Core-collapse Supernovae and Neutron Star Formation

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Neutron stars are usually supposed to be an offspring of core-collapse supernovae. Their properties such as mass, spin, magnetic field, at birth are determined by the dynamics of core-collapse leading eventually to the formation of neutron star. The core-collapse supernova is an energetic explosion of $\sim 10^{53}$erg that occurs at the end of the quasi-static evolutions of stars more massive than $\sim 10\mathrm{M}_{\odot}$. It is supposed to be driven by the gravitational collapse of the central core, followed by the core-bounce and the formation and propagation of a shock wave. Unfortunately, despite intensive and extensive investigations by many researchers over the years, the mechanism of explosion remains to unraveled. The issue is how to expel the stagnant shock wave out of the core. Although the most popular mechanism has been the neutrino-heating, some other ideas, such as the instability of the standing accretion shock wave and its possible coupling with oscillation modes of proto neutron star or the magnetorotational mechanisms, are attracting researchers in the field. They will be important not only for the explosion mechanism but also for the explanation of the proper motions, initial spin periods and magnetic fields of the nascent neutron stars. In this talk, I will review these hot topics concerning the supernova mechanism and the formation of neutron stars.