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High fidelity pseudopotentials for ultracold atomic gases[1] PASCAL BUGNION, GARETH CONDUIT, RICHARD NEEDS, Cambridge University — An accurate computational description of ultracold atoms interacting with effective repulsive interactions has proved elusive. Previous computational work has either used a truly repulsive potential (most often, a hard sphere potential), which fails to recover the very short-range nature of the interactions, or the excited states of an attractive potential. In this presentation, we propose a new pseudopotential, inspired by those used in electronic structure work. This potential is carefully tuned to recover the correct scattering length and effective range for a broad range of atomic energies, and does not have an undesirable bound state. This will greatly facilitate quantum Monte-Carlo and exact diagonalization simulations of cold atoms. We have used this potential to study the zero-temperature phase diagram of ultracold atomic gases at $k_F a \geq 0$, obtaining accurate values for the ferromagnetic phase transition at different polarizations.

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