High-resolution spectroscopy and multichannel quantum-defect-theory analysis of high Rydberg states of xenon.

E. N. Toutoudaki[1], H. Herburger[1], U. Hollenstein[1], F. Merkt[1]*

[1] Department of Chemistry and Applied Biosciences, ETH Zürich, 8093 Zürich, Switzerland

High-resolution spectra of high *n*p and *n*f Rydberg states of Xe were measured by single - photon excitation from the metastable state of Xe $(5p)^5(6s)^1\ ^3P_2$ to the energy region located below the Xe^+ $(5p)^5\ ^2P_{3/2}$ ionization threshold. The experiments were carried out using a pulsed Fourier-transform-limited narrow-band UV laser and a supersonic-beam apparatus.

The fine and hyperfine structures of *n*p and *n*f Rydberg states of the nine most abundant isotopes of xenon have been analyzed in the range of the principal quantum number between 60 and 75 using multichannel quantum-defect-theory (MQDT). For the analysis of the fine structure of xenon, the formalism introduced by Lu and Lee [1] and Lu [2] was followed. This formalism was extended by Wörner et al. [3,4] and Schäfer et al. [5] to treat the hyperfine structure in Rydberg states of ^{129}Xe and ^{131}Xe. By using the eigenquantum defects and channel interaction parameters for the even-parity states of xenon from Schäfer et al. [5], improved values of the ionization energies and the isotopic shifts have been determined from the MQDT analysis.

[1] C.-M. Lee and K. T. Lu, Phys. Rev. A, **1973**, 8, 1241.
[2] K. T. Lu, Phys. Rev. A, **1971**, 4, 579 .
[3] HJ Wörner, U. Hollenstein, and F. Merkt, Phys. Rev A, **2003** , 68, 032510.
[4] HJ Wörner, M. Grütter, E. Vliegen, and F. Merkt, Phys. rev. A, **2005** , 71, 052504; **2006** , 73, 059904(E).
[5] M. Schäfer, M. Raunhardt, and F. Merkt, Phys. Rev. A, **2010**, 81, 032514.