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Probes of the Progenitors, Engines and Physics behind Stellar Collapse

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Understanding the nature of the stellar collapse plays an important role in a wide range of astrophysics. Stellar collapse produce the compact remnants (neutron stars and black holes) that make up a menagerie of exotic astrophysics objects from pulsars and X-ray binaries to the merging compact objects detected in gravitational waves. Stellar collapse plays an important role in most gamma-ray burst engines and their supernovae disseminate many of the heavy elements into the universe. But, to understand the true impact of stellar collapse on these phenomena, we must understand the engine driving supernova explosions. Despite recent successes supporting the convection-enhanced, neutrino-driven engine driving these explosions, we are far from a complete picture of these explosions. For example, uncertainties in stellar evolution prior to collapse and the engine itself make quantitative predictions from stellar collapse. Here we review our current understanding of stellar collapse (both the engine and its progenitor stars) and the observations (both current and proposed) to help us improve this understanding.

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