The Orbital Period of Moons Based on Kepler's Laws Related to Eccentricity

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My project investigated if Kepler’s Laws of Planetary Motion can apply to orbits of the moons around each planet. My hypotheses were: there will be a strong correlation between published and calculated periods to orbit the planet, orbital speeds will decrease as eccentricity increases, and orbital periods will increase as eccentricity increases. For each moon and planet, I recorded orbital speed, time to orbit, average distance, eccentricity, and semimajor axis from various resources. I calculated the apogee and perigee of each moon and planet by multiplying the semimajor axis in meters by the sum of 1 + the eccentricity and 1 – eccentricity respectively. I then calculated the orbital period of each moon and planet according to Kepler’s Laws with the equation T^2 = (4pi2/GM)a^3 and converted the period from seconds to hours. Based off the apogee, perigee, eccentricity, and average distance from the sun, I made proportional diagrams of the orbital tracks of the planets. I then made diagrams of the orbital tracks of the 8 most analogous moons of each planet, while including all of Neptune, to see how synchronous the moons around each planet is to the planets around the sun. I also made a model of Neptune’s Nereid and Triton moons to demonstrate the large variation in the eccentricity of moons. I used Pearson Product Moment Correlation Coefficients to compare the factors of calculated and recorded period, eccentricity, orbital speed, and distance. They all showed statistically significant correlations. Kepler’s Laws describe the moons’ orbits around the planets.

Awards Won: