Symmetry, density profiles and momentum distribution of multicomponent mixtures of strongly interacting 1D Fermi gases

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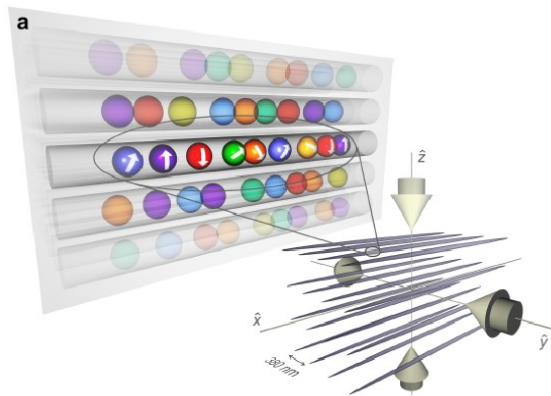
Array of one dimensional fermionic mixtures (figure from Pagano et al Nature Physics 2014).

We consider a mixture of one-dimensional strongly interacting Fermi gases up to six components, subjected to a longitudinal harmonic confinement. In the limit of infinitely strong repulsion we provide an exact solution which generalizes the one for the two-component mixture. We show that an imbalanced mixture under harmonic confinement displays partial spatial separation among the components, with a structure which depends on the relative population of the various components. Furthermore, we provide a symmetry characterization of the ground and excited states of the mixture introducing and evaluating a suitable operator, namely the conjugacy class sum. We show that, even under external confinement, the gas has a definite symmetry which corresponds to the most symmetric one compatible with the imbalance among the components. We also study the properties of the momentum distributions, focusing on the asymptotic behavior, which is closely related to the interaction energies.