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Hyperfine Structure in $^{208,209}Bi^{80+,82+}$ - a Test of QED in Strong Magnetic Fields

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The measurement of the ground-state hyperfine structure in H-like and Li-like highly charged ions is supposed to provide the best test of QED in the strong magnetic field regime. The measurement of both charge states is required to remove nuclear structure uncertainties, originating in the magnetic dipole moment distribution inside the nucleus (Bohr Weisskopf effect). Such a test has been carried out for ^{209}Bi and –after correction of the nuclear magnetic moment from an NMR experiment –the agreement between experiment and theory was reasonable. There is, however, still an ongoing discussion about the appropriateness of the specific difference between the hyperfine structures of the two charge states to remove nuclear structure uncertainties. To resolve this issue, a measurement of the hyperfine structure in ^{208}Bi has been started but sensitivity has to be improved. This isotope has to be artificially produced in a thick stripper foil and to be isolated in the ESR. This procedure has been established in the beamtimes of E142 for the production of ^{229}Th and is now employed in the still ongoing beamtime of E128.

For hydrogen-like $^{209}Bi^{82+}$, a laser resonance signal with a very good signal-to-background ratio was just detected with approximately 2×10^5 ions in the storage ring. A search for the resonance signal of $^{208}Bi^{82+}$ is currently ongoing. For $^{208}Bi^{80+}$ photon detection is not suitable anymore at such low ion numbers since the transition is in the red region (more background) and has about two orders of magnitude longer lifetime (less photons). Therefore it has been suggested to explore whether dielectronic recombination can be used as a tool for the detection of the laser resonance transition. This proposal was twice ranked with grade A in the G-PAC meeting 2017 and 2020 but so far this experiment was not possible due to the short-circuit in one of the drift tubes in the electron cooler. Instead, we had used the beamtime to search for the hyperfine structure in H-like ^{208}Bi.

We propose to carry out the experiment on the Li-like ion after the electron cooler has been repaired.

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