MEP 2003

IODINE ($\lambda \approx 543$ nm)

Absorbing molecule $^{127}I_2$, b_{10} component, R(106) 28-0 transition (1)

1. CIPM recommended values

The values f = 551 580 162 400 kHz
λ = 543 515 663.608 fm
with a relative standard uncertainty of 4.5×10^{-11} apply to the radiation of a laser stabilized to an external iodine cell and subject to the following conditions:

- cold point temperature (0 ± 2) °C (2);
- frequency modulation width, peak-to-peak, (2.0 ± 0.5) MHz.

2. Source data

Adopted value:	f = 551 580 162 400 (25) kHz	$u_c/y = 4.5 \times 10^{-11}$
	for which:	
	λ = 543 515 663.608 (24) fm	$u_c/y = 4.5 \times 10^{-11}$

calculated from

f / kHz	u_c/y	source data
551 580 162 397.1	1.3×10^{-11}	[1]

Given the small number of calibrations and the individual behaviour of participating lasers in this calibration, the CCL considered it prudent to adopt an uncertainty of 25 kHz for the recommended value. The final CCL value chosen was f = 551 580 162 400 (25) kHz with the following operating conditions:

- cold point temperature (0 ± 2) °C (2);
- frequency modulation width, peak-to-peak, (2.0 ± 0.5) MHz.

Other techniques such as FM or modulation transfer detection can be used to realise the standard, provided the value can be shown to remain within the stated uncertainty.

It was felt appropriate not to define the laser type.

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**, 182-183 and Metrologia, 2003, **40**, 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.

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(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.

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

$\lambda \approx 543$ nm $^{127}I_2$ R(12) 26-0

a_n	$[f(a_n) - f(b_{10})]$/MHz	u_c/MHz	a_n	$[f(a_n) - f(b_{10})]$/MHz	u_c/MHz
a_1	–1162.24	0.02	a_9	–679.420	0.005
a_2	–909.87	0.02	a_{10}	–596.134	0.005
a_3	–900.11	0.03	a_{11}	–485.61	0.01
a_4	–853.336	0.005	a_{12}	–476.35	0.01
a_5	–848.131	0.005	a_{13}	–423.23	0.01
a_6	–795.92	0.01	a_{14}	–410.01	0.01
a_7	–752.382	0.005	a_{15}	–305.910	0.005
a_8	–733.134	0.005			

Frequency referenced to b_{10}, R(106) 28-0, $^{127}I_2$: f = 551 580 162 400 kHz [2]

Ref. [3–9]

Table 2

$\lambda \approx 543$ nm $^{127}I_2$ R(106) 28-0

b_n	$[f(b_n) - f(b_{10})]$/MHz	u_c/MHz	b_n	$[f(b_n) - f(b_{10})]$/MHz	u_c/MHz
b_1	–573.765	0.005	b_9	-114.575	0.005
b_2	–320.462	0.005	b_{10}	0	–
b_3	–291.59	0.01	b_{11}	124.83	0.01
b_4	–282.143	0.005	b_{12}	132.31	0.01
b_5	–253.675	0.005	b_{13}	154.51	0.01
b_6	–172.693	0.005	b_{14}	162.65	0.01
b_7	–159.428	0.005	b_{15}	287.24	0.01
b_8	–127.760	0.005			

Frequency referenced to b_{10}, R(106) 28-0, $^{127}I_2$: f = 551 580 162 400 kHz [2]

Ref. [3–9]

4. References

[1] Ma L.-S., Picard S., Zucco M., Chartier J.-M., Robertsson L., Balling P., Kren P., Qian J., Liu Z., Shi C., Viliesid Alonso M., Xu G., Tan S. L., Nyholm K., Henningsen J., Hald J., Windeler R., Absolute Frequency Measurement of the b_{10} component of the R(106) 28-0 Transition in $^{127}I_2$ at λ=543 nm, provisionally published in *Rapport BIPM-2004/16*.

[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).

[3] Chartier J.-M., Hall J. L., Gläser M., Identification of the I_2-saturated absorption lines excited at 543 nm with the external beam of the green He-Ne Laser, *Proc. CPEM'86*, 1986, 323.

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