

12.425

Lecture 10

Thursday October 25, 2007

The focus of this lecture is to study and discuss exoplanet secondary eclipse light curves, review blackbody radiation, and determine how star's and planet's temperatures can be defined by the black body radiation curves. Students will define temperature and assess exoplanet temperature data reported in the news.

The first in-class exercise asks students to review ten light curves and decide whether the graphs represent secondary eclipses caused by exoplanets. They should also describe what the graphs are showing in terms of exoplanets measurements and the physical scenario of the planet's orbit about the star.

A secondary eclipse of a star by its exoplanet occurs when the planet approaches the part of its orbit when it goes behind the star. Therefore, in the light-curve examples, the baseline of a positive secondary eclipse will be the flux of the planet plus the flux of the star. The secondary eclipse represents the subtraction of light of the planet from that baseline. Examples one and four and six through ten are measurements of an exoplanet secondary eclipse by the host star. Note that examples 5 and 7 are upward sloping trends. A slight dip in the light curve is present, but the transit becomes more clear as the data is reduced as shown in examples six, eight, and nine. See lecture slides 19, 21, and 22 for more details.

The second in-class exercise asks students to calculate the temperatures of the exoplanets using the secondary eclipse curves from the previous exercise, assuming the planets and stars are blackbodies. Students will use the derive an estimate for the planet-star flux ratio, i.e., the flux of the planet/flux of the star = $T_{\text{planet}} R_{\text{planet}}^2 / T_{\text{star}} R_{\text{star}}^2$, given on slide 33 to calculate the temperatures

of planets in light-curves 1, 6, and 8 using the data given on slide 36. Note that the radius of the star must be converted to Jupiter radii.

Students found the temperature of the exoplanet in example: one to be 841 K; six to be 2400 K; and eight to be 600-700 K. After reviewing the definitions of temperature, students will note that these calculations represent brightness temperature because the temperatures were measured only at one wavelength.