Supernovae-abstract

Corresponding to the presentation by Lars Köhler

Supernovae settle the end for massive stars, the more heavy ones thereby end in core-collapse Supernovae, releasing energies up to 10^{52}ergs (=10 Bethe). Describing all the involved mechanisms and reproducing the observed processes with all properties is a big challenge for theoretical physics and modern day computers. During a core-collapse Supernova, the mass of the outer layers of the star starts to fall into the center, compressing the star, rising its density and temperature. The rise in density gets stopped once the core reaches a density of 3-4 times nuclear density (about $6*10^{14}$g/cm^3), producing a core of nuclear matter that rebounds and sends a shock outwards pushing against the in-falling outer matter. However this outgoing shock wave alone is in most cases not enough to expel the stars outer layers since its energy is lost by dissociating nuclei into nucleons, losing about 8 MeV per nucleon and due to the emission of neutrinos. Furthermore it is the neutrinos coming from the core which heat up the material in intermediate distance, thereby reviving the shock after its stagnation. This process, also called delayed explosion, finally leads to expelling the stars outer layers.