# Studies on the Hyperfine Structure of Highly-Charged Hydrogen- and Lithium-like Ions

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A number of laser-spectroscopic experiments on the hyperfine structure of highly-charged ions has been carried out at GSI in Darmstadt during the last years. Such experiments provide a serious test of our understanding of the fundamental interactions of matter under extreme conditions. The fact that the relevant interactions are concentrated very close to the nucleus makes these investigations particularly sensitive to higher order contributions. For several hydrogen-like ions, however, recent laser experiments have determined level splittings [1,2] which could not yet be fully reproduced by theory. By taking into account quantum electrodynamical (QED) corrections, the theoretical results occur outside of the experimental uncertainty [3,4].

When compared with hydrogen-like ions, further information about the hyperfine interaction of the nucleus with the electronic cloud of high-$Z$ ions can be obtained by studying the ground-state splitting of few-electron ions. The simplest systems which have a closed $K$-shell are lithium-like ions. In the traditional approach to theoretical hyperfine splitting studies, the different contributions from the electron-electron interaction, QED effects, and the extended nucleus are obtained *additively*. This also applies to the coupling of the electrons with the motion of the nucleons as is summarized by the Bohr-Weisskopf effect.
An alternative view point is taken by the dynamic correlation model (DCM) which includes both the coupling of the internal nuclear motion as well as the electronic interaction and the creation and annihilation of virtual electron-positron pairs within the same framework. In this model, the hyperfine structure splitting for lithium-like $^{209}Bi^{80+}$ ions is reduced by about 1.3 % if compared with previous calculations [5,6]. The present results have initiated a detailed investigation of the structure of lithium-like ions which are heavier then bismuth, in order to analize the new experiments on lithium-like uranium, which have been proposed with PHELIX [7].

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