
Science & Technology by Vin Berg

Voyager mission to Saturn transforms Newtonian physics

As of now, one sure conclusion can be drawn from Voyager 1's trip to Saturn: God has run rings around Sir Isaac Newton. Some specialists are trying to shoe-horn the recorded facts into the structure of Newtonian mechanics. But Saturn has presented remarkable anomalies to the physicist. Among the big surprises was the discovery of many new rings. Where before scientists believed there to be a half dozen, there are as many as a thousand differentiated strands swirling around the planet in at least 95 clearly demarcated divisions. Three new moons were discovered, bringing Saturn's known lunar complement to 15. Titan, the moon believed to possess a methane atmosphere, was discovered to have a 90 percent nitrogen atmosphere, the remainder being methane saturated with hydrocarbons comparable to the early chemical-reducing phase of the Earth's evolution.

Reported Dr. Bradford Smith, head of the Voyager camera team: "We may have to develop a whole new breed of celestial mechanics to account for the newly revealed Saturnian mysteries." The following are among the foremost phenomena to be explained:

- The most famous gap in the ring system, called the Cassini Gap after its 17th-century discoverer, is not a gap at all, but an area filled with additional rings, presenting the picture of a multigrooved phonograph record.

- A newly discovered F-ring, whose existence had been inferred from the earlier Pioneer spacecraft's visit to Saturn, lies farthest out from the planet, and is actually two rings or strands would around each other like a braid or double helix.

- As the rings swirl around Saturn's gaseous cloud-tops—the planet has no definite surface—linear structures rise up like "spokes" from the planet, spanning the rings, remaining stable for hours at a time, then dispersing.

- Two of Saturn's moons are orbiting in the same path but at different velocities; although long occupying the common orbit, they have not collided.

When first confronting these phenomena, one NASA

scientist described the display of ring-and-lunar interactions as a set of "nightmares" for Newtonian celestial mechanics. The fundamental proposition of Newtonian physics is that any complex, multibody system can be reduced to the included interactions between pairs of bodies. From the Newtonian standpoint, for example, the solar system is not a system at all, but a summation of the two-body relationships of the planets to the sun.

Similarly, Saturn's ring-moon system does not constitute anything higher in order than the presumed net effect of two-body interactions. Sum them all up, taking account of the way moon-moon, moon-planet, moon-ring, and ring-planet relationships may modify each other. Once electromagnetic "perturbations" are thrown in, everything that can be said about a multibody system is said.

Thus, prior to Voyager 1's investigation, scientists explained the Cassini Gap on the basis of "gravitational resonance," which explains the rise of a complex order on the basis of concentrations or depletions of two-body gravitational forces. Any particles orbiting in the Cassini area will be revolving about twice as fast as the farther-out moon Mimas, and so, every second orbit will line up with Mimas eventually being pulled out of that area into a ring orbit, and leave a "gap." But Voyager 1 revealed the existence of rings in the Cassini Gap, albeit of less density than contiguous rings.

Classical resonance theory, confronted with the *multiple-density differentiations within* the gap area, can explain the area only "on a gross level," one NASA office stated.

Another instance is the explanation attempted for the newly discovered F-ring—gravitational "shepherding." The ring's particles, small rocks and ice, are like "sheep" maintained in the ring-formation "flock" by two "shepherd" moon located on either side of the ring. The faster-moving moon on the inside of the ring toward the planet exerts gravitational force on those particles that might tend to drop out toward the planet, giving them energy to stay in the higher-ring orbit. The moon outside the

ring, away from the planet, would exert an oppositely directed force, shepherding the particles back down into the ring orbit.

But there are only two “shepherds” for this very unruly flock. What the F-ring’s double-strand braiding? Are the particles electrically charged? And what of the other rings? Where are their shepherds? If a “shepherd” thesis explains only one feature of one ring (but not other features), and cannot explain any features of other rings, can it be any explanation at all? “Too many divisions,” one NASA specialist entered in his notebook as the ring system first appeared on the data screen. “They’re in the wrong places to agree with classical resonance theory. We need more satellites. Need to find some embedded large particles.” But no missing moons or large embedded particles have been found.

Turning to the “spoke” phenomena periodically exhibited, these linear structures appear to rotate with the electromagnetic field of Saturn itself, and so could represent certain ring-particles temporarily lining up above or below the plane of the rings, like iron filings before a magnet. But why do they arise, and who do they disperse? What could cause electromagnetic force to temporarily take precedence over gravity—and then give way to it again?

A startling mystery is represented in the two moons traveling in the same orbit, but at different velocities. The inverse square formulation of the law of gravity states that gravitational force increases with the decrease in the square of the distance ($K = 1/r^2$). As the faster moon closes in on the slower one, it should gain energy and accelerate into a collision. They should have smashed each other to bits long ago. Some underlying causal process not within the purview of Newton’s law proves to be operative at precisely the point that Newton’s law should be inexorable, the point of approaching collision.

Kepler’s alternative

What Newtonian reductionism denies is that in a multibody system there can be an inherent, multibody collective effect, qualitatively different from simple two-body effects and their combinations. In fact, the preponderance of evidence from Saturn—and not only Saturn—is that a lawful ordering of the parts by the geometry of the whole is the sort of premise required for a new celestial physics.

Such an approach was taken by Johannes Kepler when, a generation before Isaac Newton, he sought to discover the laws of planetary motion in terms of a solar-system-as-a-whole rigor. For Kepler, there was a single underlying “plan” that determined the relative positioning, velocity, and general behavior of the planets, in a way that could not be reduced to nine separate two-body systems. For precisely such reasons, Kepler, although his laws of planetary motion would

permit any freshman schoolboy to deduce Newton’s laws, himself formulated no “law” of gravity.

Classical mechanics, inclusive of the inverse square formulation, resulted from a lowering of scientific outlook imposed by Newton’s bowdlerization of Kepler’s actual achievements. Kepler formulated three basic laws of planetary motion on the basis of a single physical hypothesis; Newton adopted Kepler’s laws in simplified form, discarding the physical hypothesis and abandoning the entire causal problem.

Kepler’s hypothesis stated that “Motion is dispensed by the sun in the same manner as light . . . a measure of the attenuation of which may be derived from the proportion of the circles [orbits] themselves.” A solar force field acts causally on the planets, attenuating with distance. From this, he was able to establish that in equal times, an orbiting planet sweeps out equal areas of “space” between it and the sun; that such orbits are not circular, but ellipses with the sun at one focus; and his Third Law, that the squares of the planets’ periods of revolution (t) vary directly with the cubes of their mean distance from the sun (d).

$$t_1^2/t_2^2 = d_1^3/d_2^3$$

But Kepler’s concern was to reduce the three laws to one, thus proving “the harmony of the spheres.” Does there exist an underlying ordering principle—perhaps inherent in the solar force field itself—that would comprehend the solar system as a single system?

Kepler was able to prove that the distances of the planets treated as radii of concentric circles correspond to a certain ordering of the five regular Platonic solids; he also proved that the relative angular velocities of the planets were *harmonic*—closely corresponding to the mathematical ratios of different string lengths producing notes that harmonize. These are not laws, but powerful geometric and harmonic correlations, in truth, signifying a well-defined mathematical relationship, in respect to which there must exist some underlying causal necessity.

Let us suppose that the solar system originated as a vortical mass of plasma, as Kepler’s hypothesis—and the evidence from Voyager 1—suggests to the plasma physicist. In that case singularities arising in the plasma to form *planets* will occur in specifically determined regions of plasma temperature, density, and frequency, much as a vibrating string yields nodal points at certain specific, and often *harmonic* frequencies.

In plasmas, very hot ionized gases, the tendency is to go from less-ordered to more-ordered states in which, intense concentrations of electromagnetic energy, called solitons, form out of nearly uniform fields; filament-like threads twist out of uniform plasma; closed field structures much like smoke rings appear. Plasma behavior cannot be explained on the basis of Newtonian physics.