PHY 517 / AST 443: Observational Techniques

Fall 2017

Due 10/4/2017

1. Radio interferometry with two mirrors (see arXiv 1601.06161):

   - The separation between the two mirrors, called baseline length B, causes a time delay, τ, in the arrival of the signal at the second detector. Using the angles of the telescope pointing θ_o and to an object in the sky θ, show that $\tau = \frac{\sin\theta - \theta_o}{c}$.
   - Consider now the field due to a source of frequency ν each detector: $E_1(t) = E_o(\theta_o)\cos[2\pi\nu t]$, $E_2(t) = E_o(\theta_o)\cos[2\pi\nu(t-\tau)]$. Show that the total power detected by the receiver is $P(\theta) = E^2(\theta_o)[1 + \cos(2\pi\nu\tau)]$ for a point source. What do you need to assume to arrive at this expression?
   - Define the visibility. Then, show that the fourier transform of the visibility of the sun is $|V(B_\lambda)| = \frac{\sin(\pi B_\lambda \alpha)}{\pi B_\lambda}$, where α is the diameter of the sun.

2. Find the baseline of the mirrors used to create the fringes in Figure 3 of arXiv 1601.06161.