

New Energy Levels of the Pr Atom found by Analyzing a Fourier Transform Spectrum

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Using a high-resolution Fourier transform spectrum [1], prominent but up to now not classified spectral lines in the near infrared spectral region, which showed sufficiently resolved hyperfine (hf) patterns, were studied. If the hf pattern of the line under investigation could be simulated reliably, we got from the hf structure the total angular momenta and the hyperfine constants A of the involved levels (the quadrupole hyperfine constant B can be assumed to be zero). Searching now in our database of Pr levels for levels having proper J and A, we could identify one of the combining levels. The energy of the other one can then be calculated using the center of gravity (cg) wave number of the line. A newly found level must explain with high accuracy other spectral lines with respect to their cg wavelength and to the hyperfine pattern. Sometimes also energies and A-values of known levels were corrected (e.g. level 21424.11 cm^{-1} , $J=7/2$, $A=435 \text{ MHz}$, as given in ref. [2], was changed to $21424.059 \text{ cm}^{-1}$, $J=7/2$, $A=502(3) \text{ MHz}$). Some of the newly found levels are listed in Table 1, together with the explained lines.

new odd level			explained line			lower even level			
J	energy (cm^{-1})	A (MHz)	wavelength (\AA)	C	Int	J	energy (cm^{-1})	A (MHz)	B (MHz)
9/2	21438.488	1040(5)	6789.618	nl	6	11/2	6714.184	474.692	-29.633
			7813.607		12	9/2	8643.824	797(2)	-
			7928.395	nl	8	11/2	8829.063	769(1)	-30(20)
			8214.829	nl	15	11/2	9268.726	977(1)	-24(20)
			8498.565	nl	3	11/2	9675.029	683(1)	-
			9433.968	nl	5	11/2	10841.407	530(3)	-
			9490.053	nl	5	11/2	10904.034	301(1)	-20(10)
			9749.525		11	9/2	11184.396	692(1)	15(30)
			9835.661	nl	18	7/2	11274.229	1286(1)	-10(20)
11/2	22077.806	1038(4)	5665.569		70	9/2	4432.225	923.2(4)	-22(7)
			6919.618		14	13/2	7630.132	776.286	-43.592
			7925.918		11	13/2	9464.440	1056(1)	-15(10)
5/2	24500.390	760(10)	5539.063	nl	41	5/2	6451.808	1189.6(6)	-5(5)
			6855.784	nl	7	7/2	9918.190	1057.4(5)	22(6)
			7777.498	nl	4	5/2	11646.312	1317(10)	-
			8413.293	nl	4	7/2	12617.700	883(2)	-
			8790.599		5	5/2	13127.722	156(1)	0(10)
			9711.652	nl	7	3/2	14206.294	184(2)	-
			9816.012		9	5/2	14315.745	1063(2)	-

Table 1: New levels and classified lines. C comment: nl means the line is not contained in commonly used wavelengths tables, e.g ref. [3].

References

- [1] B.Gamper, Z.Uddin, M.Jahangir, *et al.* J. Phys. B: At. Mol. Opt. Phys. **44** (2011) 045003 (7pp)
- [2] A.Ginibre, PhD Thesis Université de Paris-sud (1988)
- [3] Wavelength Tables, edited by G.R. Harrison (The M.I.T. Press, 1969)