Supernovae and the Origin of the Elements

Alexander Heger

Associate Professor of Physics and Astronomy, University of Minnesota

The big bang made essentially only hydrogen, helium, and some traces of lithium - very different from the universe we find today, filled with life and the elements necessary to life. Almost all of these elements, from carbon to uranium, were synthesized in stars, most of them in massive stars at least ten times the mass of the sun, and dispersed in gigantic explosions that we observe as supernovae. In this seminar I will give an overview of how massive stars evolve and how they synthesize all these elements by various processes, some more exotic than others, and how massive stars evolve in general. What we do not know very well at this time, however, is how the entire process of chemical evolution of the universe started, how the very first generation of stars were formed, just a few billion years after the big bang, and how they lived and died.

Bio I study the life and explosive death of massive stars and the origin of the elements, and am generally interested in nuclear astrophysics. Specifically, my work comprises the study of massive and very massive stars (10-1000 solar masses); the first generations of stars in the universe (Pop III stars); evolution of rotating massive stars and the spin of their remnants; mixing and transport processes in the stellar interior; nucleosynthesis and the origin of elements, including galacto-chemical evolution - which elements are made where and when; supernovae (mechanisms and nucleosynthesis); gamma-ray bursts (collapsars and similar models) and their progenitors; modeling of Type I X-ray bursts and superbursts (thermonuclear explosions on the surface of neutron stars). "I blow up stars for a living."