The GOLEM diagnostics

Vojtěch Svoboda & GOLEM team

March 12, 2012

Outline of the talk

1. Data acquisition system
2. Radiation
   - Photodiodes
   - Fast cameras
   - Spectra
   - HXR
3. Magnetic diagnostics
   - Loop voltage
   - Toroidal magnetic field
   - Current through the chamber and plasma
   - Mirnov coils - plasma position
4. Particle Flux
   - Rake probe
5. Basic diagnostics
6. Conclusion

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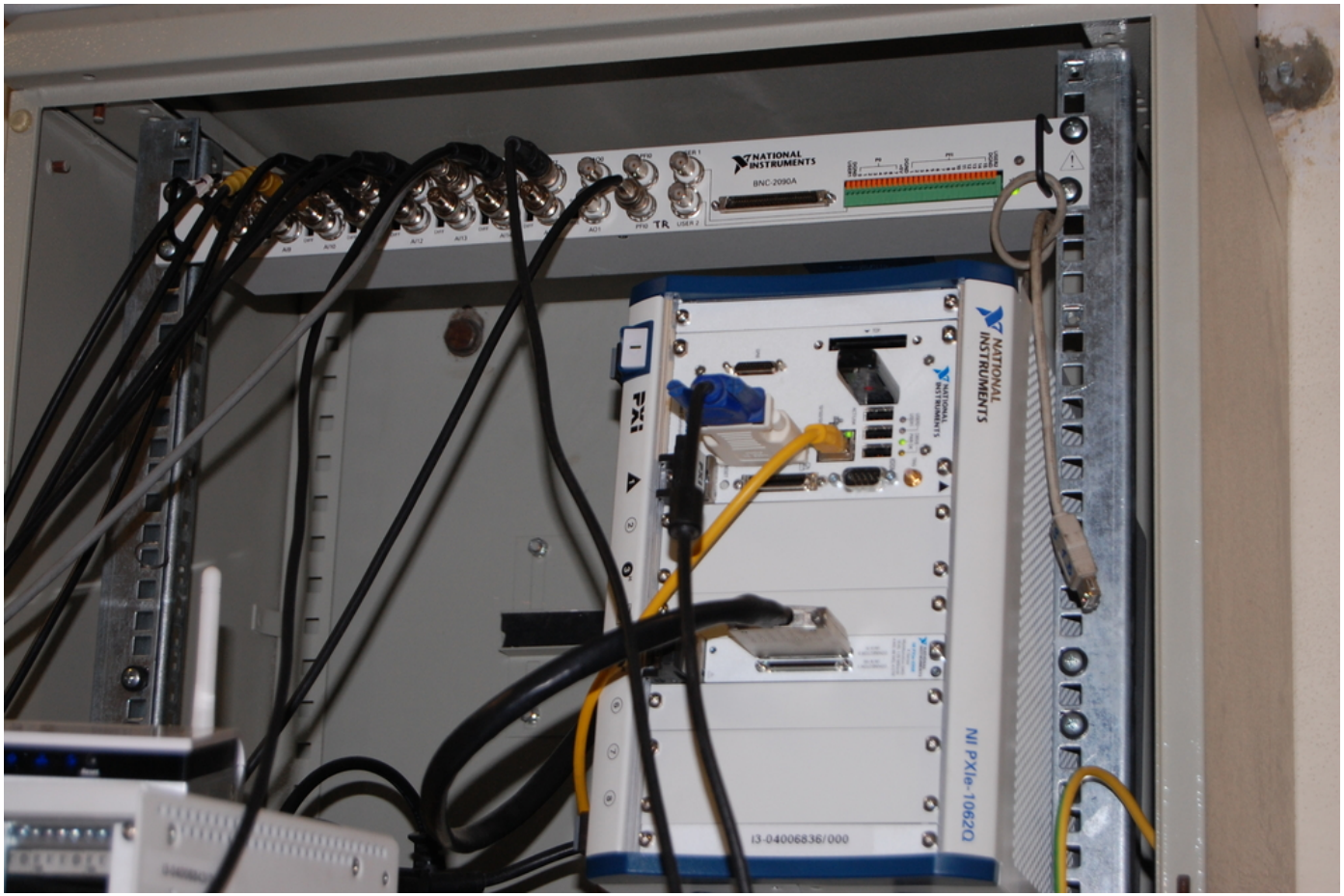
Data acquisition system I - basic

NI PXI-1031

Data acquisition system II - turbo



NI PXIe-1062Q

Data acquisition system III - papouchSt

Papouch DAS1210

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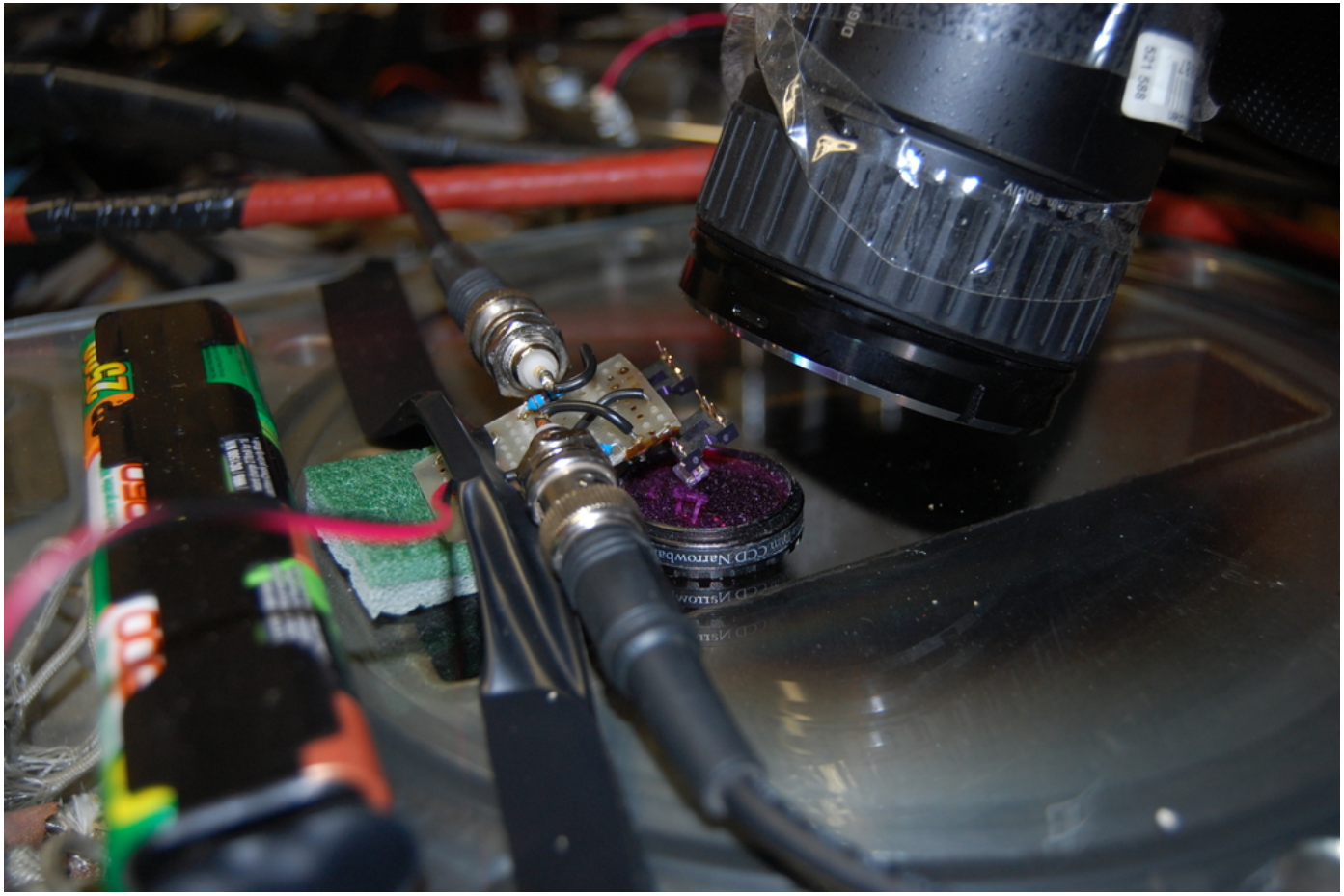
South-Upper port: Photodiodes (I-w/o filter, II-H_α filter)



Manual, H_α Spectral sensitivity

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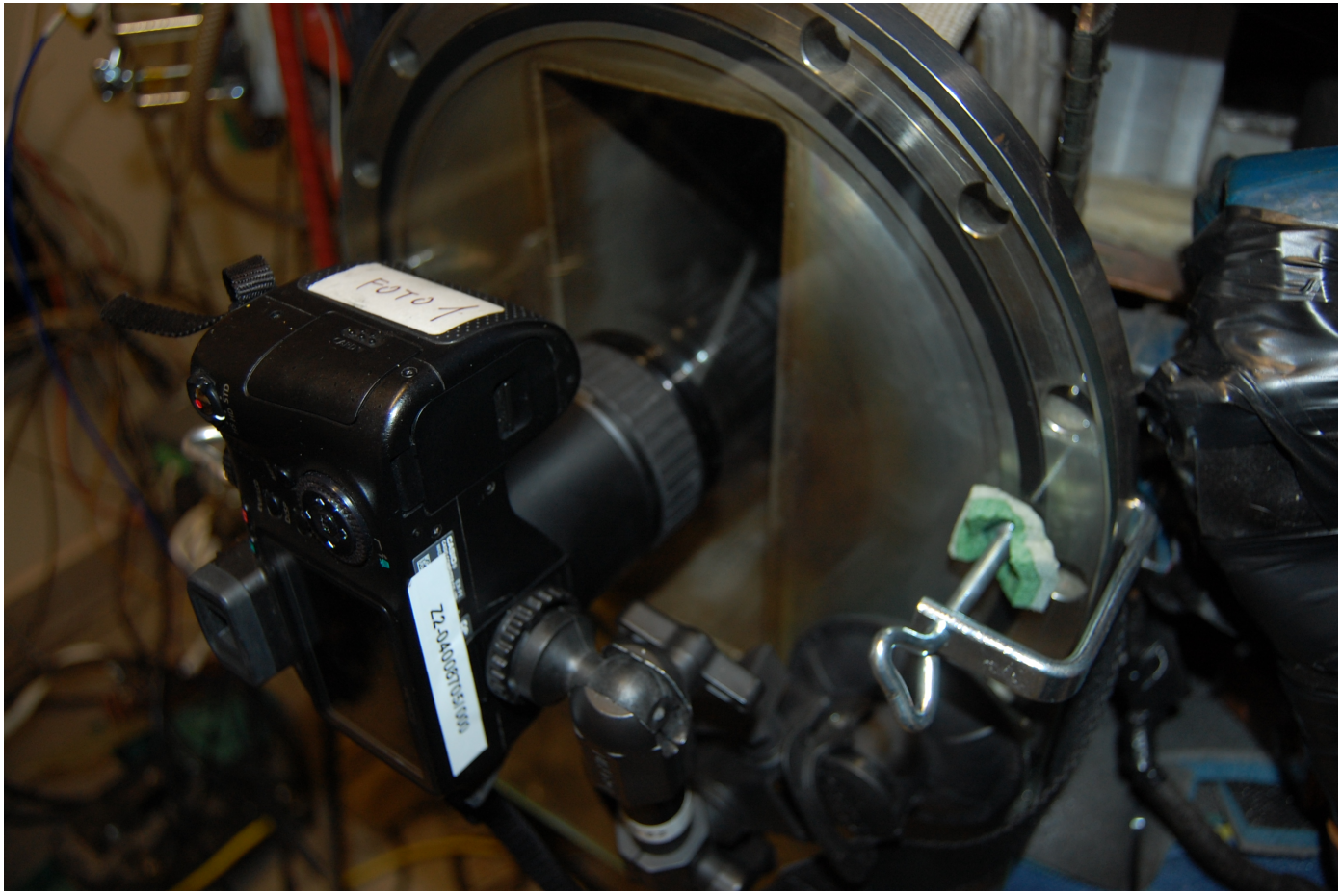
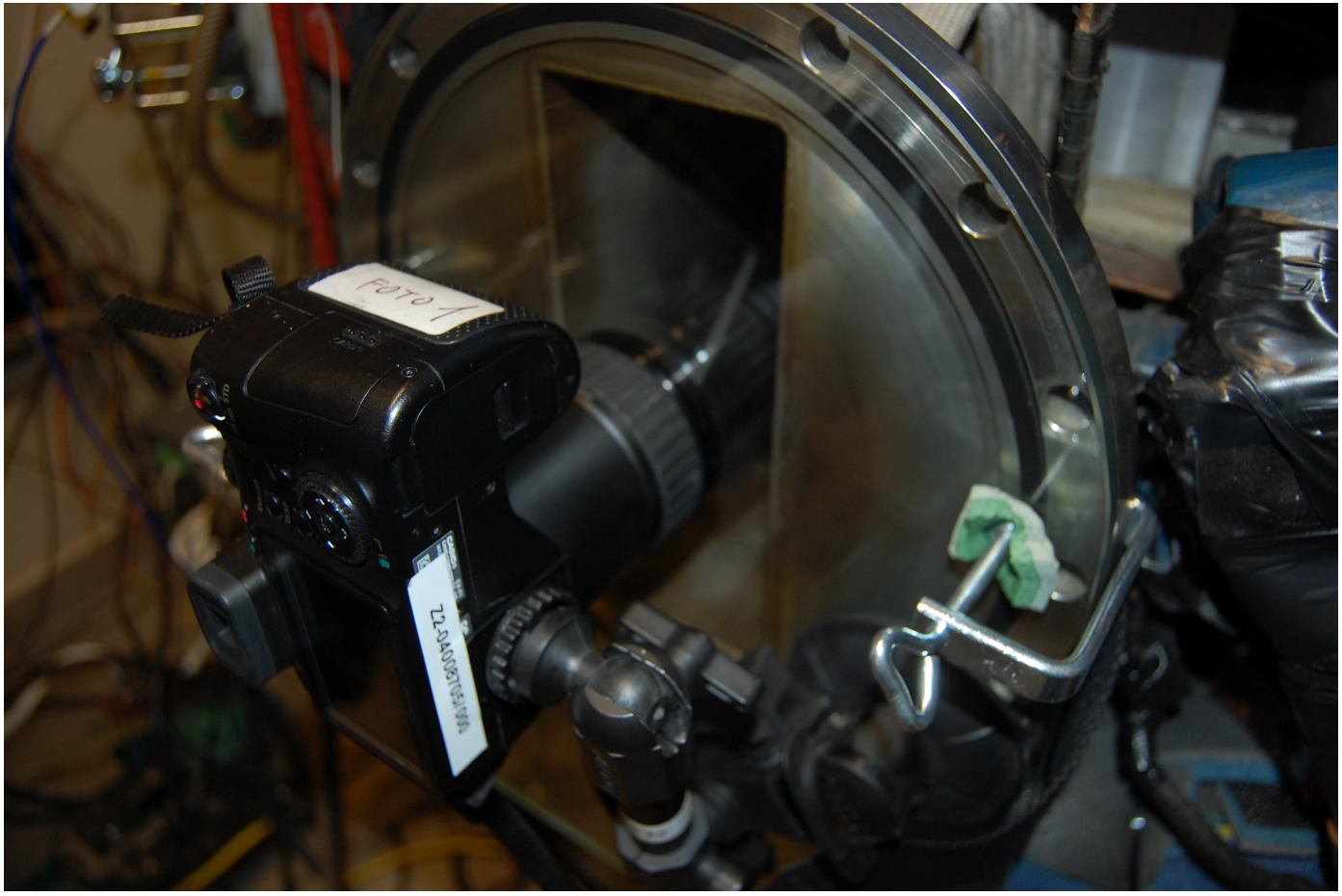
South-Middle port: Fast camera CASIO FX1 I



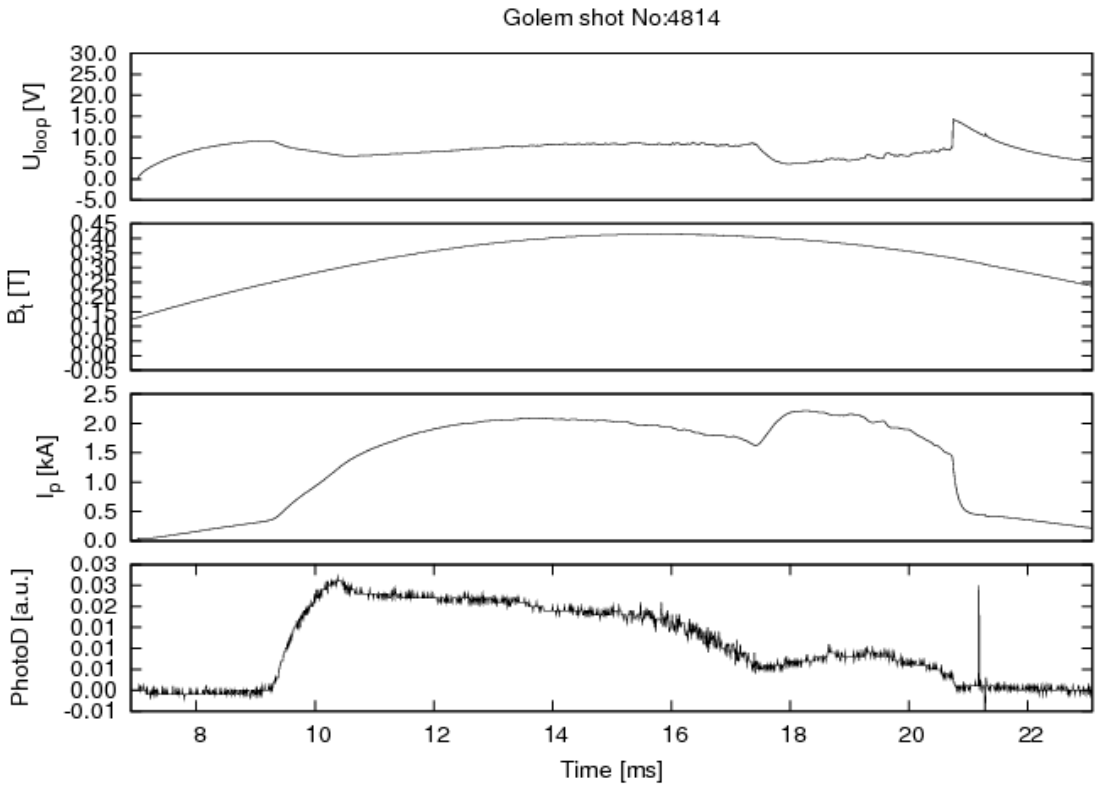
Manual, Graph

South-Upper port: Fast camera CASIO FX1 II

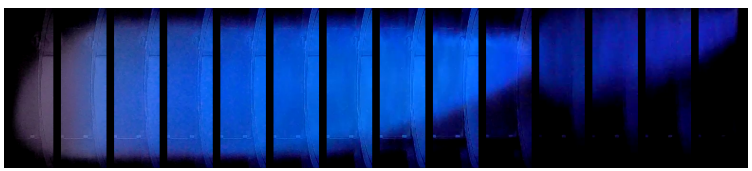


Manual, Graph

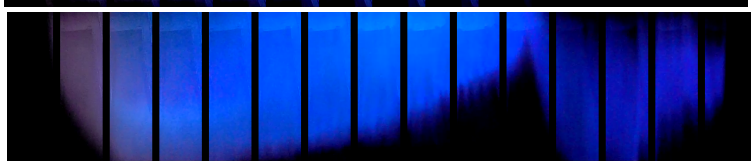
Fast camera CASIO FX1 - results



TOP view:



SIDE view:



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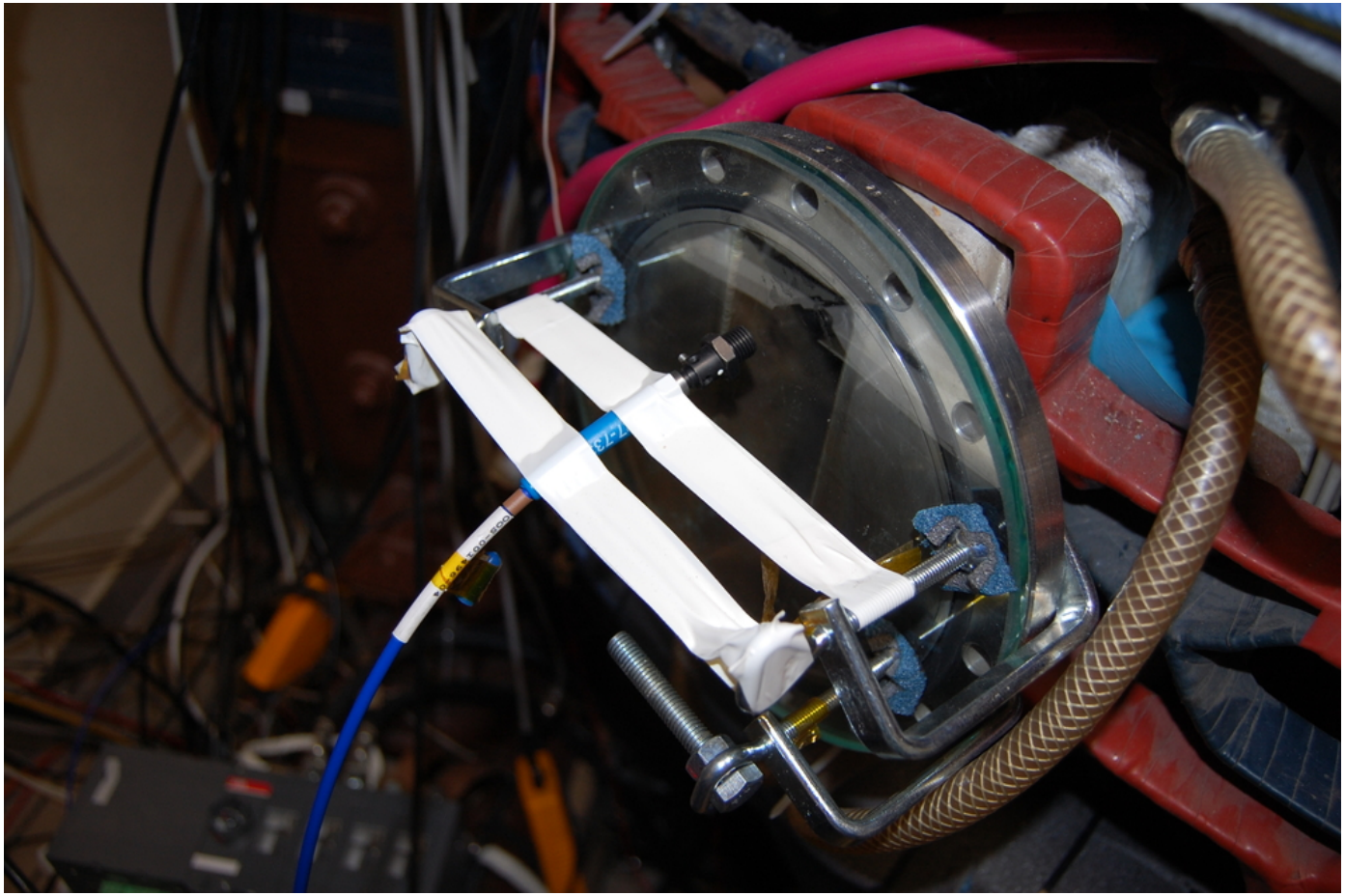
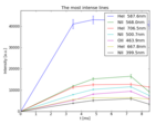
Fiber connecting spectrometer HR2000+





He spectrum No:7163

Spectrometer HR2000+ES

He spectrum No:7163

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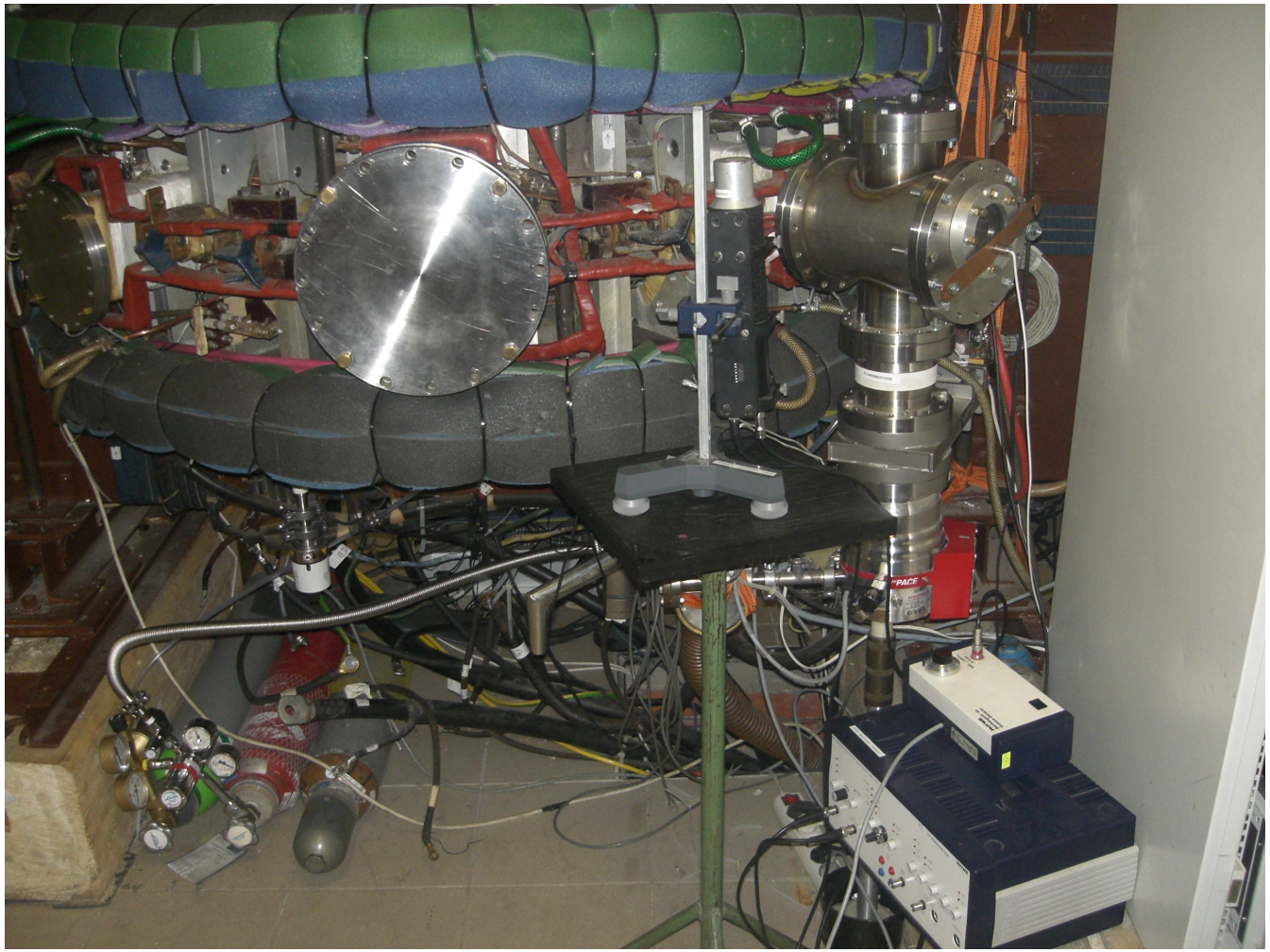
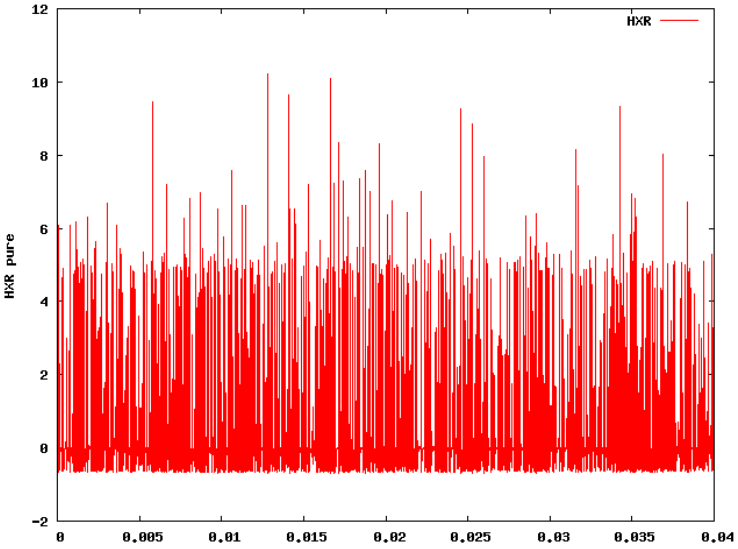
HXR

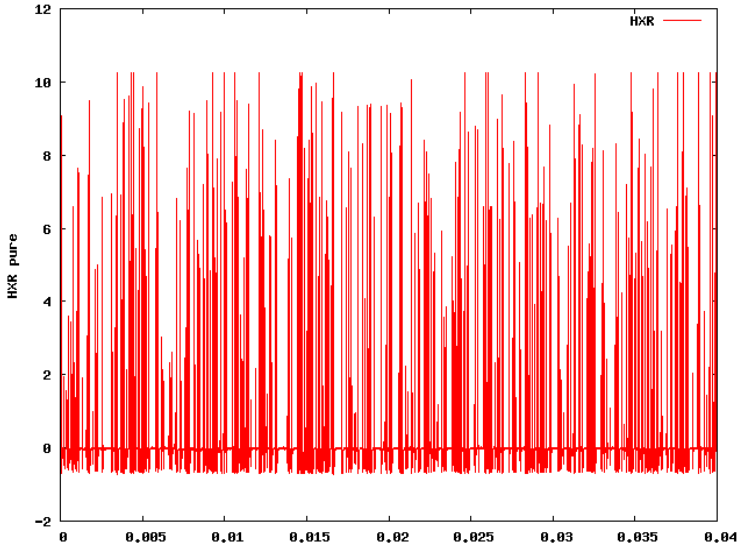


Gamma detector Phywe

Manual

HXR


HXR
HXR pure
12
10
8
6
4
2
0
-2
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04


HXR
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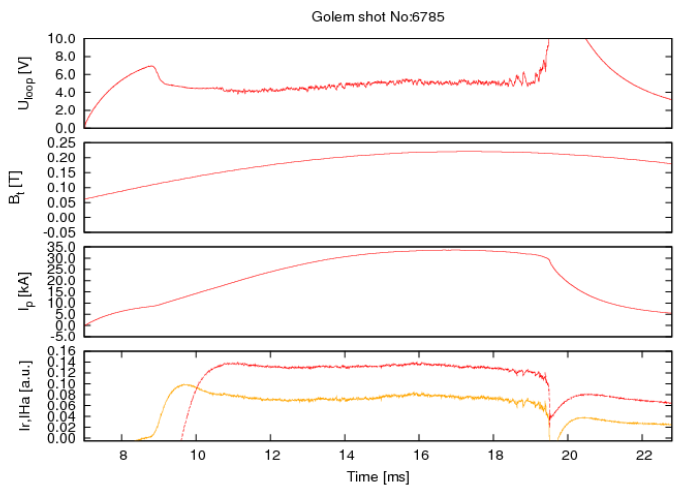
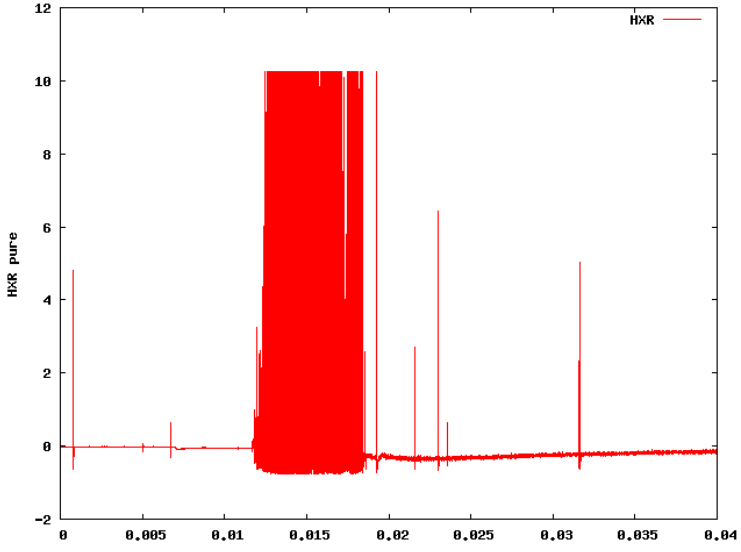

Golem shot No:6785
U_loop [V]
B_t [T]
I_p [kA]
I_r,IHa [a.u.]
Time [ms]
8
10
12
14
16
18
20
22


HXR
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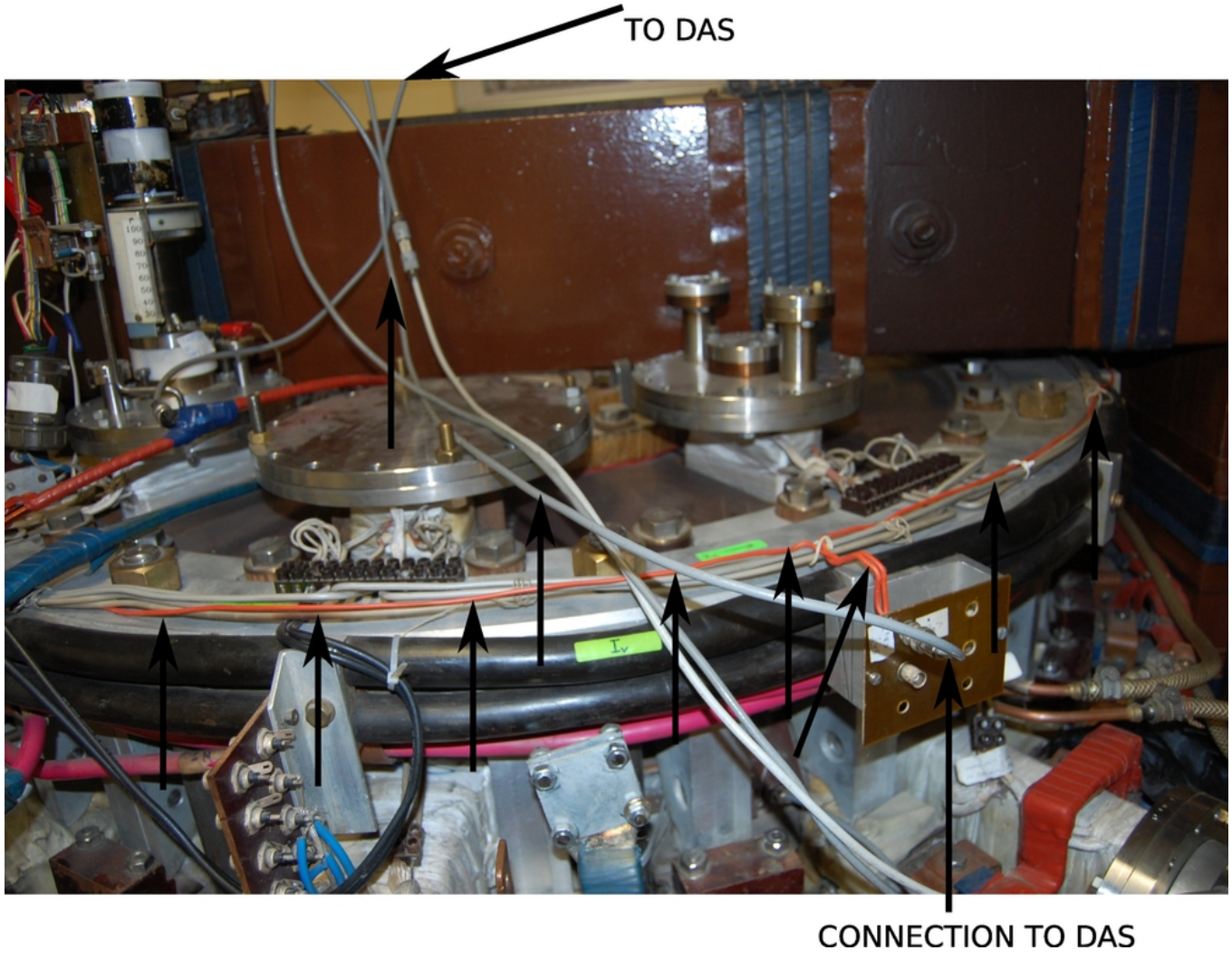
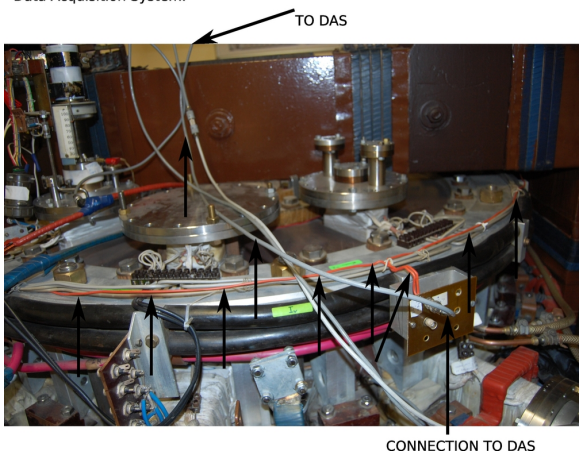
Loop Voltage

Diagnostics: U_{loop} - simple single loop of wire around the tokamak, connected to Data Acquisition System.



Basic diagnostic - Loop Voltage

Diagnostics: U_{loop} - simple single loop of wire around the tokamak, connected to Data Acquisition System.



Is deduced from ...

- bla

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Bt

Basic diagnostic - toroidal magnetic filed B_t

Is deduced from small coil measurements with three operations:

- offset identification from first 4500 data rows).
- time integration (it is a magnetic diagnostic, where $U_{acquired} \sim \frac{dB_t}{dt}$)
- multiplication of calibration factor C_{Bt}

$$\left\langle U^{Bt}_{offset} \right\rangle = \frac{1}{4500} \sum_{i=0}^{4500} U^{Bt}_i; \; B_t \approx C_{Bt}(\sum_{i=0}^{40000} U^{Bt}_i \Delta t - \left\langle U^{Bt}_{offset} \right\rangle t).$$

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Basic diagnostic - total current I_{total}, I_{pl+ch} respectively

Is deduced from Rogowski coil measurements with three operations:

- offset identification from first 4500 data rows).
- time integration (it is a magnetic diagnostic, where $U_{acquired} \sim \frac{dI_{total}}{dt}$)
- multiplication of calibration factor C_{rog}

$$\left\langle U^{rog}_{offset} \right\rangle = \frac{1}{4500} \sum_{i=0}^{4500} U^{rog}_i; \; I_{total} \approx C_{rog}\left(\sum_{i=0}^{40000} U^{rog}_i \Delta t - \left\langle U^{rog}_{offset} \right\rangle t \right).$$

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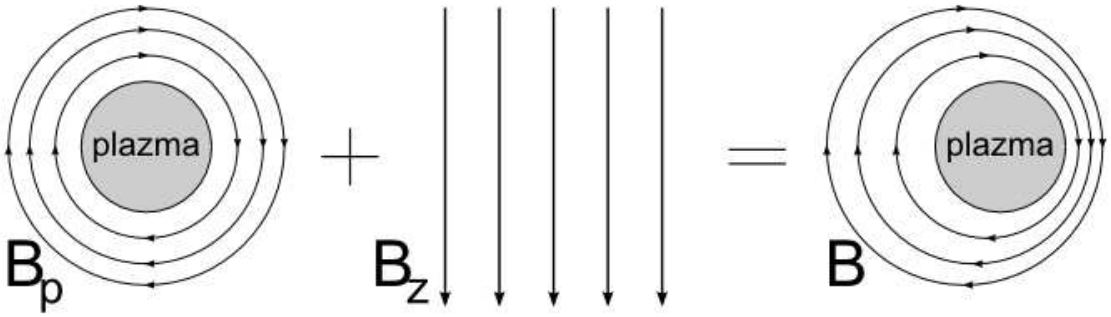
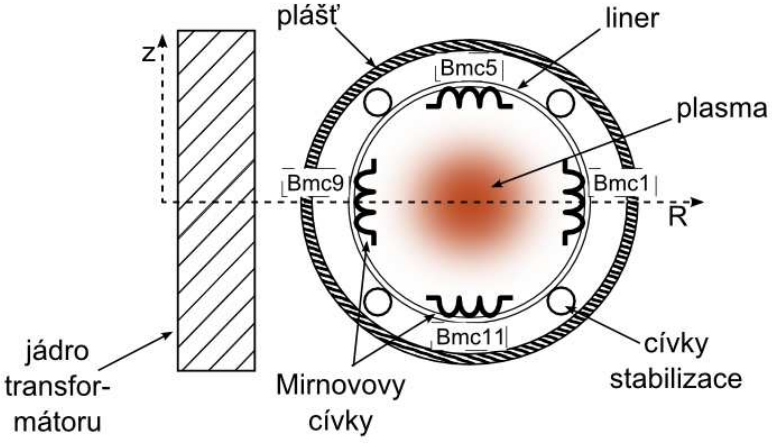
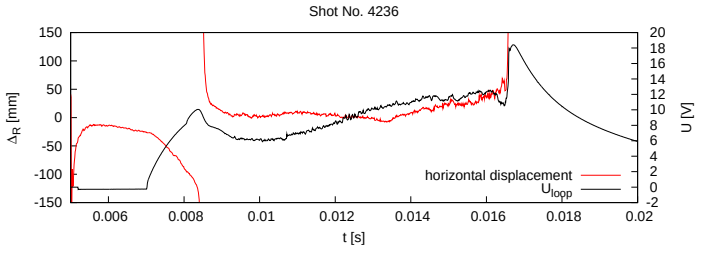
Plasma Position using Mirnov Coils







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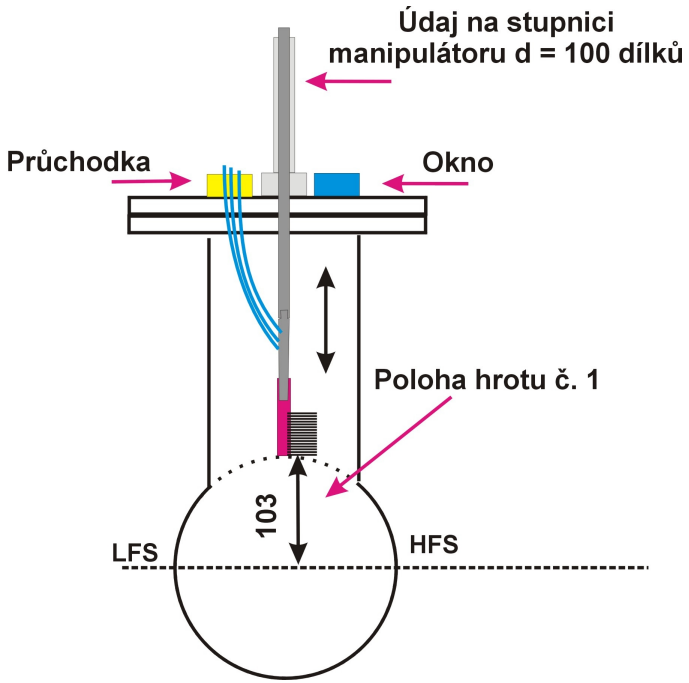
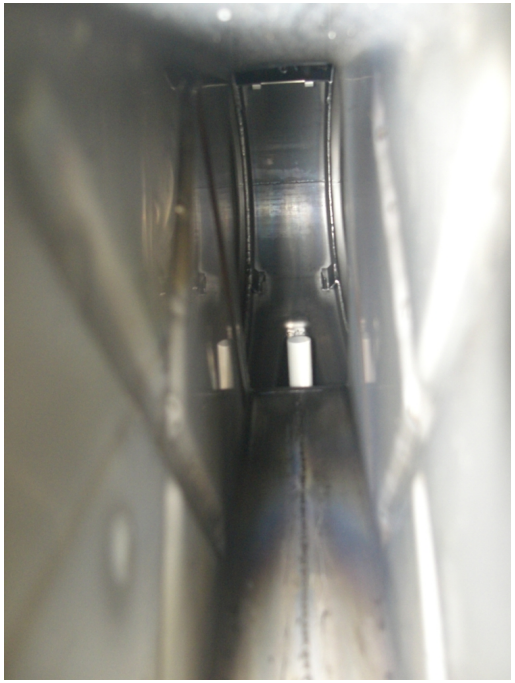
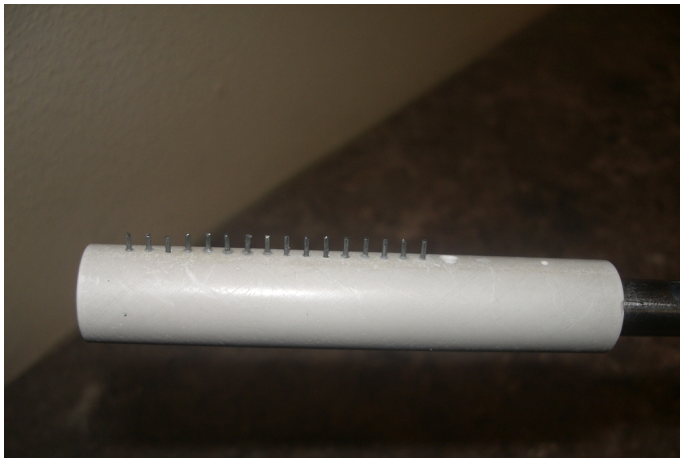
SouthEast-Bottom: Rake probe

Description,  Discharge sequence

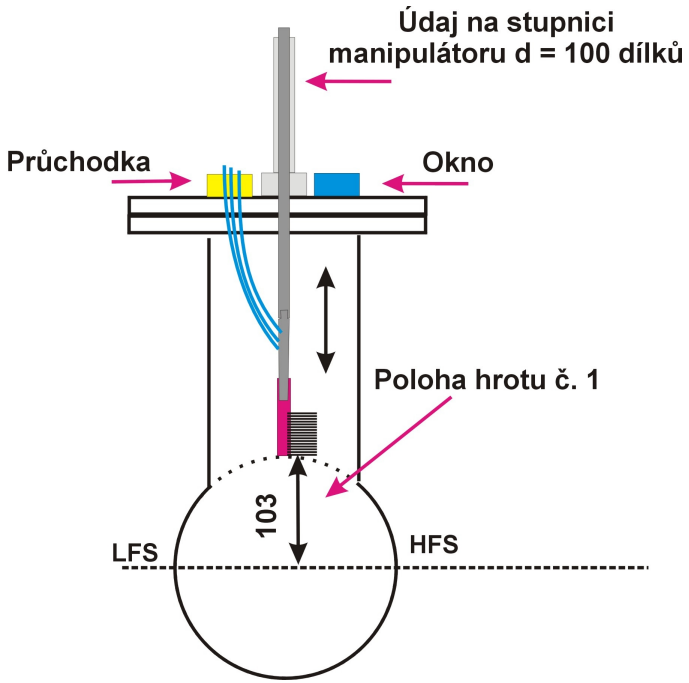
Rake probe (2012)

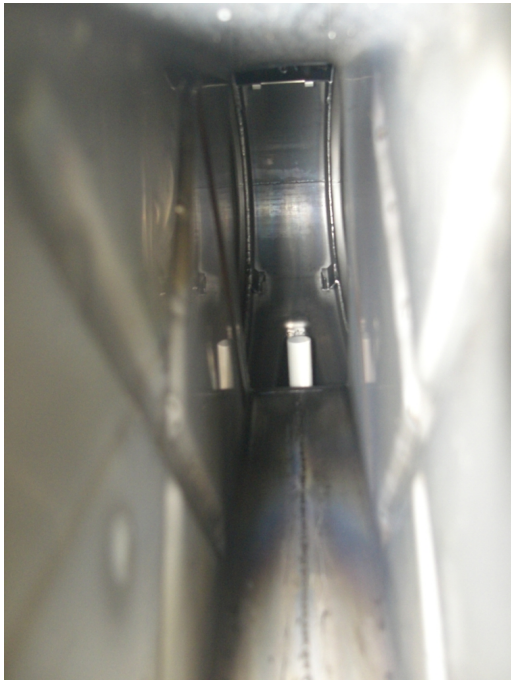


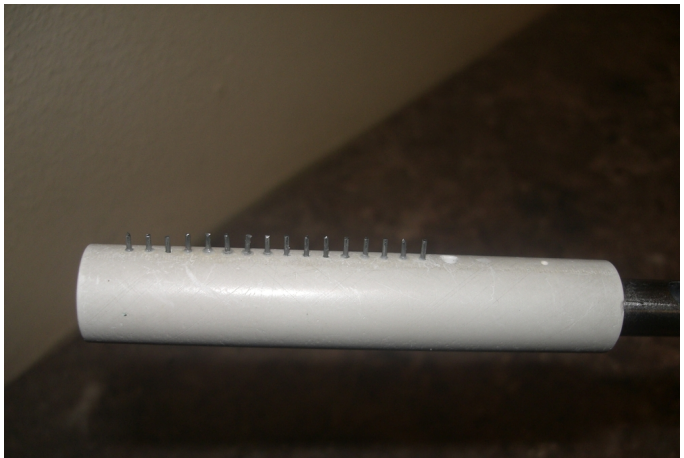




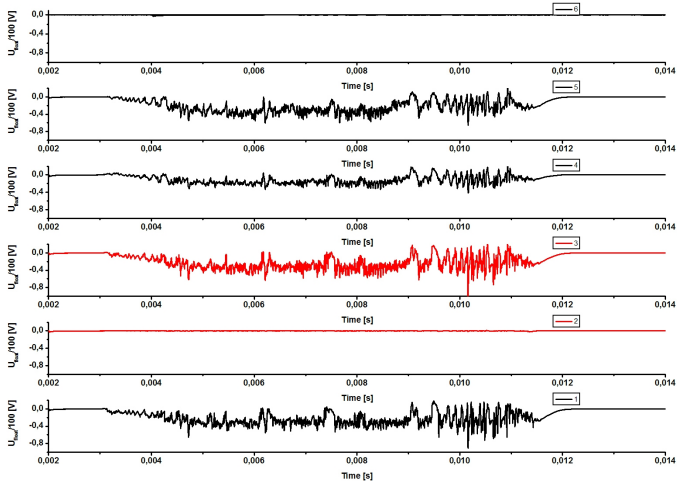
Rake probe (2012)

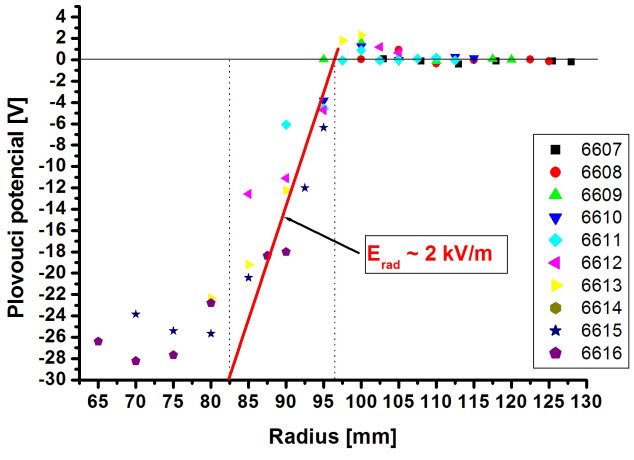


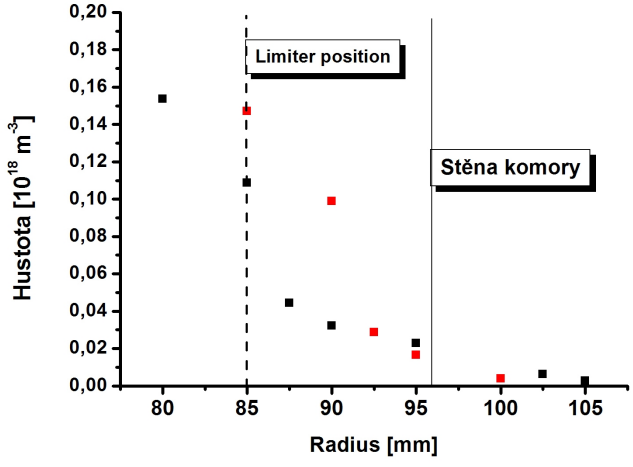




Rake probe (2012) - results







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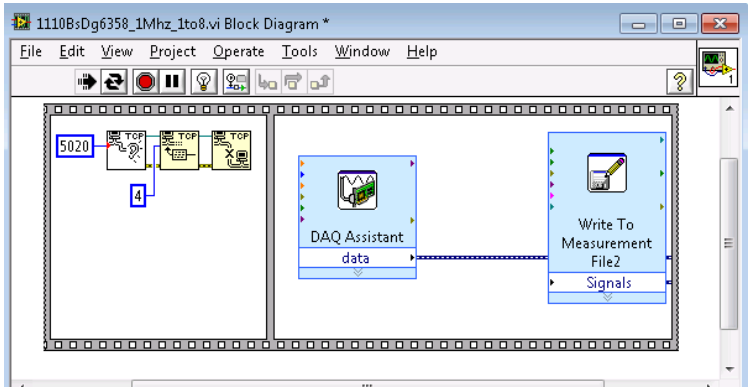
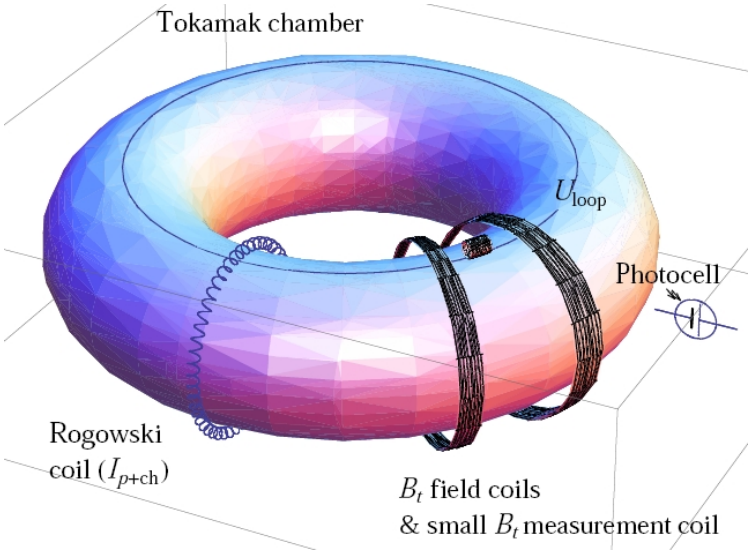
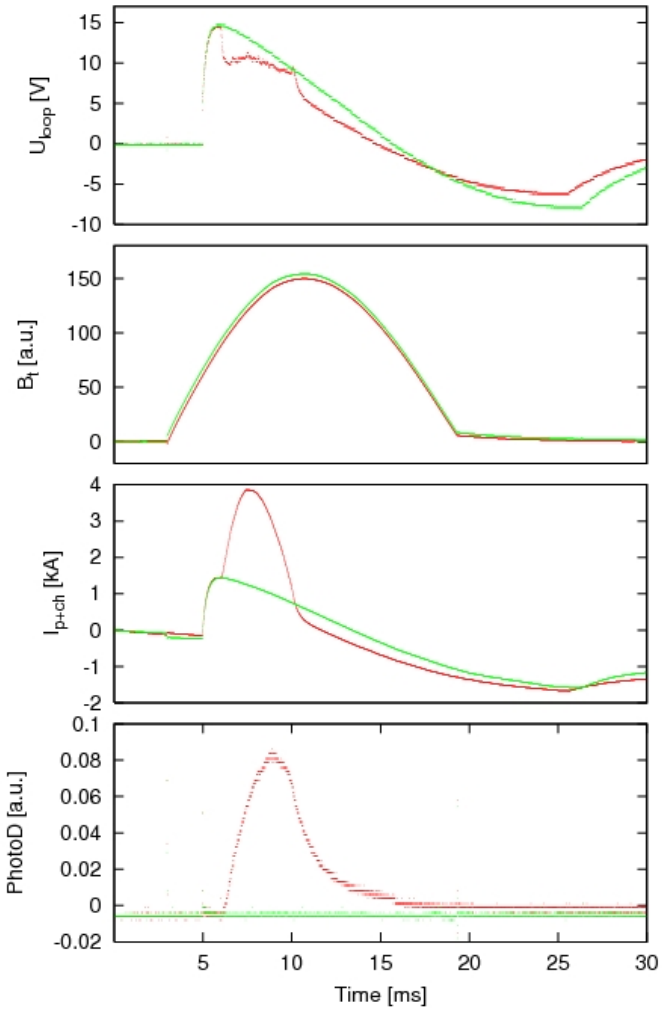
Basic plasma diagnostics in tokamak GOLEM



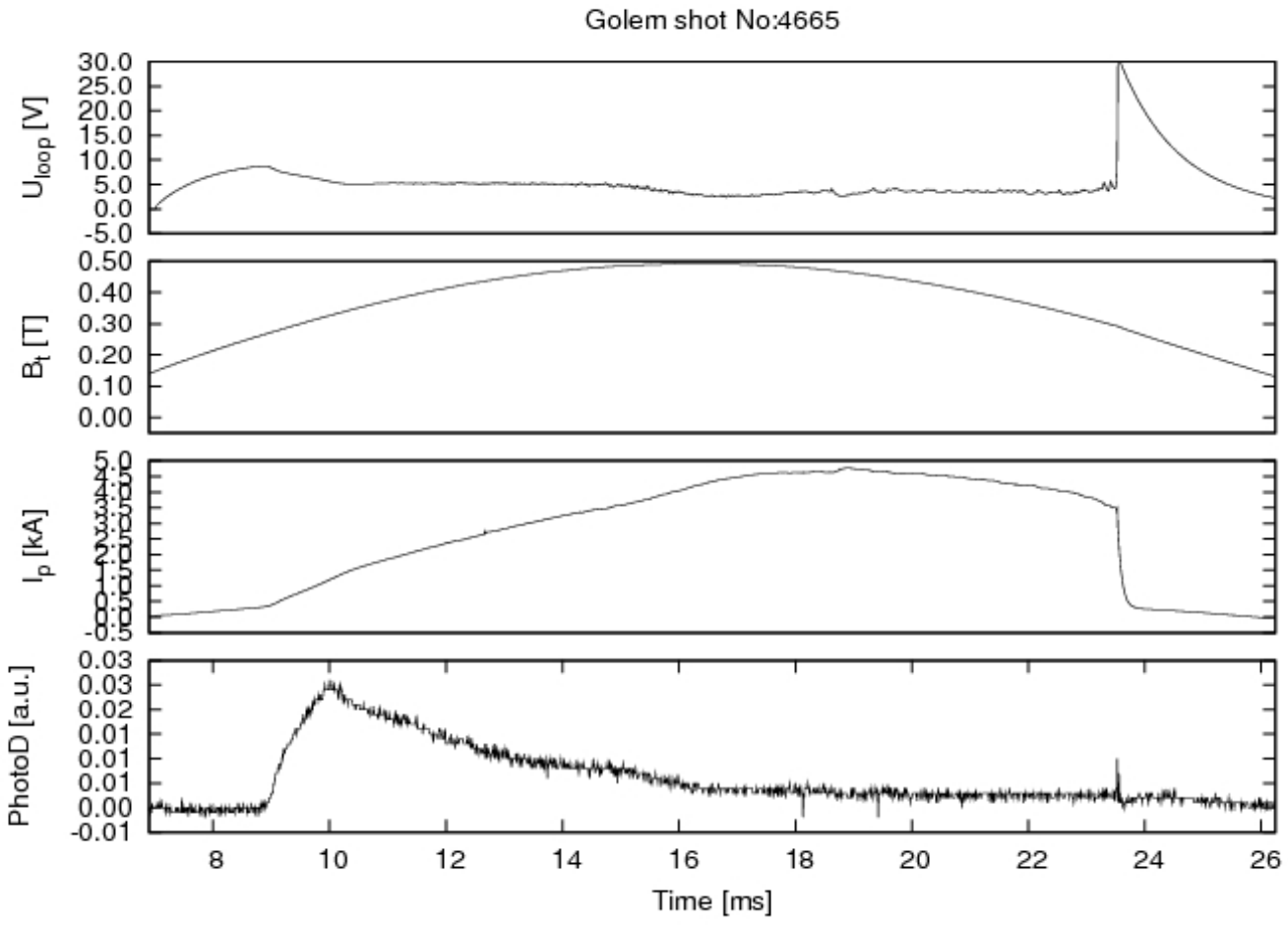
PXI system with PXIe 6358





Data Acquisition System based on: NATIONAL INSTRUMENTS

Golem discharge



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Acknowledgement

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

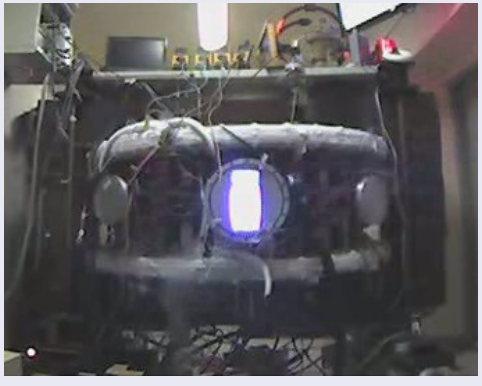
GOLEM team (students, teachers, technicians)

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, Jan Stöckel, Gabriel Vondrasek, Ondrej Vrba, Frantisek Zacek, and Jiri Zara.

Special thanks: NATIONAL INSTRUMENTS™

Final

Thank you for your attention



http://gomtraic.fjfi.cvut.cz,
you are welcome.

References I

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V. Svoboda, B. Huang, J. Mlynar, G.I. Pokol, J. Stockel, and G Vondrasek.
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