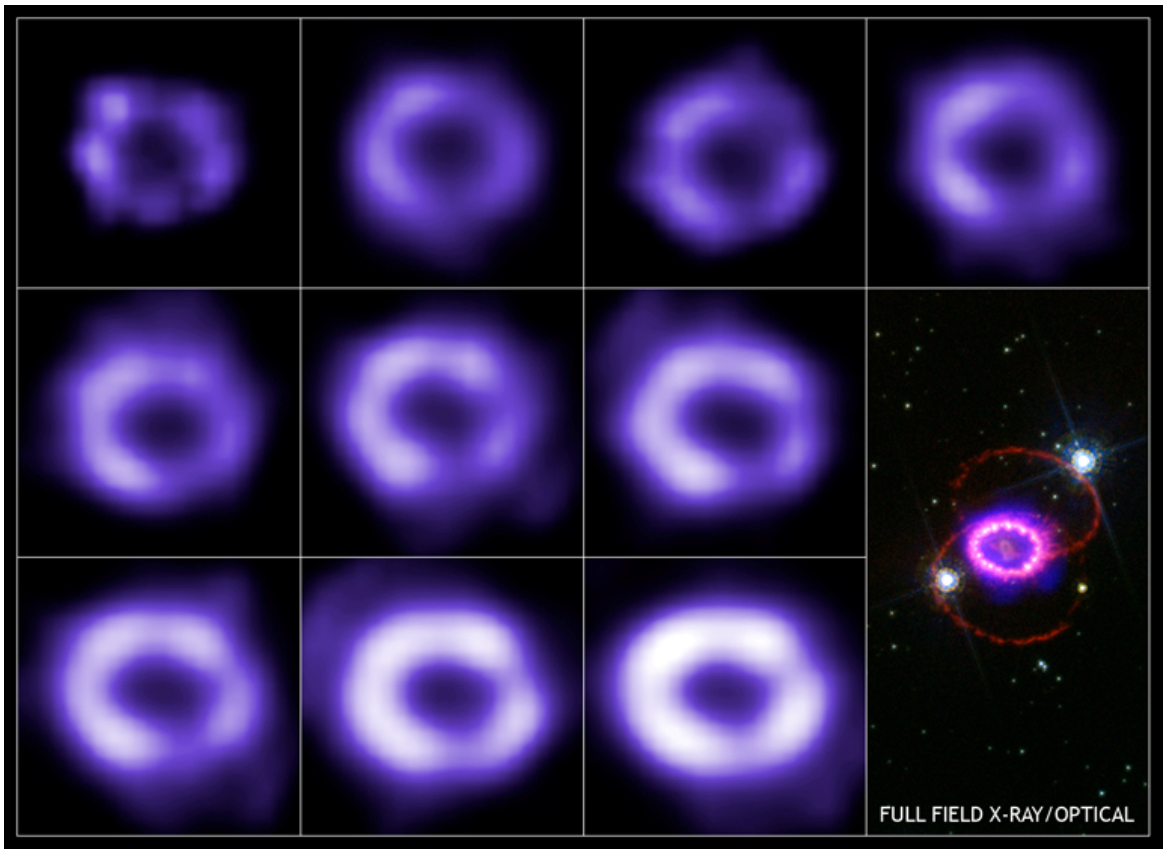

In March, 1987 a supernova occurred in the Large Magellanic Cloud; a nearby galaxy to the Milky Way about 160,000 light years away from Earth. The site of the explosion was traced to the location of a blue supergiant star called Sanduleak -69º 202 (SK -69 for short) that had a mass estimated at approximately 20 times our own sun.The series of image above, taken by the Chandra X-ray Observatory, shows the expansion of the million-degree gas ejected by the supernova between January, 2000 (top left image) to January, 2005 (lower right image). The width of each image is 1.9 light years.

Problem 1 - Using a millimeter ruler, what is the scale of each image in light years/millimeter?

Problem 2 - If 1 light year = 9.5×10^{12} kilometers, and 1 year = 3.1×10^{7} seconds, what was the average speed of the supernova gas shell between 2000 and 2005?

Problem 1 - Using a millimeter ruler, what is the scale of each image in light years/millimeter?

Answer: The width of each image is about 38 millimeters, so the scale is 1.9 light years / 38 mm = **0.05 light years/mm**.

Problem 2 - If 1 light year = 9.5×10^{12} kilometers, and 1 year = 3.1×10^{7} seconds, what was the average speed of the supernova gas shell between 2000 and 2005?

Answer: First convert the scale to kilometers/mm to get 0.05 LY/mm x (9.5×10^{12} kilometers / 1 LY) = 4.8×10^{11} kilometers/mm.

Next, students will have to measure the outer diameter of an irregular shape. They may do this by making several measurements across different chords through the center of the shell, and averaging the numbers. Because the outer edge is not sharp due to brightness gradients, students will also have to decide at what point the edge of the shell occurs and then use this visual definition consistently in the other edge measurements.

The diameter of the top left supernova ring is about 19 millimeters. The bottom-right ring has a diameter of about 27 millimeters, so the change on radius was (27 - 19)/2 = 4 millimeters. This corresponds to a physical distance of 4 mm x (4.8×10^{11} kilometers/mm) = 1.9×10^{12} kilometers. The elapsed time was (January 2005 - January 2000) = 5 years or 5 years x (3.1×10^{7} seconds / 1 year) = 1.6×10^{8} seconds. The average speed is then V = 1.9×10^{12} kilometers / 1.6×10^{8} seconds = **12,000 kilometers/sec**.

Note to Teacher: Although this is the average speed, students can investigate whether the shell has been moving at a constant speed during this 5-year period, or if the gas shell has been accelerating or deceleration by measuring the speed differences between the consecutive images which can be found at:

http://chandra.harvard.edu/photo/2005/sn87a/more.html …….for specific image dates

http://chandra.harvard.edu/photo/2005/sn87a/index.html ……. supernova information