Stationary states and fractional dynamics in systems with long range interactions

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Dynamics of many-body Hamiltonian systems with long range interactions is studied, in the context of the so called $\alpha-$HMF model. Building on the analogy with the related mean field model, we construct stationary states of the $\alpha-$HMF model for which the spatial organization satisfies a fractional equation. At variance, the microscopic dynamics turns out to be regular and explicitly known. As a consequence, dynamical regularity is achieved at the price of strong spatial complexity, namely a microscopic inhomogeneity which locally displays scale invariance.