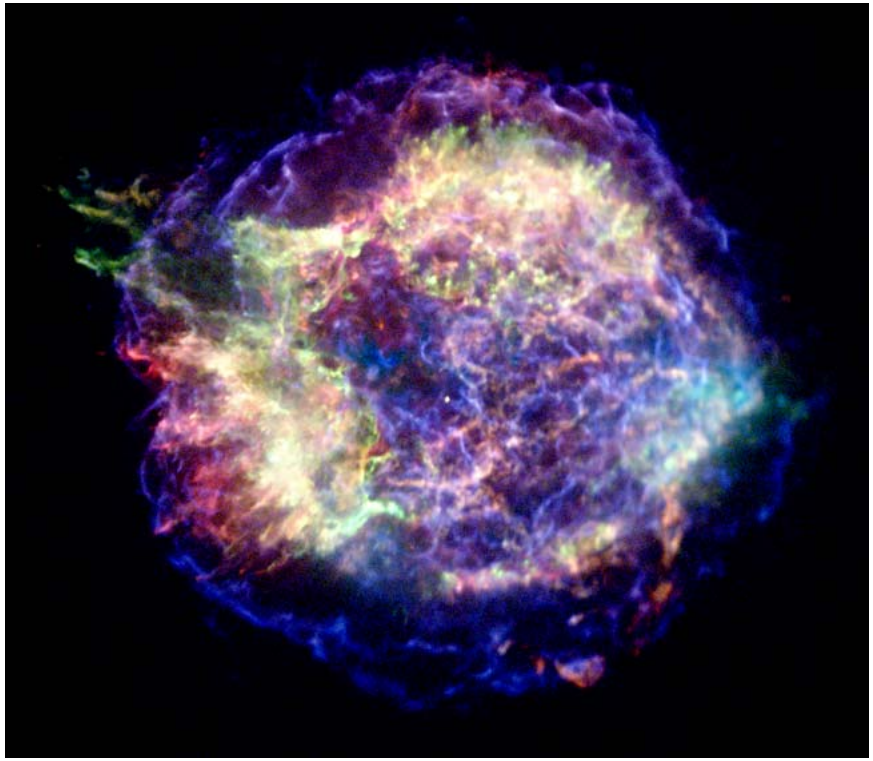
Chandra Science Highlight

Cassiopeia A: Chandra Discovers Evidence for Efficient Shock Acceleration of Cosmic Ray Electrons

Chandra X-ray Observatory ACIS image.



This energy-colored image was created from 1.08 Ms of Chandra data from Cassiopeia A (Cas A). In the image low (0.5-1.5 keV), medium (1.5 - 2.5 keV), and high (4.0-6.0 keV) energy photons are colored red, green and blue respectively. Most of the X-ray photons are thermal radiation from ejecta which has passed through a hot reverse shock wave. Radiation from the forward shock wave, which appears as the wispy blue filamentary structure, is dominated by high-energy synchrotron emission from accelerated electrons.

- The present study examined X-ray spectra for more than 10,000 regions of the shock wave
- These spectra were used to show that electrons are accelerated to extremely high energies at a rate near the maximum rate predicted by the diffusive shock acceleration theory. According to this theory electrons and ions are accelerated when they bounce back and forth across the shock front.
- This discovery provides compelling evidence that supernova remnants are key sites for energizing charged particles, and may help to explain the acceleration of charged particles on scales ranging from the magnetosphere of Earth, to extragalactic jets thousands of light years in length.

Distance to Cas A: About 10 thousand light years.

Credit: NASA/CXC/MIT/UMass Amherst/M.D.Stage et al

REFERENCE: M. Stage, et al, Nature Physics, Volume 2, Issue 9, p. 614 (2006)

NOVEMBER 2006

CXC operated for NASA by the Smithsonian Astrophysical Observatory