spin speed and R is its radius. For a fluid macro body, term (MG/4) is a constant. Hence, value of term ($\omega\,\text{Tan}\,\omega$) is inversely proportional to cube of its radius.

Putting $\omega = \frac{v}{R}$ in equation (3); $\left(\frac{MG}{4}\right)\frac{1}{R^3} = \frac{v}{R}\text{Tan}\,\omega$, $\left(\frac{MG}{4}\right)\frac{1}{R^2 v} = \text{Tan}\,\omega$ **(4)**

Should magnitude of angular speed or radius of a galactic cloud become comparatively more, inward radial motions of 3D matter-particles due to gravitational collapse become too slow to compensate for their outward displacement due to centrifugal action. Matter-contents of galactic cloud continue to spread outwards in planes of its spin. As linear speeds of 3D matter-particles, in their circular paths, approach linear speed of light, they breakdown to primary particles (bitons). Accumulation of independent bitons around a spinning galactic cloud forms its halo. Interactions between halos of two neighbouring galaxies modify their parameters until the both galaxies exert sufficient repulsion against gravitational attraction between them to maintain constant distance between them. As long as this stage continues, it may be considered as a stable galaxy.

Linear speed of 3D matter-particles, near outer periphery of a stable galaxy, may be approximated to speed of light, c.

Replacing v by c in equation (4); $\frac{MG}{4R^2 c} = \text{Tan}\,\omega$

Approximate spin speed of a stable galaxy, $\omega = \text{Tan}^{-1}\frac{MG}{4R^2 c}$ **(5)**

Gravitational collapse and accelerating spin motion of fluid macro body cannot be stopped. Hence, these actions continue to change parameters of fluid macro body. A fluid macro body, like a newly formed galactic cloud in free space, expands until its angular speed is sufficiently lowered, when 'centripetal force' is sufficient to maintain curvature of its periphery. However, such a large fluid macro body can sustain its stability of radial size only as long as equation (5) is satisfied.

Since a stable galaxy is a spinning-fluid macro body, its gravitational collapse and acceleration of spin motion continues, during and even after brief period of stability. Its constituents have constant tendencies to spread outward. As diameter of galaxy increases further and linear speeds of primary particles approach linear speed of light, they breakdown to independent photons and radiate in various directions, away from galaxy. Gradually, whole of galaxy disintegrates and disburses.

Should magnitude of angular speed or radius of galactic cloud (or its central region) becomes comparatively lesser (or it is not spinning) during its condensation, outward motion of 3D matter-particles becomes too slow to compensate for their inward radial motion due to gravitational collapse. Galactic cloud will shrink at an accelerating pace to form a single, very dense macro body (black hole), with low spin speed or without spin motion at all. This macro body has no protection from gravitational attraction towards other macro bodies in space, as in the case of stable galaxy.

Conclusion:

Stable radial size and nature of a very large galactic cloud (formed in free space by accumulation of inter-galactic clouds and debris) is determined by its spin speed during condensation. With low or no spin speed, a galactic cloud condenses to become a 'black hole'. As long as spin speed of a galactic cloud corresponds to equation (5), it can maintain its stability as an independent static galaxy. Should its spin speed exceed magnitude given by equation (5), galactic cloud will gradually disintegrate and lose most of its matter-content into free space.

Reference:

[1] Nainan K. Varghese, *MATTER (Re-examined)*, http://www.matterdoc.info

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