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Current status and future prospects of geoneutrino detection

Starting from the mid-twentieth century, the electron antineutrinos originating from the radioactive β⁻ emitters inside our planet, geoneutrinos, were proposed as a precious tool for exploring the inner Earth. While decaying, ⁴⁰K and the radioisotopes belonging to ²³⁸U and ²³²Th decay chains release geoneutrinos and energy in a well-fixed ratio. The energy released in these radioactive decays together with the secular cooling of our planet represents one of the main heat sources powering the internal dynamic processes of the Earth. Because of their weak interaction with matter, geoneutrinos can pass through our planet almost without interacting, bringing to surface useful information about Earth's interior. 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 ²³⁸U and ²³²Th geoneutrinos. The combination of experimental results and geochemical/geophysical modeling permits to estimate the U and Th content of our planet's mantle and in turn to derive its radiogenic heat production. The obtained results can be framed in the puzzle of the diverse proposed Earth's compositional models, analyzing their implications on planetary heat budget and composition.

The promising potential of geoneutrinos in investigating deep Earth radioactivity confer them a prestigious role in the comprehension of the geodynamical processes of our planet and lets us glimpse a bright future for this discipline in view of next generation SNO+ (Canada) and JUNO (China) experiments. We must expect much more from this field as novel proposed concepts and technologies promise to allow the attainment of directional information and the possible detection of the still elusive ⁴⁰K geoneutrinos, taking a further step towards the understanding of the Earth.

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