Cold Atomic Collisions in High Partial Waves: From Feshbach Resonance to Dipolar Spin Loss

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The successes of atomic quantum gas research to a large degree can be credited to van der Waals universality, whereby atom-atom interactions are describable by a contact form with interatomic potential details wrapped into a few scattering parameters such as scattering length, etc. The strength as well as the sign of the effective contact interactions can be tuned from small to large, zero or divergent, or attractive to repulsive, as have been demonstrated extensively with s-wave Feshbach resonances. Interactions in non-zero partial waves are usually ineffective because collision energies, especially for ultracold atoms, are typically smaller than their centrifugal barrier heights. Nevertheless, anisotropic spin-spin interactions, such as the magnetic dipole-dipole interaction and the second order spin-orbit interaction, could alter the situation and lead to significantly enriched context for van der Waals universality. We will describe recent efforts in this direction by reporting the observations of “broad” p- & d-wave Feshbach resonances between 85Rb-87Rb atoms and a threshold d-wave Fano-shape-resonance in spin-dipolar loss of Bose condensed 87Rb atoms.

This series of studies are carried out in collaboration with Drs. Sheng DONG, Yue CUI, Yuan-Gang DENG, Yi-Quan ZOU, Gao-Ren WANG, Su YI, Meng-Khoon TEY, and Bo GAO.

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