Project 4.1 Laser spectroscopy of diatomic molecules

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Background:

The main goal of the scientific work performed in our laboratory is to investigate excited electronic states of polar diatomic molecules using modern laser spectroscopy techniques. We find molecular constants and shapes of potential energy curves of chosen electronic states with high accuracy. Results of our work allow for improvement of theoretical models. Ultracold polar molecules are also a perfect platform for investigating the fundamentals of quantum physics and chemistry. Diatomic molecules possessing permanent electric dipole moments (PEDMs) have already been employed to realize first ultracold controlled chemical reactions, precision measurements, and quantum simulations of many-body dynamics, while prospects for use in quantum computing have driven the recent developments of single-molecule control with optical tweezers. Most of the mentioned exciting applications are based on PEDMs resulting in long-range intermolecular dipolar interactions and possibilities for control with an external electric field.

The research methodology is based on a laser polarization labelling spectroscopy technique, which allows to record high resolution spectra of the investigated molecules, as well as thermoluminescence and laser induced fluorescence. The experimental resources available in our laboratories include state-of-the art laser systems, specialized detection systems and spectroscopic cells designed for production of specific diatomic molecules. The numerical Pointwise Inverted Perturbation Approach method developed in our group enables construction of molecular potentials for investigated electronic states basing on experimental spectra, even for states with exotic shapes of potential curves.

Aim:

Group of laser spectroscopy offers a possibility to enter into Ph.D project on laser spectroscopy of polar diatomic molecules. The project is focused on investigation of structure of selected excited electronic states of diatomic molecules, particularly built of silver atom and alkali metal atom, including determination of corresponding molecular constants and potential energy curves. Diatomic ground-state molecules such as KAg and CsAg, have permanent electric dipole moments reaching 10 D, while the most polar ultracold molecules considered previously have had PEDMs at least twice smaller. Effectively, characteristic lengths of dipolar interaction in ultracold gases of KAg and CsAg molecules can be more than an order of magnitude larger than those of the most polar ultracold molecules studied until now.

Requirements:

- MSc university degree in one of the following disciplines: Atomic Physics, Molecular Physics, Optics, Laser Physics,
- good spoken and written English skills,
- experience in laboratory work,
- strong motivation for scientific work, particularly experimental work

Funding:

Scholarship: 5000 PLN per month, before subtracting obligatory employer and employee social security contributions (~15%).

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