ICTP-IAEA School on Atomic and Molecular Spectroscopy in Plasmas

Spectral Unraveling of EUV Lithography Light Sources

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Abstract

Sn laser produced plasmas (LPPs) are of great technological interest, being used as sources of extreme ultraviolet (EUV) light in next-generation nanolithographic applications. Due to the complex electronic configurations of the relevant ions $Sn^{7+...14+}$, arising from their open 4*d* subshell, spectroscopic investigation of these plasmas such as level and line identifications can be challenging. These sources also emit radiation outside this wavelength band and have a spectrum including deep ultraviolet (DUV) wavelengths. Spectral monitoring from EUV to DUV wavelengths is necessary to establish a full energy balance. Spectral information can be provided by a broadband spectrometer based on a transmission grating. The transmission geometry enables a compact design and a straightforward alignment. We will unravel two types of plasma sources of EUV light using such spectrometers. The first type is a state-of-the-art CO_2-gas-laser-driven source while the second type is a prototype solid-state-laser-driven source. The spectral characteristics of the sources are expected to differ, and a direct comparison will provide insights into the fundamental-physics limitations of their performance regarding both EUV and DUV emissions. This goal will be achieved through two research objectives: (A) providing a full spectral characterization of these sources, through the development of a novel transmission-grating enabling single-diffraction order spectrometry and; (B) providing a spatially resolved spectral “image” of the source, through the development of a novel imaging transmission grating.