

## Possible Explanation of the 'Spokes' Observed in Saturn's Rings

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### Abstract

This paper offers a possible explanation of the formation and disappearance of the 'spokes' in Saturn's ring. It is proposed that Saturn's rings consist of a small percentage of pyrolytic carbon which is highly diamagnetic and superconducting.

(Note: Corrections are made by viXra Admin to conform with the requirements on the Submission Form)

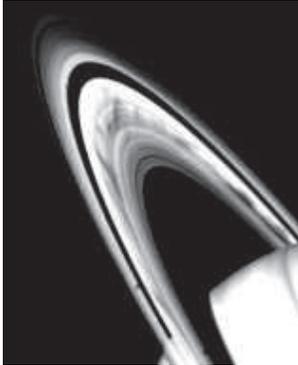


Fig 1: Dark spokes in Saturn's B ring observed by Voyager (JPL NASA)

Observed first during the Voyager Spacecraft flybys in the early 1980's, it was realized that these strange features, which flare out like spokes on a bicycle wheel, were not caused by gravitational interactions with the planet, moons or ring material. Further observations were made by Cassini in 2005 when it was confirmed the spokes are likely related to the gas giant's global magnetic field. (Space.com)

Scientists explain the spokes in Saturn's ring due to electrostatically charged dust particles that are suspended in Saturn's magnetic field. As such these particles rotate in sync with the planet rather than its ring particles which display Keplerian motion about Saturn. At times these electrostatically charged dust particles lose their electrostatic charge and fall back into the main ring structure hence the spokes disappear at times.

I predict that the 5-7% carbon which constitutes Saturn's rings is diamagnetic pyrolytic carbon. Pyrolytic carbon is a man-made substance, but I predict that Saturn's rings also consist of pyrolytic carbon. To form this type of carbon high temperatures of above 1400K is required. Research suggests that during Saturn's formation the innermost parts of its protoplanetary disk (cloud) would have reached these temperatures. See Fig 2 below which represents protoplanetary disk formation.

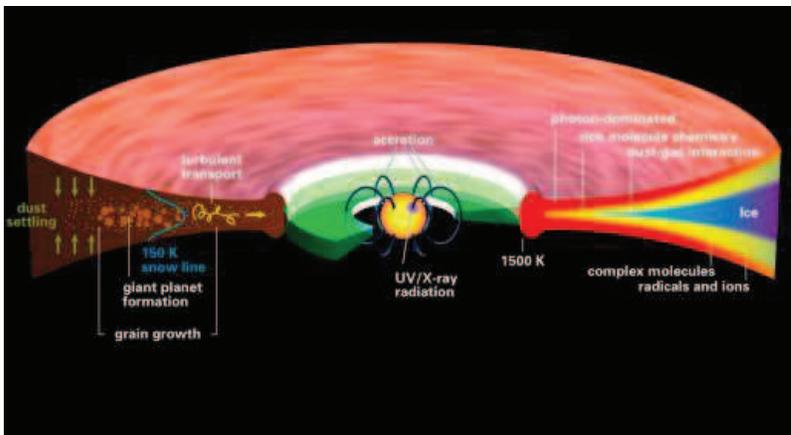


Fig 2: Protoplanetary disk formation

Hydrocarbons at this temperature can be converted to pyrolytic carbon. Research also indicates that the Cassini mission found an abundance of various hydrocarbons in the 'rain' produced by Saturn's rings. See Fig 3 which represents the composition of ring rain produced by Saturn's rings.

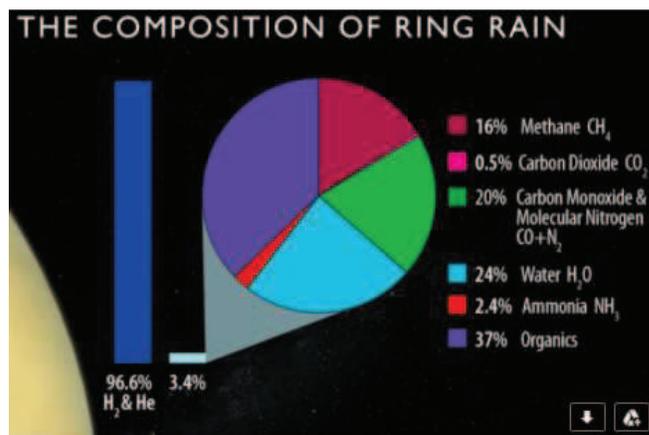


Fig 3: Data showing the Composition of Ring Rain from Cassini Mission

Pyrolytic carbon which is also diamagnetic may also explain the 'spokes' which are observed in Saturn's rings. Because pyrolytic carbon is so diamagnetic none of it would have been detected in the 'rain' between Saturn's rings.

My suggestion is that the 'spokes' are fine grains of silicates that have been covered in pyrolytic carbon due to the process of pyrolysis during the formation of Saturn. Pyrolytic carbon is the best-known material that displays the most similar properties to superconducting materials ie diamagnetism. See table 1 below which indicates the highly diamagnetic nature of pyrolytic carbon.

Material	$\chi_v$ [ $\times 10^{-5}$ (SI units)]
Superconductor	-105
Pyrolytic carbon	-40.9
Bismuth	-16.6
Mercury	-2.9
Silver	-2.6
Carbon (diamond)	-2.1
Lead	-1.8
Carbon (graphite)	-1.6
Copper	-1.0
Water	-0.91

Table 1: Diamagnetic Materials

<https://byjus.com/jee/diamagnetic-materials/>

These fine grains of silicates covered in pyrolytic carbon enable them to levitate above the main ice-ring structures due to their highly diamagnetic nature, thus producing the observed spoke structures that rotate in sync with the rotation of Saturn's magnetic field. The 'spokes' are most visible at the two seasonal equinoxes as the illumination of the rings is greatly reduced making possible unique observations highlighting features that depart from the ring plane ie the levitated fine grains of silicates covered in pyrolytic carbon (spokes). The 'spokes' become visible mainly due to two reasons. The first being due to planet shine from Saturn which reflects off the ice particles in the rings but is absorbed by the fine grains of silicates covered in pyrolytic carbon during the seasonal equinoxes. Secondly, due to varying magnetic susceptibility of the pyrolytic carbon grains caused by change in the intensity of illumination from the sun.

In 2012, a research group in Japan demonstrated that pyrolytic carbon can respond to laser light or **sufficiently powerful natural sunlight** by spinning or moving in the direction of the field gradient. **The carbon's** magnetic susceptibility **weakens upon sufficient illumination**, leading to an unbalanced magnetisation of the material and movement when using a specific geometry. (Wikipedia)

This may explain why the spokes in Saturn's rings appear seasonally at the equinoxes when the illumination of the sun is at a minimum. Hence the pyrolytic carbon grains levitate above the main ring. Illumination from the sun causes a weakening of the pyrolytic carbon's magnetic susceptibility, causing the pyrolytic carbon grains to return back to the main ring.