Study of Ocean Bottom Detector for observation of geo-neutrinos from mantle

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Observation of geo-neutrinos originating from radioactive isotopes in the Earth (238U,232Th, etc.) can be converted to the amount of radioactive isotopes and the heat generated by their decays which governs the Earth dynamics.
KamLAND experiment achieved world's first observation of geo-neutrinos in 2005. Improvement of observation accuracy allowed us to reach the level where we can obtain geoscientific knowledge. However, it is hard to obtain information on the mantle because 70% of neutrinos observed by detector currently operating or planned are derived from the crust (Figure 1).
Given that the oceanic crust is thinner than the continental crust and has lower densities of U and Th, Ocean Bottom Detector (OBD) makes it sensitive to geo-neutrinos originating from Earth's mantle. OBD is expected to provide transformative insights into the deep Earth.Unique feature of OBD is separation from the reactors which are the main background sources of continental detectors. In addition, this movable detector can observe at multiple points in the ocean.
Scientists at the University of Hawaii started to discuss the idea of observing the geo-neutrinos on the sea floor 15 years ago as the detector called "Hanohano"(Figure 2). Unfortunately, the idea has not been realized yet.
In 2019 joint research between Tohoku University and JAMSTEC was started to lead the comprehensive research relating to understanding the Earth's deep interior and realize OBD. We are currently working on the design of 10-ton prototype detector for the ultimate goal of a 10-50kt detector.
The prototype detector will demonstrate necessary technological developments and measure the environment which will be references for future detector design.
In this presentation, we will present results of detector design based on Monte Carlo simulation.

Keywords: Geo-neutrino, mantle, solid earth science

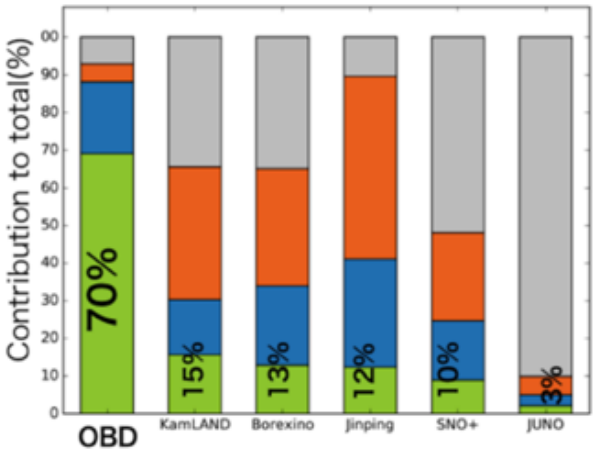

Figure 1: Percentage of each source
Gray: reactor neutrino
Orange: crust wihin 500km
Blue: other crust
Green: mantle-derived Geo-neutrino

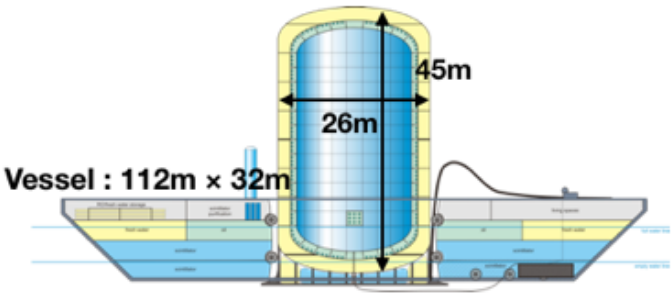

Figure 2:design of Hanohano

