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Multi-Branch Spin Chain Models for Strongly interacting Spinor Fermi and Bose gases in One-Dimension LI YANG, HAN PU, Rice Univ — By mapping a 1D spinor Fermi or Bose gases wavefunction to a direct product of a spinless fermion wavefunction and a spin chain wavefunction, we obtain a spin-charge coupling Hamiltonian which is a multi-branch spin chain model. The charge part of this model are p-wave $\overleftarrow{\partial}\,\delta(x)\overrightarrow{\partial_-}$ interactions. The spin part of this model are spin parity projection operators. Previously obtained spin chain models (Nature Commun. **5**, 5300. Phys. Rev. A **90**, 013611. Phys. Rev. A **91**, 043634.) are first order perturbation of this multi-branch spin chain model. With this model, for particles in a harmonic trap in strongly interacting regime, we study breathing mode frequencies and the system's response to a spin dependent magnetic gradient and quench dynamics. We also studied the properties of the system with large particle numbers under local density approximation. The resulted spin chain models are studied by exact numerical methods such as Matrix Product States. Other than harmonic trap we also considered traps with $\delta(x)$ impurity, which can not be approximated by local density approximation.

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