

RECOMMENDATION CCTF PSFS 2 (2021)

Updates to the CIPM list of standard frequencies

The Consultative Committee for Time and Frequency (CCTF), at its 22nd session in 2020 and 2021,

considering that

- a common list of “Recommended values of standard frequencies for applications including the practical realization of the metre and secondary representations of the second” has been established,
- the CCL-CCTF Frequency Standards Working Group (WGFS) has reviewed several candidates for updating the list;

recommends

that the following transition frequencies shall be updated in the list of recommended values of standard frequencies:

- the unperturbed optical transition $5s^2\ ^1S_0 - 5s5p\ ^3P_0$ of the $^{115}\text{In}^+$ ion with a frequency of $f_{115\text{In}^+} = 1\ 267\ 402\ 452\ 901\ 041.3$ Hz and an estimated relative standard uncertainty of 4.3×10^{-15} ;
- the unperturbed optical transition $6s^2\ ^1S_0 - 6s6p\ ^3P_0$ of the ^{199}Hg neutral atom with a frequency of $f_{199\text{Hg}} = 1\ 128\ 575\ 290\ 808\ 154.32$ Hz and an estimated relative standard uncertainty of 2.4×10^{-16} (this radiation is already endorsed as a secondary representation of the second);
- the unperturbed optical transition $3s^2\ ^1S_0 - 3s3p\ ^3P_0$ of the $^{27}\text{Al}^+$ ion with a frequency of $f_{27\text{Al}^+} = 1\ 121\ 015\ 393\ 207\ 859.16$ Hz and an estimated relative standard uncertainty of 1.9×10^{-16} (this radiation is already endorsed as a secondary representation of the second);
- the unperturbed optical transition $5d^{10}6s\ ^2S_{1/2} - 5d\ ^96s^2\ ^2D_{5/2}$ of the $^{199}\text{Hg}^+$ ion with a frequency of $f_{199\text{Hg}^+} = 1\ 064\ 721\ 609\ 899\ 146.96$ Hz and an estimated relative standard uncertainty of 2.2×10^{-16} (this radiation is already endorsed as a secondary representation of the second);
- the unperturbed optical transition $6s\ ^2S_{1/2} (F = 0, m_F = 0) - 5d\ ^2D_{3/2} (F = 2, m_F = 0)$ of the $^{171}\text{Yb}^+$ ion with a frequency of $f_{171\text{Yb}^+}$ (quadrupole) = $688\ 358\ 979\ 309\ 308.24$ Hz and an estimated relative standard uncertainty of 2.0×10^{-16} (this radiation is already endorsed as a secondary representation of the second);
- the unperturbed optical transition $6s\ ^2S_{1/2} - 4f\ ^{13}6s^2\ ^2F_{7/2}$ of the $^{171}\text{Yb}^+$ ion with a frequency of $f_{171\text{Yb}^+}$ (octupole) = $642\ 121\ 496\ 772\ 645.12$ Hz and an estimated relative standard uncertainty of 1.9×10^{-16} (this radiation is already endorsed as a secondary representation of the second);
- the unperturbed optical transition $6s^2\ ^1S_0 - 6s6p\ ^3P_0$ of the ^{171}Yb neutral atom with a frequency of $f_{171\text{Yb}} = 518\ 295\ 836\ 590\ 863.63$ Hz and an estimated relative standard uncertainty of 1.9×10^{-16} (this radiation is already endorsed as a secondary representation of the second);
- the unperturbed optical transition $5s\ ^2S_{1/2} - 4d\ ^2D_{5/2}$ of the $^{88}\text{Sr}^+$ ion with a frequency of $f_{88\text{Sr}^+} = 444\ 779\ 044\ 095\ 486.3$ Hz and an estimated relative standard uncertainty of 1.3×10^{-15} (this radiation is already endorsed as a secondary representation of the second);
- the unperturbed optical transition $5s^2\ ^1S_0 - 5s5p\ ^3P_0$ of the ^{88}Sr neutral atom with a frequency of $f_{88\text{Sr}} = 429\ 228\ 066\ 418\ 007.01$ Hz and an estimated relative standard uncertainty of 2.0×10^{-16} ;

This radiation is now endorsed as a secondary representation of the second;

- the unperturbed optical transition $5s^2\ ^1S_0 - 5s5p\ ^3P_0$ of the ^{87}Sr neutral atom with a frequency of $f_{87\text{Sr}} = 429\ 228\ 004\ 229\ 872.99$ Hz and an estimated relative standard uncertainty of 1.9×10^{-16} (this radiation is already endorsed as a secondary representation of the second);
- the unperturbed optical transition $4s\ ^2S_{1/2} - 3d\ ^2D_{5/2}$ of the $^{40}\text{Ca}^+$ ion with a frequency of $f_{40\text{Ca}^+} = 411\ 042\ 129\ 776\ 400.4$ Hz and an estimated relative standard uncertainty of 1.8×10^{-15} ;

This radiation is now endorsed as a secondary representation of the second;

- the unperturbed ground-state hyperfine transition of ^{87}Rb with an unchanged frequency of $f_{87\text{Rb}} = 6\ 834\ 682\ 610.904\ 312\ 6$ Hz and an estimated relative standard uncertainty of 3.4×10^{-16} (this radiation is already endorsed as a secondary representation of the second).

that the BIPM publish in electronic form:

- the list of recommended values of standard frequencies updated accordingly,
- the list of publications reporting measurements from which these values are obtained by least square fit adjustment,
- the output covariance matrix derived from this least square adjustment

and informs the CIPM accordingly.