ON THE POSSIBILITY OF q-PROFILE MEASUREMENT BY OBSERVATION OF PELLET ABLATION BY A FAST-FRAMING CAMERA AT ASDEX UPGRADE

H.W. Müller, M. Bessenrodt-Weberpals, K. Büchl, M. Kaufmann, P.T. Lang, P. McCarthy, V. Mertens, I. Miroshnikov, W. Schneider, H. P. Zehrfeld, H. Zohm, ASDEX Upgrade Team*
Max-Planck-Institut für Plasmaphysik, EURATOM-Assoziation
** Technical University St. Petersburg*

Knowledge and control of the current-density-profile in a tokamak is of great importance for interpretation and future active control of improved stability and confinement. Another aim of fusion research is the control of bootstrap current with respect to advanced tokamaks. We report on the possibility of q-profile measurement by observation of pellet ablation clouds using a fast-framing camera at ASDEX Upgrade.

When injecting a pellet into a hot plasma, the ablating material forms a spatial sequence of flux tubes following the magnetic field lines. Inside the flux tube, a cold, dense, high collisional plasma, containing a small fraction of neutrals, emits visible light after undergoing collisional excitation. Therefore, it is possible to observe the flux tube. Observation along the pellet path by means of a fast-framing camera, enables to measure the inclination angle of the magnetic field with respect to the torus midplane. For our investigations, we used a fast-framing camera with rotating mirror, developed at the TU St. Petersburg. The temporal resolution of the sequence was $4\mu s$. During one pellet ablation, we got up to 63 frames.

The measured inclination angle is a local quantity in contrast to the safety-factor being a flux surface quantity. Therefore, further information about the flux surface from an equilibrium code is necessary to obtain the safety-factor from the inclination angle. The results of our q-profile measurement by pellet ablation were compared to the results of other diagnostics for q-profile measurement at ASDEX Upgrade. There was good agreement with the results obtained by the magnetic equilibrium reconstruction, but, towards the plasma center, some differences appeared, reflecting the fact that the magnetic reconstruction faces increasing uncertainties when progressing to the inner flux surfaces. By varying the current profiles used for the magnetic reconstruction, an equilibrium producing the measured profile of inclination angles could be found.

We analysed the precision of the reported measurement and the resulting error bars on the q-profile.