Potential of geo-neutrino measurements at JUNO and the Local 3D model

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On behalf of the JUNO collaboration

The Jiangmen Underground Neutrino Observatory (JUNO)
20 kton LS detector
3%/\sqrt(E) energy resolution
A multiple-purpose neutrino experiment: Reactor neutrinos, Supernova neutrinos, Geo-neutrinos, Solar neutrinos, Sterile neutrinos, Atmospheric neutrinos, Exotic searches

Geo-neutrinos: a new probe of Earth’s interior
Open questions about natural radioactivity in the Earth
1 - What is the radiogenic contribution to terrestrial heat production?
2 - How much U and Th are in the crust and particularly in the mantle?
3 - A global check of the standard geochemical model (BSE)?
4 - What is hidden in the Earth’s core? (geo-reactor, \(^{40}\)K, …)

Geo-neutrinos: anti-neutrinos from the Earth.
U, Th, and \(^{40}\)K in the Earth release heat together with anti-neutrinos in a well fixed ratio. They bring to Earth’s surface information about the chemical composition of the whole planet.

The energy spectrum

- 400 events/year, much larger than existing experiments
- With 10 years: total uncertainty reach 5% (2\(\sigma\))
- Comparison of the global reference model (18% crust) and a benchmark accuracy of the local model (8% crust)

The Local Crust Geophysical Model
Zhi-Wei Li (IGGWH, CAS)
Ruo-Han GAO (CUGB)

Why Local 3D model

- Significant uncertainties exist in current global models. High-resolution local crust model are needed
- Global CRUST1.0 model has low resolution (1° × 1°)
- Global abundance model has no spatial resolution and large uncertainties

Geophysical data source
Continuous Seismic Waveforms, from 450 Stations in South China

The Local Crust Geochemical Model
Ruo-Han GAO (CUGB)

Data collection (U & Th abundances), 3000 points
Preliminary surface model (0.5° x 0.5°) Preliminary vertical model (4 layers)

JUNO Potential in Measuring Geo-neutrinos

- Near continental margin, affected by the geology evolution of South China Block and the South China Sea
- Paleogeographic evolution of South China fold belt during Permian-Jurassic time and proposed flat-slab subduction model for propagating
- Local geology, including the geometry of strata, distribution rocks play important role in geo-\(\nu\) flux estimation

Local Neutrino Geo-Science Working Group