



IFJ PAN Kraków

ELQA Activities

Jaromir Ludwin

Division of Scientific Equipment and Infrastructure Construction



The Institute



- Established in Krakow in 1955
- First cyclotron built in 1958 (14.5 MeV deuterons and 29 MeV alpha particles)

See more: <https://www.ifj.edu.pl/en/institute/history.php>



The Institute

- Currently one of the biggest institutes of the Polish Academy of Sciences
- Conducting research in fields of
 - Particle physics
 - Nuclear and strong interaction physics
 - Condensed matter physics
 - Bio-physics
- Two special divisions
 - [Cyclotron Centre Bronowice](#) (hadron therapy centre – 250 MeV proton beam, 2 gantries, ocular radiotherapy facility)
 - [Division of Scientific Equipment and Infrastructure Construction](#) (cryogenic infrastructure, mechanical workshop, design office)

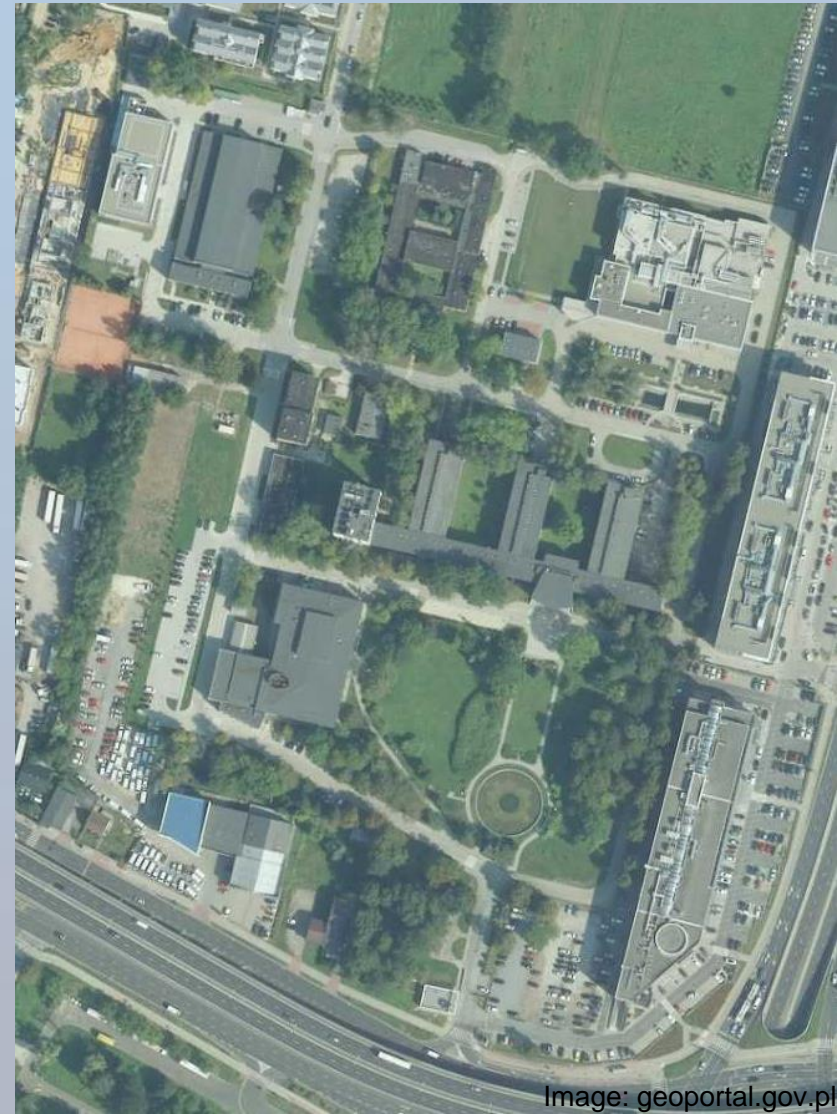


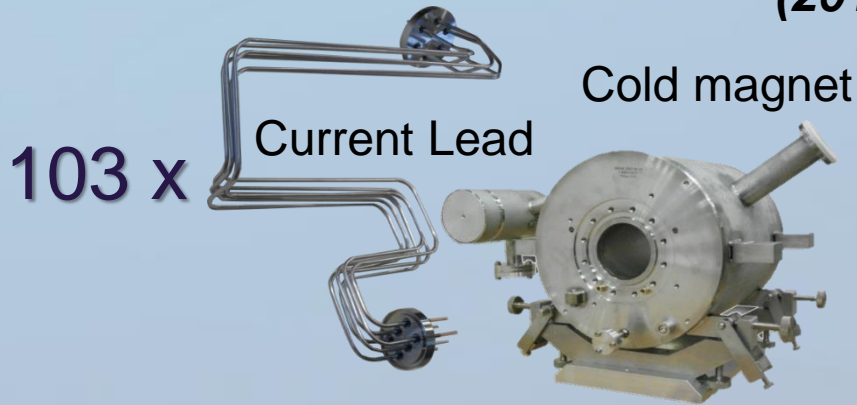
Image: geoportal.gov.pl



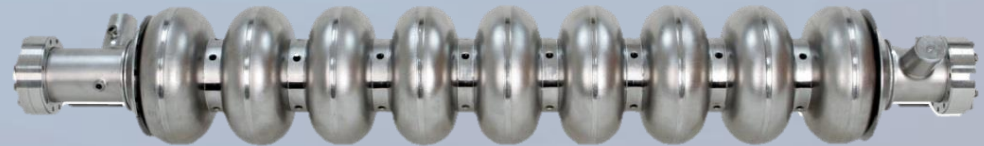
Examples of our projects

Division of Scientific Equipment and Infrastructure Construction

Qualification tests of superconducting components of the accelerator E-XFEL (2010 – 2015)



Cavity 840 x



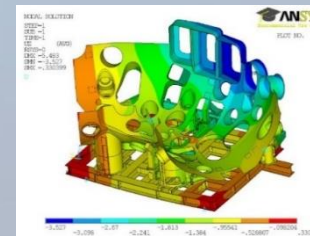
103 x Cryomodule



Division of Scientific Equipment and Infrastructure Construction

Wendelstein 7-X Stellarator assembly (2007 – 2012)

- Preparation and installation of 120 systems supplying superconducting coils.
- Completing of 220 splices of superconducting cables.
- Manufacturing of 30 sets of mechanical elements for polychromators.
- Verification calculations (FEM) of the designed equipment for the assembly, storage and transport of external module tanks.



Division of Scientific Equipment and Infrastructure Construction

ITER – design and prototype works (2010 – 2024)

2010-2013: FEM calculations of ITER infrastructure elements

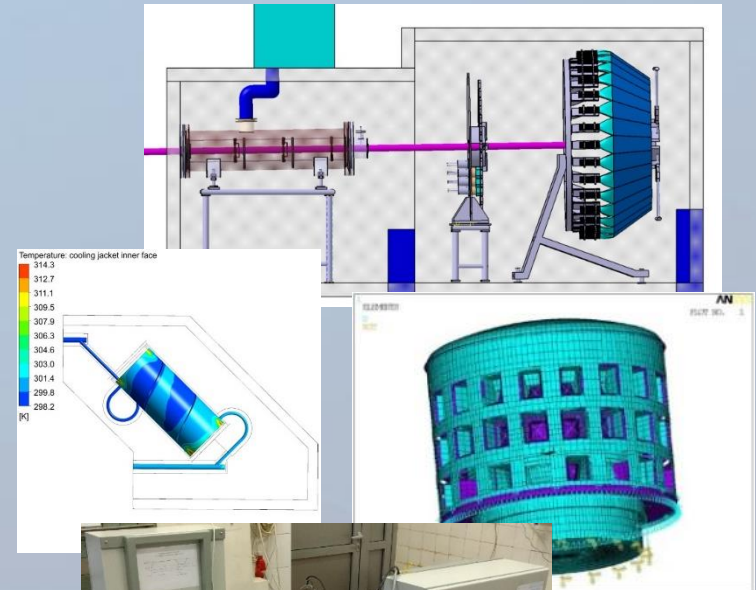
- static analyses for nonlinear effects (buckling) and fatigue
- dynamic analysis for seismic loads.

2013-2024: Radial Neutron Camera (RNC)

- Thermo-hydraulic design and analysis (detector cooling system)
- Electromagnetic analyses (dynamic loads and electromagnetic shields)
- Design of RNC components (adjustable collimators and rotary detectors)
- CAD design support

2014-2016: High Resolution Neutron Spectrometer (HRNS)

- Coordination of the engineering part of the project
- Leading role in CAD design
- Thermo-hydraulic design and analysis - detector cooling system
- Electromagnetic analysis – detector shielding system against the influence of magnetic field

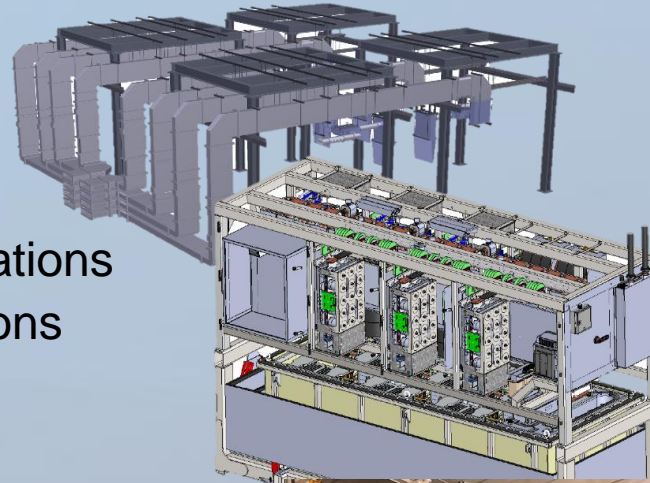


Division of Scientific Equipment and Infrastructure Construction

ESS – Installations and testing (2017 – 2027)

RF installations

- S-tub installations
- LLRF installations
- Local protection system installations
- RF power distribution installations



Power converter installations

- Klystrons Modulators for RFQ and DTL
- Klystron Modulators for Medium / High Beta
- Power converters for magnets

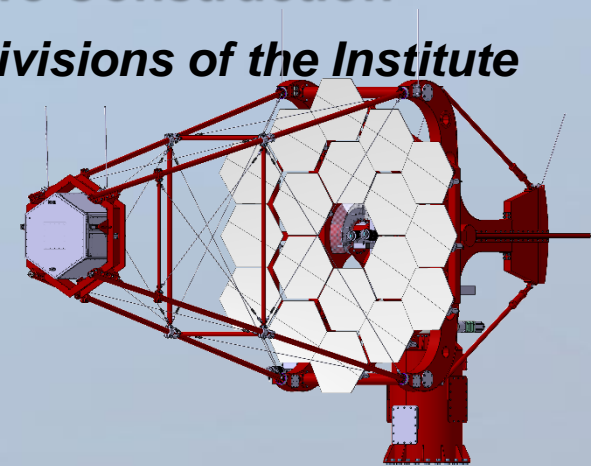
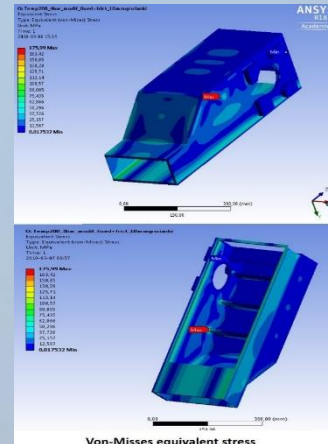
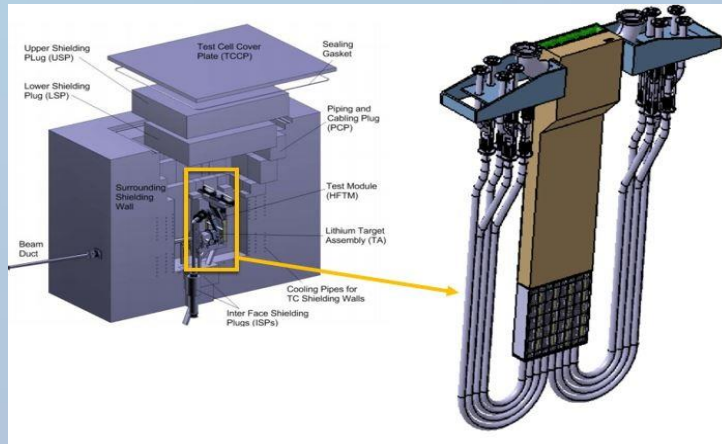


RF Cryomodule Tests

- Preparation and execution of qualification tests of 30 cryomodules

Division of Scientific Equipment and Infrastructure Construction

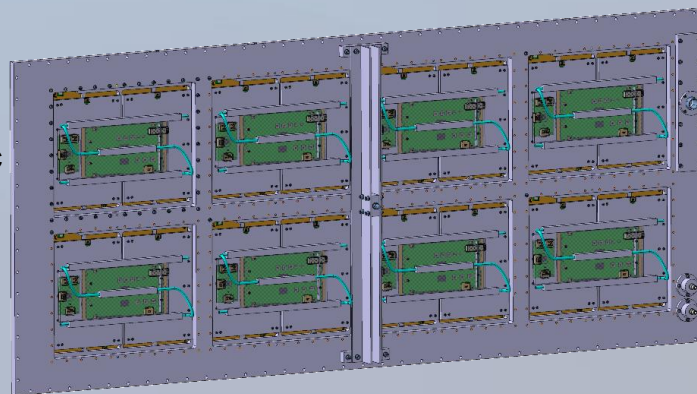
Many projects done in collaboration with scientific divisions of the Institute



Building of 2nd prototype and installation of two Cherenkov telescopes in Czech Republic – collaboration with Department of Gamma-Ray Astrophysics

STUMM (IFMIF-DONES) in collaboration with Department of Radiation Transport Physics

T2K (ND280 detector upgrade) – collaboration with Department of Cosmic Ray Research and Neutrino Studies



IFJ PAN contribution

- Design and manufacturing
- 4 full-size modular frames
- 36 supports for MicroMegs



History of CERN – IFJ PAN ELQA collaboration

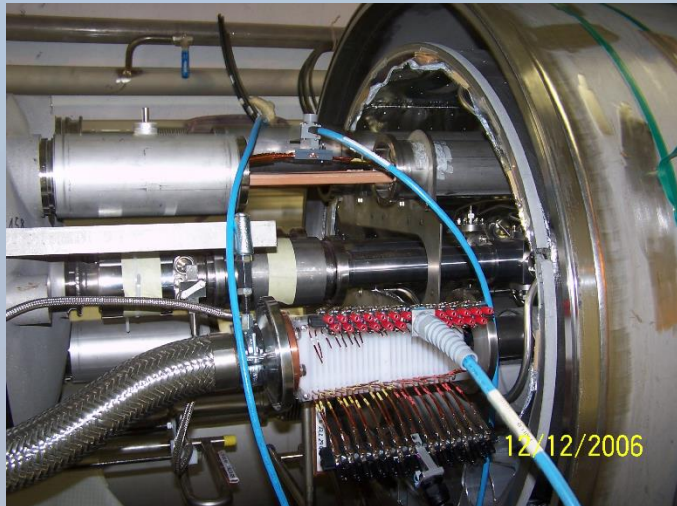
First Collaboration Agreement between
CERN and IFJ PAN related to ELQA activities
signed on 2003 (left photo)
and updated in 2005 (right photo)



Source: A. Kotarba

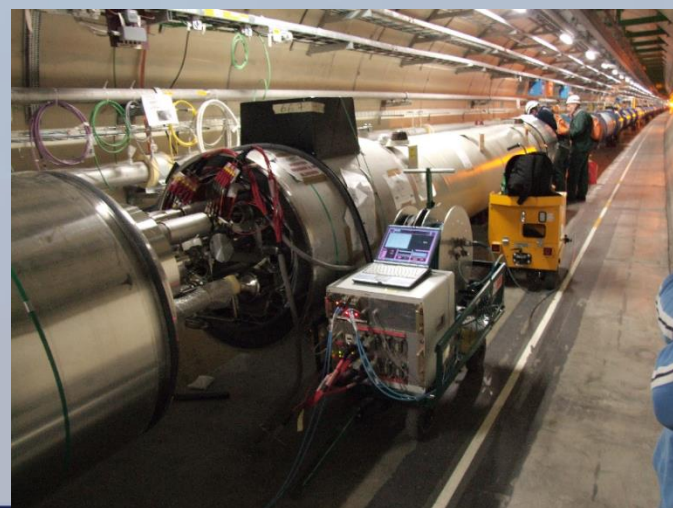
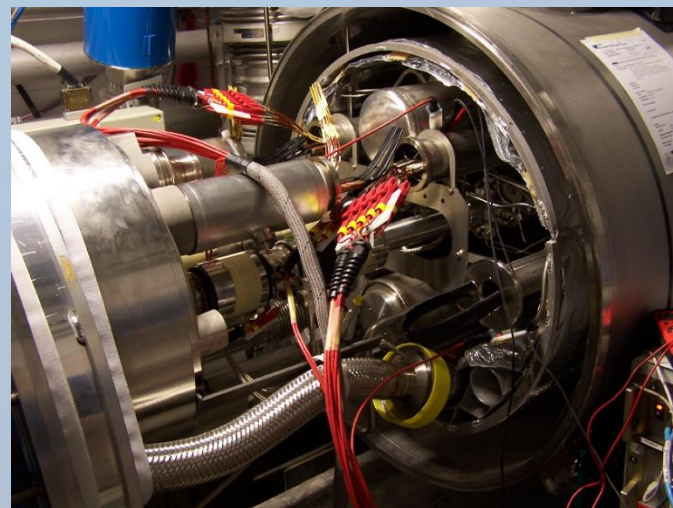
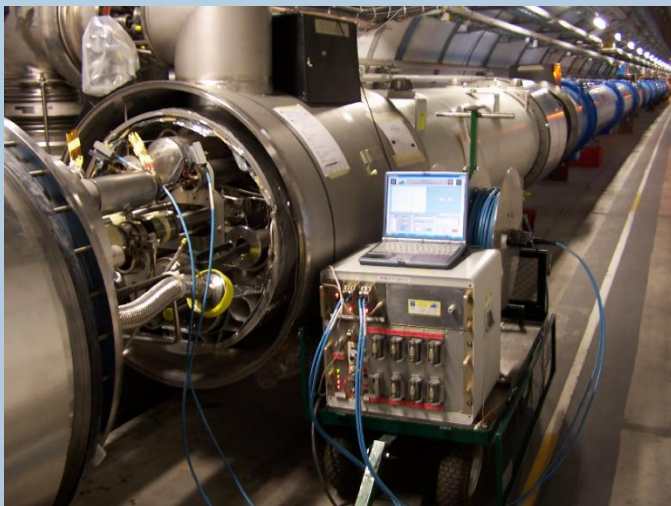


IFJ PAN ELQA Team at CERN – Arc Interconnection Verification



Source: A. Kotarba

Partial Arc Qualification



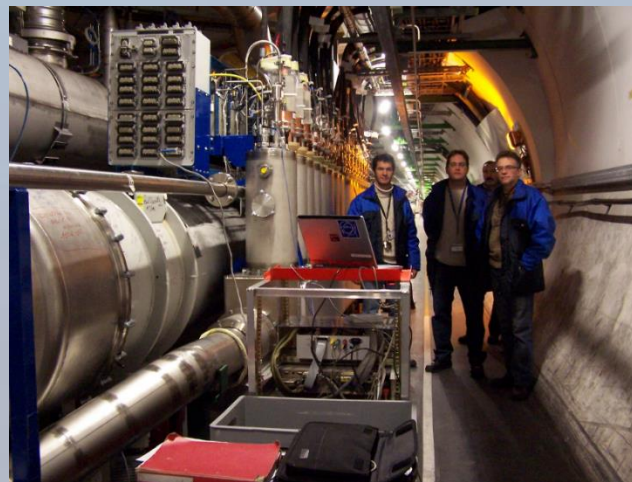
Source: A. Kotarba

First TP2 - TP4 tests



Source: A. Kotarba

First TP4 tests



Source: A. Kotarba

Equipment used during LHC assembly and early HC



Source: A. Kotarba

Line-N Factory



Source: A. Kotarba



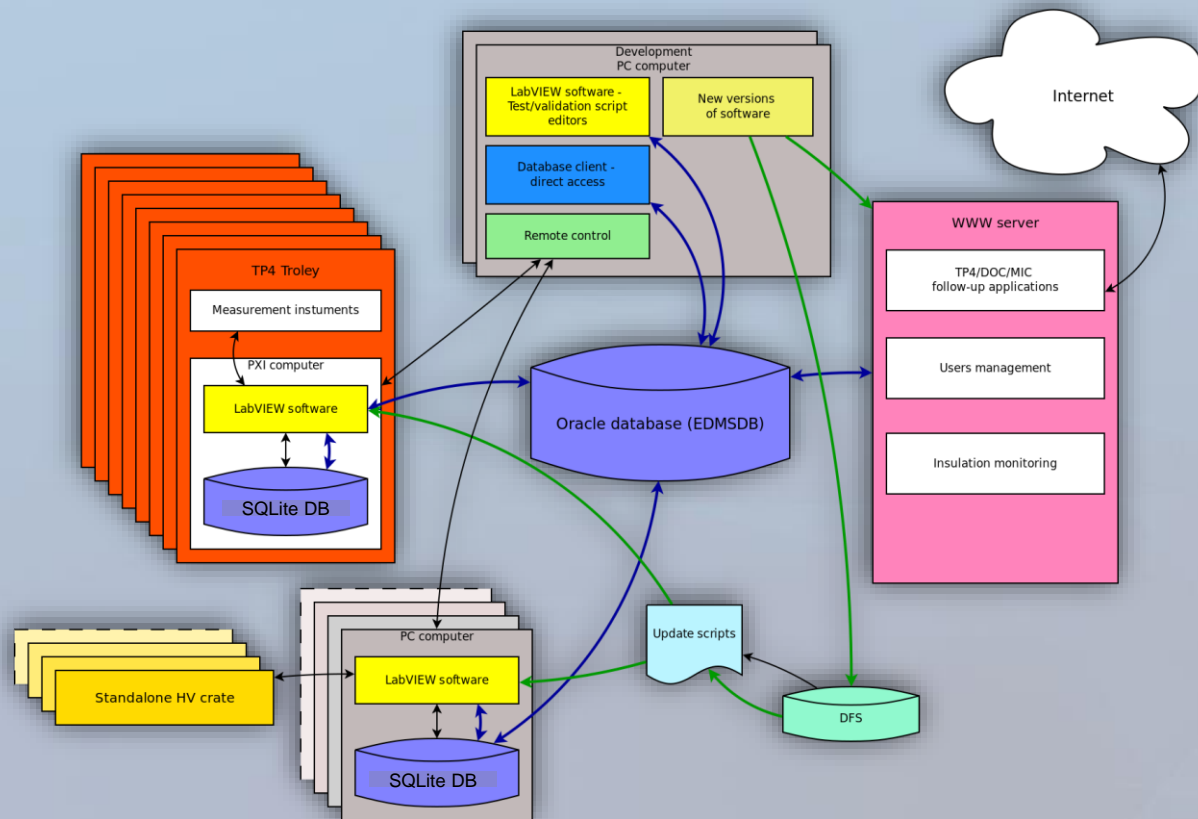
Summary of the collaboration

We have been working together since the beginning of the LHC, during:

- LHC assembly
- Hardware commissioning
- Recovery after 2008 incident
- Long Shutdowns 1 and 2
- Technical stops

ELQA hardware and software are our basic tools, which we (Institute and CERN) have created on our own. This provides the tightest possible feedback loop between user and developer.

Maintenance of the TP4 measurement system





Maintenance of TP4 system

Hardware

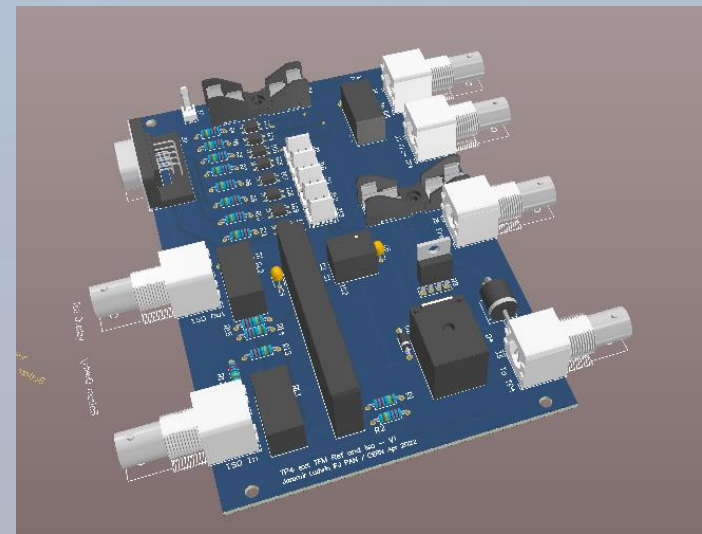
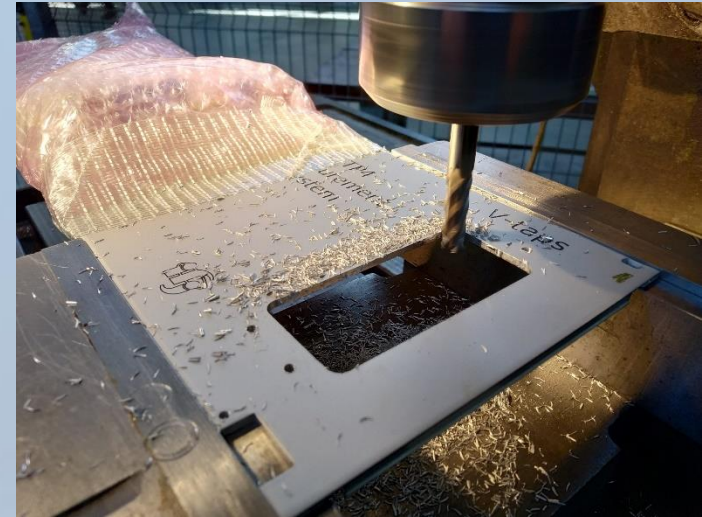
- General hardware maintenance
- Upgrade of gain/phase analyser (EoL of currently used device)

Software

- Universal test and measurement application
- ELQA database optimisation
- Full implementation of local TFM
- Upgrade of MIC QHR application
- ELQA test plan web application
- Additional PXI based monitoring applications

Hardware

- Initial system check
- Removal of all devices and cleaning
- Upgrade of power distribution box and check of grounding system
- Preparation of fasteners for new and relocated devices
- Replacement of all connectors
- Retightening of all screws
- Replacement of broken cables
- Design and production of new PCBs for external TFM reference and TFM isolation amplifier



TP4 instruments rearrangement



24 VDC to 230 VAC converter

Power supply for the TP4 crate

TP4 Crate (multiplexers and reference resistors)

PXI computer with two DMM cards

Powertek amplifier (output +/- 12V, 700 mA RMS, 1A peak)

Agilent 6643A DC Power Supply (0-35V, 0-6.0A)

Powertek GP102 gain phase analyser with dual analysis channels and generator

TP4 instruments rearrangement



Agilent 6643A DC Power Supply (0-35V, 0-6.0A)

Power supply for the TP4 crate

TP4 Crate (multiplexers and reference resistors)

PSM1700 gain phase analyser with dual analysis channels and generator

PXI computer with two DMM cards

Powertek amplifier (output +/- 12V, 700 mA RMS, 1A peak)

24 VDC to 230 VAC converter

Replacement of all connectors



Harting pins after few thousand mating cycles



Conclusions

- There is a huge record of fruitful collaboration between CERN and IFJ PAN, in particular in the field of Electrical Quality Assurance.
- TP4 maintenance project started with a significant delay, but we are catching up with the schedule.
- Our experts are working on many projects, ranging from accelerator technology to fusion.
- We are really good at building and testing.