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The binary star Tau Ophiuchi

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The binary star Tau Ophiuchi is a difficult system to study. Although 633 observations were made between 1835 and 2014, they do not cover the full period of the orbit, which I calculate as 230.21 years, nor include the time of periastron passage, 1834.55 by my calculations. The difficulty arises from trying to obtain an orbit that statistically satisfies the observations and also the dynamics of binary star motion. The orbit published in the Washington double star catalog fails to satisfy the dynamics because the variation of mean anomaly with time, which should be linear, shows, decided nonlinearity. The best fit orbit I calculate satisfies statistics, with satisfactory randomness of the residuals, but fails dynamically because the orbit is hyperbolic, eccentricity of 1.05, impossibility. By use of semi definite programming to solve for both the orbital elements and the constant of areal velocity I finds an orbit that, although not entirely satisfactory statistically as measured by a statistical test for randomness of the residuals, 259 runs out of an expected 317, results in a mean anomaly that varies linearly with time and thus satisfies the dynamics. The sum of the masses of the two components, 6.07 solar masses, also becomes consistent with the primary, according to observational astronomers, being a giant star, although one cannot calculate the individual masses. The orbit is a high eccentricity ellipse, eccentricity 0.773, with perihelion 211.41, node 60.10 and inclination 54.64, all in degrees. This binary shows the importance of both statistics and dynamics for successful orbit computation.

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