

Scattering resonances in low-energy SrF-Sr inelastic collisions

Modern physical chemistry is the study of phenomena in chemical systems based on laws and concepts of physics. In particular, a scope of study includes microscopic objects like atoms and molecules which demonstrate quantum effects with fundamental importance. However, remarkable progress in laser cooling and trapping of atoms developed by Chu, Cohen-Tannudji and Phillips, who were Nobel laureates in Physics in 1997, allows for observation of quantum effects exposed by macroscopic systems. Clouds of ultracold atoms and molecules studied in the experimental works are the coldest objects in the Universe that are maintained even at temperatures nK. Therefore, ultracold matter is a unique tool applied in the fascinating fields corresponding to atomic clocks, quantum simulations, and chemistry with possibility to select internal states of reactants.

The aim of this project is an understanding of resonances which occur during collisions between polar molecules and closed shell atoms. More recent experiments show that resonances are responsible for changes in the angular distribution of collision products. For this reason we will study the possibilities for control of product distributions using the external electric field.

Our research will be theoretical in nature. The SrF-Sr system corresponds to a recently, laser cooled molecule which collides with a colder atom. Obtained results of the project will also allow for an evaluation of a sympathetic cooling of a molecule which may occupy a one from the lowest rotational states during collisions with an atom. The sympathetic cooling of neutral molecules is a still big challenge in the field of atomic, molecular, and optical physics.