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SNO+ is a multipurpose, low background, liquid scintillator neutrino detector. It is located 2km underground at SNOLAB in Sudbury, Canada. It is currently being filled with 800 tonnes of liquid scintillator, after the successful completion of the water phase of the experiment. Once the detector is filled, studies into several physics topics will begin, including reactor antineutrinos and geo-neutrinos. After the scintillator phase, 4 tonnes of tellurium will be loaded into the liquid scintillator as the primary objective of SNO+ is to search for the neutrinoless double-beta decay of Te-130.

SNO+ can observe geo-neutrinos coming from the uranium and thorium decay chains via inverse beta decay reactions with protons in the liquid scintillator. The measured geo-neutrino flux will be compared with KamLAND and Borexino results in a global analysis to help constrain models of radiogenic heat production in the deep Earth. This talk will present the current status of the SNO+ detector and the geo-neutrino measurement prospects.

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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

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