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Optical frequency dissemination over fiber network

E. Cantin(1,2), M. Tonnes(1), D. Xu(1), F. Frank(1), P. Tuckey(1), P.-E. Pottie* (1), O. Lopez(2) and A. Amy-Klein (2)
(1) SYRTE, Observatoire de Paris, Université PSL, CNRS, Sorbonne Université
Paris, France, e-mail: paul-eric.pottie@obspm.fr;
(2) Laboratoire de Physique des Lasers
CNRS, Université Sorbonne Paris Nord,
Villetaneuse, France; e-mail: amy@univ-paris13.fr

We report on the dissemination of optical frequency standard, on active telecommunication network, to multiple users. **This network enable optical clock comparison with France's neighbouring countries and allows simultaneously ultra-high resolution spectroscopy with atoms and molecules in research labs**.

Coherent optical fiber links are the only technique to date to enable remote optical clock comparisons with uncertainties below 1E-17 in less than a few tens of seconds, opening a new era of optical metrology [1]. Fiber links are therefore rapidly expanding. The ranges of fiber links were extended up to thousands of km [2-4], to the point they can be joined and form a concatenation of such links [5].
Provided that such techniques can be used on a fiber network, fiber links create also unique opportunities for a wide range of high precision measurements in any physics laboratories. Achieving such a goal requires not only multiple user dissemination techniques [6], but also to develop the technique from a point-to-point link to a coherent fiber network. To that aim, our groups explore several dissemination techniques and network building blocks It requires also an uptime and cycle slip free operation of the fiber links to be more than 99% over week(s) of operation. We successfully transferred the knowledge and knowhow, and now industrial grade equipment and industrial operated links reaches the target of about 99% over 1 month [7].
In this paper, we will present the latest results we achieved with the REFIMEVE network [8]. We will show experimental data supporting some science cases, as optical clock comparison and search for dark matter, and molecular spectroscopy. We will also report on the technical and fundamental limit of such coherent fiber links [9,10] and draw prospects for future applications [11,12].

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