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Lifetime measurements and transition probabilities in Mo II

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Abstract
Lifetimes have been measured using time-resolved laser-induced fluorescence for 16 odd levels in the doublet, quartet and sextet systems of Mo II, with energies in the range 48 000–61 000 cm^{-1}. Absolute transition probabilities and oscillator strengths are determined for 110 UV and visible transitions ($208 < \lambda < 485$ nm) from a combination of experimental lifetimes and theoretical branching fractions. The theoretical results are obtained using the HFR method including core polarization effects.

1. Introduction

Accurate atomic transition probabilities for heavy atoms and ions are needed in different fields of physics, including astrophysics and fusion research. An efficient and well-established approach for obtaining the required data consists of combining lifetime measurements using selective laser excitation with theoretical or experimental branching fraction (BF) determinations. For experimental BFs Fourier transform spectroscopy (FTS) is an appropriate and efficient method.

Experimental transition probabilities in Mo II are scarce. The first results were the arc measurements of Corliss and Bozman (1962), but these results are now known to be affected by large systematic errors and they have been superseded by more recent data. Schnehage *et al* (1983) determined relative f-values for 174 Mo I and 58 Mo II transitions in the range 24.7–557.0 nm from wall-stabilized arc and hollow cathode measurements. The Mo I data were normalized to an absolute scale using four experimental lifetime values from Kwiatkowski *et al* (1981). However, the oscillator strengths for Mo II were reported on a relative scale only as no Mo II lifetimes were available at that time.

The first lifetime measurements in Mo II are due to Hannaford and Lowe (1983). They measured lifetimes for 15 levels of the z ^{6}F°, z ^{4}P°, z ^{6}P° and z ^{6}D° terms using the technique of laser-induced fluorescence (LIF) from a sputtered metal vapour.

Experimental BFs in Mo II for transitions from 197 to 437 nm have been measured by Sikström *et al* (2001) from intensity-calibrated spectra recorded with the Lund UV Fourier transform spectrometer. This paper also reported radiative lifetimes for ten levels measured using LIF. Oscillator strengths of 91 transitions were derived by combining the BFs with all available experimental lifetimes.

Theoretical lifetimes and oscillator strengths in Mo II have been calculated by Quinet (2002) using a relativistic Hartree–Fock (HFR) approximation including core-polarization (CPOL) effects. An extensive set of new f-values was calculated for 386 Mo II lines in the wavelength range extending from 180 to 746 nm.

The lifetimes measured by Hannaford and Lowe (1983) concern levels with energies in the range 45 800–50 700 cm^{-1}. Lifetimes for higher energy levels are missing although transitions from these levels are likely to be observed in astrophysics or in plasma physics. The purpose of the present paper is to extend the measurements of Hannaford and Lowe (1983) to levels of higher energies. Thus, we report lifetime measurements for levels with energies in the range 48 000–61 000 cm^{-1}. Transition probabilities are also deduced for 110 UV and visible transitions depopulating the levels for which new lifetime values have been obtained.

Table 1. Mo II levels considered and the corresponding excitation schemes.

Energy[a] (cm^{-1})	Designation[a]	Excitation λ_{air} (nm)	Laser mode	Observed λ_{air} (nm)
48 022.815	$4d^4(^5D)\ 5p\ z\ ^4P^\circ_{3/2}$	208.17	3ω	280.8, 324.1
50 302.913	$4d^4(^5D)\ 5p\ z\ ^6D^\circ_{7/2}$	263.88	3ω + 2S	267.3
51 373.170	$4d^4(^5D)\ 5p\ z\ ^4F^\circ_{3/2}$	256.63	3ω + 2S	370.3
51 732.690	$4d^4(^5D)\ 5p\ z\ ^4F^\circ_{5/2}$	257.44	3ω + 2S	274.6, 369.3
52 217.587	$4d^4(^5D)\ 5p\ z\ ^4F^\circ_{7/2}$	257.94	3ω + 2S	271.7, 368.8
52 843.296	$4d^4(^5D)\ 5p\ z\ ^4F^\circ_{9/2}$	253.85	3ω + 2S	267.3, 278.5, 363.5
54 238.949	$4d^4(^5D)\ 5p\ z\ ^4D^\circ_{1/2}$	235.45	3ω + S	334.7, 338.0
54 688.002	$4d^4(^5D)\ 5p\ z\ ^4D^\circ_{3/2}$	234.38	3ω + S	329.8
55 216.203	$4d^4(^5D)\ 5p\ z\ ^4D^\circ_{5/2}$	231.51	3ω + S	332.1
55 706.937	$4d^4(^5D)\ 5p\ z\ ^4D^\circ_{7/2}$	236.64	3ω + S	329.2
57 892.289	$4d^4(^3H)\ 5p\ z\ ^4H^\circ_{7/2}$	234.16	3ω + S	317.5
58 196.928	$4d^4(^3H)\ 5p\ z\ ^4H^\circ_{9/2}$	233.21	3ω + S	315.3
58 761.258	$4d^4(^3H)\ 5p\ z\ ^4H^\circ_{11/2}$	230.70	3ω + S	312.2
59 492.157	$4d^4(^3H)\ 5p\ z\ ^4H^\circ_{13/2}$	226.97	3ω + S	308.8
59 841.060	$4d^4(^3F)\ 5p\ z\ ^2D^\circ_{3/2}$	223.94	3ω	424.5
60 992.764	$4d^4(^3F)\ 5p\ z\ ^2D^\circ_{5/2}$	218.93	3ω	412.2

[a] The level energies and designations are from Nilsson and Pickering (2003).
3ω designates the third harmonics of the dye laser.
S and 2S represent the first- and second-order Stokes components.

2. Classified lines and term analysis in Mo II

The ground level of Mo II is $4d^5\ a\ ^6S_{5/2}$. The level structure of this ion was first studied by Meggers and Kiess (1926) who established 27 levels. Later on, Schauls and Sawyer (1940) and Rau (1949) extended the analysis. An extensive experimental work on this ion was performed by Kiess (1958) who measured wavelengths of 3800 lines with uncertainties of ±0.01 Å. The experimental values of the 238 excited levels reported in the NIST compilation (Sugar and Musgrove 1988) for the $4d^5$, $4d^45s$ and $4d^45p$ configurations were taken from this analysis.

More recently, an extensive list of classified Mo II transitions between 152.9 and 721.7 nm has been reported by Nilsson (2002). These data were recorded with the Lund UV Fourier transform spectrometer (Sweden) and the Imperial College VUV Fourier transform spectrometer (UK). As a consequence, the term system of Mo II was extended by Nilsson and Pickering (2003) and energy values were reported for 330 levels (153 even and 177 odd levels) belonging to the $4d^5$, $4d^45s$, $4d^35s^2$, $4d^46s$, $4d^45d$, $4d^45p$ and $4d^35s5p$ configurations.

The energy levels, their designations as well as the wavelengths reported in the present paper are taken from Nilsson (2002) and Nilsson and Pickering (2003).

3. Lifetime measurements

In the present work, the lifetimes of 16 odd levels in the doublet, quartet and sextet systems of Mo II have been measured using the time-resolved laser-induced fluorescence (TR-LIF) technique applied to a laser-produced plasma.

The experimental setup used is similar to that described previously (Bergström *et al* 1988, Biémont *et al* 2001, Zhang *et al* 2001, Xu *et al* 2004) and only a brief description is presented here.

Free Mo II ions were obtained from a laser-produced plasma. Laser pulses characterized by a 532 nm wavelength, a 10 Hz repetition rate and a 10 ns duration were obtained from a Nd:YAG laser (Continuum Surelite). The pulses were focused vertically on the surface of a rotating pure molybdenum target in a vacuum chamber creating a plasma containing molybdenum atoms and ions in different ionization stages.

To populate the levels of interest, UV laser pulses were obtained in the following way. The 8 ns long output of an injection-seeded Nd:YAG laser (Continuum NY-82) with a repetition rate of 10 Hz and a single pulse energy of 400 mJ was reduced to 1–2 ns in a stimulated Brillouin scattering compressor. These pulses pumped a dye laser (Continuum Nd-60) with a DCM dye. The dye laser output was frequency doubled or tripled in a nonlinear optical system consisting of a KDP crystal, a retarding plate and a BBO crystal. According to the excitation schemes given in table 1, Stokes stimulated Raman scattering components were produced by focusing the harmonic radiation into a hydrogen conversion cell with a gas pressure of about 10 bar. The excitation laser beam was selected using a quartz Pellin–Broca prism and sent horizontally through the vacuum chamber where it interacted with the created molybdenum ions about 5 mm above the target.

The measured levels belong to the $z\ ^4P^\circ$, $z\ ^6D^\circ$, $z\ ^4F^\circ$, $z\ ^4D^\circ$, $z\ ^4H^\circ$ and $z\ ^2D^\circ$ odd terms. Of these levels, only $z\ ^4P_{3/2}$ (at 48 022 cm^{-1}) was excited directly from the ground level. In all other cases we started from either the $a\ ^6D$ or the $a\ ^4G$ terms.

The fluorescence from the excited levels was imaged on the entrance slit of a $f = 1/8$ monochromator and detected by a Hamamatsu R3809U photomultiplier with a risetime of 0.15 ns. The time-resolved signal was averaged over 1000 laser pulses. The experimental lifetimes were extracted by a weighted least-squares fit of a single exponential decay,

Table 2. Experimental and theoretical lifetimes (in ns) in Mo II.

		Experiment		Theory	
Level[a] (cm^{-1})	Designation[a]	Previous	This work	Previous	This work
45 853.395	$4d^4(^5D)$ 5p z $^6F^{\circ}_{1/2}$	4.9(3)[b]		4.9[d]	4.8
46 148.283	$4d^4(^5D)$ 5p z $^6F^{\circ}_{3/2}$	4.9(3)[b]		4.8[d]	4.7
46 614.470	$4d^4(^5D)$ 5p z $^6F^{\circ}_{5/2}$	4.9(3)[b]		4.7[d]	4.6
47 232.275	$4d^4(^5D)$ 5p z $^6F^{\circ}_{7/2}$	5.0(3)[b]		4.6[d]	4.5
47 999.856	$4d^4(^5D)$ 5p z $^6F^{\circ}_{9/2}$	4.4(3)[b]		4.4[d]	4.4
48 960.043	$4d^4(^5D)$ 5p z $^6F^{\circ}_{11/2}$	4.3(3)[b]		4.2[d]	4.2
48 022.815	$4d^4(^5D)$ 5p z $^4P^{\circ}_{3/2}$	4.8(4)[b], 4.9(3)[c]	4.9(2)	5.1[d]	4.8
50 577.720	$4d^4(^5D)$ 5p z $^4P^{\circ}_{5/2}$	4.7(4)[b], 4.5(3)[c]		4.6[d]	4.6
49 041.073	$4d^4(^5D)$ 5p z $^6P^{\circ}_{3/2}$	3.0(4)[b], 2.2(2)[c]		2.1[d]	2.1
48 860.829	$4d^4(^5D)$ 5p z $^6P^{\circ}_{5/2}$	3.3(4)[b], 2.8(2)[c]		3.0[d]	2.8
49 481.300	$4d^4(^5D)$ 5p z $^6P^{\circ}_{7/2}$	2.9(4)[b], 2.1(2)[c]		2.1[d]	2.1
49 949.756	$4d^4(^5D)$ 5p z $^6D^{\circ}_{1/2}$	4.3(4)[b], 4.3(3)[b]		4.5[d]	4.3
50 192.337	$4d^4(^5D)$ 5p z $^6D^{\circ}_{3/2}$	4.3(3)[c]		4.5[d]	4.4
49 609.086	$4d^4(^5D)$ 5p z $^6D^{\circ}_{5/2}$	3.5(4)[b], 2.9(2)[c]		2.9[d]	3.1
50 302.913	$4d^4(^5D)$ 5p z $^6D^{\circ}_{7/2}$	4.3(3)[b], 4.0(3)[c]	4.0(3)	4.4[d]	4.2
50 705.942	$4d^4(^5D)$ 5p z $^6D^{\circ}_{9/2}$	4.3(3)[b], 4.4(3)[c]		4.7[d]	4.5
51 373.170	$4d^4(^5D)$ 5p z $^4F^{\circ}_{3/2}$		4.2(3)	4.6[d]	4.7
51 732.690	$4d^4(^5D)$ 5p z $^4F^{\circ}_{5/2}$		4.2(3)	4.5[d]	4.6
52 217.587	$4d^4(^5D)$ 5p z $^4F^{\circ}_{7/2}$		4.0(3)	4.4[d]	4.4
52 843.296	$4d^4(^5D)$ 5p z $^4F^{\circ}_{9/2}$		4.0(3)	4.3[d]	4.3
54 238.949	$4d^4(^5D)$ 5p z $^4D^{\circ}_{1/2}$		5.1(3)	5.8[d]	5.5
54 687.002	$4d^4(^5D)$ 5p z $^4D^{\circ}_{3/2}$		5.0(3)	5.5[d]	5.2
55 216.203	$4d^4(^5D)$ 5p z $^4D^{\circ}_{5/2}$		4.6(3)	5.1[d]	4.9
55 706.937	$4d^4(^5D)$ 5p z $^4D^{\circ}_{7/2}$		4.5(3)	4.8[d]	4.7
57 892.289	$4d^4(^3H)$ 5p z $^4H^{\circ}_{7/2}$		4.9(3)	5.2[d]	5.2
58 196.928	$4d^4(^3H)$ 5p z $^4H^{\circ}_{9/2}$		4.9(3)	5.2[d]	5.2
58 761.258	$4d^4(^3H)$ 5p z $^4H^{\circ}_{11/2}$		4.8(3)	5.0[d]	5.0
59 492.157	$4d^4(^3H)$ 5p z $^4H^{\circ}_{13/2}$		4.6(3)	4.8[d]	4.7
59 841.060	$4d^4(^3F)$ 5p z $^2D^{\circ}_{3/2}$		7.6(1.0)	9.1[d]	8.5
60 992.764	$4d^4(^3F)$ 5p z $^2D^{\circ}_{5/2}$		6.6(5)	7.4[d]	7.5

[a] The level energies and designations are from Nilsson and Pickering (2003).
[b] Hannaford and Lowe (1983).
[c] Sikström *et al* (2001).
[d] Quinet (2002) (Calculation *F*).

convoluted with the shape of the laser pulse, to the fluorescence signal. In addition, a polynomial background representation could be added in the fit. About ten curves were recorded and averaged for each level investigated. The 16 lifetimes obtained are given in table 2, where the error bars reflect not only the statistical uncertainties but also a conservative estimate of possible remaining systematic errors.

4. Transition probabilities

For the calculations of branching fractions we adopted the theoretical HFR model (Cowan 1981) previously described by Quinet (2002) (model *F* in that work); see the discussion in the original paper. The computational procedure included the following configurations: $4d^5$, $4d^45s$, $4d^46s$, $4d^45d$, $4d^35s^2$, $4d^35p^2$, $4d^35d^2$ and $4d^35s5d$ (even parity) and $4d^45p$, $4d^46p$, $4d^44f$, $4d^45f$, $4d^35s5p$ and $4d^35p5d$ (odd parity).

A Mo^{3+} ionic core of the type $[Ar]3d^{10}4s^24p^64d^3$ was considered with a value for the dipole polarizability, α_d, equal to 5.67 a_0^3 (Fraga *et al* 1976) and a cut-off radius, r_c = 1.73 a_0. In addition, the final wavefunctions were obtained by a parametric fit of the Slater parameters using the experimental energy levels.

In the previous work of Quinet (2002), the optimization process was performed using the experimental energies compiled by Sugar and Musgrove (1988) for the $4d^5$, $4d^45s$ and $4d^45p$ configurations. Moreover, for the odd-parity levels the fit was limited to the lowest experimental values ($E < 62\,000$ cm^{-1}) because some levels, above that limit, had no spectroscopic designations in the NIST compilation.

In the present work, a new fit was carried out using the designations and experimental energy levels published by Nilsson and Pickering (2003). This allowed us to refine the parametric adjustment of the $4d^5$, $4d^45s$ and $4d^45p$ configurations and to extend it to the $4d^46s$, $4d^45d$ and $4d^35s5p$ configurations. More precisely, for the even parity, all the levels of Nilsson and Pickering (2003) were used to fit the average energies (E_{av}), the direct (F^k) and exchange (G^k) electrostatic integrals and the spin–orbit (ζ_{nl}) parameters belonging to the $4d^5$, $4d^45s$, $4d^46s$ and $4d^45d$ configurations. The configuration interaction integral (R^k) between $4d^5$ and $4d^45s$, together with effective interaction parameters α and β

Table 3. Transition probabilities for Mo II lines depopulating the levels for which the lifetimes have been measured in the present work. Only the most intense transitions ($\log gf > -1.50$) are quoted. $a(b)$ is written for $a{\cdot}10^{b}$.

E_{Low}[a] (cm^{-1})	Designation[a]	$E_{\mathrm{Upp.}}$[a] (cm^{-1})	Designation[a]	λ[b] (nm)	log gf[c]	gA[c] (s^{-1})	Int.[b]
12 034.420	$(^5\mathrm{D})5\mathrm{s}\ ^6\mathrm{D}_{3/2}$	47 208.734[d]	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{P}^{\circ}_{1/2}$	284.2148	−0.92	9.86(7)	61
15 699.390	$4\mathrm{d}^5\ ^4\mathrm{P}_{3/2}$	47 208.734[d]	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{P}^{\circ}_{1/2}$	317.2744	−0.90	8.28(7)	169
15 890.422	$4\mathrm{d}^5\ ^4\mathrm{P}_{1/2}$	47 208.734[d]	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{P}^{\circ}_{1/2}$	319.2097	−1.25	3.67(7)	83
16 796.468	$4\mathrm{d}^5\ ^4\mathrm{D}_{1/2}$	47 208.734[d]	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{P}^{\circ}_{1/2}$	328.7200	−1.38	2.56(7)	57
24 372.408	$(^5\mathrm{D})5\mathrm{s}\ ^4\mathrm{D}_{1/2}$	47 208.734[d]	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{P}^{\circ}_{1/2}$	437.7758	−1.08	2.90(7)	93
24 659.500	$(^5\mathrm{D})5\mathrm{s}\ ^4\mathrm{D}_{3/2}$	47 208.734[d]	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{P}^{\circ}_{1/2}$	443.3496	−1.14	2.47(7)	85
0.000	$4\mathrm{d}^5\ ^6\mathrm{S}_{5/2}$	48 022.815	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{P}^{\circ}_{3/2}$	208.1681	−1.15	1.10(8)	53
12 417.632	$(^5\mathrm{D})5\mathrm{s}\ ^6\mathrm{D}_{5/2}$	48 022.815	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{P}^{\circ}_{3/2}$	280.7753	−0.43	3.13(8)	222
15 691.451	$4\mathrm{d}^5\ ^4\mathrm{P}_{5/2}$	48 022.815	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{P}^{\circ}_{3/2}$	309.2074	−0.75	1.25(8)	212
16 796.468	$4\mathrm{d}^5\ ^4\mathrm{D}_{1/2}$	48 022.815	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{P}^{\circ}_{3/2}$	320.1499	−1.34	2.97(7)	57
17 174.332	$4\mathrm{d}^5\ ^4\mathrm{D}_{3/2}$	48 022.815	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{P}^{\circ}_{3/2}$	324.0715	−0.95	7.13(7)	152
17 344.363	$4\mathrm{d}^5\ ^4\mathrm{D}_{5/2}$	48 022.815	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{P}^{\circ}_{3/2}$	325.8677	−1.40	2.49(7)	55
24 659.500	$(^5\mathrm{D})5\mathrm{s}\ ^4\mathrm{D}_{3/2}$	48 022.815	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{P}^{\circ}_{3/2}$	427.9011	−1.00	3.67(7)	117
25 112.565	$(^5\mathrm{D})5\mathrm{s}\ ^4\mathrm{D}_{5/2}$	48 022.815	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{P}^{\circ}_{3/2}$	436.3632	−0.96	3.87(7)	119
12 417.632	$(^5\mathrm{D})5\mathrm{s}\ ^6\mathrm{D}_{5/2}$	50 302.913	$(^5\mathrm{D})\ 5\mathrm{p}\ ^6\mathrm{D}^{\circ}_{7/2}$	263.8761	−0.07	8.25(8)	948
12 900.680	$(^5\mathrm{D})5\mathrm{s}\ ^6\mathrm{D}_{7/2}$	50 302.913	$(^5\mathrm{D})\ 5\mathrm{p}\ ^6\mathrm{D}^{\circ}_{7/2}$	267.2843	−0.06	8.06(8)	878
13 461.113	$(^5\mathrm{D})5\mathrm{s}\ ^6\mathrm{D}_{9/2}$	50 302.913	$(^5\mathrm{D})\ 5\mathrm{p}\ ^6\mathrm{D}^{\circ}_{7/2}$	271.3504	−0.82	1.38(8)	119
25 112.565	$(^5\mathrm{D})5\mathrm{s}\ ^4\mathrm{D}_{5/2}$	50 302.913	$(^5\mathrm{D})\ 5\mathrm{p}\ ^6\mathrm{D}^{\circ}_{7/2}$	396.8651	−1.32	2.03(7)	59
15 199.383	$4\mathrm{d}^5\ ^4\mathrm{G}_{5/2}$	51 373.170	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{3/2}$	276.3616	−0.61	2.18(8)	182
15 699.390	$4\mathrm{d}^5\ ^4\mathrm{P}_{3/2}$	51 373.170	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{3/2}$	280.2353	−1.33	4.05(7)	27
15 890.422	$4\mathrm{d}^5\ ^4\mathrm{P}_{1/2}$	51 373.170	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{3/2}$	281.7441	−1.11	6.50(7)	39
16 796.468	$4\mathrm{d}^5\ ^4\mathrm{D}_{1/2}$	51 373.170	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{3/2}$	289.1273	−0.73	1.49(8)	33
17 174.332	$4\mathrm{d}^5\ ^4\mathrm{D}_{3/2}$	51 373.170	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{3/2}$	292.3220	−1.13	5.83(7)	43
24 137.912	$4\mathrm{d}^5\ ^4\mathrm{F}_{3/2}$	51 373.170	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{3/2}$	367.0666	−1.11	3.90(7)	49
24 372.408	$(^5\mathrm{D})\ 5\mathrm{s}\ ^4\mathrm{D}_{1/2}$	51 373.170	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{3/2}$	370.2546	−0.44	1.79(8)	262
24 659.500	$(^5\mathrm{D})\ 5\mathrm{s}\ ^4\mathrm{D}_{3/2}$	51 373.170	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{3/2}$	374.2338	−0.89	6.23(7)	93
15 330.789	$4\mathrm{d}^5\ ^4\mathrm{G}_{7/2}$	51 732.690	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{5/2}$	274.6297	−0.48	2.94(8)	271
15 691.451	$4\mathrm{d}^5\ ^4\mathrm{P}_{5/2}$	51 732.690	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{5/2}$	277.3780	−1.19	5.58(7)	43
15 699.390	$4\mathrm{d}^5\ ^4\mathrm{P}_{3/2}$	51 732.690	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{5/2}$	277.4392	−0.78	1.43(8)	122
17 174.332	$4\mathrm{d}^5\ ^4\mathrm{D}_{3/2}$	51 732.690	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{5/2}$	289.2808	−0.66	1.75(8)	48
17 344.363	$4\mathrm{d}^5\ ^4\mathrm{D}_{5/2}$	51 732.690	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{5/2}$	290.7112	−0.96	8.82(7)	74
23 934.630	$4\mathrm{d}^5\ ^4\mathrm{F}_{5/2}$	51 732.690	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{5/2}$	359.6347	−0.97	5.56(7)	71
24 659.500	$(^5\mathrm{D})\ 5\mathrm{s}\ ^4\mathrm{D}_{3/2}$	51 732.690	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{5/2}$	369.2640	−0.24	2.85(8)	446
25 112.565	$(^5\mathrm{D})\ 5\mathrm{s}\ ^4\mathrm{D}_{5/2}$	51 732.690	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{5/2}$	375.5489	−0.91	5.88(7)	94
12 900.688	$4\mathrm{d}^5\ ^6\mathrm{D}_{7/2}$	52 217.587	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{7/2}$	254.2672	−0.84	1.50(8)	129
15 427.895	$4\mathrm{d}^5\ ^4\mathrm{G}_{9/2}$	52 217.587	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{7/2}$	271.7348	−0.37	3.87(8)	376
15 691.451	$4\mathrm{d}^5\ ^4\mathrm{P}_{5/2}$	52 217.587	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{7/2}$	273.6956	−0.71	1.74(8)	169
16 947.078	$4\mathrm{d}^5\ ^4\mathrm{D}_{7/2}$	52 217.587	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{7/2}$	283.4396	−0.90	1.05(8)	47
17 344.363	$4\mathrm{d}^5\ ^4\mathrm{D}_{5/2}$	52 217.587	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{7/2}$	286.6688	−0.49	2.66(8)	84
23 853.578	$4\mathrm{d}^5\ ^4\mathrm{F}_{7/2}$	52 217.587	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{7/2}$	352.4587	−0.73	9.95(7)	169
23 934.630	$4\mathrm{d}^5\ ^4\mathrm{F}_{5/2}$	52 217.587	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{7/2}$	353.4686	−1.30	2.70(7)	74
25 112.565	$(^5\mathrm{D})\ 5\mathrm{s}\ ^4\mathrm{D}_{5/2}$	52 217.587	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{7/2}$	368.8303	−0.18	3.30(8)	479
25 341.898	$(^5\mathrm{D})\ 5\mathrm{s}\ ^4\mathrm{D}_{7/2}$	52 217.587	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{7/2}$	371.9777	−1.13	3.60(7)	57
13 461.113	$4\mathrm{d}^5\ ^6\mathrm{D}_{9/2}$	52 843.296	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{9/2}$	253.8457	−0.37	4.42(8)	300
15 447.043	$4\mathrm{d}^5\ ^4\mathrm{G}_{11/2}$	52 843.296	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{9/2}$	267.3270	−0.29	4.84(8)	433
16 947.078	$4\mathrm{d}^5\ ^4\mathrm{D}_{7/2}$	52 843.296	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{9/2}$	278.4987	−0.19	5.59(8)	327
23 833.154	$4\mathrm{d}^5\ ^4\mathrm{F}_{9/2}$	52 843.296	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{9/2}$	344.6083	−0.54	1.63(8)	176
25 341.898	$(^5\mathrm{D})\ 5\mathrm{s}\ ^4\mathrm{D}_{7/2}$	52 843.296	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{F}^{\circ}_{9/2}$	363.5143	0.04	5.56(8)	579
22 864.466	$4\mathrm{d}^5\ ^2\mathrm{D}_{3/2}$	54 238.949	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{D}^{\circ}_{1/2}$	318.6382	−1.22	3.95(7)	51
24 137.912	$4\mathrm{d}^5\ ^4\mathrm{F}_{3/2}$	54 238.949	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{D}^{\circ}_{1/2}$	332.1189	−1.20	3.79(7)	46
24 372.408	$(^5\mathrm{D})\ 5\mathrm{s}\ ^4\mathrm{D}_{1/2}$	54 238.949	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{D}^{\circ}_{1/2}$	334.7267	−0.70	1.17(8)	137
24 659.500	$(^5\mathrm{D})\ 5\mathrm{s}\ ^4\mathrm{D}_{3/2}$	54 238.949	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{D}^{\circ}_{1/2}$	337.9755	−0.68	1.21(8)	151
23 934.630	$4\mathrm{d}^5\ ^4\mathrm{F}_{5/2}$	54 687.002	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{D}^{\circ}_{3/2}$	325.0738	−0.79	1.01(8)	107
24 372.408	$(^5\mathrm{D})\ 5\mathrm{s}\ ^4\mathrm{D}_{1/2}$	54 687.002	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{D}^{\circ}_{3/2}$	329.7683	−0.81	9.56(7)	97
24 659.500	$(^5\mathrm{D})\ 5\mathrm{s}\ ^4\mathrm{D}_{3/2}$	54 687.002	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{D}^{\circ}_{3/2}$	332.9212	−0.46	2.09(8)	233
25 112.565	$(^5\mathrm{D})\ 5\mathrm{s}\ ^4\mathrm{D}_{5/2}$	54 687.002	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{D}^{\circ}_{3/2}$	338.0213	−0.57	1.55(8)	165
26 603.864	$(^3\mathrm{P})\ 5\mathrm{s}\ ^4\mathrm{P}_{1/2}$	54 687.002	$(^5\mathrm{D})\ 5\mathrm{p}\ ^4\mathrm{D}^{\circ}_{3/2}$	355.9713	−1.38	2.20(7)	22

Table 3. (Continued.)

E_{Low}[a] (cm^{-1})	Designation[a]	$E_{Upp.}$[a] (cm^{-1})	Designation[a]	λ[b] (nm)	log gf[c]	gA[c] (s^{-1})	Int.[b]
23 853.578	4d^5 ^{4}F$_{7/2}$	55 216.203	(^{5}D) 5p ^{4}D$^\circ_{5/2}$	318.7587	−0.62	1.56(8)	136
23 934.630	4d^5 ^{4}F$_{5/2}$	55 216.203	(^{5}D) 5p ^{4}D$^\circ_{5/2}$	319.5847	−1.22	3.92(7)	30
24 659.500	(^{5}D) 5s ^{4}D$_{3/2}$	55 216.203	(^{5}D) 5p ^{4}D$^\circ_{5/2}$	327.1662	−0.64	1.41(8)	135
24 836.319	4d^5 ^{2}F$_{5/2}$	55 216.203	(^{5}D) 5p ^{4}D$^\circ_{5/2}$	329.0704	−0.74	1.12(8)	127
25 112.565	(^{5}D) 5s ^{4}D$_{5/2}$	55 216.203	(^{5}D) 5p ^{4}D$^\circ_{5/2}$	332.0902	−0.23	3.58(8)	329
25 341.898	(^{5}D) 5s ^{4}D$_{7/2}$	55 216.203	(^{5}D) 5p ^{4}D$^\circ_{5/2}$	334.6396	−0.43	2.19(8)	206
27 627.858	(^{3}P) 5s ^{4}P$_{3/2}$	55 216.203	(^{5}D) 5p ^{4}D$^\circ_{5/2}$	362.3685	−1.19	3.27(7)	26
15 691.451	4d^5 ^{4}P$_{5/2}$	55 706.937	(^{5}D) 5p ^{4}D$^\circ_{7/2}$	249.8279	−1.13	7.79(7)	58
23 833.154	4d^5 ^{4}F$_{9/2}$	55 706.937	(^{5}D) 5p ^{4}D$^\circ_{7/2}$	313.6466	−0.46	2.35(8)	159
23 853.578	4d^5 ^{4}F$_{7/2}$	55 706.937	(^{5}D) 5p ^{4}D$^\circ_{7/2}$	313.8477	−1.10	5.37(7)	31
25 112.565	(^{5}D) 5s ^{4}D$_{5/2}$	55 706.937	(^{5}D) 5p ^{4}D$^\circ_{7/2}$	326.7633	−0.81	9.73(7)	77
25 341.898	(^{5}D) 5s ^{4}D$_{7/2}$	55 706.937	(^{5}D) 5p ^{4}D$^\circ_{7/2}$	329.2313	0.18	9.28(8)	765
29 022.466	(^{3}P) 5s ^{4}P$_{5/2}$	55 706.937	(^{5}D) 5p ^{4}D$^\circ_{7/2}$	374.6433	−1.13	3.53(7)	25
29 034.426	(^{3}F) 5s ^{4}F$_{9/2}$	55 706.937	(^{5}D) 5p ^{4}D$^\circ_{7/2}$	374.8113	−1.07	4.05(7)	38
15 199.383	4d^5 ^{4}G$_{5/2}$	57 892.289	(^{3}H) 5p ^{4}H$^\circ_{7/2}$	234.1592	−0.58	3.19(8)	84
26 041.359	(^{3}H) 5s ^{4}H$_{7/2}$	57 892.289	(^{3}H) 5p ^{4}H$^\circ_{7/2}$	313.8717	−0.14	4.90(8)	82
26 405.839	4d^5 ^{2}G$_{7/2}$	57 892.289	(^{3}H) 5p ^{4}H$^\circ_{7/2}$	317.5051	−0.32	3.20(8)	89
26 488.470	(^{3}H) 5s ^{4}H$_{9/2}$	57 892.289	(^{3}H) 5p ^{4}H$^\circ_{7/2}$	318.3405	−1.04	5.98(7)	11
28 877.238	(^{3}F) 5s ^{4}F$_{5/2}$	57 892.289	(^{3}H) 5p ^{4}H$^\circ_{7/2}$	344.5500	−0.63	1.33(8)	38
29 699.468	(^{3}G) 5s ^{4}G$_{5/2}$	57 892.289	(^{3}H) 5p ^{4}H$^\circ_{7/2}$	354.5990	−1.00	5.35(7)	14
15 427.895	4d^5 ^{4}G$_{9/2}$	58 196.928	(^{3}H) 5p ^{4}H$^\circ_{9/2}$	233.7424	−1.29	6.25(7)	17
15 330.789	4d^5 ^{4}G$_{7/2}$	58 196.928	(^{3}H) 5p ^{4}H$^\circ_{9/2}$	233.2128	−0.56	3.35(8)	82
26 068.808	4d^5 ^{2}G$_{9/2}$	58 196.928	(^{3}H) 5p ^{4}H$^\circ_{9/2}$	311.1636	−1.13	5.06(7)	21
26 405.839	4d^5 ^{2}G$_{7/2}$	58 196.928	(^{3}H) 5p ^{4}H$^\circ_{9/2}$	314.4625	−1.29	3.46(7)	10
26 488.470	(^{3}H) 5s ^{4}H$_{9/2}$	58 196.928	(^{3}H) 5p ^{4}H$^\circ_{9/2}$	315.2820	0.18	1.03(9)	197
26 739.737	(^{3}H) 5s ^{4}H$_{11/2}$	58 196.928	(^{3}H) 5p ^{4}H$^\circ_{9/2}$	317.8004	−0.94	7.67(7)	12
30 019.626	(^{3}G) 5s ^{4}G$_{7/2}$	58 196.928	(^{3}H) 5p ^{4}H$^\circ_{9/2}$	354.7942	−1.00	5.26(7)	15
15 447.043	4d^5 ^{4}G$_{11/2}$	58 761.258	(^{3}H) 5p ^{4}H$^\circ_{11/2}$	230.8001	−1.25	7.02(7)	16
15 427.895	4d^5 ^{4}G$_{9/2}$	58 761.258	(^{3}H) 5p ^{4}H$^\circ_{11/2}$	230.6981	−0.44	4.55(8)	93
26 488.470	(^{3}H) 5s ^{4}H$_{9/2}$	58 761.258	(^{3}H) 5p ^{4}H$^\circ_{11/2}$	309.7687	−0.81	1.07(8)	24
26 739.737	(^{3}H) 5s ^{4}H$_{11/2}$	58 761.258	(^{3}H) 5p ^{4}H$^\circ_{11/2}$	312.1995	0.32	1.43(9)	216
27 114.158	(^{3}H) 5s ^{4}H$_{13/2}$	58 761.258	(^{3}H) 5p ^{4}H$^\circ_{11/2}$	315.8932	−1.03	6.17(7)	8
29 034.426	(^{3}F) 5s ^{4}F$_{9/2}$	58 761.258	(^{3}H) 5p ^{4}H$^\circ_{11/2}$	336.2998	−0.70	1.19(8)	23
30 213.841	(^{3}G) 5s ^{4}G$_{9/2}$	58 761.258	(^{3}H) 5p ^{4}H$^\circ_{11/2}$	350.1942	−0.72	1.04(8)	25
26 739.737	(^{3}H) 5s ^{4}H$_{11/2}$	59 492.157	(^{3}H) 5p ^{4}H$^\circ_{13/2}$	305.2322	−0.82	1.08(8)	17
27 114.158	(^{3}H) 5s ^{4}H$_{13/2}$	59 492.157	(^{3}H) 5p ^{4}H$^\circ_{13/2}$	308.7621	0.43	1.89(9)	213
30 391.605	(^{3}G) 5s ^{4}G$_{11/2}$	59 492.157	(^{3}H) 5p ^{4}H$^\circ_{13/2}$	343.5376	−0.43	2.06(8)	35
33 601.411	(^{3}H) 5s ^{2}H$_{11/2}$	59 492.157	(^{3}H) 5p ^{4}H$^\circ_{13/2}$	386.1289	−1.06	3.91(7)	67
22 864.466	4d^5 ^{2}D$_{3/2}$	59 841.060	(^{3}F) 5p ^{2}D$^\circ_{3/2}$	270.3612	−1.21	5.64(7)	19
26 603.864	(^{3}P) 5s ^{4}P$_{1/2}$	59 841.060	(^{3}F) 5p ^{2}D$^\circ_{3/2}$	300.7801	−1.29	3.81(7)	10
27 879.033	4d^5 ^{2}F$_{5/2}$	59 841.060	(^{3}F) 5p ^{2}D$^\circ_{3/2}$	312.7806	−1.36	2.97(7)	12
32 124.340	(^{3}P) 5s ^{2}P$_{1/2}$	59 841.060	(^{3}F) 5p ^{2}D$^\circ_{3/2}$	360.6902	−0.77	8.55(7)	36
36 289.031	(^{3}F) 5s ^{2}F$_{5/2}$	59 841.060	(^{3}F) 5p ^{2}D$^\circ_{3/2}$	424.4724	−0.63	8.79(7)	61
39 243.688	(^{1}D) 5s ^{2}D$_{3/2}$	59 841.060	(^{3}F) 5p ^{2}D$^\circ_{3/2}$	485.3634	−1.17	1.89(7)	773
16 947.078	4d^5 ^{4}D$_{7/2}$	60 992.764	(^{3}F) 5p ^{2}D$^\circ_{5/2}$	226.9668	−1.37	5.55(7)	19
22 444.510	4d^5 ^{2}D$_{5/2}$	60 992.764	(^{3}F) 5p ^{2}D$^\circ_{5/2}$	259.3376	−0.87	1.34(8)	48
27 410.473	4d^5 ^{2}F$_{7/2}$	60 992.764	(^{3}F) 5p ^{2}D$^\circ_{5/2}$	297.6891	−1.08	6.31(7)	18
27 627.858	(^{3}P) 5s ^{4}P$_{3/2}$	60 992.764	(^{3}F) 5p ^{2}D$^\circ_{5/2}$	299.6288	−1.03	7.01(7)	19
33 146.559	(^{3}G) 5s ^{2}G$_{7/2}$	60 992.764	(^{3}F) 5p ^{2}D$^\circ_{5/2}$	359.0129	−1.22	3.11(7)	50
34 419.517	(^{3}P) 5s ^{2}P$_{3/2}$	60 992.764	(^{3}F) 5p ^{2}D$^\circ_{5/2}$	376.2114	−1.17	3.13(7)	39
36 741.555	(^{3}F) 5s ^{2}F$_{7/2}$	60 992.764	(^{3}F) 5p ^{2}D$^\circ_{5/2}$	412.2342	−0.55	1.10(8)	66
37 431.722	(^{1}G) 5s ^{2}G$_{7/2}$	60 992.764	(^{3}F) 5p ^{2}D$^\circ_{5/2}$	424.3099	−1.19	2.38(7)	17
39 913.210	(^{1}D) 5s ^{2}D$_{5/2}$	60 992.764	(^{3}F) 5p ^{2}D$^\circ_{5/2}$	474.2607	−1.03	2.76(7)	13

[a] Designations and level values from Nilsson and Pickering (2003).
[b] Experimental results Nilsson (2002). The intensities have not been normalized.
[c] HFR + CPOL calculations: This work.
[d] Level retained in this table despite of the fact that it has not been measured in the present work (see the text).

within these two configurations, was also adjusted. For the odd parity, all the experimental levels reported by Nilsson and Pickering (2003) up to 75 000 cm^{-1} were used to optimize the E_{av}, F^k, G^k, ζ_{nl}, α and β parameters belonging to 4d^{4}5p and the average energy of the 4d^{3}5s5p configuration. The odd levels above 75 000 cm^{-1} were excluded from the fit because in most cases it was difficult to uniquely relate them to the theoretical values since most of those levels are strongly mixed. The standard deviations of the fits were 84 cm^{-1} for the even parity (153 levels) and 128 cm^{-1} for the odd parity (149 levels).

The weighted transition probabilities (gA) and oscillator strengths (log gf) of the transitions depopulating the levels measured in the present work are reported in table 3. The table is restricted to the strongest lines (log gf > −1.50) originating from the 16 odd levels quoted in table 2, for which lifetimes were measured in the present work. We have added the depopulating channel of the level (^{5}D)5p z ^{4}P$^\circ_{1/2}$ situated at 47 208 cm^{-1}, the only level of the z ^{4}P$^\circ$ term not measured in the present work. For comparison the last column of table 3 gives the laboratory intensities obtained by Nilsson (2002) without correcting for the instrumental response.

5. Results and discussion

The available lifetimes in Mo II are reported in table 2 where the results obtained in the present work are compared to previous values. When comparing the LIF measurements of Sikström *et al* (2001) with the lifetimes reported by Hannaford and Lowe (1983), it is seen that the agreement is good when the lifetimes are longer than about 4 ns. For the shorter values, there is a clear discrepancy (outside the error bars), the values of Sikström *et al* (2001) being shorter. This discrepancy can be explained, as pointed out by Sikström *et al* (2001), by a better time resolution and shorter excitation pulses in the latter experiment. For the two levels common to our work and that of Sikström *et al* (2001) there is perfect agreement.

In the last column of table 2, we report the theoretical HFR+CPOL lifetimes calculated by Quinet (2002) (calculation *F*) as well as the new results obtained in the present work. The differences between the two calculations are only marginal, the mean ratio being 0.984 ± 0.030 for 30 levels (the uncertainty representing the standard deviation around the mean). A very good agreement between the theoretical lifetimes and the experimental results is also observed. In fact, the mean ratio τ (HFR+CPOL)/τ (Exp) is 0.934 ± 0.100 and 1.011 ± 0.035 when considering the measurements of Hannaford and Lowe (1983) and Sikström *et al* (2001), respectively. The same ratio becomes 1.067 ± 0.040 when comparing the 16 experimental lifetimes of the present work with the theoretical HFR+CPOL values. It should also be emphasized that theory favours the shorter lifetimes found by Sikström *et al* (2001) over those of Hannaford and Lowe (1983).

The importance of core-polarization effects in the Mo II spectrum must not be underestimated. They change the calculated lifetimes by about 30% as can be seen by comparing calculations *C* and *F* in Quinet (2002) and from table 2

Table 4. Oscillator strengths (log gf) and transition probabilities (gA) in Mo II sorted by air wavelengths. The observed wavelengths and laboratory intensities are taken from Nilsson (2002).

λ (nm)	log gf	gA (s^{-1})	Int.
208.1681	−1.15	1.10(8)	53
226.9668	−1.37	5.55(7)	19
230.6981	−0.44	4.55(8)	93
230.8001	−1.25	7.02(7)	16
233.2128	−0.56	3.35(8)	82
233.7424	−1.29	6.25(7)	17
234.1592	−0.58	3.19(8)	84
249.8279	−1.13	7.79(7)	58
253.8457	−0.37	4.42(8)	300
254.2672	−0.84	1.50(8)	129
259.3376	−0.87	1.34(8)	48
263.8761	−0.07	8.25(8)	948
267.3270	−0.29	4.84(8)	433
267.2843	−0.06	8.06(8)	878
270.3612	−1.21	5.64(7)	19
271.7348	−0.37	3.87(8)	376
271.3504	−0.82	1.38(8)	119
273.6956	−0.71	1.74(8)	169
274.6297	−0.48	2.94(8)	271
276.3616	−0.61	2.18(8)	182
277.3780	−1.19	5.58(7)	43
277.4392	−0.78	1.43(8)	122
278.4987	−0.19	5.59(8)	327
280.2353	−1.33	4.05(7)	27
280.7753	−0.43	3.13(8)	222
281.7441	−1.11	6.50(7)	39
283.4396	−0.90	1.05(8)	47
284.2148	−0.92	9.86(7)	61
286.6688	−0.49	2.66(8)	84
289.1273	−0.73	1.49(8)	33
289.2808	−0.66	1.75(8)	48
290.7112	−0.96	8.82(7)	74
292.3220	−1.13	5.83(7)	43
297.6891	−1.08	6.31(7)	18
299.6288	−1.03	7.01(7)	19
300.7801	−1.29	3.81(7)	10
305.2322	−0.82	1.08(8)	17
308.7621	0.43	1.89(9)	213
309.7687	−0.81	1.07(8)	24
309.2074	−0.75	1.25(8)	212
311.1636	−1.13	5.06(7)	21
312.1995	0.32	1.43(9)	216
312.7806	−1.36	2.97(7)	12
313.6466	−0.46	2.35(8)	159
313.8477	−1.10	5.37(7)	31
313.8717	−0.14	4.90(8)	82
314.4625	−1.29	3.46(7)	10
315.2820	0.18	1.03(9)	197
315.8932	−1.03	6.17(7)	8
317.5051	−0.32	3.20(8)	89
317.8004	−0.94	7.67(7)	12
317.2744	−0.90	8.28(7)	169
318.3405	−1.04	5.98(7)	11
318.6382	−1.22	3.95(7)	51
318.7587	−0.62	1.56(8)	136
319.5847	−1.22	3.92(7)	30
319.2097	−1.25	3.67(7)	83
320.1499	−1.34	2.97(7)	57
324.0715	−0.95	7.13(7)	152
325.0738	−0.79	1.01(8)	107
325.8677	−1.40	2.49(7)	55
326.7633	−0.81	9.73(7)	77
327.1662	−0.64	1.41(8)	135

Table 4. (Continued.)

λ (nm)	log gf	gA (s^{-1})	Int.
328.7200	−1.38	2.56(7)	57
329.0704	−0.74	1.12(8)	127
329.2313	0.18	9.28(8)	765
329.7683	−0.81	9.56(7)	97
332.0902	−0.23	3.58(8)	329
332.1189	−1.20	3.79(7)	46
332.9212	−0.46	2.09(8)	233
334.6396	−0.43	2.19(8)	206
334.7267	−0.70	1.17(8)	137
336.2998	−0.70	1.19(8)	23
337.9755	−0.68	1.21(8)	151
338.0213	−0.57	1.55(8)	165
343.5376	−0.43	2.06(8)	35
344.5500	−0.63	1.33(8)	38
344.6083	−0.54	1.63(8)	176
350.1942	−0.72	1.04(8)	25
352.4587	−0.73	9.95(7)	169
353.4686	−1.30	2.70(7)	74
354.5990	−1.00	5.35(7)	14
354.7942	−1.00	5.26(7)	15
355.9713	−1.38	2.20(7)	22
359.0129	−1.22	3.11(7)	50
359.6347	−0.97	5.56(7)	71
360.6902	−0.77	8.55(7)	36
362.3685	−1.19	3.27(7)	26
363.5143	0.04	5.56(8)	579
367.0666	−1.11	3.90(7)	49
368.8303	−0.18	3.30(8)	479
369.2640	−0.24	2.85(8)	446
370.2546	−0.44	1.79(8)	262
371.9777	−1.13	3.60(7)	57
374.2338	−0.89	6.23(7)	93
374.6433	−1.13	3.53(7)	25
374.8113	−1.07	4.05(7)	38
375.5489	−0.91	5.88(7)	94
376.2114	−1.17	3.13(7)	39
386.1289	−1.06	3.91(7)	67
396.8651	−1.32	2.03(7)	59
412.2342	−0.55	1.10(8)	66
424.3099	−1.19	2.38(7)	17
424.4724	−0.63	8.79(7)	61
427.9011	−1.00	3.67(7)	117
436.3632	−0.96	3.87(7)	119
437.7758	−1.08	2.90(7)	93
443.3496	−1.14	2.47(7)	85
474.2607	−1.03	2.76(7)	13
485.3634	−1.17	1.89(7)	773

in Nilsson and Pickering (2003). Their inclusion in the calculations is thus essential for obtaining an accurate scale for the transition probabilities.

Weighted transition probabilities (gA) and oscillator strengths (log gf) are reported in table 3 for 110 UV transitions (208 < λ < 490 nm). They have been obtained by a combination of the experimental lifetimes and the theoretical BFs. No experimental BFs are available for these high-excitation levels. There are no other results available for comparison, but the absolute scale is well established on the basis of the available lifetimes as discussed above. For the convenience of the user, table 4 lists the oscillator strengths and transition probabilities sorted by air wavelengths.

The new results for Mo II reported in this paper fill in some gaps in the existing data for this ion of astrophysical interest and it is anticipated that they will help astrophysicists in quantitative investigations of stellar spectra, particularly for investigating the chemical composition of Ap stars.

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