Questionnaire
previous to the 2007 meeting of the
CCL-CCTF Frequency Standards Working Group

Note: Results will be considered only if there is a publication or at least acceptance for publication at the date of the meeting.

1. Have you made absolute frequency measurements of radiations included in the CCL list of recommended radiations (Mise en Pratique 2005)?

   Yes [X] No [ ]

   $^{199}Hg^{+}$ 1 064 721 609 899 144.94 (97) Hz

   Via a direct comparison to the NIST primary fountain standard NIST-F1
   W.H. Oskay, et al., Phys. Rev. Lett. **97**, 020801 (2006).

   ^{87}Sr 429 228 004 229 874.0(1.1) Hz

   Via an indirect comparison to the NIST primary fountain standard NIST-F1
   M.M. Boyd, et al., Phys. Rev. Lett. **98**, 083002 (2007).

   If yes, please list the values and uncertainties obtained and the methods used and refer to the publication(s) in which they may be found. Please be sure to include measurements made in other laboratories in your country.

   1.1. If yes, indicate for each one whether you think that any of these measurements should modify the current value and uncertainty already on the list.

   Yes [X] No [ ]

   ^{87}Sr This measurement represents an important improvement in the relative uncertainty previously reported by Ye's group at JILA

   (add as many lines as necessary)

2. Have you made absolute frequency measurements of radiations included in the CCTF list of secondary representations of the second?

   Yes [X] No [ ]

   See above

   2.1. If yes, please list the values and uncertainties obtained and the methods used and refer to the publication in which they may be found. Please be sure to include measurements made in other laboratories in your country.

   See above

2.2. If yes, indicate for each one whether you think that any of these measurements should be proposed as an update of existing value and uncertainty to be considered at the next CCL-CCTF Joint WG meeting just prior to the CCTF (2008/2009).

Yes [X] No [ ]

See above

(add as many lines as necessary)

3. Have you made absolute frequency measurements of other radiations not included in these lists?

Yes [ ] No [X]

If yes, please list the values and uncertainties obtained and the methods used and refer to the publication in which they may be found. Please be sure to include measurements made in other laboratories in your country.

3.1. If yes, indicate if any of these sources should be included in a updated list of "Recommended values of standard frequencies for applications including the practical realization of the metre and secondary representations of the second, and present your arguments for a positive assessment.

Recommended for the MeP:

Yes [ ] No [ ]

Recommended for secondary representation of the second

Yes [ ] No [ ]

(add as many lines as necessary)

4. Are you currently developing new frequency sources or are you aware of such sources developed in your country?

Yes [X] No [ ]

Al^+ single-ion optical frequency standard @ 1 121 015 393 207 851. … Hz

A single aluminum ion and a single beryllium ion are simultaneously confined in a linear Paul trap, coupled by their mutual Coulomb repulsion. This coupling allows the beryllium ion to sympathetically cool the aluminum ion, and also enables transfer of the aluminum's electronic state to the beryllium's hyperfine state, which can be measured with high fidelity. These techniques are applied to a measurement of the clock transition frequency, 1 121 015 393 207 851. … Hz. They are also used to measure the lifetime of the metastable clock state, 20.6 ± 1.4 s, the ground state 1S0 g-factor, gS = −0.00079248(14), and the excited state 3P0 g-factor, gP = −0.00197686(21), in units of the Bohr magneton.

If yes, please give a brief description of your experiment.

NAME: …James C. Bergquist ……

INSTITUTE: …NIST ……

Note: After the decision of the CIPM in autumn 2006

that

- the CCL-*Mise en Pratique* WG and CCL/CCTF JWG be combined into a single CCL-CCTF frequency standards working group,
- the *Mise en Pratique*-CCL list of Recommended Radiations and CCTF Secondary Representation list be combined into a single new list of "Recommended values of standard frequencies for applications including the practical realization of the metre and secondary representations of the second",
- other frequencies may be proposed, evaluated and maintained on the frequency standards list by the CCL-CCTF frequency standards WG, not all of which are adopted as CCL-preferred radiations or CCTF-accepted representations,
- the CCTF consider and recommends those frequencies which it proposes the CIPM to accept as secondary representations of the second,
- the CCL considers and recommends those frequencies which it deems important for use in high accuracy length metrology, and
- the frequency values list is maintained on the BIPM website.

the CCL-CCTF frequency standards working group at its meeting in September 2007 will thus be required

1. to recommend to the CCL, frequency standards to be added to the list of recommended radiations,
2. to follow the development of frequency standards to be considered at the next CCTF as possible secondary representations of the second (no decision before the next CCTF),
3. to recommend other frequencies relevant for science or technology.

Additional information:

The current list of recommended frequencies as secondary representations of the second contains

- the unperturbed ground-state hyperfine quantum transition of ^{87}Rb with a frequency of $f(^{87}Rb) = 6\,834\,682\,610.904\,324$ Hz and an estimated relative standard uncertainty of 3×10^{-15},

- the unperturbed optical $5d^{10}\,6s\ ^2S_{1/2}\ (F = 0) - 5d^9\,6s^2\ ^2D_{5/2}\ (F = 2)$ transition of the $^{199}Hg+$ ion with a frequency of $f(^{199}Hg+) = 1\,064\,721\,609\,899\,145$ Hz and a relative standard uncertainty of 3×10^{-15},

- the unperturbed optical $5s\ ^2S_{1/2} - 4d\ ^2D_{5/2}$ transition of the $^{88}Sr^+$ ion with a frequency of $f(^{88}Sr^+) = 444\,779\,044\,095\,484$ Hz and a relative uncertainty of 7×10^{-15},

- the unperturbed optical $6s\ ^2S_{1/2}\ (F = 0) - 5d\ ^2D_{3/2}\ (F = 2)$ transition of the $^{171}Yb^+$ ion with a frequency of $f(^{171}Yb^+) = 688\,358\,979\,309\,308$ Hz and a relative standard uncertainty of 9×10^{-15},

- the unperturbed optical transition $5s^2\ ^1S_0 - 5s5p\ ^3P_0\ ^{87}Sr$ neutral atom with a frequency of $f(^{87}Sr) = 429\,228\,004\,229\,877$ Hz and a relative standard uncertainty of 1.5×10^{-14}.