The Astronomers II

2020-10-19

Tycho Brahe (1546-1601)

- a Danish nobleman who got interested in astronomy
- later became court astronomer (and astrologer) to King Frederick II of Denmark and later the Holy Roman Emperor Rudolf II (and had a reputation as an alchemist)
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  (possibly due to his having a prosthetic nose, having lost much of his original in a duel with a 3rd cousin over who was the better scholar)
- last major "naked eye" astronomer, (telescopes coming into use in the early 1600s)
- put alot of effort into designing equipment and observatories to get very accurate observations of the planets.
- his data helped lead to the discovery that planetary orbits are elliptical by Kepler
- he proposed a compromise between geocentric & heliocentric theories by having the planets (except for the Earth) orbit the Sun, but having the Sun orbit the Earth. This combined the mathematical advantages of heliocentrism with the philosophical/religious advantages of geocentrism.

Johannes Kepler (1571-1630)

- son of a mercenary soldier and an innkeeper's daughter
- very interested in math from a young age
- astronomer (& astrologer) & mathematician

Best known for his 3 laws of planetary motion:

1) The orbit of a planet is an ellipse with the Sun at one of the foci.

2) A line joining a planet to the Sun, sweeps out equal areas in equal times.

3) The square of the period of the orbit is proportional to the cube of the semi-major axis of the orbit.

1) & 2) were published in 1609 using Tycho Brahe's data to engineer. (Kepler worked as Brahe's assistant from 1597-1601) (after which Kepler became the court astronomer & astrologer to Rudolf II and his successors)

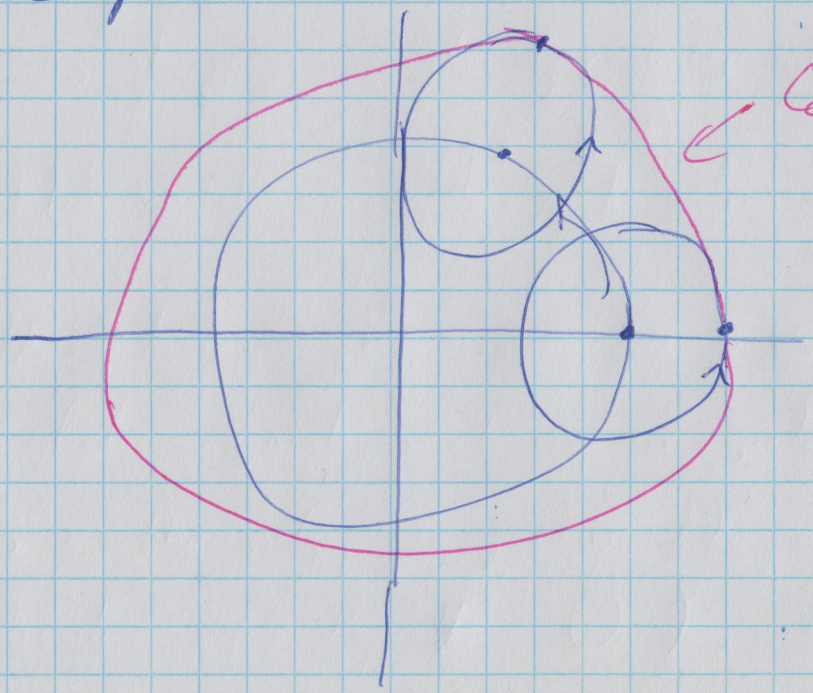
3) was published in 1619 & then observed in 1621 that the three laws appeared to hold for the four largest moons of Jupiter.

He also did work in optics and designed a refracting telescope that improved on Galileo's design, in particular in increasing sharpness and decreasing abberation.

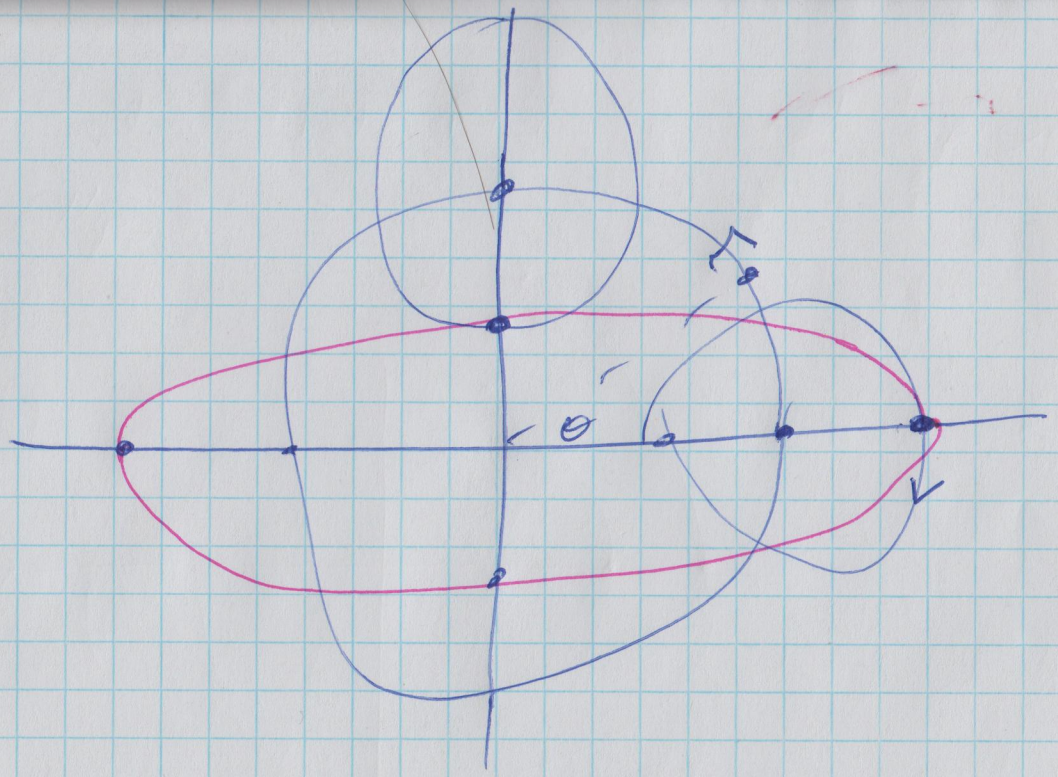
Published the most accurate astronomical tables to date (c 1621)

As a mathematician he was a very sophisticated user, but also did original work on regular polyhedra, solid geometry, including methods for computing the volumes of solids of revolution (in particular wine barrels ), the "marriage problem" (evaluated 11 prospects over two years after his first wife died and the analyzed when he should have stopped...), sphere packing (explaining the hexagonal structure of honeycombs), gave the first proofs of the properties of logarithms (after being criticized by his former mentor for using them when nobody knew why they really worked.

It's worth noting that Ptolemaic-style epicycles can generate ellipses



⇒ Say we have a small circle of radius 1, have its center travel on a larger circle of radius 2, with both rotating at the same rate (relative to their centers), but in opposite directions.



Parametric representation: $x = 2\cos(\theta) + \cos(-\theta) = 3\cos(\theta)$

$y = 2\sin(\theta) + \sin(-\theta) = \sin(\theta)$

Which satisfies the equations for the ellipse $\frac{x^2}{3^2} + y^2 = 1$.