論文内容の要旨

論文題目：

Search for Supernova Relic Neutrino at Super-Kamiokande
（スーパーカミオカンデにおける超新星背景ニュートリノ探索）

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The diffuse supernova neutrino background from all the past supernovae, known to be Supernova relic neutrino (SRN), were searched for in Super-Kamiokande, which is a large water Cherenkov detector located at 1000m underground in the Kamioka mine. Three data taking phases were used in this analysis and each phase has a livetime of 1496 days (SK-I), 791 days (SK-II) and 548 days (SK-III). This is the first search for SRN using SK-II and SK-III data.

From the old SK-I analysis, we developed a new statistical method based on the Poisson distribution which is more suitable for small statistics. We improved the data reduction method from SK-I old analysis in order to increase the efficiency and to lower the detection energy threshold. This enabled us to lower the analysis energy threshold down to 16 MeV from 18 MeV with better signal efficiency.

No evidence for SRN signals were found in this search. The 90% confidence level upper limits on SRN anti-electron neutrinos were obtained for nine theoretical models which predict the spectrum and absolute flux of SRN. The obtained flux limits by the combined analysis of SK-I, SK-II and SK-III range from 2.0 /cm^2/sec to 2.2 /cm^2/sec (Neutrino energy > 17.3 MeV) depending on the spectrum shape of the SRN model considered.

Our results are now close to the predicted SRN flux ranging from 0.4 - 4.6 /cm^2/sec

(Neutrino energy > 17.3 MeV) as shown in Fig 1. Based on the improved analysis method and increased statistics, the new results presented in this thesis superseded the previous SK-I limit. The obtained limits are an order of magnitude better than the value from other experiments as shown in Fig 2.

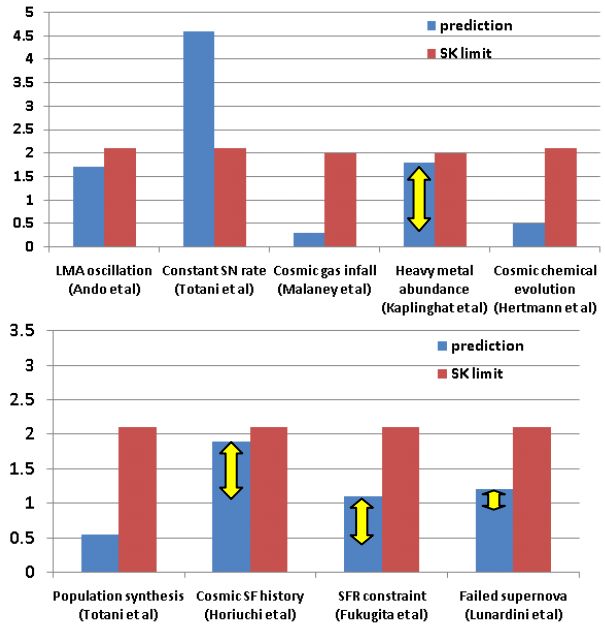

Figure 1: Expected flux from each theoretical SRN model and 90% CL flux limit obtained from this analysis

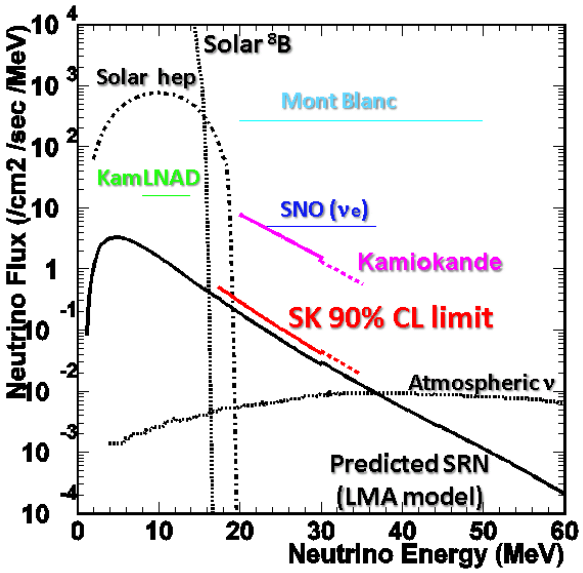

Figure 2: The SRN flux limit in this analysis (Red line) and other experiments (colored lines). Black solid line shows expected SRN spectrum.