

HW 7, #2

- a) in the degraded image of Earth, the smallest features one can distinguish are roughly

$$L \sim 1000 \text{ km} = 10^6 \text{ m}$$

- b) According to Gaia DR3, the TRAPPIST-1 system has a parallax of

$$\pi = 80.2 \times 10^{-3} \text{ arcsec}$$

thus

$$d = \frac{1}{\pi} = 12.5 \text{ pc} = 3.84 \times 10^{17} \text{ m}$$

- c) The angular resolution required to distinguish continents at this distance is

$$\theta \sim \frac{L}{d} = \frac{10^6 \text{ m}}{3.84 \times 10^{17} \text{ m}} = 2.6 \times 10^{-12} \text{ rad}$$

$$= 2.6 \times 10^{-12} \text{ rad} \times 206265 \frac{''}{\text{rad}}$$

$$= 5.4 \times 10^{-7} \text{ arcsec}$$

- d) An interferometer acting at $\lambda = 500 \text{ nm}$ in the optical would need to have separation S of

$$\theta \approx \frac{\lambda}{S} \rightarrow S \approx \frac{\lambda}{\theta}$$

$$S \approx \frac{500 \times 10^{-9} \text{ m}}{2.6 \times 10^{-12} \text{ rad}} \approx 192,000 \text{ m} \\ = 192 \text{ km}$$