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Velocity and attenuation of seismic waves in random media: A spectral function approach

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This contribution investigates the scattering of scalar and elastic waves in two-phase materials and single-mineral-cubic, hexagonal, orthorhombic-polycrystalline aggregates with randomly oriented grains. Based on the Dyson equation for the mean field, explicit expressions for the imaginary part of Green's function in the frequency-wavenumber domain $(\omega, \mathbf{p})$, also known as the spectral function, are derived. This approach allows the identification of propagating modes with their relative contribution, and the computation of both attenuation and phase velocity for each mode. The results should be valid from the Rayleigh (low-frequency) to the geometrical optics (high-frequency) regime. Applications of the proposed theory to the structure of the inner core of the Earth will be presented. In particular, it will be shown that our scattering theory can explain the striking correlation between velocity and attenuation and the associated hemispherical variations revealed by PKP waves propagating through the inner core of the Earth. The implications for inner core dynamics will be summarized.