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Singularities in Formation of Solar System Bodies

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Abstract: Evidence for Black Hole singularities within galaxies and smaller objects is briefly reviewed. Decades of data support the existence of a supermassive black hole in the Milky Way and other galaxies. Observations suggest that primordial singularities could form the seeds of formation for galaxies and even smaller objects. Observations from the Cassini mission to Saturn point to singularities within our solar system and planet.

Introduction

New images from the James Webb Space Telescope, along with data from the Cassini spacecraft, show possible indications of singularities in our solar system. The latest data from JWST shows that massive galaxies and their central black holes are primordial, formed shortly after the Big Bang. Primordial Black Holes were thought to be tiny due to the speed of light. Massive primordial Black Holes are another indication that the early speed of light was much greater. (Riofrio, 2012)

Black Hole Singularities

Black Holes, or singularities, are among the most fascination results of General Relativity. In their simplest form, proposed by Michell in 1783, Black Holes are concentrations of mass so dense that their escape velocity exceeds the speed of light. Today they have been calculated to give off radiation (Hawking, 1971). Their presence may explain puzzles of solar system formation.

A Black Hole singularity has the well-known Schwarzschild radius R:

$$R = \frac{2Gm}{c^2}$$

Where G is gravitational constant, m is Black Hole mass and c is speed of light.

A Black Hole can be described as having a surface area:

$$A = \frac{16\pi G^2 m^2}{c^4}$$

Here A is area of a spherical surface $4\pi R^2$.

The well-known work of Hawking and Bekenstein concluded that Black Holes are not truly black. Due to quantum effects, they radiate energy with high efficiency (Hawking, 1972). Other researchers have found that radiation forms jets out the north and south poles, following magnetic field lines. Radiation and magnetic fields can be considered signs of a Black Hole.

Bekenstein calculated that a Black Hole has entropy given by:

$$S = \frac{kc^3}{4\hbar G} A$$

Where k is the Stefann-Boltzmann constant, S is entropy (Bekenstein, 1973)

Hawking concluded that a Black Hole radiates with peak temperature given by:

$$T = \frac{\hbar}{2\pi kc} \kappa$$

Where T is peak temperature, κ is surface gravity (Hawking, 1973)

The surface gravity may be given by:

$$\kappa = \frac{4\pi Gm}{A}$$

Where A is surface area, κ is gravity at event horizon R.

Radiation temperature T is then inversely proportional to Black Hole mass m:

$$T = \frac{\hbar c^3}{8\pi kGm} = \frac{1.2\times 10^{23} Kkg}{m}$$

As an example, a Black Hole of mass $m = 10^{12} kg$ radiates at temperature $T = 1.2 \times 10^{11} K$.

A Black Hole's radiation has emitted power proportional to the inverse-square of mass:

$$P = f(t)\frac{4.8\times 10^{33} W}{m^2}$$

Where P is radiated power and *f(t)* is a factor of order 1(Semiz, 1995).

Rings of Saturn

Saturn's Rings are a source of wonder and puzzlement. Most calculations show they should decay in less than 100 million years, yet they are found to be nearly as old as our Solar System. A mathematical Roche Limit claimed that moons could not exist, but Cassini has found many moons orbiting in the Rings. The mysterious Rings demonstrate conditions similar to formation of the Solar System.

During its approach to Saturn, the Cassini spacecraft detected sources of radiation within the Rings (Bhardwaj, 2005). The Radio and Plasma Wave Instrument found plasma wave signals that erupted in fountains spreading 45 degrees from vertical (Gurnett, 2005). New imagery from the James Webb Space Telescope, adding to data from the Chandra Observatory, shows X-ray sources within the Rings. Source of radiation within the icy Rings has been a mystery.

Cassini found propellor-like features within the Rings, leaving wakes *10-20 km* long, the signs of unseen objects. These objects orbit in a band *3200 km* wide at altitude of about *130,000km* from Saturn. Their mass is estimated as that of a *100 m* asteroid or about $10^9 kg$, typical for a primordial Black Hole. Computer simulations treat these objects as point masses, like Black Holes. (Tiscareno, 2006)(Sremcevic, 2007)(Porco and Spitale, 2010)

Engineering Enceladus

The most compelling Cassini discoveries came from Enceladus, the 530 km moon orbiting within Saturn's E Ring. This icy moon has been found to be warm, hiding beneath her frozen surface an ocean of liquid water. (Yeager, 2008). Enceladus' interior produces enormous heat, estimated at *15.8 GW*, where the maximum energy from tidal forces is estimated at only *0.3 GW*. The heat is concentrated at the South Pole, where great geysers spew water vapor into Space. (Brown, 2006) (Hansen, 2006) (Dong, 2011)

Researchers have speculated about radioactive aluminium and iron. The only naturally-occurring radioactive isotope of aluminum, Al26, has a half-life of only 720,000 years. The longest-lived isotope or iron, Fe60, has a half-life of 1.5 million years. Even if these elements were found in Enceladus, the moon should have run out of fuel billions of years ago.

Because the Southern hot spot spews materiel from the Moon's interior into Space, Cassini can sample what Enceladus is made of. The atmosphere contains nitrogen, which is produced from the decomposition of ammonia (NH_3). That process requires temperatures in excess of 850K. The atmospheric plume also contains traces of methane (CH_4), carbon dioxide (CO_2), propane (C_3H_8) and acetylene (C_2H_2). Radioactive isotopes of these elements are all very short-lived.

The existence of Black Hole singularities within planetary bodies was first suggested by Trofimenko (1990). More recent work was written independently by this author (Riofrio, 2005) and Zhilyaev (2007). Primordial Black Holes are theorised to exist in large numbers throughout Space. As galaxies contain central Black Holes, stars and planetary bodies could also form around them.

Enceladus' core and behavior can be modeled with a central singularity of $10^{12} kg$, a mass typical for a primordial Black Hole. This object would consume only *2.8 kg/yr* and generate$7.9 \times 10^9 W$ of radiation. Water and other molecules near this centre are heated to a plasma. Electrons are stripped from atoms, and the resulting ions are drawn into circular orbits around the singularity. The resulting electric current generates a magnetic field with the "positive" pole in the South, similar to Earth.

Electrons and positively charged ions spiral along magnetic field lines to form bipolar jets, the telltale sign of a Black Hole singularity. The northern jet is composed of electrons which are absorbed by the moon's interior. More massive protons of the southern jet penetrate these layers to warm the South Pole. Escaping water molecules erupt into space as geysers, as observed by Cassini.

Unless Saturn's Rings are replenished, they would decay within 100 million years. Then we would face the anthropic question of why they exist in the right time for humans to enjoy them. Thanks to the Cassini spacecraft, we have witnessed the E Ring being resupplied from the moon Enceladus. Presence of a Black Hole singularity can power the geysers replenishing the Rings, maintaining them indefinitely.

Moons Tethys and Dione have also been observed to emit charged particles. (Burch, 2007). Prometheus has been photographed emitting streams of gas, possibly following magnetic field lines, replenishing the D Ring (Murray, 2005). Prometheus has density of only *0.27 g/cc*, within a Roche Limit where liquid objects were thought not to exist at all. Moons and Rings of Saturn, thought to show conditions similar to the solar system's formation, are possible locations of Black Holes.

Saturn itself has a "hot spot" centred at the South Pole. Gas giant planets such as Saturn also produce enormous amounts of heat, from Saturn 2.8 times as much energy as the planet receives from the Sun. Saturn and Jupiter have enormous magnetic fields. The giant planets could also contain small singularities.

Applications to Earth

Previous studies have left many mysteries about Earth. The planet produces internal heat estimated at 47 *TW*. As with Enceladus, primitive ideas about radioactive decay can not account for this heat. Earth also produces a magnetic field with the positive pole in the South, like Enceladus, though Earth's magnetic poles migrate relative to the geographic poles.

The biggest puzzle about planets is how they formed. Since the time of Pierre Laplace, the solar system has been theorised to have condensed from a rotating gas cloud in Space. In this theory the centre would grow so hot that hydrogen would fuse into helium, igniting the Sun, while the remainder would condense into planets. However, all calculations show that unless the gas particles were massive as mountains, they would not condense but dissipate.

Observations of giant planets like Saturn and moons like Enceladus are clues that Earth could also have formed around a primordial singularity. This tiny object would consume approximately $1.6 \times 10^4 kg/yr$ of Earth to produce 47 *TW* of radiation, keeping the core hot indefinitely. Outward radiation pressure would prevent more of Earth from being absorbed, creating an equilibrium. The singularity would rotate independently of Earth, generating a planetary magnetic field.

A tiny Black Hole within Earth would be surprising, but solve mysteries of the planet. It would explain Earth's internal heat, magnetic field, and even its formation from dust in Space. Data from spacecraft like Cassini, along with observatories like JWST, shine light upon these mysteries. This research is a work in progress, and will shortly lead to a longer article.

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