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Imaging detector

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Geo-neutrinos are emitted from radioactive elements, such as Uranium and Thorium, in the Earth's interior. Those elements contribute about one half of Earth's heat source. With high transmissivity of neutrinos, geo-neutrino may enable us to measure heat sources in the deep mantle. Since 1-kton liquid scintillator detector "KamLAND" detected geo-neutrinos in 2005, it has been expected as a new probe of Earth's interior. At present, an Italian detector "Borexino" is also observing geo-neutrinos, realizing a "stereo observation". However, observation points are still not enough. In addition, lack of the directional information of geo-neutrinos are serious disadvantage in making the data more precise. We are now developing a new detector for directional measurement of geo-neutrinos, aiming at installing it in KamLAND in the near future. Geo-neutrinos are electron antineutrinos being detected with an inverse beta decay channel with a free proton. Directional information of the neutron, emitted in the inverse beta decay channel, should be measured, in order to measure the direction of the incoming electron antineutrino. To this purpose, we are developing liquid scintillators doped with Lithium-6, which has large neutron capture cross section, and imaging detectors, which detect the vertex position of neutron capture precisely. In this poster, imaging detectors, that we are developing, are reviewed. To detect feeble light emission of the scintillator (actually one photon level), and determine the emission position precisely, optics with large acceptance and small aberration, together with a light detector with high quantum efficiency and positional sensitivity should be employed. In our current R&D, a hopeful design is that with a mirror of diameter 50 cm, and a 256-channel multi-anode photomultiplier tube. Highlighting that design, we will review the latest progress, plan of installing it, expected geophysical results.

Keywords: neutrino, geo-neutrino, radiogenic heat source