

RF-Developments at PSI

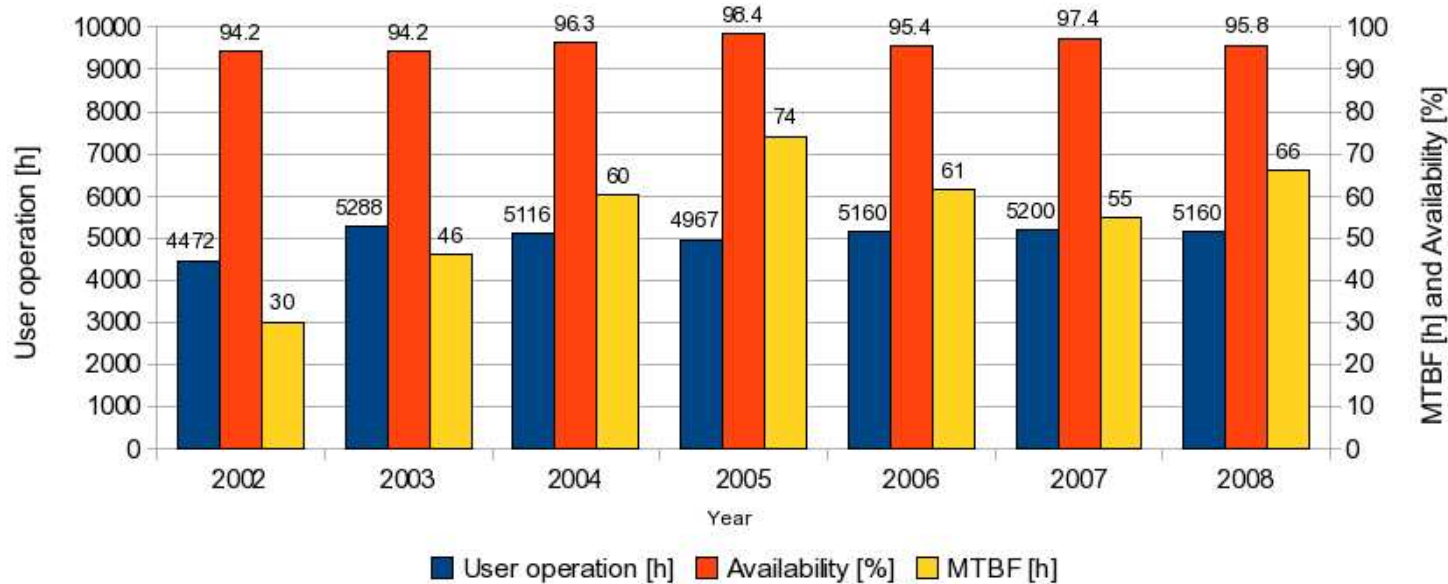
L. Stingelin
for the PSI RF-group



Overview

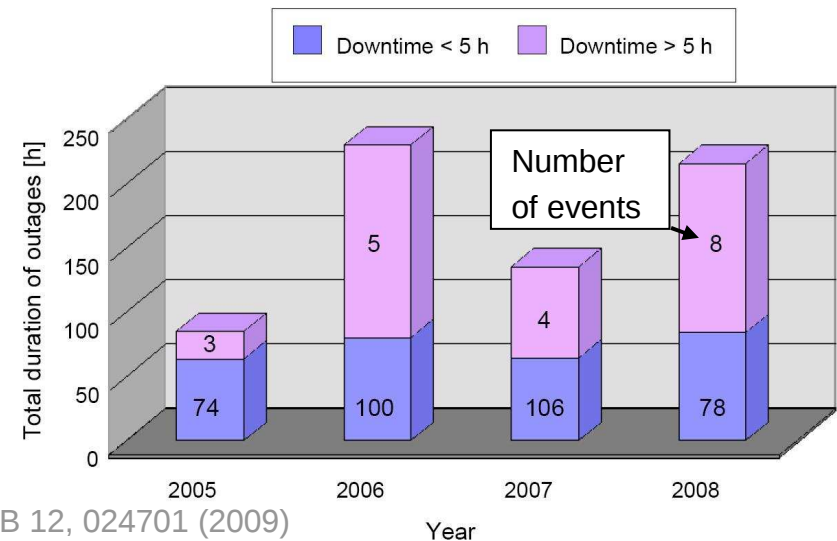
- Operation statistics
- RF-noise analysis with IR beamline
- 500MHz 50kW solid-state amplifier
- Electron gun development for SwissFEL

Operation Statistics

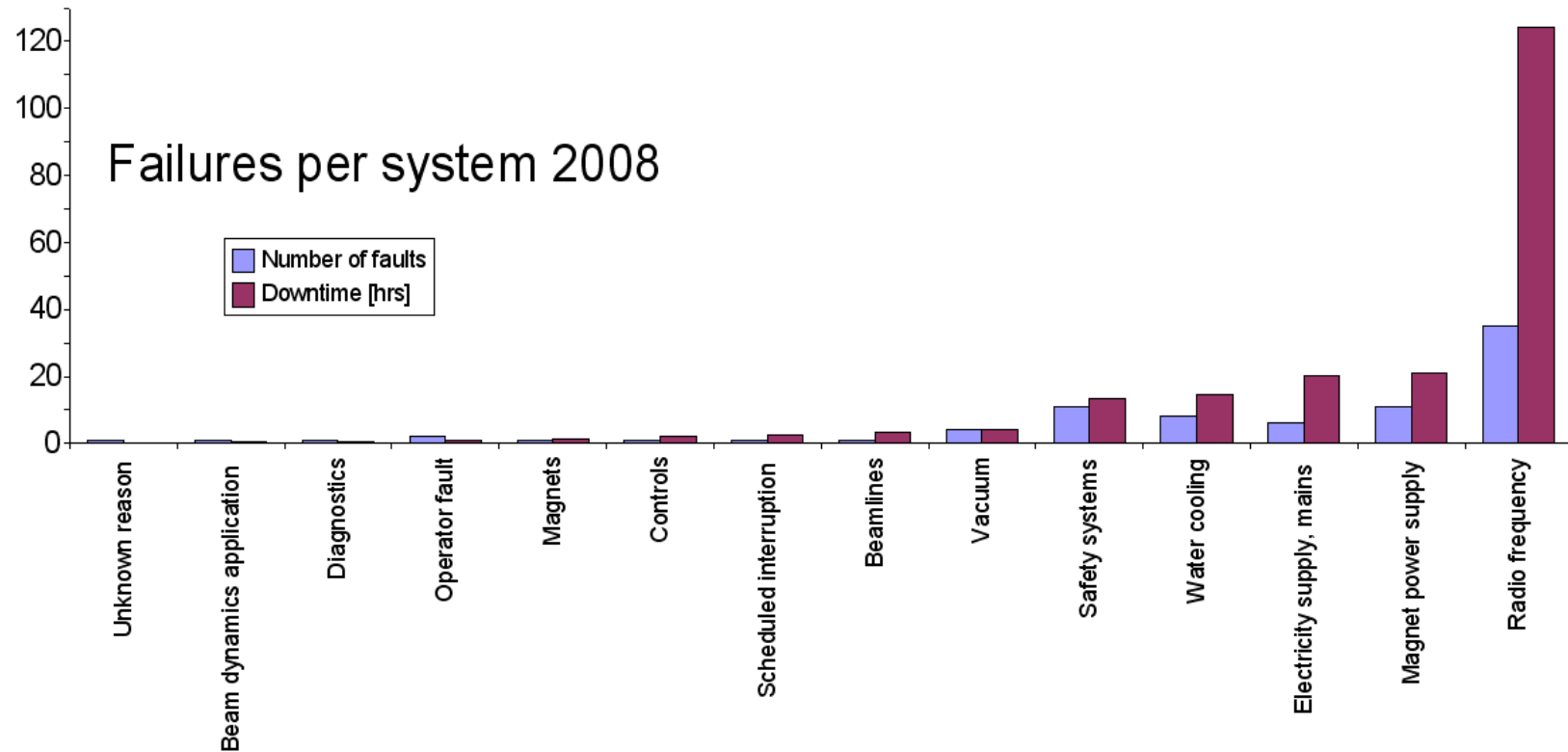


Availability:

- Average 2002-2008: 96.0%
- Jan.-Aug. 2009: 99.0%



Operation Statistics



Major events:

- 16kV transformer short circuit
- RF cavity water leaks
- RF coupler water leak



SLS RF Upgrade Programs

Accomplished:

- ✓ Mini S-band teststand in the LINAC
- ✓ Emergency water-valves at cavities installed (close in case of vacuum interlock)

Work in progress:

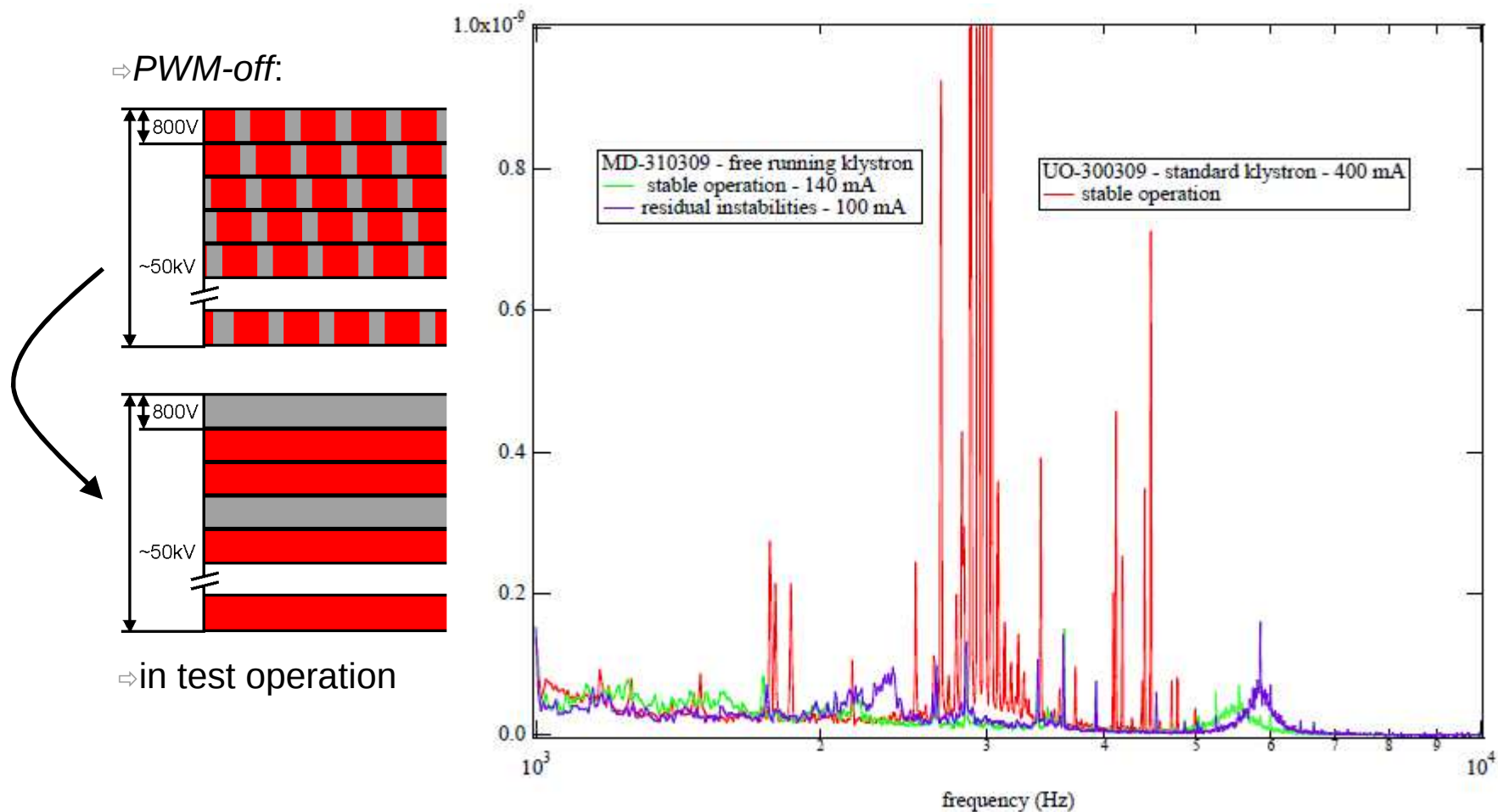
- ☐ New e-gun trigger system (reduce jitter)
- ☐ 500MHz teststand at the booster rf plant (solidstate amplifier for booster cavity)
- ☐ Coincidence arc detectors (about 20 beam dumps per year due to arcs: evtl. false detection)
- ☐ HOM detector boards from ELETTRA?
- ☐ New input power couplers of ELETTRA type (under construction at PSI workshop)
- ☐ Evtl. replace 500MHz RF cavities in far future? (water leaks)
- ☐ Acquire spare parts for S3HC (tuning system, feedthroughs, V-box)

Rejected:

- × Superconducting main-RF cavities (rejected: cost & reliability concerns)

kHz-noise: problem for IR-users

Source: Klystron HV-PS pulse-width-modulation





Test-operation with *PWM off*:

- Improvement of noise spectrum at IR-beam line by about 2 orders of magnitude.

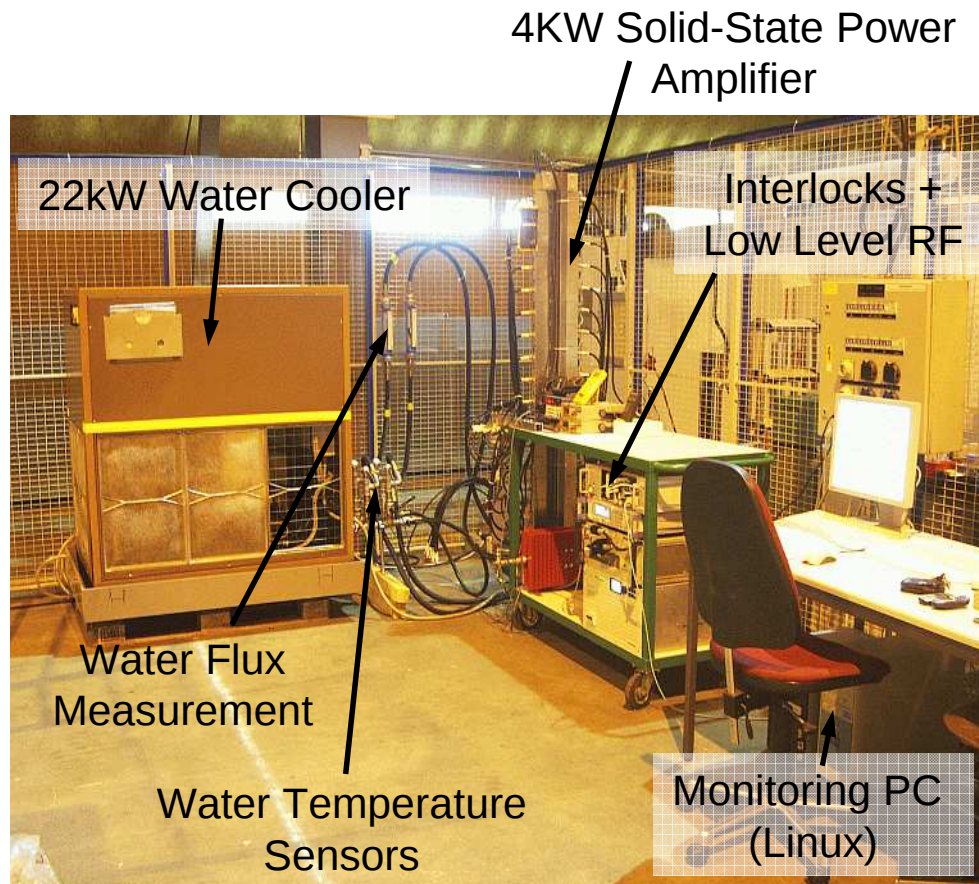
✓ 3-day experiment with 400mA and *PWM off* had no negative effect (software adjusts number of modules to keep HV within 800V range)

Next steps:

- ☐ beam-line tests with *PWM off* at 400mA
- ☐ Test of new hardware from Thomson Turgi for stable HV with PWM and less noise



500MHz Solid-State Amplifier



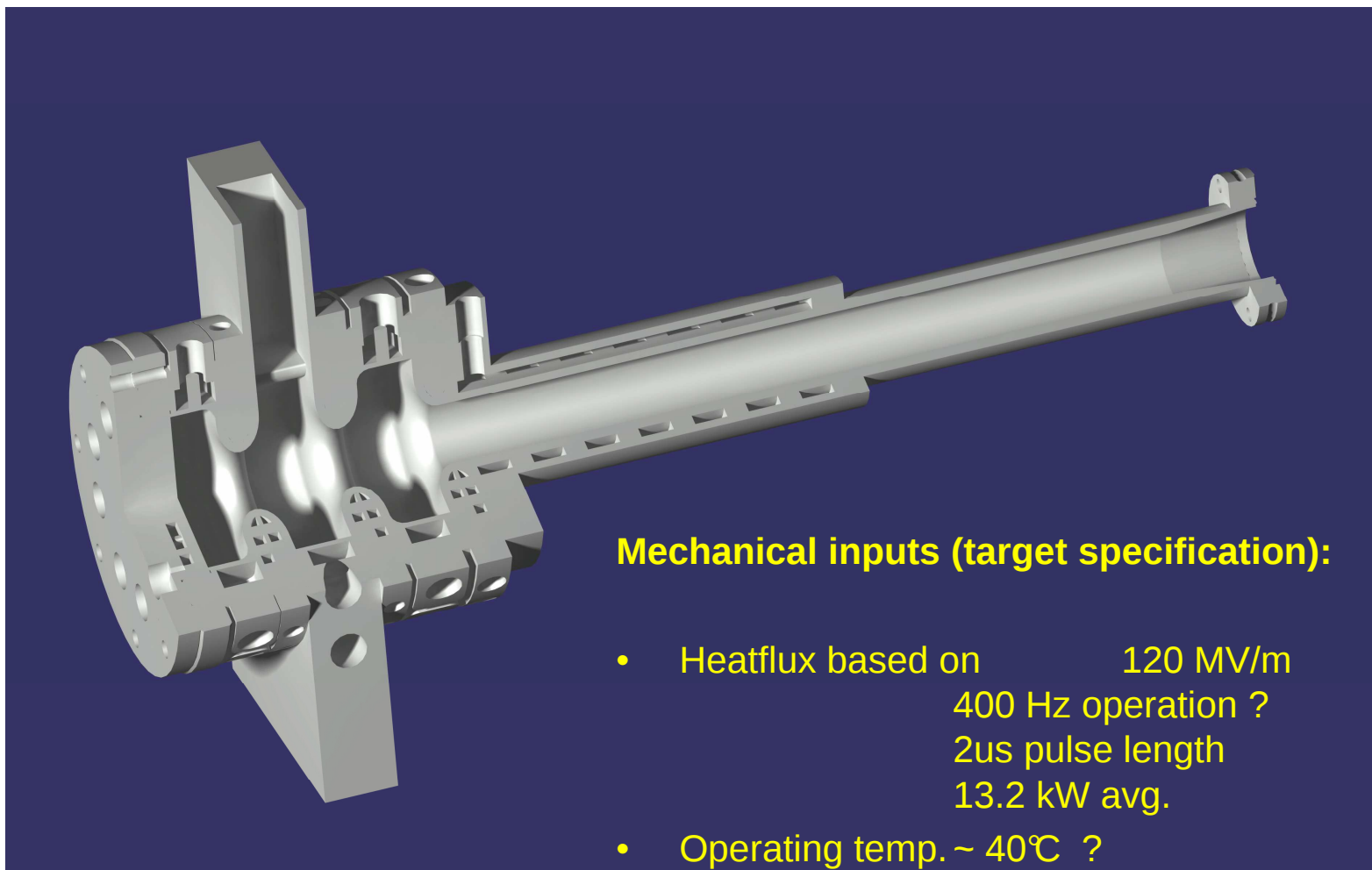
Status of 50kW prototype:

- ✓ 4kW power tests
- ✓ Control- and Interlock system
- ✓ RF-design of power splitter, combiner and directional coupler

- Waiting for cooling concept and test-stand at SLS booster rf-plant.
- Test of 2 new transistor types

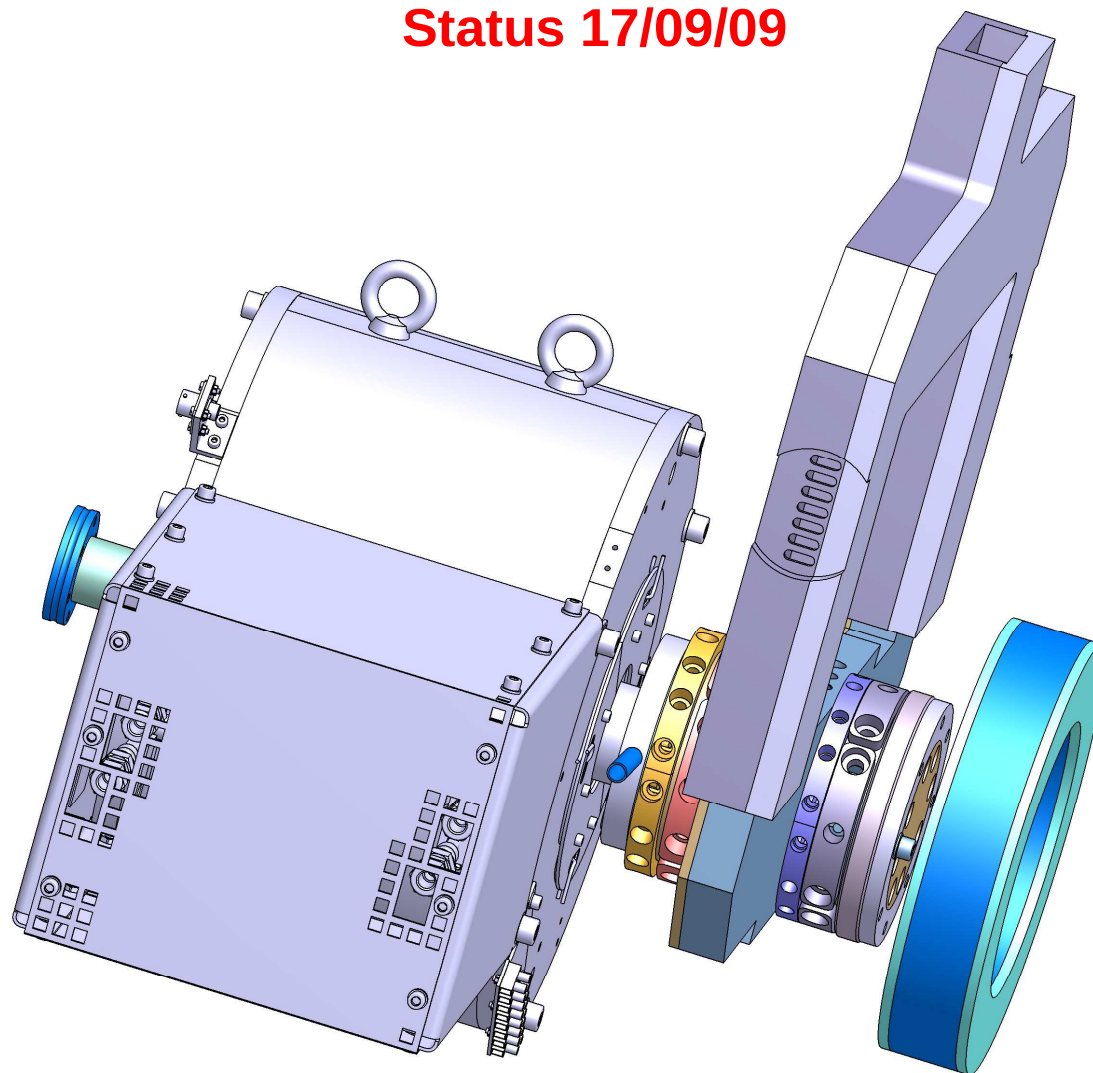
SwissFel Gun No. 1

(first design iteration)

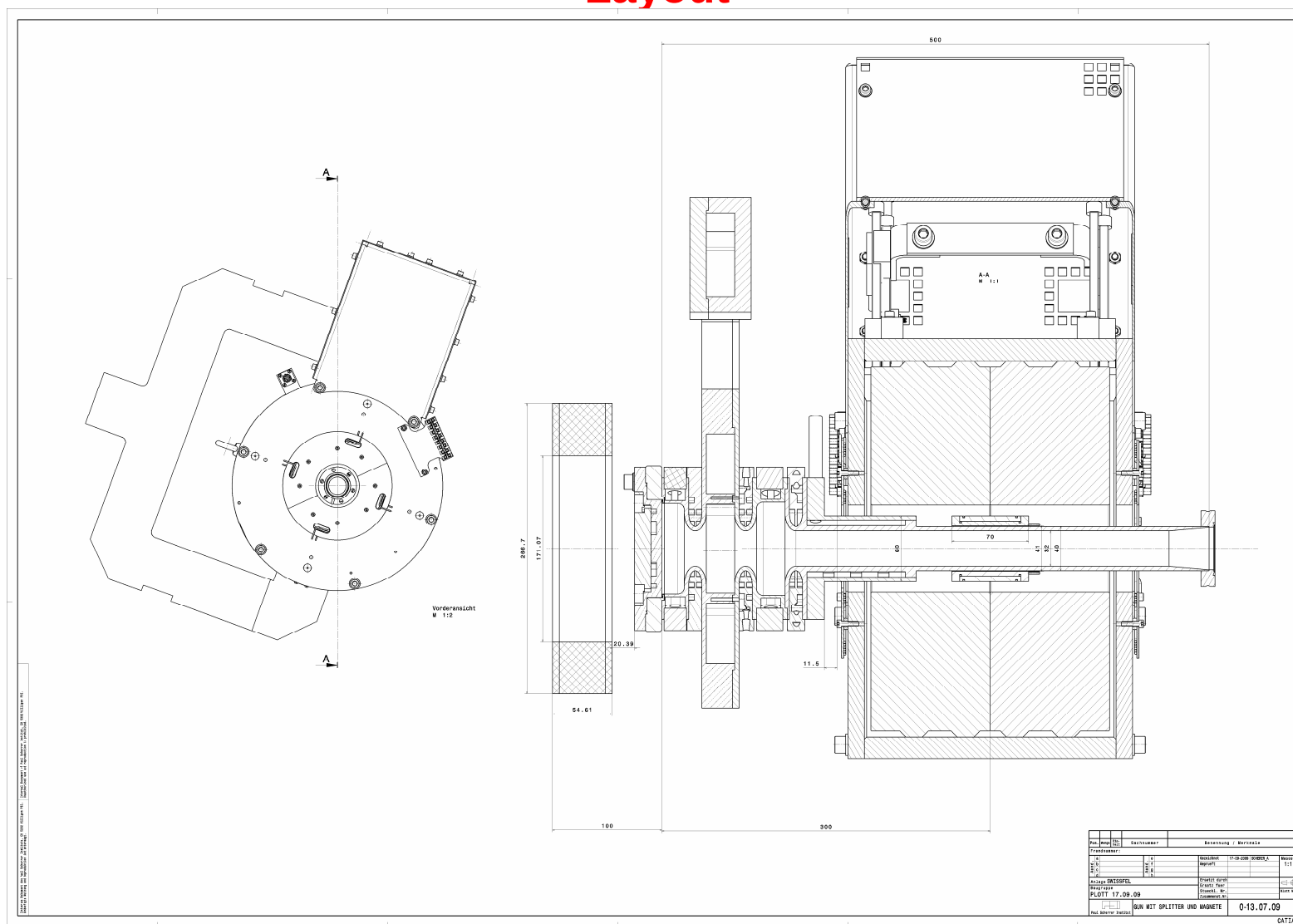


(M.Bopp, J.Y. Raguin, F.Scherer)

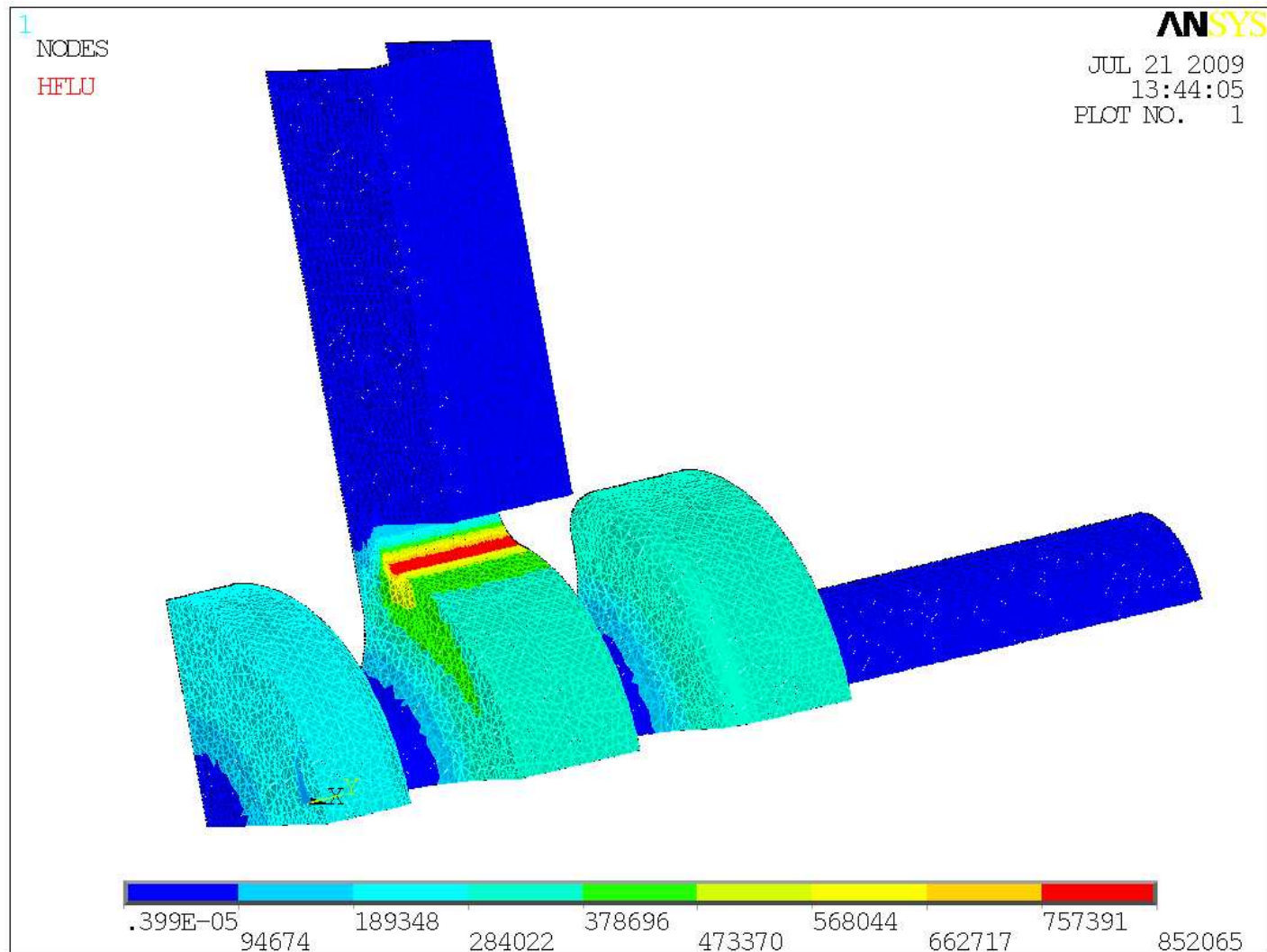
Status 17/09/09



Layout

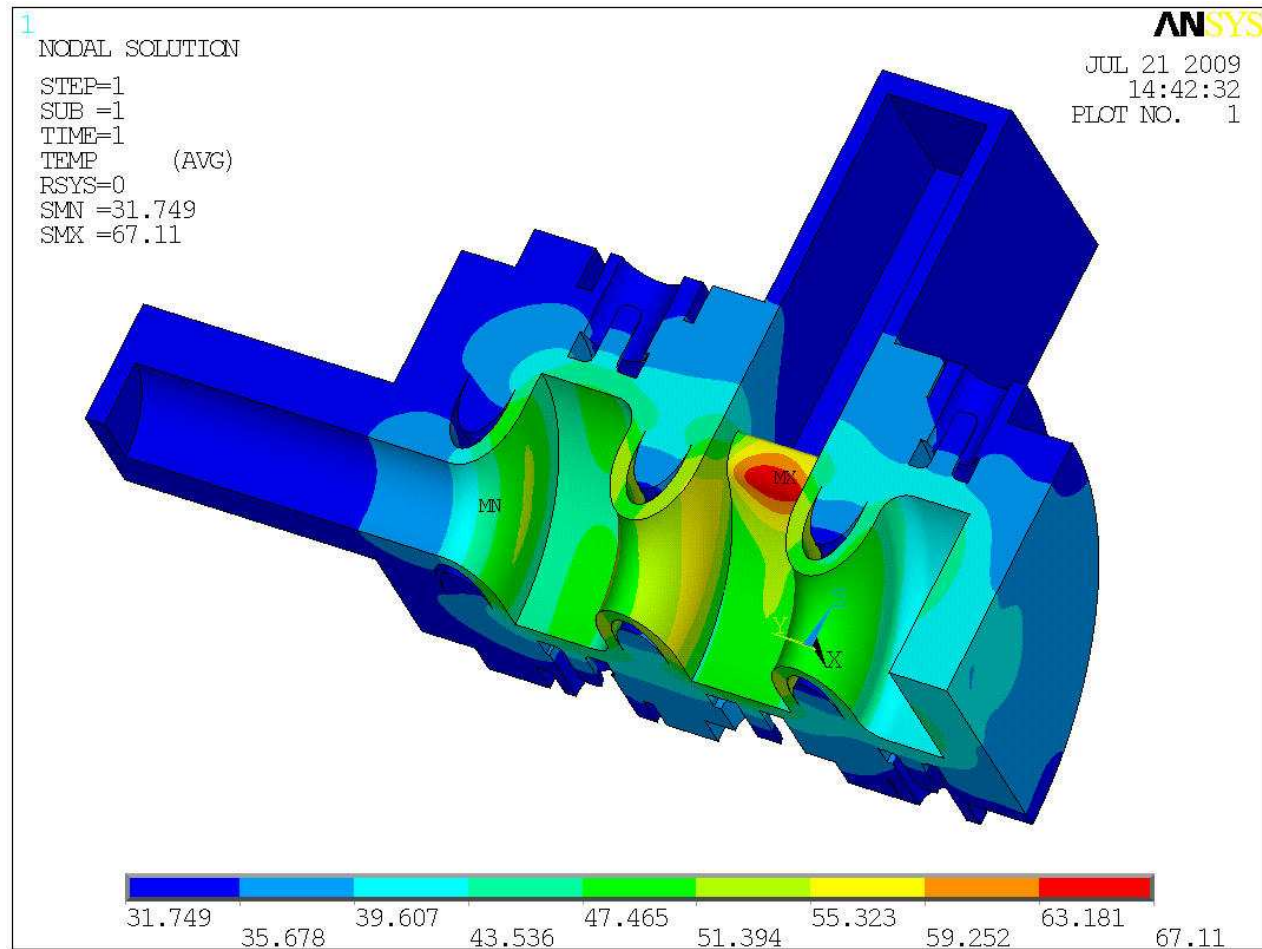


Heat flux

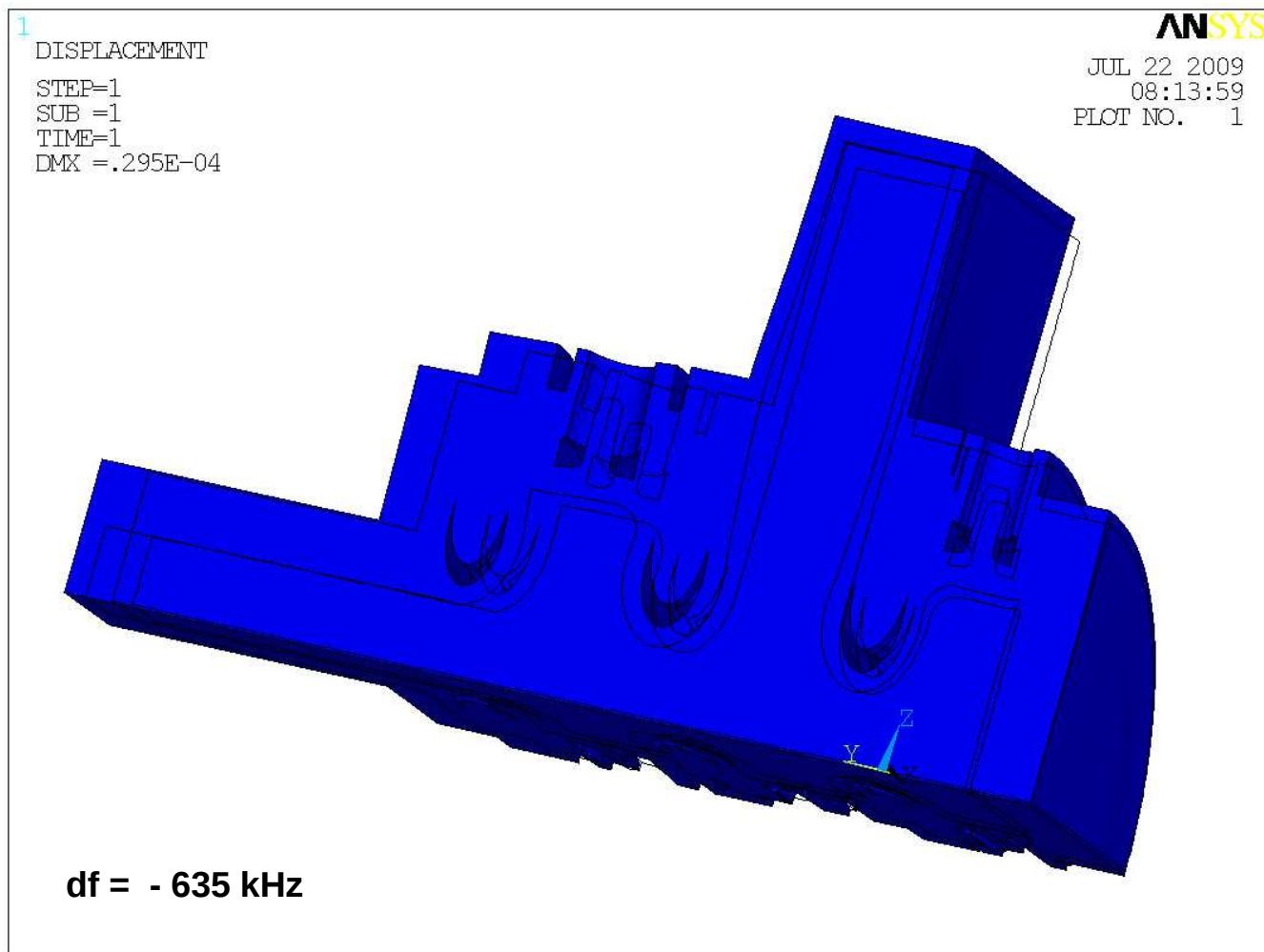


Temperature distribution

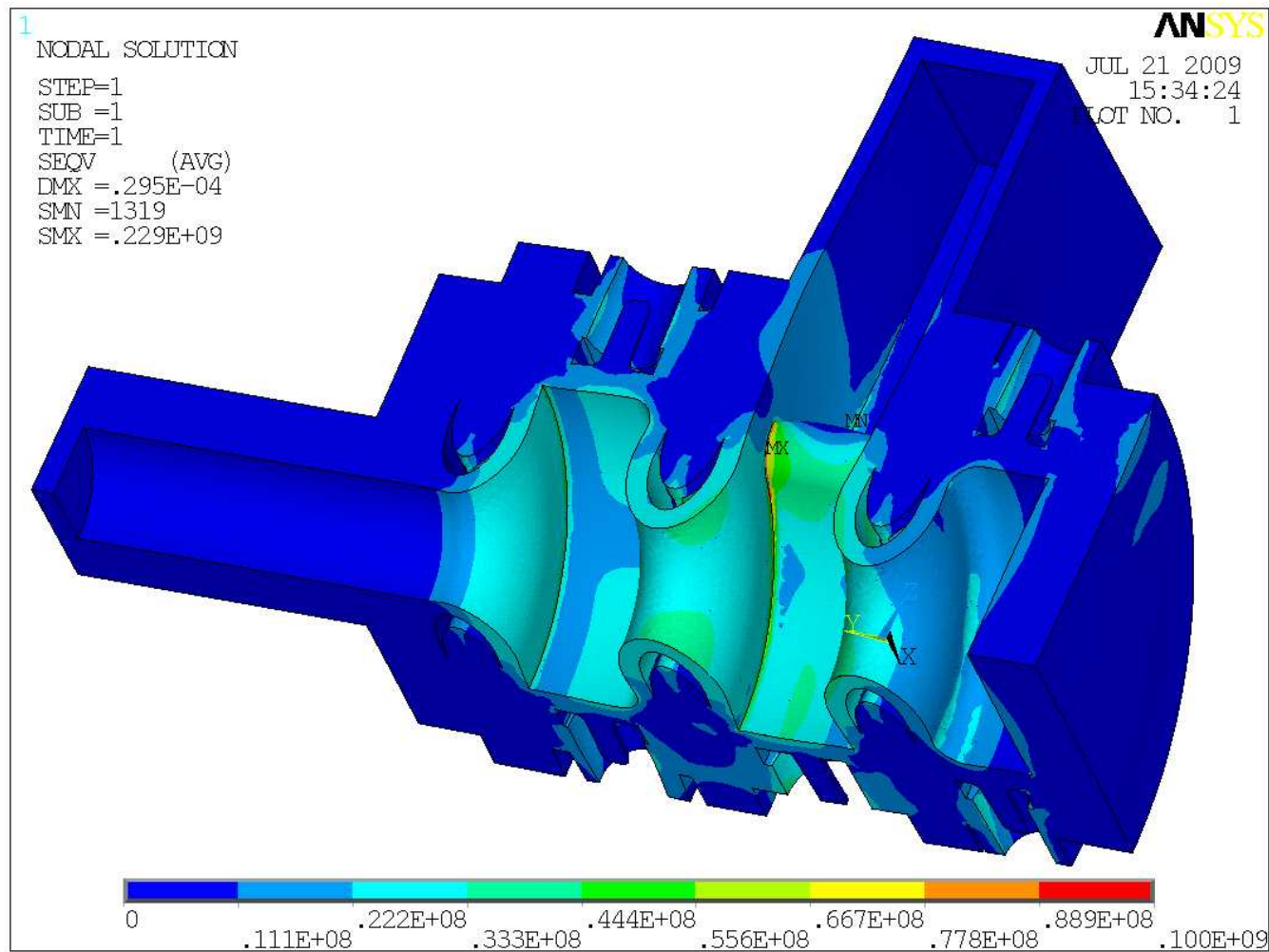
α_k : 7500 W/m²K / Water inlet temp. 30°C



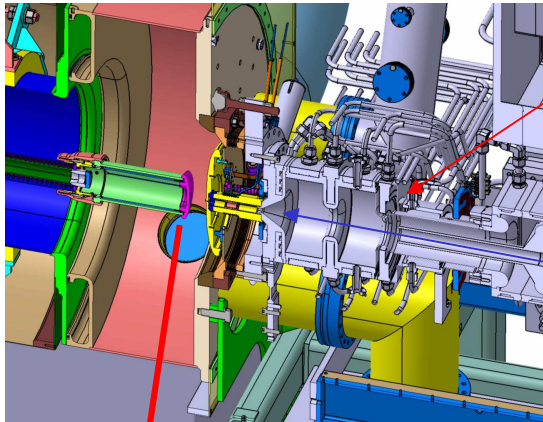
Deformation



Stress to high!

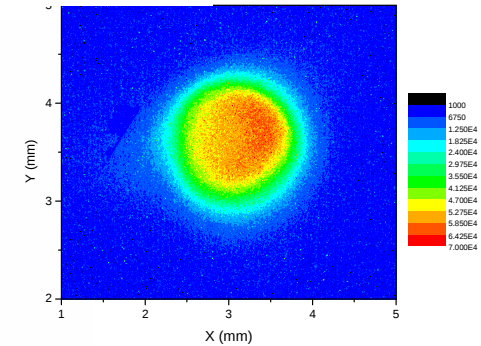
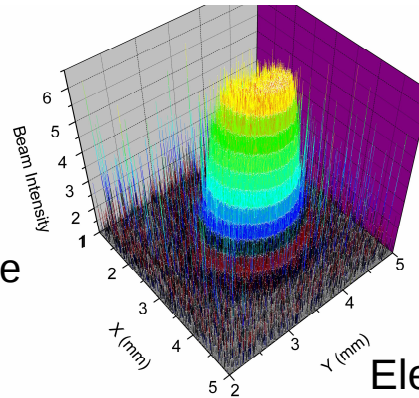


Low Emittance Gun for SwissFEL

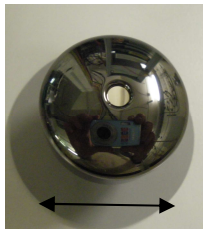


RF cavity
45 MV/m

Laser Pulse
10 ps;

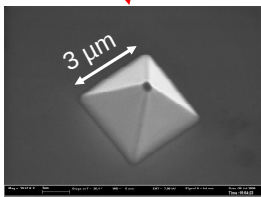


Electron Beam Distribution
(0.5 mm.mrad; 40 pC; 5 MeV)

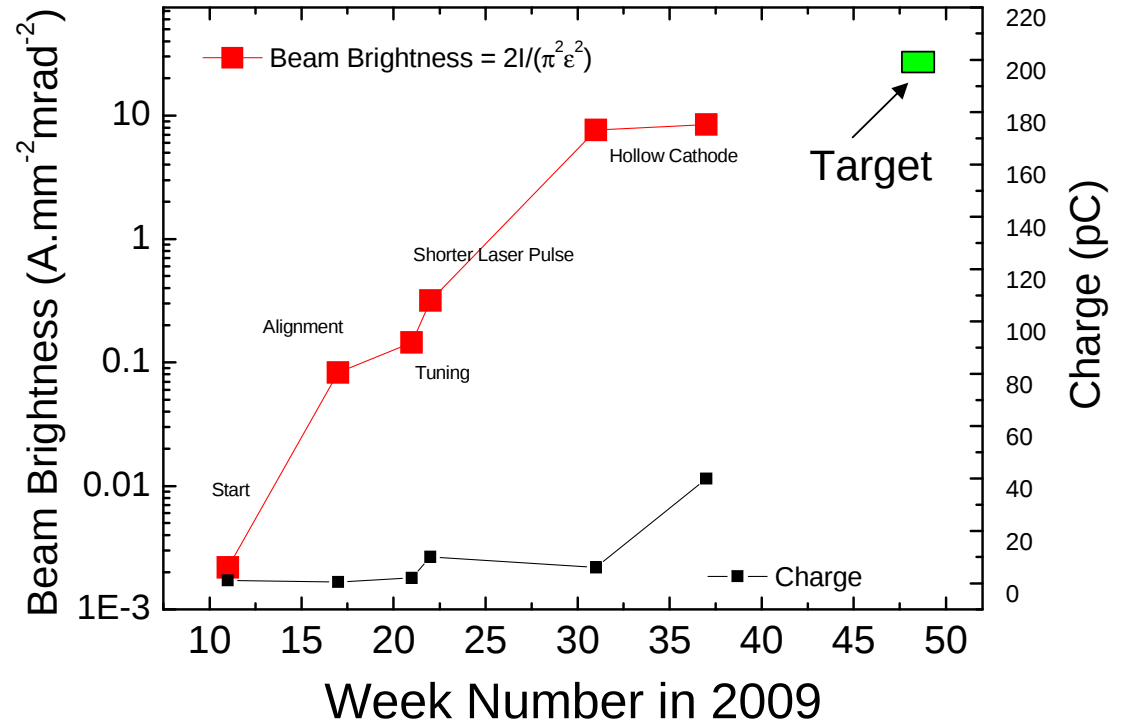


5 cm

Cathode:
Diamond-Like
Coating
150 – 300 MV/m



Pyramid:
Field Emitter
(Example)



(R. Ganter, C.Gough et al.)