MEP 2005

IODINE ($\lambda \approx 515$ nm)

Absorbing molecule $^{127}I_2$, a_3 component, P(13) 43-0 transition [(1)]

1. CIPM recommended values

The values f = 582 490 603 442 kHz
λ = 514 673 466.368 fm
with a relative standard uncertainty of 8.6×10^{-12} apply to the radiation of a laser stabilized with an iodine cell external to the laser, and subject to the conditions:

- cold point temperature (–5 ± 2) °C, corresponding to a I_2 pressure of (2.4 ± 0.5) Pa [(2)];
- saturating beam intensity <40 mW cm^{-2}.

2. Source data

Adopted value:	f = 582 490 603 442 (5) kHz	$u_c/y = 8.6 \times 10^{-12}$
	for which:	
	λ = 514 673 466.368 (4) fm	$u_c/y = 8.6 \times 10^{-12}$

calculated from

f / kHz	u_c/y	source data
582 490 603 378.8	2.6×10^{-12}	[1]
582 490 603 447.3	1.3×10^{-12}	[8]

When corrected for pressure shifts, there is good agreement to 0.4 kHz between NIST-JILA and LPL values, bearing in mind that the iodine cell arrangement is significantly different for each case:

f / kHz	u_c/y	source data
582 490 603 441.8	2.6×10^{-12}	[1]
582 490 603 442.6	1.3×10^{-12}	[8]
Unweighted mean:	582 490 603 442.2	

The CCL recommended value was chosen as the mean of the two values, rounded to 582 490 603 442 kHz, with an uncertainty reduced from the 10 kHz 2003 value to 5 kHz.

(1) All transitions in I_2 refer to the $B^3\Pi\, 0_u^+ - X^1\Sigma_g^+$ system.

(2) For the specification of operating conditions, such as temperature, modulation width and laser power, the symbols ± refer to a tolerance, not an uncertainty.

3. Absolute frequency of the other transitions related to those adopted as recommended and frequency intervals between transitions and hyperfine components

These tables replace those published in BIPM Com. Cons. Long., 2001, **10**, 179-181 and Metrologia, 2003, **40**, 125-126.

The notation for the transitions and the components is that used in the source references. The values adopted for the frequency intervals are the weighted means of the values given in the references.

For the uncertainties, account has been taken of:

- the uncertainties given by the authors;
- the spread in the different determinations of a single component;
- the effect of any perturbing components;
- the difference between the calculated and the measured values.

In the tables, u_c represents the estimated combined standard uncertainty (1 σ).

All transitions in molecular iodine refer to the B-X system.

Table 1

$\lambda \approx 515$ nm $^{127}I_2$ P(13) 43-0

a_n	$[f(a_n) - f(a_3)]$ / kHz	u_c / kHz	a_n	$[f(a_n) - f(a_3)]$ / kHz	u_c / kHz
a_1	–131 770	1	a_{12}	435 599	3
a_2	–59 905	1	a_{13}	499 712	5
a_3	0	—	a_{14}	518 000	1 000
a_4	76 049	1	a_{15}	587 396	2
a_5	203 229	5	a_{16}	616 756	5
a_6	240 774	5	a_{17}	660 932	5
a_7	255 005	1	a_{18}	740 000	1 000
a_8	338 699	5	a_{19}	742 000	1 000
a_9	349 717	5	a_{20}	757 631	10
a_{10}	369 000	1 000	a_{21}	817 337	5
a_{11}	393 962	2			

Frequency referenced to a_3, P(13) 43-0, $^{127}I_2$: f = 582 490 603 442 kHz [2]

Ref. [3–6]

Table 2

$\lambda \approx 515$ nm $^{127}I_2$ (R15) 43-0					
b_n	$[f(b_n) - f(b_1)] / \mathrm{kHz}$	u_c / kHz	b_n	$[f(b_n) - f(b_1)] / \mathrm{kHz}$	u_c / kHz
b_1	0	—	b_{12}	566 287	5
b_2	69 739	5	b_{13}	630 782	5
b_3	129 155	5	b_{14}	658 178	5
b_4	217 000	1 000	b_{15}	725 166	5
b_5	335 828	5	b_{16}	739 394	5
b_6	368 000	1 000	b_{17}	791 673	5
b_7	396 442	5	b_{18}	865 523	5
b_8	471 000	1 000	b_{19}	874 840	5
b_9	472 000	1 000	b_{20}	892 895	10
b_{10}	500 627	5	b_{21}	947 278	10
b_{11}	525 207	5			

Frequency referenced to a_3, P(13) 43-0, $^{127}I_2$: f = 582 490 603 442 kHz [2]
$f(a_1$, P(13) 43-0$) - f(a_3$, P(13) 43-0$)$ = – 131 770 (1000) kHz
$f(b_1$, R(15) 43-0$) - f(a_1$, P(13) 43-0$)$ = 283 835 (5000) kHz [4]

Ref. [4,5]

Table 3

$\lambda \approx 515$ nm $^{127}I_2$ R(98) 58-1					
d_n	$[f(d_n) - f(d_6)]/\mathrm{kHz}$	u_c /kHz	d_n	$[f(d_n) - f(d_6)]/\mathrm{kHz}$	u_c /kHz
d_1	–413 488	5	d_9	225 980	5
d_2	–359 553	5	d_{10}	253 000	1 000
d_3	–194 521	5	d_{11}	254 000	1 000
d_4	–159 158	5	d_{12}	314 131	5
d_5	–105 769	5	d_{13}	426 691	5
d_6	0	—	d_{14}	481 574	5
d_7	172 200	5	d_{15}	510 246	5
d_8	200 478	5			

Frequency referenced to a_3, P(13) 43-0, $^{127}I_2$: f = 582 490 603 442 kHz [2]
$f(d_6$, R(98) 58-1$) - f(a_3$, P(13) 43-0$)$ = –2 100 000 (1 000) kHz [7]

[5, 7]

4. References

[1] Jones R. J., Cheng W.-Y., Holman K. W., Chen L., Hall J. L., Ye J., Absolute-frequency measurement of the iodine-based length standard at 514.67 nm, *Appl. Phys*, 2002, **B 74** 597-601.

[2] Recommendation CCL 2c (*BIPM Com. Cons. Long.*, 11th Meeting, 2003) adopted by the Comité International des Poids et Mesures at its 92nd Meeting as Recommendation 1 (CI-2003).

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