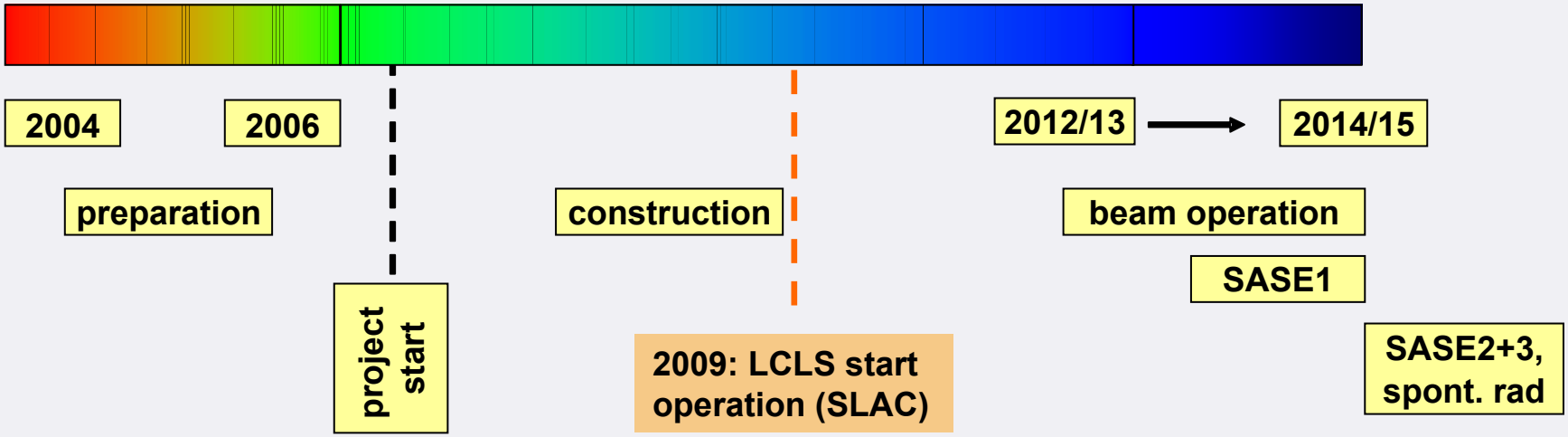
Informationsveranstaltung FH-ILC

Ein erster Überblick über die Aktivitäten im Beschleunigerbereich, die sich als gemeinsame Arbeitsprojekte für XFEL und ILC anbieten.

Einleitende Bemerkungen …

Hans Weise / July 11th, 2007

Die viel erwähnte / zitierte Synergie zw. XFEL und ILC



industrialization of all Linac sub-systems

production

commissioning

acceptance test and installation

input for ILC

FLASH FLASH FLASH operation experience XFEL XFEL XFEL

XFEL: which ILC questions are answered?

- how to build a 100 accelerator module linac using TESLA Technology
- how to industrialize the SCRF on a 5% ILC scale
- how to extrapolate from TTF / FLASH by a factor of 20
  Remark: ILC eq. 20 XFEL
- how to start and organize an international project based on in-kind contributions

Zusammenarbeit zwischen FH und XFEL

Idee: Auf dem Weg zum ILC will FH den Aufbau des kalten XFEL Linac unterstützen.

Nicht nur bei DESY ist inzwischen verstanden, daß die Realisierung dieses Linacs - basierend auf der TESLA Technologie - ein essentieller Bestandteil des weiteren ILC R&D Programms ist.

Wir sollten die immer wieder angesprochene Synergie mit Leben füllen.

Weg: Einzelne kleine Teams (organisatorisch bei FH zusammengefasst) unterstützen verschiedene Arbeitspakete der WPG1 (kalter Linac) durch aktive *hauptamtliche* Mitarbeit.

Win-Win Situation für FH und XFEL

Gewinn für FH:

Hervorragende Ausbildung durch Einbindung in ein spannendes Projekt

Verbesserung der Ausgangssituation bzgl. ILC

Gewinn für M:

Unterstützung durch erfahrene Mitarbeiter, die auch nach dem ersten Strahl im Linac nicht verloren gehen.

Ein gemeinsames Projekt fördert das gemeinsame Interesse an Projekten nach dem XFEL.

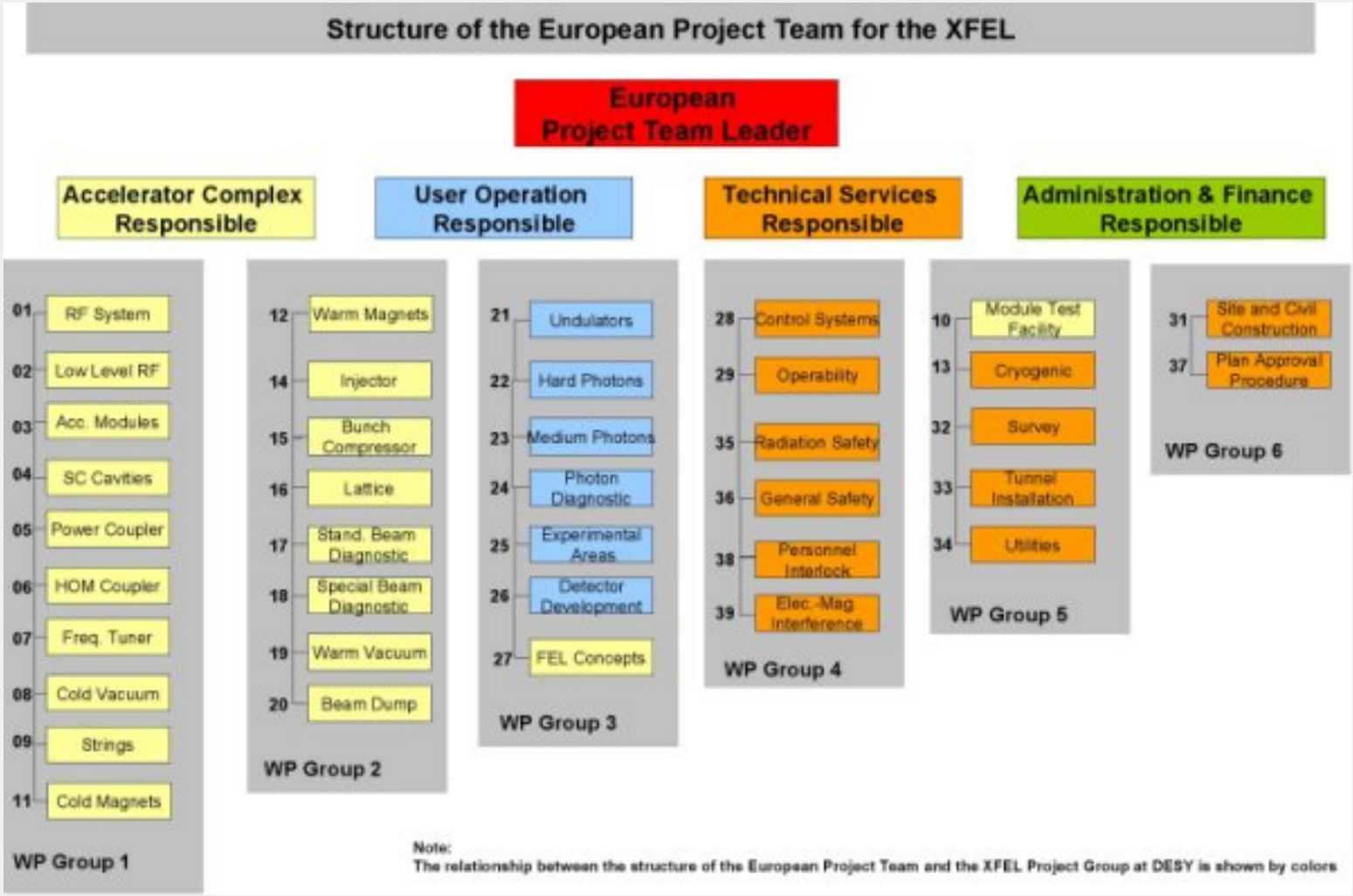
Themenbereiche FH und XFEL

Cavities im Reinraum	(Axel Matheisen)
Cavity Tests	(Wolf-Dietrich Möller)
Cryo-Module	(Kay Jensch)
Datenbank u. QA	(Dieter Gall)
Cavity R&D / Liste Marc Ross	(Detlef Reschke)

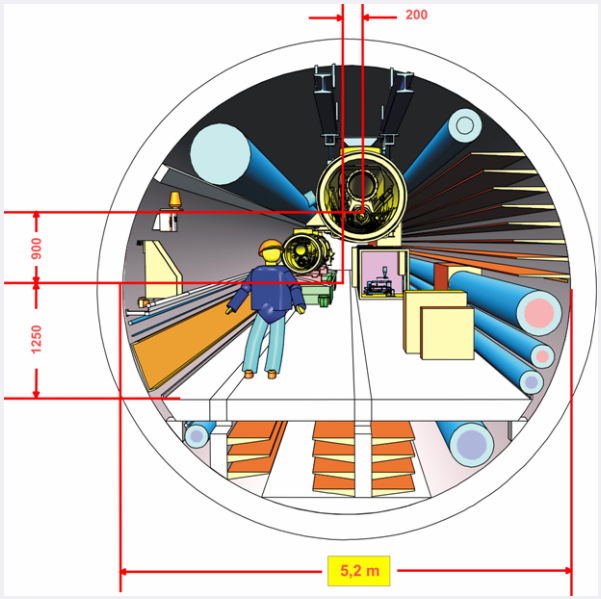
Neben diesen ausgewählten Themenbereichen gibt es selbstverständlich viele andere Möglichkeiten…

Auf den folgenden Folien noch einige Bilder zur Inspiration…

XFEL Project Structure



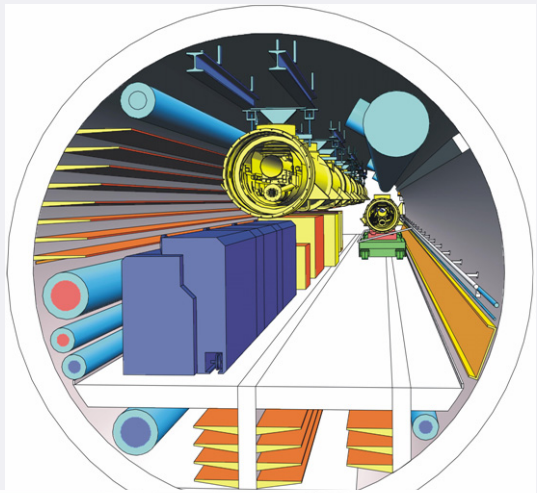
XFEL Tunnel

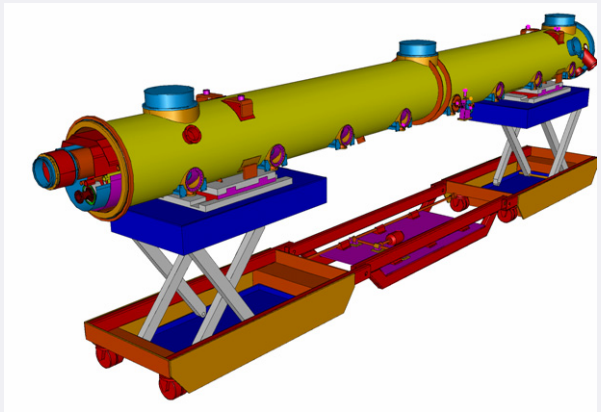


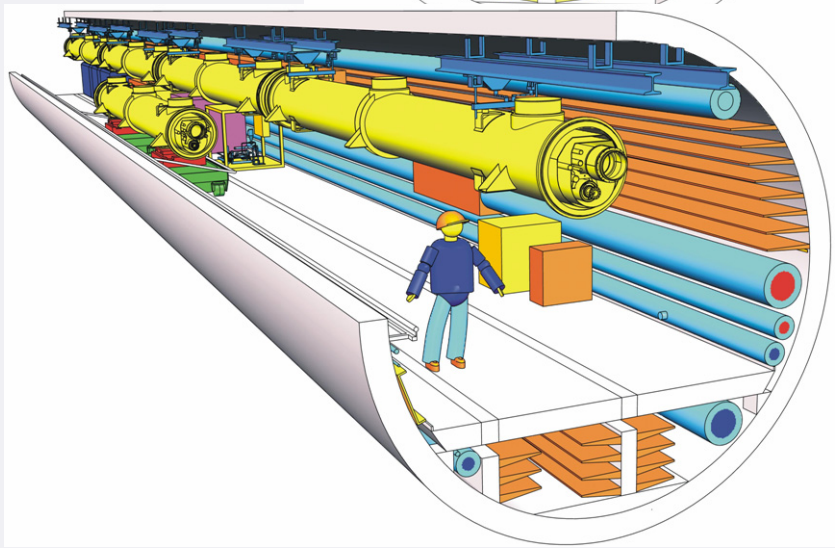
The **XFEL tunnel layout** was developed in several iterations.

A **mockup** is currently under construction.

Installation procedures are under study.







XFEL Tunnel Mockup

XFEL Accelerator Components

RF Gun + 1 single acc.module

25 units (4 acc. modules each)

(1) x 4 x 8 x 23.6 = 500 MeV

(2+1) x 4 x 8 x 23.6 = 1.5 + spare -> 2 GeV

(20+1) x 4 x 8 x 23.6 = 15.1 + spare -> 17.5 GeV

Rapid start-up scenario for 17.5 GeV

101 Accelerator Modules

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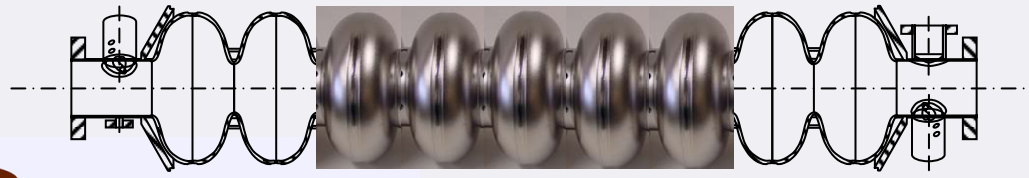
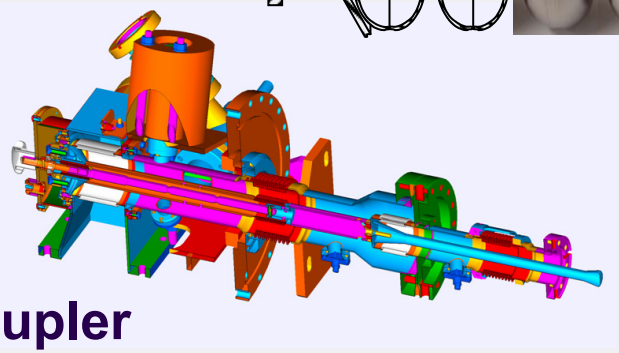
module installation from 3/2012 until 7/2012 **at a rate of 1 unit / day**
all modules to be tested at AMTF between mid 2010 and mid 2012

cold-mass delivery at a rate of 1/week; 1st cold-mass delivered Q4/2009
1st cavity string components Q3/2009
1st module spring 2010
i.e. **all accelerator components ready to order end of 2008**; actual R&D status supports this

XFEL Accelerator Components

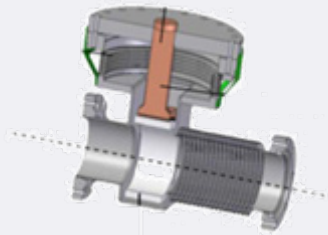
cavities



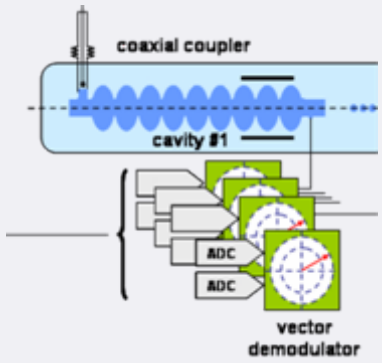


coupler

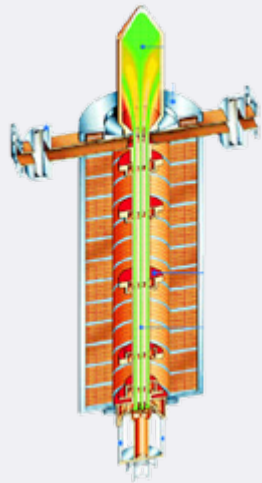
TESLA Technology



HOMs



LLRF



RF

XFEL Cavities

The XFEL will use 800 accelerating cavities (rapid start-up scenario)

which is approx 5% of the ILC design.

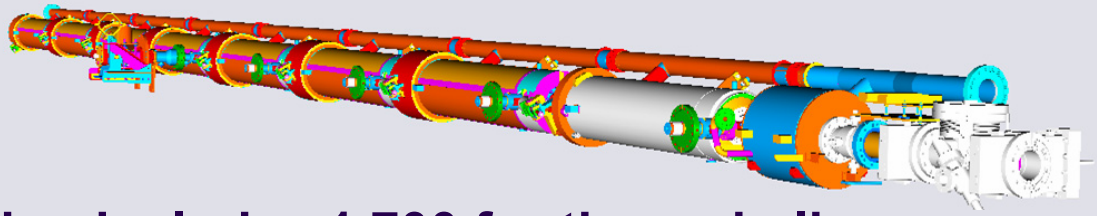
There are at least two well established ‘sources’ for an **industrial cavity production** guaranteeing the required rate of 8 to 10 cavities per week over two years. **At the companies, new infrastructure is required** but the effort is well understood.

Cavity treatment will be done in industry. In order to prepare this, two companies will do the first electro-polishing of 12 9-cell cavities each in 2007.

The **quality check** will be done in terms of a vertical test on the XFEL/DESY site. The **tested cavities will be given to industry** for string/module assembly.

Cavity Strings

While the XFEL will use 100 cavity strings of 8 cavities each,



the ILC design includes 1,700 for the main linac.

The **technology transfer** to industry is done for the XFEL.

Minor differences in the module design have basically no impact.

The XFEL foresees two parallel lines (companies) for string assembly.

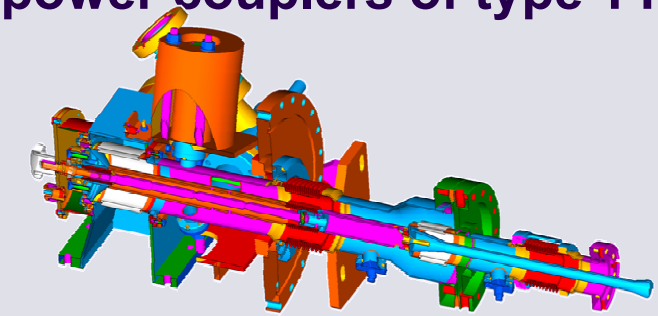
RF Main Power Couplers

While the XFEL will use 800 RF main power couplers of type TTF III,

the ILC design is based on

the same coupler type,

but needs 15,000.



Also here the **technology transfer** to industry is done for the XFEL (LAL Orsay).

At the end, **several companies** should be qualified to build a larger number of couplers.

The XFEL foresees at least two parallel lines (companies) for coupler production.

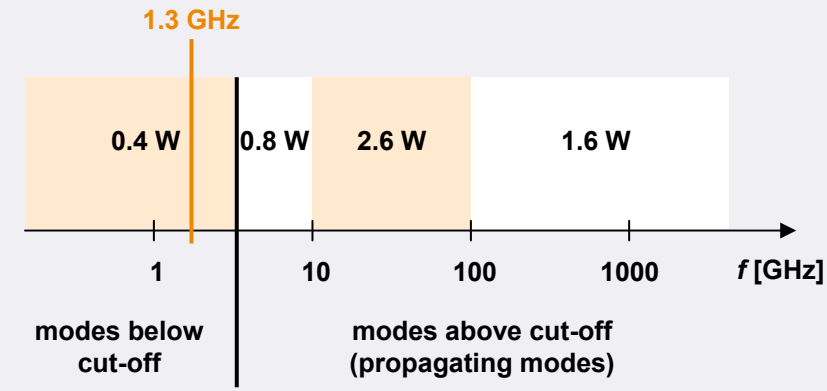
Coupler conditioning might be still done at the labs, the transfer to industry requires setting-up complete RF stations. Not a principle problem….

Damping of Higher Order Modes (HOMs)

The spectrum of the XFEL electron bunch (σ_z = 25 µm) reaches high frequencies up to 5 THz.

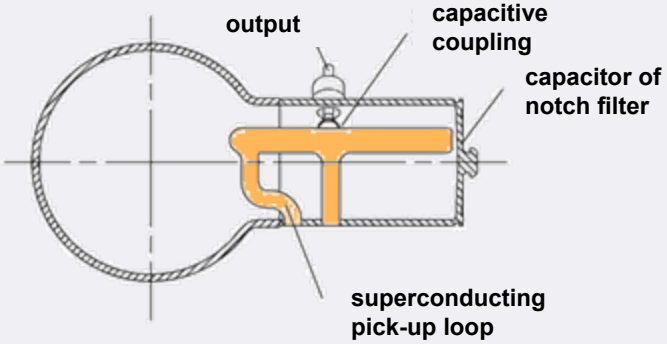
The standard accelerator module has an integrated loss factor of 135 V/pC.

The total power deposited by the nominal beam is 5.4 W per module.

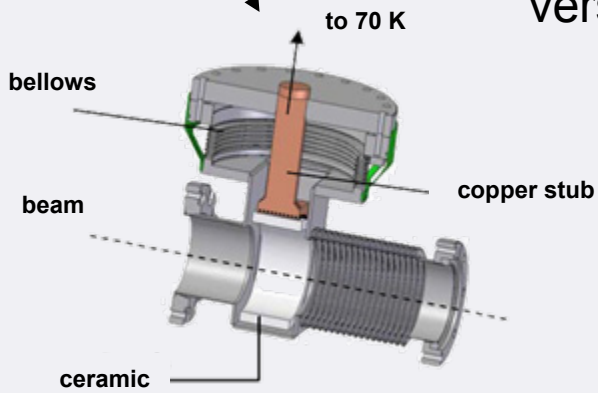


The ILC should have a little less HOM power at high frequencies.

Nevertheless, **HOM couples and absorbers are required.** The XFEL version is available.

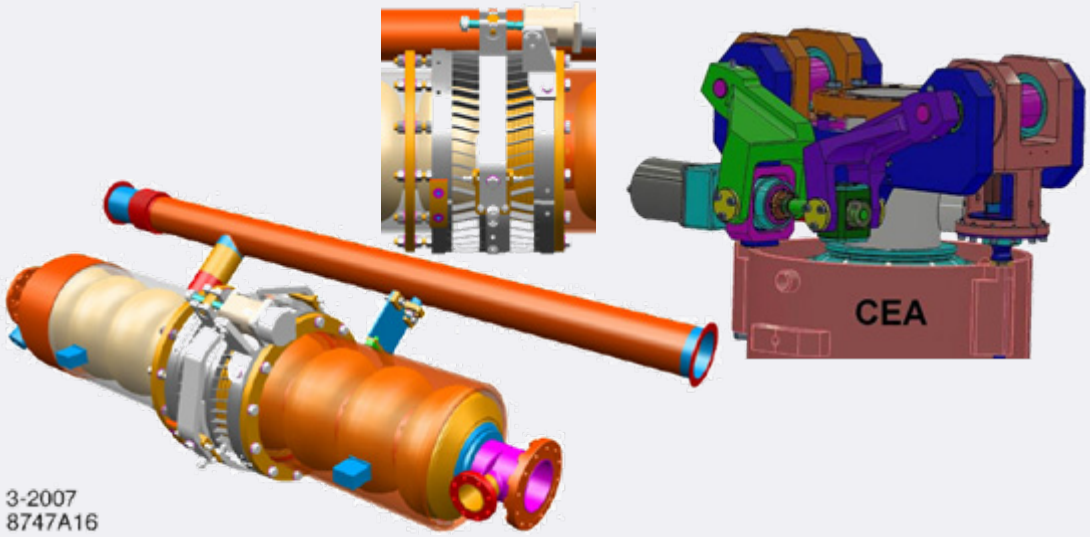


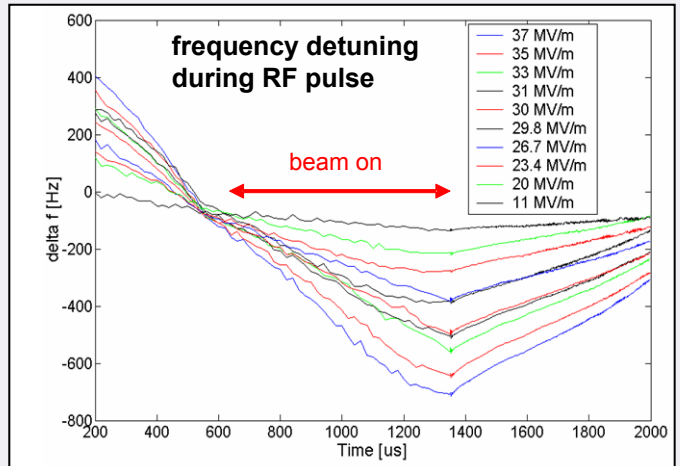
HOM coupler

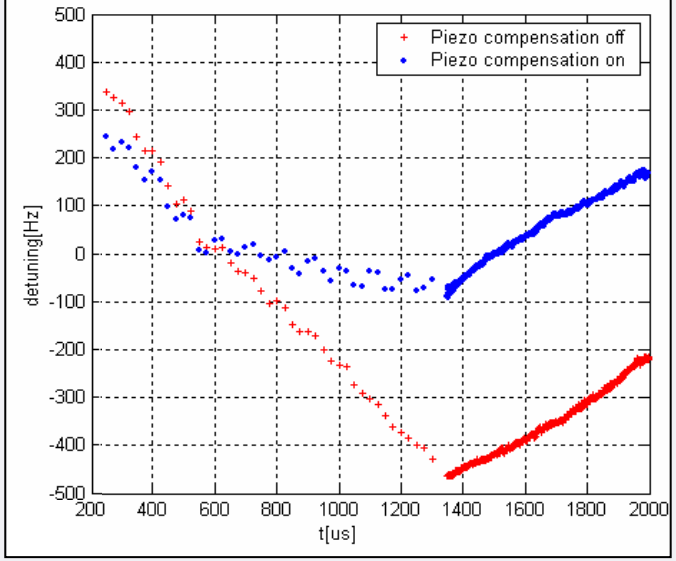


beam pipe absorber

Slow and Fast Frequency Tuner





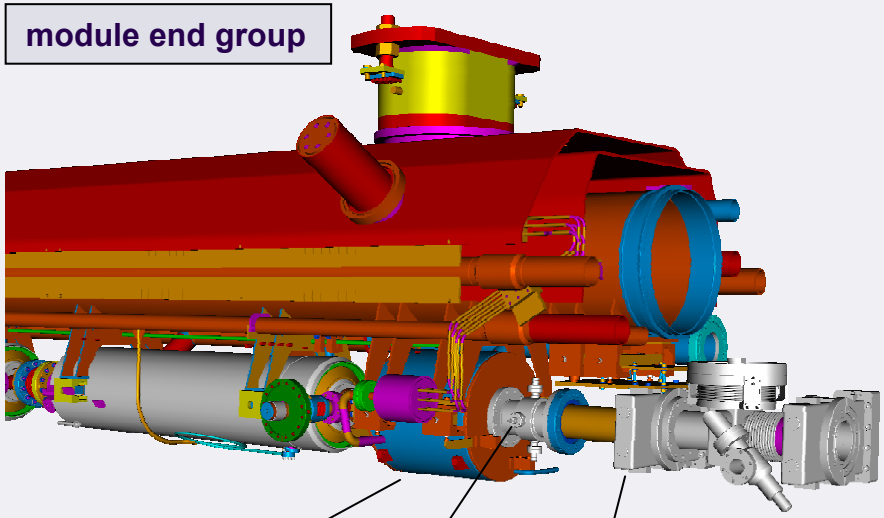


On the first glance XFEL and ILC tuner look completely different. But **critical parts** like motor, gear box, and eventually piezos (fast tuner) **can be identical**.

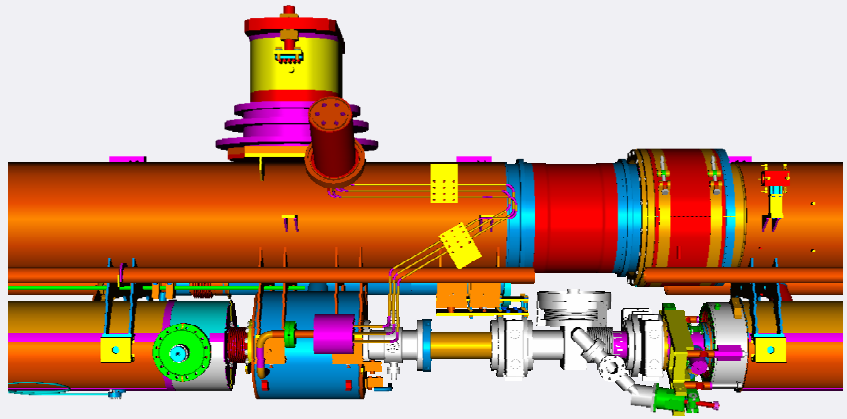
- The slow tuner compensates for drifts; 400 kHz range, 1 Hz resolution.
- The fast tuner compensates the Lorentz-Force detuning during the RF pulse.

Accelerator Module (Cryomodule)

module end group



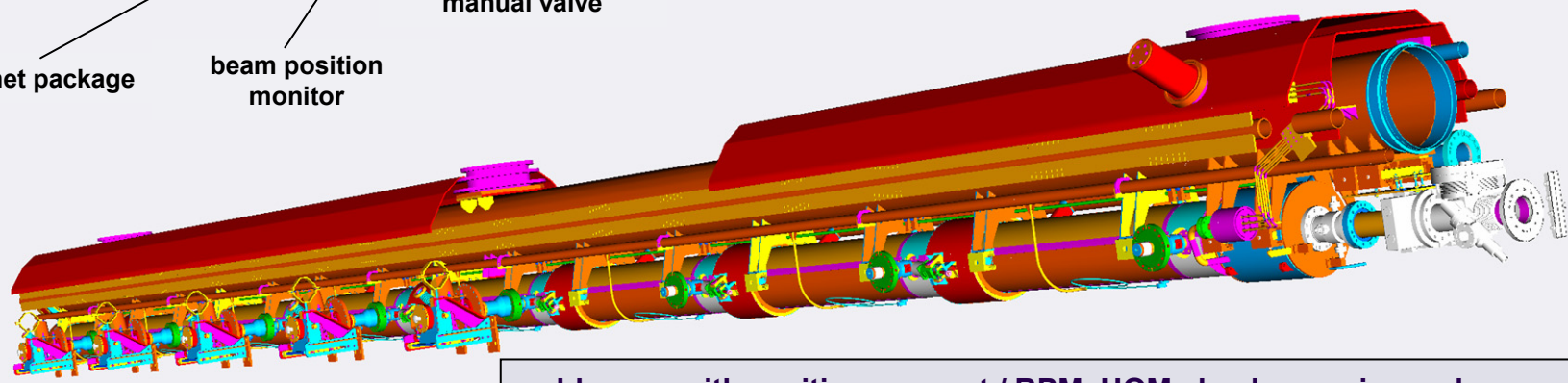
module to module connection



manual valve

magnet package

beam position monitor



cold mass with cavities, magnet / BPM, HOM abs. beam pipe, valve

Accelerator Module (Cryomodule)

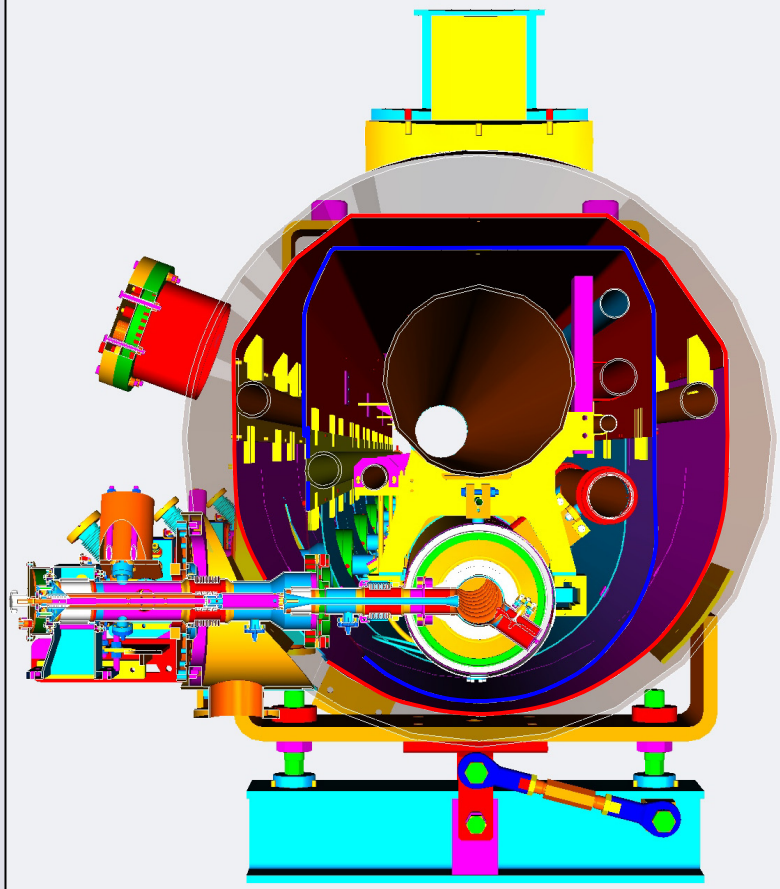
The XFEL accelerator module is based on the 3rd cryomodule generation tested at the TESLA Test Facility and designed by INFN.

Already 10 cryomodules have been built and commissioned for the TTF Linac.

Module 6 and Module 7 (repl. ACC3) were just recently installed at TTF/FLASH.

Additional cryostats will be available end of this year:

- **Module 8 (most likely ACC7)**
- **Module 9 (FNAL ass. kit)**
- **Module 3** (spare ACC1, sched. 2008)**
- **2-3 cold masses in 2008**



The **same principle design** is used for XFEL and ILC.

Minor modifications (quads, BPM, nbr. of cavities, overall length) should have almost no impact on industrialization.

Open issue: **vibration sensitivity** in the ILC case. The XFEL requirements are fulfilled.

Accelerator Module (Cryomodule)