

Problem Set 9

PHYSICS 443
November 18, 2020

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1. The angle between the two stars is

$$\begin{aligned}\theta &= \tan^{-1}\left(\frac{50 \times 10^6 \text{ km}}{10 \text{ ly}}\right) \\ &= 5.285 \times 10^{-7} \text{ rad}\end{aligned}$$

From the Rayleigh criterion,

$$\begin{aligned}\sin(\theta) &= 1.22\lambda/D \\ \sin(5.285 \times 10^{-7}) &= 1.22 (500 \text{ nm}) / (2r) \\ r &= 66.1 \text{ m}\end{aligned}$$

2. The forth secondary maxima is given by the grating equation for $N = 2$

$$\gamma = \frac{9\pi}{4}$$

For the forth secondary maxima and a zero of the envelope to coincide, $\beta = 1\pi$, and the ratio is then

$$\frac{b}{h} = \frac{\beta}{\gamma} = 4/9$$

3. For the sodium doublet,

$$\begin{aligned}\Delta\lambda &= 589.592 \text{ nm} - 588.995 \text{ nm} \\ &= 0.597 \text{ nm} \\ \text{RP} &= nN = \frac{\lambda}{\Delta\lambda} \\ N &= \frac{589.2935 \text{ nm}}{0.597 \text{ nm}} \\ &= 987 \text{ lines}\end{aligned}$$