CENTRIPETAL FORCE & GRAVITY

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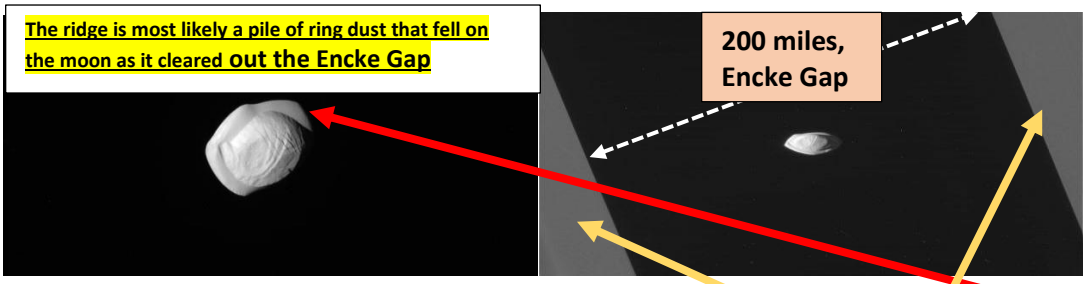
Pan, Moon of Saturn, Looks Like a Cosmic Ravioli (or Maybe a Walnut)

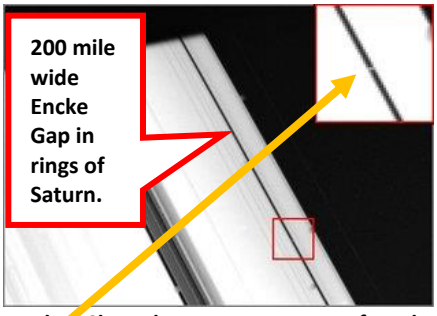


INTRODUCTION: Gravity provides centripetal force Keeping moons od Saturn in orbit. Knowing moon's period of orbit(T) & radius of orbit(R) mass of planet orbited can be found from Kepler's third law.

A raw image of Pan, a moon of Saturn, captured by the Cassini spacecraft on Tuesday. The **ridge around Pan's equator could be a couple of miles high and is likely made of dust from Saturn's rings.**

In a stunning set of close-ups, Pan, a diminutive moon of Saturn, looks like a floating ravioli lost in space, or a wrinkled flying saucer. NASA's Cassini spacecraft took the photographs on Tuesday, passing within 15,268 miles of **the moon, which has a diameter of about 20 miles, roughly the size of New York City.**" These are the clearest images ever seen of Pan, named after the flute-playing Greek god of hunters and shepherds. They depict a ridge around the moon's Equator that rises perhaps a couple of miles.

Pan is one of Saturn's shepherd moons, clearing out a 200-mile-wide space in Saturn's rings known as the Encke Gap. "To see it with that detail, to be able to count craters on it," said Mark R. Showalter, an astronomer at the SETI Institute in Mountain View, Calif., who discovered Pan in 1990, "I could remember when it was not even a pixel." In the mid-1980s, astronomers noticed that the ring edges along the gap had a scalloped appearance, almost like waves of water, possibly the wake of a small moon orbiting within the gap. By refining the calculations, Dr. Showalter, then at the NASA Ames Research Center, figured out an orbit for the unseen moon. He went back to images taken by the Voyager 2 spacecraft during its flyby of Saturn in 1981.



Mark R. Showalter, an astronomer, found a dot in an image taken by Voyager 2 — the discovery of Pan.

Introduction(continued): $G\,Mm/R^2 = m\,v^2/R$, where $v = R\omega = R2\pi f = 2\pi r/T$, thus $G\,\cancel{m}M/R^2 = \cancel{m}4\pi^2R^2/GR$

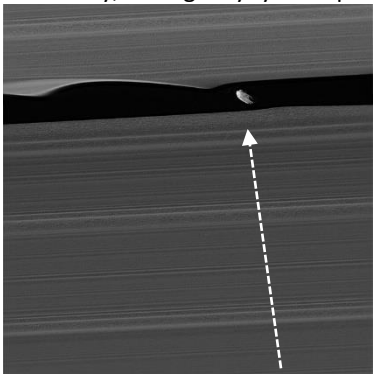
$$M = [4\pi^2/G](R^3/T^2)$$ Kepler's 3rd Law

DATA from Wikipedia: Pan moon: T = 13.8 hrs., R(semi major axis) = 133,584 km., Daphnis moon: T = 14 hrs., R = 136,505 km.

QUESTIONS: (a) Convert 13.8 hrs. into seconds ?, (b) Find mass of Saturn from Pan data?, (c) Convert 14 hrs. into seconds?, (d) Find M_{SATURN} from Daphnis data?

HINTS: G = gravitational constant = 6.67 X 10^{-11} $Nm^2/kg.^2$, 1 hr. = 3600 seconds ,1000 m. = 1 km.

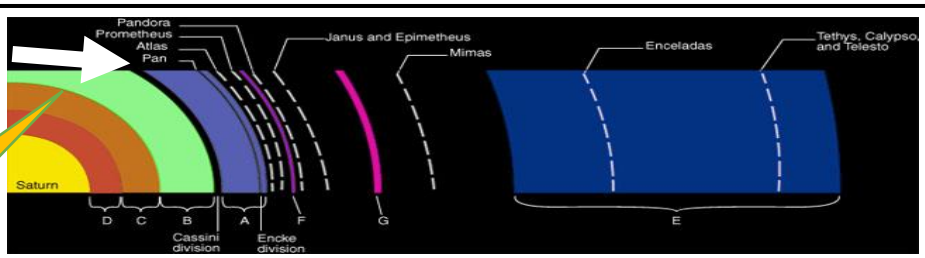
In January, during a flyby of Daphnis, another of the shepherd moons, Cassini was able to successfully take only one photograph.



Cassini took this image of Daphnis, a 5-mile-wide moon, in January. Daphnis' gravity also opened a gap in Saturn's rings and created the scalloped wave pattern at the ring edges.

ANSWERS: (a) T_{PAN} = 4.97 X 10^4 s. , (b) M_{SATURN} CALCULATED = ~ 5.718 X 10^{26} kg., (c) $T_{DAPHNIS}$ = 5.04 x 10^4 s., (d) M_{SATURN} calculated from Daphnis = ~5.7 X 10^{26} kg.

NOTE from Author: NASA lists mass of Saturn as 5.693 X 10^{26} kg., thus original work of Newton's law of gravitation (GmM/R^2) and Kepler's initial observation Of third law as T^2 is proportional to R^3 are very valid. Pure poetry in the physical World. Thanks to Kepler and Newton. Dr. Cise



PAN MOON