Summary of Lecture 5

Key points include:

1. In ancient times, astronomy was critical for agriculture and navigation.
2. Cultures therefore kept records of the seasons, lunar cycles, etc., and had various reactions to eclipses. Even subtle, long-term trends such as the precession of the equinoxes were known more than 2000 years ago, and ancient monuments from all over the world were oriented for astronomical occurrences such as solstices. We will focus on ancient Greek cosmology because they not only measured and kept records, but developed a predictive *model* of the (apparent) motions of the Sun, Moon, planets, and stars.
3. Eratosthenes measured the size of the Earth, using geometric assumptions and with the help of soldiers marching off the distance. He, and all educated people in at least the Greek civilization > 2000 years ago, knew that the Earth was roughly a sphere.
4. It seems obvious to our senses that the Earth is stationary, whereas everything moves around us (the Earth-centered, or geocentric, cosmology). Competing with this was the Sun-centered, or heliocentric, cosmology.
5. In both models (geocentric and heliocentric, through and including the much-later model of Copernicus), all motion was along circles. This was because circles were considered to be perfect shapes, i.e., those who produced these models were driven by aesthetics.
6. However, again in both models, to explain the astronomical data carefully collected over centuries, it was necessary to add complications. For example, to explain the apparent motion of a given planet, the planet could not simply move at a constant speed along its circle. Instead, it moved in a circle whose *center* moved along a guiding circle. This "circle on a circle" is called an *epicycle*, and although it was aesthetically displeasing to have that complexity, modelers of the sky accepted it because it seemed necessary to explain the observations.
7. Particularly vexing to the geocentric modelers was *retrograde motion*, where a planet mainly appeared to go in one direction relative to the "fixed stars" most of the time, but would sometimes temporarily reverse its motion. This was easy to understand in the heliocentric model.
8. So why did the geocentric model hold sway for so long? One reason is that if the Earth rotated or moved around the Sun, we "obviously" would know (surely we'd feel the rotation like a merry-go-round, and if we moved around the Sun then we'd see parallax of the closest stars, i.e., their direction would appear to change over the course of a year).