Anisotropy of the Inner Core

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The Earth’s inner core, buried beneath the crust, mantle, and outer core, is a difficult target to study. Nevertheless, large collections of inner-core sensitive data at IRIS and other institutions are allowing for improved imaging of this deepest structure. We have investigated the anisotropic property of the inner core using normal-mode data obtained from seismograms available at the IRIS Data Management Centre, as well as body-wave information from IRIS and elsewhere (Figure 1).

To obtain an inner-core model that is compatible with long-period free oscillations and short-period body-wave data, we invert the normal-mode, absolute and differential travel-time measurements simultaneously for a model of inner-core anisotropy. This model predicts a difference in wave speed of about 0.2 km/s with fast wave propagation along the Earth’s rotation axis and slow wave propagation along the equatorial plane (Figure 2).

Although arrival times of PKP-DF (or PKIKP) from epicentral distances between 120° and 173° are consistent with such anisotropy, PKP-DF observations from nearly antipodal distances (between 173° and 180°) deviate significantly from the predictions based upon the joint inversion. The antipodal data correspond to the central 300 km of the inner core, and they require a difference in wave speed of about 0.8 km/s. Furthermore, even though the fast propagation direction is the same as in the overlying layer, the direction of slow propagation is ~45° from the rotation axis. These observations suggest that the inner core consists of at least two layers (Figure 2).