Contribution ID: **1095** Type: **Poster**

Mantle insights from KamLAND and Borexino results

Friday, 8 July 2022 20:10 (20 minutes)

The latest results from KamLAND (Japan) and Borexino (Italy) experiments give us an unprecedented opportunity to investigate the inner Earth. For almost 20 years these experiments have been collecting the feeble signal coming from geoneutrinos, the electron antineutrinos produced in the ²³⁸U and ²³²Th decay chains inside our planet. The energy released in these radioactive decays (i.e., the radiogenic power) together with the slow secular cooling of our planet represents one of the main heat sources powering the internal dynamic processes of the Earth. Since ²³⁸U and ²³²Th release heat and geoneutrinos in a well-fixed ratio, the measurement of the geoneutrino flux at Earth's surface permits to constrain the uranium and thorium content of our planet's and in turn to derive the terrestrial heat power.

We present insights on mantle radioactivity and on the contribution of radiogenic heat to the Earth's energy budget, obtained from the combination of latest geoneutrinos results from KamLAND and Borexino and an exhaustive review of crustal models. A comprehensive statistical framework combining experimental uncertainties and correlations arising from geochemical and geophysical modeling allowed us to recover a robust estimate for the mantle geoneutrino signal of 8.9^{+5.1}_{−5.5} TNU (corresponding to a radiogenic heat production of 12.5^{+7.1}_{−7.7} TW), representing the most precise estimate of the mantle geoneutrino signal to date. The obtained results have been discussed and framed in the puzzle of the diverse Earth's compositional models, analyzing their implications on planetary heat budget and composition. The presented methodology may be used in the analysis of the future results expected from SNO+ (Canada) and JUNO (China) experiments.

In-person participation

Yes

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Session Classification: Poster Session

Track Classification: Neutrino Physics