# PETRA III RF Status Report

## Main parameter:

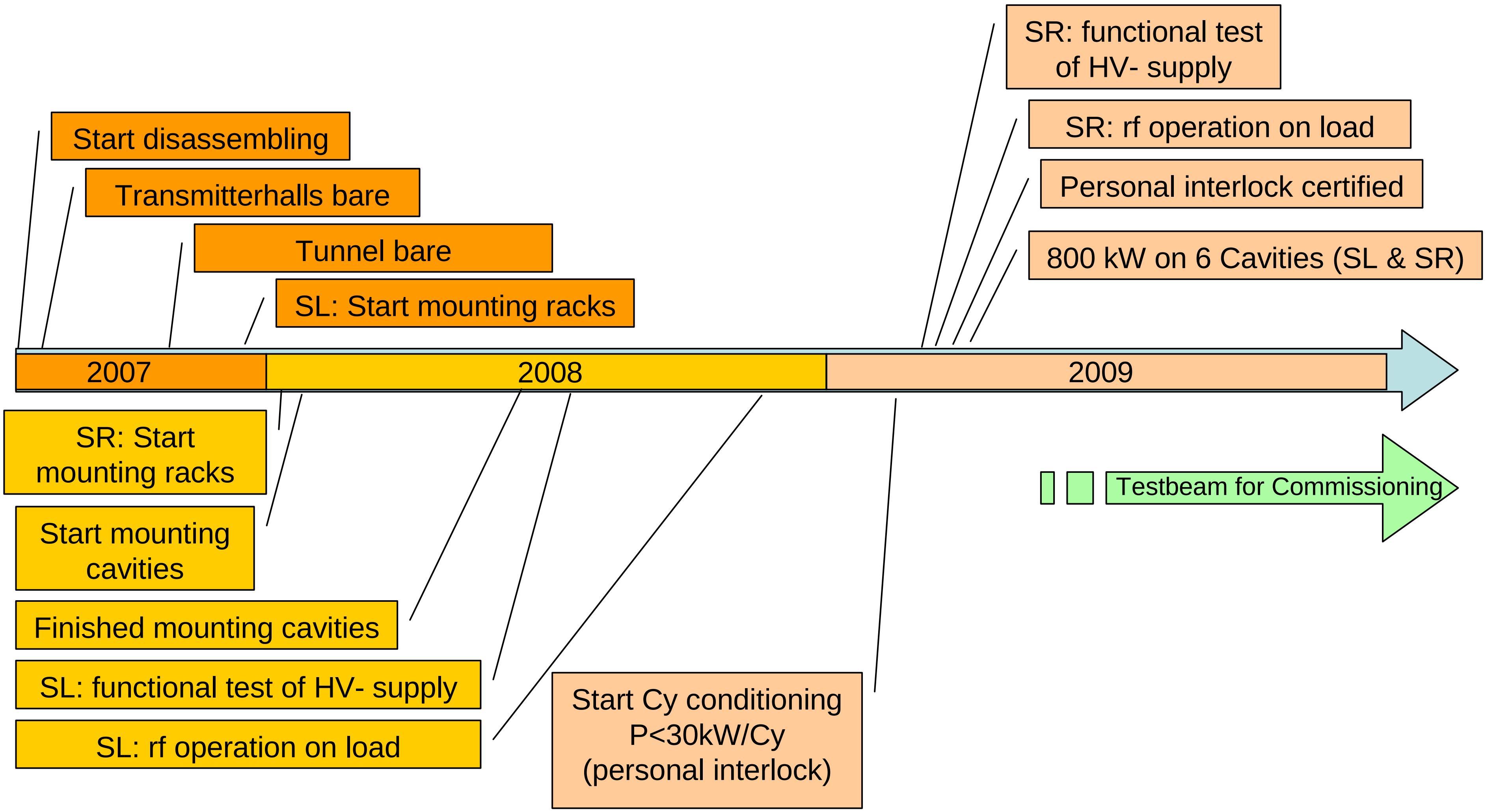
**Machine:**

| | |
|---|---|
| Beam Energy: | $E_0$ = 6 GeV |
| Length: | l = 2304 m |
| Arc radius | 191.73 m and 22.918 m |
| Beam Current: | $I_0$ = 100 mA (200 mA) |
| loss per turn | $U_l$ = 7.590 MeV |
| Emittance (hor) | ε = 1 nmrad ! |
| Operating mode | Topping up |

**RF:**

| | |
|---|---|
| Frequency: | $f_{RF}$ = 499.6645 MHz |
| Beam Power (100mA): | $P_{beam}$ = 759 kW (dipol, undulators, damping wigglers and HOM losses) |
| Circumferencial Voltage: | $U_c$ = 20 MV (in 12 7-cell cavities, power per coupler: 124 kW) |
| rf-Power (100mA): | $P_{rf}$ = 1573 kW (2 transmitter á 786 kW) |

# Timescale of Refurbishment



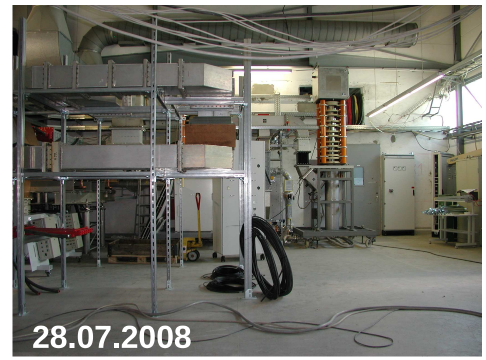
# 500-MHz RF-System

Transmitter hall SL (Geb. 42a)




Transmitter hall SR (Geb. 42b)






Tunnel



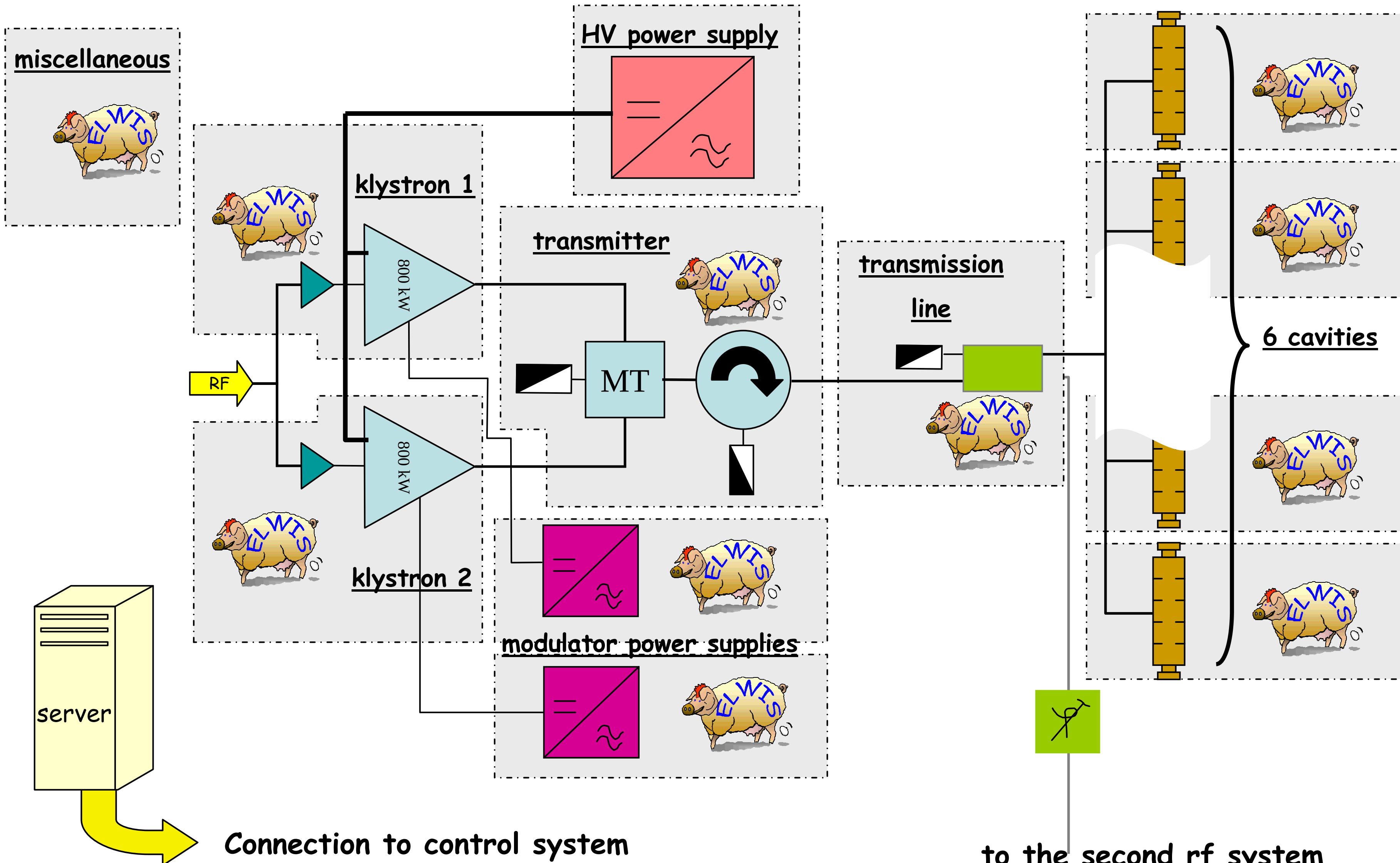
# HV- Installations

Transmitter hall SL, Westwand



Transmitter hall SL, HV-Raum


# Distributed ELWIS- Modules




Connection to control system

to the second rf system

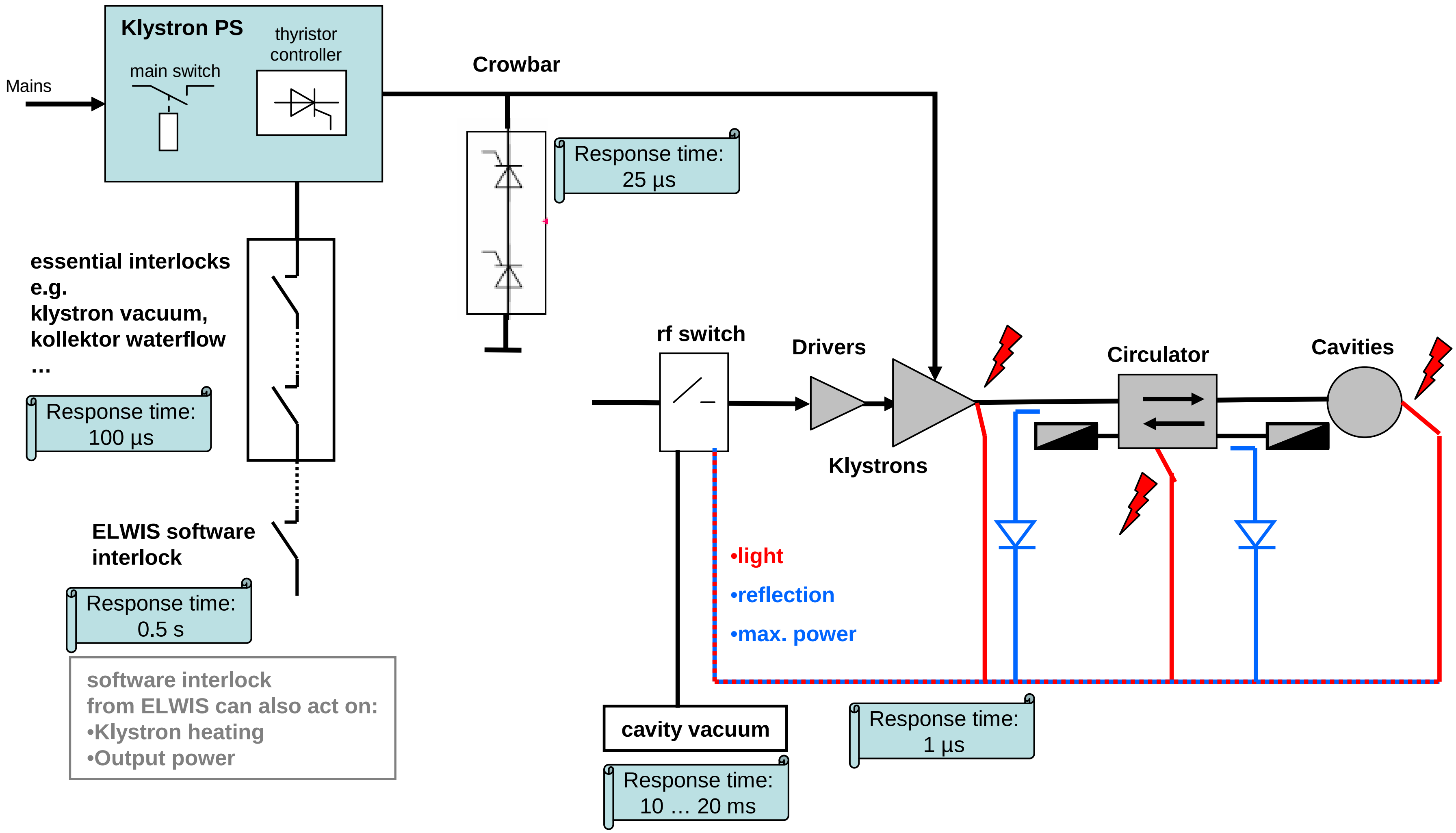
# ELWIS Advantages

Lots of functionality is done by software.

Advantages:

- Changes can be made more easy:
  - Cavity- detuning algorithm
  - Switch- on procedures
  - Change of interlock- configurations (this can be done during operation)
- Maintenance from everywhere
  - calibration from office
  - Change in amplifier gain or other parameters can be changed from office

# Different Interlocks



# Reliabilities of RF Systems

| Machine | HERA | DORIS-3 | DESY-2 | APS [1] | ESRF [2] | LEP [3] |
|---|---|---|---|---|---|---|
| Year of Analysis | 1999-2000 | 2001 | 2002 | 2001 | 2001 | 1999 |
| Number of rf Systems | 8 | 2 | 1 | 2 | 2 | 20 |
| Type of rf system | 2 Kly., 10…16 Cav. | 1 Kly., 4 Cav. | 2 Kly., 8 Cav. | 1 Kly., 8 Cav. | 1 Kly., 2…4 Cav. | 2 Kly., 14…16 Cav. |
| MTBTrip | 1,2d | 6,5d | 11d | 6d | 4d | 0,45d |
| **MTBTrip per rf system** | **10d** | **13d** | **11d** | **12d** | **8d** | **9d** |

*Around 10d seemed to be „state of the art"*

[1] D.Horan, „**Performance of the APS 350MHz RF Systems**“, Proceedings of the CWRF Users Group Meeting, Argonne National Laboratory, 13.-15. March 2002
[2] J.M.Mercier, “**Operation of the RF at the ESRF** “, Proceedings of the CW-RF Users Group Meeting, Argonne National Laboratory, 13.-15. March 2002
[3] H.Frischholz, ”**10 Years of operational Experience with the LEP/RF High Power System**”, Proceedings of the CW-RF Users Group Meeting, Argonne National

# Reliabilities of RF Systems

- Trip doesn't mean that something has to be repaired
- Often a "*reset*" is sufficient
- MTBFailure is something like 60 … 100 d

**There is potential to increase reliably !**

**How?**

- Example 1: **Klystron Focus Interlock:**
  - Sensors for:
    - » Current through the solenoid
    - » Voltage over the solenoid,
    - » Magnetic field inside the solenoid

Only Switch off if at least 2 of the signals will exceed the limit.

- Example 2: **Klystron Body-Temperature Interlock:**
  - · Slow temperature raise above the limit => decrease klystron-current until temperature is stable.
  - · Fast temperature raise above the limit => switch off klystron high-voltage
  - · Instantaneous raise above the limit => ignore (must be sensor or electronic error)

This could be done if there is an "intelligent" monitoring of signals (ELWIS).

**Design plan is: MTBTrip > 20d** (now 55 Trips @ 20 weeks @ 2 systems => MTBTrip=5d)

# What Went „Wrong" & What Has To Be Done

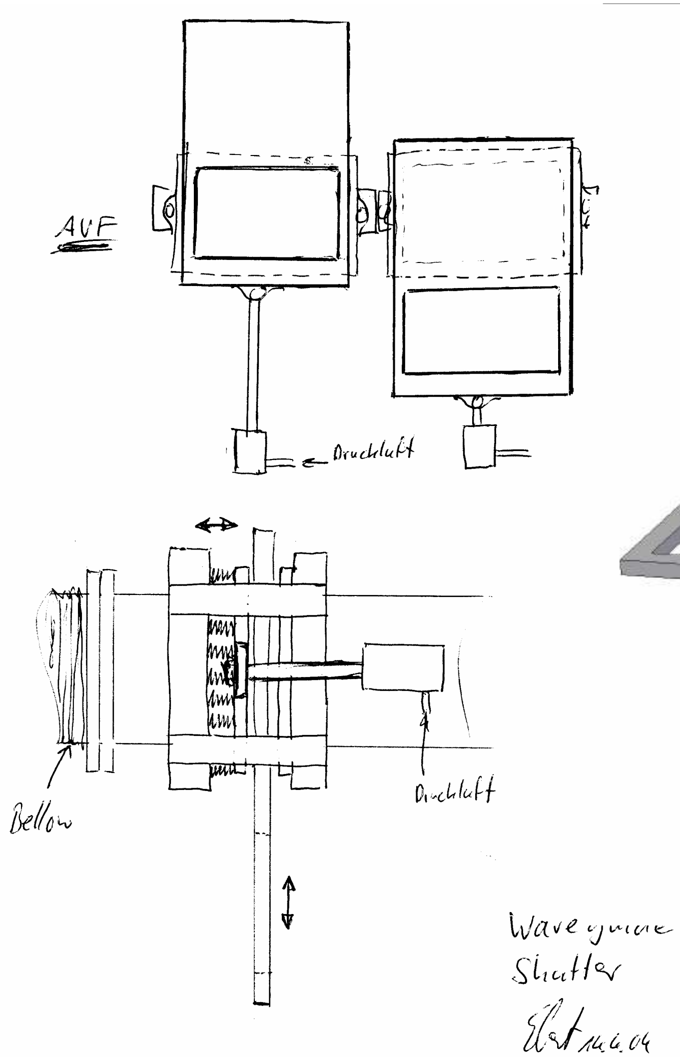
Trouble:

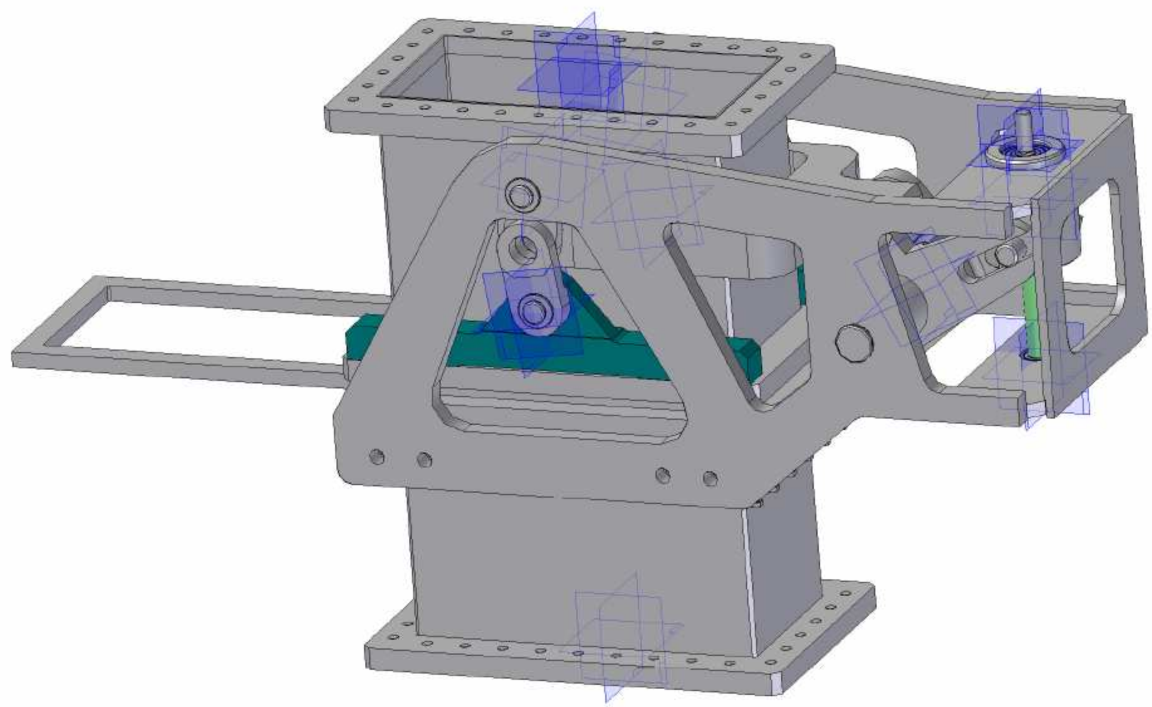
- 2 cavity- coupler with high losses => changed
- Crack of a coupler @ high power pulse operation

Next steps:

- Integration of transient- recorders
- Implementation of "advanced" interlocks
- Installation of waveguide- shutter
- Test an modification of waveguide- trombones (high power WG phase shifter)
- regular operation one transmitter @ 12 Cavities
- workings points closer to saturation

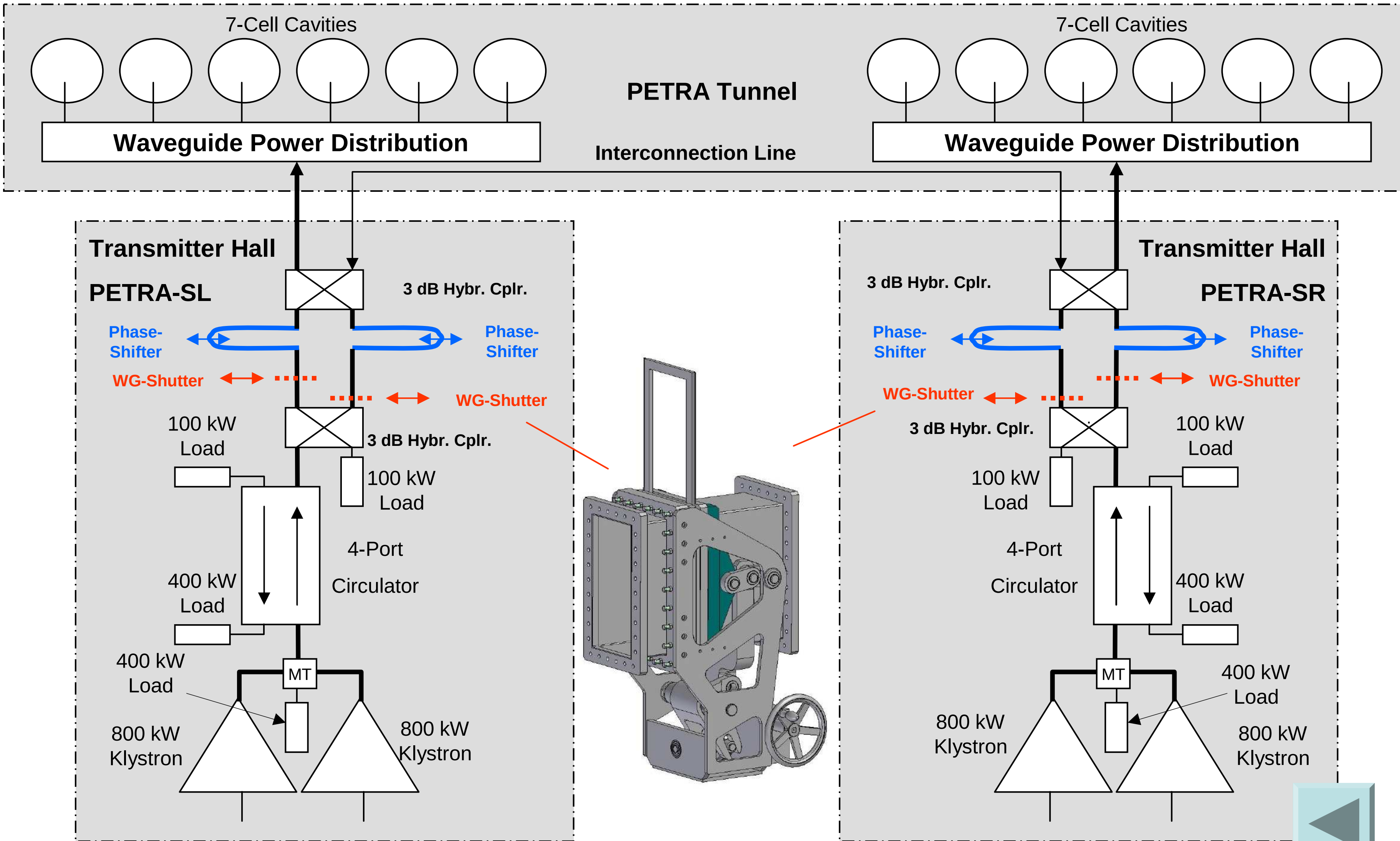
# Waveguide- Shutter



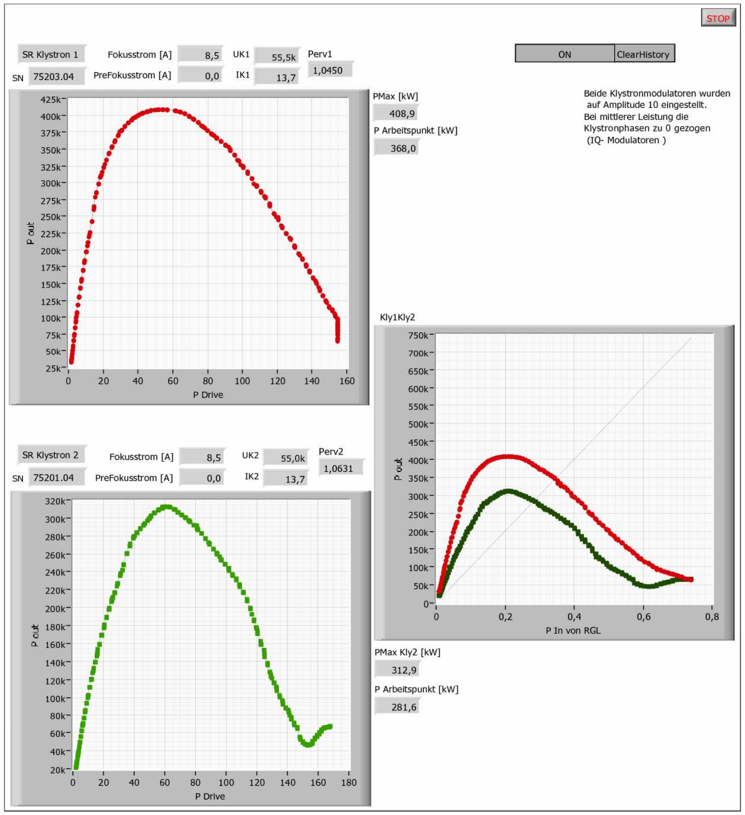



# Waveguide- Phaseshifter

# Operating Modes



# Workingpoint Optimization




- Goal:
  - operation 10 % below saturation
  - optimized efficiency for certain power ranges
- Difficulties:
  - Not to drive the klystron over saturation-point

1st try: limit the drive power