Computer modelling of intensities of helium Stark lines in regions of levels anticrossings.

R. Drozdowski[1], J. Kwela[1], and L. Windholz[2]

[1] *Institute of Experimental Physics, University of Gdańsk, ul. Wita Stwosza 57, 80-952 Gdańsk, Poland*
[2] *Institut für Experimentalphysik, Technische Universität Graz, Petersgasse 16, 8010 Graz, Austria*

Presenting Author: fizrd@ug.edu.pl

Studies of the Stark effect of noble gas atoms have been performed since the discovery of this effect in 1913. Nevertheless, these investigations were restricted to relatively low field strengths; thus, several effects, like levels-anticrossings, which appear in high electric fields, remained unnoticed and undescribed. Theoretical description of the Stark effect in high fields is very difficult and needs high computer power, since the electric field mixes states with different parities and different principal quantum numbers. Thus, calculation with huge energy matrices is necessary. Furthermore, many specific atomic date from other experiments or calculations are needed. For many years systematic experimental investigations of the Stark effect of the noble gases He, Ne, Ar, Kr and Xe have been performed in Graz. However, because of difficulties with theoretical interpretation of the spectra only a small part of the result has been published so far.

From the theoretical point of view the case of the lightest noble gas, He, is the most convenient for description. The structure of He is relatively well know and for higher atomic states the approximation of hydrogen - like wave function can be used.

In our earlier papers [1, 2] we presented experimental and theoretical investigations of shifts of lines from spectral series 2^3P - n^3Q ($n = 3 \div 10$, Q = S, P, D, ...), 2^1S - n^1Q ($n = 3 \div 9$, Q = S, P, D, ...) and 2^1P - n^1Q ($n = 3 \div 9$, Q = S, P, D, ...) in electric fields up to 1600 kV/cm. The applied fields were high enough that patterns belonging to neighboring principal quantum numbers overlapped each other - we observed interesting levels - anticrossings effects. These effects are reflected in a variation of intensities of the observed Stark lines. By matching various superpositions of the excited states in the intensity calculations we can follow results of observation. We performed computer simulations for the levels anticrossings regions between n = 6, 7 and n = 7, 8 in the second triplet series (2^3P - n^3Q, Q = S, P, D, ...).

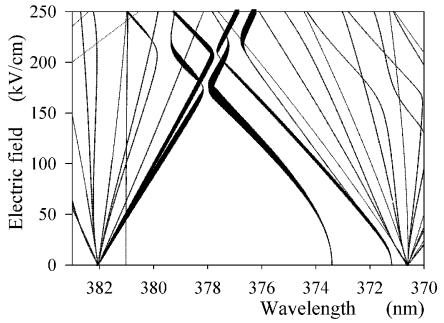

Figure 1: *Intensities of four strongest Stark lines obtained in computer simulations for the anticrossing region n = 6, 7. We considered excitation of parabolic triplet states:* $|6401\rangle$, $|6500\rangle$, $|7060\rangle$ *and* $|7051\rangle$.

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References

[1] L. Windholz *et al.* Phys. Scr. **78** 065303 (2008)
[2] L. Windholz *et al.* J. Opt. Soc. Am. B **29** 934 (2012)