Report to the 15th session of the Consultative Committee for Time and Frequency (CCTF), 20-21 June 2001

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1. Clocks for TAI

1.1 Commercial clocks

At present, the Swiss timescale is based on 8 commercial cesium tubes, 7 of which are located at METAS, the eighth at the Observatoire de Neuchâtel. The link between the two institutes is realized by GPS Common View. We compute both, a free running atomic timescale TA(CH) and the steered timescale UTC(CH).

1.2 Cold continuous beam standard

The development of a new primary frequency standard is a joint effort of METAS and ON. The device is based on a continuous beam of laser cooled cesium atoms. The assembly of the resonator has been completed towards the end of 1999 and first 1-Hz Ramsey fringes were recorded early in the year 2000. Figure 1 shows a typicall scan over all $\Delta m_F = 0$ transitions.

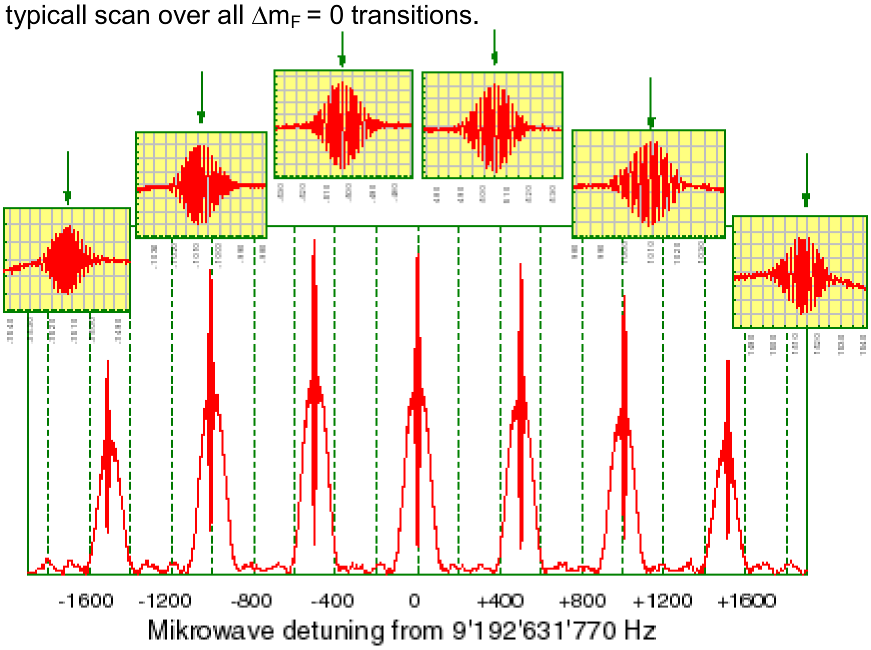
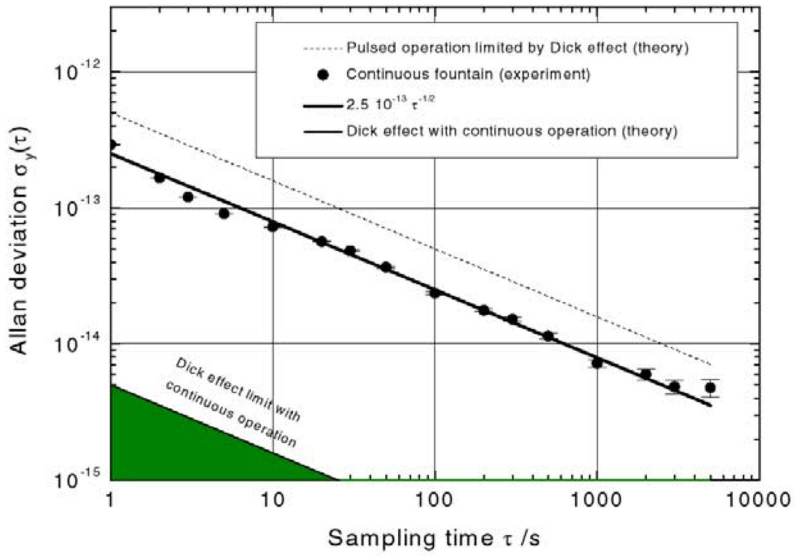


Fig 1: Scan of the microwave frequency over all $\Delta m_F = 0$ transitions.

Using a hydrogen maser as local oscillator and a frequency chain from a commercial cesium tube we were able to mesure a frequency instability of 2 10^{-13} $\tau^{-1/2}$ between 10 s and 10'000 s. This instability is limited by the atomic shot noise of the beam and can be decreased further if the flux of atoms is increased. At this stage we are already taking advantage of the continuous character of the standard since the instability would be higher due to aliasing effects if the same local oscillator was employed in a pulsed fountain. Fig. 2 shows a stability plot of the fountain measured against a hydrogen maser.



The experimental values are represented by dots. It can be seen that the present stability is already better than the stability that would be obtained with the same local oscillator in a pulsed fountain. The Dick limit for the continuous fountain as predicted by theory is also indicated on Fig. 2.
An accuracy evaluation is under way.

2. Time Links

2.1 GPS Common View

The main means of time transfer between METAS and other time centers is GPS Common View. METAS runs two NBS-type receivers and records data according to the BIPM-schedule.

2.2 GPS Multichannel receiver

METAS operates a multi-channel GPS receiver on an experimental basis.

2.3 GPS Carrier Phase Experiment

METAS is involved in a study of time and frequency transfer by GPS Carrier Phase (CP). In a collaboration with the Astronomical Institute of the University of Berne (AIUB) the so-called GeTT-terminals have been developed and successfully employed in different campaigns. By installing GeTT stations at the PTB in Germany and the USNO in Washington it was possible to test the method over a very long baseline and to gain experience with the method over more than two years. Intercomparison between GPS CP and other techniques, such as Two Way Satellite Time and Frequency Transfer (TWSTFT) or GPS Common View could also be investigated.
One of the GeTT terminals has participated in the calibration trip with the BIPM receiver. In parallel, two GeTT terminals have been differentially calibrated against each other for accurate time transfer.

3. Time dissemination services

3.1 HBG

Starting on 1st of June 2000, METAS has taken over from Swisscom the responsibility for the longwave timecode transmitter HBG. The distributed code has been slightly modified and is now compatible with the German transmitter DCF 77.

3.2 Modem

Two time code generators conntected to two independent public telephone lines are operated at METAS. The time code is compliant with the European Telephone Time Code format.

3.3 NTP

A new time service has been put into operation in April 2001. METAS maintains a public stratum 1 NTP-Server, distributing the Swiss official time over the Internet.

4. Clocks in space.

Observatoire de Neuchâtel contributes to the ACES experiment (Atomic Clock Ensemble in Space) to be flown in 2005 on the Columbus Orbital Facility of the International Space Station. The payload will consist of the cold Cs clock (BNM-LPTF/CNES), the H-maser (ON, electronics package from Italy), and a microwave link for T/F transfer with ground clocks.
The engineering model of the H-maser is due mid 2002, final delivery in 2004

5. Future satellite navigation systems

Atomic clocks for the first generation of GALILEO satellites are being developed in Neuchâtel: the passive hydrogen maser (S-PHM, mass 17kg, one-day stability 10^{-14}) will be provided by ON, while the back-up Rubidium clock is developed at TEMEX Neuchâtel Time. Work towards the second generation of GALILEO space clocks is also planned in both institutions.