

Exercises 5: Imaging & Photometry

1. Calculate the separation of the slits over a telescope objective in the first type of Michelson stellar interferometer, which would be required to measure the diameter of Ganymede a) at opposition and b) near conjunction of Jupiter. Take Ganymede's diameter to be 5000 km and the eye's sensitivity to peak at 550 nm. (This is exercise **2.5.1** from Kitchin's *Astrophysical Techniques*.)
2. Observations of a quasar that is thought to be at a distance of 15000 Mpc just reveal structure to a VLBI working at 50 GHz. If its maximum baseline is 9000 km, what is the linear scale of this structure. (This is exercise **2.5.2** from Kitchin's *Astrophysical Techniques*.)
3. The light grasp of a telescope, diameter d , compared to the dark adapted eye, is given by $G = 2 \times 10^4 d^2$. Assuming that the dimmest star the eye can register is of magnitude 6^m , show that the limiting magnitude of the telescope is given by

$$m_L = 16.8 + 5 \log_{10} d.$$

4. Calculate the absolute magnitude of Jupiter from its apparent magnitude at opposition, -2.6 , and the absolute magnitude of M31 from its apparent magnitude, $+3.5$ (assuming it to be a point source). Their distances are respectively 4.2 AU and 670 kpc. (This is exercise **3.1.1** from Kitchin's *Astrophysical Techniques*.)
5. Calculate the distance of a Cepheid whose apparent magnitude is $+13^m$ on average, and whose absolute magnitude is -4^m on average, assuming that it is affected by interstellar absorption at a rate of 1.5×10^{-3} mag pc $^{-1}$. (This is exercise **3.1.2** from Kitchin's *Astrophysical Techniques*.)
6. Standard UBV measures of a main sequence star give the following results: $U = 3.19$; $B = 4.03$; $V = 4.19$. Hence calculate or find $(U - B)$, $(B - V)$; Q ; $(B - V)_0$, E_{B-V} ; $(E_{U-B}, (U - B)_0)$; spectral type; temperature; distance (assuming that the interstellar absorption shown in figure 3.1.15 of Kitchin's *Astrophysical Techniques* may be applied); U_0 , B_0 , V_0 and M_V . (This is exercise **3.1.3** from Kitchin's *Astrophysical Techniques*.)