



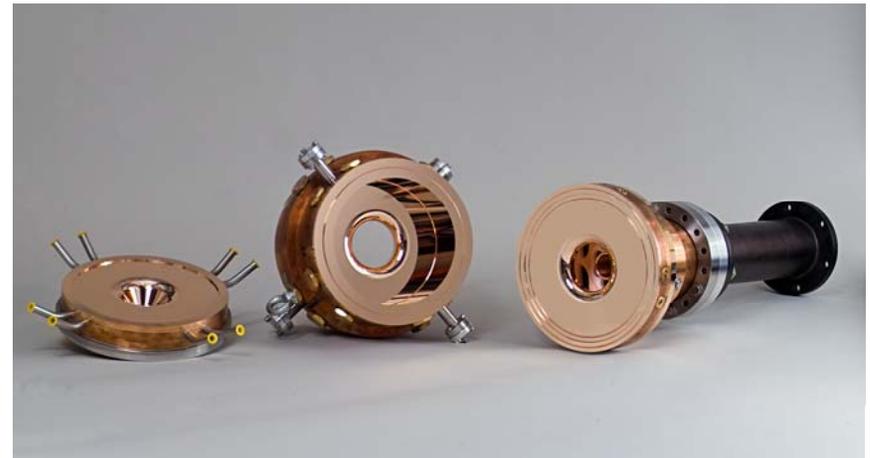
PSI-XFEL RF-System

fel.web.psi.ch

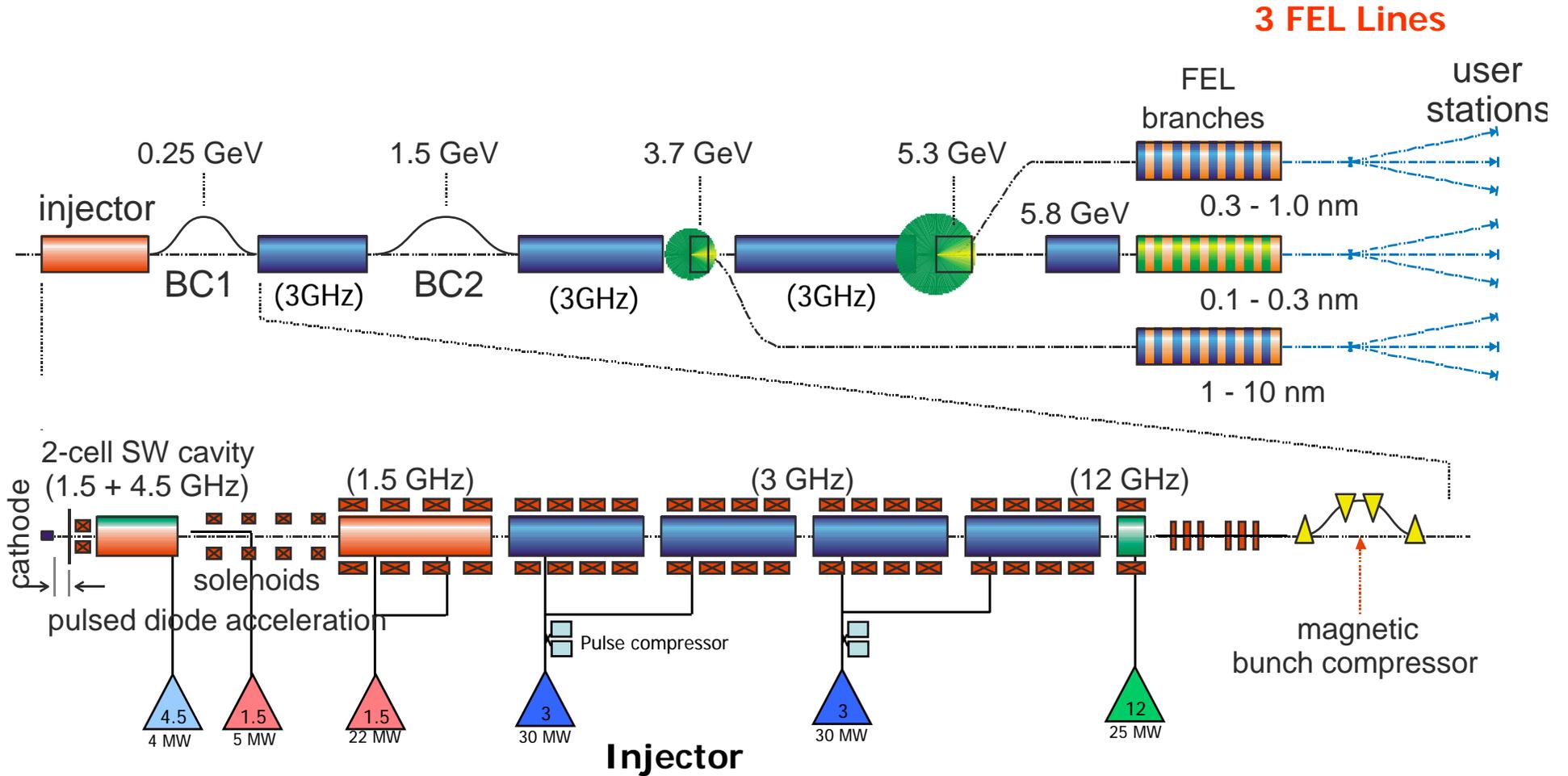
C. Geiselhart

**2008 Fifth CW and High Average Power RF
Workshop**

- Concept
- Current state of the RF-System



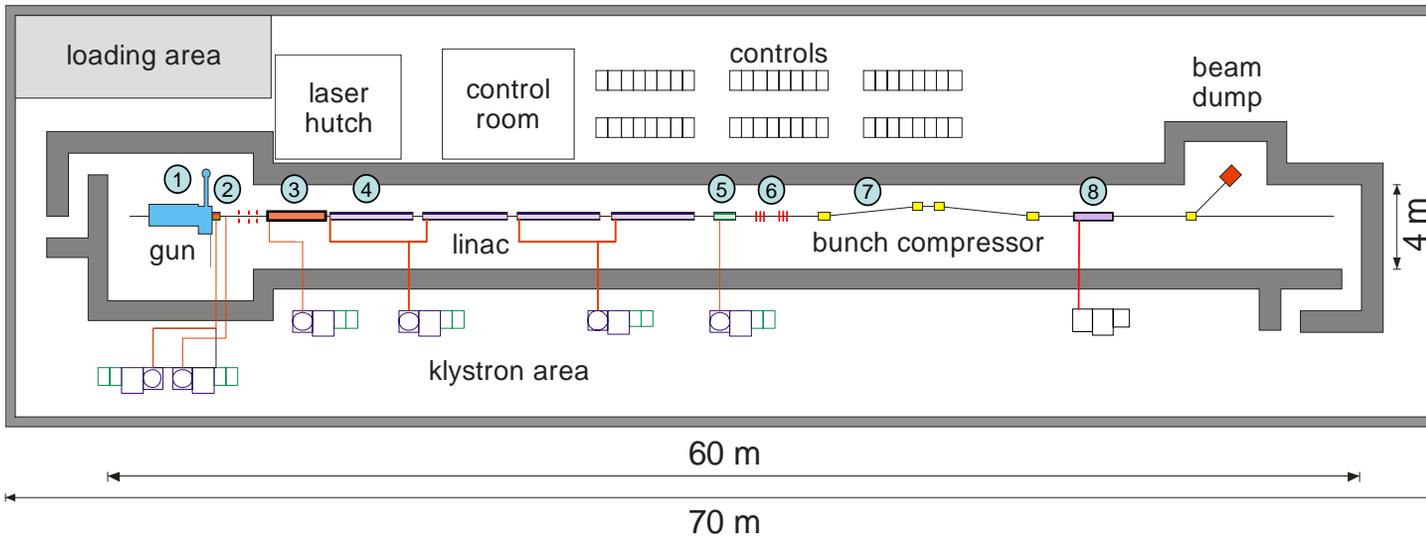
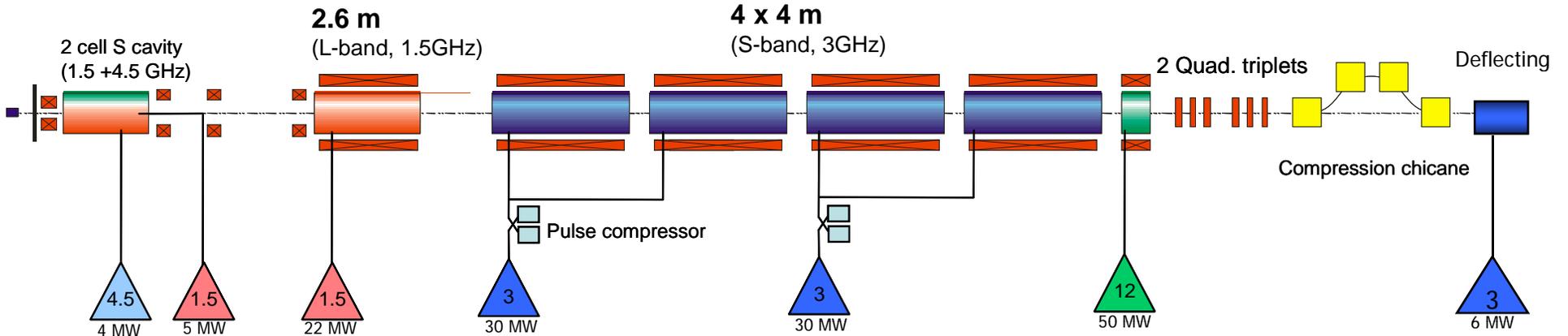
PSI-XFEL Concept / Layout



Covering the wavelength range: $\lambda = 0.1 \text{ nm} - 10 \text{ nm}$

R. Bakker

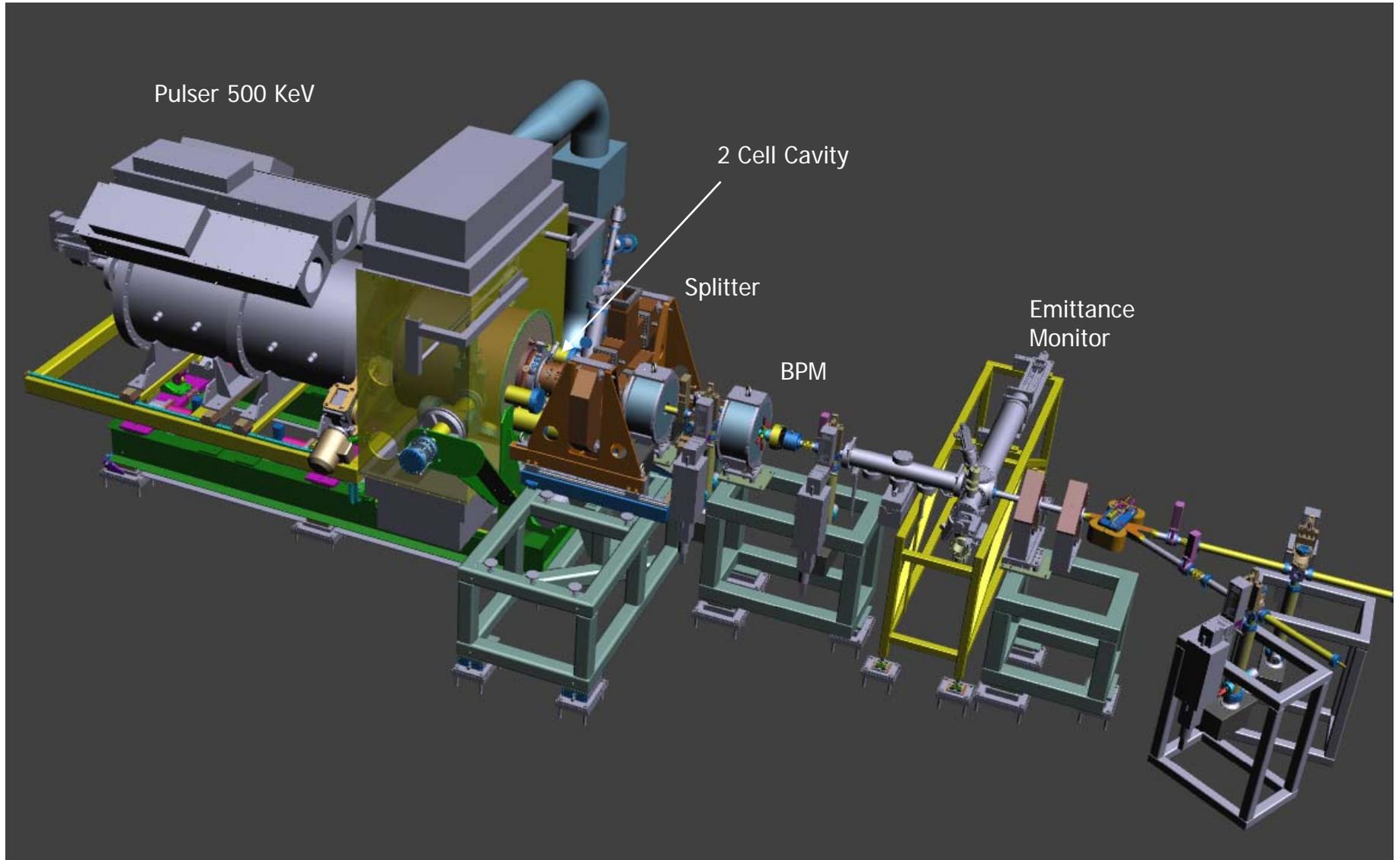
250 MeV Injector Test Facility - Accelerator Layout



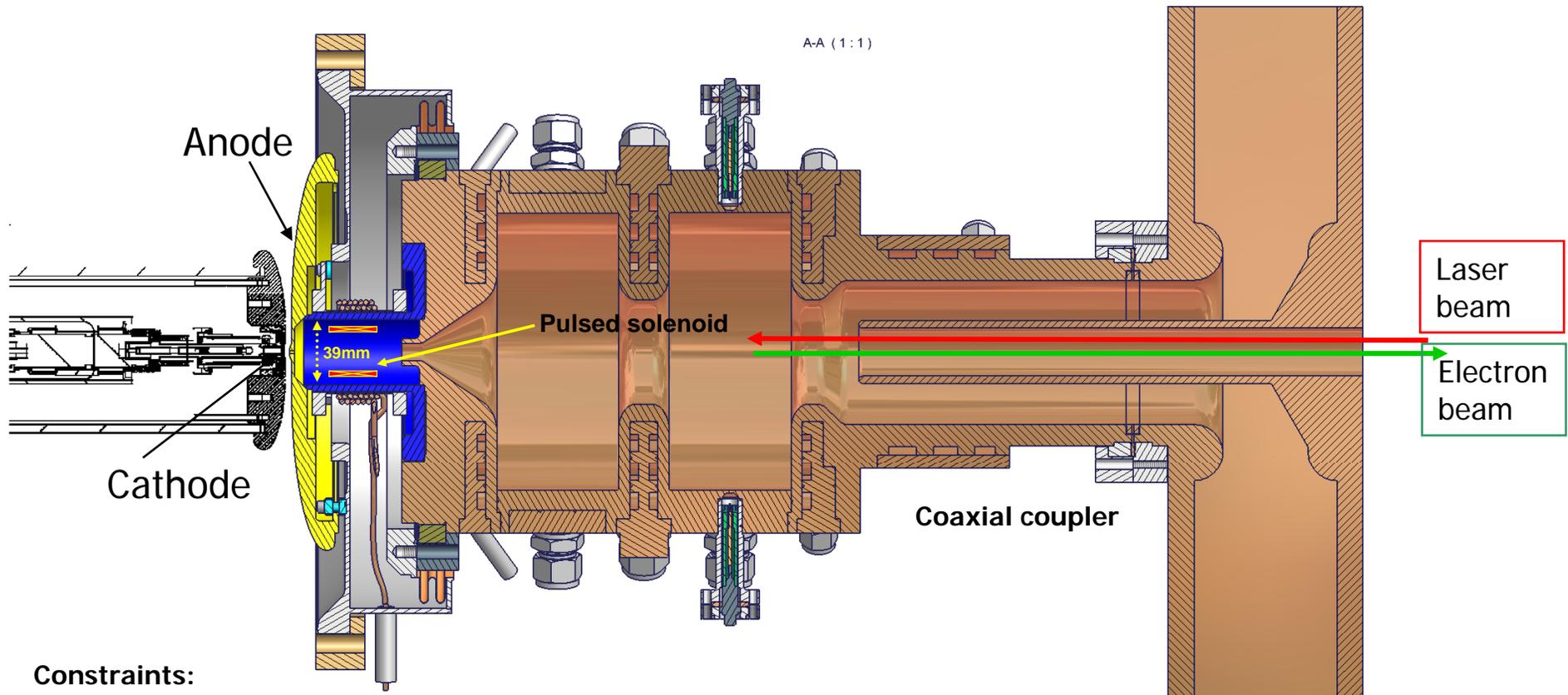
- (1) HV pulser
- (2) 2 cells-2 freq. cavity
- (3) L-band TW structures
- (4) S-band TW structures
- (5) X-band harmonic cavity
- (6) quadruple triplets
- (7) compression chicane
- (8) S-band deflecting cavity

Repetition rate: 10Hz injector test stand – 100Hz FEL

4 MeV Test Stand



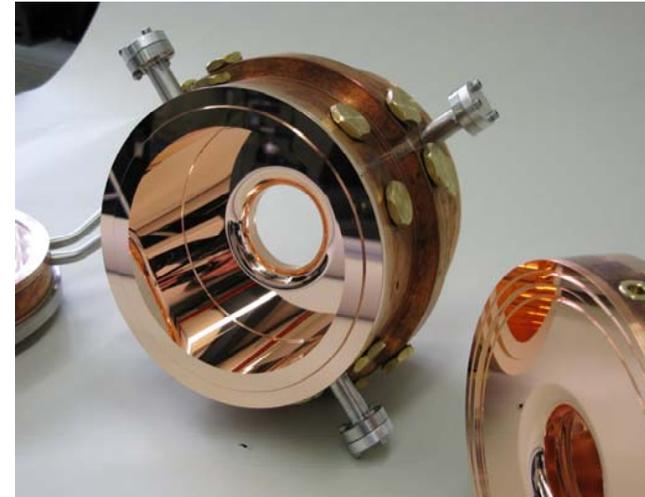
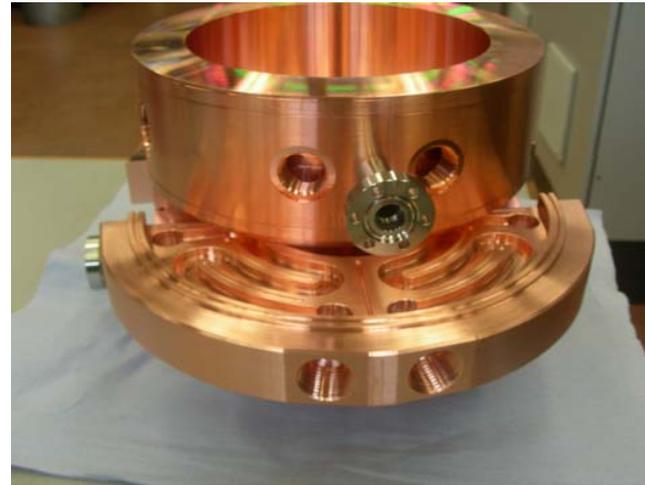
Diode & 2 Cell Cavity Prototype for the 4 MeV Test Stand



Constraints:

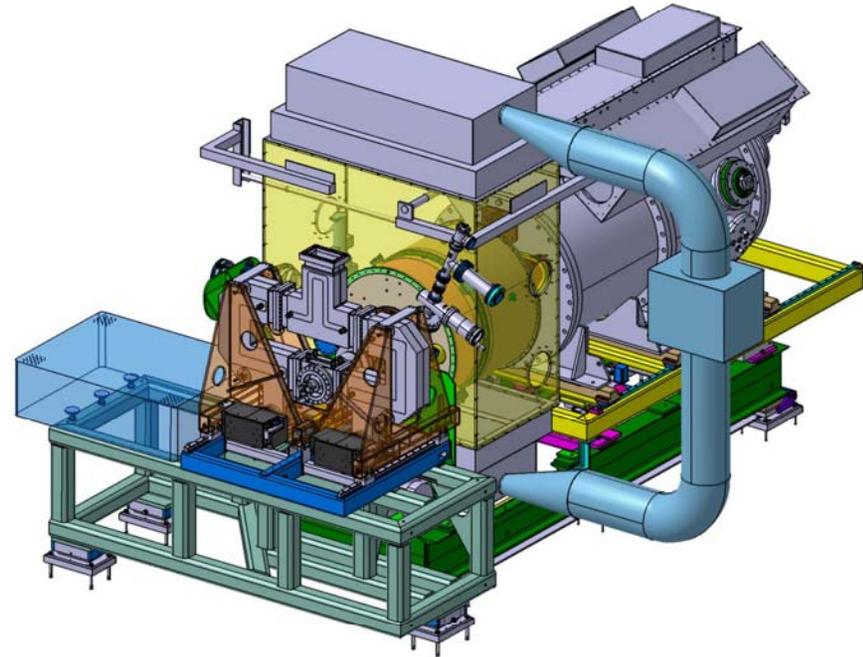
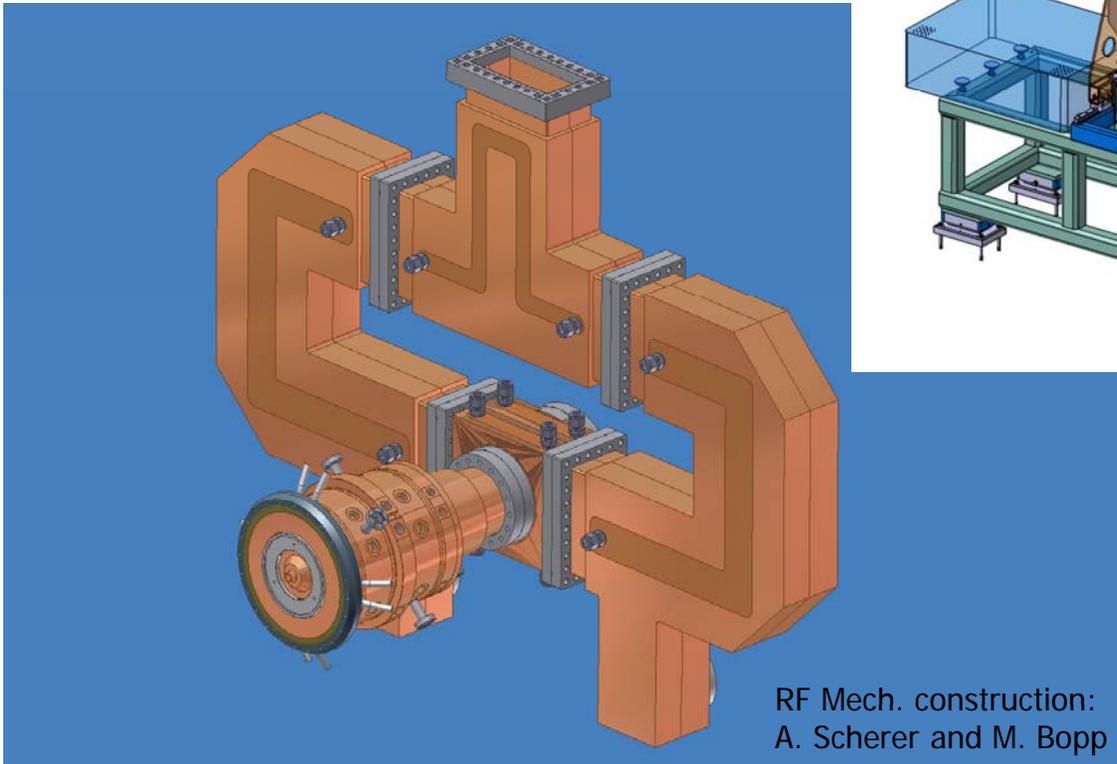
- Short drift space between cavity and pulser tank
- First solenoid close to the cathode field ~up to 0.3T (pulsed coil)
- **Second version: 2 frequency cavity 1.5 - 4.5 GHz (under study)**

First Prototype: Two Cell 1 Frequency Cavity

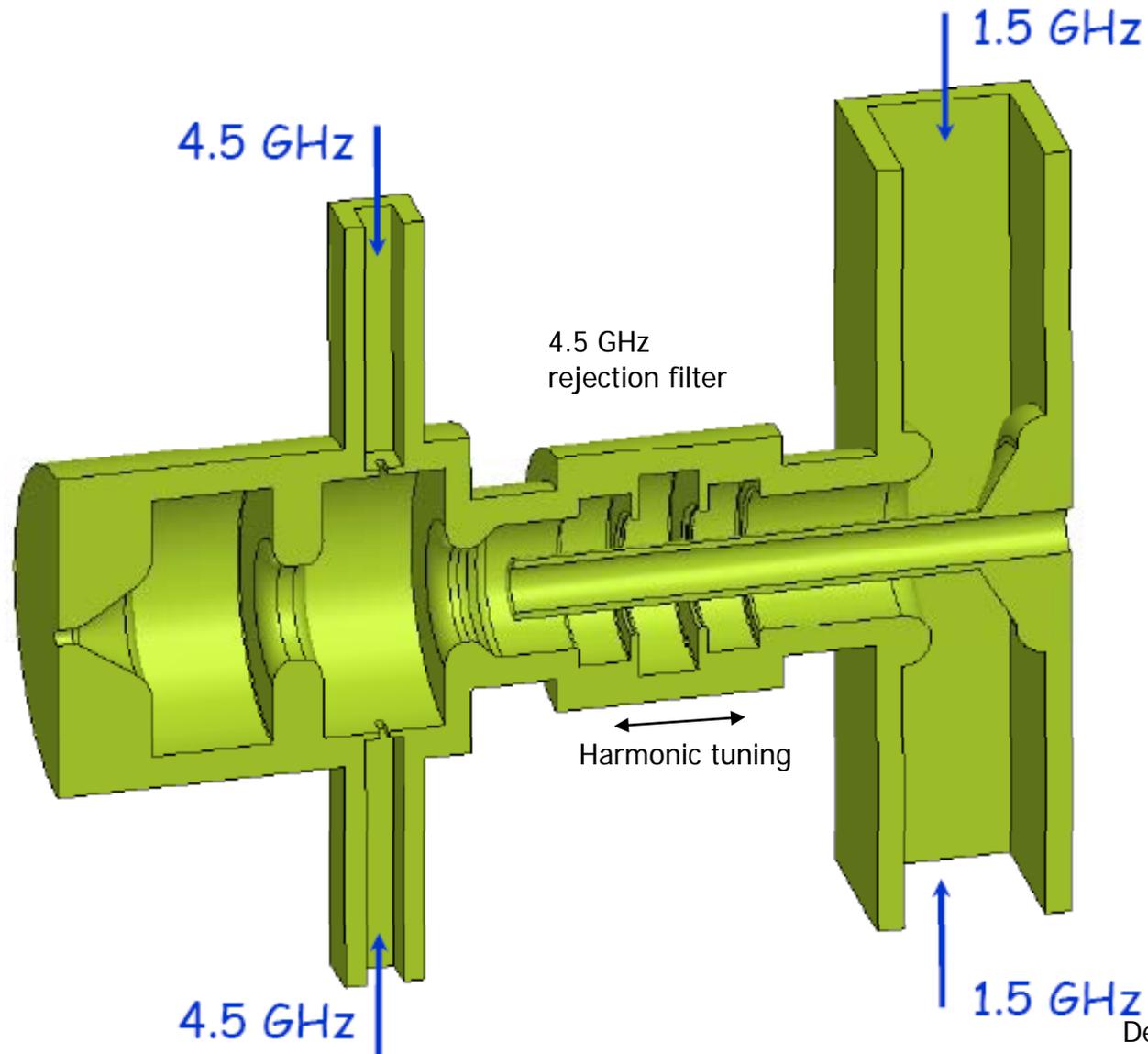


Design: J.-Y. Raguin

Power Splitter for 1 Frequency Prototype



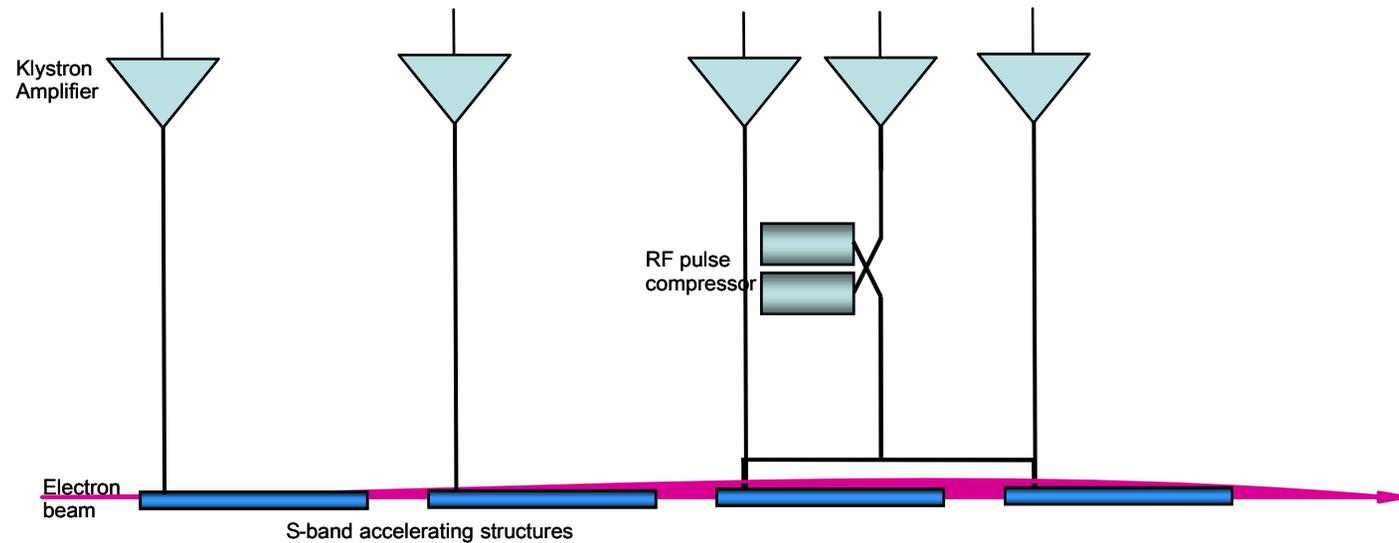
2 Cell – 2 Frequency Cavity for Optimal Longitudinal Phase Space Shaping



Design: J.-Y. Raguin

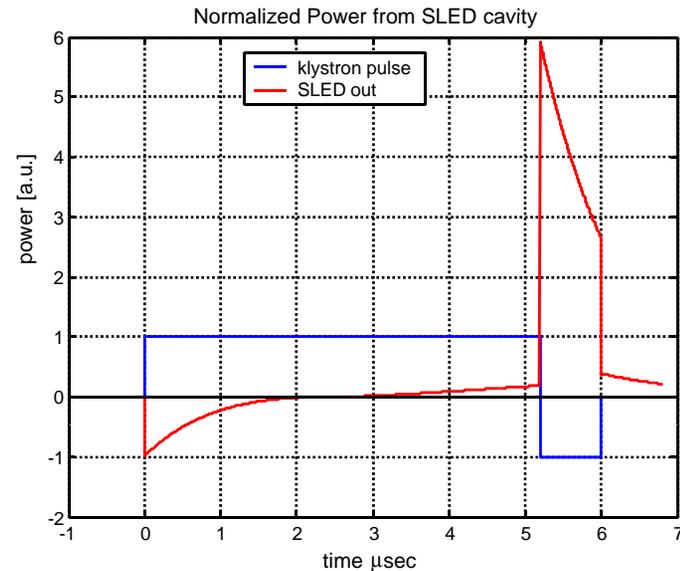
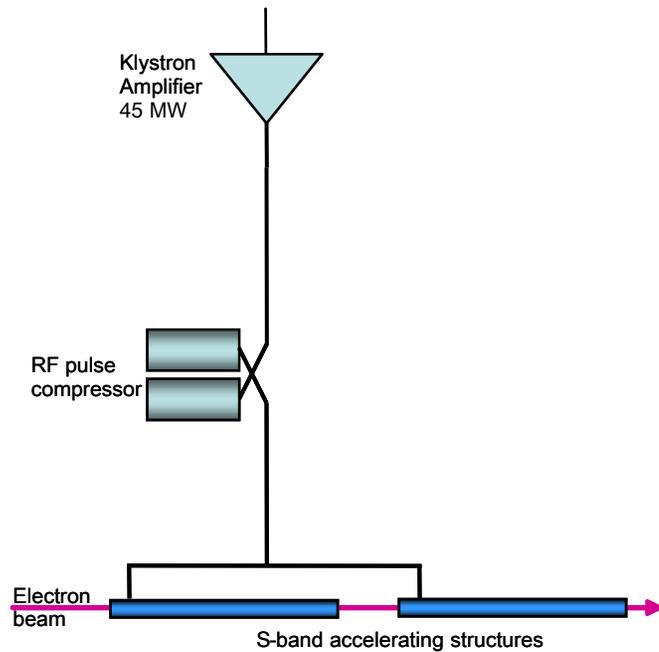
Starting S-band RF layout for the 250 MeV injector

TH2100	MODE Injector	Mode high gradient test (25 MV/m)	Mode RF Compressor (FEL)
Klystron RF Power	30 MW	60 MW	45 MW
Klystron RF Pulse length	1.5 μ s	1.5 μ s	4.5 μ s

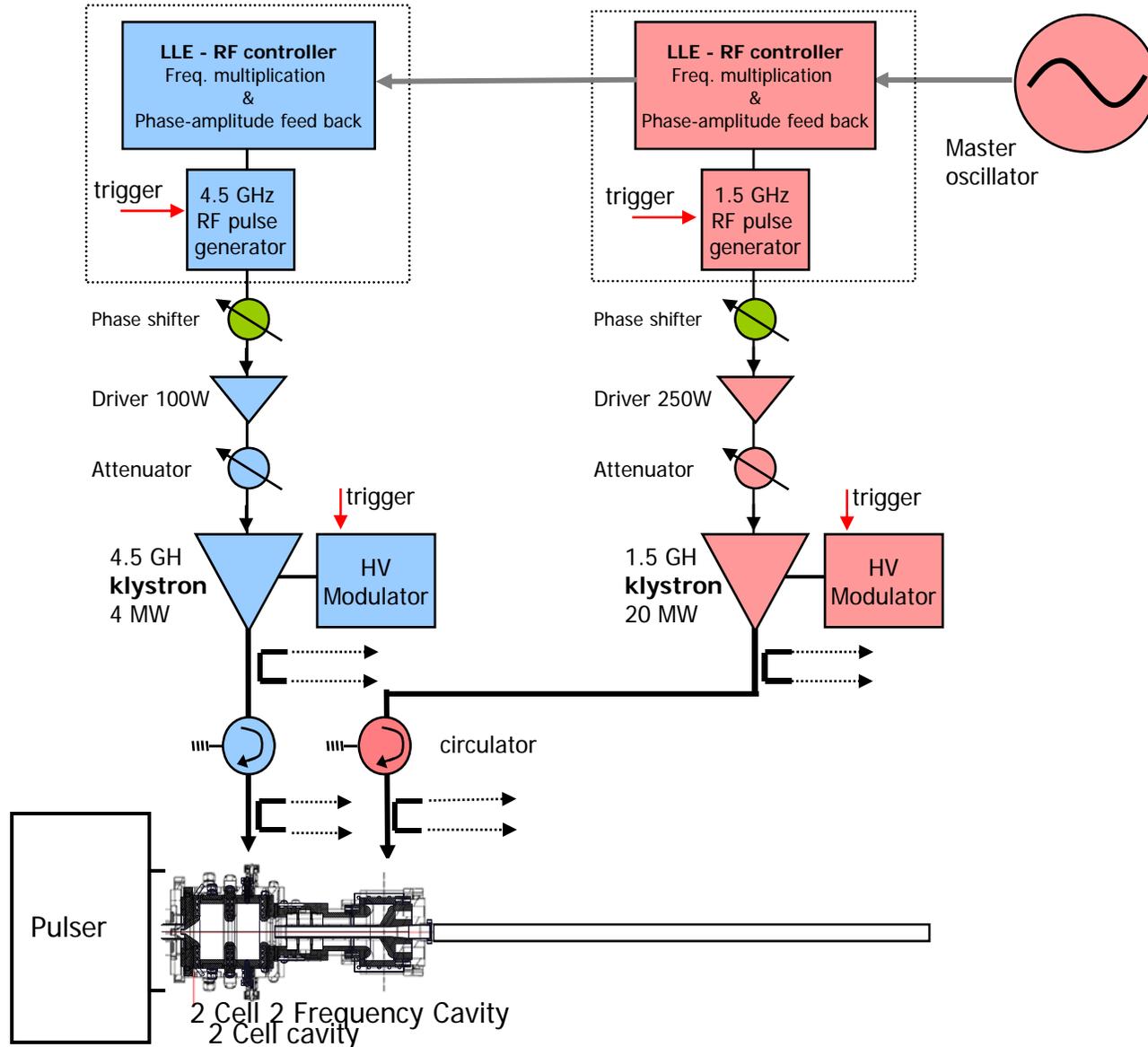


Thales S-Band Compressor Cavity TH20457 (CERN Design)

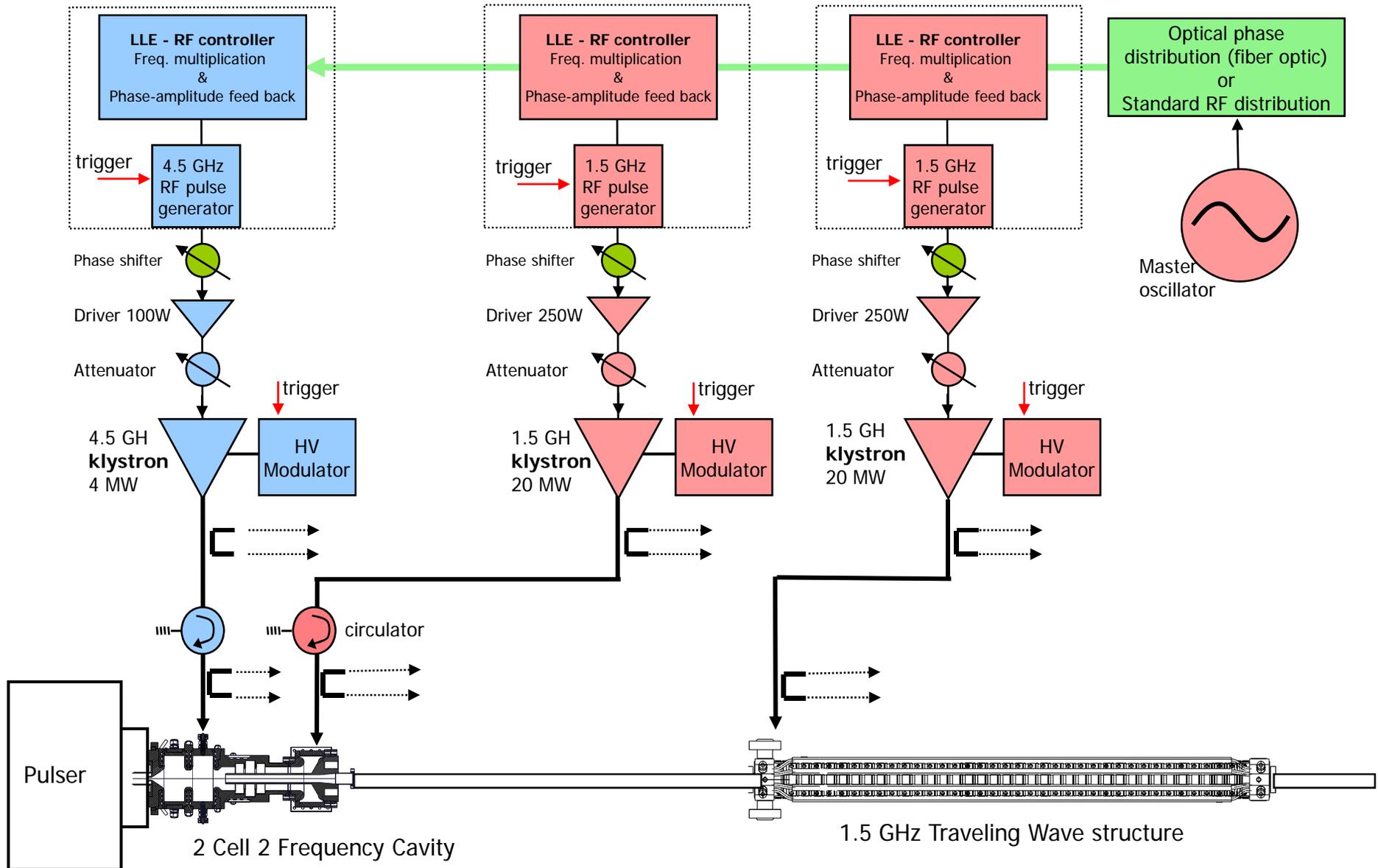
RF input: 45MW @ 5.5 μ s RF pulse
 Output: 140 MW 1.2 μ s flattop pulse



4MeV Teststand RF System

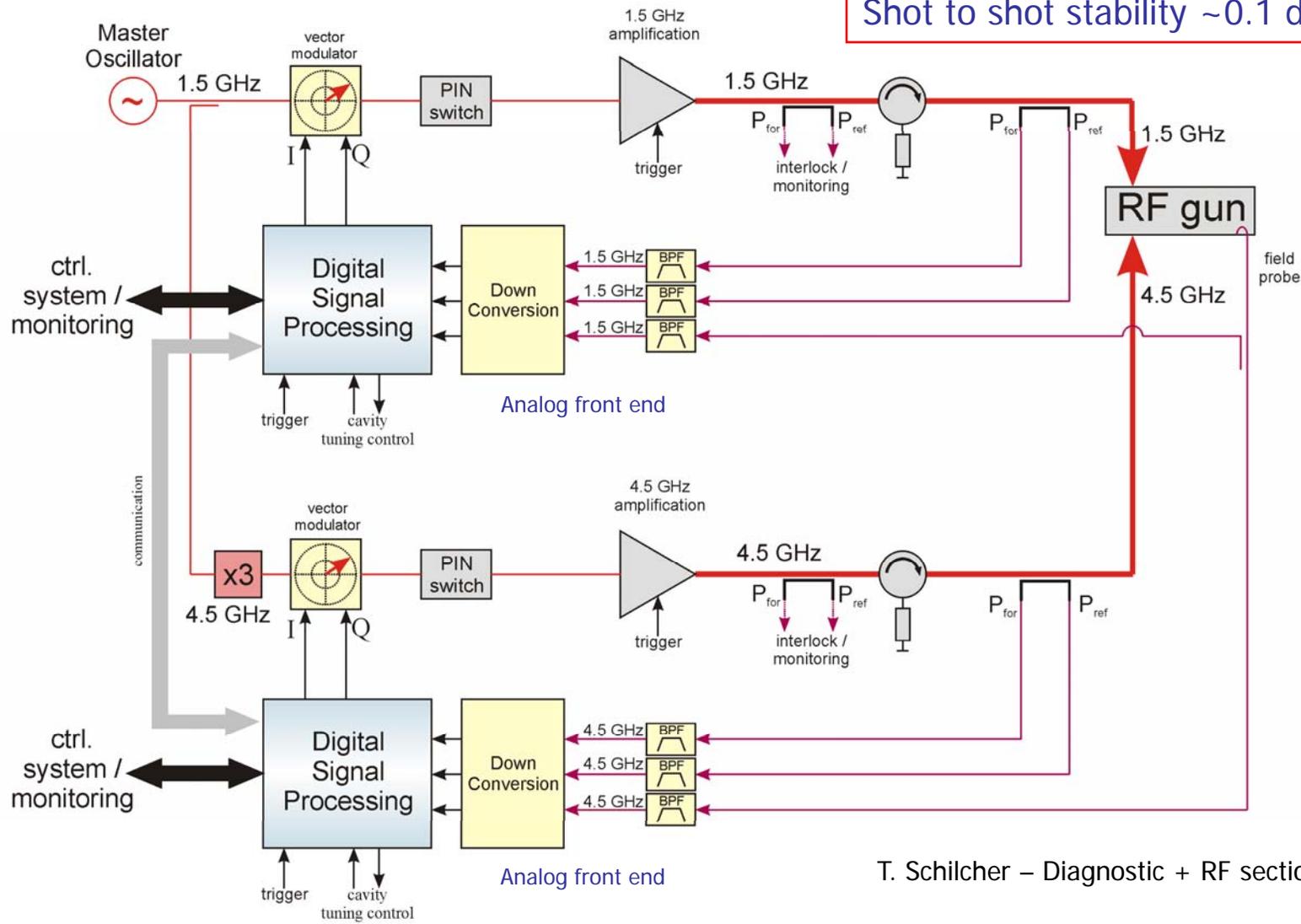


Pre-Injector



RF Systems – Feed Back Concept

Shot to shot stability ~ 0.1 deg RF

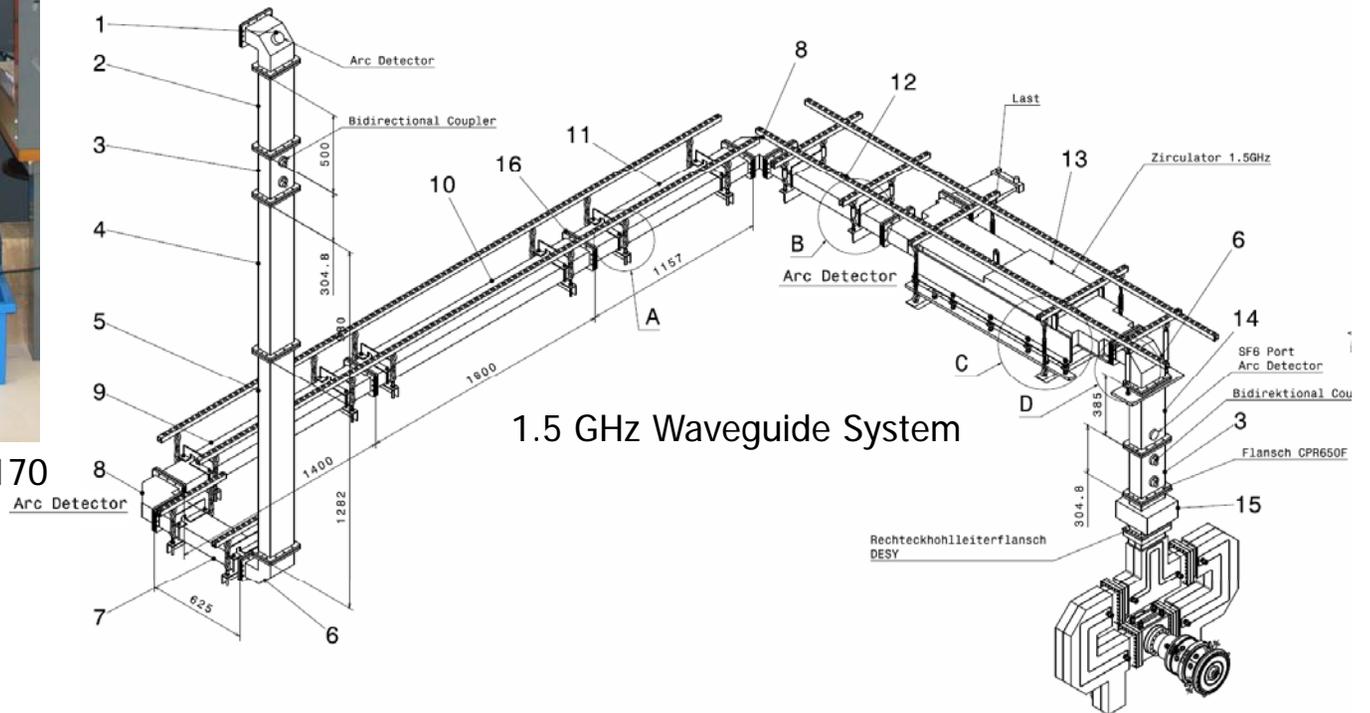
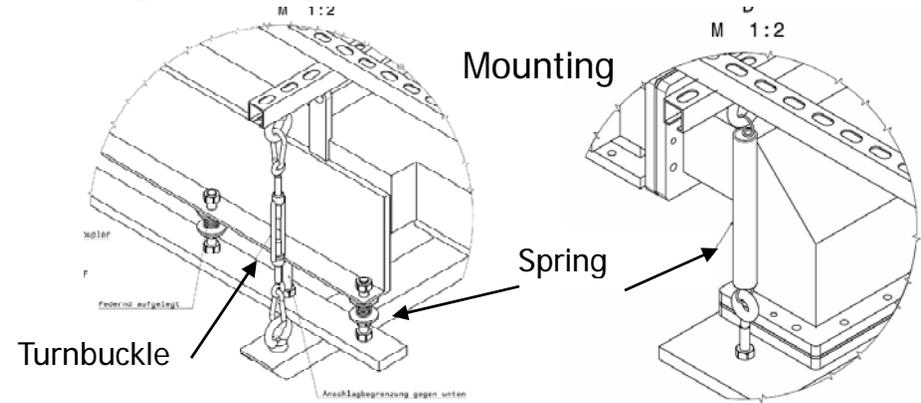


T. Schilcher – Diagnostic + RF section

4MeV Teststand Waveguide-Systems



1.5 GHz Klystron TH 2170
Modulator & Tank



1.5 GHz Waveguide System

Power Sources for 2 Frequency Cavity

- **1.5 GHz:**
- Thales klystron TH2170 – 20 MW – 5 μ s – 100 Hz.
- **Modulator from the company PPT** *Standard PFN + Thyatron current switch*
- *Standard Stangenes Tank.*
- *Same source klystron for the 1.5 GHz TW structure - modulator technology still open.*

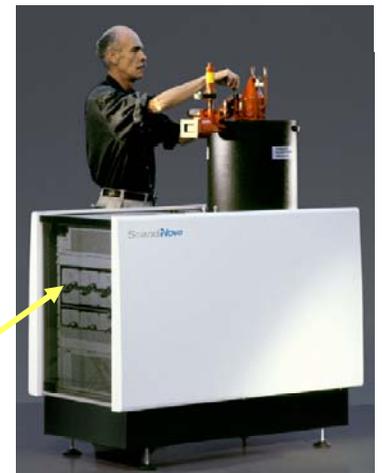
PFN V	40 kV
PFN I	3 kA
Rise time	1 μ s
Flat top	5 μ s
Kly V	250 kV
Kly I	240 A
Rep rate	100 Hz



Tank & multi primary double core pulse transformer

- **4.5 GHz** - collaboration with P. Pearce (CERN):
- 4 MW IEAC* klystron available at this frequency.
- *Order placed for two tubes – 10 months delivery, ~March 2008*
- *IGBT based modulator from SCANDINOVA ordered (delivery ~March 2008).*

IGBT V	1.2 kV
IGBT I	1 kA
Rise time	1 μ s
Flat top	4 μ s
Kly V	120 kV
Kly I	75 A
Rep rate	100 Hz



IGBT switches 1.2 kV

*Institute of Electronics, Chinese Academy of Sciences Beijing, China



Thanks for your attention