



The Hubble Space Telescope took the image of the Eagle Nebula (M-16). This star-forming region is in the constellation Serpens, and located 6,500 light years from Earth. It is only about 6 million years old, and the dense clouds of interstellar gas are still collapsing to form new stars. This image is 2.5 arcminutes across.

Problem 1 – If an angular size of 200 arcseconds corresponds to 1 light year at a distance of 1000 light years. What is the size of this field at the distance of the nebula?

Problem 2 – What is the scale of this image in light years/millimeter?

Problem 3 – Our Solar System is about $1/400$ of a light year across. How big is it, in millimeters, at the scale of this photo?

Problem 4 - How many times the size of our solar system is the smallest nebula feature you can see in the photo?

Problem 1 – If an angular size of 200 arcseconds corresponds to 1 light years at a distance of 1000 light years. What is the size of this field at the distance of the nebula?

Answer: First we have to find out the scale of the image at the distance of the nebula. The field is stated to be 2.5 arcminutes across. At the distance of the nebula, 6,500 light years, the scale would be $200 \text{ arcseconds} = 6,500/1000 \times 1 \text{ light year} = 6.5 \text{ light years}$.

Since 1 arcminute = 60 arcseconds, by converting units we have $2.5 \text{ arcminutes} \times (60 \text{ arcseconds/arcminutes}) \times (6.5 \text{ ly}/200 \text{ arcseconds}) = 4.9 \text{ light years}$. The field is 4.9 x 4.9 light years in size.

Problem 2 – What is the scale of this image in light years/millimeter? Answer: The Hubble image is 140 millimeters across. Since this equals 4.9 light years, the scale is $4.9 \text{ ly}/140\text{mm} = 0.035 \text{ light years/millimeter}$.

Problem 3 – Our Solar System is about 1/400 of a light year across. How big is it, in millimeters, at the scale of this photo? Answer: At the scale of the photo ,1/400 of a light years = $0.0025 \text{ light years} = 0.0025/.035 = 0.07 \text{ millimeters}$. This is about the same size as the 'period' at the end of this sentence .

Problem 4 - How many times the size of our solar system is the smallest nebula feature you can see in the photo? Answer: Some features are about 0.2 millimeters in size, which equals $0.2 \text{ mm}/0.07 = 2.8 \text{ times the diameter of our solar system!}$