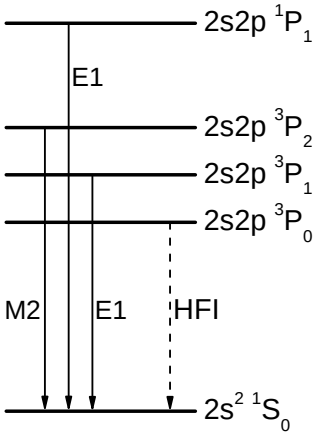
Storage-Ring Measurements of Hyperfine Induced and Two-Photon Transition Rates in Berylliumlike Ions

Stefan Schippers

Institute for Atomic and Molecular Physics, Justus-Liebig-University Giessen, Leihgesterner Weg 217, 35292 Giessen, Germany

Abstract. Extremely long lived atomic states are highly sensitive to correlations within the atomic shell and even to the nuclear structure of the ions. An example of this is the lowest excited state in beryllium-like ions, i.e, the $2s2p\,^3P_0$ state, which cannot decay via a one-photon transition. However, the hyperfine interaction can quench the $2s2p\,^3P_0$ state if the nucleus has nonzero magnetic moment.

Theoretical calculations [1-5] of hyperfine induced (HFI) transition rates in beryllium-like ions disagree significantly with the until recently only available experimental result [6]. The measured results were obtained from an experiment with $^{47}Ti^{18+}$ ions at the Heidelberg heavy-ion storage ring TSR. In order to broaden the experimental data base, HFI lifetime measurements with other beryllium-like ions are currently carried out at the TSR. Most recently, new results were obtained for $^{33}S^{12+}$ ions [7]. These results will be presented and compared with corresponding theoretical calculations which predict a HFI $2s2p\,^3P_0 \rightarrow 2s^2\,^1S_0$ transition rate of 0.093 s^{-1} [2,3] for this ion. Perspectives for measurements of the the competing E1M1 two-photon transition rate in beryllium-like ions [8] will be discussed as well.



Simplified level diagram of a berylliumlike ion. The one-photon transitions are labeled E1 (electric dipole), M2 (magnetic quadrupole), and HFI (hyperfine induced). Numbers in square brackets denote powers of 10. In case of nonzero nuclear spin the hyperfine induced $^3P_0 \rightarrow {}^1S_0$ transition rate $A_{\rm HFI}$ acquires a finite value.

References

[1] J. P. Marques *et al.*, Phys. Rev. A **47**, 929 (1993).
[2] K. T. Cheng *et al.*, Phys. Rev. A **77**, 052504 (2008).
[3] M. Andersson *et al.*, Phys. Rev. A **79**, 032501 (2009).
[4] J. Li and C. Dong, Plas. Sci. Technol. **12**, 364 (2010).
[5] J. Li *et al.*, Phys. Lett. A **375**, 914 (2011).
[6] S. Schippers *et al.*, Phys. Rev. Lett. **98**, 033001 (2007).
[7] S. Schippers *et al.*, Phys. Rev. A **85**, 012513 (2012).
[8] D. Bernhardt *et al.*, J. Phys.: Conf. Ser. (in press).