QED Corrections in Highly-Charged Ions

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The interest in Quantum ElectroDynamic (QED) applications to atomic systems, bound state QED, has been enhanced significantly in recent years, mainly through the experimental success in producing and studying highly charged ions. These heavy few-electron systems are extremely relativistic and provide an excellent test of both relativity and QED in a region not previously carefully investigated.

For highly-charged ions it is appropriate to make an expansion of the total electromagnetic interaction in terms of the number of exchanged photons, but an expansion in the binding potential is not appropriate.

Extending our previous work on the corrections to the one-photon exchange effect in the ground-state of helium-like ions [1, 2], we have now performed two-photon exchange calculations on excited states in helium-like systems.

A theory has also been developed for evaluating the QED contributions to an effective Hamiltonian within a space of quasi-degenerate levels. This is applied to the quasi-degenerate $1s\,2p_{1/2}$ and $1s\,2p_{3/2}$ levels in He-like systems, and is important in the low Z-region but may have a significant effect also in the medium Z-region.

[1] Ingvar Lindgren, Hans Persson, Sten Salomonson and Leonti Labzowsky
Phys. Rev. A 51 (1995), 1167

[2] Hans Persson, Sten Salomonson, Per Sunnergren and Ingvar Lindgren
Phys. Rev. Lett. 76 (1996), 204