6. PARTICIPATION IN THE MAST PROGRAMME[1]

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6.1. INTRODUCTION

The main objective of this project is the development and scientific exploitation of a microwave reflectometer for MAST[2], operating in O-mode FM-CW in three frequency bands (K, Ka and U), from 18 to 60 GHz.

During 2004, the VCO oscillator (Ka-band) has been replaced, resulting on a significant reduction of higher order harmonic levels. New static and dynamic calibration curves have been extracted and included in the data processing. The video amplifiers have been replaced improving the signal to noise level. The tuning circuit has been upgrade to fulfil the requirements of full band operation. The dedicated fast data acquisition system based on a VME board developed by CFN with capability to pre-program the samples has been brought to full operation. Several software tools for data analysis have been adapted. The scientific exploitation of the diagnostic has started.

6.2. EXPERIMENTAL RESULTS

6.2.1. Tests

The ASDEX-Upgrade ray-tracing code has been adapted to assess the power losses of the signals received by the MAST microwave antennas. Results (Figure 6.1) show that the diagnostic can accommodate a misalignment smaller than half the dimensions of the antenna mouth.

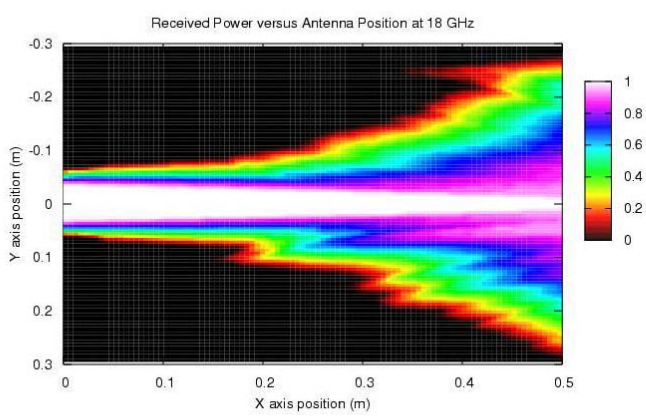

Figure 6.1 – Power received in the antenna (launching frequency 18 GHz) versus the position of the antenna mouth centre. Plasma edge is at 55cm.

6.2.2. Density profiles

Figure 6.2 displays a plasma density profile obtained with the Thomson scattering diagnostic in the plasma core (green) and with the reflectometry diagnostic at the plasma edge (red).

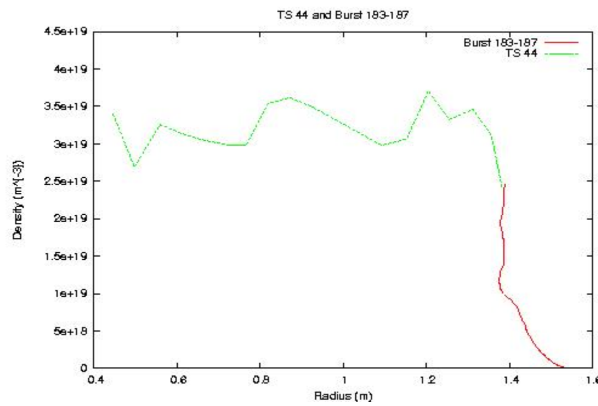

Figure 6.2 – Plasma density profile obtained from Thomson Scattering (green) plus Reflectometry (red).

The MAST reflectometry diagnostic can resolve fast plasma events such as ELMs. Figure 6.3 shows the abrupt outward movements of the probed layer coinciding with the spikes of the D_α signal (in green) at the ELM occurrence, indicating a sudden flattening of the edge density profile.

Additional information is obtained from the time evolution of the spectra of the signal reflected from a probed layer with $n_e = 0.6\times10^{19}$ m^{-3} (Figure 6.4). At each ELM, a broadening of the spectra is observed due to the increase of plasma turbulence at the plasma edge. In the second ELM, the group delay of the probing microwaves (indicating the distance from the antenna to the reflecting layer) increases shortly after the onset of the ELM and the decrease (from 0.224 to 0.2248 s) indicating a recovery phase in agreement with the decrease of the D_α signal.

[1] Work carried out in collaboration with the Association EURATOM/UKAEA. Contact Person: Geoffrey Cunningham.

[2] MAST is a tokamak of the Association EURATOM/UKAEA.

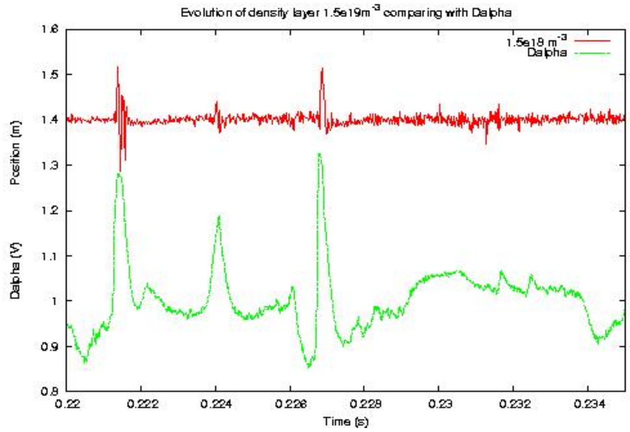

Figure 6.3 - Temporal evolution of a density layer of $1.5x10^{19}\ m^{-3}$ (in red) compared to the Dalpha signal of the plasma (in green).

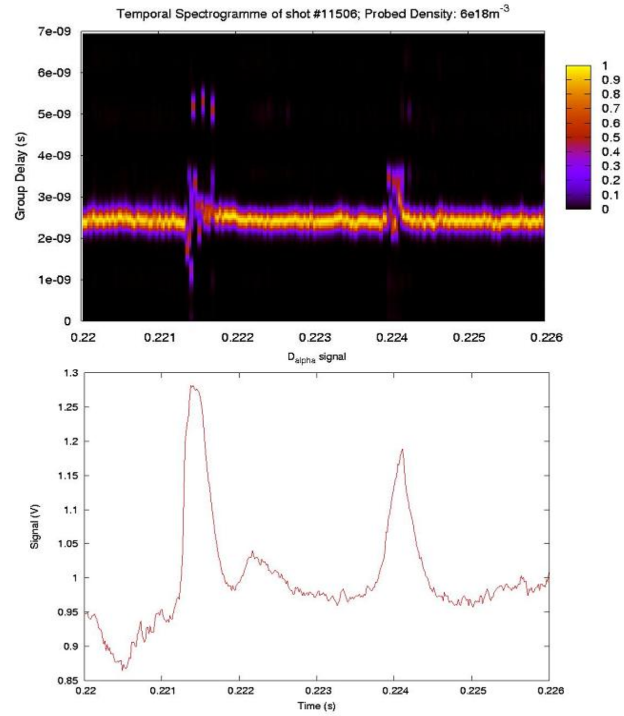

Figure 6.4 – Time evolution of spectra of the signal reflected from density layer $n_e = 0.6e^{19} m^{-3}$.