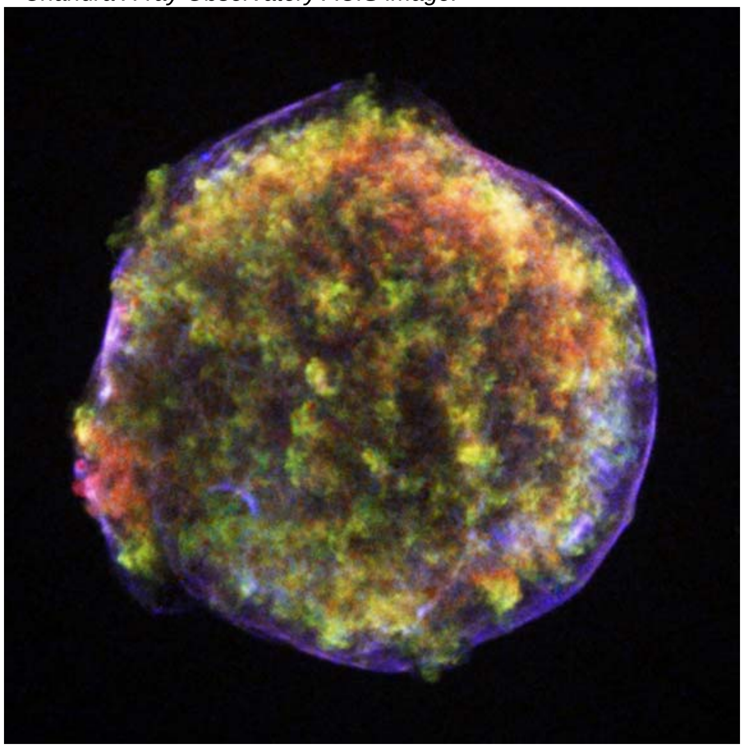
Chandra Science Highlight

Tycho's Supernova Remnant:
The Hot, expanding Debris of a Supernova Observed in 1572

Chandra X-ray Observatory ACIS image.



Scale: The angular diameter of the supernova remnant is 8 arc minutes, corresponding to a linear diameter of 17 light years for an estimated distance of 7,500 light years.

(Credit: NASA/CXC/Rutgers/J. Warren & J. Hughes et al.)

The Chandra image shows a bubble of hot gaseous supernova debris (green and red) inside a more rapidly moving shell of extremely high-energy electrons (blue). These features were created as the supersonic expansion of the debris into interstellar gas producing two shock waves - one that moves outward and accelerates particles to high energies, and a reverse shock that moves into the debris and heats it.

- According to the standard theory, the outward-moving shock wave should be about 2 light-years ahead of the stellar debris. What Chandra found instead is that the stellar debris has kept pace with the outer shock and is only about half a light-year behind.
- The relative expansion speeds of the hot debris and the high-energy shell indicate that a large fraction of the energy of the outward-moving shock wave is going into the acceleration of atomic nuclei to extremely high energies.
- This finding strengthens the case that supernova shock waves are an important source of cosmic rays - high-energy nuclei which constantly bombard Earth.

Reference: J. Warren et al. 2005, the Astrophysical J. (In press)
see also Astro-ph/0507478