Neutrino nucleon elastic scattering in heaven and earth

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The neutrino nucleon elastic cross section is very sensitive to the fraction of the proton's spin carried by strange quarks. For nuclear targets, measuring the ratio of neutrons to protons, or neutral to charge current events, can cancel many systematic errors. An elastic scattering experiment is very attractive at the new high flux neutrino beam lines.

Neutrino nucleon elastic and quasi elastic scattering dominates the opacity for core collapse supernovae. These giant stellar explosions radiate most of their energy in neutrinos. Important weak magnetism corrections enhance the antineutrino luminosity, lead to large mu and tau numbers for the hot proto-neutron star, and change the electron fraction (electrons per baryon, Y_e) of ejected material. This change in Y_e is important for nucleosynthesis.

Finally, neutrino nucleon, and neutrino nucleus elastic scattering provides a new way to detect core collapse supernovae. The large cross sections and sensitivity to all neutrino flavors allows yields that could be as high as several events per *ton* for a galactic supernova at 10 kpc. This is much larger than the yield of hundreds of events per *kiloton* expected in existing light water detectors. However, detecting low energy nucleon or nuclear recoils with low backgrounds is a challenge. Nevertheless, recent progress in designing low energy solar neutrino and dark matter detectors suggests that this may be possible. An elastic detector could provide important information on the mu and tau neutrino flux.