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Time-Resolved Measurement of Optical Emission Line Profiles from Electron Cyclotron Resonance Ion Source Plasma

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Optical emission spectroscopy provides a noninvasive method to probe the properties of hot and highly charged magnetically confined plasmas. The optical emission line profiles enable, for example, identifying the different species and characterizing the relative population densities and temperatures of the ions and neutrals forming the plasma. The feasibility of this approach has been demonstrated at University of Jyväskylä accelerator laboratory by measuring the light emitted by Electron Cyclotron Resonance Ion Source (ECRIS) plasma with a high-resolution spectrometer setup POSSU (Plasma Optical SpectroScopy Unit). In these previous studies the emission line profiles were measured by scanning the desired wavelength range by rotating the diffraction grating of the spectrometer. This process is slow compared to many interesting plasma phenomena, thus limiting the applicability of the setup. Recently, POSSU has been upgraded by changing the light sensor from a photomultiplier tube to a position sensitive imaging sensor. As a result, it is possible to measure simultaneously a 1 - 2 nm wavelength range, with a spectral resolution in the order of picometers, without moving the grating. This enables time-resolved study of the optical emission line profiles. The measured wavelength region can be chosen between 370 nm and 870 nm, which covers the visible light spectrum, by turning the grating. The time evolution of optical emission line profiles emitted from the JYFL 14 GHz ECRIS plasma, during shifting plasma conditions induced by changing the gas balance, has been measured to demonstrate this new capability. The temporal evolution of temperatures and emission intensities of selected ion and neutral species, correlated with extracted ion beam currents, are presented.

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Yes

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