

Report to the 17th session of the Consultative Committee for Time and Frequency (CCTF), 14th and 15th September 2006

Swiss Federal Office of Metrology and Accreditation (METAS)

1. Clocks for TAI

1.1 Commercial clocks

At present, 4 cesium standards and 1 hydrogen maser form together the ensemble of clocks that METAS operates for the local time scales UTC(CH) and TA(CH). This number has been maintained since the last report to CCTF in 2004. The data of all clocks are reported to BIPM and contribute to the computation of UTC.

1.2 Cold continuous beam standard

FOCS-1 is a primary frequency standard based on a continuous beam of cold cesium atoms, developed in collaboration with the Observatory of Neuchâtel. The design and partial results have been presented on various occasions. Short-term instabilities of $2 \cdot 10^{-13} \tau^{-1/2}$ are now obtained routinely with the apparatus and are limited by the signal to noise ratio of the available atomic flux. Unfortunately, efforts towards an accuracy evaluation have been thwarted by reliability problems of a rotating light trap inside the vacuum system. Indeed, one of the major differences between pulsed fountains and the continuous fountain is the fact that atoms that are interrogated must be protected from stray light produced by the other atoms which undergo simultaneously the cooling process. The devised rotating light trap based on a stepping motor fulfils the optical attenuation requirements but does not meet the necessary reliability conditions.

METAS and ON collaborate also on the construction of a second continuous fountain standard FOCS-2. The goal of this second instrument is to achieve lower short-term instabilities through a higher atomic flux obtained by implementing two techniques. First, a pre-cooling of the cesium will increase the number of atoms that can be captured in the moving molasses which is the source of the continuous atomic beam. Second, an improved scheme of transverse cooling of the launched atoms based on an optical lattice shall reduce the lateral temperature of the atomic beam and increase further the number of useful atoms. Both techniques have been successfully demonstrated in a separate experiment and are now implemented on FOCS-2. The construction of FOCS-2 is completed and the first Ramsey fringes with FOCS-2 are expected by the end of this year.

2. Timescales

METAS generates two separate time scales: TA(CH) which is free running and UTC(CH) which is steered to track UTC.

For the time being, UTC(CH) is still a paper clock. However, one of our current development projects, named UTC(CH) Real Time, aims at replacing UTC(CH) by a steered hardware clock in the course of 2007. The new time scale generation architecture involves a pair of redundant micro phase steppers tracking independently a common paper time scale.

2. Remote Comparisons

2.1 GPS links

The comparisons tying UTC(CH) into UTC are based on GPS-Common-View observations. To this end METAS operates two Ashtech Z-XII-T receivers. The link labeled CH00 (site WAB1) is used as TAI link, ID CH01 (site WAB2) is operated as a back-up. METAS took part with both links, CH00 and CH01, in the calibration campaign run by BIPM in November 2004.

2.2 IGS-Station

WAB2 is an official IGS station since June 2005. We use the same free running hydrogen maser to steer the IGS station and the TWSTFT-station. The low instability of the maser makes WAB2 interesting for studies of time and frequency transfer by GPS Carrier Phase (CP). At the same time WAB2 is well suited for comparisons between TWSTFT and GPS CP.

2.3 TWSTFT-Station

A TWSTFT-station has been commissioned at METAS at the beginning of 2005. The station is fully automated and participates now regularly in the comparisons with the partner stations in Europe and Northern America.

The station is steered by the hydrogen maser which is part of the METAS clock ensemble. Because UTC(CH) is a paper clock calculated once per day, the state of the hydrogen maser with respect to UTC(CH) is obtained by interpolation for all epochs different from UTC 00:00.

The link between PTB and METAS has been calibrated in June 2006. However, the TWSTFT-station is not yet the TAI-link.

3. MRA

The CMC for Time and Frequency of METAS have successfully passed the review process and were added to the Appendix C in April 2005.