Laboratory spectroscopy of photoionized silicon plasma generated with 0.5 keV blackbody radiator

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X-ray spectroscopy with an x-ray satellite is the main observational method to give information about compact objects. Evolution of compact 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 the binary systems. To derive physical properties from the observations, x-ray astronomers rely on non-local-thermodynamical-equilibrium (non-LTE) atomic physics in a cold ambient gas subject to an extreme radiation field, for which the mean radiation temperature is of the order of 1 keV. High power laser is the unique facility that can produce a several keV blackbody radiator by the mean of implosion [1, 2].

Laser implosion is used to create a flash of brilliant Planckian x-rays those simulate x rays from the astronomical compact object. The imploded core approaches 0.5 keV in temperature and 0.1 g/cm^2 in areal density. This areal density is high enough to be optically thick for 1.4 (= 0.5 x 2.8) keV x-rays, then the imploded core emits Planckian x rays whose radiation temperature is 0.5 keV. A cold and rarefied silicon plasma, mimicking the stellar wind around the compact object, is generated in the vicinity of the core. The silicon plasma is photoionized by intense radiation from the core plasma, then x rays emitted from the plasma have characteristic spectra those are quite similar to astronomical x-ray spectra. The observations were analyzed with several atomic codes coupled with a hydrodynamic simulation code to confirm non-LTE atomic physics relevant to x-ray astronomy.

References

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