High precision laser spectroscopy of Li-like Kr^{33+} at 136eV and perspectives for hyperfine structure studies at highest Z with FLASH

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Synopsis High precision laser spectroscopy on highly charged ions by resonant excitation by soft x-ray photons from the free electron laser FLASH.

High-resolution laser spectroscopy measurements of the $2\ ^2S_{1/2} - 2\ ^2P_{3/2}$ fine-structure transition of Li-like Kr^{33+} ions have been carried out at the Free Electron Laser in Hamburg FLASH. Highly charged Kr ions were produced and trapped in an electron beam ion trap (EBIT) and resonantly excited by soft X-ray photons at 136 eV produced by FLASH. Generally, investigations of such transitions in highly charged Li-like ions are of great interest since they in principle enable precision tests of quantum electrodynamics (QED) at strong fields. A preliminary data analysis results in the measured transition energy of 136.189(6) eV with an accuracy of below 50 ppm, improving the so far best measurement value [1] by a factor of 6. The new value is in excellent agreement with recent theoretical calculations including relativistic recoil, electron-correlation and QED effects [2]. We will also discuss the perspectives for hyperfine structure studies in heavy Li-like systems like Bi^{80+} utilizing the EBIT and the high-resolution plane grating PG monochromator beamline at the FLASH facility. Using the same measurement technique as for Li-like Krypton should allow us to reach an accuracy level needed to disentangle contributions from nuclear size effects and QED to the hyperfine splitting energy and by that enabling us for the first time to test QED-contributions in the regime of strong electromagnetic fields at highest Z on a few percent level.

References

[1] Ph. Bosselmann *et al.* 1999 *Phys. Rev.* A **59**, 1874
[2] Y. S. Kozhedub *et al.* 2010 *Phys. Rev.* A **81**, 042513

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