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JULOC□A Local 3-D High-Resolution Crustal Model in South China for Forecasting Geoneutrino Measurements at JUNO

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Geothermal energy is one of the keys for understanding the mechanisms for driving the plate tectonics and mantle dynamics. The surface heat flux, as measured in boreholes, provide limited insights into the relative contributions of primordial versus radiogenic sources of the interior heat budget. Geoneutrino, electron antineutrino that produced from the radioactive decay of the heat producing elements, is a unique probe that obtain direct information about the amount and distribution of heat producing elements in the crust and mantle. Cosmochemical, geochemical, and geodynamic compositional models of the Bulk Silicate Earth (BSE) individually predicts different mantle neutrino fluxes, and therefore may be distinguished by the direct measurement of geoneutrinos. Due to low counting statistics, the results from geoneutrino measurements at several sites are inadequate to resolve the geoneutrino flux. However, the JUNO detector, currently under construction in South China, is expected to provide an exciting opportunity to obtain a highly reliable statistical measurement, which will produce sufficient data to address several vital questions of geological importance. However, the detector cannot separate the mantle contribution from the crust contribution. To test different compositional models of the mantle, an accurate estimation of the crust geoneutrino flux based on a three-dimensional (3-D) crustal model in advance is important. This paper presents a 3-D crustal model over a surface area of 10□ × 10□ grid surrounding the JUNO detector and a depth down to the Moho discontinuity, based on the geological, geophysical and geochemical properties. This model provides a distinction of the volumes of the different geological layers together with the corresponding Th and U abundances. We also present our predicted local contribution to the total geoneutrino flux and the corresponding radiogenic heat. Compared to previous studies, our method has helped to effectively reduce the uncertainty of geoneutrino flux prediction by constructing the composition of the surface layer through cell by cell which are independent to each other.

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