Investigation of the hyperfine structure of atomic vanadium for energetically high-lying levels up to 45 000 cm^{-1}

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The focus of present work is to extend the data of magnetic dipole hyperfine structure constant A for energy levels of atomic vanadium up to 45 000 cm^{-1} of atomic vanadium. Using the Fourier Transform spectrometer (Bruker IFS 125HR), which is located at the Laser Centre of the University of Latvia, spectra of vanadium-argon plasma were recorded in the spectral range from 12 000 cm^{-1} to 30 000 cm^{-1} with resolution of 0.03 cm^{-1}. The vanadium plasma was produced in a hollow cathode discharge. The hollow cathode lamp was cooled by liquid nitrogen in order to reduce the Doppler broadening.

For the purpose of the present study, transitions have been chosen, between such energy levels, for which the constant A of one of them was unknown. The hyperfine structure of 60 atomic vanadium lines lying in the spectral range from 14 000 cm^{-1} to 28 000 cm^{-1} (360 nm to 706 nm) were analysed. The classification and the wavelength of the center of gravity of the investigated lines were taken from [1]. The computer program Fitter [2] was used to determine the magnetic dipole hyperfine structure constant A by fitting the hyperfine structure of spectral lines with a Voigt profile function. For each line, the A constant for one of the two involved levels was well-known from literature [3-9] and was fixed during the fit.

We could newly determine the magnetic dipole hyperfine structure constant A for 18 energy levels of even parity belonging to the configurations $3d^34s^2$, $3d^44s$, $3d^44d$, $3d^34s4d$ and $3d^34s5s$, as well as for 37 energy levels of odd parity belonging to the configurations $3d^44p$ and $3d^34s4p$. With our new results, the hyperfine structure constants for all experimantally known energy levels of both parities up to 45 000 cm^{-1} are now available for atomic vanadium.

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