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Emergence of the Green function in field-field correlations and equipartion for elastic waves.

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In the heterogeneous Earth, multiple scattering takes place and average field intensities or energy densities follow diffusive processes for long lapse times. Multiple P to S energy conversions by the random inhomogeneities result in equipartition of elastic waves which means that, in the phase space the available elastic energy is distributed among all the possible states of P and S waves, with equal amounts in average. In such diffusive regimes the P to S energy ratio equilibrates in a universal way independent of the particular details of the scattering. The presence of equipartion was used to justify the reconstruction of Green functions from field-field correlations of diffuse scalar waves. The arguments were given for scalar problems in which equipartition is extremely difficult to demonstrate experimentally. We shortly review the arguments for finite bodies (associated with a discrete spectrum) as well as for a scalar 2D homogeneous body for which we discuss the relation with the Aki's 'Spectral Auto-Correlation' technique. In the case of a heterogeneous elastic medium with homogeneous background, the P/S energy ratio can be written easily. We present here the calculation of the two-point field-field correlation for a distribution of elastic plane waves (which are eigenfunctions of the homogeneous reference model). We demonstrate that the Fourier transform of azimuthal average of the cross-correlation of motion between two points within an elastic medium is proportional to the imaginary part of the exact Green tensor function between these points for a particular P/S energy ratio in the incoming fields. It turns out that the required energy ratios are precisely the ones expected from equipartition both in 2D and 3D. This canonical computation shows the close relationship between equipartition, long range correlations and Green function. It emphasizes the importance of multiple scattering for Green function reconstruction. In absence of equipartition, correlations do provide valuable results of physical sig-

nificance by reconstructing specific arrivals even if they do not allow retrieving the complete Green function.