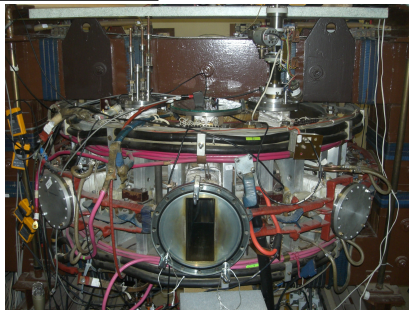


Golem tokamak for education and training

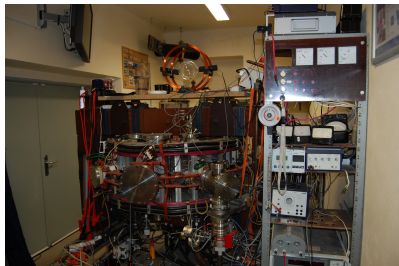
Vojtěch Svoboda, Jan Stöckel for IBA 2011



Outline of the talk

- 1 The GOLEM tokamak
- 2 Forecast 2010
- 3 Virtual Operation of the GOLEM tokamak
- 4 Forecast 2010

The Golem tokamak - the oldest tokamak in operation



Scientific eras:

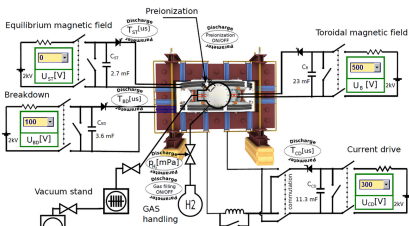
- 1960-1974 **TM1-MH**
USSR: Kurchatov institut near Moscow.
- 1977-2007 **CASTOR**
CSSR/CSFR/CR: Inst. of Plasma Physics, Prague.

Educational era:

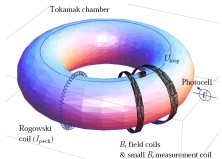
- 2009- **GOLEM** CR: Czech technical University, Prague

Unique remote operation capability

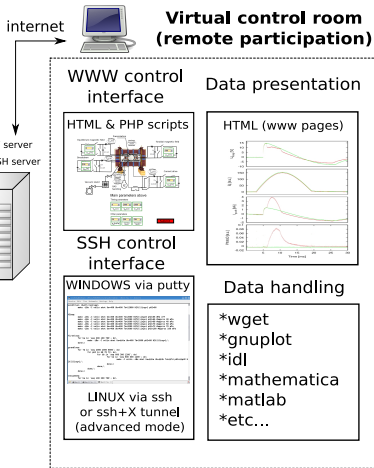
Tokamak control room



Plasma diagnostics



Virtual control room (remote participation)



Forecast IBA, September 2010

- September 2010: SOFT 2010 contribution.
- Group of 3 high school students from the "Cesta k vede" (Path to Science) project collaboration on the Golem tasks.
- December 2010: GTE Global Tokamak Experiment <http://www.tokamakglobal.com> (SUMTRAIC 2010 post action)
- Spring 2011: Jindrich Kocman, FNSPE CTU Prague. Bachelor thesis 2009-2010. Plasma position stabilization studies on tokamak GOLEM.
- Excursions.
- Practicum for seniors in the frame of University of third age II planned.

FUSENET - WP7, hardware

Ceiling: 43 kEuro and 2.75 ppm.

- DAS system (oscilloscope, increase the number of data acquisition channels) ~ 31 kEUR
- Tokamak power circuits (Thyristor, Capacitors, Relays) ~ 11 kEUR
- Vacuum operation (galvanic insulation, chamber components) ~ 6 kEUR
- Gas filling system (control valves) ~ 5 kEUR
- Diagnostics enhancement (current probes, microwave interferometry for plasma density measurement, equipment for Langmuir probe measurement, HXR detector, interference filter for H_{α} line,) ~ 7.5 kEUR
- Software IDL ~ 1.5 kEUR
- Software: IDL, MATLAB ~ 5 kEUR
- Remote participation hardware ~ 2 kEUR
- Additional tokamak operator (Czech part) 2.25 ppm ~ 11 kEUR



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Multi-mode remote participation on the GOLEM tokamak

V. Svoboda^{a,*}, B. Huang^{d,e}, J. Mlynář^{a,b}, G.I. Pokol^c, J. Stöckel^b, G. Vondrášek^a

^a Faculty of Nuclear Sciences and Physical Engineering CTU Prague, CZ-115 19, Czech Republic

^b Institute of Plasma Physics AS CR, CZ-182 21 Prague, Czech Republic

^c Institute of Nuclear Techniques, Budapest University of Technology and Economics, Association EURATOM-HAS, H-1111 Budapest, Hungary

^d Culham Centre for Fusion Energy, OX14 3DB, Abingdon, Oxfordshire, United Kingdom

^e Department of Physics, University of Durham, South Road, Durham DH1 3LE, United Kingdom

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ABSTRACT

The GOLEM tokamak (formerly CASTOR) at Czech Technical University is demonstrated as an educational tokamak device for domestic and foreign students. Remote participation of several foreign universities (in Hungary, Belgium, Poland and Costa Rica) has been successfully performed. A unique feature of the GOLEM device is functionality which enables complete remote participation and control, solely through Internet access. Basic remote control is possible either in online mode via WWW/SSH interface or offline mode using batch processing code. Discharge parameters are set in each case to configure the tokamak for a plasma discharge. Using the X11 protocol it is possible to control in an advanced mode many technological aspects of the tokamak operation, including: i) vacuum pump initialization, ii) chamber baking, iii) charging of power supplies, iv) plasma discharge scenario, v) data acquisition system.

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Path to science



High school students at scientific projects

- Ondrej Grover: Interferometry measurements.
- Adam Shindlery: Probes diagnostics.
- Ondrej Vrba: Radiation diagnostics.

12/2010 - Global Tokamak Experiment , 12 countries, 38 students, 80 discharges, 4 hours of operation

iter the way to new energy
china eu india japan korea russia usa

Home The Machine The Science The Organization The Project Glossary Contact ITER

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iter newsline

03 Dec, 2010 - #156
view printable version
<< return to Newsline #156
Fusion World

Launch of the world's first global tokamak experiment

CCFE PhD student Billy Huang has set up a website for the world's first global tokamak experiment, which began today. The project allows anyone in the world with a physics background and internet access to apply to have a go at running shots on the GOLEM tokamak in Prague, a machine that has been made remotely operable by Tokamak Engineer Dr Vojtech Svoboda and his team.

"The Tokamak Global Experiment is an innovative project that gives participants the opportunity to change real parameters on a real machine, from anywhere in the world," said Billy Huang (pictured right). "Our goal with this project is to get people participating and interested in fusion research around the globe."

GOLEM is one of the oldest tokamaks in the world, originating from Russia. Although not nearly as large as JET, GOLEM still produces small amounts of fusion energy and is used as an educational device.

Promotion of this initiative, which is run in conjunction with the Institute of Plasma Physics of the Czech Republic and the Czech Technical University, is mainly targeted at university level physics students, but anyone with a physics background is welcome to register to run an experiment (see <http://tokamakglobal.com/>). On its debut day, the experiment was a success and received 37 applications from ten countries. The organisers plan to run more sessions in the future.

Delighted with this response to the project, Billy Huang said: "It's been a real challenge setting up the website, but to have so many people from countries across the world already participating in real live fusion experiments is great."

Read more about the Culham Centre for Fusion Energy (CCFE) [here](#).

<< return to Newsline #156

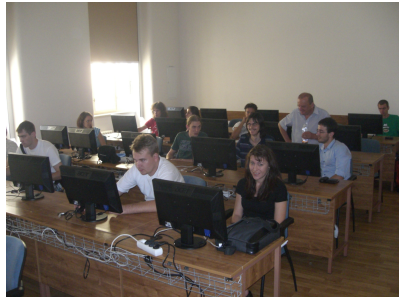


India, UK, Belgium, France,
Germany, Hungary, Poland,
Russia, Slovakia, Slovenia,
USA, Czech Rep.

Quotation

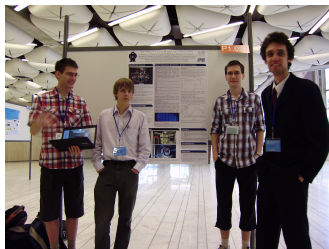
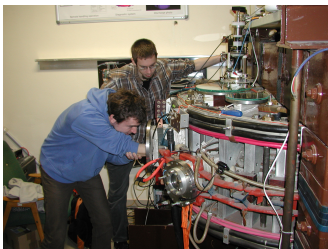
It was great! .. Many thanks for the excellent site design and for the interesting experiment. I hope that it will ever happen again. I and another student has already been discussed the results of shots yesterday the whole evening and today ...

Summer Training School on Plasma Physics SUMTRAIC 2011

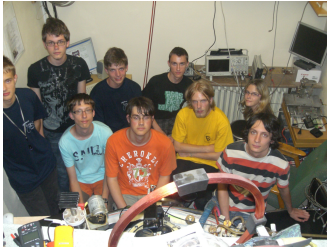


Bachelor thesis

- BT 2011 - DT 2012: Jindrich Kocman. Plasma position stabilization on Tokamak GOLEM
- BT 2010 - DT 2012: Tomas Markovic. Magnetic Field Configurations and Their Measurement on Tokamak GOLEM
- BT 2011: Ondrej Pluhar. Interactive model of tokamak GOLEM.



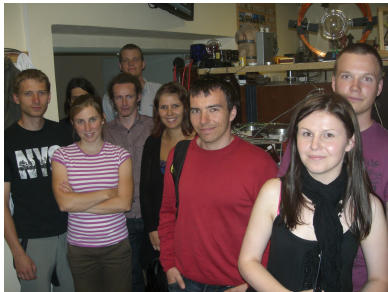
The week of Science



Microprojects

- Dynamic Stabilization of the Plasma Position in the Tokamak GOLEM.
- Plasma Position Detection with the Fast Camera on the Tokamak GOLEM.
- Learning Algorithms on the tokamak GOLEM.
- Vertical Plasma Position Detection with the Mirnov Coils.

Excursions ≈ 20

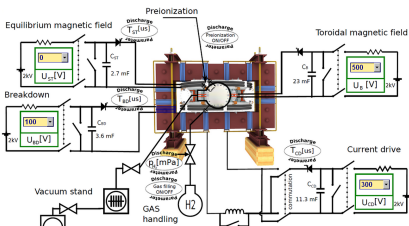


University of the 3rd age

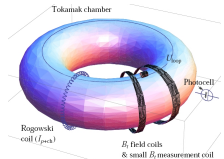


Unique remote operation capability

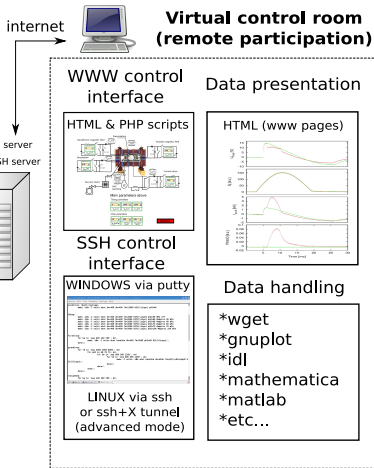
Tokamak control room



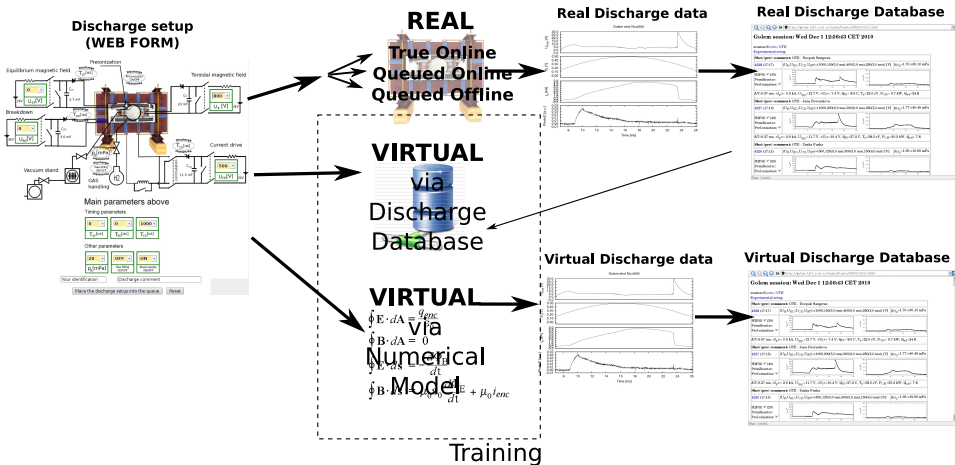
Plasma diagnostics



Virtual control room (remote participation)



Real/Virtual Operational Modes of the GOLEM tokamak



Forecast IBA, October 2011

- Path to Science - cont.
- Bachelor and Diploma Thesis - cont.
- Excursions - cont.
- University of third age - cont.
- The week of science - cont 2012.
- SUMTRAIC - cont 2012.
- **Automated Virtual Guide of the Tokamak.**
- **Winter Remote Tokamak Physics School GOMTRAIC 2012.**

Scientific projects?

HTS ..

Acknowledgement

Acknowledgement

The financial support by FUSENET, MSM 6840770039, MSM 6840770014 and A1581 is acknowledged.

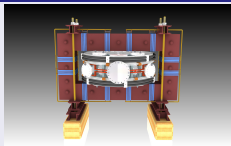
Special thanks to the GOLEM team (students, teachers, technicians)

Edita Bromova, Zdenek Cespiro, Ivan Duran, Vladimir Fuchs, Ondrej Grover, Pavel Hacek, Billy Huang, Igor Jex, Michal Kazda, Jindrich Kocman, Martin Kubic, Ondrej Kudlacek, Petr Liska, Tomas Markovic, Jan Mlynar, Michal Odstrcil, Tomas Odstrcil, Ondrej Pluhar, Gergo Pokol, Ondrej Sebek, Adam Sindlery, Michal Smid, Gabriel Vondrasek, Frantisek Zacek, and Jiri Zara.

Winter school of Plasma Physics - Marianska 2011 (Tokamak, probably COMPASS, with NBI)



Thank you for your attention



<http://golem.fjfi.cvut.cz>,
you and your students are welcome

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