

Density effects in antiprotonic helium revisited

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The density shift and broadening of E1-transition lines in antiprotonic helium atoms at helium target pressure of 1 bar and temperatures about 6K are of the order of several ppm, same as the leading relativistic and spin corrections [PRL84,2350(2000)], and needed to be taken into account. To reduce the systematic uncertainty of experimental data, the current spectroscopy measurements of antiprotonic helium spectra by the ASACUSA collaboration are being performed at much lower helium densities and temperatures; however, at the higher level of experimental accuracy achieved recently the density effects prove to be still of importance. We report the numerical results for the density shift and broadening of one-photon transition lines for a wide range of helium target temperatures, obtained with an interaction potential calculated ab initio.

We also present the extension of the semi-classical method used above to the evaluation of the density shift and broadening of two-photon as well as of magnetic M1 transition lines, of interest for high precision spectroscopy of antiprotonic helium and, possibly, other exotic atoms.

Primary author: Prof. BAKALOV, Dimitar (Bulgarian Academy of Sciences)

Presenter: Prof. BAKALOV, Dimitar (Bulgarian Academy of Sciences)

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