OPEN-SHELL MOLECULES - SPECTROSCOPIC RESEARCH

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Over the last few years a new class of diatomic molecules began to attract attention of physicists, particularly those who are interested in the field of "ultracold physics". These dimers built of one alkali metal atom and one alkaline earth (like) atom are open-shell molecules, and are often referred to as "doubly polar molecules", since they have both electric and magnetic permanent dipole moments. Under the ultracold conditions they are proposed for studying many-body quantum systems like dipolar quantum gases, lattice-spin models of quantum magnetism, or extended Hubbard models, and may be used to process quantum information. Recently several experiments have been oriented towards the production of this new class of ultracold molecules. However it has turned out that in case of such ultracold experiments at the stage of planning as well as during manipulations performed with such molecules physicists need basic information concerning molecular energy levels, spectroscopic constants like vibrational and rotational constants, information about shapes of the potential energy curves (PECs) and their depths, and mutual interactions between neighbouring electronic states.

During my talk I shall present results of two independent experiments conducted in Amsterdam and Warsaw laboratories with the RbSr molecule. The first one is based on two-colour photoassociation spectroscopy, while in the second experiment thermoluminescence and laser induced fluorescence spectroscopy are used. Both types of experiments are carried out for the first time for this system. Joint analysis of data obtained in both laboratories allowed us to get information about positions of energy levels and shapes of PECs for the ground $1^2\Sigma^+$ and exited $2^2\Sigma^+$ states in the RbSr molecule. Calculations performed with the constructed, experimental potentials demonstrated their power, since we were able to predict positions of Feshbach resonances, confirmed in later experiments.