INTENSITY RADIAL PROFILE STUDY OF CV(308 eV) LINE AT TOKAMAK CASTOR

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I. Introduction

The most intensive lines of the H- and He-like Carbon have been clear identified in an ultra-soft x-ray (XUV) wavelength range, 1-10 nm. The scanning of the emission spectra performs the basic information on Carbon behaviour in a plasma. In addition, the present used XUV diagnostic systems perform the absolute and the time resolved measurements of the selected resonance line with enough high accuracy and make possible the observation of the temporal behaviour of the impurity concentration in tokamak plasma by a relatively simple way.

In CASTOR, the impurity content monitoring was managed by use of the multichannel monochromator equipped by multilayer disperse element and sensitive detection assembly. Later our interest was turned to the design and fabrication of an imaging like instrument, which enables to observe the spatial and temporal behaviour of the impurity content in a relative large volume of plasma.

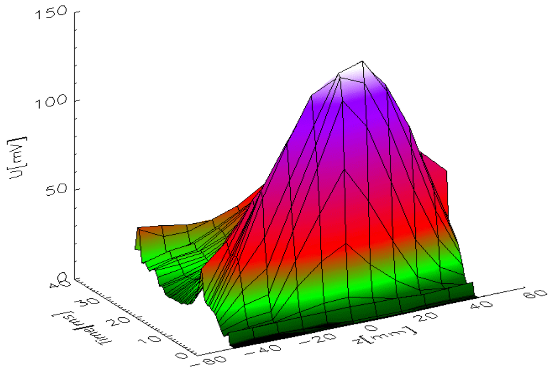

Fig.1 *Time evolution of CV intensity radial profile in ohmic heating regime*

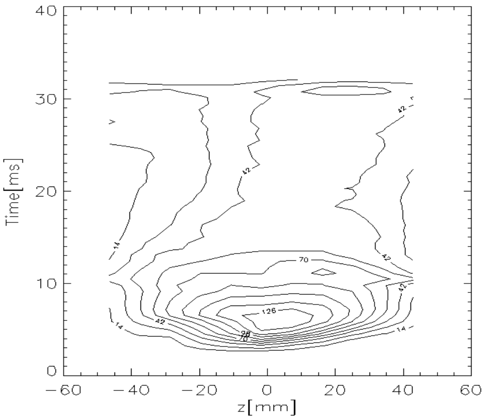

Fig.2 *Contour plot of CV intensity dedicated from Fig.1*

II. CV radial profile measurement

The radial profile of the chord - integrated intensity of CV(308 eV/4.03 nm) spectral line was measured by tilting of the Imaging XUV Monochromator over the full plasma radial cross-section of 170 mm in diameter. The imaging reduced factor is equal three. The emission from the plasma volume of 60 mm in radial dimension is imagined at the two-stage microchannel plate assembly of 20 mm effective diameter, which is screened by 0.24 µm thick Ag filter. The detector consist of the eight anode-collectors each of 2 mm width and of 0.5 mm spacing.

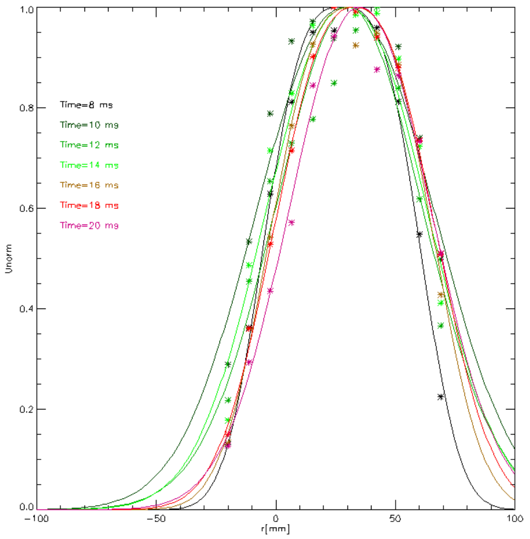

Fig.3 *Normalised radial intensity profile, diameter of plasma limiter: 170 mm*

The signal of each collector represents the emission power detected at different view angle and can be processed for line profile reconstruction. The final radial profile is created by combination all of the “collector profiles“ . The spatial resolution, influenced by collector width, is found better than 10 mm in plasma volume. The use of the multi-anode-collector brings an other useful remarkable profit: a direct observation of the time evolution of radial profile of the spectral line emission, **Fig.1**, and space & time contours of the equal intensity levels presented in **Fig.2** .

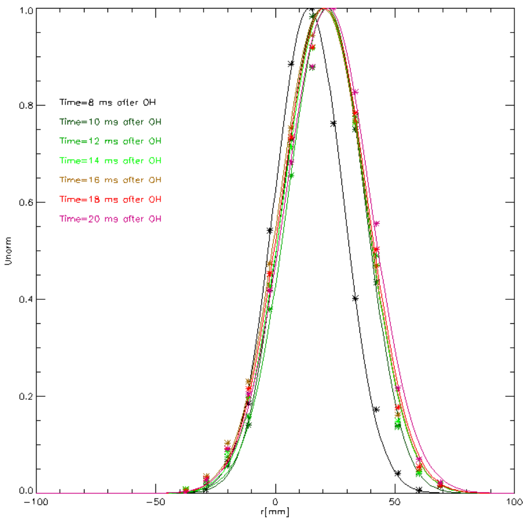

Fig.4 *Normalised radial intensity profile, diameter of plasma limiter: 120 mm*

The shape variations of radial profile of Carbon CV(308eV/4.03nm) line detected emission power during the plasma discharge are shown in **Fig. 3** and **Fig.4** for different diameters of the plasma limiter,170 mm and 120 mm. The experimental points are interspaced by Gaussian-like curve. In ohmic heating regime, the plasma discharge conditions are kept near to the same during the twenty following discharges, which are usually used for plasma cross scanning. The changing of the profile half-width by changing of the limiter diameter confirm the supposed space-resolution of the used method. Compare **Fig.3** and **Fig.4**.

III. Effect of biasing on CV radial profile

A biasing electrode installed in CASTOR can be moved in radial direction. Usually the biasing potential is applied in quasi-state plasma conditions, approximately ten milliseconds after the discharge start. The biasing pulse duration is 5 ms only. Depending on biasing electrode radial position and applied biasing potential the different influence of biasing on plasma parameters behaviour is observed. If the biasing electrode is positioned inside the last closed magnetic surface, at radius of 50 mm, and applied potential is + 200V, the intensity of Halpha falls during the biasing and consequently the chord-integrated intensity of CV line emission grows up, while the intensity of CIII line, which is proportional to Carbon inflow, stay unchanged, see in **Fig. 5.** Remarkable profile changes are observed after the biasing pulse only, see **Fig. 6** and **7**. In another cases of the biasing, the CV line profile grows up together with the intensity of Halpha and CIII line.

IV. Discussion

The absence of the direct measurements of the radial profile of the electron temperature and electron density during the plasma discharge in tokamak CASTOR makes the treatment of the imaging XUV spectroscopy results very difficult. The observed radial profile of the chord-integrated intensity of the CV line emission is central for the excitation potential

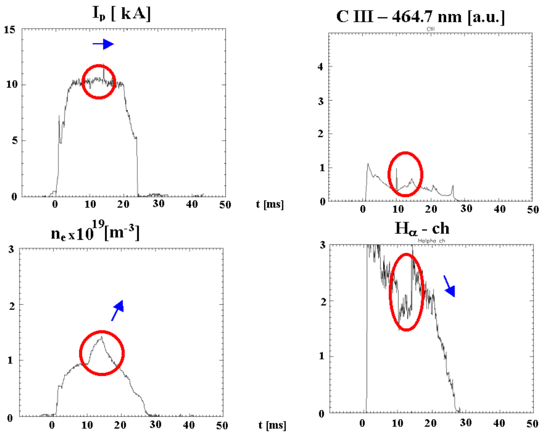

Fig.5 *Plasma discharge parameters. Biasing at 10 ms, Δt=5 ms*

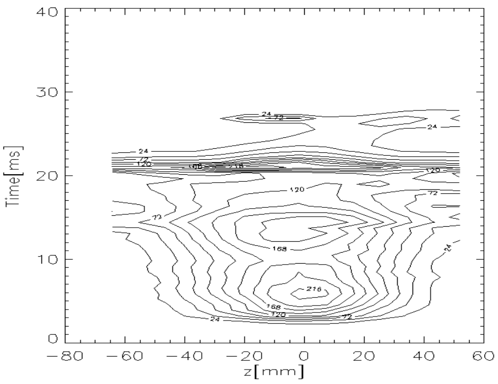

Fig.6 *Time and space evolution of CV intensity contours. Biasing at 10 ms, Δt=5 ms*

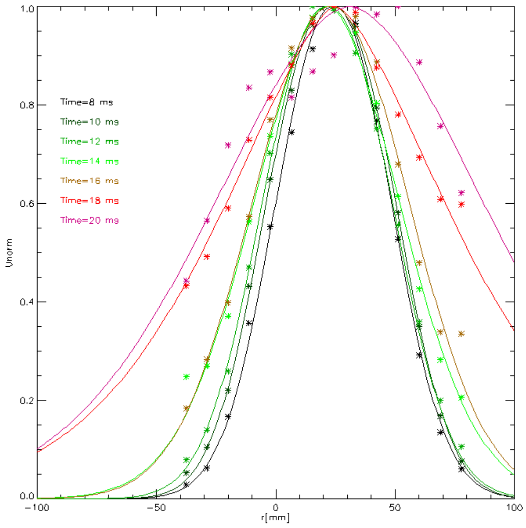

Fig.7 *Normalised radial intensity profile. Biasing at 10 ms, Δt=5 ms*

of this line is much higher than central electron temperature. Such character of the radial profile is consistent with model calculations using the emission&transport code STRAHL, if the central electron temperature is taken near to 150 eV, the profiles of Te and ne are fitted in parabolic form and average diffusion coefficient D is higher than 2 m^2/s. Unfortunately the spatial resolution of the current used experimental spectroscopy method is insufficient for more precise analyse of the diffusion coefficient values.

V. Conclusion

The presented Imaging XUV Monochromator became a powerful instrument on radial and temporal measurements of the chord-integrated intensity of the CV(308eV/4.03 nm) spectral line emission of large plasma volume in tokamak CASTOR experimental conditions. The CV radial profiles are nearly Gaussian, but asymmetric in the tail.

The spatial resolution of detection system of the presented instrument is necessary to improve with the view of impurity transport study.

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VI. References

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