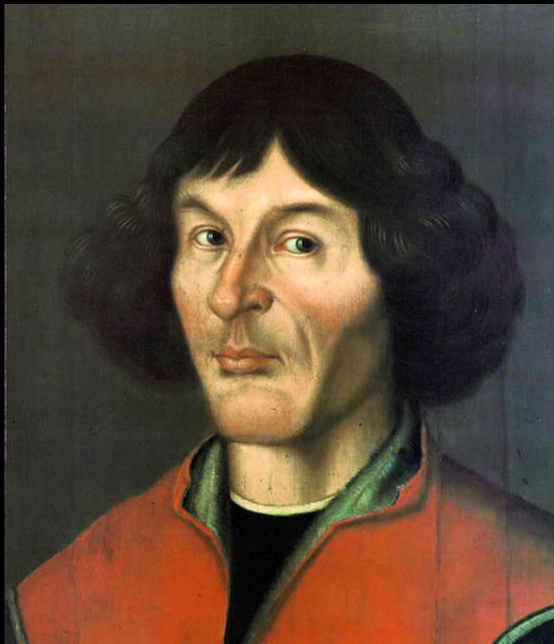
EXPLORING ARTIFICIAL SOLAR SYSTEMS WITH PTOLEMY AND COPERNICUS

Todd Timberlake

Berry College

Mount Berry, GA

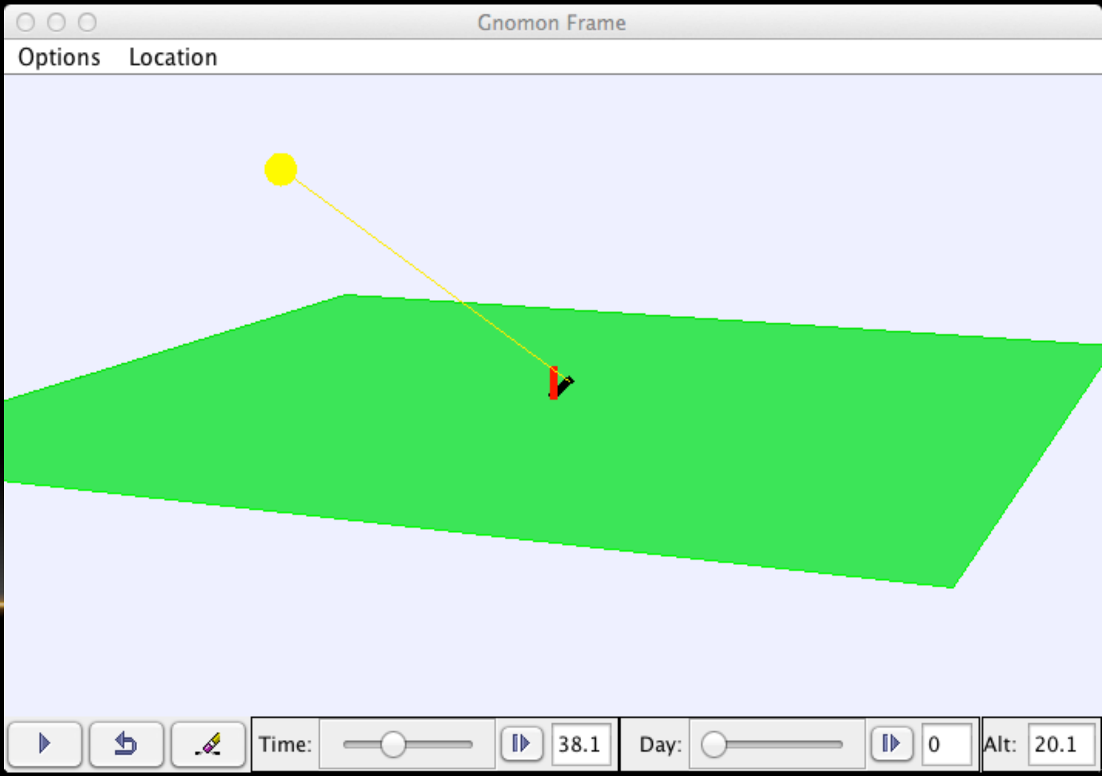


THE COPERNICAN REVOLUTION

- Audience: non-science majors.
- Content: an investigation of theories to explain the apparent motions of celestial objects, from Aristotle to Newton.
- Teaching methods: group work, lots of computer simulations (Stellarium, my own simulations).
- Group activities focus on observing our night sky (using Stellarium) and how these are modeled in Aristotelian, Ptolemaic, Copernican, Tychonic, and Keplerian astronomy (along with the physics of Galileo and Newton).
- Centerpiece: six major projects.

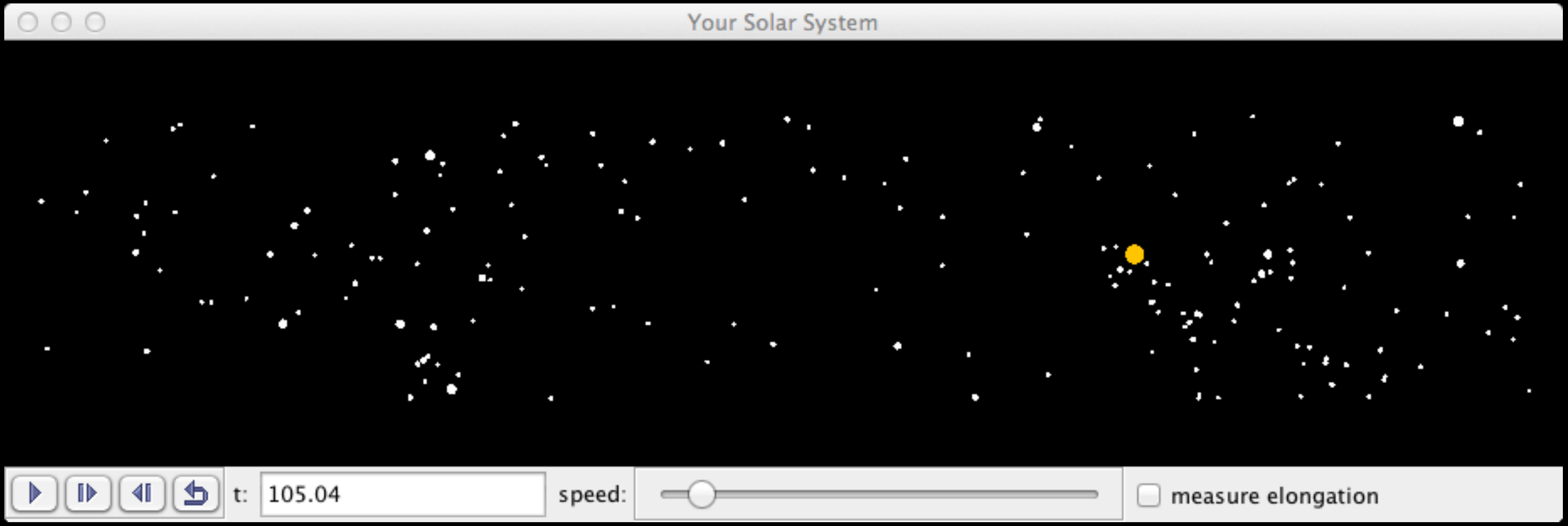
GNOMON PROJECT

- Each student gets two individualized simulations to make observations from a planet in a fictitious solar system, in order to apply their knowledge to a new situation.
- Project 1: Gnomon simulation: simulates shadows cast by a gnomon from three unknown locations on the home planet. Students determine:
  - length of solar day and tropical year,
  - latitude and (relative) longitude of three locations,
  - obliquity of ecliptic,
  - dates of solstices/equinoxes,
  - radius of planet (Eratosthenes),
  - tropic and arctic/antarctic circles.



SOLAR SYSTEM PROJECT

- Project 2: Solar system simulation: simulates the motion of the Sun and 3 planets relative to the stars as seen from the home planet. Planets are all in circular orbits for simplicity. Students determine:
- length of sidereal year,
- number of inferior/superior planets,
- synodic and zodiacal (sidereal) periods of each planet,
- maximum elongation of inferior planets,
- time from opposition to quadrature for superior planets.



PTOLEMY, COPERNICUS, AND KEPLER

- Project 3: Ptolemaic model. Students determine:
  - rotational period of celestial sphere,
  - period of solar orbit,
  - deferent and epicycle periods,
  - ratio of epicycle size to deferent size for each planet.
  - Construct a diagram of the system (justify ordering).
- Project 4: Copernican model. Students determine:
  - determine rotational period of home planet,
  - orbital period of FOUR planets,
  - radius of planetary orbits (relative to home planet's).
  - Construct a diagram of the system (has set ordering).
- Other projects on Kepler's Laws and Newtonian physics.

BENEFITS

- Students learn about historical theories, how they worked and also why they were eventually discarded.
- Students get to see how science is really done: they make their own observations and develop models to fit their data. They evaluate these models based on various criteria (and learn that the preferred model may depend on which criteria you use).
- Students gain a deep understanding of a few important models and see how these theories connect to the real world of the visible night sky.
- Students enjoy the projects, and particularly the way the projects are all connected.
- For more information:

http://facultyweb.berry.edu/ttimberlake/copernican/#projects