Astronomical Observing Techniques 2013:
Exercises on Optics
(Due on 5 November 2013 at 11:15)

October 28, 2013

1 Single Aperture vs. Interferometer

a) Explain why interferometry is especially useful for radio astronomy.

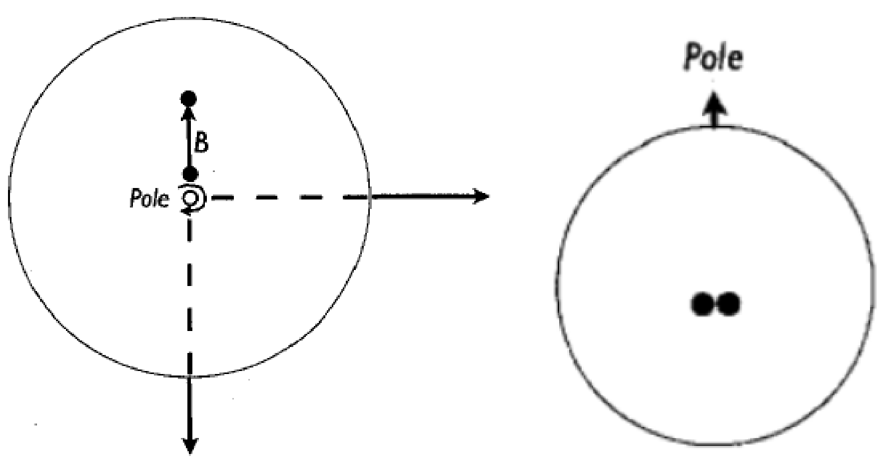
b) Give three reasons why we rather use an interferometer with a 300m baseline than a single dish of 300m diameter.

c) Why would you still prefer a single dish over an interferometer if 15m is enough for your resolution requirements?

2 Optical vs Radio Interferometers

Give at least three reasons why optical interferometry is more complicated than radio astronomy.

3 uv-Coverage



Astronomical interferometry works by measuring a set of u, v-points, the visibility distribution $V(u, v)$, which is the Fourier transform of the intensity distribution $I(x, y)$ at the position x, y on the sky. Each u, v-point is measured by one (projected) baseline. For a smooth reconstruction of the intensity distribution a good coverage of the u, v-points is required.

a) Consider a source located at the pole, and a simple two telescope interferometer (see left figure). Imagine you are the source, looking down at the Earth. What u, v-points do you gather as the Earth rotates?

b) Add more telescopes in between the two telescopes. How is the u, v-coverage increased?

c) Image the source at zero declination (see right figure) and your telescopes is at the equator. What u, v-points can you gather now as the Earth rotates?

d) In practice, an interferometer array is placed at a certain latitude, and the picture of your u, v coverage depends on the declination of your source. Can you describe how this picture changes with declination?

e) Why do you rather have more telescopes than bigger telescopes in an interferometer? How should you place the telescope with respect to each other?