

Astronomy 450: Astronomical Instrumentation Technology

Homework 3: Due date Sept. 15 at 2:00 pm. Please hand in this homework via email to hodapp@ifa.hawaii.edu with the subject line "ASTR 450 homework 3". Homework submissions time-stamped after 2:00 pm on the due date in the UH email system will be ignored. I will discuss the homework at the beginning of the class on Sept. 15, and submissions after that time would obviously have an unfair advantage.

Please read the summary article by Richard West from ESO on the relative merits of photographic plates vs. CCD, dated from 1991. Based on this and the class last week, please discuss and answer the following questions:

What size telescope does it take today to achieve equivalent imaging performance to the 2.5m Mt. Wilson telescope, the largest telescope on Earth from 1917 to 1949? Assume that both the old and today's small telescopes are capable of 3 arcsec image quality, considering the combination of site characteristics and optical quality.

Assume that the modern Silicon CCD or CMOS camera has pixels of 5 micrometers in size and a quantum efficiency of 50%. What minimum focal length of the telescope do you need to oversample the seeing by at least a factor of 2, a sampling called Nyquist-sampling?

What aperture of the telescope do you need so that a diffraction-limited resolution of 3 arcsec at visual wavelengths can be achieved?

What aperture of the modern small telescope with a digital Silicon detector is required to have a similar photon detection compared to the old 2.5m telescope using photographic plates with lower quantum efficiency? For older photographic plates, assume 1 % quantum efficiency.

Search the websites of some telescope vendors and pick a specific telescope that matches or slightly exceeds the imaging performance of the old 2.5 m telescope.