ILC-GDE
SCRF Plug-Compatibility

- focusing on cavity package -

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for the Project Managers

To be presented at SCRF WebEx Meeting ,Oct. 1, 2008

And

Ti be discussed at GDE-EC, Oct. 2, 2008

Basic Consideration

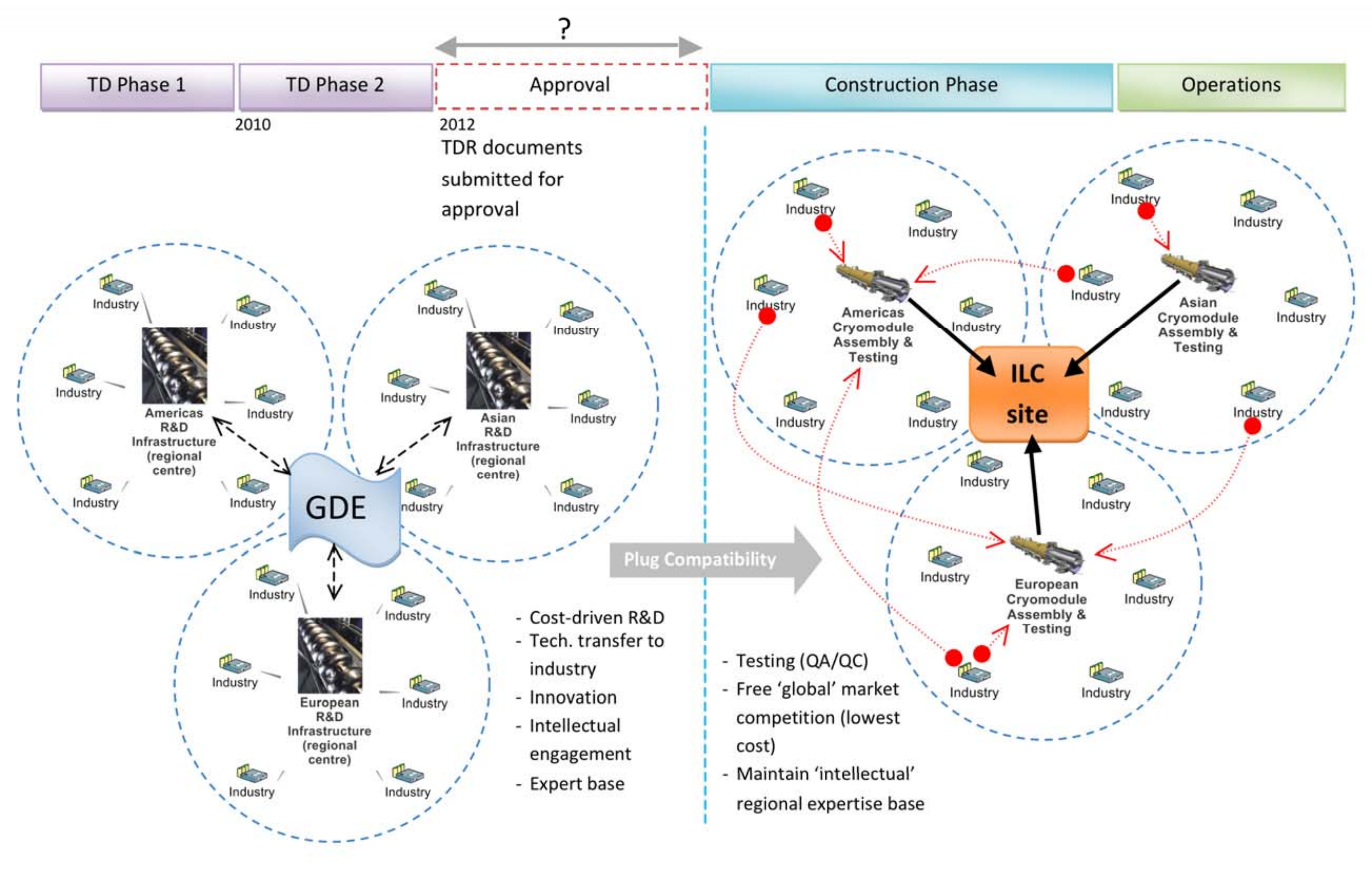
R&D Phase

- Need to continue and encourage R&D effort to improve the "gradient" performance,
- "Improvement" comes from "some change", for example,
  - **Cavity Type:** Tesla, Low-loss, Re-entrant
  - **Material:** Fine-grain or large grain
  - **Surface treatment:** EP, Rinsing,
  - **Tuner type:** Blade, Jack, etc.,
  - **Input-coupler: how to simplify the assembly**

Construction Phase

- Need to keep multiple, regional participation and industrial competition

Global Cooperation with Plug-compatible Design and R&Ds

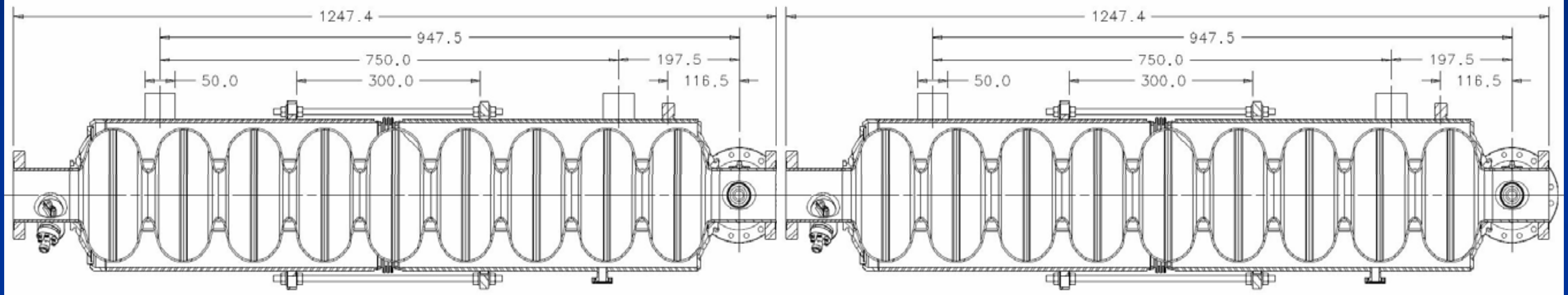


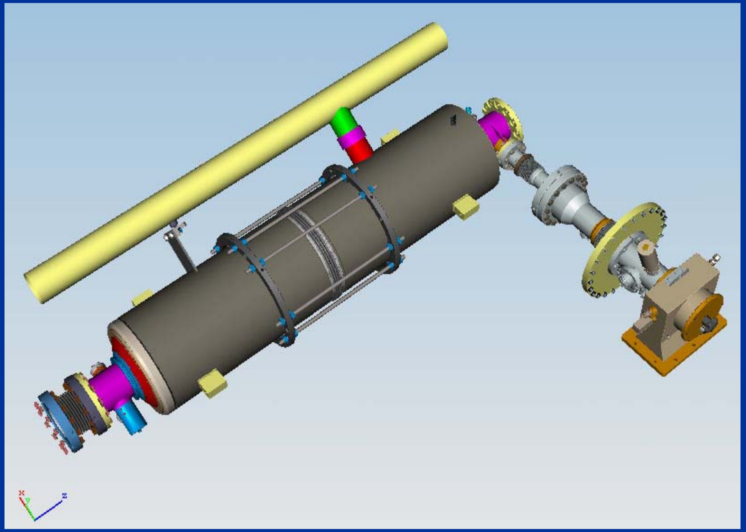
Intending the SCRF "plug-compatibility"

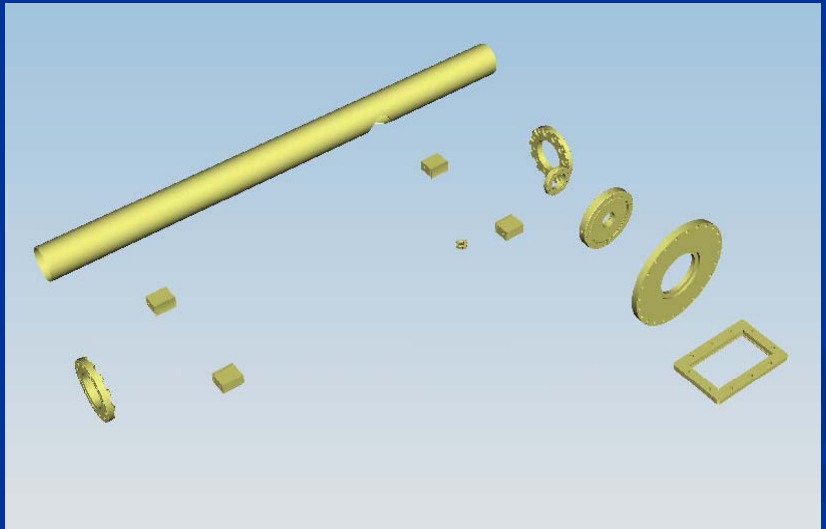
- **Cavity**
  - Status: in extended R&D stage to improve "gradient"
  - Establish: unified interface conditions,
  - Keep: "room" to improve field gradient performance,
- **Cryomodule**
  - Status: being ready for "system engineering"
  - Establish: unified interface conditions,
  - Intend: nearly identical engineering design
  - But: need to adapt to each regional industrial constraints
  - Need to study more" High Pressure Code"

Plug-compatibly of Cavities

Important for Global Cooperation

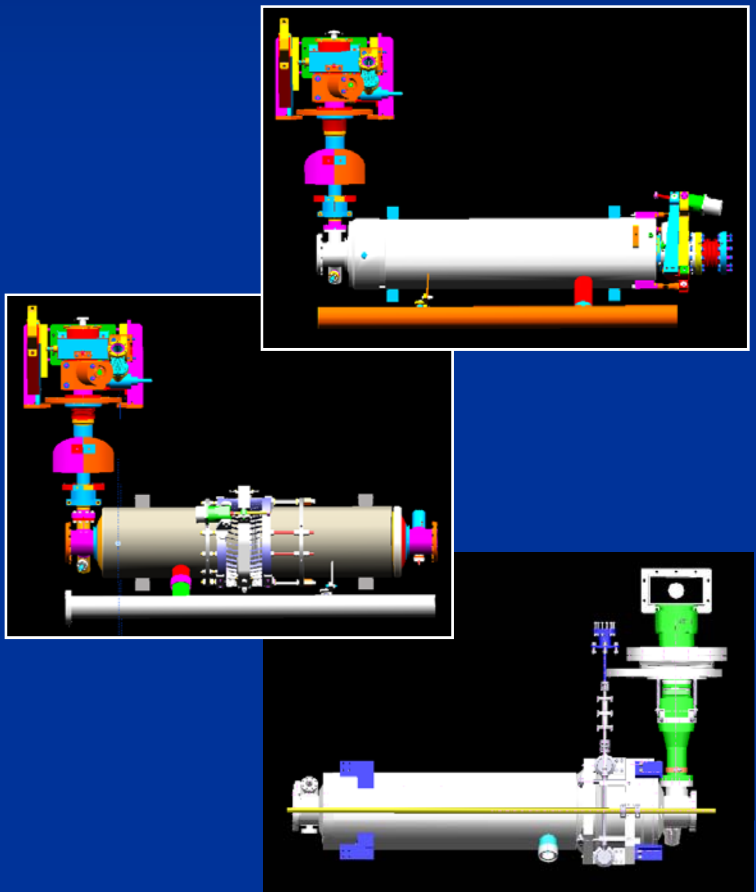






Plug-compatible interface need to be established

Plug compatible conditions at Cavity package (example)



Item	Can be flexible	Plug-compatibility
Cavity shape	yes	
Cavity Length		To be fixed
Beam-pipe Flange		To be fixed
Cavity support int.		To be fixed
Tuner	yes	
Tuner position		To be fixed
Coupler	Partly	Tunable
Coupler position		To be fixed
He vessel	yes	
H-line interface		To be fixed

Progress in "Cavity Compatibility"

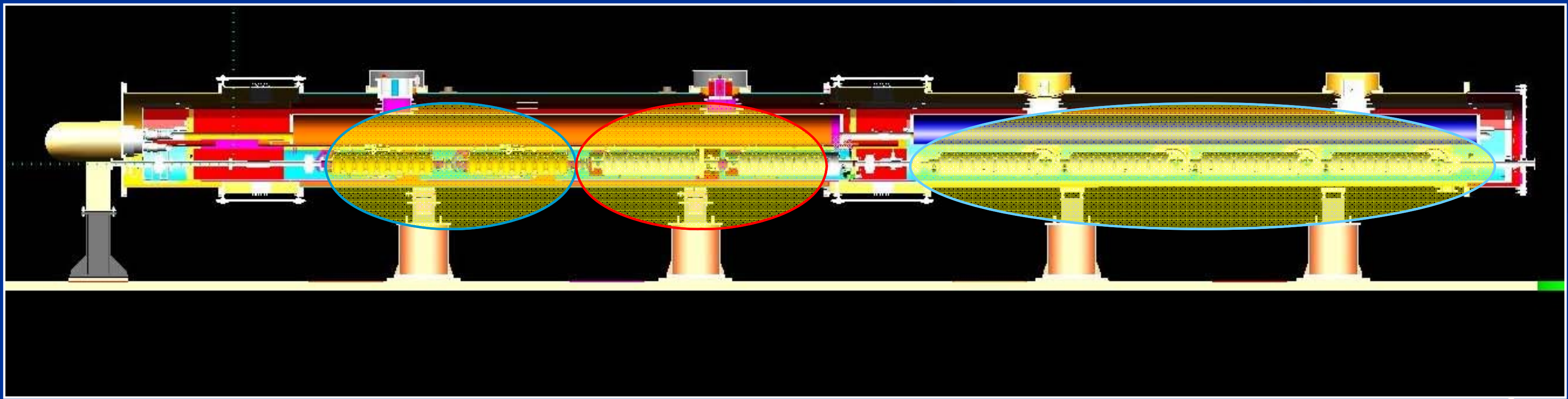
	Being Fixed	Possible changes	Under discussions
Length/pitch	1,247+bellows		
Beam-pipe flange - diameter - Gasket	 - 78 mm - Al-hex		Helicoflex to be converted with bellows joint
Input-coupler - z-location - warm-end flange	 - Upstream-end (for e-) - larger flange	- Tunable mechanism	 - Interface to cryomodule
Tuner -z-location - maintenability	 - Downstream end	 Tuner type	 - Access to motors
He-vessel - Outer diameter - Support block - He-line interface	 -Xxx mm -TBD - In: tuner-end, Out: opposit	Nb-SUS transition	 Y = 0, or shifted
Magnetic shield			Inside/outside He-v.

Boundary Conditions

- Conditions of cavity plug-compatibility
  - One cavity-package is replaceable with other cavity even in one cryomodule,
  - Cavity package design need to be optimized for easiest, best reliable assembly process during the installation into the cryomodule
    - Cavity-package is defined by the unit to be sealed-off in delivery to the site of ILC cryomodule assembly.
    - 9-cell cavity, end-strubure (coupler, HOM, etc), He-vessel, Tuner, interface to cryogenics line

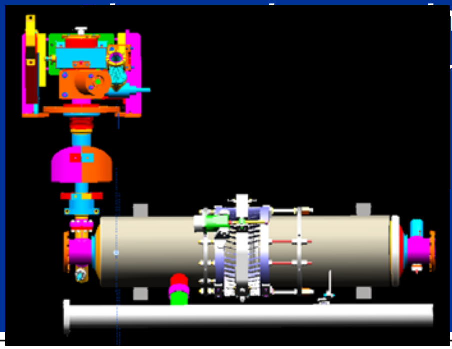
Cavity and Cryomodule Performance Test with Plug Compatibility, in Global Effort

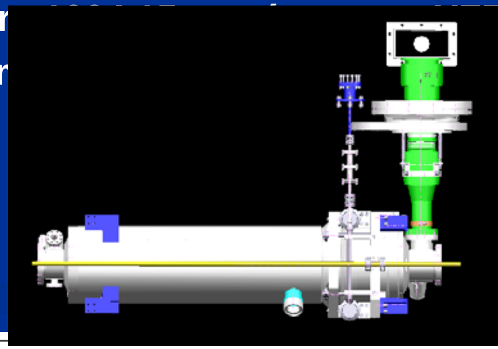
- Cavity integration and the String Test to be organized with:
  - 2 cavities from DESY and Fermilab
  - 4 cavities from KEK
  - Each half-cryomoducle from INFN and KEK

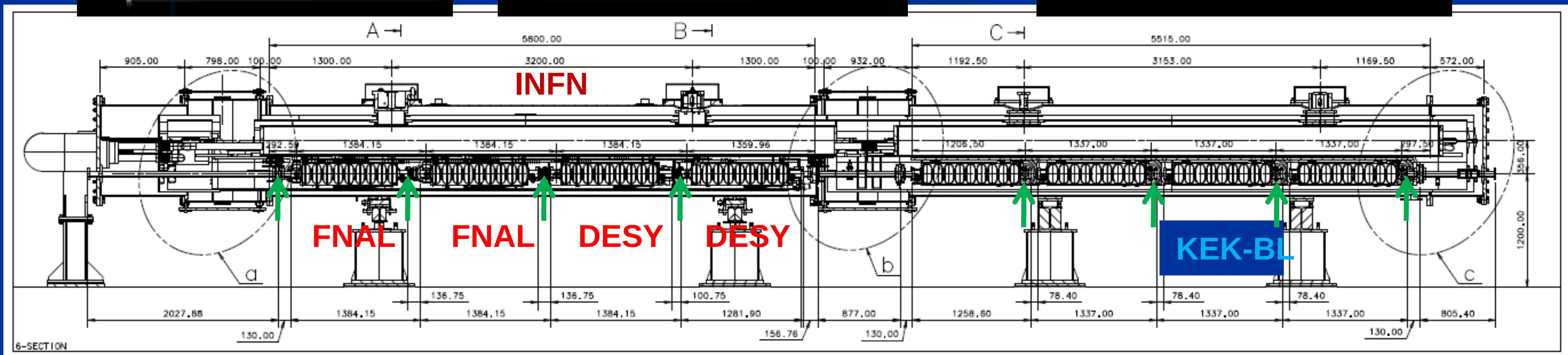


S1- Global : Cryomodule design

1. The cryomodule design has been started under the research collaboration between INFN and KEK.
    - The general module design with 3D CAD (I-Deas) has been almost completed to confirm the interfaces between Module-A, Module-C and the cryogenic system.
    - KEK and DESY & FNAL input couplers locate in the opposite side with respect to the cavity packages, however, LHe supply pipes are in the same side.
    - ... ipu ... FNAL ar ... EL).
      ... ipu ... 337.0 mr ...







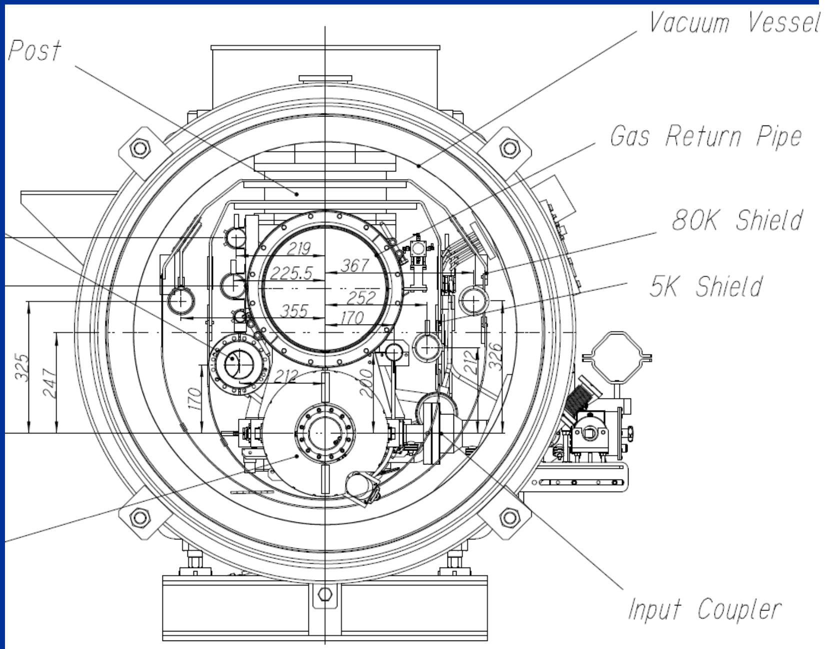
Cryogenic system **Module C** **Module A**

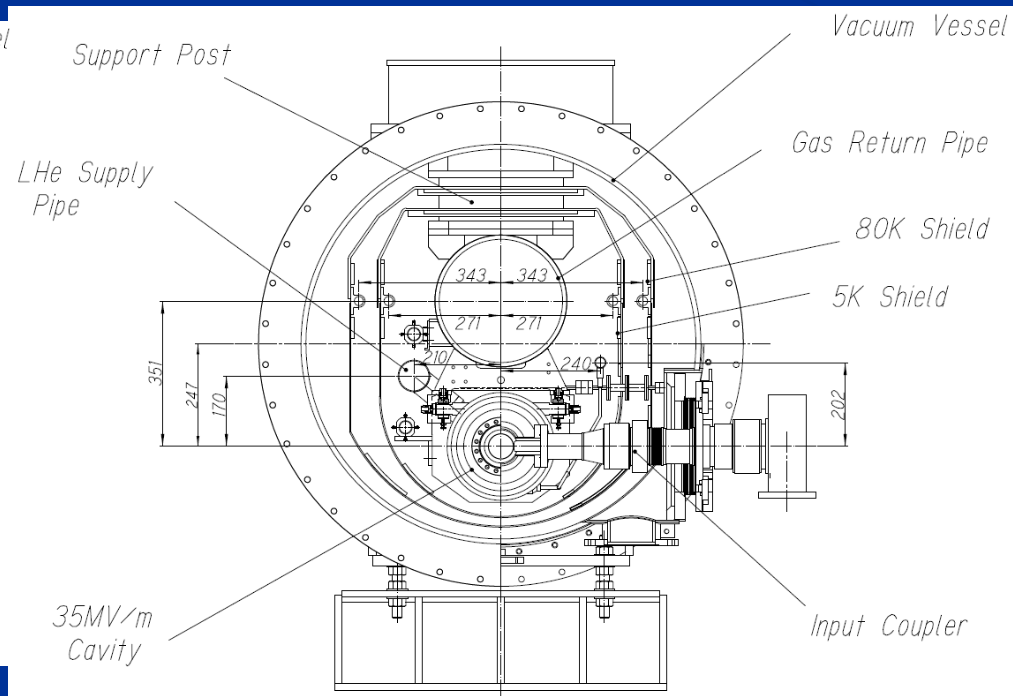
S1- Global : Cryomodule design

2. **The details of the cryostat components will be designed from October.**

- **The Module-C design is basically same as the XFEL cryomodule.**
- **The length of Module-C cryostat is designed to be 5800 mm.**
- **The interface components between KEK and INFN components are manufactured and assembled by KEK.**

3. **The design of the KEK tuner and cavity-vessel will be improved from the present configuration.**





Cross section of FNAL cavity and Module-C **Cross section of KEK-BL cavity and Module**

Summary

- **We need**
  - **Flexibility in extended R&D for the cavity performance improvement.**
  - **The plug-compatible conditions are inevitably required various efforts to be productive to be combined.**
  -
- **We aim for**
  - Global cooperation for the ILC SCRF technology with having plug-compatibility, and with scoping smooth extension to the ILC construction/production phase.

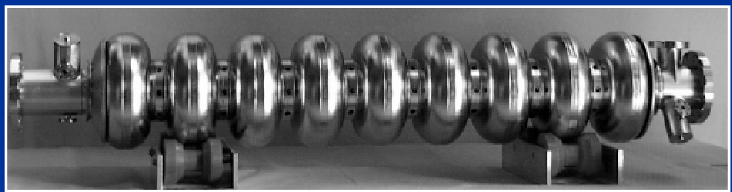
Further discussions and Process

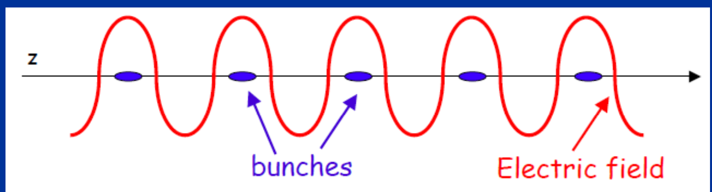
Date	Meetings	Notes
2008		
10/1	SCRF webex	Discussions within SCRF technical area
10/2	EC	Discussions with EC, and briefly AAP
10/5 or 12	PM-AAP	Discussions with AAP
10/19	PAC	Review by PAC
11/17-20	LCWS-08 in Chicago	Plug-compatibility consensus to be established
2009		
4/17-21	GDE meeting in Tsukuba	Review by AAP

Backup

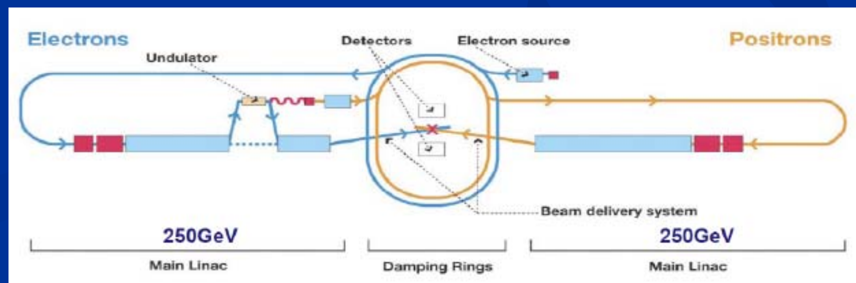
Reference Design Report, published, 2007

- **SC linacs: 2x11 km**
  - **for 2x250 GeV**
- **Injector centralized**
  - Circular damping rings
- **IR with 14 mrad crossing angle**





Parameter	**Value**
C.M. Energy	500 GeV
Peak luminosity	2×10^{34} $cm^{-2}s^{-1}$
Beam Rep. rate	5 Hz
Pulse time duration	1 ms
Average beam current	9 mA (in pulse)
Average field gradient	**31.5 MV/m**
# 9-cell cavity	14,560
# cryomodule	1,680
# RF units	560



Critical R&Ds in TDP

- **SCRF**
  - High Gradient : 35 MV/m at the yield 90 % (S0)
  - Plug-compatibility
  - System Engineering (S1, S2)
- **Conventional Facilities & Siting**
  - Tunnel: Deep/Shallow, Double/Single Tunnel
- **Accelerator Systems**
  - Positron sources,
  - Low emittance: **ATF, CESR-TA**

Main Linac Specific

- **Removal of support tunnel (single tunnel)**
  - klystron cluster
  - XFEL-like
  - Dubna option (surface klystron gallery)?

alternativ
e options

- **Klystron Cluster (HLRF)**
  - 30 klystrons located in localised surface buildings
  - ~300 MW RF power distributed in beam tunnel via over-moded waveguide
  - effectively ~1km RF unit
- **Marx modulator**
- **Reduced cost solution for process-water cooling**
  - Higher ΔT specification

STF1 : Thermal study by Module B

Measurement of heat loads with and without 5K shields by STF Module-B

(scheduled at 2009)

For the study of ILC-cryomodule design;

- **The 5 K thermal shield is considered to be removed from the cost reduction of the cryomodule.**
- **The heat load at 2K will be measured with and without 5K shields.**

ILC Cryomodule Thermal Model

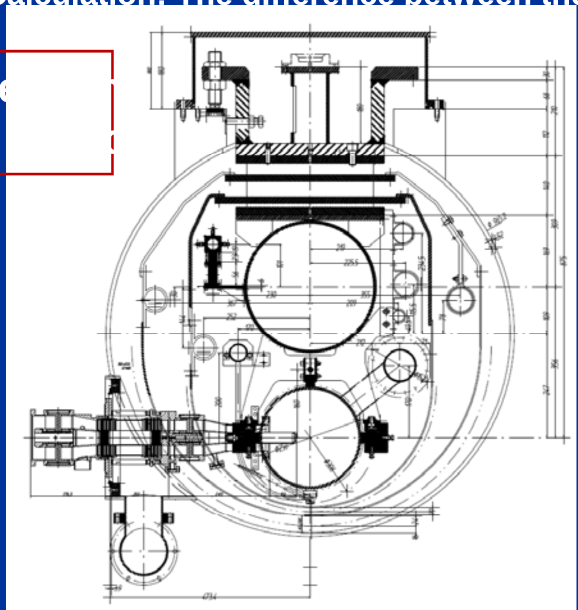
5K line : cooling the input couplers, support posts and current leads

40K line : cooling the thermal radiation shield, support posts and current leads (44K)

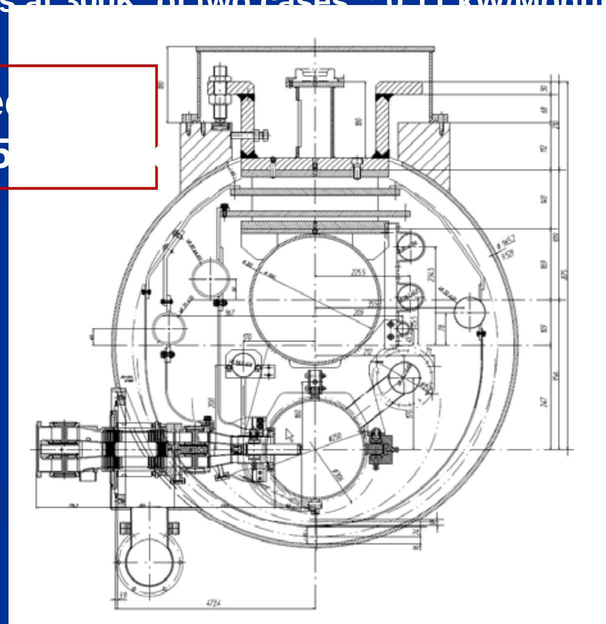
cooling HOM couplers, HOM absorber and input couplers (66K)

Calculation: The difference between the required powers at 300K of two cases : 0.11 kW/Module

Cross se
with 5K



Cross se
without 5



Cooperation with EuroXFEL and Other Projects

European X-ray Free Electron Laser Facility

- EuroXFEL SRF design gradient : 25 MV/m
- ~ 100 SCRF cryomodule, based on the experience at TTF, DESY,
- Leading SCRF industrialization (scale: 1/20 of ILC, in coming 5 years)
- Keep close cooperation with XFEL, on-going project.

Further SCRF Accelerator Project Plans investigated:

- Project X at Fermilab, SC Proton Linac at CERN, and ERL at KEK

Global Plan for SCRF R&D

Calender Year	2007	2008	2009	2010	2011	2012
Technical Design Phase	TDP-1				TDP-2	
Cavity Gradient R&D to reach 35 MV/m		Process Yield > 50%			Production Yield >90%	
Cavity-string test: with 1 cryomodule			**Global collab. For <31.5 MV/m>**			
System Test with beam 1 RF-unit (3-modulce)		FLASH (DESY)			STF2 (KEK) NML (FNAL)	