# Development of a chirped pulse laser for cooling positronium

Y. Tajima[1,*], K. Yamada[2], T. Kobayashi[1], R. Uozumi[1], A. Ishida[2], T. Namba[2], S. Asai[2], M. Kuwata-Gonokami[2], K. Shu[1,2], E. Chae[1,7], K. Yoshioka[1], N. Oshima[3], B.E. O'Rourke[3], K. Michishio[3], K. Ito[3], K. Kumagai[3], R. Suzuki[3], S. Fujino[4], T. Hyodo[5], I. Mochizuki[5], K. Wada[5] and T. Kai[6]

[1]*Photon Science Center (PSC) and Department of Applied Physics, Graduate School of Engineering, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656, Japan*
[2]*Department of Physics, Graduate School of Science and ICEPP, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan*
[3]*AIST, 1-1-1 Umezono, Tsukuba, Ibaraki 305-8568, Japan*
[4]*GIC, Kyushu University, 6-1 Kasuga-koen, Kasuga, Fukuoka 816-8568, Japan*
[5]*IMSS, KEK, 1-1 Oho, Tsukuba, Ibaraki 305-0801, Japan*
[6]*JAEA, 2-4 Shirakata, Tokai-mura, Naka-gun, Ibaraki 319-1195, Japan*
[7]*Department of Physics, College of Science, Korea University, Anam-dong 5, Seongbuk-gu, Seoul 02841, South Korea*

[*]email: tajima@fs.t.u-tokyo.ac.jp

Preparing a cold gas of Positronium (Ps) at temperatures below 10 K is essential for probing fundamental physics and realizing Bose-Einstein condensation. Because of the finite lifetime of Ps, developing a rapid cooling method is the key to cooling Ps effectively. The conventional cooling method via momentum exchange process with the Ps converter was able to cool Ps atoms down to 150 K [1], which is limited by the decrease of the cooling efficiency in the low temperature region. Laser cooling of Ps using the 1S-2P transition is a promising method for rapid cooling of Ps well below 100 K. Owing to the finite lifetime and small mass of Ps, a cooling laser is required to have a broadband spectrum and a frequency chirp to overcome the Doppler broadening [2]. A long pulse duration comparable to the lifetime of Ps is also necessary. We have developed a prototypical cooling laser that satisfies these requirements and numerically formulated the temporal and spectral structures of the laser. We refer to this unique laser as a chirped pulse train generator (CPTG). Laser cooling experiments are currently underway by using this laser system.

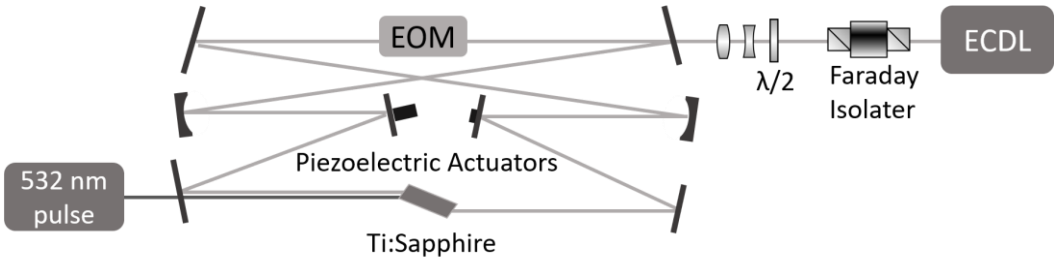


Fig.1. Schematic of the chirped pulse train generator emitting a sub-microsecond, broadband chirped pulses that consist of a train of short pulses. ECDL, external-cavity diode laser; λ/2, half-wave plate; EOM, electro-optic phase modulator.

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