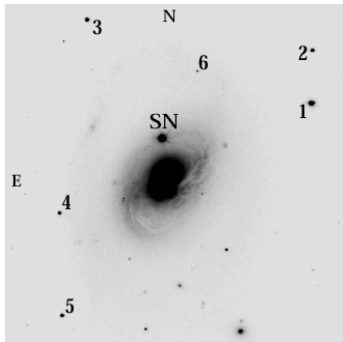


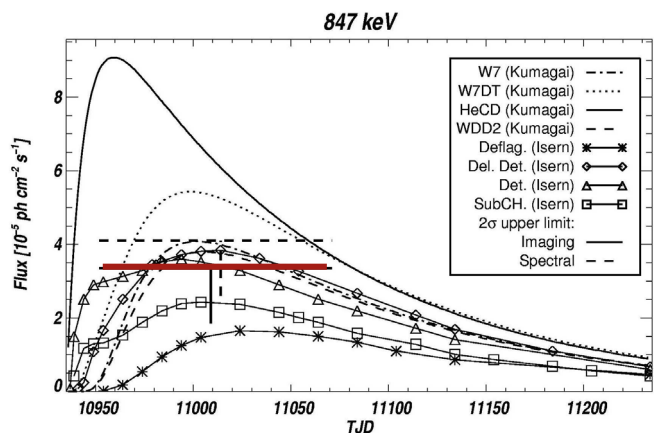
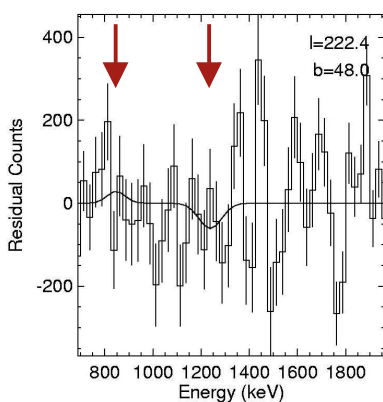
Our understanding of thermonuclear supernova (Type Ia) still is mostly based on empirical facts. Probably explosive C burning in the center of a white dwarf is ignited either through gravitational pressure exceeding the Carbon ignition threshold, or through a sound wave driven into the core by a shell He flash; two merging white dwarfs are yet another plausible model. Isotopic compositions constrain the explosion mechanism to require an initially-slow deflagration stage before the burning speed becomes supersonic. The amount of Fe group nuclei produced in the core depends critically on this ignition mechanism, on inner composition and density structure. For assumed ^{56}Ni masses, complex envelope interaction models have been developed to calculate the emerging radiation of different types at the surface.

More direct would be to measure the ^{56}Ni mass through its decay gamma-rays: ^{56}Ni decay to ^{56}Co ($t=8.8$ d) produces mainly 812 and 158 keV gamma-rays, later ^{56}Co to ^{56}Fe decay ($t=111$ d) produces mainly 847 and 1238 keV gamma-rays. At the time of ^{56}Co decay, the supernova envelope should be largely transparent to gamma-rays already, while detection of ^{56}Ni gamma-rays would testify ^{56}Ni seen through little or no overlying envelope material.



A nearby thermonuclear supernova (Type Ia) occurred around May 2, 1998 in the galaxy M96/NGC3368 at ~ 11 Mpc distance. This was the second opportunity (after SN1991T) for the Compton Gamma-Ray Observatory to calibrate the power source of a supernova, the decay of freshly-produced radioactive ^{56}Ni , directly through gamma-rays from the ^{56}Ni decay chain. With the hint for ^{56}Co lines from SN1991T from COMPTEL, it seemed justified to spend in total 14 weeks of exposure on this supernova. SN1998bu was a “typical” Type Ia event, with excess reddening attributed to the host galaxy itself.

None of the instruments aboard “Compton” detected any sign of ^{56}Ni decay gamma-rays, unexpectedly. The COMPTEL limit (2σ) to the ^{56}Co gamma-rays of $3.3 \cdot 10^{-5}$ ph $\text{cm}^{-2} \text{s}^{-1}$ directly converts into a ^{56}Ni mass limit of $0.35 M_{\odot}$, on the low side of the expected range ($0.1-1 M_{\odot}$). For “fast” models, the constraints are even more severe, because even more of the ^{56}Co decay gamma-rays should be visible in those well-mixed cases.



No gamma-rays from the ^{56}Ni decay chain have been seen in COMPTEL data over 14 weeks of exposure.

Predicted ^{56}Co decay gamma-ray light curves from thermonuclear supernova models exceed the COMPTEL upper limit for the “fast” model types where ^{56}Ni is produced in outer parts

References:

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- Plüschke S., et al., (2001) ESA-SP 459, 87