Kolloquium

Prof. Dr. Roland Diehl

MPI für extraterrestrische Physik
und TU München

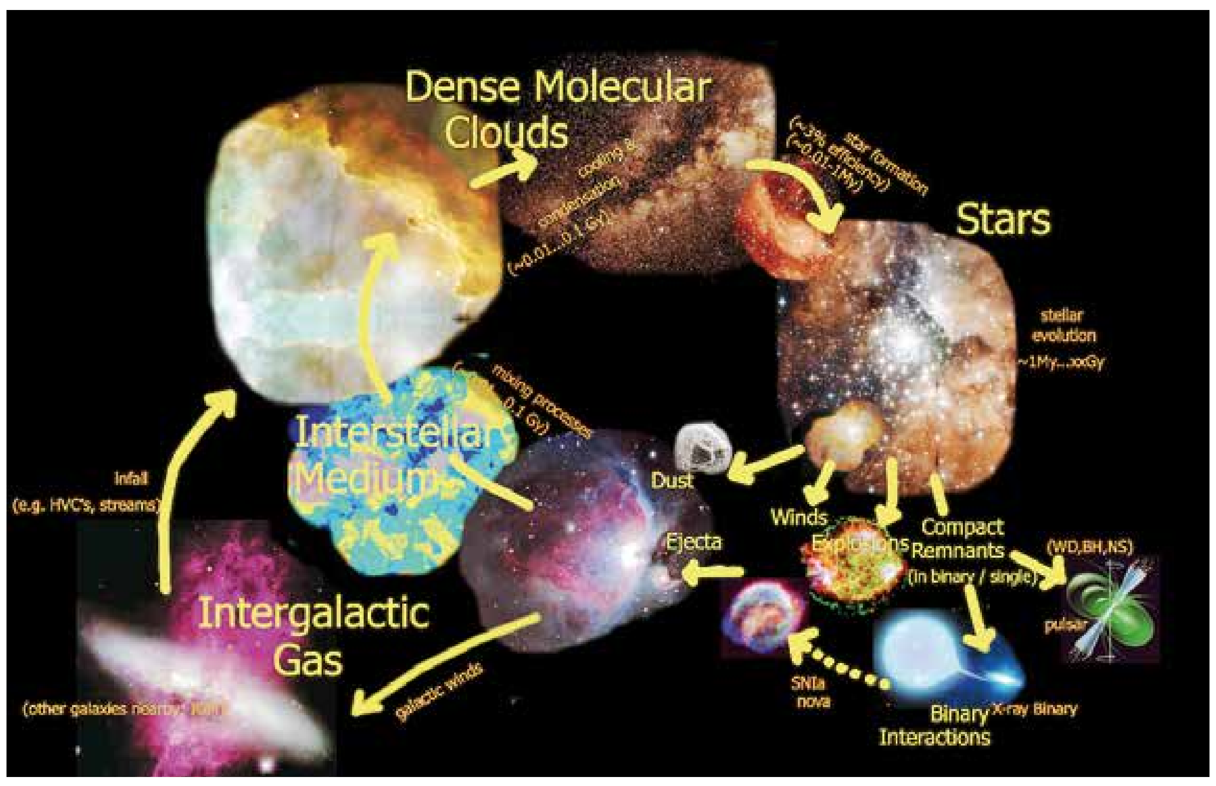
Nuclear gamma-rays from massive stars and supernova explosions

physikalisches

Mo. 06.07.15
16:00 Uhr
Ort: H34

Gamma-ray lines from cosmic sources arise from radioactive decay of unstable isotopes co-produced by nucleosynthesis, from energetic collisions among atomic nuclei which may excite nuclei above their ground level, and from interstellar annihilation of positrons ejected from a variety of candidate sources. Such gamma-ray lines are being measured with ESA's INTEGRAL space mission since its launch twelve years ago, complementing the earlier survey of NASA's Compton Gamma-Ray Observatory. The nuclei seen by those missions in their characteristic gamma-rays are ^{56}Ni, ^{57}Ni, ^{44}Ti, ^{26}Al, and ^{60}Fe from their characteristic sources, positron annihilation has been measured and mapped throughout the Galaxy both in the 511 keV line and positronium continuum.

In more detail: The ^{26}Al isotope with 1My decay time had been first direct proof of currently-ongoing nucleosynthesis in our Galaxy. This has now become a tool to study the ~My history of specific massive-star groups and associations in nearby regions throughout our Galaxy, and even large scale aspects such as the general role of superbubbles and massive-star feedback. Annihilation gamma-rays from positrons in interstellar space show a puzzling bright and extended source region central to our Galaxy which may be related to special high-energy processes in the central part of our Galaxy, but also may be partly related to nucleosynthesis. ^{56}Ni and ^{44}Ti gamma-ray lines have been used to constrain supernova explosion mechanisms: For the type Ia supernova SN2014J the surprising gamma-ray line signatures point to a non-spherical explosion. Radioactivity from ^{44}Ti has been seen from the Cas A and SN1987A supernovae afterglows, and provide new views on how such core-collapse and explosion may occur.



Above: Cosmic gas partly collapses to form stars, which evolve through nuclear burning phases until they explode or form compact remnant stars. The gas returned into interstellar medium is enriched with new nuclei, part of which radiate in characteristic and penetrating gamma-rays. Space telescopes measure these to study the changes in cosmic nuclear composition.