cw-Lyman-alpha source for laser cooling of antihydrogen in a magnetic trap

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Antihydrogen offers great opportunities to test CPT by measuring its 1s – 2s transition frequency and comparing it to the 1s – 2s transition frequency of ordinary hydrogen. Trapping the anti-atoms in a Ioffe trap makes efficient use of the antihydrogen produced and is one of the next important milestones for the whole field. A limiting factor to the accuracy of a CPT test is the residual Zeeman shift of the 1s – 2s transition frequency in the inhomogeneous field of the magnetic trap. The line shift and broadening can be minimized by laser cooling the antihydrogen atoms into a small volume close to the center of the magnetic trap.

Antihydrogen can be cooled using its 1s – 2p transition, which requires laser light at 122 nm. Continuous radiation at this wavelength can be produced by four-wave mixing in mercury vapor. Fundamental laser beams at 254 nm, 408 nm, and 545 nm are used. These fundamental beams are generated by frequency quadrupling a Ytterbium disc laser at 1015 nm, frequency doubling an Verdi pumped ti:sapphire laser at 816 nm, and frequency doubling a fiber laser at 1091 nm.