

# Zoe's Practice Problem

Supernova remnant 0509-67.5 is in the Large Magellanic Cloud ( $d_{LMC} \approx 50 \text{ kpc}$ ). Its angular radius is measured to be  $\approx 15''$  and the velocity of the shock is  $\approx 6500 \text{ km/s}$

a) What is the linear radius of SNR 0509?

b) Estimate the age of this SNR in years

c) Some recent papers estimate  $t_{0509-67.5} \approx 315 \text{ yr}$ . How does this compare to your estimate? Explain how an assumption you made may affect your result.

d) SNR 0509-67.5 has a reverse shock, which can be measured using [Fe XIV] ( $\lambda = 5303 \text{ \AA}$ ) coronal line emission as a proxy for its position. In what part of the electromagnetic spectrum is the Fe XIV emitting?

Sources:

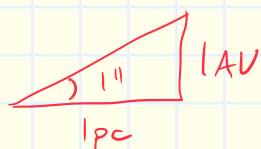
Hovey, Hughes, & Eriksen 2015  
Pietrzyński et al 2019  
Arunachalam et al 2022

# Zoe's Practice Problem

SOLN

Supernova remnant 0509-67.5 is in the Large Magellanic Cloud ( $d_{LMC} \approx 50 \text{ kpc}$ ). Its angular radius is measured to be  $\approx 15''$  and the velocity of the shock is  $\approx 6500 \text{ km/s}$

a) What is the linear radius of SNR 0509?



$$\text{so } \theta["] = \frac{r[\text{AU}]}{d[\text{pc}]}$$

$$r[\text{AU}] = \theta["] d[\text{pc}] = 15 \cdot 50,000 = 7.5 \times 10^5 \text{ AU}$$

$$r = 1.12 \times 10^{14} \text{ km} \quad (1 \text{ AU} = 1.496 \times 10^8 \text{ km})$$

b) Estimate the age of this SNR in years

$$(\text{assume no } \vec{a}) \quad \vec{x} = \vec{v}t \rightarrow t = \frac{\vec{x}}{\vec{v}} = \frac{r}{v} \approx 1.73 \times 10^8 \text{ s}$$

$$(1 \text{ yr} = 3.156 \times 10^7 \text{ s})$$

$$= 547 \text{ yr}$$

c) Some recent papers estimate  $t_{0509-67.5} \approx 315 \text{ yr}$ . How does this compare to your estimate? Explain how an assumption you made may affect your result.

$547 \text{ yr} > 315 \text{ yr}$  but they are approx. the same order of magnitude.

We assumed that  $v_{\text{shock}} = \text{constant}$ , when in reality, the shock is decelerating over time. This could explain why our age estimate is larger.

d) SNR 0509-67.5 has a reverse shock, which can be measured using  $[\text{Fe XIV}]$  ( $\lambda = 5303 \text{ \AA}$ ) coronal line emission as a proxy for its position. In what part of the electromagnetic spectrum is the Fe XIV emitting?

Optical (green)

Sources:

Hovey, Hughes, & Eriksen 2015  
Pietrzyński et al 2019  
Arunachalam et al 2022