MECHANICAL DESIGN OF A TWO DIMENSIONAL TURBULENCE MEASUREMENT ON MAST TOKAMAK USING BEAM EMISSION SPECTROSCOPY (BES)

Istvan Gabor Kiss[1], Botond Meszaros, Daniel Dunai, Sandor Zoletnik[1], Anthony Field, Rob Gaffka[2]

[1] *KFKI RMKI, Budapest, Hungary*
[2] *CCFE, Culham Science Centre, Abingdon, Oxon, UK*

Corresponding author: kiss@rmki.kfki.hu

An interesting and exhaustively researched part of plasma physics is the investigation of plasma turbulence with theoretical calculations and verifying them with experiments. This is important because turbulence is responsible for the anomalous heat- and particle-transport which contributes essentially to the quality of confinement in fusion plasmas.
KFKI RMKI has started an overall program for investigation of turbulence on different tokamaks since a decade. The Beam Emission Spectroscopy (BES) is one of the techniques in the program.
The essence of the BES is to shoot a high energy neutral atomic beam into the hot plasma which excites beam atoms, then during their de-energization, they emit light. One must collect this light with an appropriate optical system and measure its intensity with a high efficiency detector. From its signal, the density profile of the plasma and its rapid changes can be determined. This optical system should be able to collect enough light from the plasma-beam interaction. Because of this it should be located close to the source of light. In order to complete this, the first optical elements are usually installed in the vacuum vessel in a well defined location, satisfying other requirements.
Today, for the design and construction of these systems the competent engineering background is indispensable since the devices are becoming more and more complex and because of the harsh operating conditions inside the tokamak.
This article will present the mechanical design of the new MAST BES system, with special emphasis on its in-vessel components. This system shall operate beside an existing, preliminary version of the system.
Its first optical elements are placed inside the vacuum vessel. It includes a rotatable first mirror, that will be used to scan along the neutral beam, a folding mirror, and some lenses as well. These elements are custom made ones due to their large diameters. Requirement was the adjustability of the first mirror's rotation axis without affecting its centre point.
Additionally a shutter had to be designed to close the system protecting them from certain impacts during vessel conditioning.
After manufacturing and assembling the BES system, it has been extensively tested at RMKI involving vacuum integrity and first mirror reproducibility tests.