Visualization of magnetic field lines at the WEGA stellarator

P. Drewelow, T. Bräuer, M. Otte and F. Wagner

Max-Planck-Institut für Plasmaphysik branch Greifswald, EURATOM Assoziation, Wendelsteinstraße 1, 17491 Greifswald, Germany

peter.drewelow@ipp.mpg.de

Magnetic confinement can be applied to provide sufficient thermal insulation for plasmas in fusion-experiments. However, field perturbations can decrease the quality of confining field configurations significantly. The precise knowledge of the magnetic configuration is therefore of interest. A common method to survey the magnetic field structure in a stellarator, utilizes electrons as test particles, which follow the magnetic field line. To detect a beam of those electrons, a fluorescent detector, e.g. a moving bar or a transparent mesh, is placed in a usually poloidal cross section of the vacuum vessel. For different radial positions of the electron source, a picture of the intersection points of the beam on the respective flux surface is taken. The result is a poloidal cut view of the magnetic flux surfaces like shown in figure 1 a. This technique has been applied in different experiments before [1, 2 and 3].

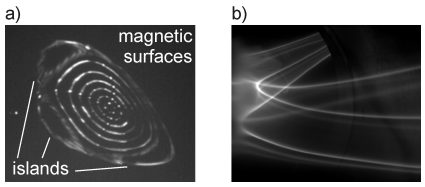

Figure 1: (a) Poloidal cross sectional view of magnetic flux surfaces at WEGA [1], (b) tangential view in the WEGA torus with a luminescent trace visualizing a magnetic field line.

A new measurement technique will be presented, which provides additional 3-dimensional information on the structure of the magnetic field in a stellarator type experiment. It makes use of the fact that an electron beam folowing a field line in a background gas creates a luminescent trace because of electron impact excitations [4]. Thus, a magnetic field line can be visualized in the whole torus as shown in figure 1 b. The spatial structure of the trace is analyzed by means of close-range photogrammetry. In addition to the poloidal cut views obtained with the fluorescent bar method, this technique provides 3-dimensional information on the magnetic field. The presented work comprises of a test and optimization of the main diagnostic components and measurements of magnetic field lines at the stellarator WEGA. The results of this survey are presented and discussed with respect to error sources and possible future applications.

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[3] O. Motojima, H. Yamada et al., Physisc of Plasmas **6** No. 5 (1999), pp 1843
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