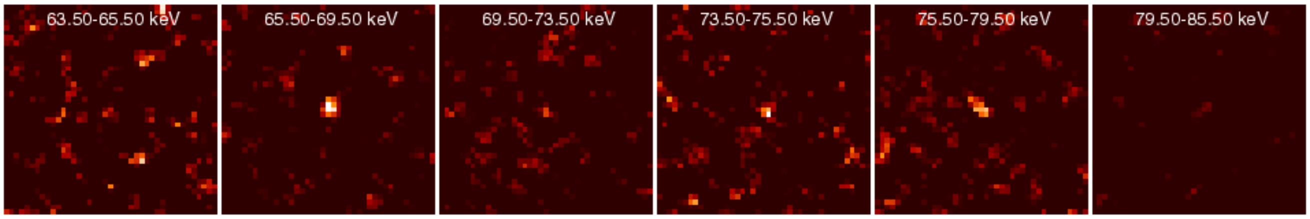
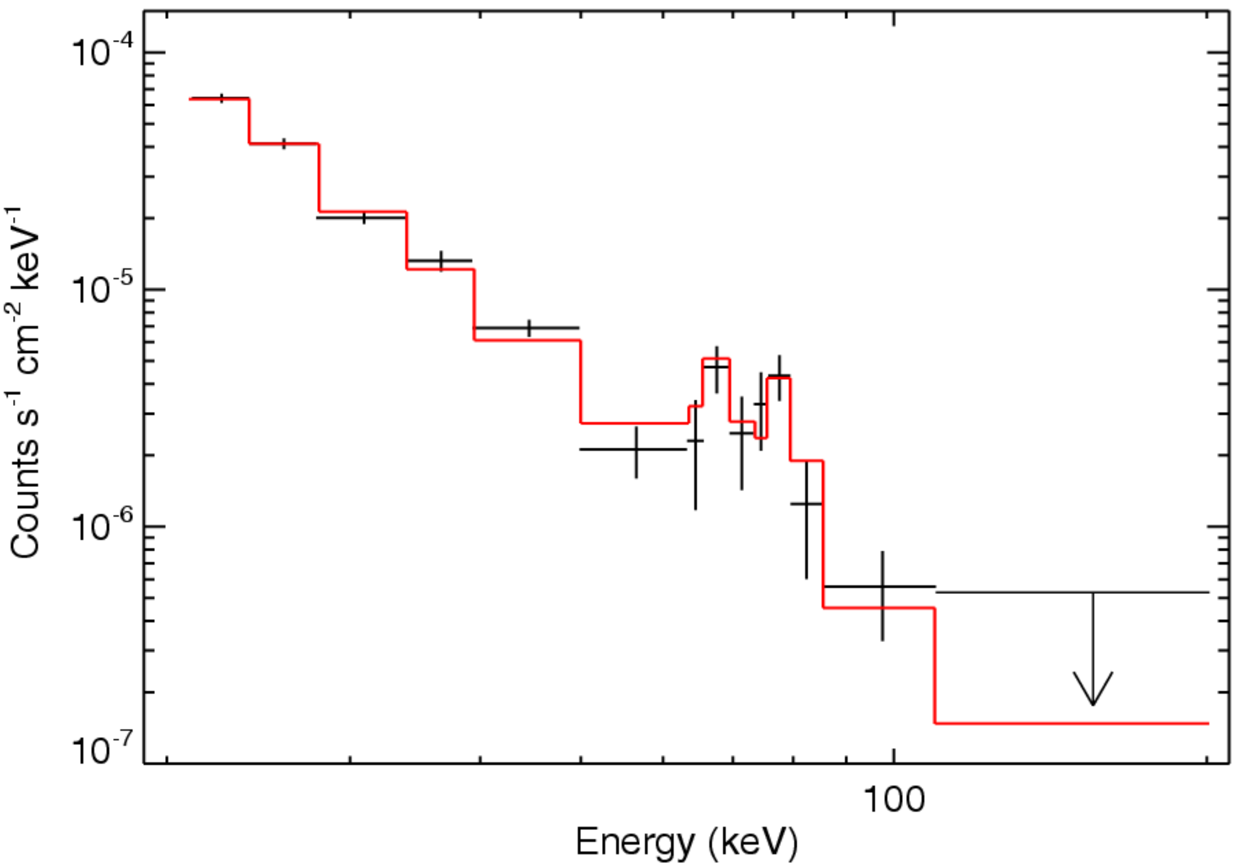
INTEGRAL

Picture of the Month

September 2006





Gamma ray emission from Cassiopeia A

Supernovae and their remnants are the main galactic nucleosynthesis sites. Few radioactive isotopes are accessible to gamma-ray astronomy for probing these stellar explosions. Among them, ^{44}Ti is a key isotope for the investigation of the inner regions of supernovae and their young remnants. With a lifetime of 86 years, it emits three gamma-ray lines at 67.9, 78.4 (from ^{44}Sc) and 1157 keV (from ^{44}Ca), observable with SPI and IBIS onboard INTEGRAL. Cassiopeia A is the youngest known Galactic supernova remnant and is indeed the only one from which the line emission from ^{44}Ti decay has been unambiguously detected. The images at the top presents IBIS/ISGRI images centered on Cassiopeia A in six energy bands (indicated in the images) around the two ^{44}Sc lines which show that the source brightens at the line energies. The bottom image shows the resulting spectrum of the supernova remnant well fitted by a power law with an index of ~ -3.3 and two separated lines at 67.9 and 78.4 keV, each detected at 3 sigma above the continuum emission.

Deep observations (3.2 Ms effective exposure) with INTEGRAL IBIS/ISGRI of the Cassiopeia region allowed to detect the two-low energy ^{44}Sc lines at 67.9 and 78.4 keV in Cassiopeia A. Besides the robustness provided by these IBIS/ISGRI spectroimaging observations, the main improvements compared to previous measurements are the clear separation of the two lines and the significant detection of the hard X-ray continuum up to 100 keV, well fitted by a single power-law. The estimate of the line flux is sensitive to that of this underlying continuum whose nature is still unknown (synchrotron or nonthermal bremsstrahlung?). The ^{44}Ti yield deduced from these observations is ~1.6 * 10^{-4} solar masses. This mass of ejected ^{44}Ti is generally thought to be unusually large in comparison with spherical explosion models but could be explained by several effects such as asymmetries during the explosion and a high explosion energy (see the paper by Renaud, M. et al., ApJ Volume 647 (2006), pages L41 - L44).

Based on this firm detection of the ^{44}Ti signature in Cassiopeia A with IBIS/ISGRI, the expected results with SPI, thanks to its fine spectral resolution should help us for the first time to constrain the kinematics of the innermost layers of the explosion.

Credits: M. Renaud (CEA-Saclay, SAp)

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