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Recent improvements in the detection of supernovae with the IceCube observatory

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With a lattice of 5160 photomultiplier tubes, IceCube monitors one cubic kilometer of deep Antarctic ice in order to detect neutrinos via the Cherenkov photons emitted by charged secondaries arising from their interactions in matter. Due to subfreezing ice temperatures, the photomultipliers'dark noise rates are particularly low. Therefore a collective rate enhancement introduced by interacting neutrinos in all photomultipliers can be used to search for the signal of galactic core collapse supernovae, providing excellent sensitivity for those of galactic origin. A detailed understanding of the characteristics and temporal changes of the dark rate background has been achieved and cosmic ray muons, responsible for the majority of fake supernova candidate triggers, are rejected in real time. An addition to the standard data acquisition allows us to buffer all registered photons in the detector in case of a serious alert. By analyzing these data, a precision determination of the burst onset time and
the characteristics of rapidly varying fluxes, as well as estimates of the average neutrino energies and - for supernovae ending in a black hole - of the burst direction may be obtained. Such data are also crucial to characterize details of the noise behavior and of the atmospheric muon background.

Collaboration

IceCube

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