KMI Colloquium

X-ray Probing of Death of a Massive Star

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Abstract:

X-ray observations of supernova remnants provide us a unique opportunity to probe the explosion mechanisms of supernovae. In this seminar, we will introduce our recent results on the Galactic supernova remnant Cassiopeia A using X-rays, which provides important evidence of how the progenitor star exploded.

Recent multi-dimensional simulations of the delayed neutrino-driven explosion suggest that high-entropy buoyant plumes that are produced from the neutrino-driven convection help massive stars to explode. Such asymmetries during the explosions can be tested by their ejecta distribution and elemental compositions obtained from X-rays. For example, outwardly protruding Fe-rich fingers in Cassiopeia A seem to support this picture. Here, detecting signatures of specific elements synthesized in the high-entropy nuclear burning regime (i.e., α-rich freeze out) would be among the strongest substantiating evidence. We show observations of such elements, stable Ti and Cr in the shocked high-velocity Fe-rich ejecta of Cassiopeia A. The metal composition of the plumes agrees well with predictions for strongly neutrino-processed proton-rich ejecta (but still we cannot completely dismissed the production at the neutron-rich region at the present). Our results support that the neutrino-driven convective engine was really working in the supernova of Cassiopeia A. We also introduce that the future X-ray missions will be very useful for probing physics of the supernova engine.