Solar Neutrinos and Supernova Burst Neutrinos at Hyper-Kamiokande

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SOLAR NEUTRINOS

Physics motivation

* Neutrino oscillation

- Can the spectrum up-turn to the vacuum oscillation dominant region be seen?
- Can the day-night asymmetry be seen?
- ***** Astrophysical point of view
 - Separate high/low heavy metal model?
 - Short term variation, etc.

Precise flux measurement is a key.



Spectrum up-turn

Lowering energy threshold is crucial. It strongly depends on the photo-coverage and Q.E. (the current HK configuration is same as SK-II.)



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What's new for muon spallation B.G.

- * Spallation background was based on the SK-2 (half # of PMTs) data.
 - SK-1 data was used in the previous meeting.
- * Use modified spallation cut
 - The remaining spallation events becomes -10 times higher than SK (20 times in the previous meeting).
 - Calculate the sensitivity in the case of several factors.
- * Did not introduce high dark rate in this analysis.

Solar neutrino signal in HK





Day/Night asymmetry in 100,000 toy-MCs

in case of solar best is the solution



Sensitivity for D-N as a function of Remaining B.G.



SUPERNOVA BURST NEUTRINOS

- * In case of a galactic SuperNova, very large statistics, precise directionality and time profile are available.
- Detection of burst neutrinos from SuperNova in nearby galaxies is also possible.



What's new

- * Try to study SNs with several Mpc. (nearby Galaxy)
 * Update the expected plot by Horiuchi-san.
 * Use modified anellation and
- * Use modified spallation cut.
 - The cut efficiency becomes better, 80% (44% in the previous meeting.)
 - The remaining B.G. level becomes worse, 6.56 e-3 events/18sec. (1.23 e-3 in the previous meeting)



0.2-0.6 SN/year is expected at 4Mpc.

If the analysis energy threshold for HK is set to 18MeV for reduce B.G., the # of expected events : 0.37-0.83 @4Mpc. While the expected accidental B.G. is 0.00656 events.

The detection probability : 31-56% (N ≥ 1) @4Mpc $N_{e^+}(18 < E_{e^+} < 30) \approx 5 \left(\frac{d}{1 \text{ Mpc}}\right)^2$ 1 event from SN@4Mpc (need another information e.g. GW) every (3-20 yEars<is38xpe8t(ed $\frac{d}{1 \text{ Mpc}}$)



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Search for SN using optical measurement information - expected B.G. is 0.00656 events/18sec/0.56Mton

Nobs	P _{signal} @4Mpc	P _{bg}
Ι	26-36%	99.3%
2	5-15%	0.65%
3	0.5-4%	0.002%

Summary

* Solar neutrinos

- Honestly speaking, no chance of the big impact in the current configuration...
- Deeper (for everything) and Higher photo coverage (for spectrum up-turn) in HK is interesting.
- * Super Nova burst neutrinos
 - Promising for our galaxy, (if happens)
 - Also interesting for nearby galaxy up to several Mpc.

BACKUP

Assumption

* Same condition as SK-II.

- Event rate : 328 events/day/22.5kton/(6.5-19.5MeV)
- 6.5MeV (kin.) energy threshold

* HK 10 years sensitivity with the Solar best parameters.
* 100,000 toy-MCs are generated.

up-turn sensitivity in SK

