Proposal for a GOLEM experiment from BME NTI

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Chapter 1

Introduction

Aim of the proposed experiment series is to test the scenario of a measurement for students on GOLEM tokamak from BME NTI. Our aim is to make some basic tokamak measurements for students those are at the nuclear field within the confines of the so called special laboratories subject. For this reason and to acquaint the students with the basics of plasma physics and the GOLEM tokamak device, we will make a quite detailed instruction to the measurement in English language.

1.1 Capabilities of GOLEM

The GOLEM is a small size tokamak device with basic controls and diagnostics. It is ideal to acquaint students with tokamak operation and magnetically confined plasmas.

The parameters we would like to change during our session:

- 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).
- Vessel pressure through the vacuum system (P_v).
- Hydrogen gas pressure (P_{H2}).
- The time delay between the triggers of the toroidal field and the ohmic heating (τ).
- The temperature of the vacuum chamber (T_{ch}).

The diagnostics we would like to use during our session:

- All magnetic diagnostics those are available.
- Photocell.

Chapter 2

Proposed experiments

- Total number of shots: 60
- Mode: Offline

We propose the following measurements:

1. Vacuum shots with varying parameters to determine the electrical parameters (resistivity and inductance) of the vacuum vessel.
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
   (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!)
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.
4. An attempt to produce runaway discharges. The key question is the initial density and ionization rate.

#	p_{H2} [mPa]	U_B [V]	U_E [V]	τ [us]	notes
1-7	pump limit	200,400,800	400,800	2000,7000,13000	normal vacuum shots
8-35	60,100	400,800	200-800	7000	normal plasma shots
36-51	40,60,80,100	400,600	600,800	13000	q=2 instability shots
52-60	20,30,35	800	600,700,800	7000	runaway shots

Table 2.1: Proposed shots

2.1 Makefile

```
# echo for testing make for running
# parameters to set:
# Ue, Ub, Td, pH2, H2filling

SHOTCMD=make

# 7
vacuum_seq:
make -iBs -C velin shot Ue=400 Ub=400 Td=7000 H2filling=0 pH2=0
make -iBs -C velin shot Ue=400 Ub=400 Td=2000 H2filling=0 pH2=0
make -iBs -C velin shot Ue=400 Ub=400 Td=13000 H2filling=0 pH2=0
make -iBs -C velin shot Ue=200 Ub=400 Td=7000 H2filling=0 pH2=0
make -iBs -C velin shot Ue=800 Ub=400 Td=7000 H2filling=0 pH2=0
make -iBs -C velin shot Ue=400 Ub=800 Td=7000 H2filling=0 pH2=0
make -iBs -C velin shot Ue=800 Ub=800 Td=7000 H2filling=0 pH2=0

# 28
normal_seq:
Td=7000;\
H2filling=1;\
for pH2 in 60 100; do\
for Ub in 400 800; do\
for Ue in ‘seq 200 100 800‘; do\
${SHOTCMD} -C velin -iBs shot Ue=$$Ue Ub=$$Ub Td=$$Td pH2=$$pH2 H2filling=$$H2filling;\
done;\
done;\
done;\

# 16
qedge_seq:
Td=13000;\
H2filling=1;\
for pH2 in 40 60 80 100; do\
for Ub in 400 600; do\
for Ue in 600 800; do\
${SHOTCMD} -C velin -iBs shot Ue=$$Ue Ub=$$Ub Td=$$Td pH2=$$pH2 H2filling=$$H2filling;\
done;\
```

```
done;\
done;\

# 9
runaway_seq:
Td=7000;\
H2filling=1;\
Ub=800;\
for pH2 in 25 30 35; do\
for Ue in 600 700 800; do\
${SHOTCMD} -C velin -iBs shot Ue=$$Ue Ub=$$Ub Td=$$Td pH2=$$pH2 H2filling=$$H2filling;\
done;\
done;\
```