An ECR Table Plasma Generator

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A simple ECR plasma device was built in our laboratory using the “spare parts” of the ATOMKI ECR ion source. We call it “ECR Table Plasma Generator”.

The plasma generator so far was used to prepare and test a plasma diagnostic measurement in the visible light range. A method is being worked out to withdraw as much axial spatial information from 2D pictures for a given plasma as possible.

The intended field of usage of the plasma generator:
1. Simple, cheap and safe educational working place for students.
2. To prepare, to practice or to test measurements with electrostatic movable Langmuir probes.
3. To prepare, to practice or to test plasma diagnostic measurements in the visible light and X-ray ranges using cameras and spectrometers.
4. To cover and/or to modify solid surfaces with plasma particles, e.g. fullerene (C60) ions.
5. To test and practice special microwave modes (pulsed power, frequency sweeper, double frequency etc.).

The 14.3 GHz ATOMKI-ECRIS for highly charged plasmas and beams.

We built a second ECR facility from the spare parts of the “big” ECRIS. It became a compact device with very low power consumption which can be placed even on a table.

Technical features:
- plasma chamber ID=10.2 cm, L=20-40 cm, double walled, water-cooled
- NdFeB hexapole, L=24 cm, R=0.65 T at chamber wall, Halbach-type,
- WR-62 and WR-90 microwave connections
- microwave oscillator (HP 8350B + plug-ins)
- TWT amplifiers (max 20 W) frequency 6-18 GHz (variable).
- One or two microwaves can be coupled.
- 3 vacuum ports for electrical or motion feedthroughs, for ovens, probes, etc.
- observing window (ID=6cm) or sample holder at „extraction” side
- gas dosing system
- turbopump vacuum system

During 15 years: many spare parts in the ECR lab.

Experimental setup

This method based on elementary optical calculation

By measuring the distance between the image plane and the focal plane, the depth of field can be determined.

\[ D = \frac{f^2}{2} \]

Gas tube

Typical image of the series: The red circle shows the placement of the gas tube

We can get a 9.2mm thick slice of the plasma in the given object distance using intensity filtering in the low intensity range.

This photo series contain enough information to build a 3D picture of the plasma

In order to map axially through the plasma we took photo series by moving the camera on the axis in 10mm steps with unchanged camera settings.

3D picture of the plasma

We found that the position of the gas tube determine the structure of the plasma. Where the gas was injected the plasma appears close to the injection. However the other parts of the plasma appear at different axial distance from the injection plane (mesh 4 in exp. setup)

The ATOMKI ECR Table Plasma Generator

Radially confined ECR-plasma. The strong asymmetry caused by the side position of the gas tube. On-axis (up) and off-axis (bottom) views.

There is no axial magnetic trap and there is no extraction system at all.

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