RECOMMENDATION CCTF PSFS 2 (2021)

Updates to the CIPM list of standard frequencies[1]

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 ${}^{115}In^+$ ion with a frequency of $f_{115In+} = $ 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_{199Hg} = $ 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 ${}^{27}Al^+$ ion with a frequency of $f_{27Al+} = $ 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 ${}^{199}Hg^+$ ion with a frequency of $f_{199Hg+} = $ 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 ${}^{171}Yb^+$ ion with a frequency of f_{171Yb+} (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 ${}^{171}Yb^+$ ion with a frequency of f_{171Yb+} (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_{171Yb} = $ 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 ${}^{88}Sr^+$ ion with a frequency of $f_{88Sr+} = $ 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);

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[1] These values were agreed by the CCTF in March 2021 and became active on April 13, 2022

- the unperturbed optical transition $5s^2\ ^1S_0 - 5s5p\ ^3P_0$ of the ^{88}Sr neutral atom with a frequency of $f_{88Sr} = 429\ 228\ 066\ 418\ 007.01$ 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 $f_{87Sr} = 429\ 228\ 004\ 229\ 872.99$ 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}Ca$^+$ ion with a frequency of $f_{40Ca+} = 411\ 042\ 129\ 776\ 400.4$ 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 $f_{87Rb} = 6\ 834\ 682\ 610.904\ 312\ 6$ 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.