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Commissioning of the HITRAP cooling trap with offline ions

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The HITRAP facility is designed to decelerate and cool a bunch of about 10^5 heavy, highly charged ions (HCI). Produced by stripping at high energy, the HCI are decelerated eventually in a linear decelerator down to 6 keV/u and captured within a cylindrical Penning trap. In that trap the HCI can be cooled using electron cooling before being transferred to subsequent experiments [1]. If ions and electrons are stored simultaneously in a so-called nested trap, energy transfer can take place. The electrons cool the transferred energy off by synchrotron radiation in the strong magnetic field of up to 6 T [2].
We present the current status of the HITRAP cooling trap and the next steps of commissioning this setup with offline ions. Recently, a new electrode layout has been installed to improve reliability of the trap operation. Our tests show that the new seven-electrode design is more stable and less error prone than the old 21 electrode design.
We were able to investigate the storage of argon ions in various charge states, delivered by a small EBIT with an energy of 4 keV/q. With the approximately 40 cm long trap it was possible to capture more than 10^5 highly charged ions. Dependencies of the charge state and kinetic energy were observed as they both influence the lifetime of the stored ions. By applying the magnetron frequency of the stored ions to a quartered ring electrode we were also able to excite the ion cloud inside the trap. Moreover, in order to achieve electron cooling it was possible to store ions and electrons simultaneously in this setup, although no cooling effect was observed so far.
The next steps will be the improvement of the trap settings for the simultaneous storage of electrons and ions and the proof of electron cooling of argon ions from the local ion source. Additionally, methods for non-destructive detection of trapped particles will be applied to the setup.
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References

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[2] Giancarlo Maero: Cooling of highly charged ions in a Penning trap for HITRAP, Diss. (2008)

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