Contribution ID: **22** Type: **Poster**

HILITE - Compact Penning trap for High-Intensity-Laser Experiments

Monday, 18 July 2022 16:35 (1h 25m)

The influence of relativistic effects on tunnel ionisation of electronic systems was described in detail by theory. For hydrogen-like ions of atomic charge Z and laser radiation intensity I these effects become significant for $Z > 45(I/I_0)^{0.1}$, with $I_0 = 10^{22}\,\mathrm{W/cm^2}$. This motivates the use of highly-charged ions to investigate ionisation. Suitable candidates are hydrogen-like ions, such as O^{7+} or Ne^{9+}, as the average electric field over the 1s orbital is comparable to the electric fields of current laser systems.

To prepare a target of highly charged ions we have devised the HILITE (High-Intensity Laser Ion-Trap Experiment). The setup can store several thousand ions in a controlled ion cloud using a Penning trap. The whole setup is transportable to be used at high-power laser facilities. It includes an Electron-beam ion trap (EBIT) which can create a wide range of highly-charged ions. The produced ion bunches with a kinetic energy of about 2 keV/q are deflected by a 90° electrostatic detector. It includes two sikler lenses to compensate for the stray magnetic field of the 6 T magnet. The beamline also contains three non-destructive image charge detectors to track the ions bunches. The ions are decelerated using a two stage deceleration system and captured dynamically.
To manipulate and detect the stored ion cloud we use common procedures, such as resistive cooling, SWIFT, FT-ICR and the rotating wall technique.

We present the setup and characterisation measurements with stored Ne^{7+} ions and we will give an outlook on the planned laser-ion experiments at the Jena high-power laser system JETI200.

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Session Classification: Session 4