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Detecting 40K geoneutrinos with LiquidO

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From 25% to 70% of Earth's internal heat budget is deemed to be generated by the radioactive decays of the so-called heat producing elements (i.e. U, Th and K). Potassium, the only semi-volatile element among them, seems to show from 10% to 30% of its expected chondritic abundance, making thus uncertain any heat balance estimation. Two theories stand on the possible fate of "missing K": i) segregation of potassium into the core or ii) loss to space during planetary accretion. No experimental corroboration allows confirmation of these hypotheses yet. As a consequence, our knowledge on Earth's internal heat budget and its thermal evolution has to rely on compositional models.
Direct geoneutrino detection however permits to constrain, at least in part, Earth's radiogenic heat production and its Urey ratio. Unfortunately, present state-of-the-art detection techniques based on Inverse Beta Decay (IBD) on free protons only permit the detection of geoneutrinos having an energy above 1.8 MeV, leaving 40K-geoneutrinos (whose endpoint is at 1.3 MeV) impossible to detect. Detection via NC interactions such as elastic scattering has been proposed, however, solar and radioactivity backgrounds remain challenges limiting its feasibility.
The novel LiquidO detection technique* allows to enable for the first time the observation of 40K-geoneutrinos. LiquidO opaque detection medium allows for unprecedented particle identification and large loading capabilities for neutrino detection. A clear identification of single positrons event topology is possible upon CC interactions of geoneutrinos. This feature opens the door for the exploitation of loaded isotopes leading to new IBD interactions, making thus possible to lower the minimum detectable antineutrino energy.
A review of possible target candidates able to detect 40K-geoneutrinos will be here presented together with their IBD cross-section and the corresponding expected signal for four different potential experimental sites. A few novel possible isotope targets are presented here for the first time. The detection significance and the statistical uncertainty will then be discussed together with a possible methodology for the 40K-geoneutrino signal extraction.

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* Cabrera A. et al. - Neutrino Physics with an Opaque Detector - arXiv:1908.02859 - 2019

Author: Mr SERAFINI (ON BEHALF OF LIQUIDO COLLABORATION), Andrea (University of Ferrara & INFN)

Presenter: Mr SERAFINI (ON BEHALF OF LIQUIDO COLLABORATION), Andrea (University of Ferrara & INFN)