Status of SBL Experiment

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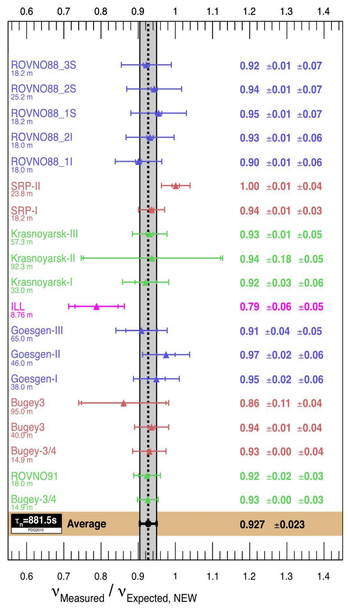
On the behalf of SBL Collaboration

SBL is a Short-BaseLine reactor neutrino experiment for searching sterile neutrinos, which will be performed using research reactor HANARO in Daejeon, Korea. HANARO has 30MW thermal power and detector will be placed at the distance of about 6m away from reactor. Currently prototype detector which has 50L of Gd-loaded LS as target is constructed and tested in several places with different overburden to understand background caused by cosmic muon and neutron. We compare background data from prototype detector and monte carlo simulation, and we make an effort to reduce background for main detector.

Short-BaseLine Experiment

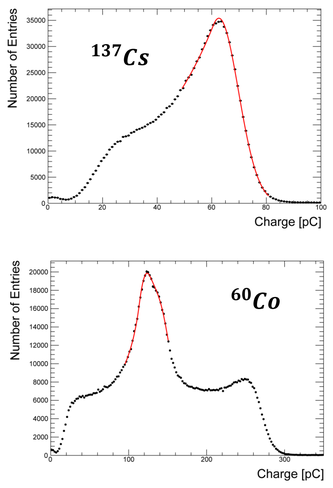
- **Testing the existence of sterile neutrinos**
- **Many short baseline experiments have reported reactor anomaly**
- **Detector should be placed on the ground, reducing background caused by cosmic muon and neutron is the most critical for increasing sensitivity**

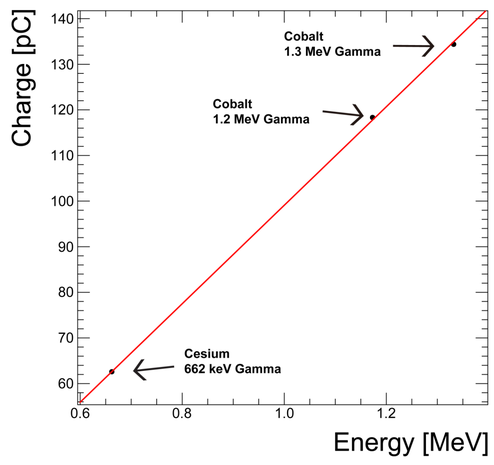


- **Collaborations**
  Kyungpook Natl. Univ., Korea
  Chonnam Natl. Univ. , Korea
  Sejong Univ. , Korea
  Institute of Basic Science, Korea
  Korea Atomic Energy Research Institute, Korea
  Chung-Ang Univ. , Korea
  Chonbuk Natl. Univ. , Korea

Energy Calibration

- **Gamma sources are placed at the center of target**
- **Fit charge spectrum of gamma source data (^{137}Cs, ^{60}Co)**





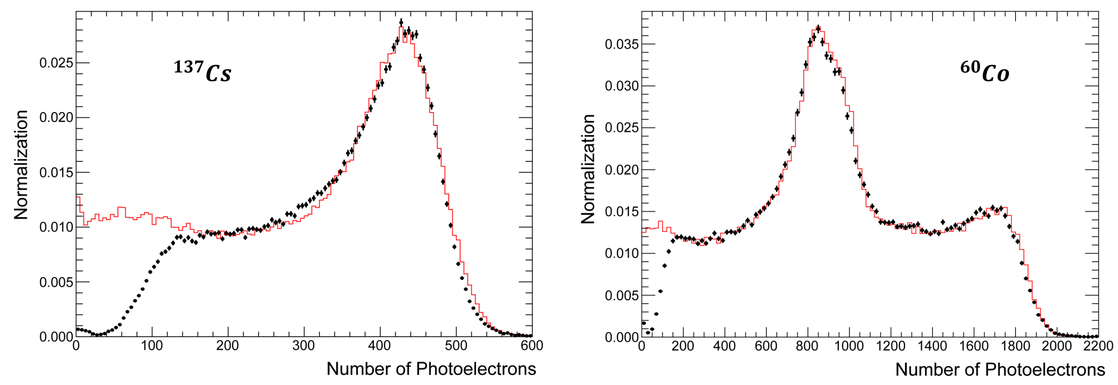
Red line : fit result

Reactor Candidates

- **Our experiment uses reactor as neutrino source.**
- **We are considering two research reactors and one commercial reactor**

Candidate	Baseline	Thermal Power	# of neutrino events/day	Overburden
HANARO	6 m	30 MW	179	-
Younggwang	24 m	2.8 GW	1052	~ 9 m.w.e
Kijang	5 m	15 MW	129	~ 23 m.w.e

Detector Simulation



Black Marker: data / Red line : simulation result

- **Light Yield : 670 pe/MeV**
- **Detector simulation is tuned by data**
- **Simulation is well-fitted with data**

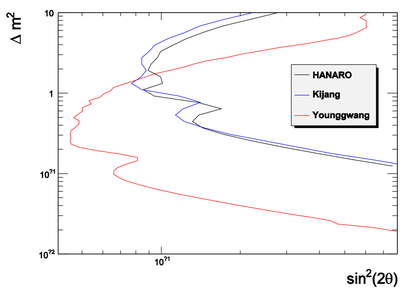
Feasibility Test

- **Perform χ^2-test**
- **500 L & 1000 L cylindrical targets are used in simulation (90% C.L.)**

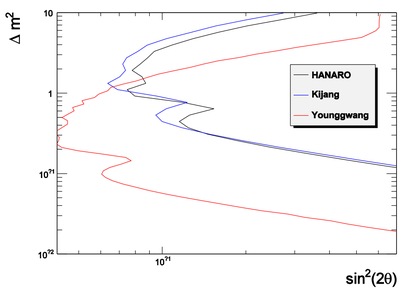
$$\chi^2 = \sum_i \frac{((a+a_e^i)N_{observed}^i - N_{theory}^i - (1+a_b)N_{bkg}^i)^2}{N_{theory}^i + N_{bkg}^i + (\sigma_{b2b}N_{bkg}^i)^2} + \sum_i \left(\frac{a_e^i}{\sigma_e^i}\right)^2 + \left(\frac{a}{\sigma}\right)^2 + \left(\frac{a_b}{\sigma_b}\right)^2$$

Reference : K. M. Heeger, arXiv: 1307.2859

- **500 L**



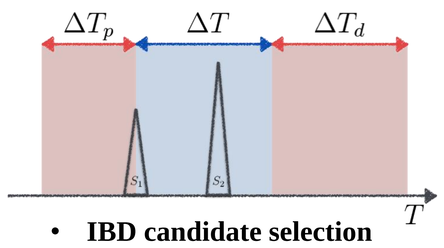
- **1000 L**



- **Sensitivity at HANARO & Kijang depends on target volume**

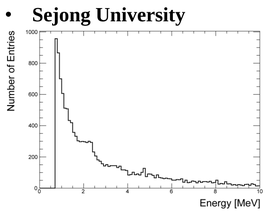
IBD Reconstruction & Background Result

- **IBD Reconstruction**

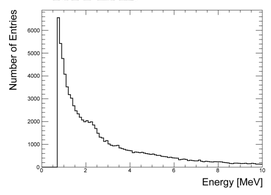


- **IBD candidate selection**
  $0.7 < E_{S_1} < 10\ MeV$
  $3 < E_{S_2} < 10\ MeV$
  $3 < \Delta T < 30\ \mu s$
- **Muon Veto condition**
  nhit ≥ 1, $T_{veto} = 100\ \mu s$
- **Multiplicity Requirement**
  $\Delta T_p = 30\ \mu s$
  $\Delta T_d = 100\ \mu s$

- **Background Energy Spectra for Prompt Events (with different overburden)**
  - **Sejong University**



  - **KT1 LAB**

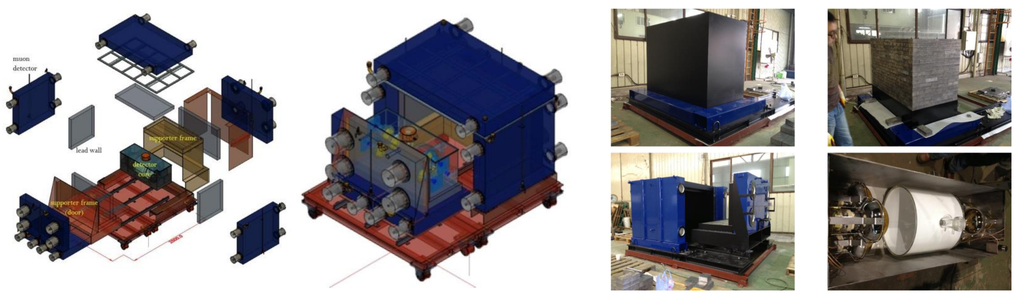


Place	Overburden [m.w.e]	Background Rate [event/d]
Sejong Univ.	~ 3.5	1277
KT1 LAB	-	8365

- **Background rate varies highly depending on overburden**

Prototype Detector

- **Before main experiment, we make prototype detector to measure background rate on the ground**



- **Prototype detector is consist of target, lead wall and muon detector**
- **Target : 50 L Gd-loaded LS in cylindrical acrylic tank**
- **Passive shield : Use lead for shielding external gamma (Thickness : 10 cm)**
- **4 π muon detector with LS**

Summary

- **SBL experiment will be performed in 3 deployment candidates.**
- **Feasibility test is performed with 3 deployment candidates.**
- **Prototype Detector**
  - **Before main experiment, prototype detector is constructed to understand background caused by cosmic muon or neutron.**
  - **In prototype detector, liquid scintillator is used as active detection material.**
  - **Electronics & DAQ system is developed and work well.**
  - **Energy calibration is performed and compared with detector simulation.**
  - **Measure background rate and understand between background and overburden.**
- **Main detector is changed from homogeneous to segmented detector.**
- **Full main detector will be constructed and committed on March, 2015.**