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Geophysical Impact of Neutrino Radiography using IceCube: Insight by Seismic Tomography

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For these two decades, the resolution and the accuracy of seismic tomography are greatly improved, and we now have consensus for the larger scale heterogeneities of the seismic velocity structure. At the same time, we noticed that seismic tomography has limitations for constraining the Earth's dynamics. To constrain the dynamics (e.g., how the mantle is convecting, and how the heat is transported to the surface), the density (rather than seismic velocity) is the key parameter. However, the fundamental problem is that we cannot uniquely constrain the density anomalies from the seismic velocity structure because various types of origins (thermal and/or chemical origins) can explain the observed velocity anomalies. If neutrino radiography could provide independent information on the density structure, it will improve our understanding to the Earth's dynamics.
In this presentation, I will focus on the core-mantle boundary region and review our current knowledge on the seismic velocity structure and its interpretations. I first compare the recent tomography models [ref. 1 and others] and show that we have consensus for the larger scale velocity structure. I next show the classical geodetic evidence which indicates that the observed velocity anomalies are primarily thermal origin [2]. But I also show recent seismological evidence which contradicts the idea that the anomalies are primarily thermal [3] and conclude that our understanding for the core-mantle boundary region is far from complete. I finally show the expected density anomalies in the sampling region of the Neutrino Radiography using IceCube for both cases when the observed velocity anomalies are thermal and thermo-chemical origins. The expected amplitudes of the anomalies are also discussed.

References

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