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Simple Analytic Theory of Cold Atom Feshbach Resonance Scattering PAUL JULIENNE, NIST, BO GAO, U. of Toledo — Magnetically tunable Feshbach resonances have been used very successfully in cold atomic gases to study a variety of condensed matter phenomena. We describe a simple analytic theory, in excellent agreement with full quantum scattering calculations, for the near-threshold resonant scattering 2-body T-matrix for magnetically tunable Feshbach resonances in ultracold atomic collisions. The theory is based on the analytic properties of the exact solutions to the Schrodinger equation for the van der Waals potential, and is characterized by 5 parameters: the scattering length, van der Waals coefficient, and reduced mass of the background entrance channel, the coupling width of the resonance, and the difference in magnetic moments between the separated atoms and the resonance level. The resonance scattering phase shift is completely characterized by two functions, an energy-dependent width and an energy-dependent shift, which are analytic functions of the background van der Waals potential. The theory permits a simple classification of resonances as open- or closed-channel dominated, and gives insight into the nature of atom pairing in scattering states. The excellent quality of the theory is illustrated by calculations of above-threshold scattering for the fermionic isotopes K-40, and Li-6 and for bosonic Rb-85.

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