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Isotopic tuning of scattering lengths of ultracold Yb atoms PAUL JULIENNE, NIST, R. CIURYLO, Nicolas Copernicus University, M. KITAGAWA, K. ENOMOTO, K. KASA, Y. TAKAHASHI, Kyoto University — The species Yb has 5 stable spinless bosonic isotopes and two fermionic ones, ^{171}Yb with I=1/2 and ^{173}Yb with I=5/2. Two-color photoassociation spectroscopy of ultracold Yb atomic gases has been used to measure the binding energies of 7 J=0 and 5 J=2 bound states near the dissociation threshold of the homonuclear molecular dimers $^{170}Yb_2$, $^{171}Yb_2$, $^{172}Yb_2$, $^{173}Yb_2$, $^{174}Yb_2$, and $^{176}Yb_2$. Fitting 3 binding energies from $^{174}Yb_2$ and $^{176}Yb_2$ determines the C_6 andC_8 van der Waals constants and the absolute number of bound states in the single ground state potential. Our mass-scaled model then accurately predicts the binding energies of the other 9 measured levels, and determines accurate scattering lengths of all 28 different isotopic combinations, including ^{168}Yb. As the reduced mass varies from 168/2 to 176/2, the scattering lengths vary through a complete cycle from $-\infty$ to $+\infty$. Thus, scattering length can be widely "tuned" by varying isotopic composition. Since all 6 species from mass 170 to 176 can be brought to the quantum degenerate regime, this gives a wide variety of mixtures for new studies of ultracold quantum gases and lattices.

Paul Julienne
NIST

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