BO1 History of Mathematics Lecture IV Newton's *Principia* Part 2: The mechanics of the universe

MT 2021 Week 2

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Johannes Kepler (1571–1630)

Engaged to sift through the astronomical data gathered by the Danish astronomer Tycho Brahe (1546–1601)

Major works: Astronomia nova (1609) Harmonices mundi (1619)



Kepler: Astronomia nova (1609)

ASTRONOMIA NOVA ΑΙΤΙΟΛΟΓΗΤΟΣ. PHYSICA COELESTIS. tradita commentariis DE MOTIBVS STELLÆ MARTIS. Ex obfervationibus G. V. TTCHONIS BRAHE: Jusiu & fumptibus **RVDOLPHI II** ROMANORVM IMPERATORIS &:c: Plurium annorum pertinaci frudio elaborata Praga, A St. C. M. St. Mathematico IOANNE KEPLERO. Gum ejurdem C4. M.** privilegio freciali ANNO RER Dionyfianz clo loc 1x.

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Kepler's laws

Kepler's laws of planetary motion (1609, 1619):

- 1. Planets move in elliptical orbits with the sun as focus
- 2. Planets sweep out equal areas in equal times
- 3. T^2 is proportional to R^3 (where T is time of one revolution, R is mean distance to sun)

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All from empirical evidence



Descartes' views of planetary motion in *Principia philosophiae* (1644):

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Descartes' views of planetary motion in *Principia philosophiae* (1644):

 the sun is one star among many

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Descartes' views of planetary motion in *Principia philosophiae* (1644):

- the sun is one star among many
- asserted that planets are carried round their suns by vortices of the surrounding 'ether'

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Descartes' views of planetary motion in *Principia philosophiae* (1644):

- the sun is one star among many
- asserted that planets are carried round their suns by vortices of the surrounding 'ether'
- claimed that theory could also explain magnetism and static electricity

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Speculations and calculations on an inverse square law of gravity:

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1645 Ismaël Bullialdus refutes a claim of Kepler that 'gravity' drops off linearly with distance, instead suggesting an inverse square law

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Speculations and calculations on an inverse square law of gravity:

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- c. 1679 Hooke corresponds with Newton and suggests that an inverse square law might lead to elliptical orbits

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 - 1687 Publication of Newton's *Principia* at Halley's expense

Something a little bit different...

Volker Remmert, *Picturing the Scientific Revolution*, Find it on Solo.

