

Rotational Dynamics of Spiral Galaxies: Dark Matter vs ElectroMagnetic Plasma Effects.

Philosophy: “Extraordinary Claims Require Extraordinary Proof”.

The rotational dynamics of our Solar System fits gravitational theory very well. No additional matter or forces are significant.

However, the measured rotational dynamics of Spiral Galaxies do NOT fit gravitational theory alone. Two different solutions have been presented to explain this gross distortion from gravitational dynamics: (1) Dark Matter , and (2) ElectroMagnetic Plasma Effects. .

ElectroMagnetic Plasma Effects.

When Plasma Physicists add known ElectroMagnetic Plasma effects into the Gravitational dynamics of Spiral Galaxies, they obtain the observed rotational dynamics of Spiral Galaxies. For scientifically published references, see the very extensive list below. Although EM Plasma Physics is well known and experimentally tested, the detailed calculations are very complex and require supercomputers that operate for months. There is no question that EM Plasma effects dominate the early formation of a Spiral Galaxy from an ionized plasma. As time progresses, matter is accreted into star formation. Then gravitational effects become stronger, as EM plasma effects become weaker as the inter-stellar plasma density decreases with time evolution. These effects are sufficiently complex that I can not describe them with simple arguments or simple mathematics. Supercomputers are necessary.

Within our Solar System, the Plasma Density is known and sufficiently low that it does not significantly affect the rotational dynamics of our Solar system. However, these EM Plasma effects are responsible for such phenomena as the “Solar Flares“, “Aurora Borealis”, “Sun Spots”, etc. within our Solar System.

Dark Matter.

As an alternative explanation of the unusual Rotational Dynamics of Spiral Galaxies, the existence of mysterious unknown Dark Matter is invoked. This Dark Matter must have a special spatial distribution to yield the observed behavior. Since Dark Matter is also allowed to vary arbitrarily with time, this introduces 3 unknown mysterious “fudge factors”. Many possible sources of Dark Matter have been proposed, but none has been experimentally verified.

Within our Solar System, the density of Dark Matter must be sufficiently low that it does not significantly affect the gravitational rotational dynamics of our Solar system. Or possibly Dark Matter does not exist anywhere at all.

Perspective.

The addition of known ElectroMagnetic Plasma effects into the gravitational dynamics of Spiral Galaxies, seems to yield the observed rotational dynamics WITHOUT the need for Dark Matter. Why invoke mysterious Dark Matter? Certainly the known EM Plasma effects should be completely and thoroughly scrutinized and confirmed before mysterious Dark Matter is invoked. “Extraordinary Claims Require Extraordinary Proof”.

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Questions:

For Spiral Galaxies, I personally have the following questions (goals) about Both the experimental data and the computer simulations via gravitational//EM/Plasma effects??

(1) In Spiral Galaxies, do the co-mingled stars and plasma-filaments rotate at the same rate? If the same rate, why??

(2) In spiral galaxies, I would guess that the rotation of stars would be primarily determined by gravitational forces, while the rotation of plasma-filaments would be primarily determined by EM plasma forces?? But all dependent upon the inter-stellar plasma density and the relevant gravitational forces (star size, etc).

(3) How are important "Dirty Plasma" effects incorporated into the EM Plasma simulations??

(4) What is the inter-stellar plasma density as functions of time and position in the spiral galaxy??

(5) The first 4 questions (above) are the crux of the interplay between gravitational forces and EM/Plasma effects, all in a "Dirty Plasma".

(6) Can the essential dynamics of spiral galaxies be semi-quantitatively described by simplified EM/gravitational equations whose features are transparent??

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PRIMARY REFERENCES.

(1) "Physics of the Plasma Universe" by Anthony Peratt.
(Springer-Verlag, 1992).

(2) See Web-site.

<http://TheUniverse.ws>

This web-site contains movies and publications of galactic formation from ElectroMagnetic Plasma computer simulations. Particularly see "What's new: published papers".

(3) "Evolution of the Plasma Universe: I. Double Radio Galaxies, Quasars, and Extragalactic Jets",

A. L. Peratt, IEEE Trans. Plasma Sci. Vol. PS-14, N.6, pp.639-660, December 1986.(1.7M)

(4) "Evolution of the Plasma Universe: II. The Formation of Systems of Galaxies",

A. L. Peratt, IEEE Trans. Plasma Sci. Vol. PS-14, N.6, pp.763-778, December 1986 (1.9M).

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In the above references, the evolution of galaxies from plasma inhomogeneities (which yield electric fields, currents and magnetic fields) is simulated. These calculations indicate a time evolution from Elliptical to Irregular to Spiral Galaxies.

A typical evolution is shown below (from Ref 4, Fig 6).

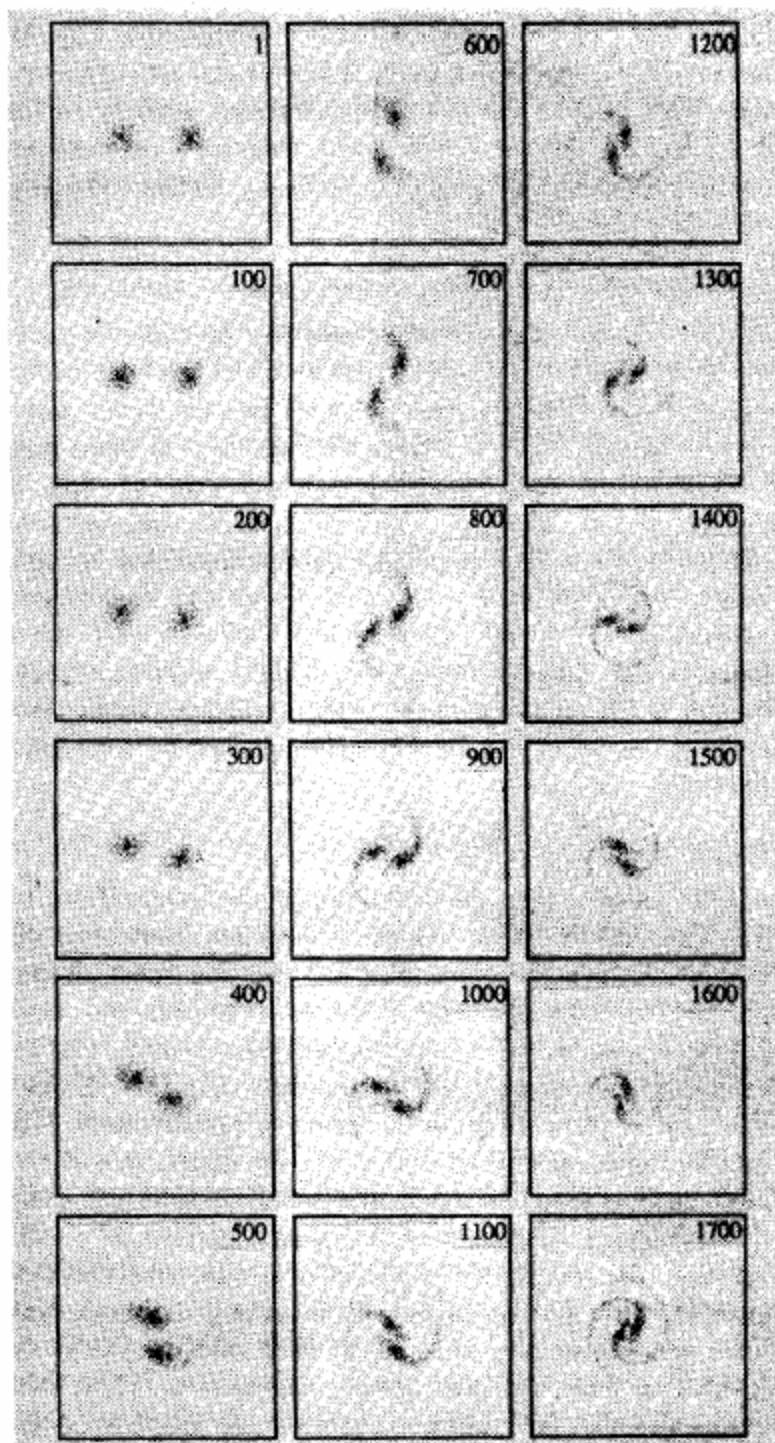


Fig. 6. Single-frame stills of plasma in galaxy simulation run DD4. $\omega_c/\omega_p = 3.0$, $T_{e0} = T_{i0} = 32$ keV, $T = 1-1700$. Acceleration field, 0.0001 cells per time step squared. Not shown is the intergalactic plasma trapped at the geometric center.

Following are the measured velocity profiles for four specific Spiral Galaxies from Ref 4, Fig 14. "Velocity Profile" means the rotational speed of the spiral galaxy as measured from the center of the spiral galaxy. The peculiarities are that the rotational speed is very low at the galactic center and rises quickly to an approximately constant rotational speed away from the center. This is completely different than expected from gravitational forces alone. For instance, in the simplest Solar System model, the planets closest to the center rotate at the very fastest speeds, and gradually decrease in speed at larger distances from the center.

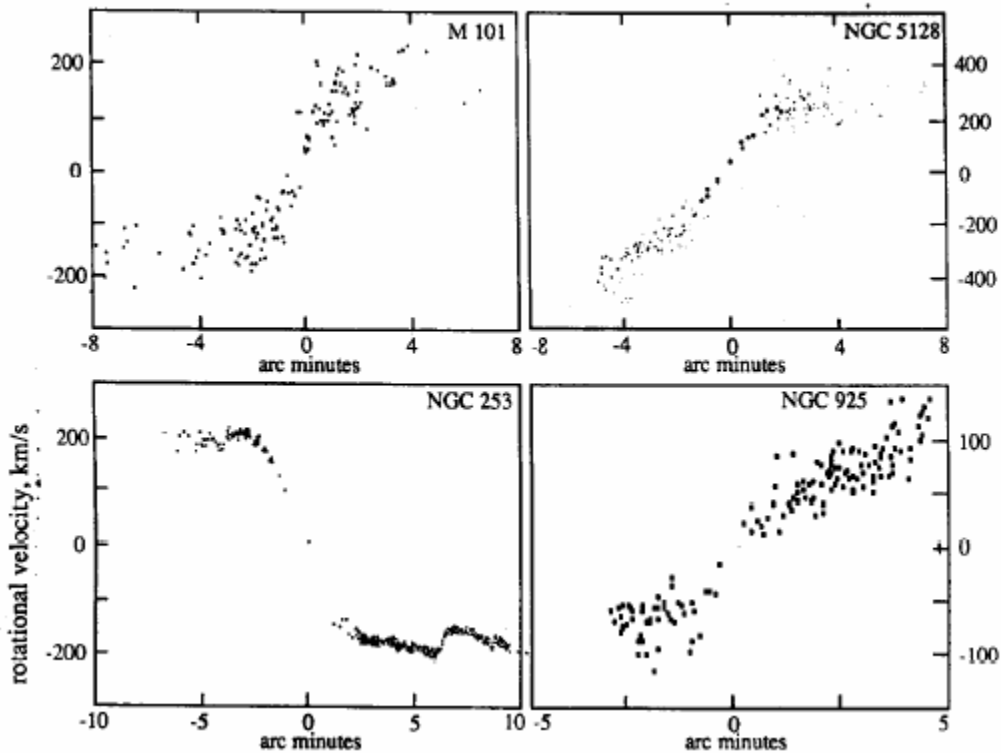
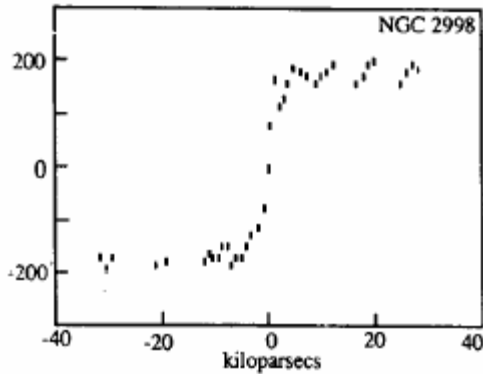


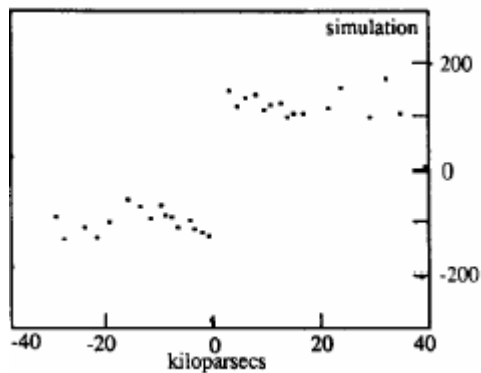
Fig. 14. Spiral galaxy rotational velocity characteristics.

Above are the measured velocity profiles for four specific Spiral Galaxies from Ref 4, Fig 14.



Above is another measured velocity profile for a specific Spiral Galaxy (Ref 4, Fig 14), again with behavior completely different than anticipated from gravitational forces alone.

Following is a computer simulation of the velocity profile for a Spiral Galaxy from Ref 4, Fig 14 including ElectroMagnetic Plasma effects.



Notice the similarity of the measured velocity profiles with the computer simulation including ElectroMagnetic Plasma effects for these Spiral Galaxies. "The plasma core rotates very nearly as a solid body, while the spiral arms grow in length as they trail out along the magnetic isobars." See Ref 4 for explicit details. The measured behavior is all very different than that obtained from gravitational effects alone, but the inclusion of ElectroMagnetic Plasma effects mimic the observed behavior. That is, the rotational speed is very low at the galactic center and rises very quickly to an approximately constant rotational speed at distances away from the center.

CONCLUSION:

The inclusion of ElectroMagnetic Plasma effects yield the UNusual (non-gravitational) rotational characteristics of Spiral Galaxies withOUT the need for Dark Matter.

Much more research is needed in the following areas.

- (1) The difference in rotational speed of stars vs plasma filaments in Spiral Galaxies.
- (2) "Dirty Plasma" effects.
- (3) Plasma Density as functions of time and position within a Spiral Galaxy.
- (4) Simplified approximate "Gravitational + EM Plasma" equations which transparently describe the interplay of gravitational and EM Plasma forces which determine the essential features of Spiral Galaxies.
- (5) The role of Conservation of Angular Momentum in the evolution from plasma to Elliptical to Irregular to Spiral Galaxies.

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