Experiments at the Frankfurt low energy storage ring (FLSR)

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Synopsis FLSR has been designed for experiments on the dynamics of atomic and molecular collisions. After successful commissioning, an experiment on the dissociative recombination of $^4HeH^+$ has been started.

FLSR is an electrostatic storage ring for ions up to energies of 80 keV at IKF (see Fig.1). It has been designed for experiments on the dynamics of atomic and molecular collisions in complete kinematics, as well as for high precision, time resolved laser spectroscopy [1,2]. FLSR comprises four experimental/diagnostic sections with one region of enhanced ion density in each of it. First beam has successfully been stored in summer of 2013.

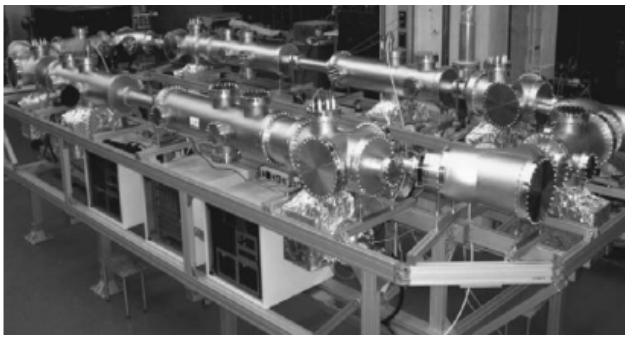

Figure 1. The **F**rankfurt **L**ow-Energy **S**torage **R**ing (**FLSR**) at IKF.

For first exploratory experiments on dissociative recombination of vibrational cool $^4HeH^+$, an electron gun has been installed in one of the experimental sections in "crossed beam" geometry with respect to the stored ion beam. For detection of the breakup of the neutralized fragments, a position resolving particle detector (MCP) has been installed at the related 0°-port.

In fig. 2 the distribution of the kinetic energy release (KER) from this experiment is shown (black dots). The KER has been calculated, selecting vibrational cool ($t_{storage}$ > 100 ms), coincident (Δt= 30ns) and coplanar events ($\Delta\phi$= 180°± 5° with respect to the center of gravity of the 2-D distribution of all events on the detector). Since in this experiment no trigger on events from the electron target is available, it has been assumed that all fragments were created in the electron target. This is incorrect for the dominant background (red dots). While the method of background subtraction is unambiguous, the KER calibration by this method is only correct for those events that really originat in the electron target. The experiment was performed at a still moderate vacuum of about 2 x10^{-10} mbar with an electron beam current of 2µA. The conditions are presently being improved by baking FLSR to better vacuum and enhancing the electron gun current. Furthermore, the installation of a gas target is discussed for experiments with trigger conditions.

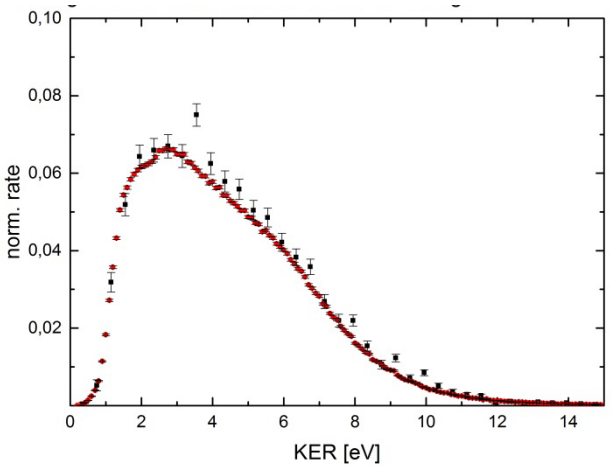

Figure 2. Preliminary results on the kinetic energy release in dissociative recombination of 20keV $^4HeH^+$-ions with electrons of 18eV kinetic energy (data points). Red dots: background from charge exchange with residual gas.

References

[1] K.E. Stiebing et al. 2010, *Nucl. Instr. and Methods in Physics Research* **A614**, 10
[2] F. King et al. 2015 *Physica Scripta Topical Issues* to be published.

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