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Realization of an atomic inner-shell x-ray laser at the Linac Coherent Light Source[1]

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Since the invention of the laser fifty years ago, laser amplification of atomic transitions have been extended to increasingly high power and shorter wavelength. We report on the first successful realization of an atomic x-ray lasing scheme based on photoionization of inner-shell electrons in Neon by the Linac Coherent Light Source (LCLS). By focusing LCLS pulses of 960 eV photon energy into a dense Neon gas sample to a micrometer sized spot, a long narrow plasma column is created on a fs time scale by photoionization of a K-shell electron. Thereby, a population inversion of the 2p-1s transition in singly ionized Neon is established, lasting for only 2.7 fs due to the subsequent Auger decay of the created core hole. Fluorescence photons emitted at the front end of the plasma column get amplified by stimulated emission, resulting in ultra bright, high-intensity x-ray pulses at 850 eV photon energy of fs duration at the exit of the plasma column. The experimental results will be discussed in conjunction with theory and self-consistent gain calculations.

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