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Strongly interacting fermions in optical lattices: from few to many particles MICHAEL WALL, LINCOLN CARR, Colorado School of Mines — We present a general procedure to derive a many-body lattice model for two-component fermions interacting through a Feshbach resonance which is valid for arbitrary scattering length and resonance width. The bare Bloch bands arising from the relevant low-energy scattering channels in free space are strongly coupled for typical broad resonances, and so are an inappropriate basis for describing strongly correlated lattice Fermions. Instead of employing these bare bands, we solve a carefully chosen interacting two-body problem in the lattice and use the two-body eigenstates as an effective closed channel in a many-body resonance model. The use of the full lattice solution for the few-body problem as opposed to a separable approximation such as the harmonic oscillator potential leads not only to significant quantitative differences in parameter values, but also qualitative differences such as tunneling along non-principal axes. Various issues of the two-body lattice problem, such as the renormalization of ultraviolet divergences and the extrapolation to an infinite number of Bloch bands, are addressed.

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