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Neutrino geoscience and reactor monitoring with direction-sensitive detectors

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The Earth is an anti-neutrino star, radiating more than 10^{25} anti-neutrinos to space every second. This immense luminosity is fueled predominantly by the ß$^{-}$ decays of radiogenic isotopes in the Earth's crust and mantle. The anti-neutrinos produced by these decays, called geo-neutrinos due to their geophysical origin, give us important clues about the composition of the Earth's interior and the size and sources of the Earth's radiogenic heat flow, both in the current epoch and throughout its evolution. In this talk, we present a novel method for measuring previously unresolved components of Earth's internal heating due to radioactivity, specifically those associated to potassium, the mantle and the core. The technique exploits the directional information of neutrino-electron elastic scattering and estimates the exposures needed to probe these contributions to the total geo-neutrino flux. These results chart the course for pioneering exploration of the veiled inner workings of the Earth. To conclude, we discuss the implications of ktonne-scale direction-sensitive detectors on nuclear non-proliferation by examining their prospects to remotely monitor nuclear reactors.

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