

Spectral Renormalization Group Theory on Networks

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Discrete amorphous materials are best described in terms of arbitrary networks which can be embedded in three dimensional space. Investigating the thermodynamic equilibrium as well as non-equilibrium behaviour of such materials around second order phase transitions call for special techniques.

We set up a renormalization group scheme by expanding an arbitrary scalar field living on the nodes of an arbitrary network, in terms of the eigenvectors of the normalized graph Laplacian[1]. The renormalization transformation involves, as usual[2] the integration over the more “rapidly varying” components of the field, corresponding to eigenvectors with larger eigenvalues, and then rescaling. The critical exponents depend on the particular graph through the spectral density of the eigenvalues, as is also found for real space renormalization group schemes.[3]

- [1] F.K.R. Chung, *Spectral Graph theory*, CBMS Regional Conference Series in Mathematics, vol.92, Conference Board of the Mathematical Sciences, Washington (1997).
[2] K.G. Wilson and J. Kogut, *Phys. Rep.* **83**, 75 (1974). [3] S.N. Dorogovtsev, A.V. Goltsev, J.F.F. Mendes, *Rev. Mod. Phys.* **80**, 1275 (2008).