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Lee-Yang-Fisher zeros for DHL and 2D rational dynamics, II. Global Pluripotential Interpretation

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In a classical work of the 1950's, Lee and Yang proved that for fixed nonnegative temperature, the zeros of the partition functions of a ferromagnetic Ising model always lie on the unit circle in the complex magnetic field. Zeros of the partition function in the complex temperature were then considered by Fisher, when the magnetic field is set to zero. Limiting distributions of Lee-Yang and of Fisher zeros are physically important as they control phase transitions in the model. One can also consider the zeros of the partition function simultaneously in both complex magnetic field and complex temperature. They form an algebraic curve called the Lee-Yang-Fisher (LYF) zeros. In this paper we study their limiting distribution for the Diamond Hierarchical Lattice (DHL). In this case, it can be described in terms of the dynamics of an explicit rational function R in two variables (the Migdal-Kadanoff renormalization transformation). We prove that the Lee-Yang-Fisher zeros are equidistributed with respect to a dynamical $(1,1)$-current in the projective space. The free energy of the lattice gets interpreted as the pluripotential of this current. We also describe some of the properties of the Fatou and Julia sets of the renormalization transformation.

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