Report to the CCL/CCTF Joint Working Group
from the Physikalisch-Technische Bundesanstalt, Germany

Questionnaire previous to the 2005 meeting of the CCL/CCTF joint working group

The CIPM on its meeting in autumn 2004 has decided that the unperturbed ground-state hyperfine quantum transition of ^{87}Rb
may be used as a secondary representation of the second with a frequency of
f_{Rb}= 6 834 682 610.904 324 Hz
and an estimated relative standard uncertainty (1σ) of 3×10^{-15}

1. Frequency sources in the microwave domain

   1.1. Have you made or are you aware of new absolute frequency measurements of the Rb hyperfine transition?

   No

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

   1.2. Are you aware of absolute frequency measurements of other microwave standards that should be proposed as secondary representations of the second?

   No

   If yes, please list the values and uncertainties obtained and the method 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.

   1.3. Are you currently developing new frequency sources in the microwave domain?

   No

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

2. Frequency sources in the optical domain

   2.1. Have you made or are you aware of new absolute optical frequency measurements suitable to serve as secondary representations of the second?

   Yes

If yes, please list the values and uncertainties obtained and refer to the publication in which they may be found.

We propose to recommend the $^2S_{1/2}(F=0)$ - $^2D_{3/2}(F=2)$ transition of a single $^{171}Yb^+$ ion confined in a Paul trap as a secondary representation of the second. The value of the line center of this transition is:

$$f(^{171}Yb^+, ^2S_{1/2}(F=0) - ^2D_{3/2}(F=2)) = 688\ 358\ 979\ 309\ 307.65\ (2.1)\ \text{Hz}$$

The details of the measurements are given in the attached File PTB_Yb.

We further propose to recommend the $^1S_0$ - $^3P_1$ transition of cold ^{40}Ca atoms as secondary representation of the second. The value of the line center of this transition is:

$$f(^{40}Ca, ^1S_0 - ^3P_1) = 455\ 986\ 240\ 494\ 144\ (5.3)\ \text{Hz}$$

The details of the measurements are given in the attached File PTB_Ca. This value agrees well with the values obtained from NIST.

2.2. Are you currently developing new frequency sources in the optical domain?

Yes

PTB is working towards a Sr lattice clock and on a Th nuclear transition [1].

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

PTB has started to set up an optical clock using the $^3P_0 - ^1S_0$ transition in ^{87}Sr trapped in an optical lattice at the magic wavelength. First measurements of the transition frequency using an optical comb are expected in 2006.

[1] E. Peik, Chr. Tamm:
Nuclear laser spectroscopy of the 3.5 eV transition in Th-229,
Europhys. Lett., **61**, 181-186 (2003)

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