Models for explaining the structure of Saturn's F ring[1]

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Abstract. With the close approaches to Saturn of Voyager 1 and 2 during their navigation in the solar system, many new features were discovered in the rings of this planet. In particular, kinks, waves, clumps and even apparent braids in Saturn's F ring can be appreciated. In this work we describe some models that could possibly explain this behaviour. All these models are based only in the Newtonian gravitational law.

Introduction

Galileo was the first man to see the rings of Saturn in 1610, although he had mistaken them for two large moons on either side of the planet. Today we know that Saturn is not the only planet with rings. Owing to ground-based observations and information sent back to the earth from spacecrafts in the late 1970's and the 1980's, we have discovered that the three other gaseous giants (Jupiter, Uranus and Neptune) are also surrounded by spinning disks of matter. In 1860 J. C. Maxwell proposed a mathematical model showing that even a very thin solid ring would be torn apart by gravitational forces. He also showed that the rings could not be fluid and concluded that the only reasonable hypothesis is that the rings consist of a multitude of satellites too small to be seen individually, but collectively giving the appearence of a smooth, continuous ring. The particulate composition of planetary rings is now well established. We have yet to see an individual ring particle, but we can deduce something about the size and composition of the particles. As it might be expected, it is Saturn's rings that have been the most carefully scrutinized, and they are by far the most complex and spectacular of all the ring systems.

[1]Work presented by the second author at the CAM-94 Physics Meeting in Cancún, México.