A novel cryogenic Paul Trap for Quantum Logic Spectroscopy of Highly Charged Ions

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A linear cryogenic Paul trap experiment (CryPTEx) has been set up in-line with an electron beam ion trap (EBIT). CryPTEx will provide long storage times for highly charged ions (HCIs) due to the extremely low background pressure within a 4K enclosure [1]. First experiments on the storage of HCIs in this trap are presently under way. Since HCIs generally do not allow for direct laser cooling, as their optical transitions have low transition rates, one needs to apply sympathetic cooling. The trapped HCIs will be coupled by Coulomb-interaction to a low-temperature bath of laser-cooled ions what ultimately should allow to resolve the natural linewidth of forbidden transitions. Our final goal is the application of quantum logic spectroscopy [2], where a singly charged ion species (Be^+) is responsible for the sympathetic cooling and state detection of the HCI. For the purpose of these high precision measurements, a second cryogenic Paul trap is currently being designed at MPIK in collaboration with PTB. The design of this trap is based on CryPTEx, where a cryogenic housing together with the ion injection capability have been realized. The next generation design will focus on decoupling of the vibration and magnetic field noise in order to obtain a noise-free environment as required for precision spectroscopy.

References

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