TESLA-Technology-Collaboration-Meeting 30 – April 1

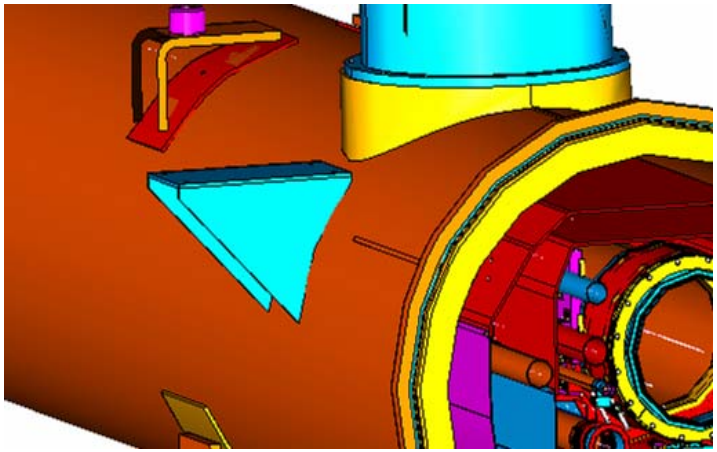
WG3: Auxillaries & Module Integration

Conveners: Helen Edwards (FNAL),Terry Garvey (LAL ORSAY), Bernd Petersen (DESY)

Outline

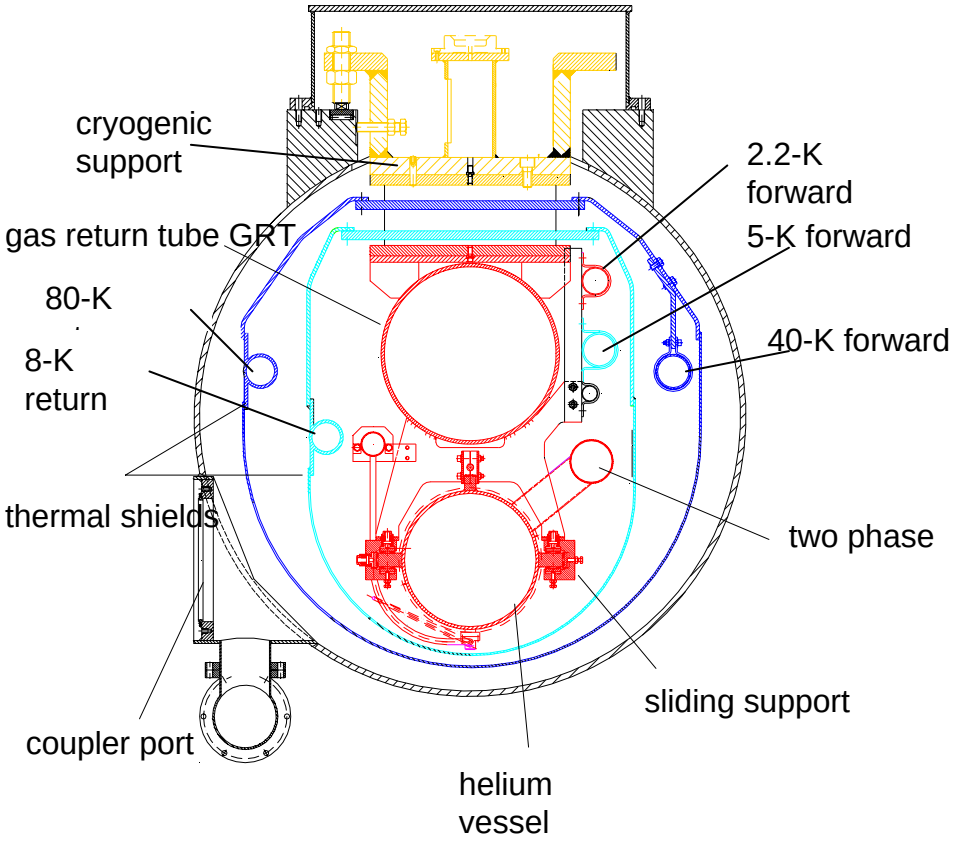
- Assessment of existing designs/prototypes
- Identification of critical reliability issues
- Existing and planned infrastructures
- Cryomodule integration issues (and impact on design)
- WG3- preliminary schedule

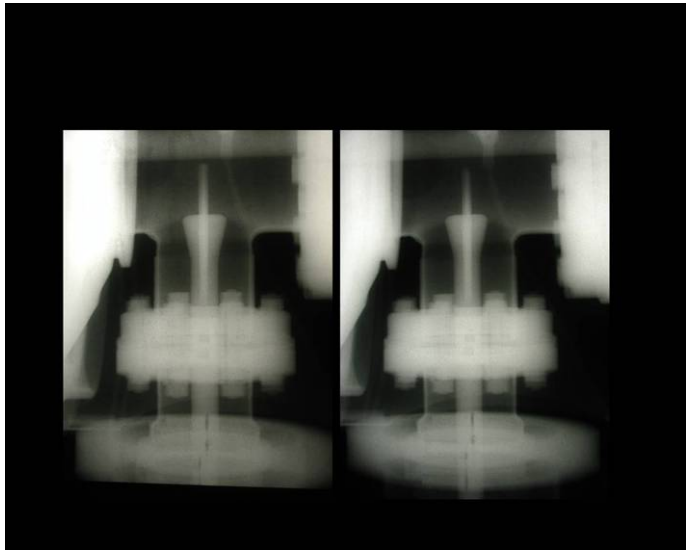
Assessment of existing designs/prototypes



- Status TTF cryomodules
- Design changes for XFEL-cryomodules
- Design changes for the ILC
- Schedule for next TTF-modules/XFEL-prototypes
- Industrialization of XFEL-cryomodules
- Access to documentation via EDMS
- Safety code issues

Main features of XFEL-cryomodule design (TESLA/TTF –type III)





300 K and 2K

Module 5 coupler 2

Cavity chain is fixed to an invar rod – couplers keep position

TTF-cryomodule design: results, static heat loads

-> **Measured static heat loads in line with the estimated theoretical values**

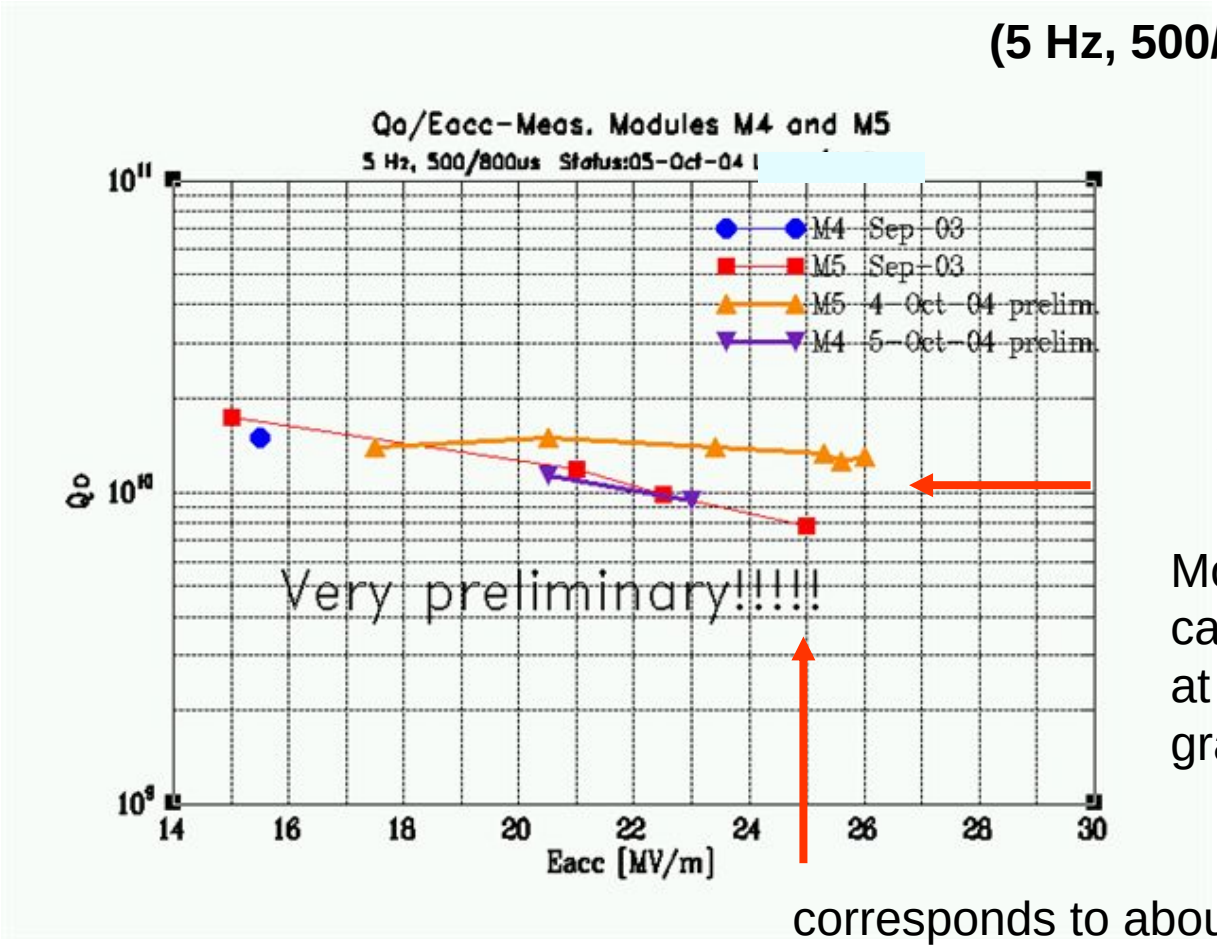
Designed, estimated and measured static Cryo-Loads TTF-Modules in TTF-Linac										
Module	40/80 K [W]			4.3K [W]			2 K [W]			Notes
Name/Type	Design	Estim.	Meas.	Design	Estim.	Meas.	Design	Estim.	Meas.	
Module 1 I	115.0	76.8	90.0 *	21.0	13,9	23.0 *	4,2	2,8	6,0 *	Open holes in isolation
Modul1 rep. I	115.0	76.8	81,5	21.0	13,9	15,9	4,2	2,8	5,0	2 end-caps
Modul 2 II	115.0	76.8	77,9	21.0	13,9	13.0	4,2	2,8	4,0	2 end-caps
Module 3 II	115.0	76.8	72.0 **	21.0	13,9	48.0 **	4,2	2,8	5,0 *	Iso-vac 1E-04 mb, 2e-caps
Module 1* II	115.0	76.8	73.0	21.0	13,9	13.0	4,2	2,8	<3.5	1 end-cap
Module 4 III	115.0	76.8	74	21.0	13,9	13.5	4,2	2,8	<3.5	1 end-cap
Module 5 III	115.0	76.8	74	21.0	13,9	13.0	4,2	2,8	<3.5	1 end-cap
Module SS	115.0	~76.8	72.0	~21.0	~13.9	12.0	~4.2	>2,8	4,5	Special, 2 end-caps
Module 3* II	115.0	76.8	75	21.0	13,9	14	4,2	2,8	<3.5	1 end-cap
Module 2* II	115.0	76.8	74	21.0	13,9	14,5	4,2	2,8	<4,5	2 end-caps
Module 6 EP	Type III, EP-Cavities Goal:Solution close to XFEL Modules									(Assembly End-04??)
										Modules under Test in TTF2-Linac

design value = 1.5 * estimated value

TTF-cryomodule design
results: dynamic losses

2K Dynamic heat losses of module 4 & 5 (type III) : about 3 W at 25 MV/m each

(5 Hz, 500/800µ s)



0.38 W/cavity

Most cavities can be operated at higher gradients !

corresponds to about 3 W each

X-FEL Cryomodule

- TTF type III design baseline for X-FEL
- 8 cavities, 1 magnet package

Modifications:

- **smaller quadrupole (super-ferric), 2K cooled,typeIII support**
- **metal gaskets and/or welded connections (under discussion)**
- **different BPM**
- **length shall match the (lambda * N/2) condition**
- **ceramic HOM absorber between modules**
- **Piezo tuner**
- **Review: larger diameters helium process tubes ?**
- **Safe-guard design**
- **Still open question: design changes needed to reduce vibrations ????**
- **industrialization**

Design modification considerations for ILC

- Cavity length- beam tubes same both ends ~ -3cm
- Tuner type- blade or Saclay type II, with integrated piezo tuner
- Quad- BPM package and power leads- needs to be packaged for clean room assembly- consider HTC leads- TESLA assembly must fit in module length
- Quad location for maximum stability of BPM and minimum Quad vibration- below center post
- Review end pipe cryo connections- efficient use of space.
- HOM absorber

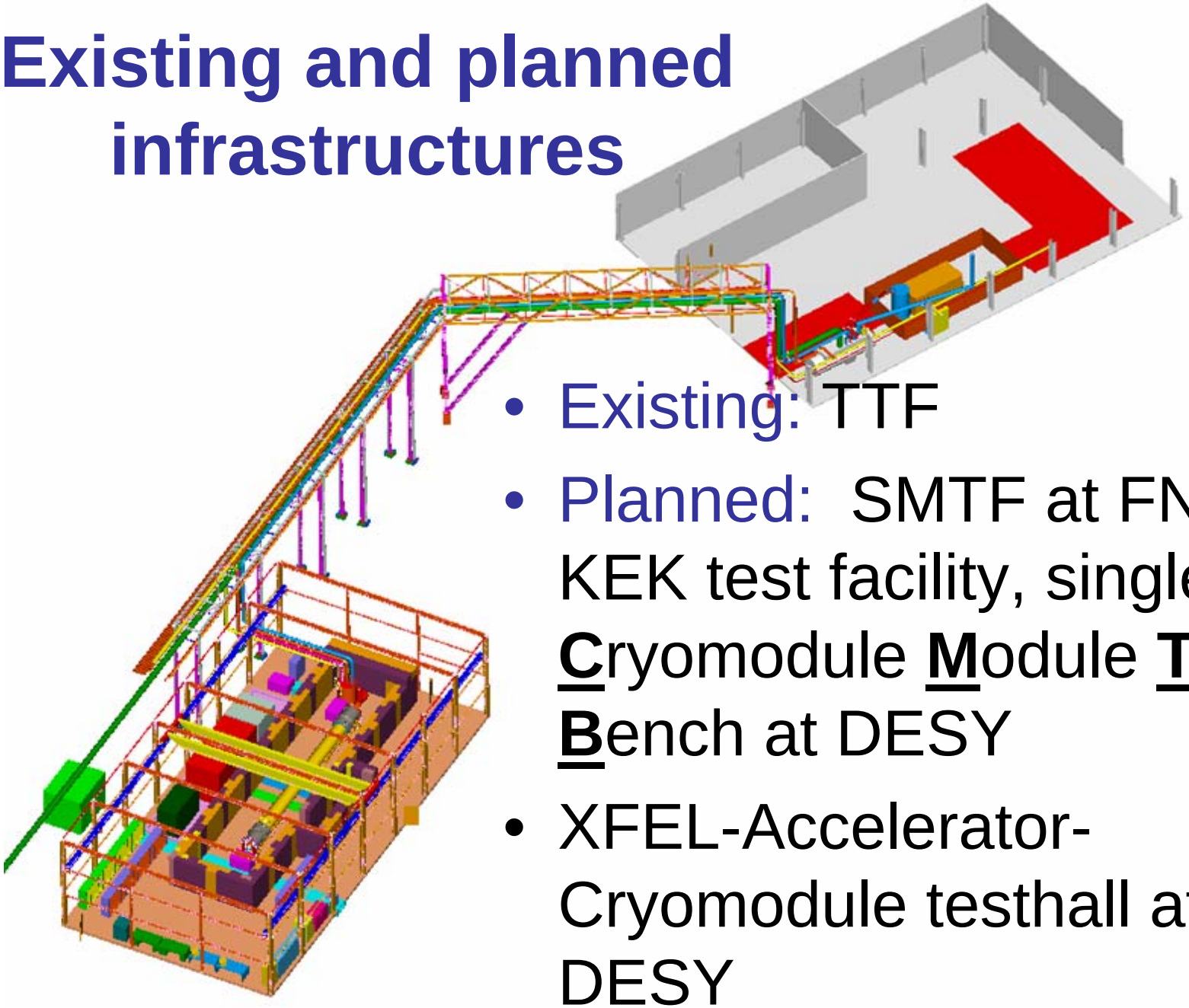
Identification of critical reliability issues

- **Tuner design, engineering, operation**
- **Analysis of vibration issues**
- **Impact from quad yoke saturation on steering coils**
- **Coupler processing**
- **Transportation of modules**
- **Started: Analysis of assembly protocols**
- **Summarize critical paths, reliability, critical developments, and test issues**

Identification of critical reliability issues (cont.)

- Tuner stepping motor inaccessible
- Piezos redundant (probably ok)
- Many vacuum flanges
- Alignment and thermal cycle stability
- Cavity contamination by rupture
- Deterioration of gradient or Coupler (reprocessing?)

Existing and planned infrastructures



- Existing: TTF
- Planned: SMTF at FNAL, KEK test facility, single **C**ryomodule **M**odule **T**est **B**ench at DESY
- XFEL-Accelerator-Cryomodule testhall at DESY

Existing and planned infrastructures

SMTF schedule ?

SMTF test program ?

KEK test facility schedule ?

KEK test facility test program ?

Prototype test program CMTB (DESY)

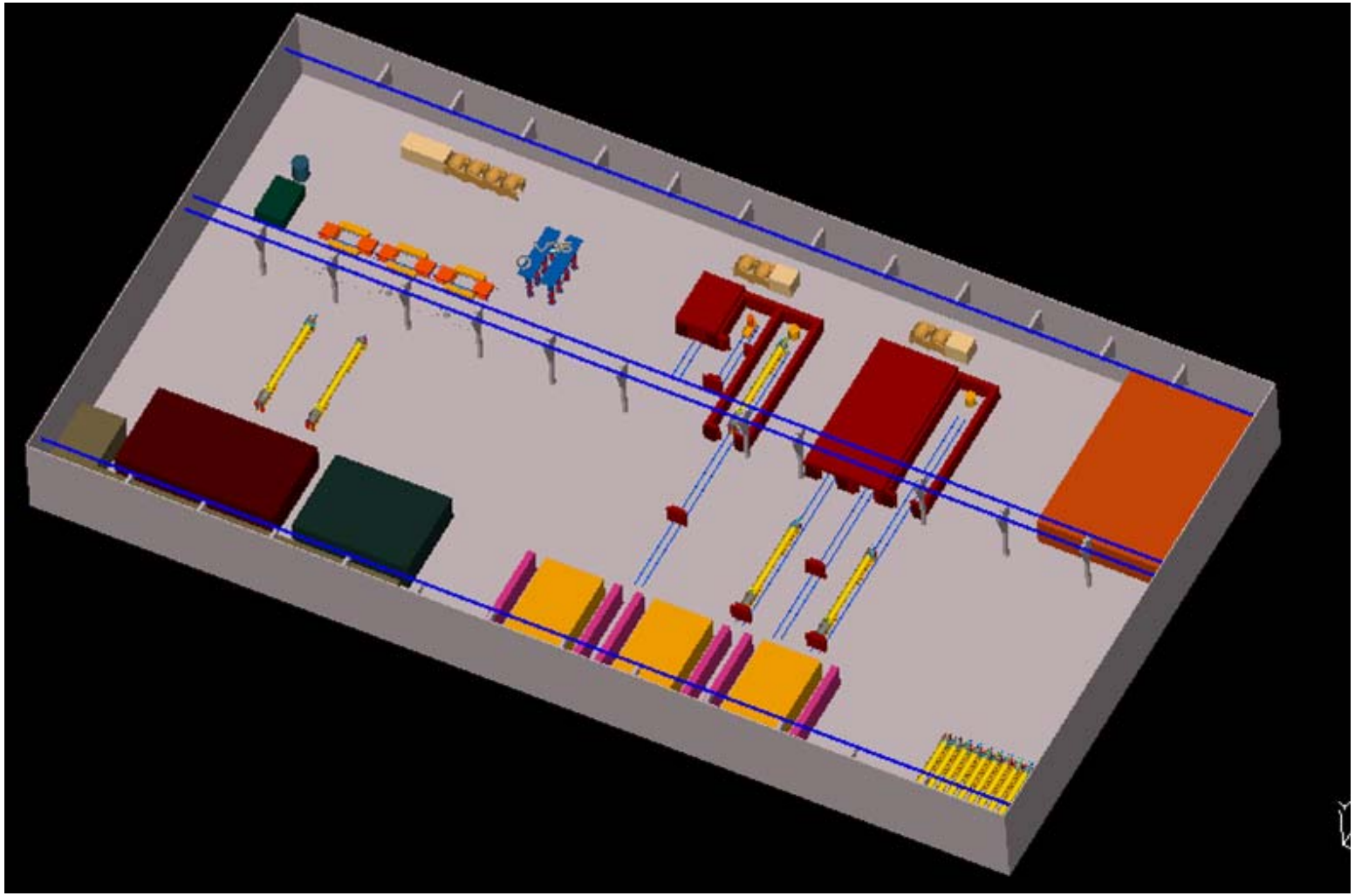
- In general: cryomodule tests independent from linac operation
- RF cavity processing / performance
- processing of RF couplers
- cryogenic performance
- tests of vacuum systems
- tests after repairs before installation into linac
- tests of new design features (2K quad ...etc.)
- dark current
- stretched wire, WPMs
- thermal cycling
- operation at different HE II bath temperatures
- insulation vacuum / beam vacuum venting
- ...etc.....

Existing and planned infrastructures

Test program and schedules for serial production of XFEL- cryomodules ?

Test program and schedules for serial production of ILC- cryomodules ?

XFEL Test Hall Layout



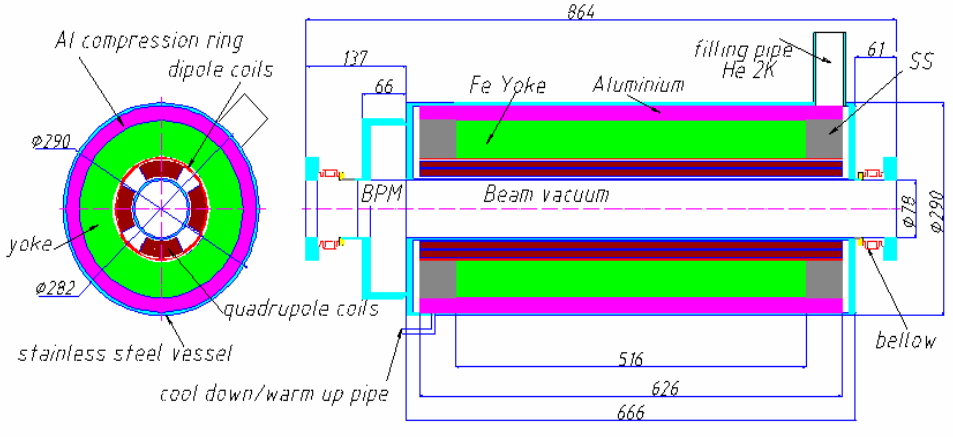
Cryomodule integration issues (and impact on design)

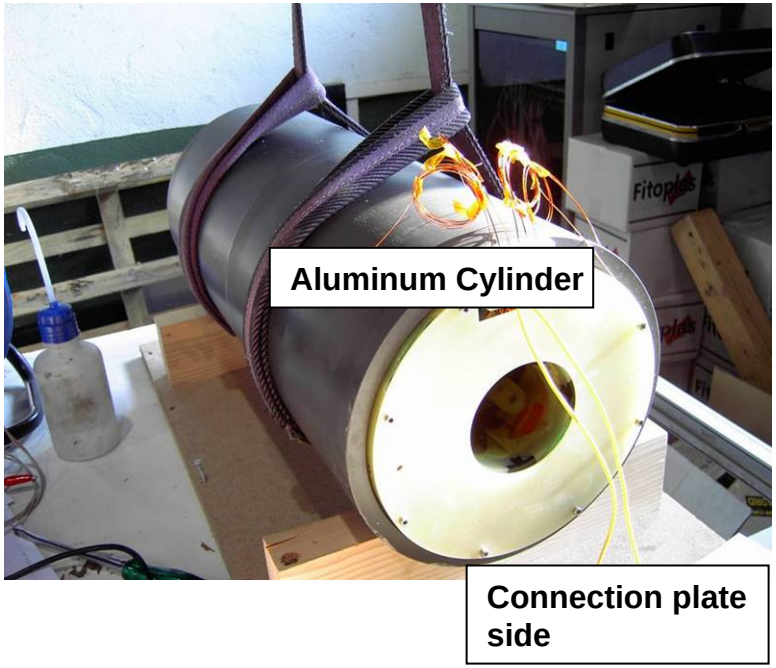
- Magnet package
- Tuners
- Couplers
- BPM design
- HOM absorber
- Module instrumentation
- Impact of automated welding procedures

TESLA Quad Magnet Package

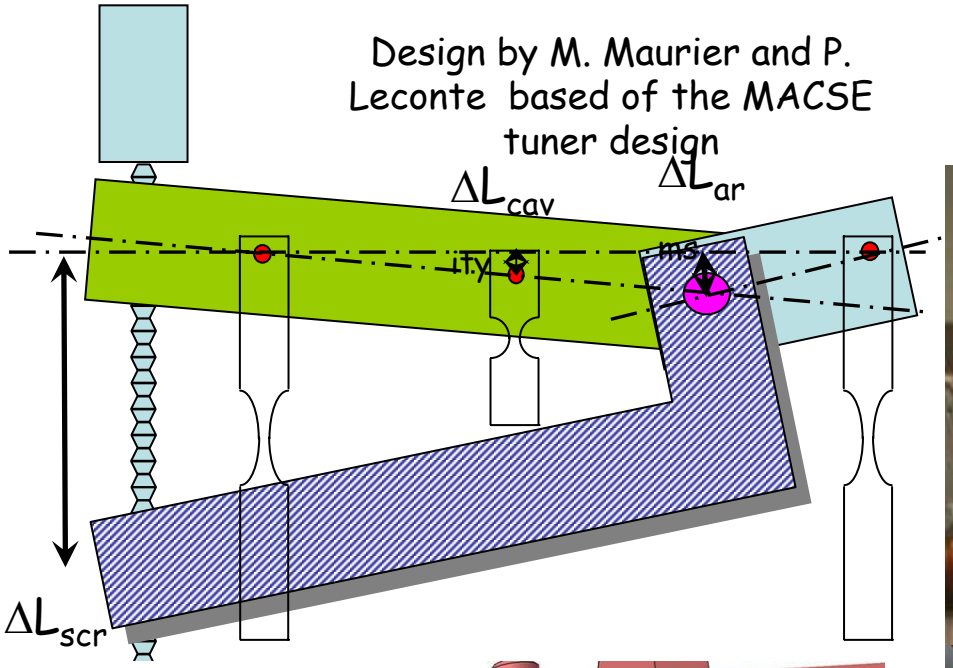
- TESLA-Magnet from Ciemat tested in February at DESY

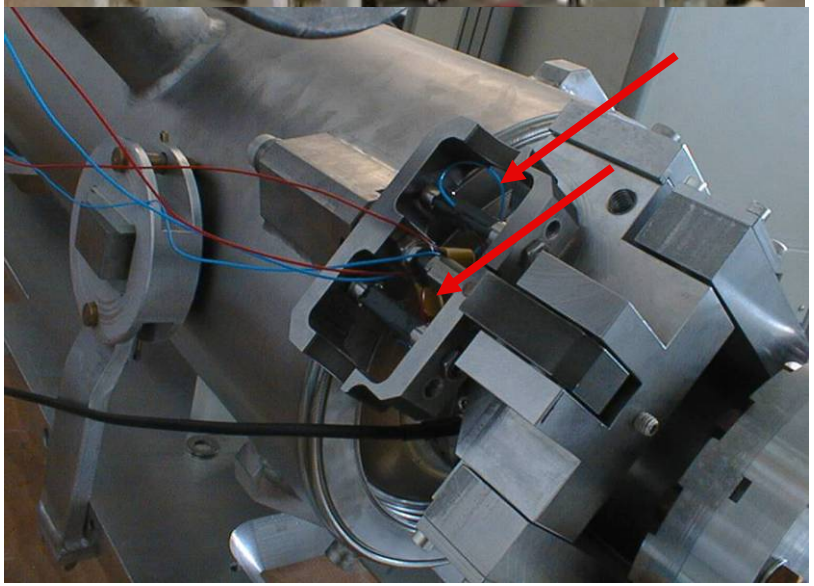
- XFEL magnet package
  - Super ferric design
  - Field simulations finished
  - Mechanical design started
  - About a factor of 2 shorter than TTF design
  - Steering coils
    - Fit in quad aperture
    - investigation for lower current solution (smaller power supplies)
- TTF magnet package also





Tuners & Piezos





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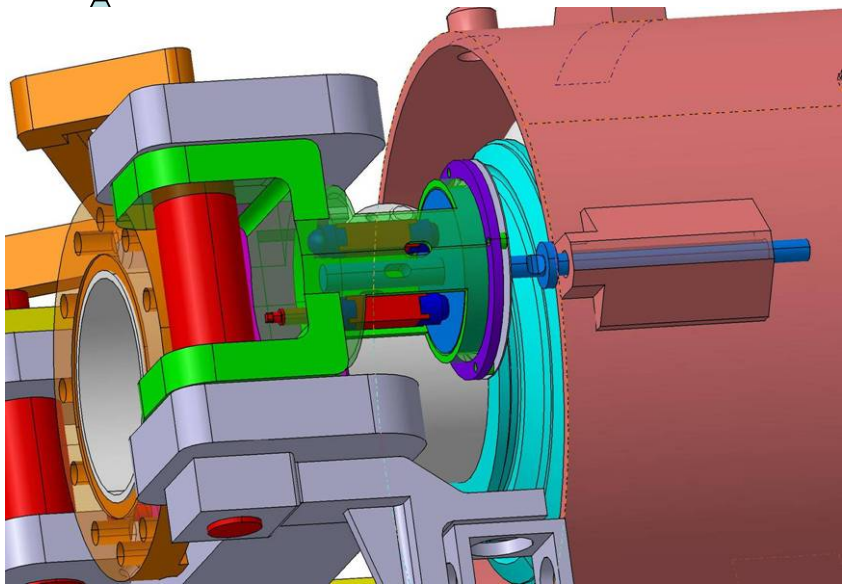
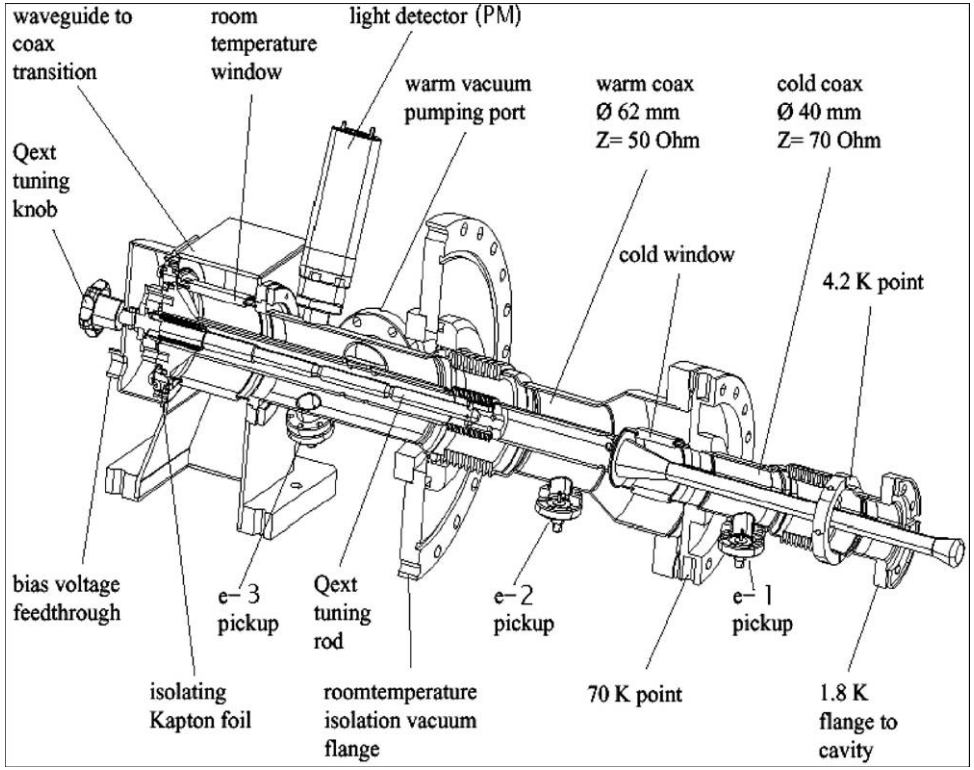
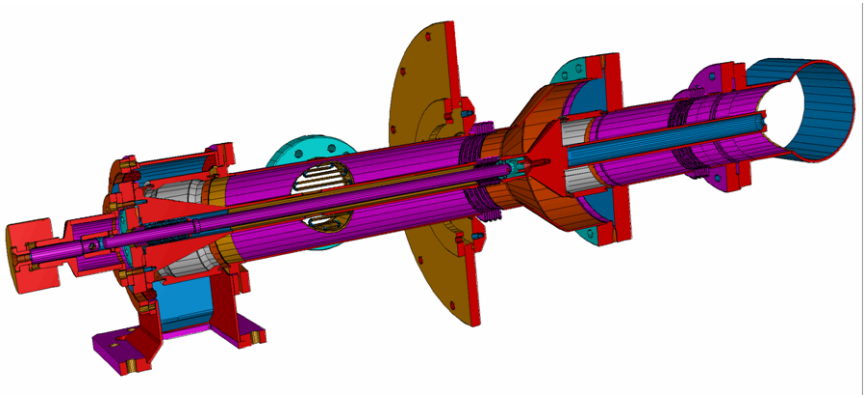


TTF Power Couplers

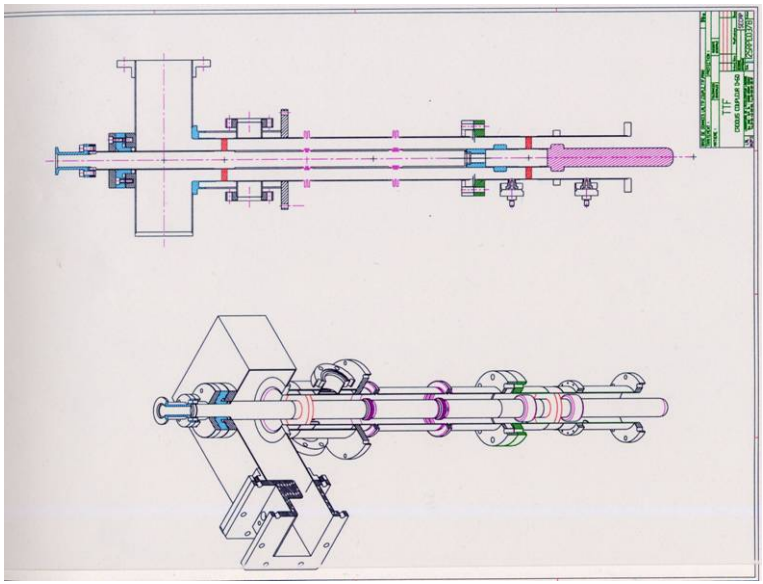
TTF 3



TTF 4 80mm - 2 prototypes tested



LAL Disk Design 60 mm



Topics & Schedule Organization I

I Wed 15:30

- **Organization- review topics, agenda, and see who wants to make presentations**
- Overview of Modules
- Status and plans for TTF and XFEL
- Some Summaries of other meetings-
  - Possible direction for ILC module
  - Perceived reliability issues, other issues & non issues

Topics & Schedule Organization II & III

II Thurs 9:00- 10:30

- Input couplers
- Tuners- mechanical & piezo

III Thurs 11:00- 12:30

- Alignment, vib and BPM specifications
- Quad packages and vibration measurements
- Module layouts,- z real-estate, interconnect real-estate
- Manufacturability, assembly, and test of modules

Topics & Schedule Organization IV

IV Thurs 14:00- 16:00

- Drawings, specifications, EDMS, critical information,Safety codes, Property rights,formats and standardization
- Module instrumentation,BPM,HOM-abs
- Module assembly and Test facility plans
- Critical R&D tests and goals
- Summarize critical paths, reliability, critical developments, and test issues. (e.g. How can we go faster?)

SUMMARY

WG3: Auxillaries & Module Integration

- Assessment of existing designs/prototypes
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