The deep-sea neutrino detector KM3NeT/ORCA, currently being built in the Mediterranean Sea near Toulon (France), is optimized for the study of oscillations of atmospheric neutrinos in the few-GeV energy range, with the main goal to determine the neutrino mass hierarchy. This is possible due to matter effects that modify the probability of neutrino oscillations along their path through the Earth. Measuring the energy and angular distributions of neutrinos with ORCA can therefore also provide tomographic information on the Earth's interior and more specifically on the electron density along the trajectory of the detected neutrino, complementary to standard geophysics methods.
In this contribution the latest results of a study of the potential of ORCA for Earth tomography are presented. They are based on a full Monte Carlo simulation of the detector response and including systematic effects. It is shown that after ten years of operation ORCA can measure the electron density in both the lower mantle and the outer core with a precision of a few percent in the case of normal neutrino mass hierarchy.

40

Geo-neutrino program at Baksan Neutrino Observatory

Authors: Albert Gangapshev[1] ; Andrey Sidorenkov[2] ; Bayarto Lubsandorzhiev[2] ; Daniil Kudrin[2] ; Dmitry Voronin[2] ; Evgeny Veretenkin[2] ; Evgeny Yanovich[2] ; Galina Novikova[2] ; Makhti Kochkarov[2] ; Nikita Ushakov[2] ; Tatiana Ibragimova[2] ; Valery Kuzminov[1] ; Valery Petkov[3] ; Vladimir Gavrin[2] ; Vladimir Kazalov[2] ; Yury Gavrilyuk[2] ; Yury Malyshkin[4]

[1] *INR RAS, KBSU*

[2] *INR RAS*

[3] *INR RAS, IA RAS*

[4] *INR RAS, INFN*

A new neutrino program has been recently lunched at Baksan Neutrino Observatory. It is planned to deploy a 10-kiloton scale detector based on liquid scintillator in the existing shaft at a depth of 4800 m.w.e.. Baksan underground laboratory is profitable in terms of low reactor neutrino flux and well measured backgrounds originating from natural radioactivity. Therefore, the experiment is well suited for geo-neutrino measurements and will enforce the world-wide effort. Besides that this detector has a good potential for registration of solar neutrinos and neutrinos from supernova explosions.

As a preparatory stage, a detector prototype with target mass of 0.5 ton and equipped with 20 10-inch PMTs is currently under construction. Another prototype of 5-ton target mass is planned for the next year. The expected performance of the first prototype and the prospects of the future multi-kiloton detector will be reported.

Poster session / 21

Geoneutrino measurements with Borexino: implications for geoscience

Author: Fabio Mantovani (on behalf of Borexino collaboration)[1]

[1] *University of Ferrara - INFN Ferrara*

Corresponding Author: mantovani@fe.infn.it

Borexino is a 280-ton liquid scintillator detector located at Laboratori Nazionali del Gran Sasso (Italy) measuring geoneutrinos from 238U and 232Th decay chains through inverse beta decay of free proton. The improved geoneutrino analysis of some 3263 days of data, taken by Borexino between December 2007 and April 2019, is candidate to provide useful insights into the composition of the Earth's interior as well as into its radiogenic heat budget.

We present the geological implications of the geoneutrinos signal results through a comparison with the predictions of different Bulk Silicate Earth models. Based on the knowledge of abundances and distributions of U and Th in the lithosphere, the mantle signal is extracted from the spectral fit of the Borexino measurement. Considering different scenarios about natural radioactivity in the deep Earth, the measured mantle geoneutrino signal has been converted to radiogenic heat. The convective Urey ratio is also extracted adopting the total radiogenic heat estimation. Finally, constraints on lower limits of U and Th abundances in the mantle are reported.

44

The Mantle's Radioactive Power - Understanding the Geoneutrino Signal

Authors: William McDonough[1] ; Ondřej Šrámek[2] ; Bedrich Roskovec[3] ; Laura Sammon[4] ; Scott A. Wipperfurth[5] ; Ingrida Semenec[6]

[1] *University of Maryland*

[2] *Charles University*

[3] *University of California, Irvine*

[4] *University of Maryland College Park*

[5] *Department of Geology, University of Maryland, College Park, Maryland, USA*

[6] *Queen's University*

Corresponding Authors: broskove@uci.edu, 18is10@queensu.ca, swipp@umd.edu, lsammon@umd.edu, ondrej.sramek@gmail.com, mcdonoug@umd.edu

Although many assume we know the Earth's abundance and distribution of radioactive heat producing elements (i.e., U, Th, and K), estimates for mantle's heat production varying by an order of magnitude and recent physics findings challenge our dominant paradigm. Geologist predict the Earth's budget of radiogenic power at 20±10 TW (terrawatts, 10^{12} watts), whereas the physics experiments predict $11.2^{+7.9}_{-5.1}$ TW (KamLAND, Japan) and $38.2^{+13.6}_{-12.7}$ TW (Borexino, Italy).

We welcome this opportunity to highlight the fundamentally important resource offered by the physics community and highlight the shortcomings associated with the characterization of the geology of the Earth. We review the findings from the continent-based, physics experiments, the prediction from geology, and assess the degree of misfit between the physics measurements and the predicted models of the continental lithosphere and the underlying mantle. Because our knowledge of the continents is so weak, models for the mantle and the bulk silicate Earth continue to be uncertain by a factor of ∼30 and ∼4, respectively. Detection of a geoneutrino signal in the ocean, far from the influence of continental, offers the potential to resolve this tension and offer an powerful tools to interrogate the composition of the continental crust.

37

Reference Models for Lithospheric Geoneutrino Signal

Authors: William McDonough[1] ; Scott A. Wipperfurth[2] ; Ondřej Šrámek[3]

[1] *University of Maryland*

[2] *Department of Geology, University of Maryland, College Park, Maryland, USA*

[3] *Charles University*

Corresponding Authors: swipp@umd.edu, mcdonoug@umd.edu, ondrej.sramek@gmail.com