Gary DeLeo (Physics) and Alex Levine (Philosophy):

Copernicus: The Problem of the Planets

Group Project Topics

All group projects minimally require 1) an oral presentation, in which all group members participate; and 2) a written exegesis of results, illustrated where appropriate, suitable for posting to the web.

Group 1. Present a close reading of Book I of Copernicus, *De Revolutionibus*, with emphasis on the importance of passages marked with marginalia in Lehigh's first edition. Explain the rhetorical and scientific function of Book I in historical context. Decipher the marginalia. What do they reveal about their author? What do they reveal about the contemporary reception of Copernicus's work?

Group 2. Using the figures and explanations in Tycho Brahe's *Astronomiae Instauratae Mechanica*, build a Tychonian sextant. Explain the differences between Tycho's astronomical sextant and a sixteenth century navigational sextant. Record observations in a manner similar to that of Tycho Brahe for several stellar and planetary bodies over several weeks. Show that these observations can be understood in the context of the Copernican model.

Group 3. Determine the approximate technical specifications of a Galilean refracting telescope. Describe the operation and characteristics of the various types of reflecting telescopes, and the history of their development. Build a Newtonian reflector, using the closest possible approximations to seventeenth century materials. Using ray-tracing methods, describe the characteristics of this reflector, including magnification, light-gathering power, and resolving power. Using your telescope, perform observations of the Galilean satellites of Jupiter, sufficient to sketch rough plots of their orbits

Group 4. Describe the historical use of sundials in the study of celestial motion. Identify an outside object on the Lehigh campus that may be used as the gnomon of a sundial. Carefully record the gnomon's shadow over several weeks, and use this to describe the apparent motion of the sun, particularly in the context of seasons. Construct equivalent gnomons for each member of your group, and compare observations made at different locations when traveling.

Group 5. Construct an optical device that would produce a *projected* image of the sun with suitable resolution to observe sunspots. Track the positions of sunspots over several weeks, and use this information to describe the rotation of the sun and the motion of the Earth about the sun (in the spirit of Galileo's observations and interpretations). Discuss the observations made by Galileo.

Group 6. Work out the mathematics required to convert the orbital positions of several planets (including Earth) into local altitude and azimuth coordinates as viewed from any position on Earth at any time and date. Construct a computer program that will perform these geometrical calculations.

Group 7. Examine the economic and institutional (e.g., religious and political) environments of Copernicus and Galileo. Describe in detail how these conditions affected the technical methods used and the thought processes applied in their studies. Describe in detail how these conditions affected the dissemination and acceptance of their observations and conclusions.

Group 8. Discuss the history of time-keeping methods (science of chronology), including the various calendars used in the past, and in use today. Discuss the compatibility of celestial and non-celestial time keeping methods. Consider various ancient and modern structures around the world that are or were used to keep track of the passage of time (e.g., Stonehenge). Describe modern methods of recording the times of events as used by astronomers.

Group 9. Examine the history of studies relating to the apparent motion of the moon, including position in the sky, phases, librational motions, and tidal effects on the Earth. Describe how these observations were explained in the context of pre-Copernican and Copernican models of the solar system. Discuss details that remained unexplained until more recent times (twentieth century), and the explanations in terms of modern physical principles.

Group 10. Discuss the relation between celestial observations and the determination of terrestrial position in the seventeenth-century context. Consider problems of both land and sea navigation. To what degree, and in what contexts are ancient and early modern methods still in use?