

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 4 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 24th March 2010. 8:15. 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 9:30.

## Chapter 2

# Proposed experiments

- Date and time: 24th March 2010. 9:30
- 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 ( $\tau$ ).
- Hydrogen gas pressure ( $P_{H_2}$ ).

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, and a more sophisticated estimate offline.
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.