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X-ray Pinhole Camera Setups used in the Atomki ECR Laboratory for Plasma Diagnostics

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Imaging of the electron cyclotron resonance (ECR) plasmas by using CCD camera in combination with a pinhole is a non-destructive diagnostics method to record the strongly inhomogeneous spatial density distribution of the X-ray emitted by the plasma and by the chamber walls. This method can provide information on the location of the collisions between warm electrons and multiple charged ions/atoms, opening the possibility to investigate the direct effect of the ion source tuning parameters to the plasma structure. Studying the bremsstrahlung radiation can give information on the lost high energy electrons and, consequently, on the energy transfer from microwave to electrons.

The first successful experiment with a pinhole X-ray camera was carried out in the Atomki ECR Laboratory more than 10 years ago. The goal of that experiment was to make the first ECR X-ray photos and to carry out simple studies on the effect of some setting parameters (magnetic field, extraction, disc voltage, gas mixing, etc.). Motivated by the unique feature of this method recently intensive efforts were taken to investigate now the effect of different RF resonant modes to the plasma structure. Comparing to the 2002 experiment this campaign used wider instrumental stock: CCD camera with a lead pinhole was placed at the injection side allowing X-ray imaging and beam extraction simultaneously. Additionally, SDD and HpGe detectors were installed to characterize the volumetric X-ray emission rate caused by the warm and hot electron domains.

In this paper detailed comparison study on the two X-ray camera and detector setups and also on the technical and scientific goals of the experiments will be presented.