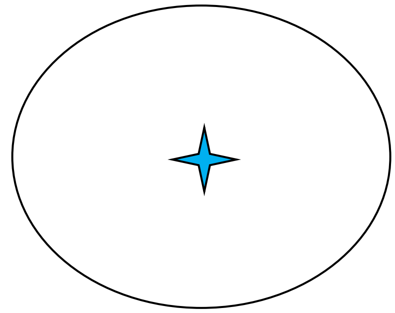
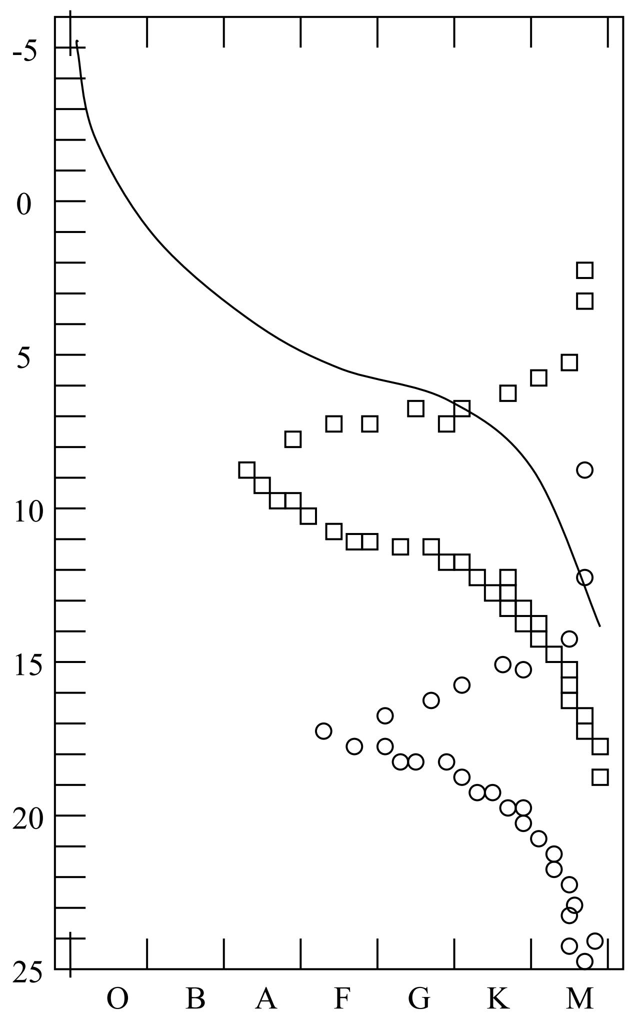
Physics 310/610 – Cosmology

Homework Set F



1. A supernova in the galaxy M33 produces a point of bright light. Over time, a ring of light forms around the star, as illustrated at right. This is presumably a circular ring, but because the ring is tilted, it looks like an ellipse, with 1 cm representing 10 mas. The top edge of the ellipse begins to glow 50 days after the supernova appears. The bottom edge of the ellipse begins to glow 199 days after the supernova.
   (a) In class we found a formula for the time delay for the leading edge (top) as a function of the angle β compared to the vertical the ring is tilted at (so $\beta = 0$ would mean we see a circle) and the actual radius R of the ring. Derive a similar formula for the trailing edge (bottom) of the ring.
   (b) Based on the shape of the ellipse, estimate β.
   (c) Using the time until illumination of the top edge, estimate the true radius of the ring (in AU, or any convenient unit). Repeat for the bottom edge. Your numbers should be fairly close.
   (d) Based on the angular size of the ellipse and its actual radius, what is the distance to the supernova, and hence to M33?



3. A cluster of stars is discovered, and the spectral type and apparent magnitude m of several member stars is plotted (circles). As a comparison, the standard main sequence is shown as the solid line (with absolute magnitudes M, instead of apparent).
   (a) What is the distance to the cluster represented by circles?
   (b) Why are there no stars on the upper part of this main sequence?
   (c) Another cluster is represented by the squares. What is the distance to this cluster?
   (d) How does the age of these two clusters compare?
   (e) A couple of the circles are very close to some of the squares on the graph. If we could go and visit these stars, would these stars be very similar? Why or why not?

There are no graduate problems for this homework