Proposal for a GOLEM experiment from BME NTI

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Chapter 1

Introduction

The proposed experiment series is a laboratory exercise performed by 7 students at the nuclear technology branch of the physics MSc program at Budapest University of Technology and Economics (BME). The laboratory exercise is to be organized at 16th September 2010. 12:15 - 18:00. Prior to the actual measurement, students are provided with detailed instructions and a 1 hour long tutorial on the basic concept of tokamaks and the characteristics of the GOLEM tokamak. Measurements at GOLEM should start at about 13:15.

Chapter 2

Proposed experiments

- Date and time: 16th September 2010. 13:15
- Total number of shots: 60
- Mode: Online
- Remote control interface: makefile script in SSH shell
- Real-time communication: Skype chat

2.1 Measurement conditions

The GOLEM tokamak is a tokamak with full remote control capability and educational purpose. It is a small size tokamak device equipped with basic controls and diagnostics having dimensions:

- Major radius at the magnetic axis: $R_0 = 0.4$ m.
- Minor radius: $r_0 = 0.1$ m.
- Radial position of the limiter: $a_0 = 0.085$ m.

The parameters to be set remotely:

- Toroidal magnetic field (B_t) through the voltage of the toroidal field capacitor bank (U_B).
- Toroidal electric field (E_t) through the capacitor bank for the ohmic heating (U_E).
- The time delay between the triggers of the toroidal field and the ohmic heating (τ).
- Hydrogen gas pressure (P_{H2}).

The diagnostics used during the proposed session and to be accessed online:

- Loop voltage (U_{loop}).
- Total toroidal current by Rogowski coil (I_{tot}).

- Toroidal field measurement coil (B_t).
- Plasma radiation by photodiode.
- Vessel pressure (P_v).
- The temperature of the vacuum chamber (T_{ch}).

2.2 Proposed discharges

1. Vacuum shots with varying parameters to determine the electrical parameters (resistivity and inductance) of the vacuum vessel. A simple estimation is to be carried out online.
2. Normal plasma shots with varying parameters and the time delay set to about 12-13 ms, which is the flat top time of the toroidal magnetic field. Aim is the estimation of:
   (a) the break down voltage - Paschen law parameters.
   (b) time trace of the plasma current
   (c) time trace of the Ohmic heating power
   (d) time trace of the edge safety factor (rough estimate!)
   (e) time trace of the central electron temperature (rough estimate!)
   (f) plasma density in each shot (order of magnitude estimate!)
   (g) time trace of the total kinetic plasma energy (order of magnitude estimate!)
   (h) energy confinement time at the "'flat top"' (order of magnitude estimate!)
   (i) Hugill diagram with H_2 pressure instead of plasma density. (Could be attempted using estimated plasma density.)
3. An attempt to detect the q=2 instability limit. To achieve this, the time delay should be set to the ramp-down of the toroidal magnetic field. Plot results in the Hugill-like diagram described above.