Laboratory experiment of astronomical photoionized plasma by utilizing high-power laser facility

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X-ray spectroscopy with x-ray satellites (Chandra, ASTRO-E, XMM-Newton) is the main observation almethod to get information about compact objects in binary systems, especially black holes. Evolution ofcompact objects is indirectly studied by observing x-ray continuum from a heated accretion disc and x-ray fluorescence from the ambient gas of the stellar wind in binary systems. X-ray line emissions in the several-keV spectral range were observed from accreting clouds of binary systems, such as CYGNUS X-3 and VELA X-1, in which high-intensity x-ray continua from compact objects (neutron stars, black holes, or white dwarfs) irradiate the cold and rarefied clouds. X-ray continuum-induced line emission accurately describes the accreting clouds, but experimental verification of this photoionized plasma model is scarce. Here we report the generation of photoionized plasmas in the laboratory under well-characterized conditions using a high-power laser. A blackbody radiator at a temperature of 500 eV, corresponding to a compact object, was created by means of a laser-driven implosion. The emerging x-rays irradiate a low density (ne < 1020 cm−3) and low temperature (Te < 30 eV) silicon plasma. Line emissions from lithium- and helium-like silicon ions were observed from a thermally cold silicon plasma in the 1.8 - 1.9 keV spectral region, far from equilibrium conditions. This result reveals the laboratory generation of a photoionizing plasma. Atomic kinetic calculations imply the importance of direct K-shell photoionization by incoming hard x-rays. Future plan of experiment on National Ignition Facility is also described.