

12.425

Lecture 12

Tuesday November 1, 2007

The focus of this lecture is to discuss direct imaging of extrasolar planets. Students will become familiar with direct-imaging planet candidates, understand what is being measured when imaging the objects, and review the planet-star flux ratio with a wrap-up summary of how scientists are planning to use the direct-imaging technique to search for extrasolar Earth-twins.

The first in-class exercise asks students to look through a series of six images and decide which features in the photos are real and which are artifacts of the telescope. Students can then try to decide which of the companion objects could be planets.

What students will notice is that it is difficult to distinguish a planet from telescope artifacts merely by looking at the images. The first image, for example, was thought to be the first-identified extrasolar planet based on theoretical interpretation of planet formation and ejection. With extensive observational data, the system was later proved to be a star in the foreground with the companion as a more distance star in the background. Looking at the objects in the images gives little context about the history or orientation of the system.

Data, however, can be deduced from the images if astronomers estimate the age and calculate the mean distance of the system from Earth. In exercise two, students will look at a table of data for four planet-candidates tagged by direct-imaging techniques. Astronomers have used an inferred theoretical age of the system to determine mass and radius of the star and the planet candidate.

Students should look at the table and decide which they believe to be planets and also answer what measured values astronomers are using to make the age, mass, radius, and spatial distance assumptions. The class may note that only one example, SCR 1845 b, falls in a semi-

major access distance from its star that is within the parameters of our own solar system, as Pluto is about 38 astronomical units from the sun. Also, students may realize that the values for mass and radius are calculated indirectly using the age of the objects deduced from their light flux, which may lead them to consider the uncertainty of the data in this chart, and therefore how uncertain astronomers are as to whether they have actually directly imaged an extra-solar planet or instead a low-mass star or failed star (brown dwarf).