

The tokamak GOLEM for GOMTRAIC

Vojtěch Svoboda on behalf of the GOLEM team

April 8, 2013

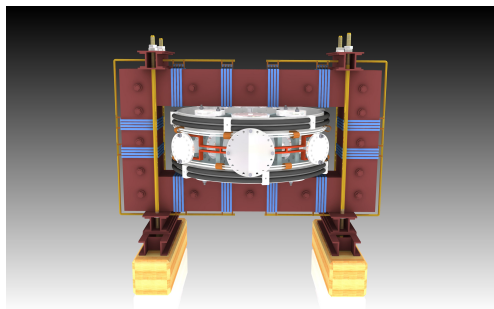
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Tokamak GOLEM - basic parameters:



- major radius $R = 0.4$
- plasma current $I_{pl} < 10$ kA
- toroidal magnetic field $B_{tor} < 1$ T
- electron temperature $T_e(0) < 200$ eV
- minor radius $a = 0.085$ m
- pulse length $t < 20$ ms
- plasma density $n_e = 0.2 - 3.0 * 10^{19}/m^3$
- ion temperature $T_i(0) < 100$ eV

GOLEM

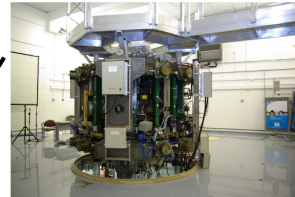
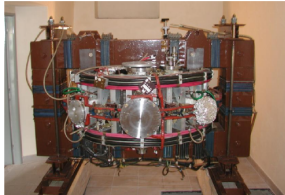


The new location of the tokamak is just next to the old Prague Jewish cemetery where Rabi Loew (Golem builder) is buried, and that is why it was renamed GOLEM (and also for the symbol of potential power you get if you know the magic). Interestingly, here in Prague, where the Golem legend originated, Golem is not perceived as a symbol of evil, but rather as a symbol of power which might be useful but is very challenging to handle. To learn more of the Golem legend, see e.g. [wikipedia](https://en.wikipedia.org/wiki/Golem).

Tokamak GOLEM for Education - Historical Background

Kurchatov Institute near Moscow,
Soviet Union
1960: **TM1-MH**

Culham Centre for Fusion Energy
Great Britain
1989: **COMPASS-D**



1974

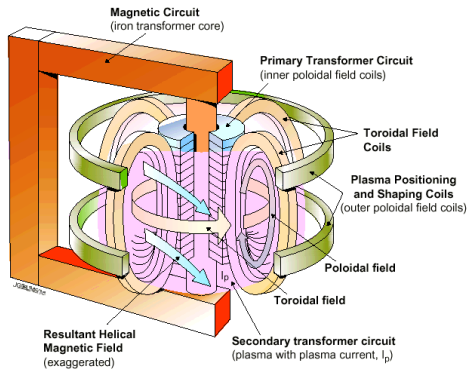
2006

Institute of Plasma Physics
Czech republic
CASTOR **COMPASS**

2008

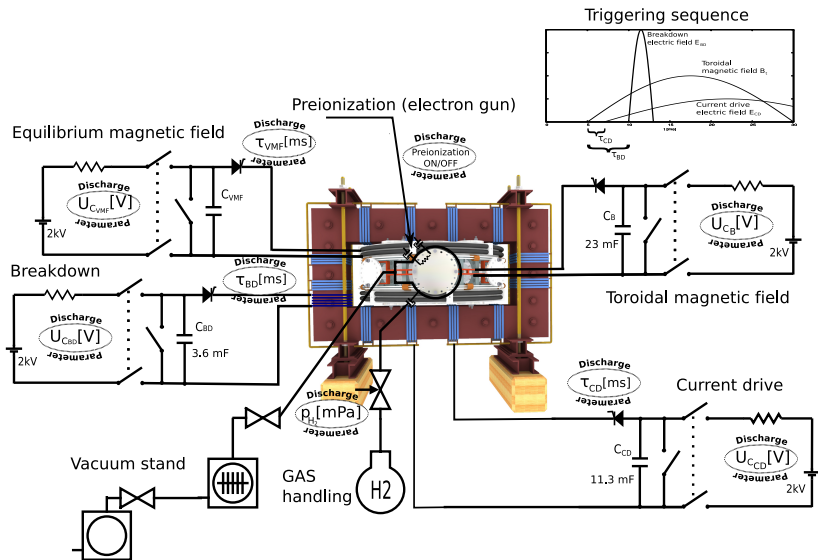
Czech Technical University Prague
Czech republic
GOLEM

Plasma in Tokamak (GOLEM) - the least to do



- Evacuate the chamber.
- Fill in the working gas.
- Toroidal magnetic field to confine plasma.
- Toroidal electric field to breakdown neutral gas into plasma.
- Toroidal electric field to heat the plasma.
- Plasma positioning.
- Diagnostics.

Engineering scheme of the GOLEM tokamak

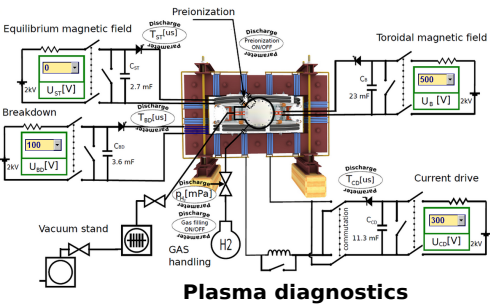


Unique remote operation capability

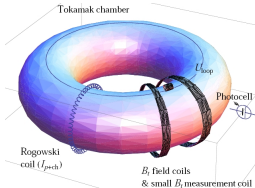
Tokamak control room

Virtual control room (remote participation)

internet



Plasma diagnostics



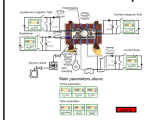
Control PC



OpenSSH server

WWW control interface

HTML & PHP scripts



SSH control interface

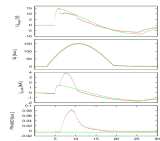
WINDOWS via putty



LINUX via ssh or ssh+X tunnel (advanced mode)

Data presentation

HTML (www pages)



Data handling

- *wget
- *gnuplot
- *idl
- *mathematica
- *matlab
- *etc...

Content

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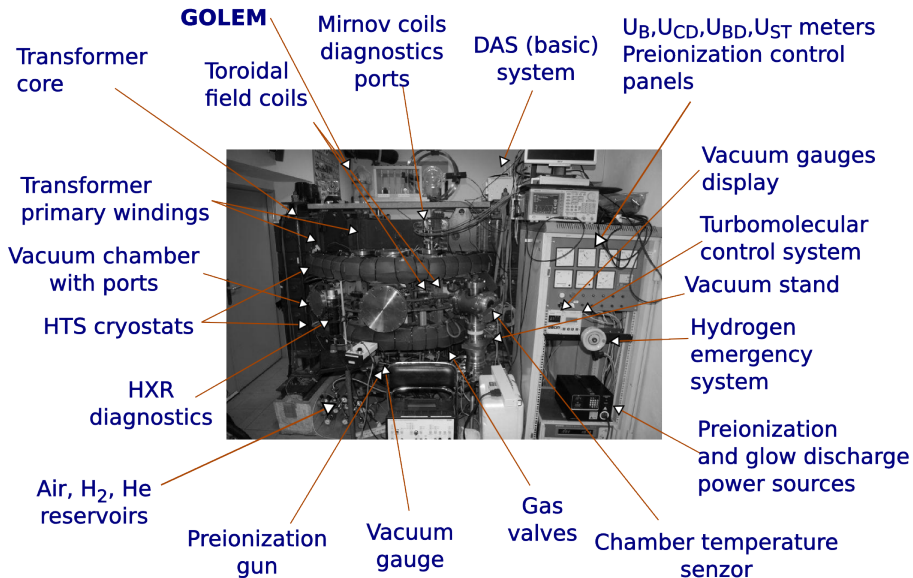
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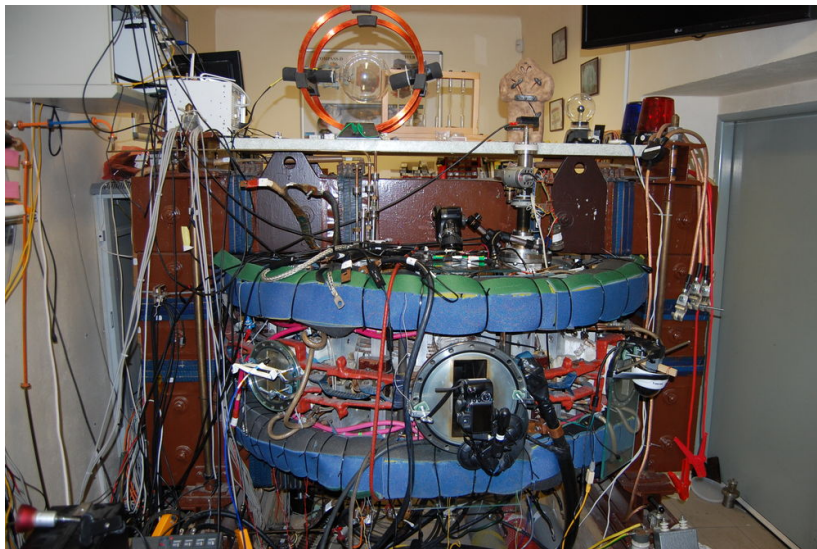
The Golem tokamak - South view (02/12)



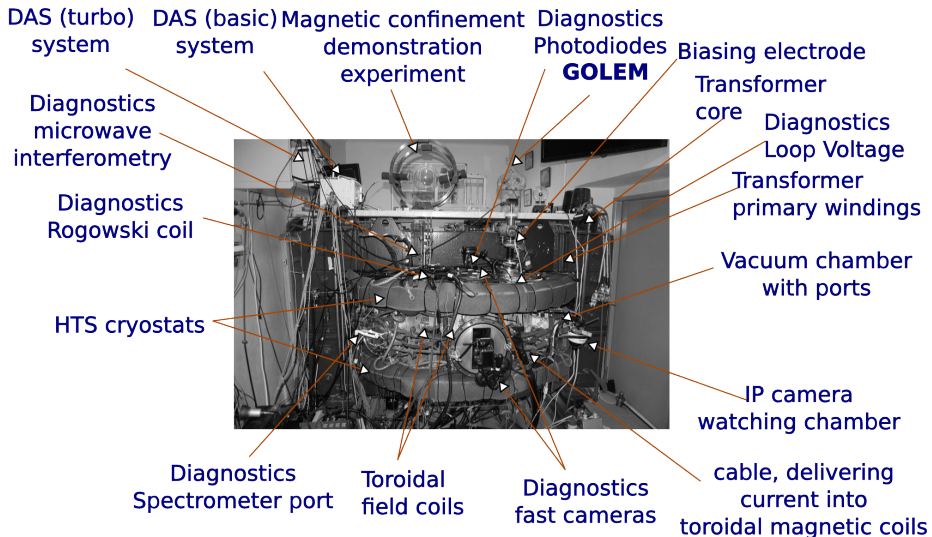
The Golem tokamak - South view (02/12)



The Golem tokamak - North view (02/12)



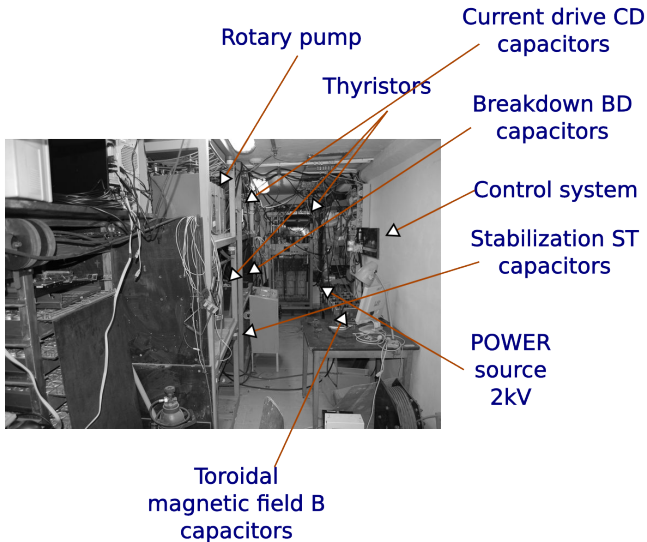
The Golem tokamak - North view (02/12)



Infrastructure room (below tokamak)



Infrastructure room



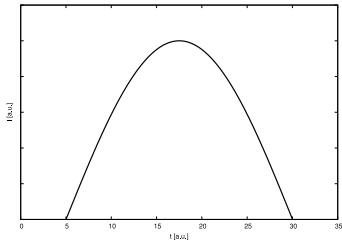
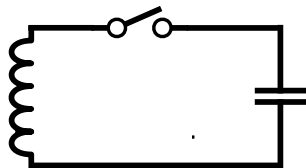
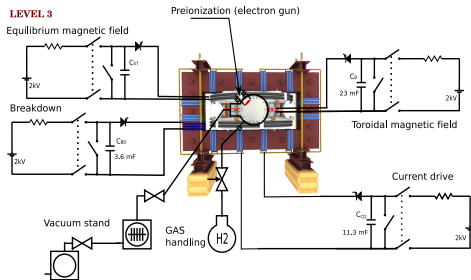
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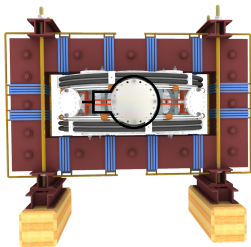
3 Experimental setup

Insertion - LC circuit



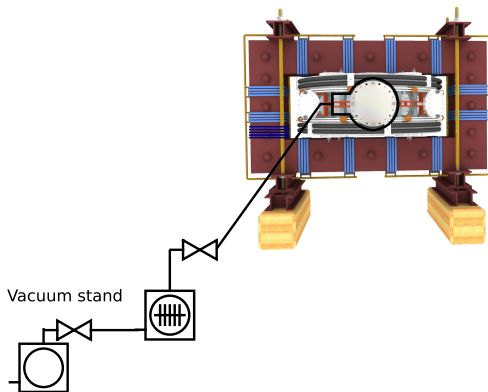
Tokamak GOLEM - basic

LEVEL 0



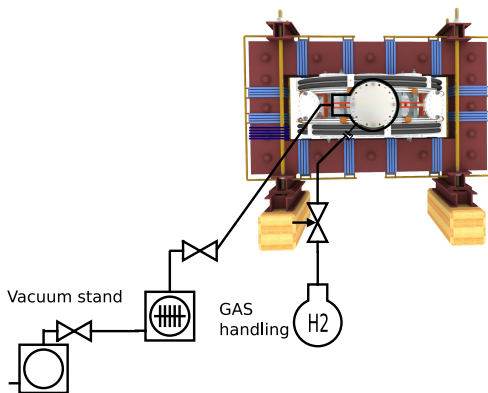
+ vacuum pumping system (100 kPa \rightarrow \approx 1 mPa)

LEVEL 0



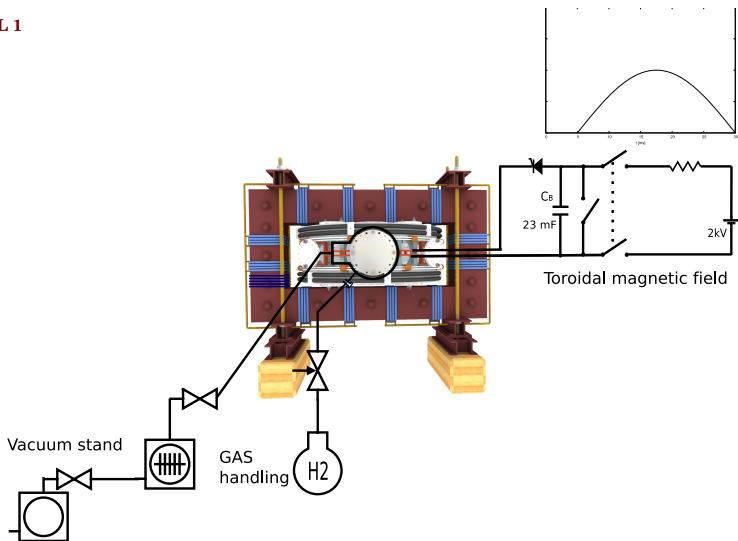
+ working gas management (H_2 or He)

LEVEL 0



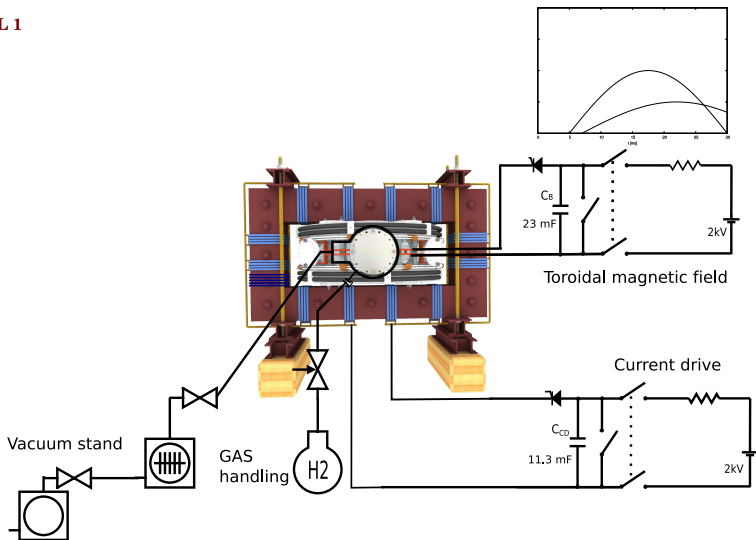
+ toroidal magnetic field B_{tor} .. plasma confinement

LEVEL 1



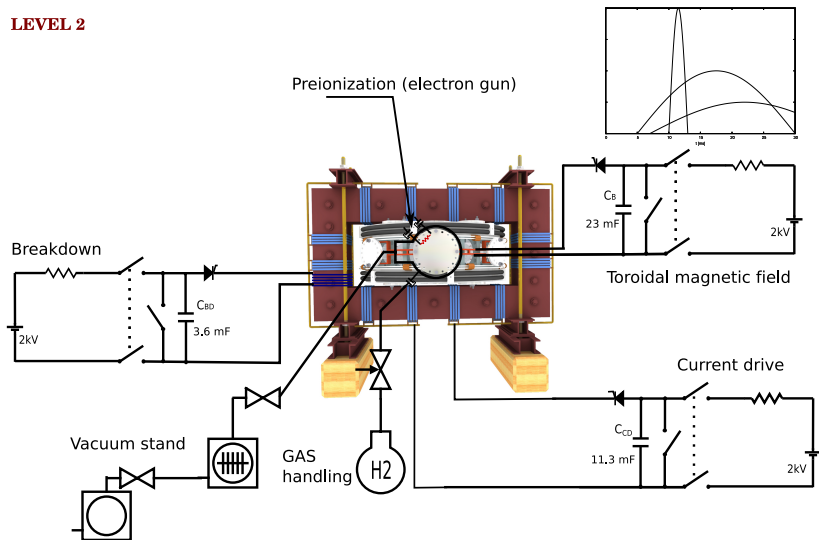
+ toroidal electric field E_{CD} .. plasma heating

LEVEL 1



+ toroidal electric field E_{BD} .. plasma creation

LEVEL 2



+ equilibrium magnetic field B_{EQ} .. plasma stabilization

LEVEL 3

