

The “orbit” of the Sun: Kepler was Right

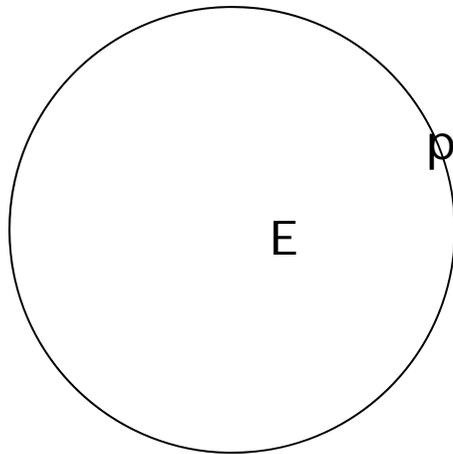
Elliptical orbit can be mimicked with  
Ptolemaic circle + equant

However direct measurement of variation in  
solar image diameter across the year  
indicated Kepler was right

At apogee: 31' 8" (Cassini) 31' 0" (Riccioli  
& Grimaldi)

At perigee: 32' 10" (C) and 32' 4" (R & G)

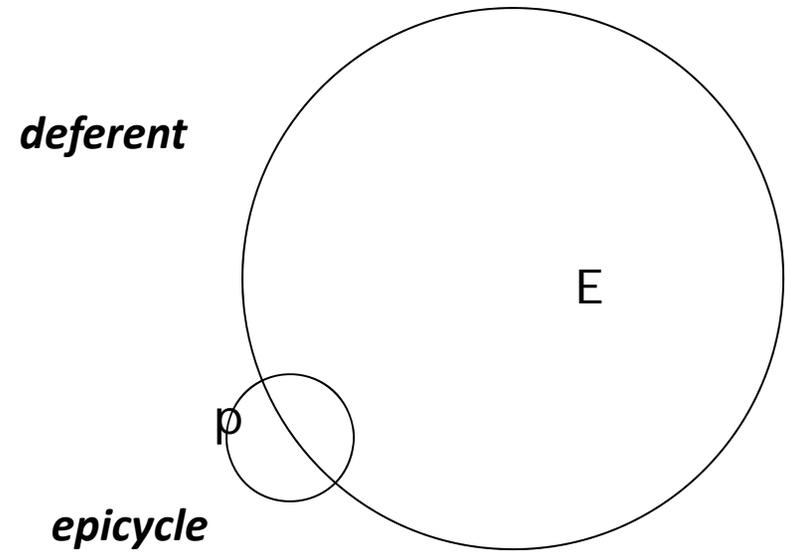
**How to combine circular orbits and uniform speeds in order to platonically “save the phenomena” [and make your life difficult...]**



***eccentric***

A planet moving at uniform speed on a circular but eccentric orbit is seen by Earth as moving at variable angular speed

A non-eccentric deferent



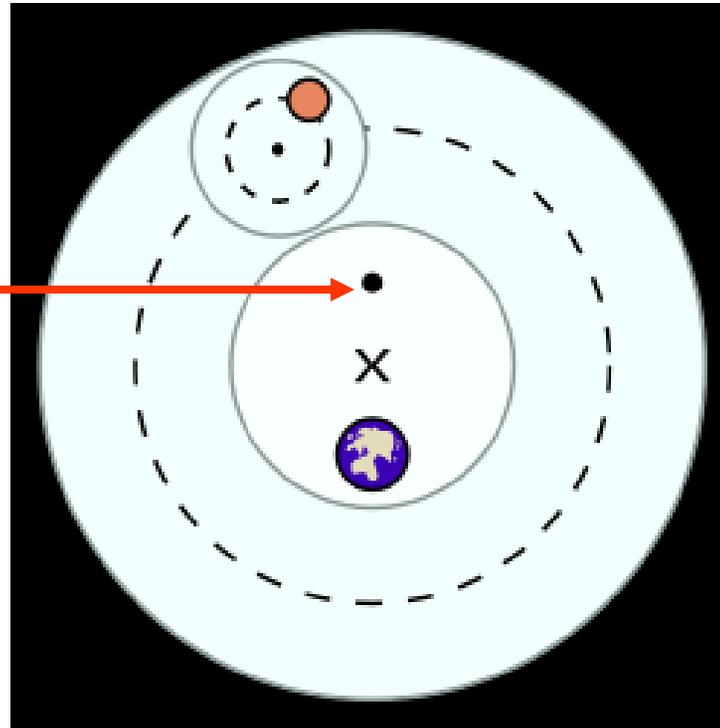
***deferent***

***epicycle***

A planet moving at uniform speed on an epicycle, the center of which orbits at uniform speed on a circular deferent, itself eccentric, can be seen by Earth to temporarily invert its motion.

The *Equant Point*, opposite Earth w.r.t. the center of the deferent.

In order to better describe the motions of superior planets, **Ptolemy** proposed that the center of the planet's epicycle move at constant angular speed as seen from the Equant point, rather than from the center of its deferent.



A number of astronomers later found fault with idea, a breach with the platonic postulate of uniform circular motion of a planet w.r.t. to the center of its orbit. Among those was **Copernicus**.

# The Scientific Method

***“Knowledge comes from generalizing from what is observed”***

**[Francis Bacon 1561-1626]**

**+**

***Classic Greek approach of deduction with logical rigor from first postulates:***

***Observe, generalize, distill basic rules; then push them to their extreme logical power. If predictions are confirmed, theory lives. If they are not, theory is rejected → a new, broader theory is needed: one that explains correctly the results the old one explained, plus those the old one did not explain:***

***→ we then have a “paradigm shift”***

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# The Scientific Method

*The variety of the scientific experience is broad, but scientists speak the same language, albeit in different “dialects”:*

*-Some disciplines are quite formal, their basic axioms are very mathematical, e.g. Physics*

*-Some are “data rich”, requiring attention to sifting the fundamental from the circumstantial, e.g. Meteorology and Geology*

*-Some are “data poor”, and a theory’s worth is evaluated by its ability to extrapolate to currently unobserved phenomena, e.g. Early Universe Cosmology*

*They all agree on being empirical, open-minded, skeptical, sensitive to the need of theory to be vulnerable,  
i.e. open to the possibility of being proved wrong*

***The language of science is the same across borders, races and gender; the glue of the scientific community is its method***

# A scientific theory

- *A brief set of postulates which apply to a broad set of phenomena*
- *Capable of describing all extant observations*
- *And of predicting the results of future ones*
- *It needs to be fertile and vulnerable,*
- *Broad and simple*

A scientific theory not only describes known facts; it also predicts the outcome of new experiments or observations

"The problem with communication is the *illusion* that it has been accomplished."  
G. B. Shaw