Multicomponent Strongly-Interacting Few-Fermion Systems in One Dimension

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Recent advances in cooling and trapping ultracold atomic gases in quasi one-dimensional setups give us a versatile setup to test and develop our understanding of Nature. Some remarkable results such as the Tonks-Girardeau gas [1] or "quantum Newton's cradle" [2] were already obtained in the lab. Those results show a clear distinction between the strongly and weakly correlated systems and allows us to develop and test theoretical predictions for strongly interacting systems.

Here we develop an analytical model for a strongly-interacting multicomponent few-fermion system. This setup that has been realized recently [3] and has features that can be used in atomtronics. To gain knowledge about such systems we study strongly-interacting fermions with two hyperfine spin states in one dimension. Specifically we consider fermionic particles in an external potential for infinite repulsion between the particles. We develop an analytical approach to the solution from a few-body point of view and show that particles with different spins tend to separate in the trap [4]. Our results can be used to describe also dynamical properties of the system, e.g. tunnelling from the system, that can be addressed experimentally [5].

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