### **MEP 2003**

## **IODINE** ( $\lambda \approx 543 \text{ nm}$ )

# 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

 $\lambda = 543\ 515\ 663.608\ \text{fm}$ 

with a relative standard uncertainty of  $4.5 \times 10^{-11}$  apply to the radiation of a laser stabilized to an external iodine cell and subject to the following conditions:

- cold point temperature  $(0 \pm 2)$  °C <sup>(2)</sup>;
- frequency modulation width, peak-to-peak,  $(2.0 \pm 0.5)$  MHz.

#### 2. Source data

Adopted value:

f = 551 580 162 400 (25) kHz

 $u_c/y = 4.5 \times 10^{-11}$ 

for which:

 $\lambda = 543\ 515\ 663.608\ (24)\ \text{fm}$ 

 $u_c/y = 4.5 \times 10^{-11}$ 

#### calculated from

f/kHz	u <sub>c</sub> /y	source data
551 580 162 397.1	$1.3 \times 10^{-11}$	[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  $(0 \pm 2)$  °C <sup>(2)</sup>;
- frequency modulation width, peak-to-peak,  $(2.0 \pm 0.5)$  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.

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

For the specification of operating conditions, such as temperature, modulation width and laser power, the symbols  $\pm$  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  $\sigma$ ).

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

	Table 1						
$\lambda \approx 543 \text{ nm}^{-127} \text{I}_2 \text{ R}(12) 26-0$							
$\mathbf{a}_n$	$[f(\mathbf{a}_n) - f(\mathbf{b}_{10})]/\mathbf{MHz}$	$u_{\rm c}/{ m MHz}$ a	$\mathbf{a}_n$	$[f(\mathbf{a}_n) - f(\mathbf{b}_{10})] / \mathbf{MHz}$	$u_{\rm c}/{ m MHz}$		
$a_1$	-1162.24	0.02 a	<b>1</b> 9	-679.420	0.005		
$a_2$	-909.87	0.02 a	$a_{10}$	-596.134	0.005		
$a_3$	-900.11	0.03 a	$a_{11}$	-485.61	0.01		
a <sub>4</sub>	-853.336	0.005 a	$a_{12}$	-476.35	0.01		
a <sub>5</sub>	-848.131	0.005 a	$a_{13}$	-423.23	0.01		
$a_6$	-795.92	0.01 a	$a_{14}$	-410.01	0.01		
a <sub>7</sub>	-752.382	0.005 a	1 <sub>15</sub>	-305.910	0.005		
$a_8$	-733.134	0.005					

Ref.	[3-9]

Table 2 $\lambda \approx 543 \text{ nm}^{-127} I_2 \text{ R}(106) 28-0$						
$b_n$	$[f(\mathbf{b}_n) - f(\mathbf{b}_{10})]/\mathbf{MHz}$	u <sub>c</sub> /MHz		$[f(\mathbf{b}_n) - f(\mathbf{b}_{10})]/\mathbf{MHz}$	u <sub>c</sub> /MHz	
b <sub>1</sub>	-573.765	0.005	<b>b</b> <sub>9</sub>	-114.575	0.005	
$b_2$	-320.462	0.005	$b_{10}$	0	_	
$b_3$	-291.59	0.01	b <sub>11</sub>	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 <sub>15</sub>	287.24	0.01	
$b_8$	-127.760	0.005				

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  $\lambda$ =543 nm, provisionally published in *Rapport BIPM-2004/16*.
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