The IceCube Neutrino Observatory, situated at the geographic South Pole, was completed in December 2010. A lattice (IceCube Array) of 5160 photomultiplier tubes forms one cubic kilometer of deep ice. It is in order to detect neutrinos via Cherenkov photons emitted by charged particles of their interaction in matter. Another 324 optical sensors are implemented in frozen water tanks (IceTop) and can be used for vetoing downward going events. Since IceCube’s geometry was optimized to detect neutrinos with energies from 10³ to 10⁴ eV, it offers high potential for the observation of neutrinos from extraterrestrial sources. The detector is capable of detecting inverse beta neutrino interactions up to the energy of 10⁷ eV and can be used for studies of cosmic neutrino backgrounds. The IceCube Collaboration has calculated that IceCube could be able to detect more than 10⁸ inverse beta neutrino interactions per year. The two scenarios can be distinguished at 90% C.L. for supernovae in distances up to 30 kpc. Another simulation is based on model that includes all other flavors of neutrino interactions in ice are expected to result in a Cherenkov photon with a dominant signature (~94%) of positron: 

\[
\nu_e \rightarrow e^+ + \nu_e.
\]

Although it is still unclear how Supernova candidates follow the one distribution one can only get the probability density for our galaxy. The benchmark model is used to simulate the inverse beta decay of atmospheric neutrinos resulting in a detectable signature, L > 10⁻⁹ eV. The total cross section for all channels for neutrino interaction is all shown in the right. Using the so-called Lawrence-Linwood model one can determine the energy and homogeneity of the incident neutrino. This spherical symmetric model is preferred from the onset of the collapse up to 18 s after the core bounce. It assumes a 26 M_☉ progenitor star and its model is described in Table 18.6. All characteristics of neutrino masses are visible. The most detailed benchmark model is designed to determine the energy spectrum of ν_e (red), ν_μ (blue) and all other flavors ν_τ (green dashed).