HIGH ENERGY COSMIC RAYS FROM YOUNG NEUTRON STARS

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Cosmic ray spectrum has an intensity enhancement at energy range 10^{14-16} eV/nuc. Recently Takahasi et al. (1986) called an attention to chemical composition there. Although the data still contain large uncertainties, they argued an overabundance of calcium at high energies (Ca/Fe $\geqslant$ 2 above 10^{14} eV/nucleus) and some enhancements of medium heavy nuclei (C ~ Ar) instead of no anomalous p, He, and Fe abundances.

There are only two possibilities to produce such type of overabundance, i.e., nova and type II supernova explosions. In the case of nova explosion, however, it is hard to accelerate its ejecta up to such a high energy, and we can decline this possibility. We can expect, on the other hand, overabundance of calcium on both two proposed schemes of type II supernovae which produce neutron stars, i.e., strong and weak bouncing shock schemes (Takahashi et al. 1986). From a strong shock scheme, prompt mass ejection takes place and neutron rich isotopes (ex. ^{48}Ca) are ejected. From a weak shock scheme, the stars do not explode promptly but later by neutrino heating. The resulting Ca/Fe ratio could be ~ 1. The enhancements of other middle heavy nuclei (Si and S) are also expected.

Takahaski et al. (1986) calculated expected cosmic ray energy spectrum from type II supernova remnants including the effects of photodisintegration and leakage from our galaxy and showed good agreement with the observed data.

Clearly further observations of heavy nuclei at energies above 10^{12} eV/amu are needed. Isotope identification would be especially important as one would expect an overabundance of both ^{40}Ca and ^{48}Ca. X-ray line spectrum observation of Crab-like supernova remnants will also give the composition in the vicinity of neutron stars. These observations would be a conclusive signature of nucleosynthesis in type II supernovae and indeed could serve as a probe of the physical conditions in the NSE core, i.e., formation of neutron stars.

REFERENCE

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