Where are the GOLEM discharges in the $n.T_i.\tau_E$ vs. T_i diagram ?

Outline

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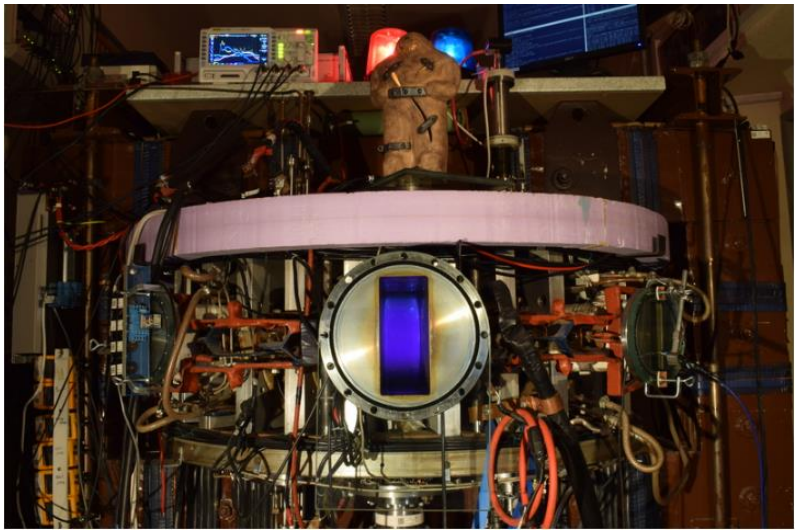
Introduction

GOLEM



- Small tokamak (R=0.4 m, a=0.06 m)
- Educational purpose

Questions:

1- How change the plasma characteristics when on varies the voltage applied to the toroidal field capacitor ?

2- Where are the GOLEM discharges in the $n.T_i.\tau_E$ vs. T_i diagram ?

Definition of some parameters

Safety factor (q) : the number of toroidal turns that a field line covers for one poloidal turn

Energy confinement time (τ_E) : the characteristic time at which energy contained in the plasma escapes from the discharge

Lawson criterion (Triple product $n.T_i.\tau_E$) : factor of merit of the discharge which must be larger than 10^{21} m^{-3}.keV.s for the fusion power to be equal to the input power

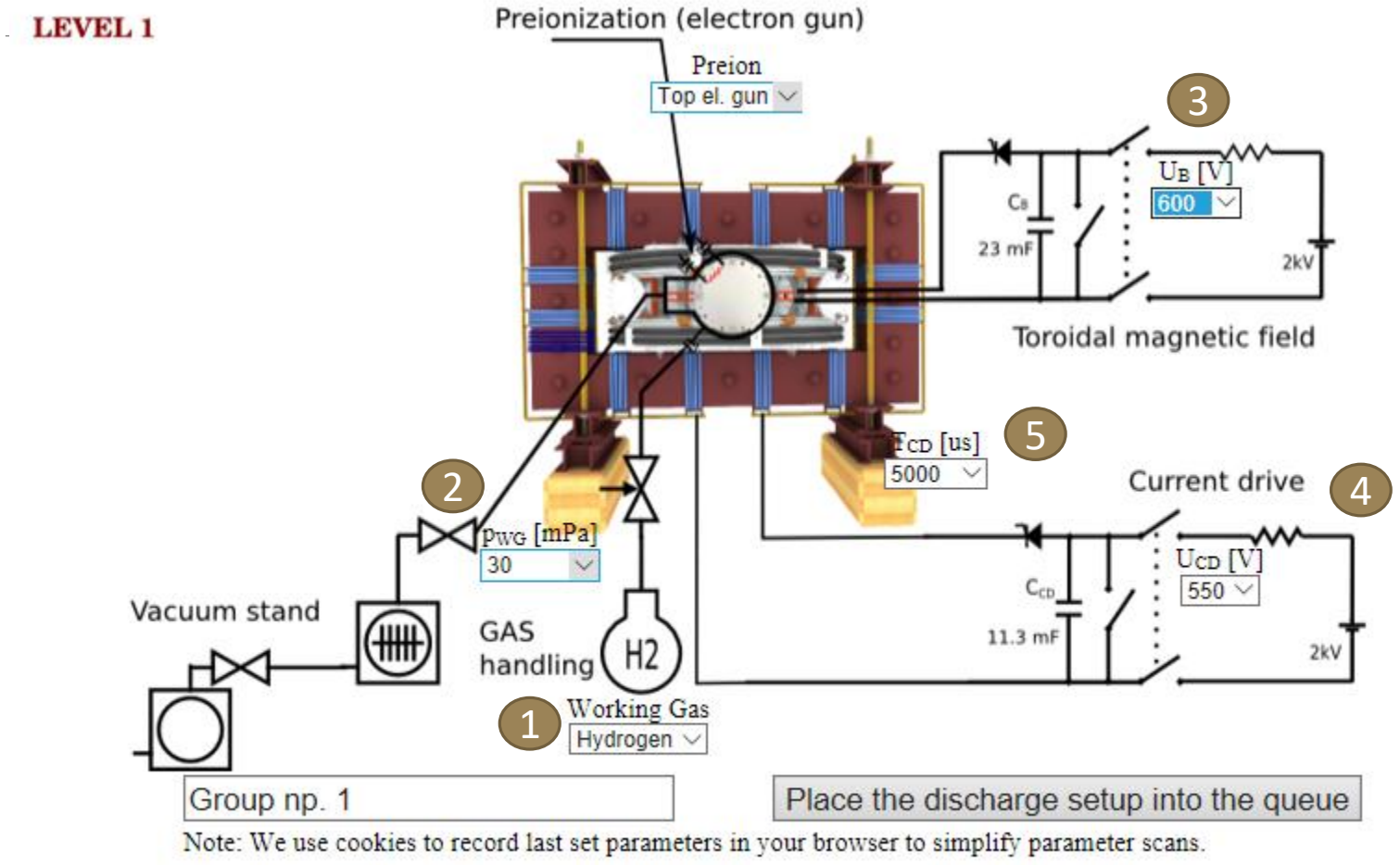
Method

- Choose parameters for a reference discharge (fill in pressure, voltages for toroidal field and current drive, delay time between field and current onsets)
- Scan the range of voltage on the toroidal field capacitor, all other parameters being kept constant
- Change one parameter from the reference discharge (current drive voltage)
- Repeat the scan on the toroidal field voltage keeping constant the new set of reference parameters

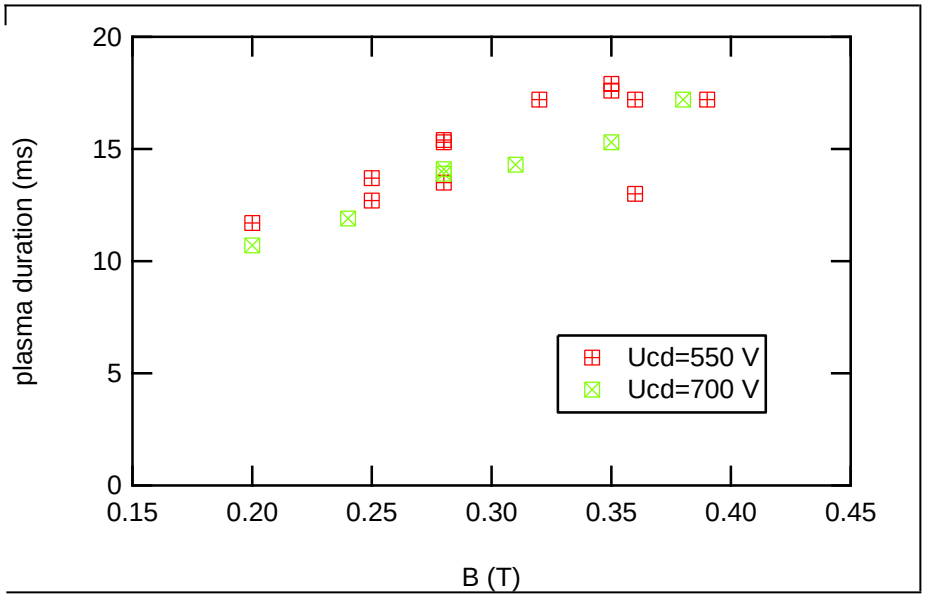
Investigated Parameters

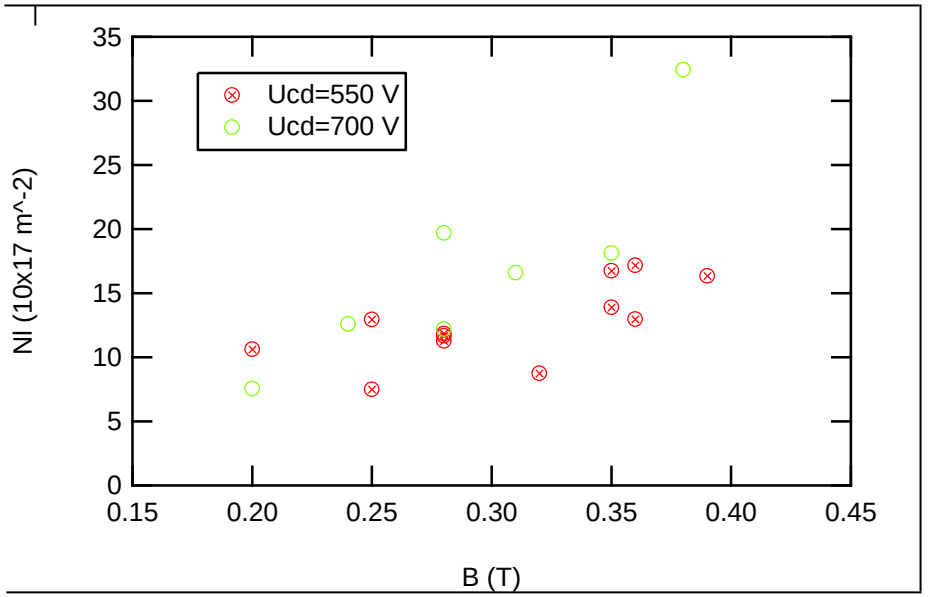
1. Hydrogen gas (H_2)
2. Pressure (P_f) : 30 mPa
3. The toroidal voltage (U_B) : 600, 700, 800, 1000, 1100 V
4. The discharge voltage (U_{CD}) : 550 V, 700 V
5. Delay (T_{CD}) : 5 ms

Remote Operation



Observation I

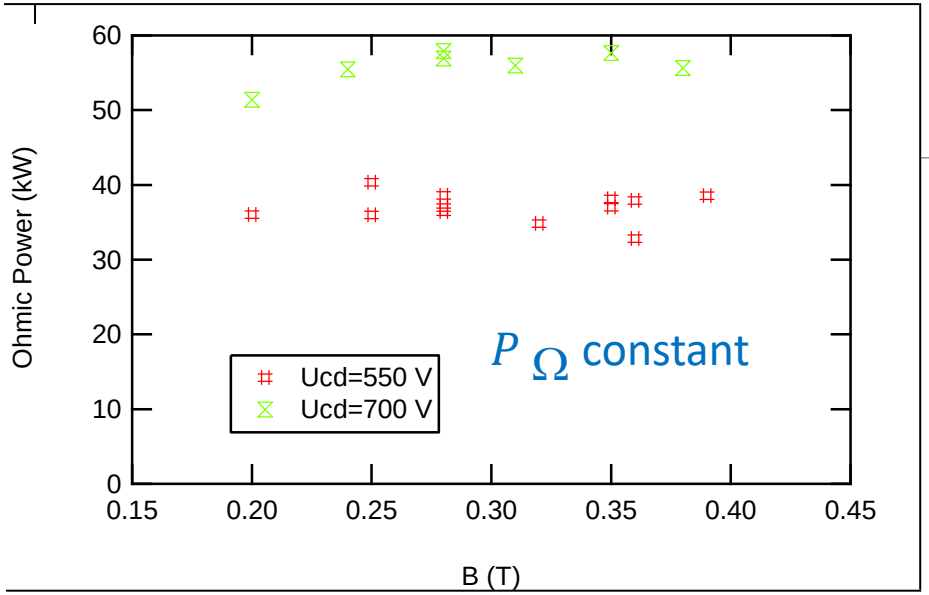


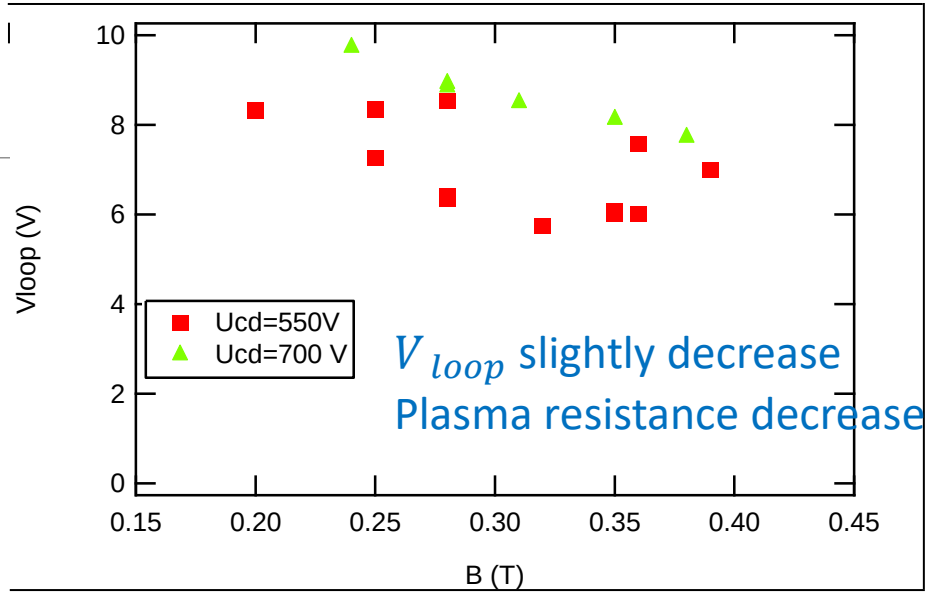


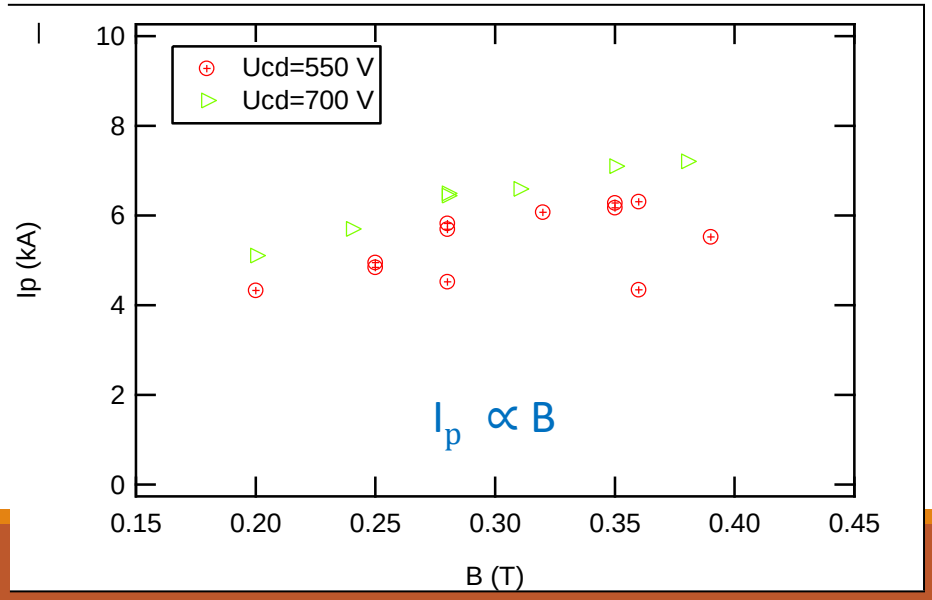
plasma duration $\propto$ B

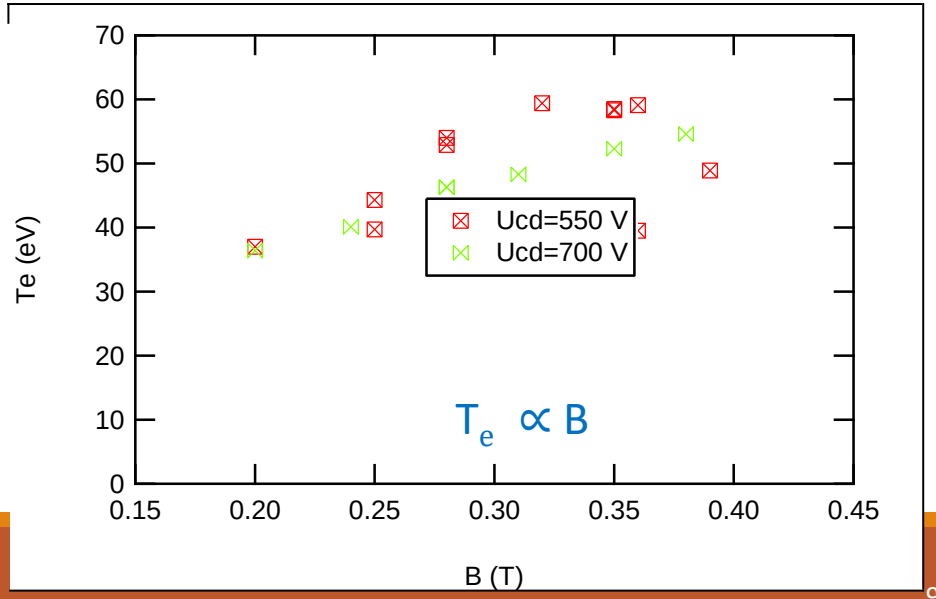
NI $\propto$ B

Observation II

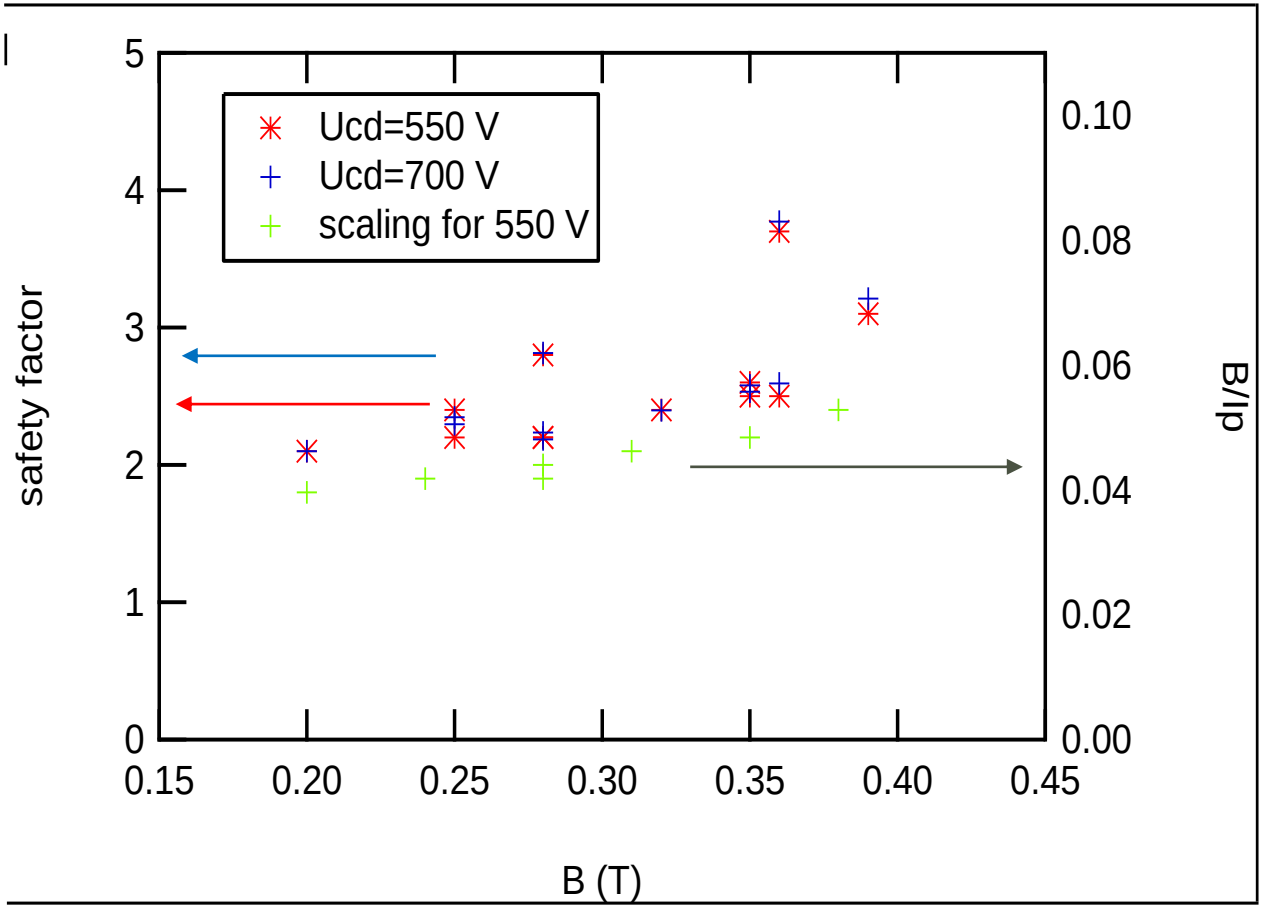




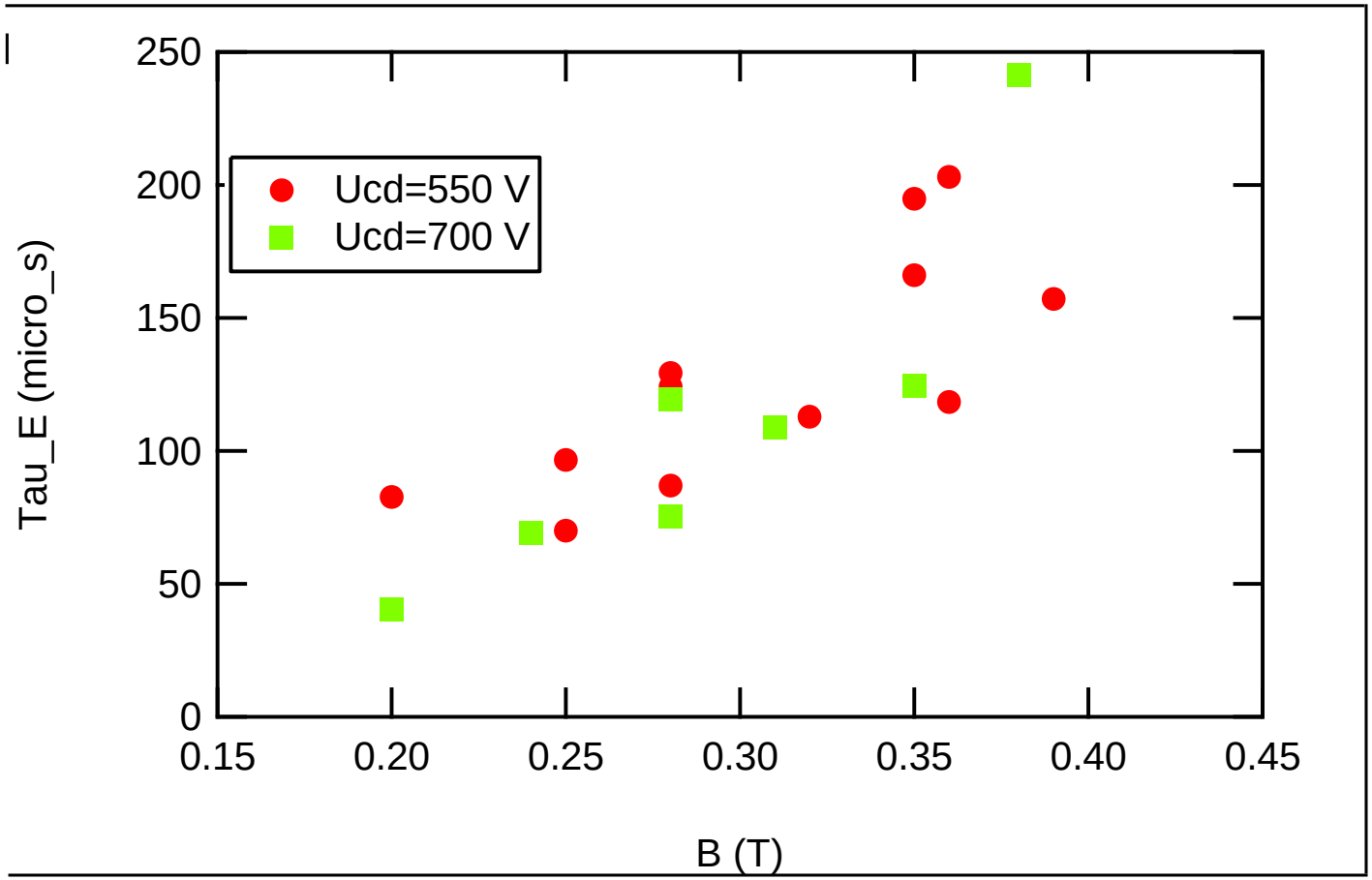




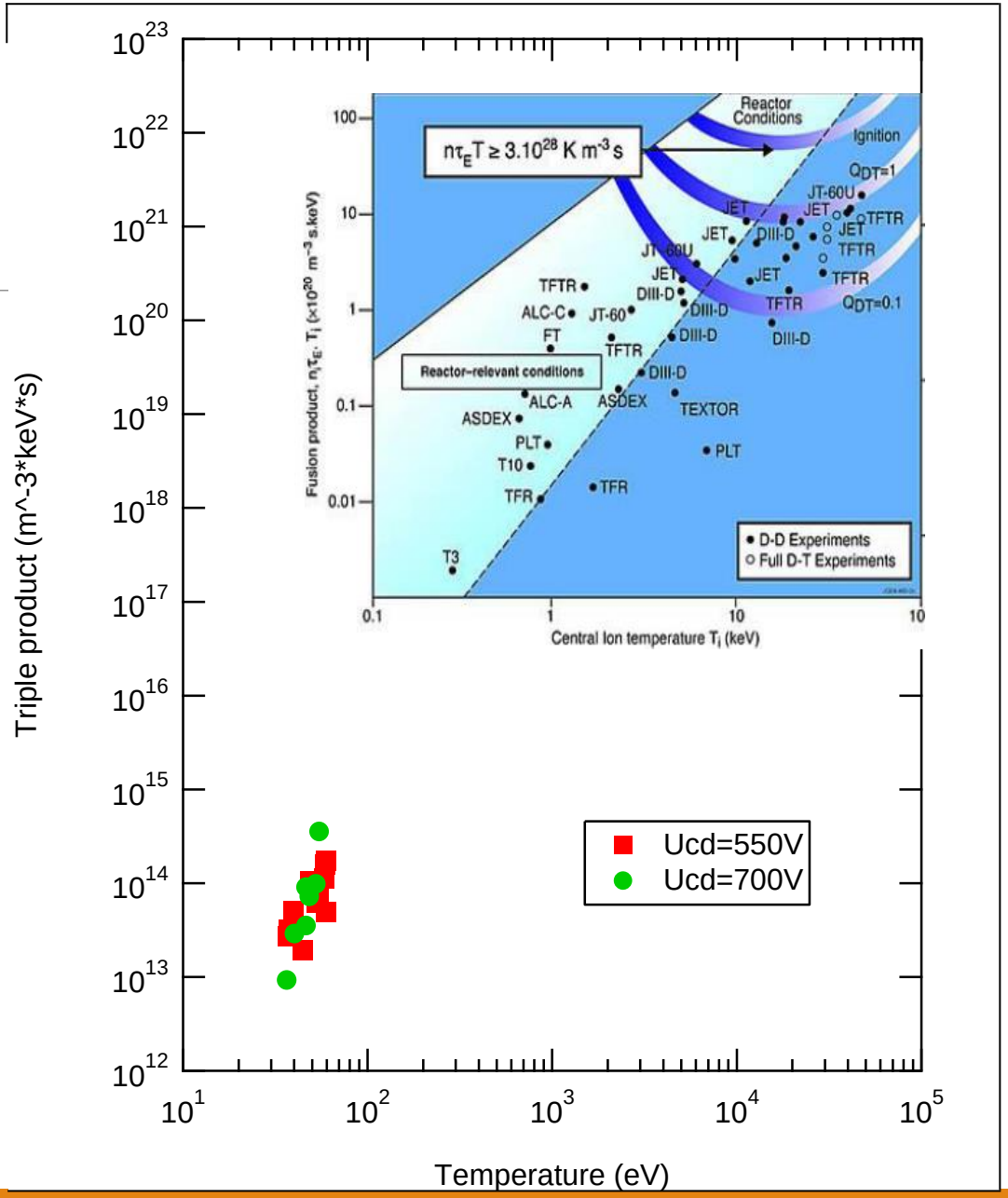
Safety factor (q∝B/Ip)



Energy confinement time $(\tau_E = \frac{2nT}{P_{ohm}} V)$



Lawson criterion



Conclusion

1- When one changes only one governing parameters (voltage on the field capacitor) of GOLEM discharges, one changes effectively all the plasma characteristics, and not only that relative to the parameter that has been modified (the toroidal field)

2- Triple product of GOLEM discharges is 8 orders of magnitude lower than the value corresponding to the break-even. This is normal because GOLEM is a very small tokamak.