

Ultrastable frequency transfer through international optical fiber links

Contract Period : 12 months (possibly 2 years)

Expected date of employment : 1 November 2020

Proportion of work : Full time

Remuneration : From 2695 € gross monthly according to experience

Desired level of education : PhD

Application : <https://bit.ly/3gyxGQx>

Missions

The post-doctoral researcher will participate to the development, optimization and exploitation of optical fiber links between France and UK, Germany and Italy. This work is part of an European project aiming at the very precise comparison of distant optical clocks, in order to investigate their consistency and, more generally, to perform advanced tests of physics, including for instance search for dark matter.

Activities

The post-doctoral researcher will join the group Metrology, Molecules and Fundamental tests of Laser Physics Department.

He/she will share his activities between experiments on a new optical fiber link to Italy and the optimization and exploitation of two existing links to UK and Germany. These optical links allow us to transfer an ultrastable optical signal over hundreds of km and thus to compare the best optical clocks in Europe.

The post-doctoral researcher will test different methods and configurations for the better performance of the link to the Italian border at Modane, analyze the free-running noise as well as the residual noise after noise compensation, and optimize the link.

The postdoctoral researcher will also carry out experiment on the French part of the two international links to UK and Germany and make frequency comparisons at LPL and at Strasbourg. He/she will perform various upgrades, process the data both of the link residual phase noise and the frequency comparisons, and assess the stability and uncertainty of the frequency transfer.

Skills

The candidates should have a PhD related to optics, laser-matter interaction, or optoelectronics with excellent experimental skills. Knowledge or experience in laser frequency stabilization, noise analysis or time-frequency fundamental metrology is beneficial.

Work context

Optical fiber links were developed in the last decade to transfer an ultrastable frequency reference over hundreds of km, with a minimal degradation of its stability and accuracy performance. They consist of transmitting an ultrastable laser, which frequency is controlled with atomic clocks, through an optical fiber to the remote lab. The propagation phase noise is detected through with an optical interferometer and is actively corrected. We demonstrated that the transferred signal frequency is copying the input signal frequency with residual fractional instabilities below 10^{-15} at 1-s averaging time. The long-term stability can reach the 10^{-20} range and the residual frequency offset is also in the 10^{-20} range.

This activity takes place at the Laboratoire de Physique des Lasers (UMR 7538 CNRS-Université Sorbonne Paris Nord, formerly Université Paris 13), in Villetaneuse, within the MMTF (Métrologie, Molécules et Tests Fondamentaux) group (<http://www-lpl.univ-paris13.fr/UK/Equipe-MMT-presentation.awp>). The work will be performed in close collaboration with SYRTE, the French national metrological institute for time/frequency, in Paris.

LPL (Université Sorbonne Paris Nord, CNRS) has pioneered the development of optical links for applications both in time and frequency metrology and in high-precision measurements, in close collaboration with SYRTE. We are developing a national metrological network to transfer an ultrastable frequency signal to 20 labs over France in the framework of the REFIMEVE+ project. This network is connected to PTB in Germany, NPL in UK and very recently INRIM in Italy in order to compare the best optical clocks of these countries with the clocks developed at SYRTE.

The postdoctoral researcher will be involved in our international collaboration networks in the frame of the Euramet project ROCIT (<https://www.euramet.org/research-innovation/search-research-projects/details/project/robust-optical-clocks-for-international-timescales/>).

During the period of link optimisation, or in case of failure, the post-doctoral researcher will have also to go to the field in order to perform local loss and spectrum measurements.