Contribution ID: **91** Type: **Poster**

Time and frequency standards at METAS and their applications for precision measurements

Monday 10 June 2024 18:00 (2 hours)

The Swiss Federal Institute of Metrology METAS and its Photonics, Time and Frequency laboratory are responsible for realizing, maintaining and disseminating the Swiss Coordinated Universal Timescale UTC(CH), and is thus contributing to the realization of UTC at the international level. The realization of UTC(CH) is based on an ensemble of atomic clocks, jointly with our own primary frequency standard FoCS-2 and the appropriate instrumentation and clock algorithms, and provides ultra-stable reference frequencies and timescales, to address a large number of different needs from the industry and for fundamental research. In this poster we will present various applications illustrating how UTC(CH) and the atomic clock ensemble at METAS can support precision physics.

First, we will present the FoCS-2 primary frequency standard [1], a laboratory-size atomic fountain clock that uses a continuous beam of cold caesium atoms to realize the definition of the second as defined in the SI system of units. The use of a continuous instead of pulsed beam of cold cesium is a unique approach, and offers several advantages, such as the absence of the Dick effect and lower atomic density. Nevertheless, the more complex geometry brings certain constraints, such as the need to implement a microwave cavity with two interaction zones, or the presence of residual light scattered lasers used for the preparation and detection of the atoms, which need to be carefully investigated. This clock has been metrologically evaluated, yielding a total relative frequency uncertainty below 2×10^{-15}. Since 2018, FoCS-2 contributes regularly to the realization of TAI, the International Atomic Time.

Second, we will present our phase-stabilized fiber-optic frequency metrology network [2], that currently serves to disseminate the ultra-stable and accurate frequencies generated at METAS to spectroscopy laboratories located at the University of Basel and ETH Zurich. The metrology network covers a total distance of 456 km in the SWITCH fiber network, using a DWDM multiplexing in the L-band. The achieved phase noise levels and link instability will be presented. Further we will show a use case of the disseminated frequency by establishing the SI-traceability of a laser in a remote laboratory.

The implemented realization of UTC(CH) with its atomic clocks, jointly with the frequency dissemination network, is a key infrastructure to provide high performance time and frequency references. Thus it serves the future needs in fundamental metrology, especially towards the implementation of the future new definition of the second based on optical clocks, and to promote new activities in fundamental research, especially in spectroscopy.

References:

[1] A Jallageas et al., Metrologia 55 (2018) 366

[2] D. Husmann et al., Opt. Express 29 (2021) 24592-24605

Authors: Dr JALLAGEAS, Antoine (METAS); Dr HUSMANN, Dominik (METAS); Dr MOREL, Jacques (METAS)

Presenters: Dr JALLAGEAS, Antoine (METAS); Dr HUSMANN, Dominik (METAS); Dr MOREL, Jacques (METAS)

Session Classification: Poster Session 1