Possibilities for spectroscopic BSM physics tests with highly charged ions in the VUV region

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Electronic states of highly charged ions (HCI) show enormously magnified fine-structure, Lamb shift and hyperfine effects making them exceptionally sensitive probes of bound-state quantum electrodynamics and nuclear physics. Being also impervious to external perturbations renders them ideal candidates for precision spectroscopy, and they can serve as frequency references in accurate clocks that could test physics beyond the Standard Model [1]. A variety of ion species and transitions can optimally be tailored to target such applications and handle them in the laboratory. With the demonstration of sympathetic cooling of HCI [2], such experiments have recently become possible. Moreover, extensions of current experiments into the vacuum-ultraviolet (VUV) region are interesting [3], since HCI withstand single and multi-photon photoionization, and possess forbidden transitions at those energies. We are developing a VUV frequency comb and a superconducting RF linear trap for such studies (fig. 1).

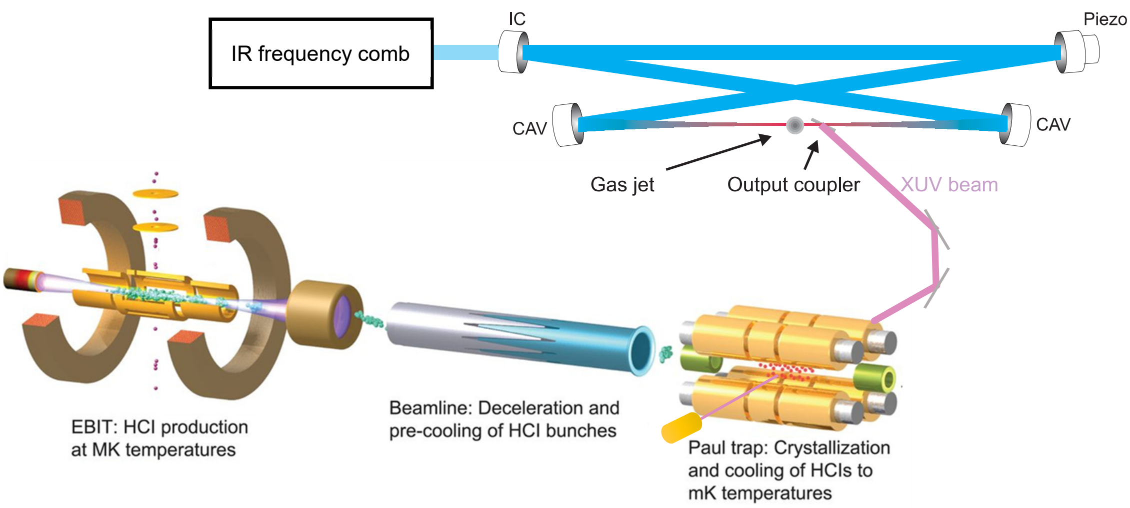

Figure 1. Scheme of an experiment combining a VUV frequency comb based on high-harmonic generation within an enhancement cavity with a RF trap for highly charged ions.

[1] M. G. Kozlov *et al.*, *Highly charged ions: Optical clocks and applications in fundamental physics*, Reviews of Modern Physics **90**, 045005 (2018).
[2] L. Schmöger *et al.*, *Coulomb crystallization of highly charged ions*, Science **347**, 1233 (2015).
[3] J. Nauta *et al.*, *Towards precision measurements on highly charged ions using a high harmonic generation frequency comb,* Nucl. Instrum. Meth. Phys. Res. B **408** 285 (2017).