Tidal Forces and the Roche Limit

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PHYS 305

Introduction

- Tidal Force: a differential forces that arises from the effects of gravity
- Cause tides and changes sea level
- Roche Limit: distance at which an orbiting satellite will disintegrate due to the tidal forces exerted on the satellite from the mass it's orbiting

Introduction

- Gravitational force:

$$F_g = -\frac{GMm}{r^2}$$

- Tidal force:

$$F_t = \frac{2GMur}{d^3}$$

- Roche limit:

$$d = R\left(2\frac{\rho_M}{\rho_m}\right)^{\frac{1}{3}}$$

http://en.wikipedia.org/wiki/Roche_limit

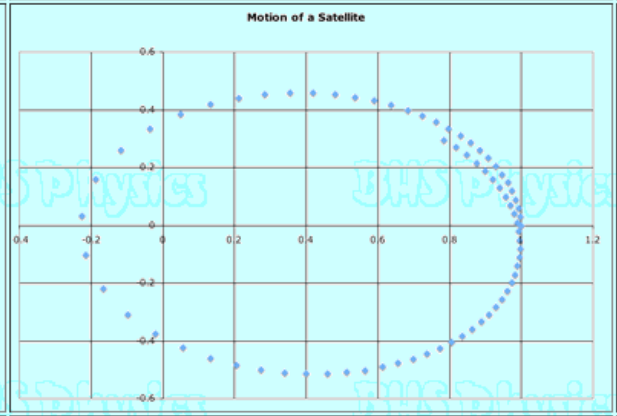
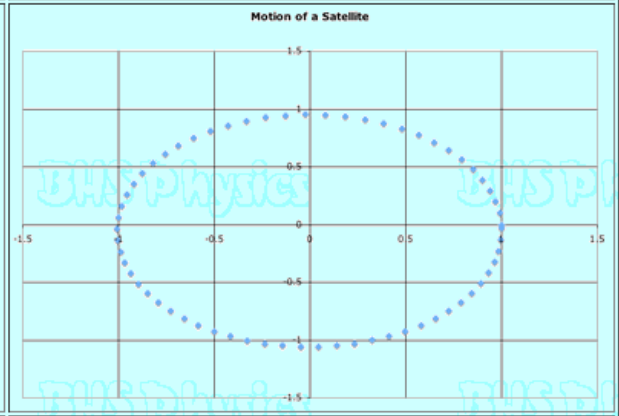
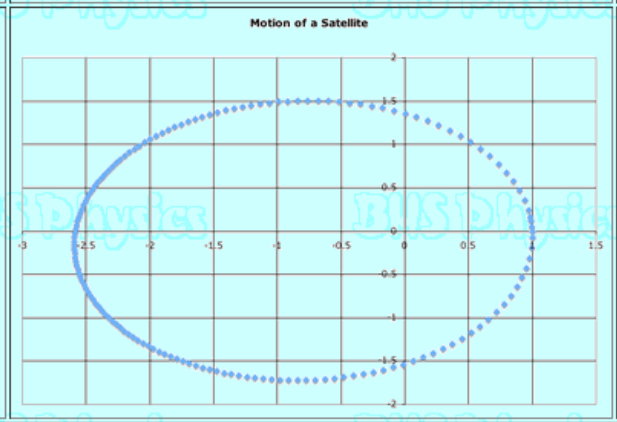
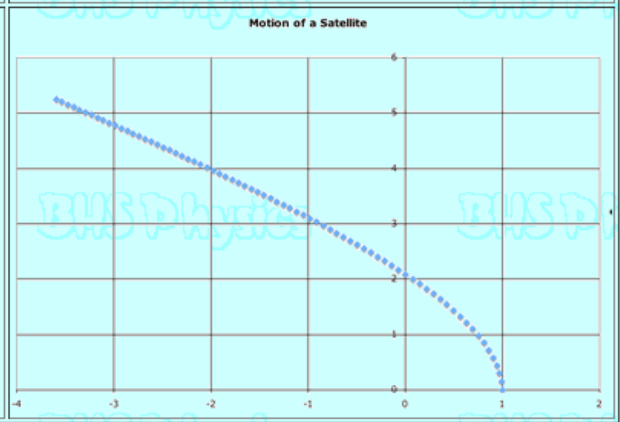
Main Program

- Plot out orbit of satellite
- Allow user-defined values for mass *m* of satellite and distance *r* between objects
- Use Runge-Kutta method to predict orbits

$$\frac{dv}{dt} = -\frac{GM}{r^2}$$

$$\frac{dv_x}{dt} = -\frac{GMx}{r^3}, \quad \frac{dv_y}{dt} = -\frac{GMy}{r^3}$$

Sample Orbital Plots

Parameters	Graph	Parameters	Graph
dt = 0.05 vo = 0.8		dt = 0.1 vo = 1.0	
dt = 0.1 vo = 1.2		dt = 0.1 vo = 1.5	

http://www.batesville.k12.in.us/physics/phynet/mechanics/gravity/lab/excel_orbits.htm

Other Features

- Find the Roche Limit distance *d* from user-input values
- Replot this distance into our orbital plot graph and compare
- Error and uncertainty? Compare RK2 with RK4

Status/Schedule

- Current project status: I have the algorithm down
- Need to setup RK method for orbits
- If possible, do a better, graphical display of orbits