

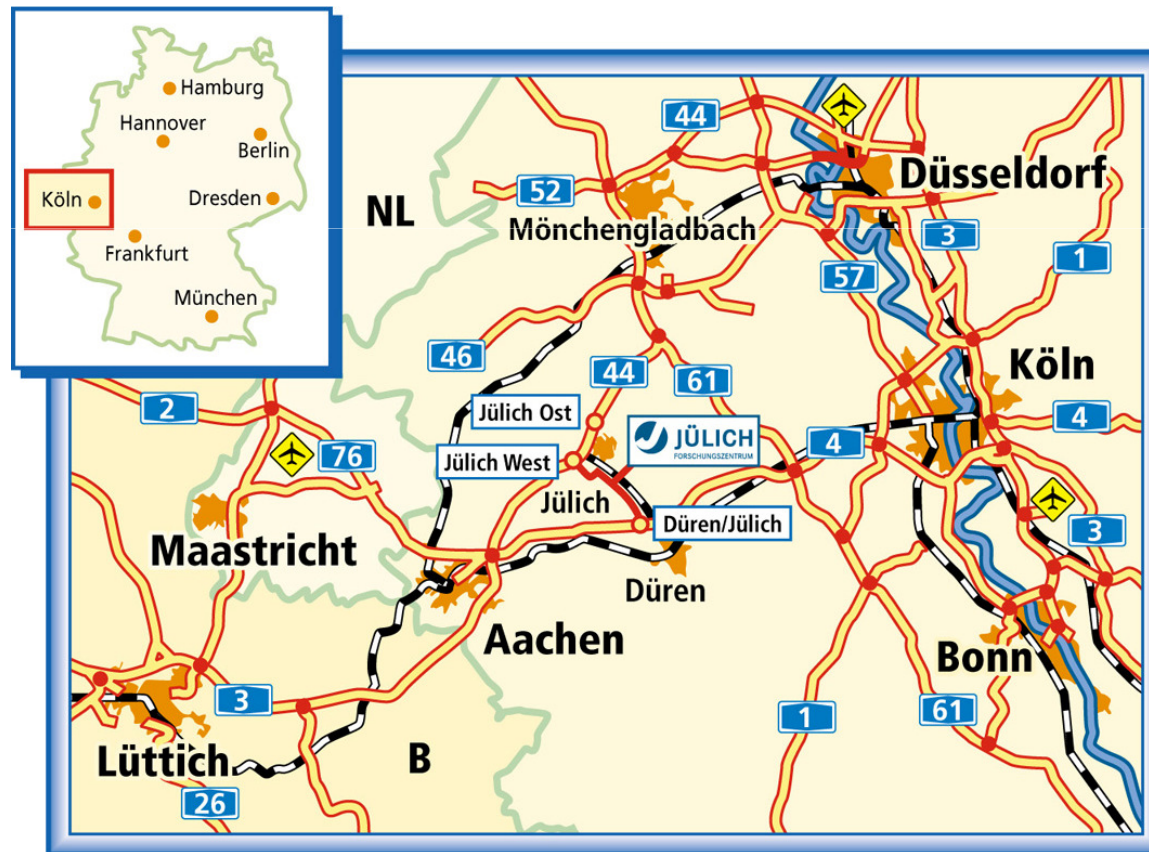
The Central Institute of Technology

Dipl.-Ing. Mihaly Pap

*Design and Engineering of Neutron Instruments Workshop - September 17 - 19, 2012 -
RAL*

The „Forschungszentrum Juelich GmbH“

We work towards comprehensive solutions for the grand challenges facing society in the future in the fields of **health**, **energy** and **environment**, and **information technology**, thus laying the foundation for future key technologies.



The „Forschungszentrum Juelich GmbH“

Facts and Figures:

about 50 institutes

total personnel: about 4,700

scientists: ~1,700 technical personnel: ~1,700

One of the institutes: ZAT = Zentralinstitut für Technologie (Central Institute of Technology)

Employees: 150

↪ who we are – ZAT mission

- **ZAT is a science and technology institute supporting the research institutes of the research center in Jülich**
- **For the institutes and externals we design, develop and build scientific equipment and experiments not available on the market**
- **We maintain and modify the setups, deliver technology consultancy and perform feasibility studies**
- With our wide competence and our experience we fulfill fast and in a flexible way the requirements of our customers and partners
- We build competences in new areas und adjust permanently our capabilities to the needs of our customers
- With our capabilities and customer oriented way of working we deliver a major contribution to the achievement of the mission statement of the Research Center Jülich.
- We offer attractive and future oriented working and apprenticeship training jobs

↳ who we are – ZAT competences

engineering und new technologies

- project management (15 engineers)
- engineering design, numerical simulations and design calculations
- feasibility studies & experiments, physical measurements
- automation and control techniques
- joining technologies & materials research
- magnetic bearing and drive systems

manufacturing technologies & assembly

- welding technologies
- high precision machining and assembling, machine manufacturing
- rapid prototyping
- glass, plastics and ceramics machining
- surface treatment techniques

inspection and approval procedures, e.g.:

- TÜV certification for pressure vessels
- certifications for welding technologies

➤ Overview

Hadron Physics (IKP: Institute for Nuclear Physics)

- Accelerator and accelerator components
- Detector systems for Proton – and Antiproton beams

Neutron Science (JCNS: Jülich Center for Neutron Science)

- Instruments for advanced Neutron sources
- Choppers for Neutron scattering (magnetic bearing)
- European Neutron Spallation Source ESS

Energy (Institutes for Energy and Climate Research)

- Instruments for Nuclear Fusions Research
- Projects for photovoltaic, full cells

Environment (Institutes for Energy and Climate Research)

- Setups for measurement of trace gases in the atmosphere

Bio-Geo Science (IBG 3: Institute for Bio- und Geo Science)

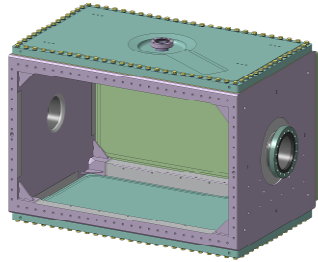
- Equipment for plant and soil investigations

Medicine (Institutes for Neuroscience and Medicine)

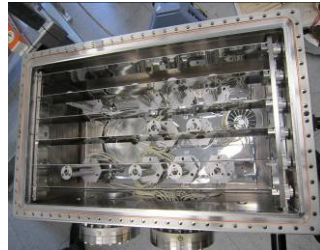
- Work for MRT- und PET- set ups
- Equipment for production of radio nuclides

PAX@COSY

PAX – Polarising Antiproton Experiments



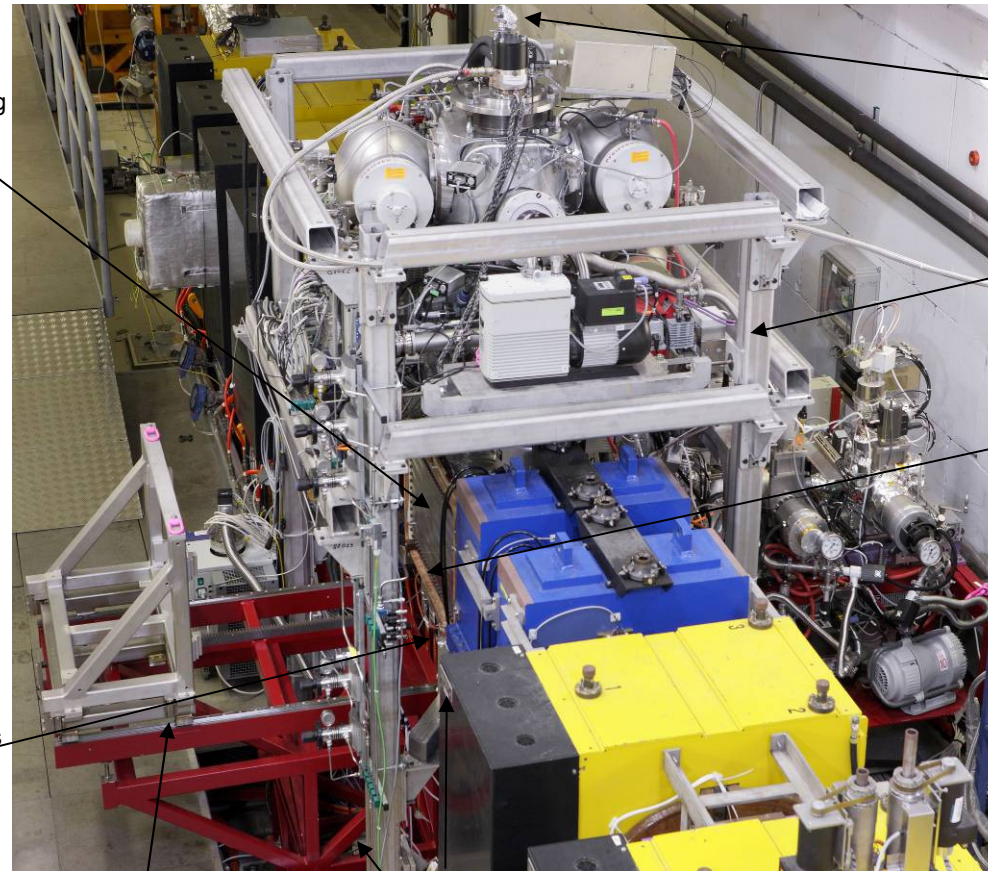
engineering, design and manufacturing of PAX target chamber



NEG-pump system with 10 NEG-pumps and heat protection jalousie



linear guided assembling system



supports for magnets

alignment of concrete elements



support for target chamber, ABS (atomic beam source) and BRP (Breit-Rabi polarimeter)

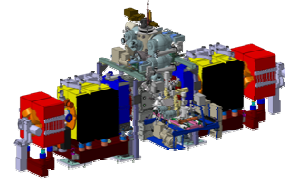


engineering, design and manufacturing of the weak field and compensation coils

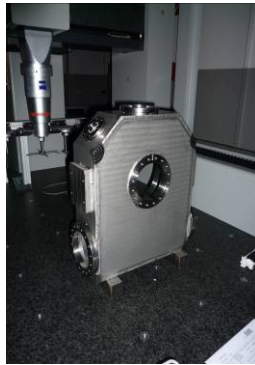


design and installation of the entire heating system :





PAX@CERN



4 UHV pump boxes with complicated geometry



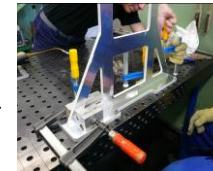
4 adjustment units for precision positioning



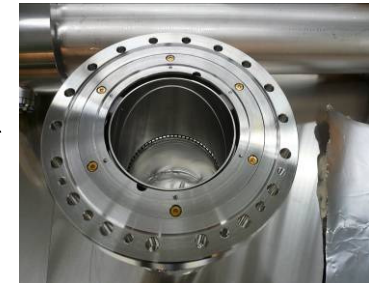
18 adjustable stands

2 supports for magnets

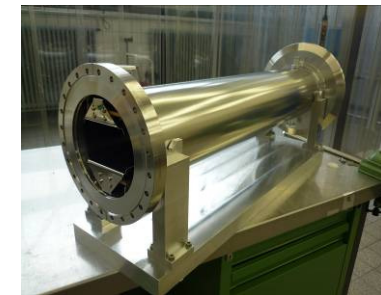
entire heating system :



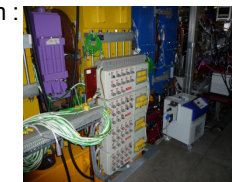
4 adapters for geodesy with tight tolerances



2 beam position monitors (BPM)



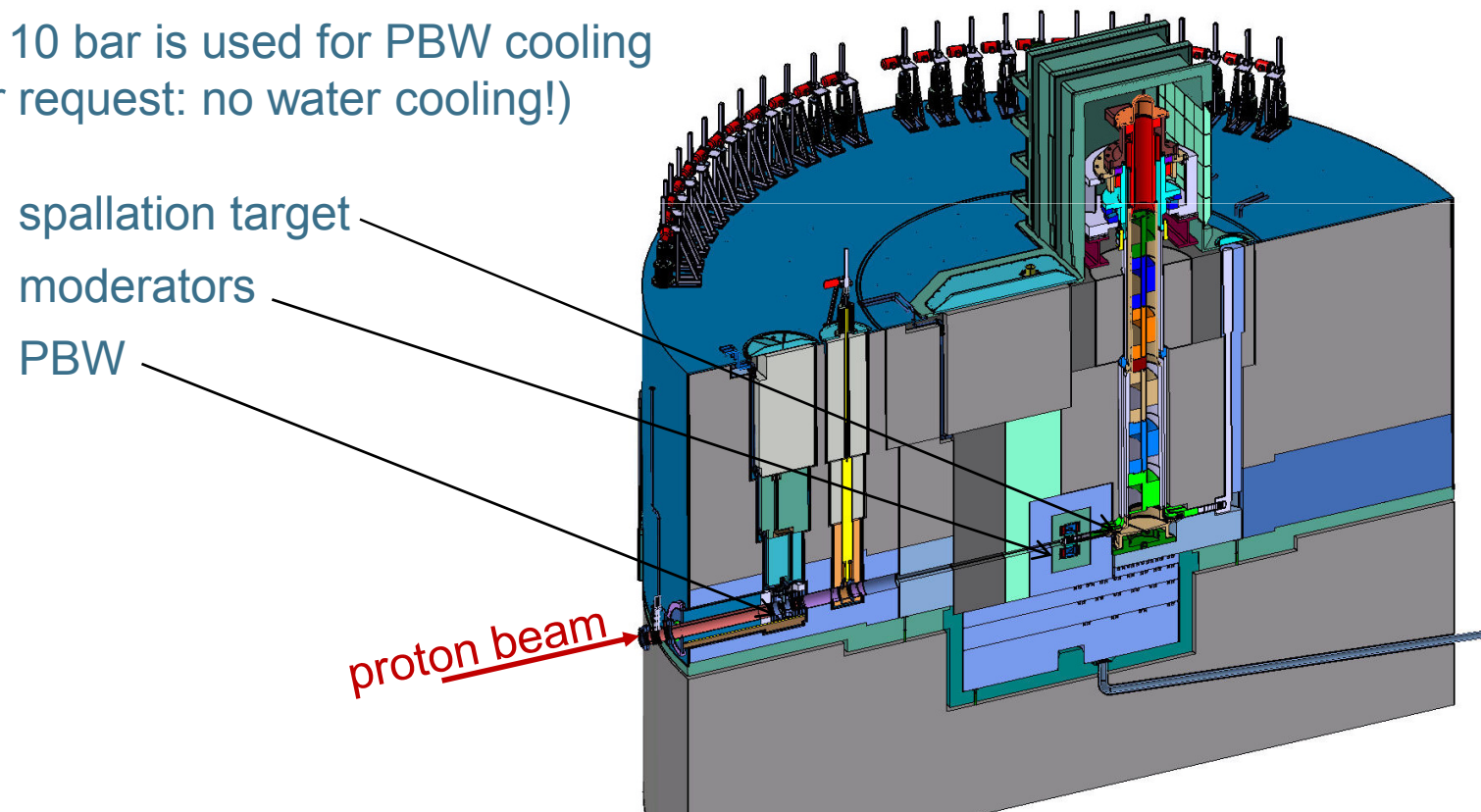
damper tube with electrodes



Proton Beam Windows

↪ contribution for ESS

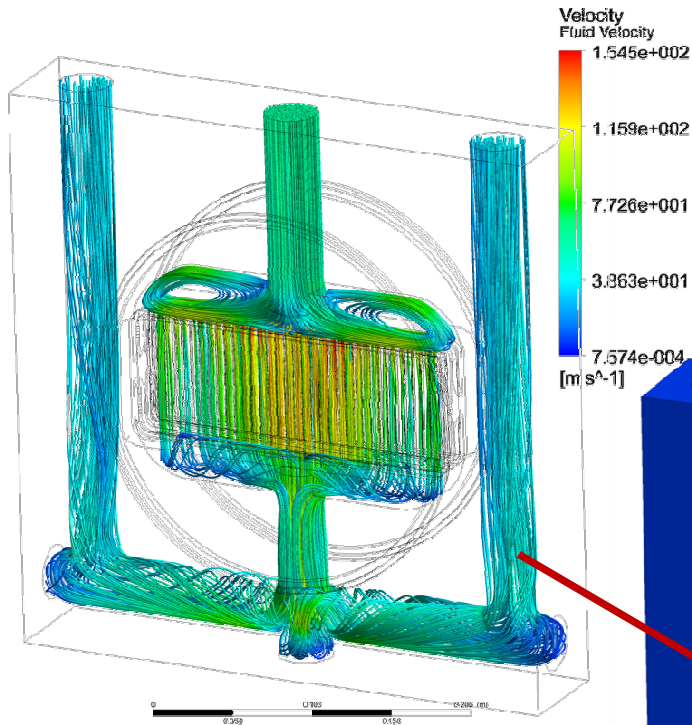
- ESS (European Spallation Source)
- Spallation target is used to produce neutrons for scientific experiments
- The PBW separates the accelerator vacuum from the helium atmosphere around the target (1 bar helium)
- Helium at 10 bar is used for PBW cooling (customer request: no water cooling!)



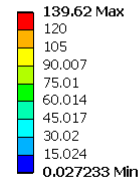
Proton Beam Windows

↪ results for the ESS PBW

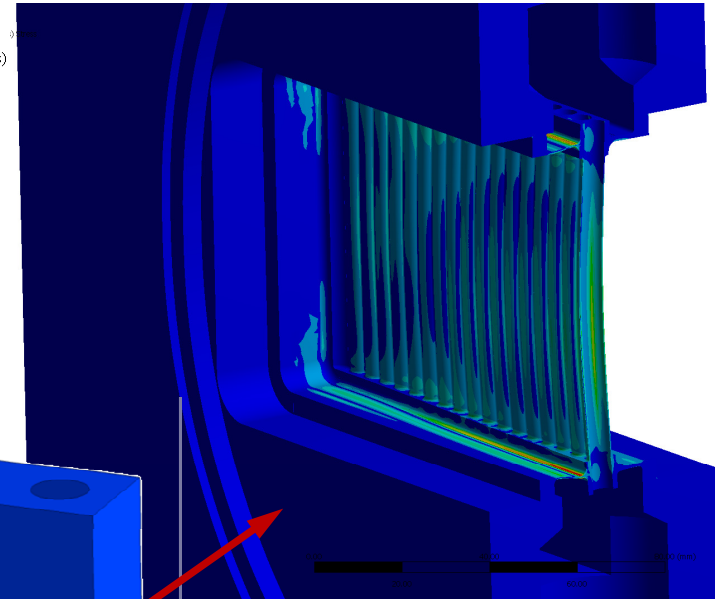
Velocities, m/s



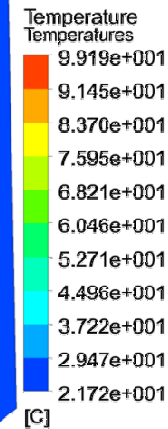
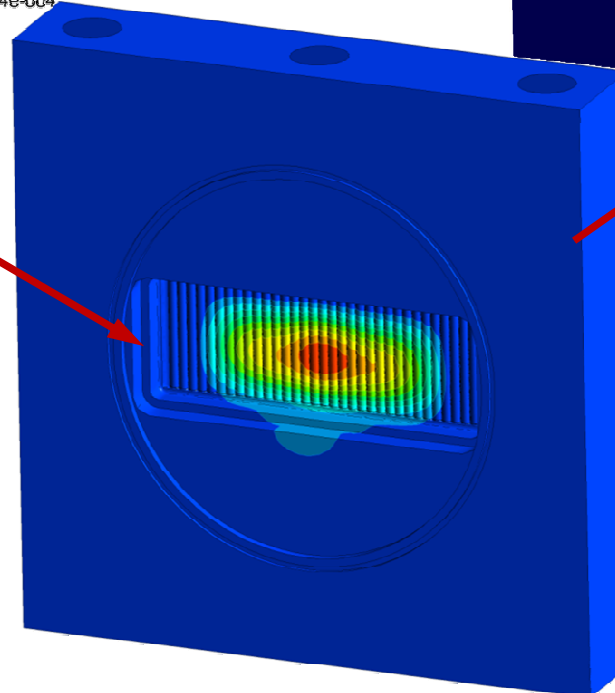
I: Static Structural
Equivalent Stress
Type: Equivalent (von-Mises)
Unit: MPa
Time: 1
06.06.2012 12:13



equivalent stress, MPa

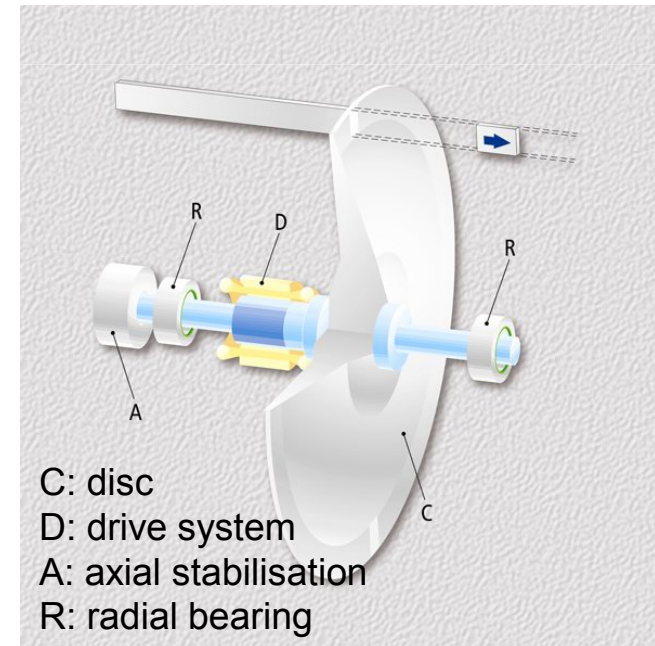


temperatures, °C



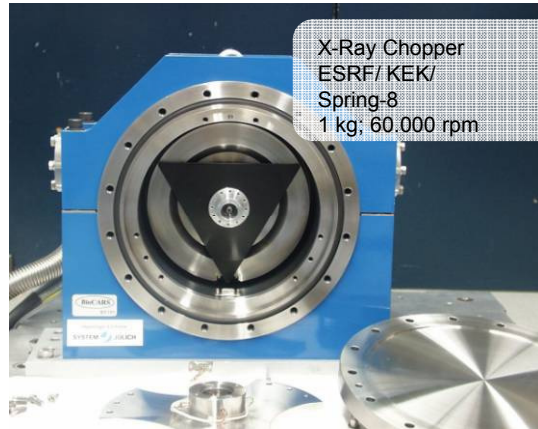
Chopper Systems

- Neutron beams are useful probes for studying the arrangement of atoms in materials
- A **neutron chopper** is essentially a disc rotated at high speed with one or more 'windows', which the neutrons can pass unhampered at particular points in time
- By arranging several choppers - one after another - special neutron pulses can be selected
- At ZAT maintenance-free **magnetic bearings** are used for such chopper systems at high rotational speeds and operating in vacuum.
- Beside neutron choppers ZAT also developed and built neutron, light pulse and x-ray pulse selectors



Chopper Design

↳ typical choppers developed at ZAT



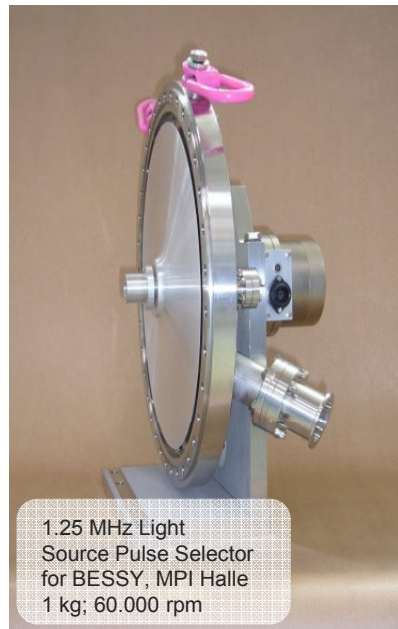
X-Ray Chopper
ESRF/ KEK/
Spring-8
1 kg; 60.000 rpm



Chopper Disk of PSI-
MARS Cascade
5 disks; max. 9 kg;
21.000 rpm



Fermi Chopper
FZJ-SV29
28 kg; 15.000 rpm



1.25 MHz Light
Source Pulse Selector
for BESSY, MPI Halle
1 kg; 60.000 rpm



Chopper Cascade
ILL-IN5 TOF
6 disks; max. 8 kg;
20.000 rpm

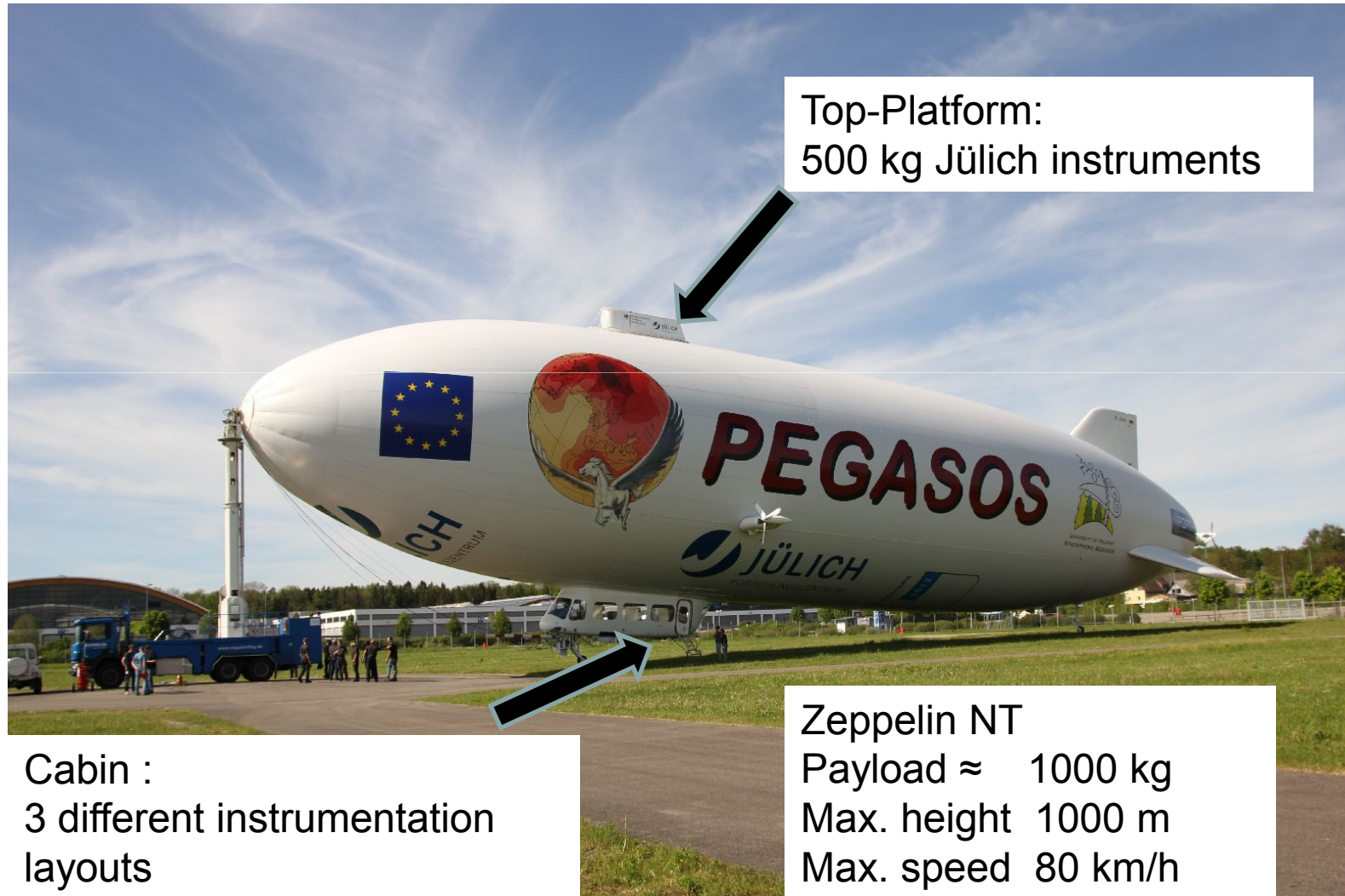


SNS-NSE
4 disks
7 kg; 3600 rpm



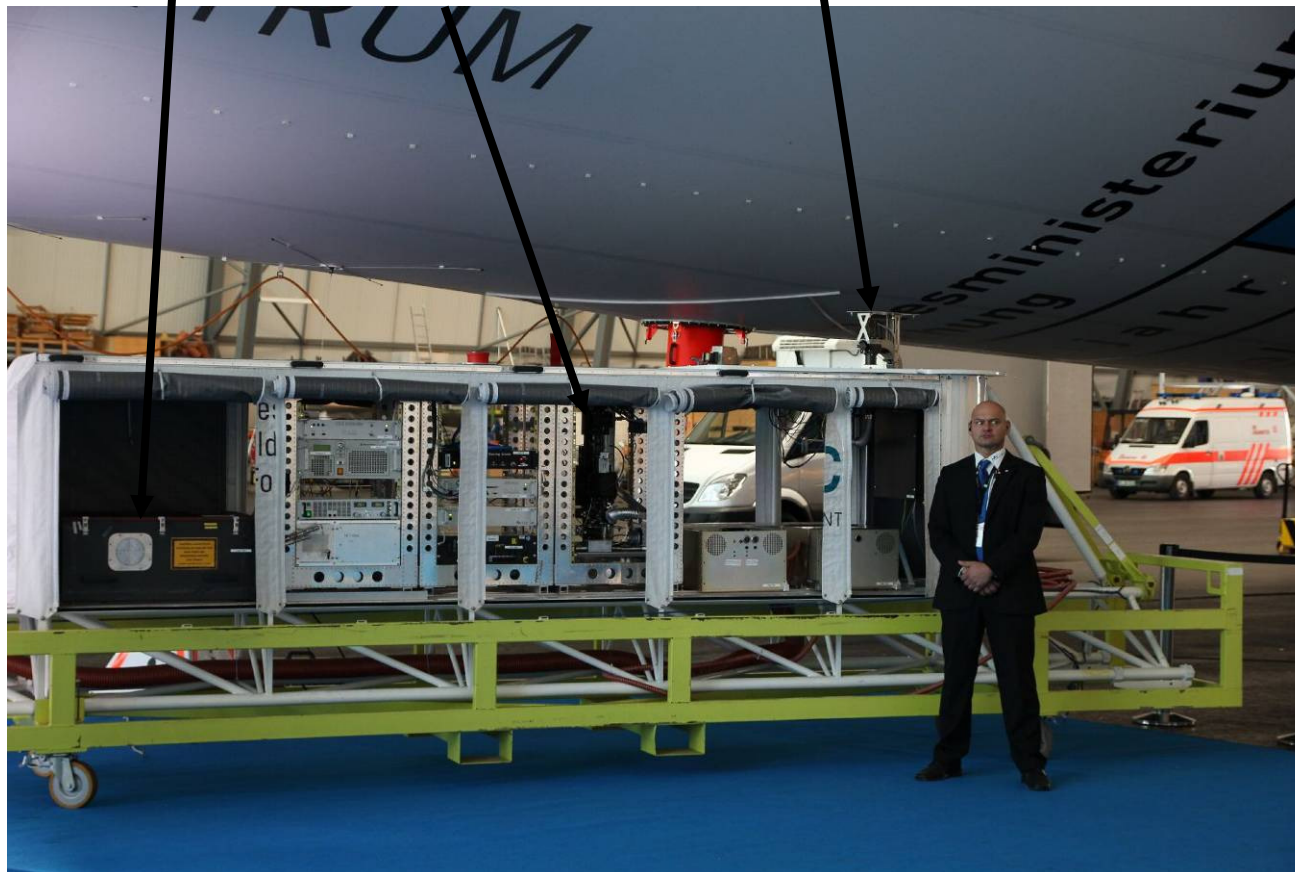
PST-Chopper
diameter 1280mm
4800 rpm

Zeppelin NT as carrier for atmospheric research



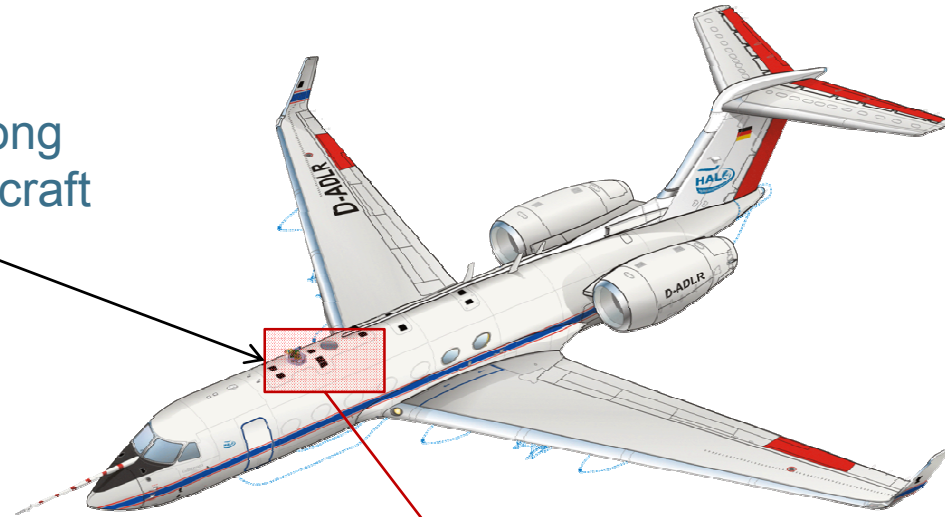
ZAT-developed instruments

- in Top Platform:
 - KALIF (calibration of LIF)
 - LILA (new laser for LIF)
 - Air Tau OH (reactivity measurement)

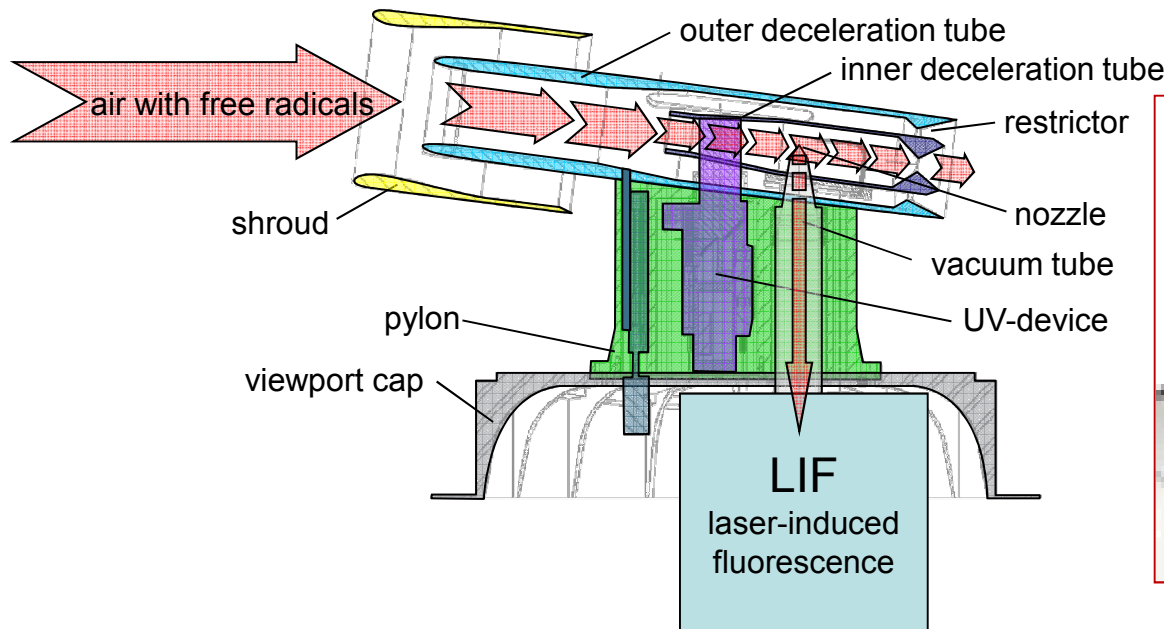


Inlet System for HALO

- HALO = high altitude and long range research aircraft
- Inlet system for LIF device (measuring radicals)



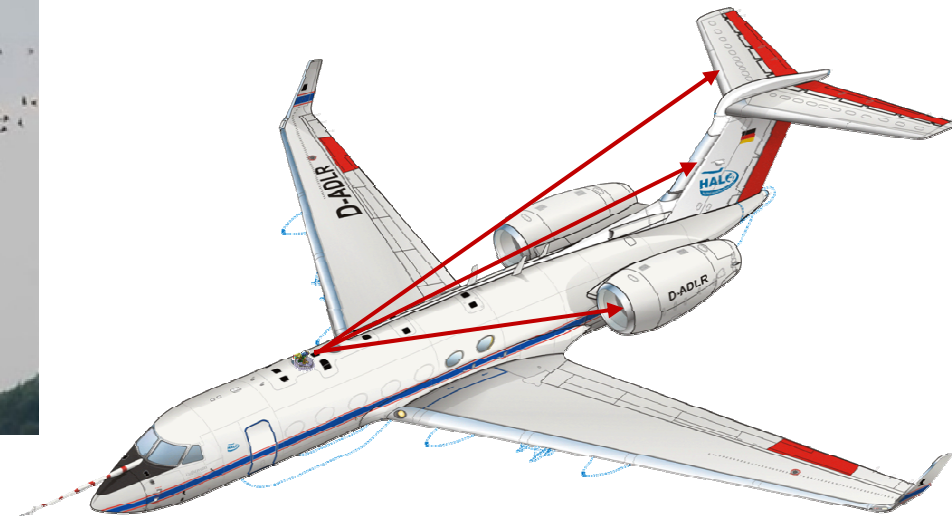
principle set-up



Inlet System for HALO

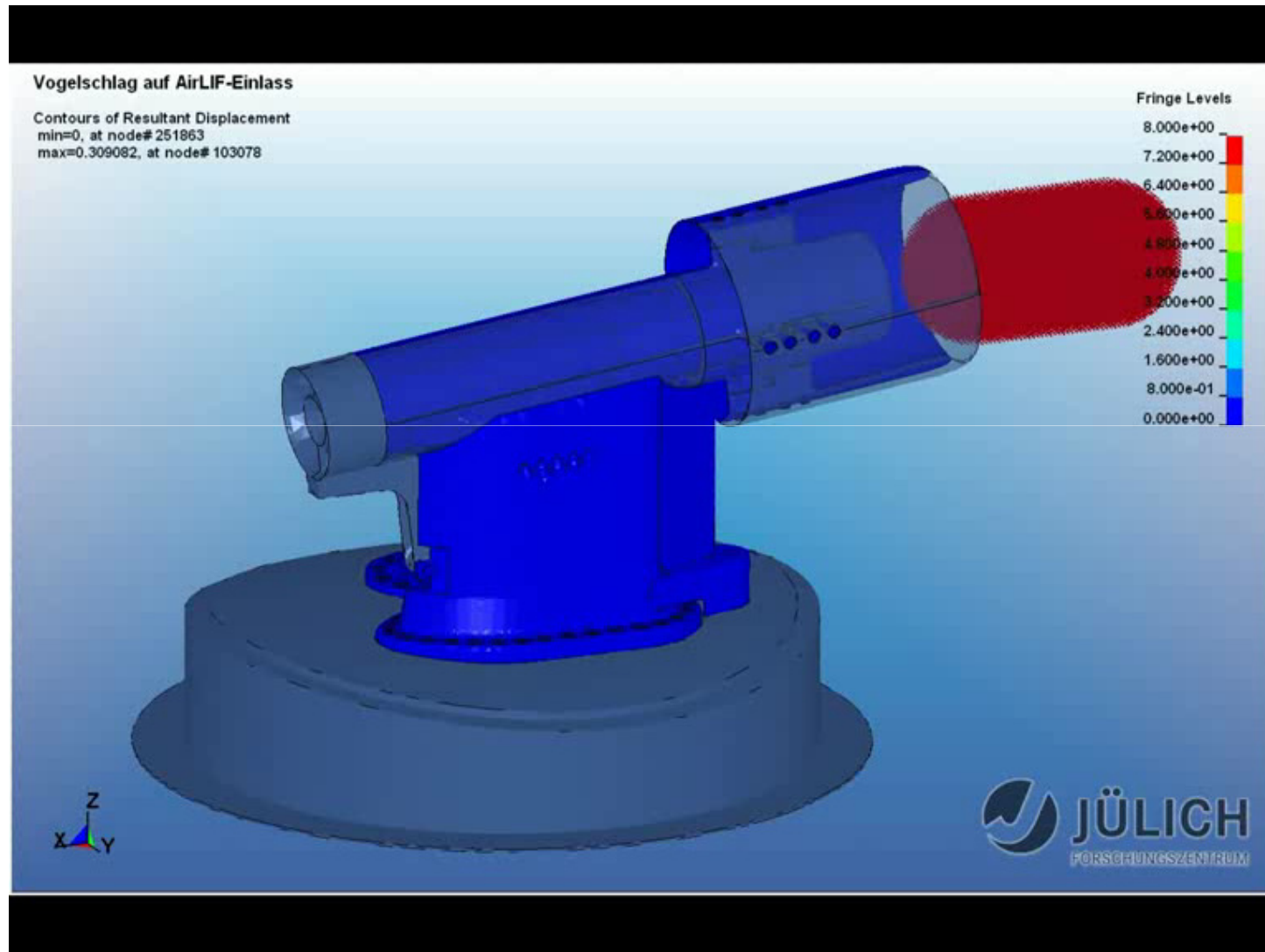
↳ bird strike event

- The 'Bird strike' load case is a critical design issue for the inlet system
- The inlet system must be robust enough to avoid impact of broken-off parts into the engines or the tail assembly
- But if the inlet system is too stiff and totally 'captures' a bird (this would be the case if the restrictor is fixed to the inlet tubes) the aircraft shell can be seriously damaged



Inlet System for HALO

↳ bird strike simulation



Inlet System for HALO

↪ bird strike simulation



GLORIA at HALO



KIT: Institute for Meteorology and Climate Research – Atmospheric Trace Gases and Remote Sensing (IMK-ASF)
FZJ: Institute for Energy and Climate Research Stratosphere (IEK-7)
DLR: Germany's national research center for aeronautics and space

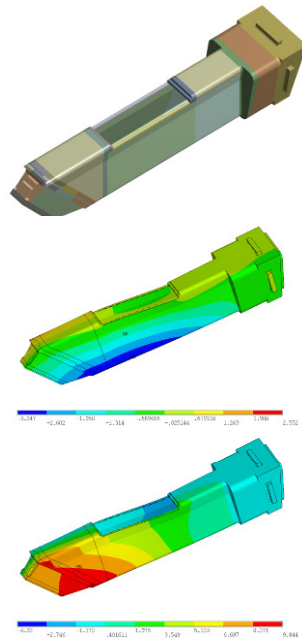
Central Institute for Technology ZAT 05/09/2012

Rhizotronanlage

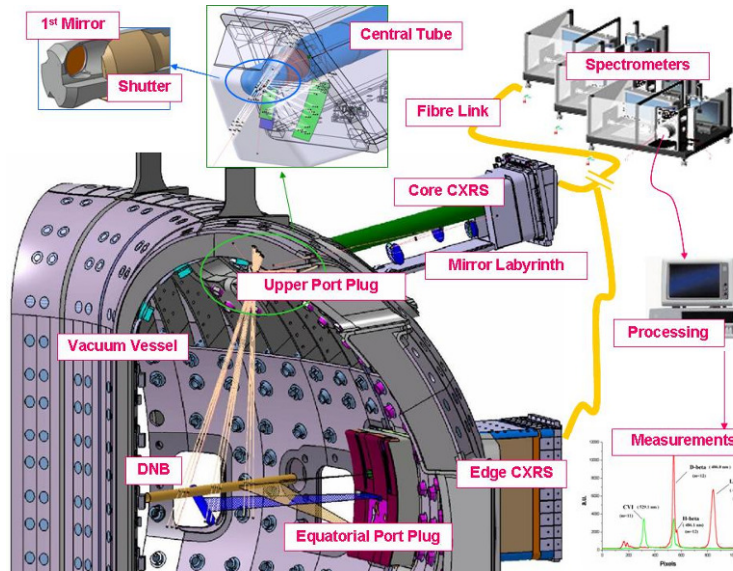


- 54 transparent tubes (each 7m long) and 108 humidity-sensors were buried in the ground of a test field.
- One end of the tubes is accessible through a basement-building.
- **Aims of the experiments:**
 1. Measuring the root density under different environmental influences with a small camera, which is moved through the transparent tubes.
 2. Measuring the humidity distribution with radar antennas, which are also moved through the tubes.

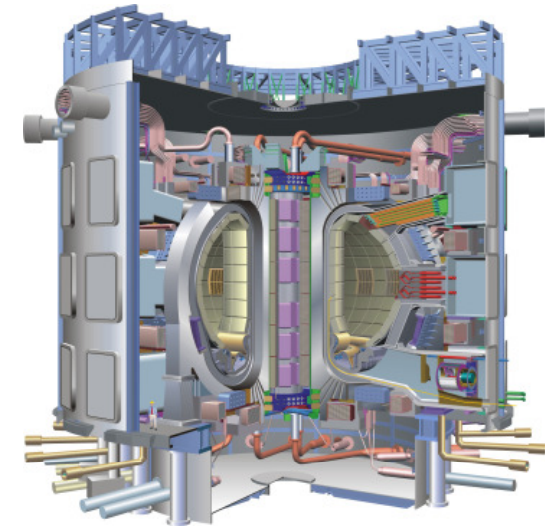
ITER



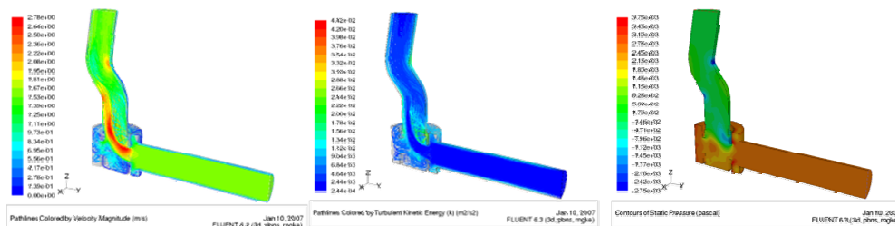
Analysis of bending stress



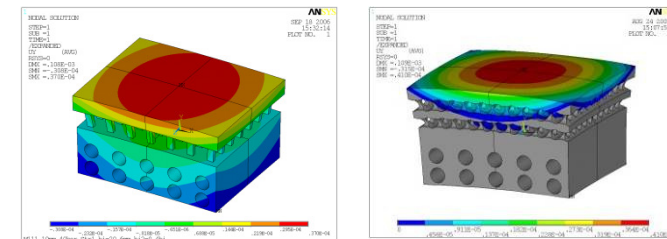
ITER cut-out with CXRS port plug



ITER cross section

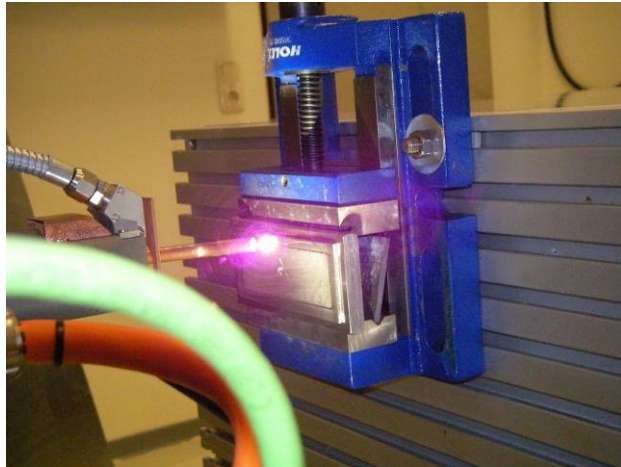


Simulation of cooling system inlet



Simulation of temperature and bending on mirror 1

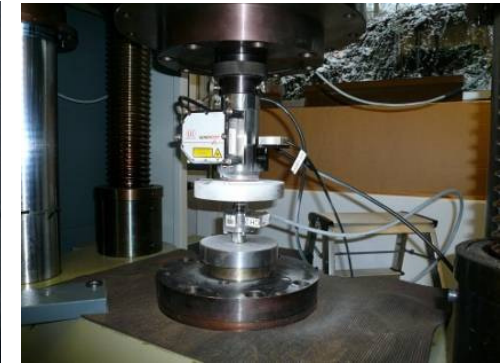
cCXRS (ITER)



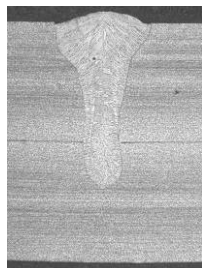
Fibre welding tests



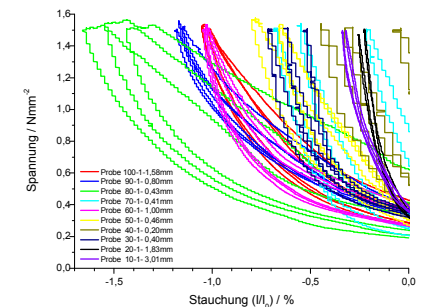
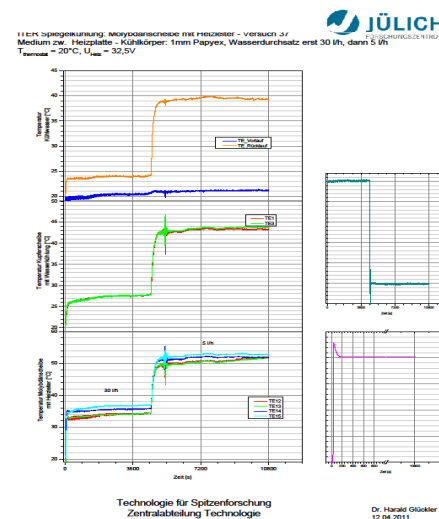
Temperature test device



Pressure test



Qualification of Fibre Laser Welding for Port Plug Seal



Investigation of heat transfer and strength values at M1 under vacuum conditions

Central Institute of Technology – ZAT

Résumé

ZAT: Technology for World-Class-R&D

- Partner for national and international scientific projects
- Projects from some thousand € up to several years and millions €
- Internal partners/customers, also externals
- **All from one source!!!**

