エクストリームフォトニクスセミナー
Extreme Photonics Seminar

No. 10

Language: Japanese

Date: Dec. 22(Thu), 2011, 15:00 ～ 17:00
Location: Cooperation Center, 5F Meeting Room, W524
（研究交流棟5階会議室 W524 ）

Title: Frequency comparison of optical lattice clocks with 17 digits precision

Speaker: Dr. Masao Takamoto (RIKEN)

With the advent of the optical frequency measurement technique using femtosecond lasers, optical clocks based on singly trapped ions and ultracold neutral atoms trapped in optical lattices are regarded as promising candidates for future atomic clocks. Sr-based optical lattice clocks were evaluated with an uncertainty of 1×10^{-15} on the basis of Cs atomic clocks and were adopted as a secondary representation of the second in 2006. To further improve their accuracy and stability, there remain essential experimental challenges. One is to find out better lattice geometries as well as atomic species that bring out the potential performance of the clock scheme, taking into account the collisional frequency shift, the blackbody radiation shift, and the atomic multipolar and hyperpolarizability effects. The other is to fully take advantage of the large number N of atoms to improve the clock stability, which is deteriorated by the instability of a probe laser due to the thermal noise of a reference cavity. Recently, we have demonstrated the frequency comparison of two optical lattice clocks synchronously interrogated by a common probe laser to cancel out the laser's frequency noise. The relative stability of 1×10^{-17} was achieved for an averaging time of 2,000 s, which is close to the quantum limit of optical lattice clocks operating with 1,000 atoms. We also discuss possible impacts of this scheme, such as investigating relativistic geodesy by comparing two accurate clocks operated in distant places.

Title: Optical science driven by high-repetition rate lasers

Speaker: Assoc.Prof. Yohei Kobayashi (ISSP, Univ.Tokyo)

High-repetition rate, mode-locked lasers are successfully used as optical frequency combs by controlling the offset frequency and the repetition frequency. The wavelength region of the optical frequency comb could be extended by frequency conversions to the infrared or XUV. High intensity, high-rep rate laser is required for the XUV comb because it is realized by high-harmonic generation. So far, 100-MHz XUV combs have been demonstrated by using an enhancement cavity technology. The intra-cavity power is limited by the mirror damage, so that we need lower repetition rate to increase the peak power of the laser, which makes higher-power coherent XUV. 10-MHz laser system would be one of the solutions for both high-intensity physics and high-precision spectroscopy. In this talk, 100-MHz and 10-MHz laser systems for XUV comb and their applications will be presented. Some other applications of the high-rep rate lasers will be also discussed.

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