ILC status and plans

Marc Ross, (Fermilab)
Nick Walker, (DESY)
and Akira Yamamoto (KEK)

Representing the ILC Global Design Effort

Highlights in Summary

- **Progress on all R&D fronts (~100 M$/Year globally**
  - Regional SCRF infrastructure now coming up to speed
  - Successful completion of CesrTA (phase 1)
- **Realistic site developments (siting)**
  - Further detailed development of mountainous site (Japan)
- **AD&I: TLCC process underway**
  - development of cost-constrained baseline for the TDR cost estimate
  - 1st BAW complete, proposals sent to Director
  - 2nd BAW being planned
- **TDP-2 focus now on consolidating cost estimate**
  - Global Mass-production of ~1200 cryomodules

Last slide from 18.10, Monday, opening GDE plenary

On-Track for TDR in late 2012 ☺

RDR to TDR: 2007 to 2010 - 12

- **Key Design Leadership by SLAC ILC team**
  - *Acknowledged*
- **Costed, Reviewed, and Published**
  - *325 Institutions*
- **Present emphasis: R & D**
  - Objective:
    - to develop a Strong International basis
    - *founded on Decentralized Leadership*
  - Industrialization

TDR = RDR + R & D

Subsystem R & D

- ***Sources***: **e- gun & e+ target system**
- ***Main Linac technology***
  - Siting flexibility
  - High Level RF
- **Interface between accelerator and detector - *MDI***

****

- **SCRF and beam test facilities covered**
  - Main Linac - FLASH, Damping Ring – CesrTA/ATF, Beam Delivery – ATF2

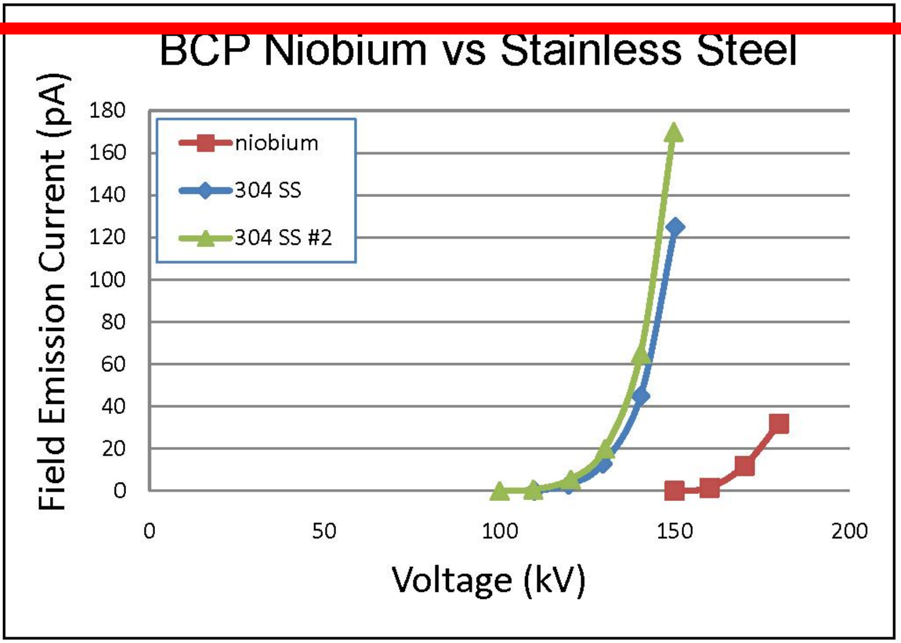
IWLC 2010 Parallel Sessions (***Sources***)

- **e-:**
  - demonstration of 3 MHz laser (SLAC)
  - and 200 KV gun (JLab)
  - (Wednesday 1600)
- **e+:**
  - Superconducting Undulator (DL/RAL)
  - Rotating Target and Flux Concentrator (LLNL)
  - Modeling (ANL)
  - Beam Tests (KEK)
  - (Wednesday 0830/Thursday 1600)

Spin-off from SCRF technology: *Polarized e- Gun HV* electrodes using polished Niobium!

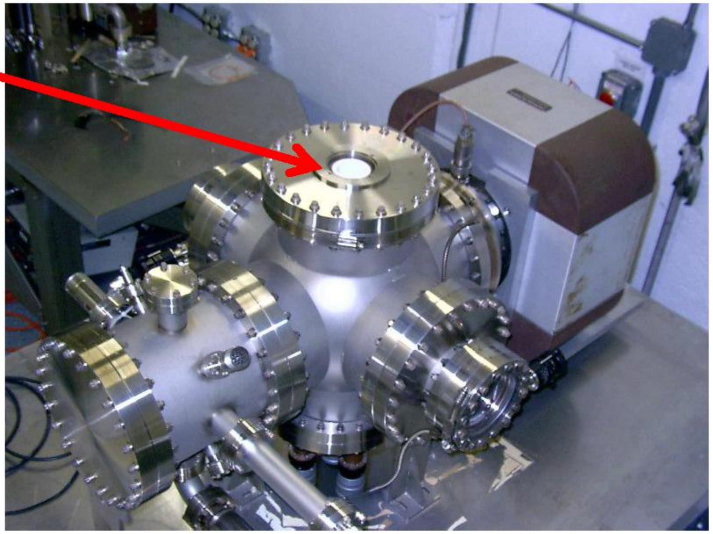
Single Crystal Niobium:

- Capable of operation at higher voltage and gradient
- Buffer chemical polish (BCP) much easier than diamond-paste-polish



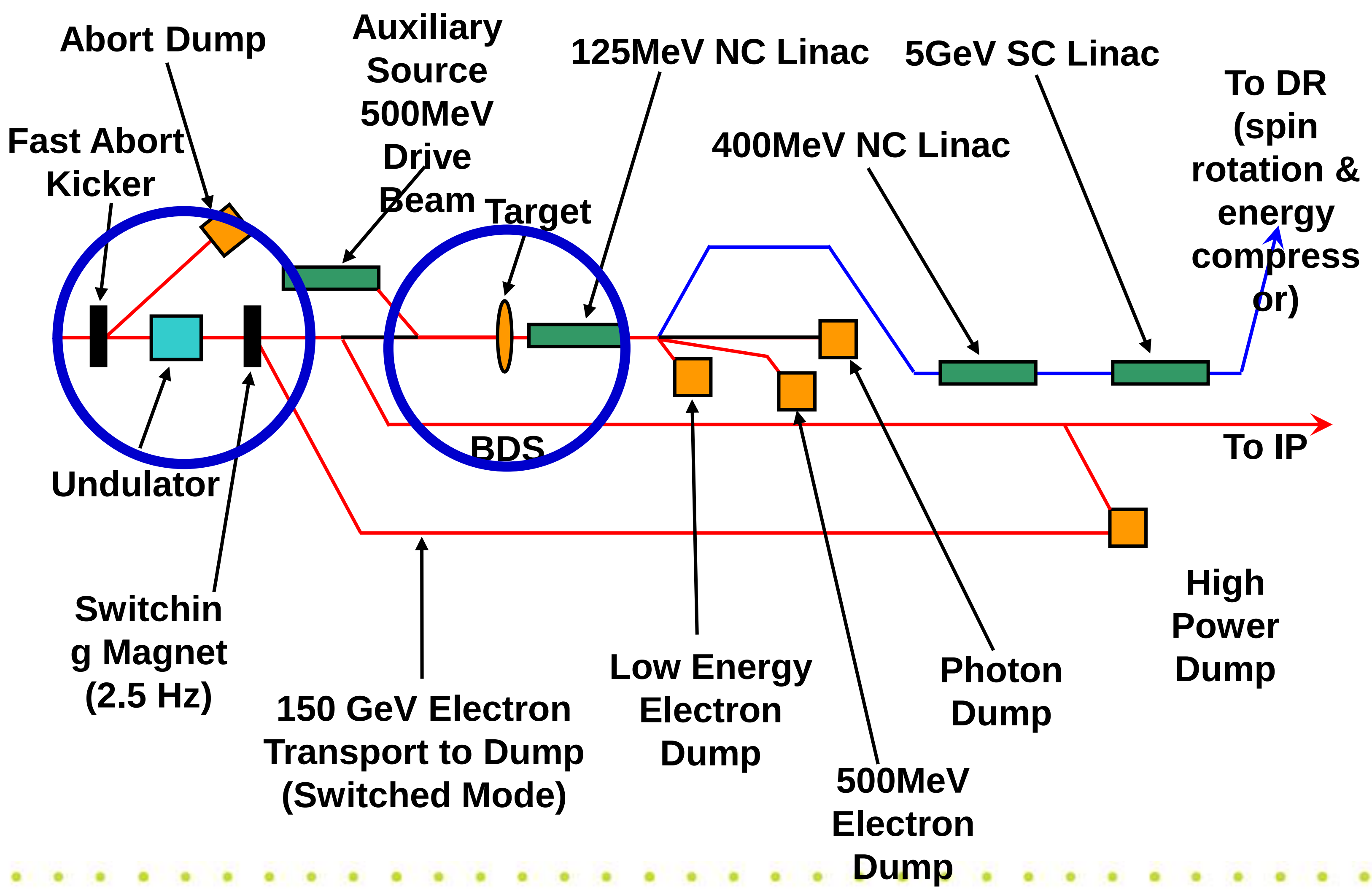
Conventional geometry: cathode electrode mounted on metal support structure

Replace conventional ceramic insulator with "Inverted" insulator: no SF6 and no HV breakdown outside chamber

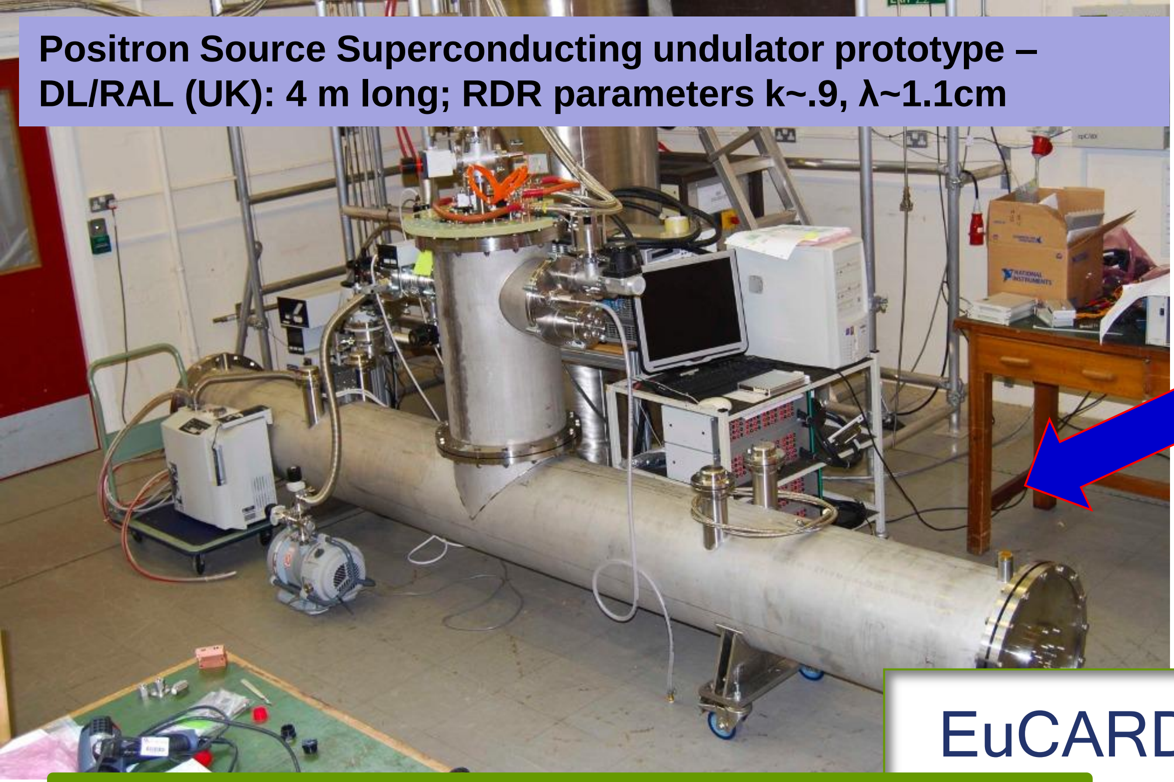


Work of Ken Surles-Law, Jefferson Lab

Undulator Positron *Source*

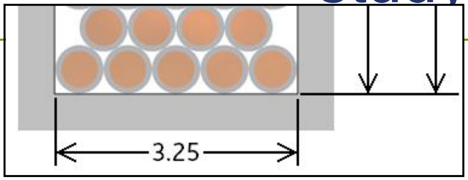


Positron Source Superconducting undulator prototype – DL/RAL (UK): 4 m long; RDR parameters k~.9, λ~1.1cm



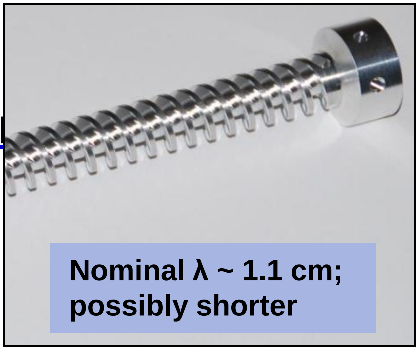
RDR baseline *superconducting undulator (SCU):* Two built in UK and fully tested Horizontal/Vertical

EuCARD – Nb_3Sn helical SCU study

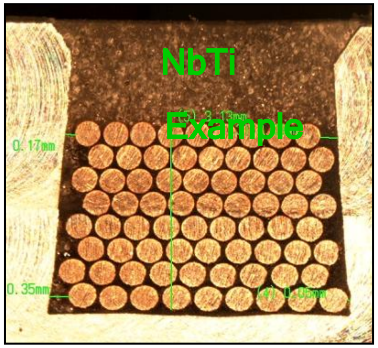


UK to build two test high-field Nb3Sn helical SCU

- Field strength at 1 kA (assuming this is possible):
  - Winding ID: Ø6.35 mm.
  - Field on axis: 1.54 T (80% higher than Nb
  - Peak field in conductor: 4.42 T.
  - Operating at 82% of potential I_c.

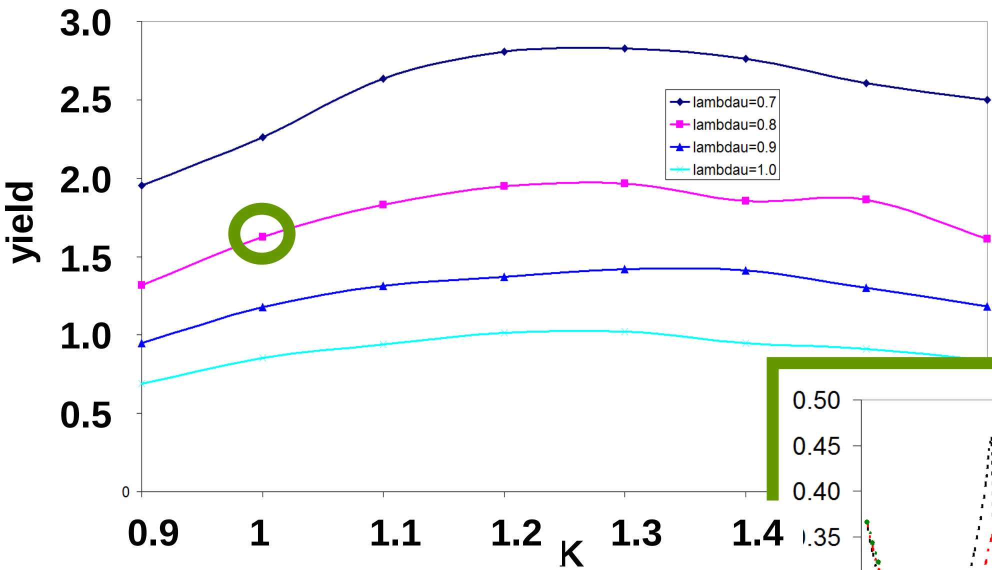


Nominal λ ~ 1.1 cm; possibly shorter



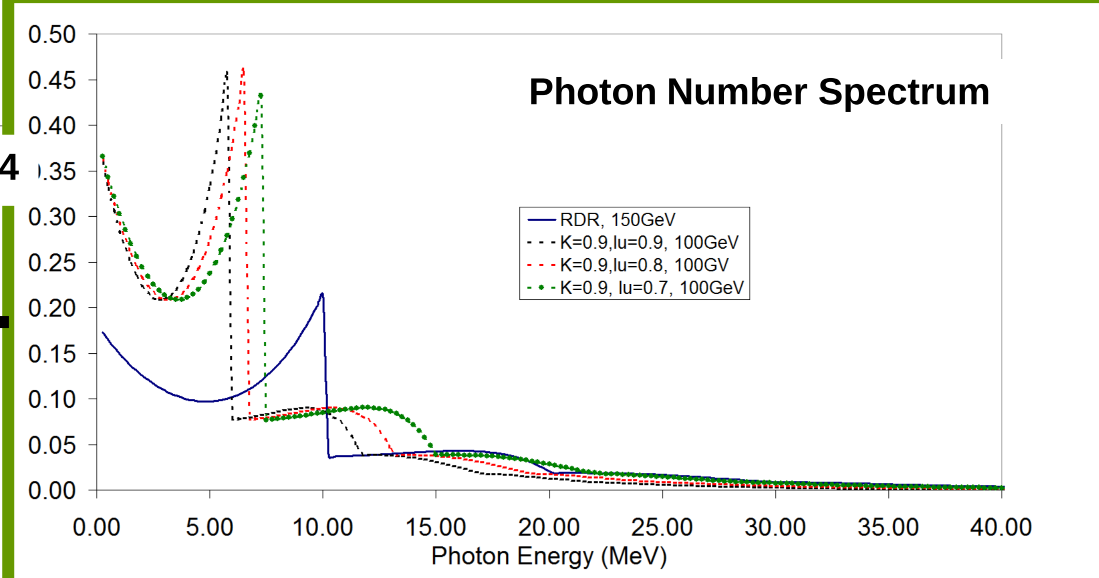
Optimum **SCU** e+ production for 200 GeV / E_cm

- **Nb3Sn helical SCU:**
  - k ~ 1; λ ~ 0.8 cm



Nominal yield at 100 GeV/beam

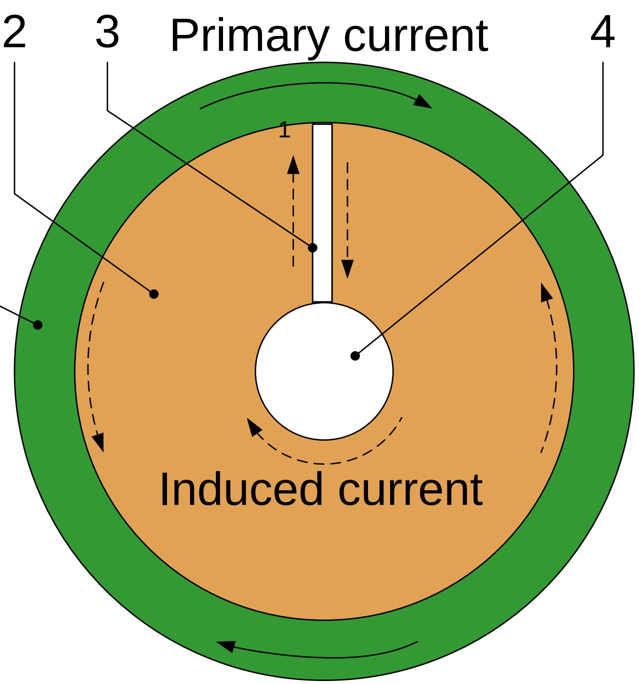
- **Using the new undulator parameters and FC, we could have a yield ~ 1 for 231 meter long undulator with 100 GeV drive beam.**
- **This maybe a better direction to go than 10 Hz operation.**



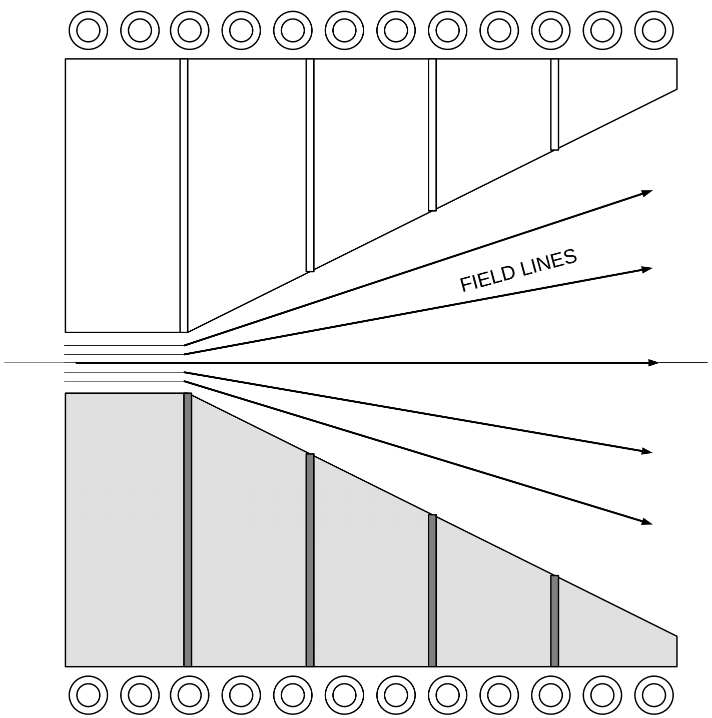
Very encouraged by interest in SCU at light sources – Diamond and APS

Flux Concentrator – proximity lens close to target

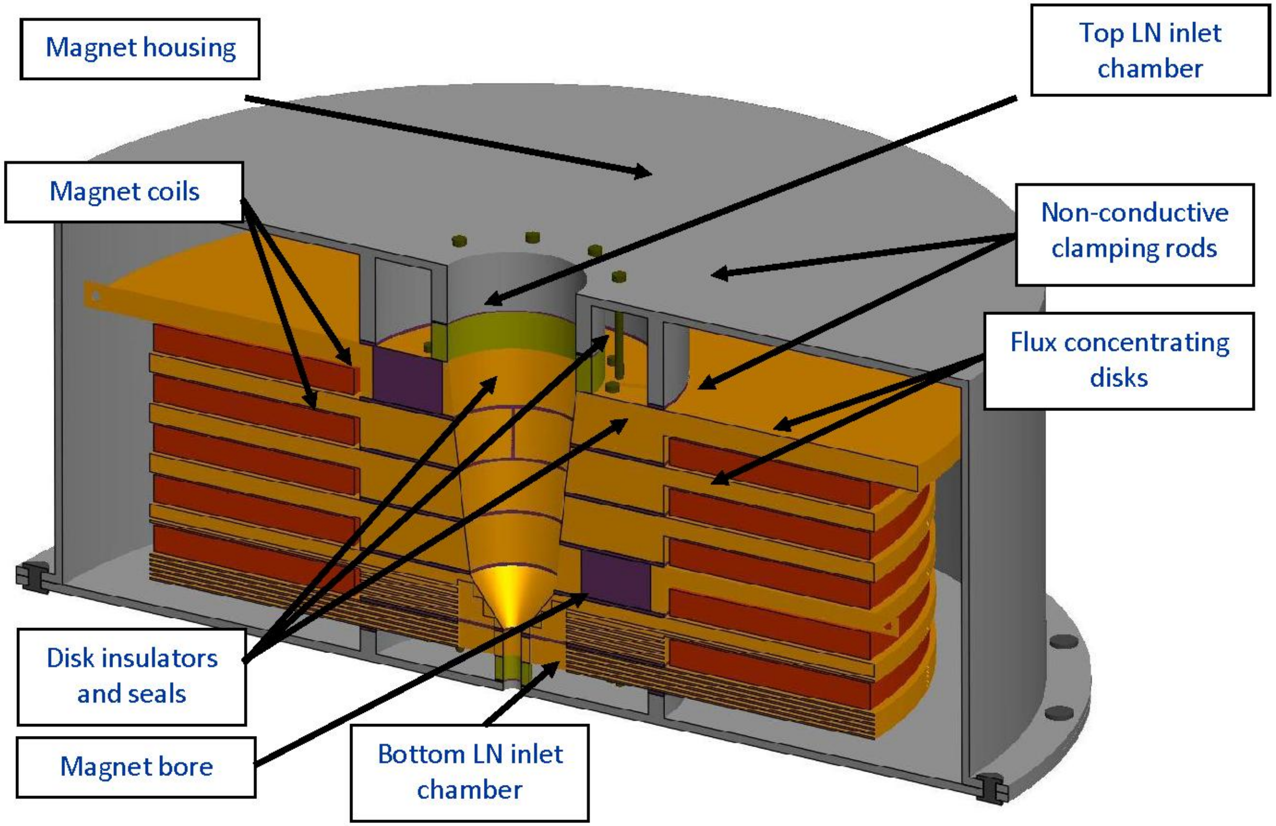
- ❑ Normal conducting magnet, resistive to radiation,
- ❑ Work at pulse mode to reduce input power,
- ❑ Magnetic flux is shifted into small central region to enhance the field.
- ❑ Release mechanic stress on coil.



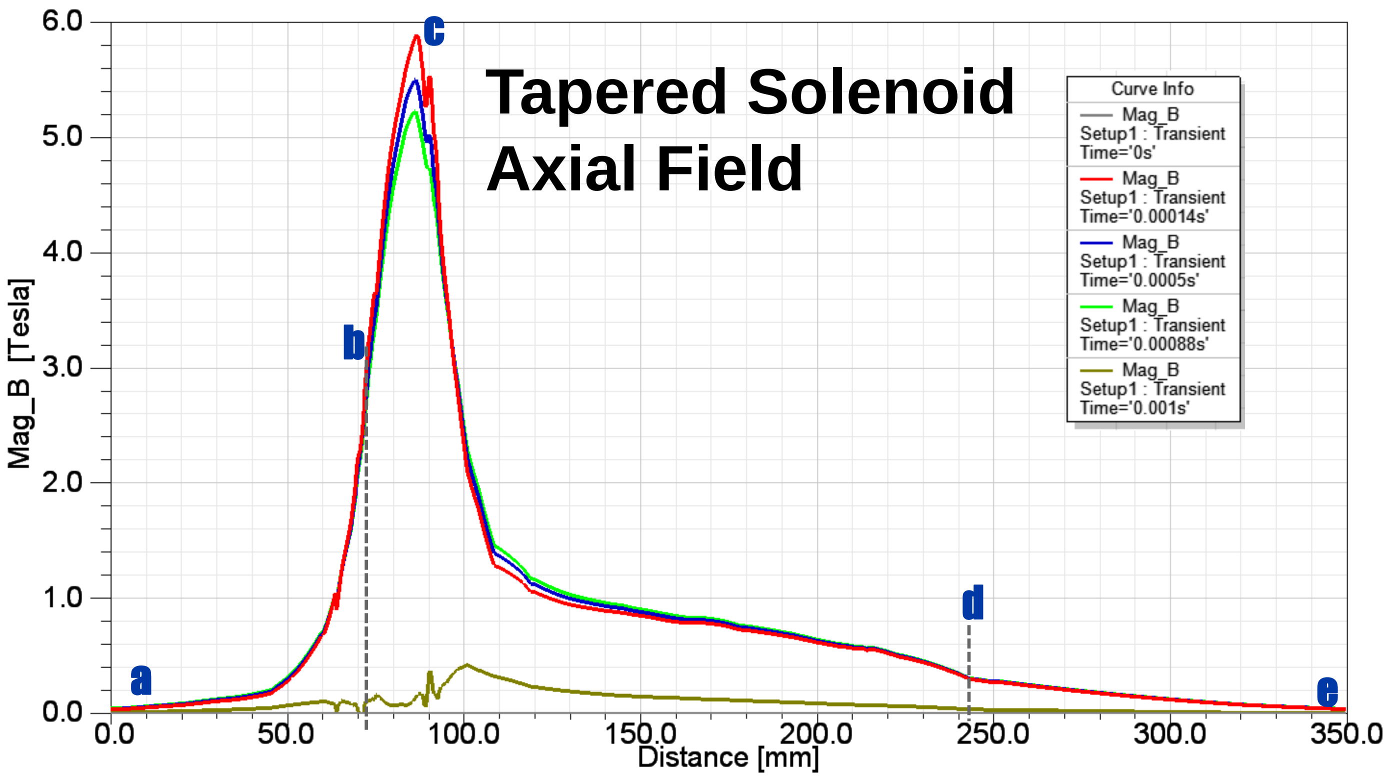
1: Primary coil,
2: Core,
3: Radial slot,
4: Bore.

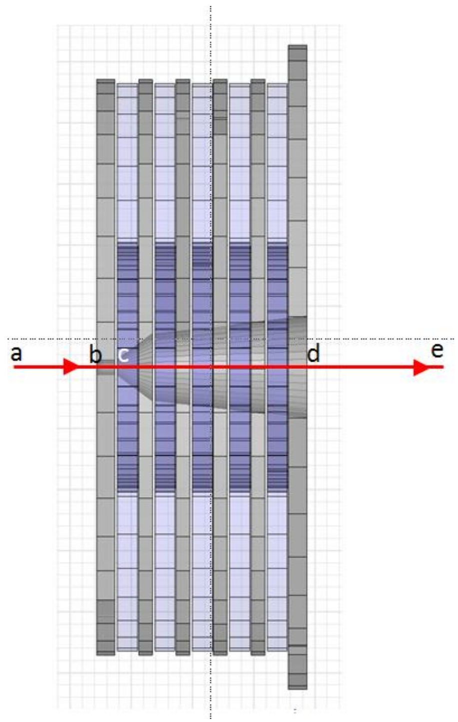


Livermore Lab Test Flux Concentrator



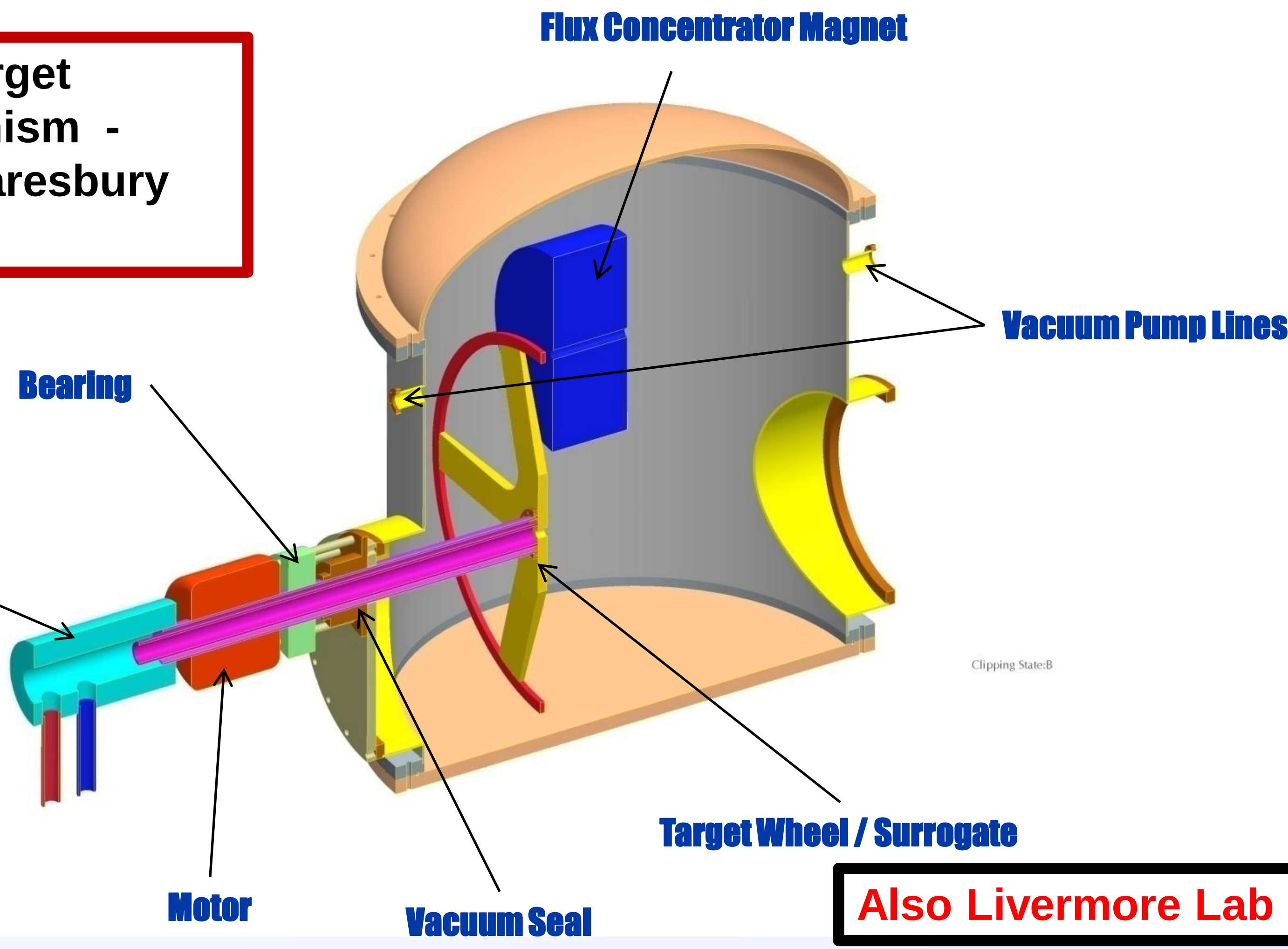
Flux Concentrator Computed |B| along centerline





Rotating Positron Target Vacuum seal test - layout

Test Target Mechanism - from Daresbury Lab (?)

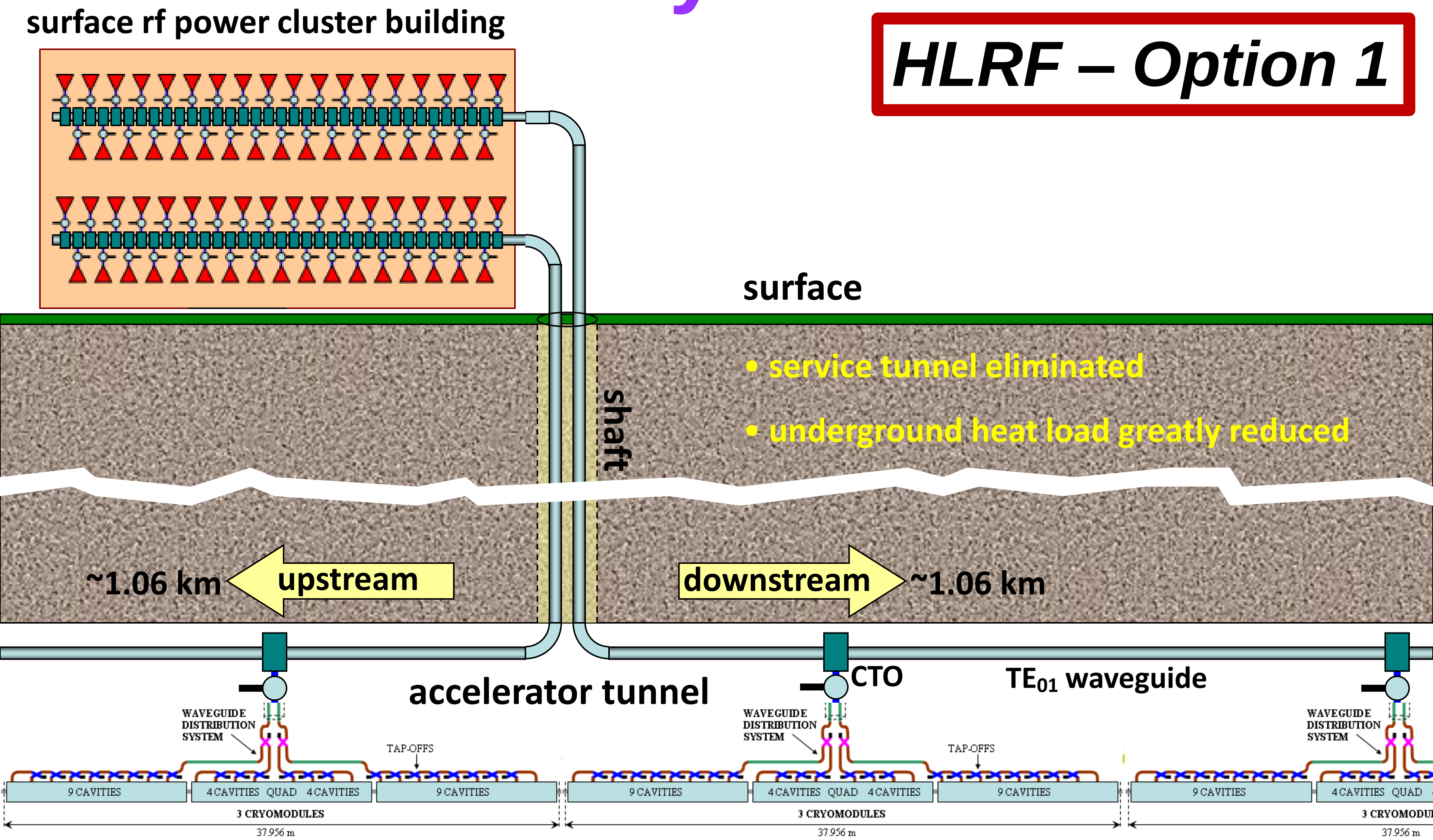


Also Livermore Lab

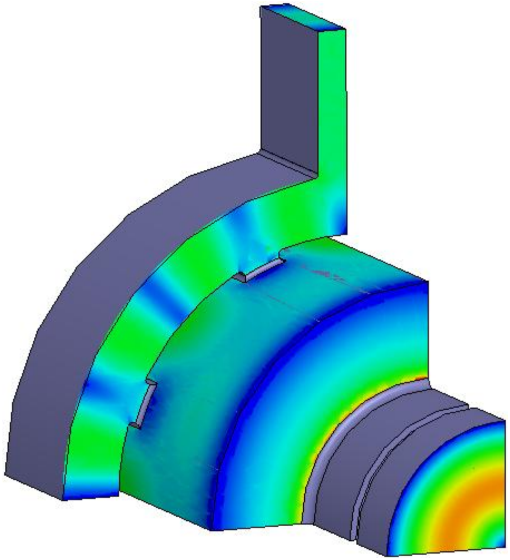
IWLC 2010 Parallel Sessions (*Main Linac Technology*)

- **Adapting the Reference Design to potential sites**
  - Mountain – region site
  - Flat land site
    - deep
    - shallow
- **Tunnel Configuration**
- **High Level RF distribution schemes**
  - Klystron Cluster System (KCS) – single tunnel with surface construction
  - Distributed RF System – single tunnel without surface construction
- **(WG 3 Wednesday 1630)**

Klystron Cluster System Layout



Coaxial Tap-Offs (CTO's)



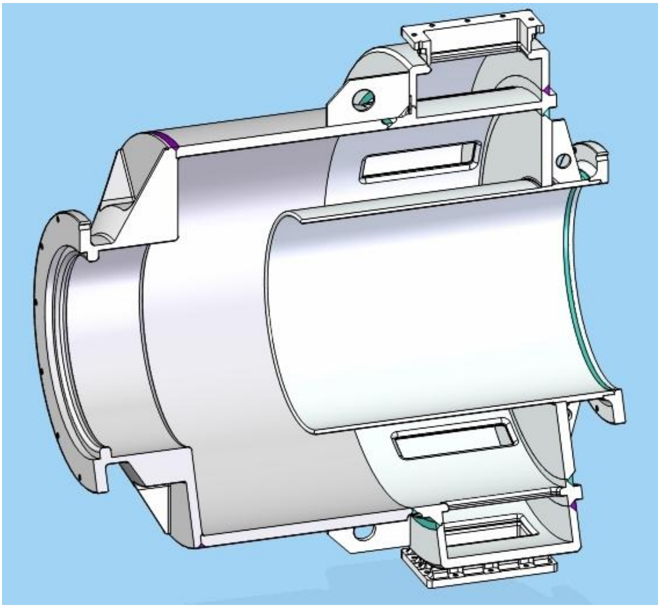
3-port device which couples power from its central circular TE_{01} waveguide through a gap into a coaxial region.

power is coupled out into a wrap-around waveguide and split between two radial WR650 ports.

Variation of the gap allows different coupling values.

In reverse, the CTO can be used for combining, given the correct power ratios and phases.

Tested to 300 MW in TE01 circular waveguide

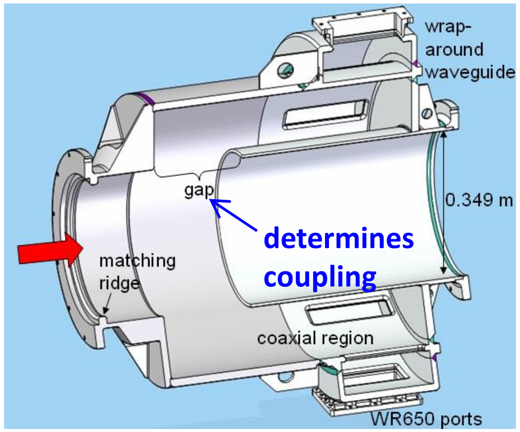


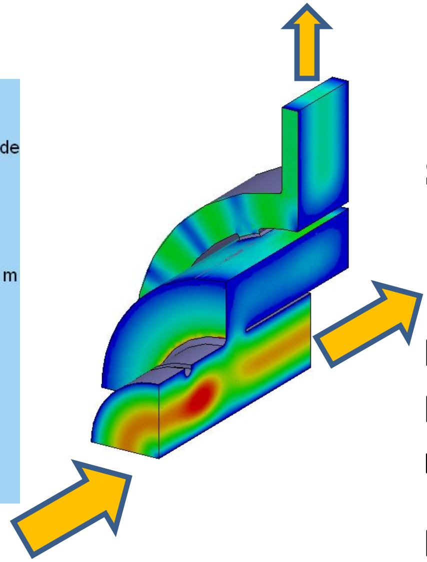
We have two welded aluminum 3-dB CTO's .

Combining and Distributing Power

Couplings ranging from ~1 to 1/28 to the TE_{01} (low loss, no surface E-field)mode are required.

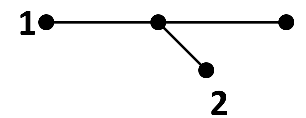
CTO (Coaxial Tap-Off)





"3-port" coupler

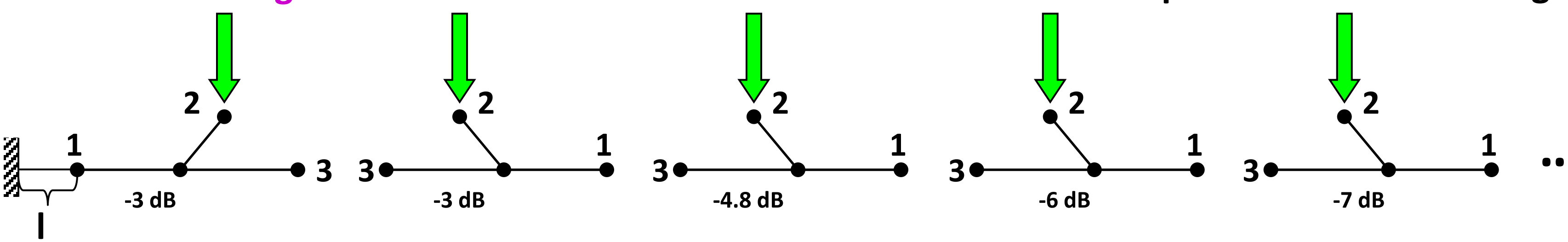
$$S = \begin{pmatrix} 0 & \sqrt{C} & \sqrt{1-C} \\ \sqrt{C} & (1-C) & -\sqrt{C(1-C)} \\ \sqrt{1-C} & -\sqrt{C(1-C)} & C \end{pmatrix}$$



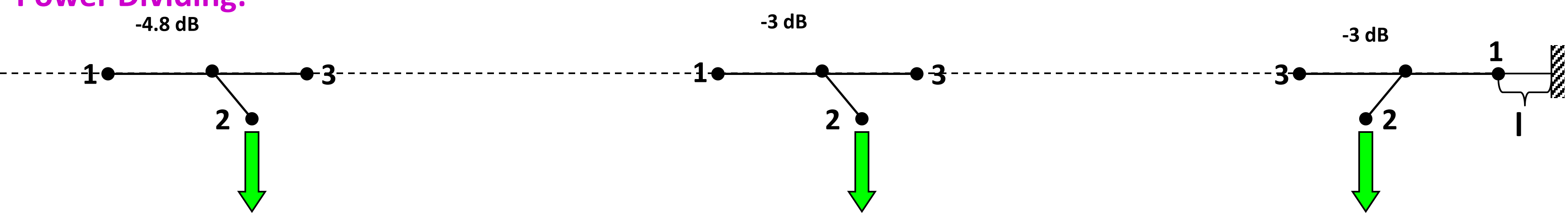
For combining, the tap-offs are installed backwards. Proper phase and relative amplitude needed for match (mismatched power goes to circulators).

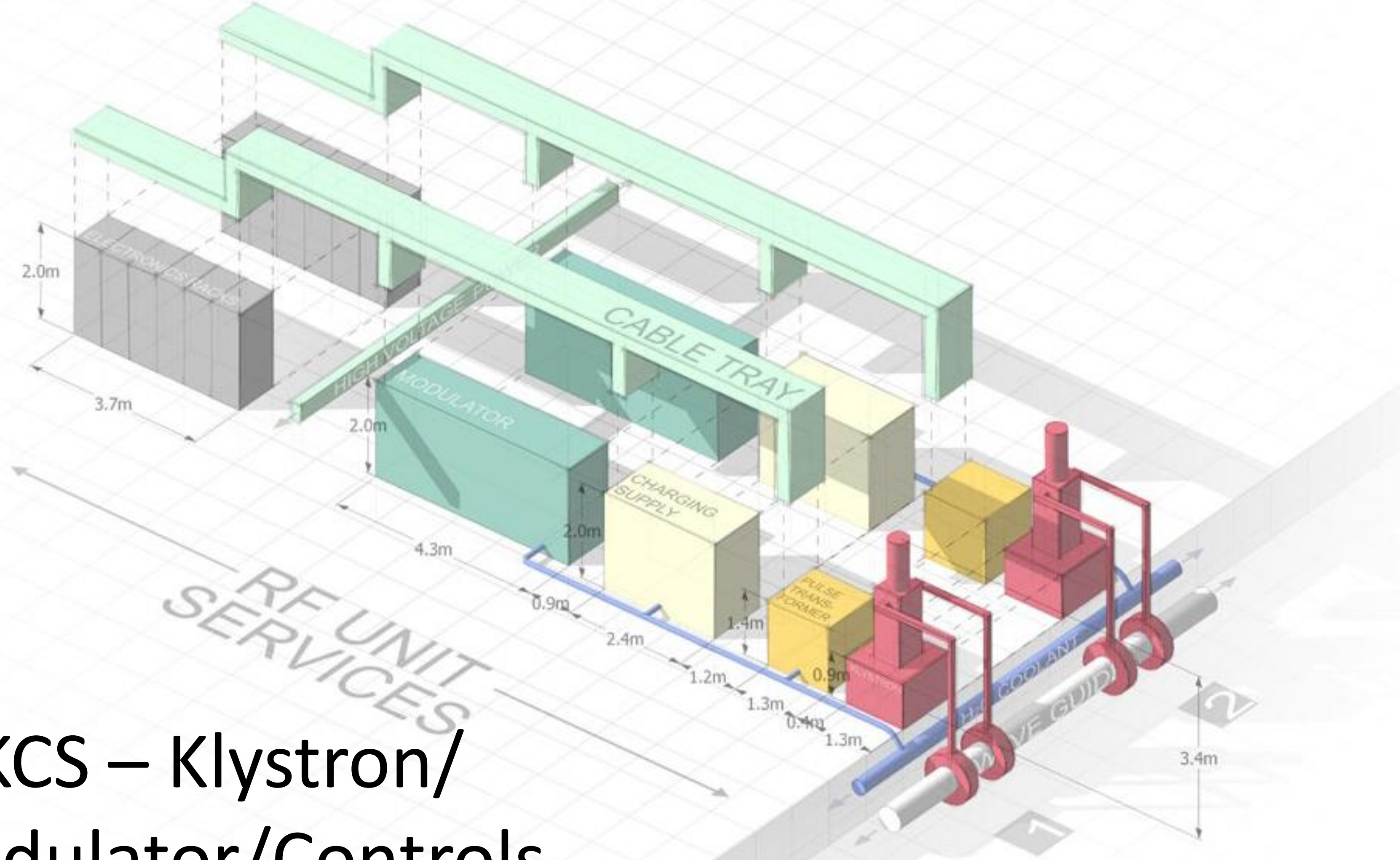
First and last CTO's are 3 dB units reversed relative to the others with port 1 shorted at the right phase.

Power Combining:



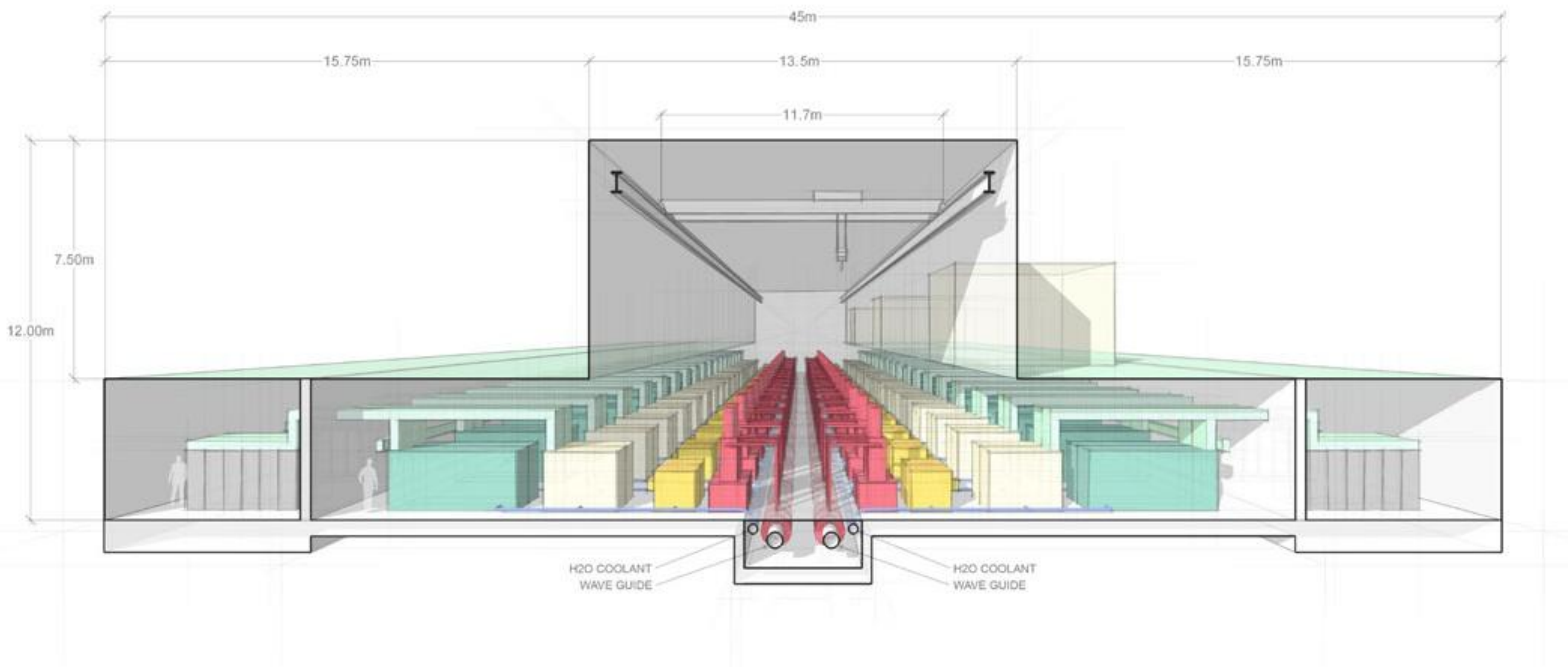
Power Dividing:





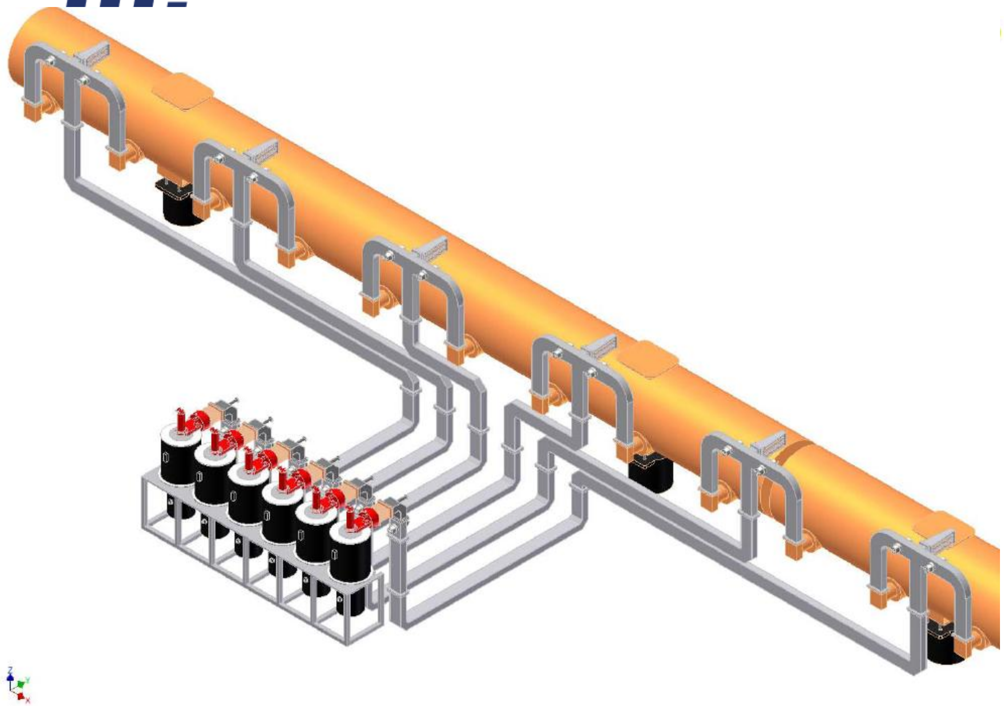
KCS – Klystron/ Modulator/Controls

PULSE TRANSFORMER	CONDUIT ROUTING
KLYSTRON	MODULATOR
ELECTRONICS RACKS	CHARGING SUPPLY

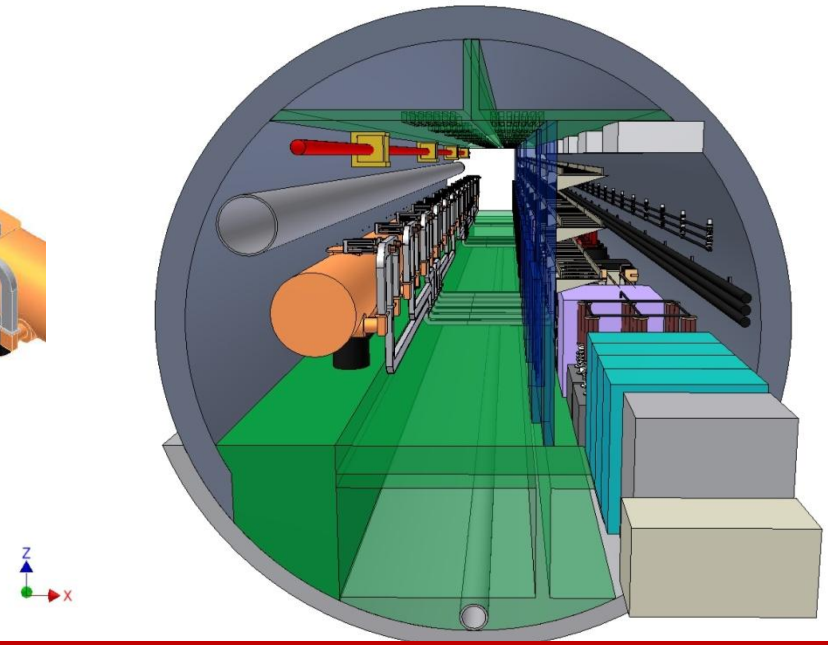


Klystron Cluster System – Surface Building

Distributed RF System

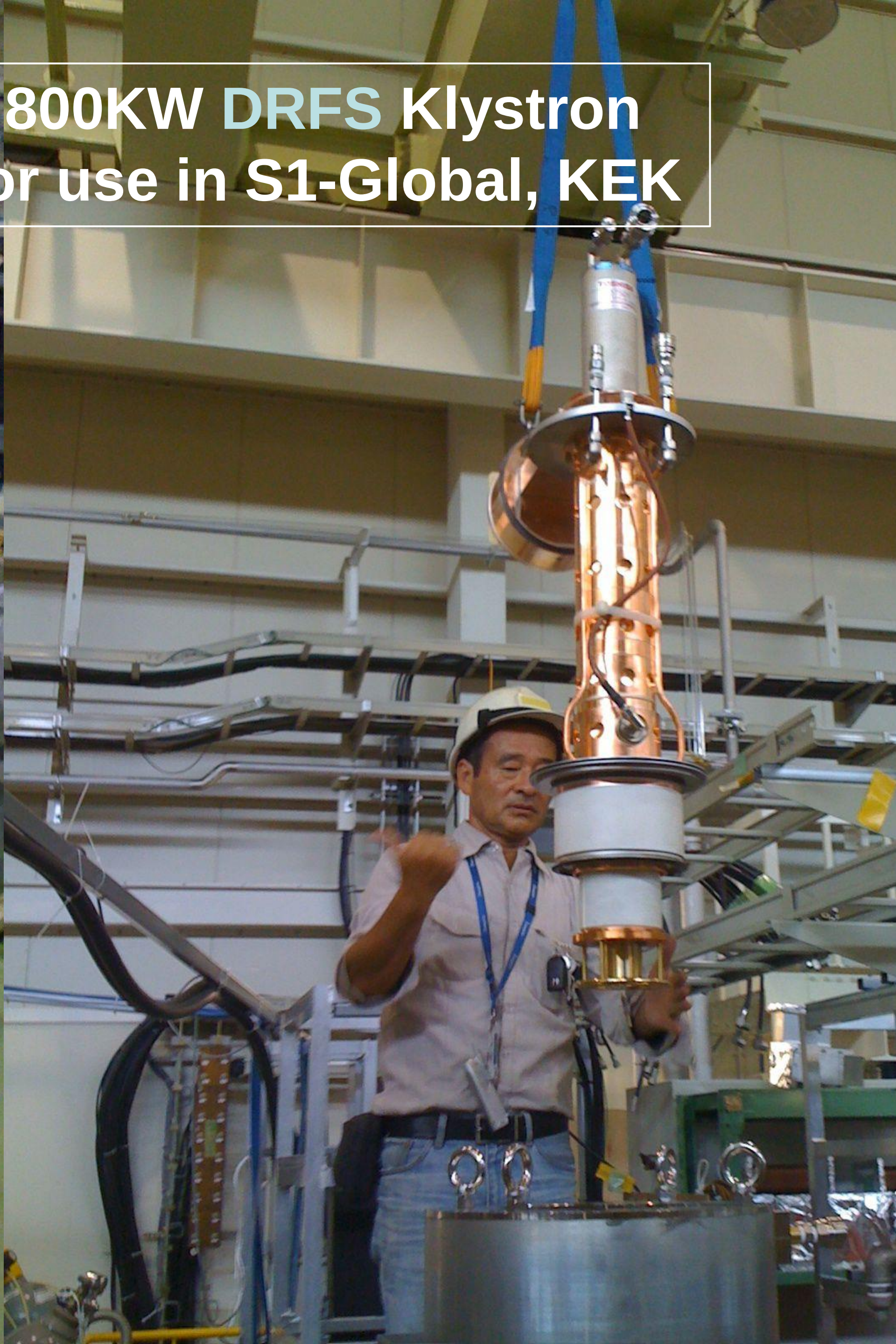


HLRF – Option 2



←SNS Linac:
'Distributed RF' (500KW)
(similar to DRFS)

Toshiba 800KW DRFS Klystron Ready for use in S1-Global, KEK



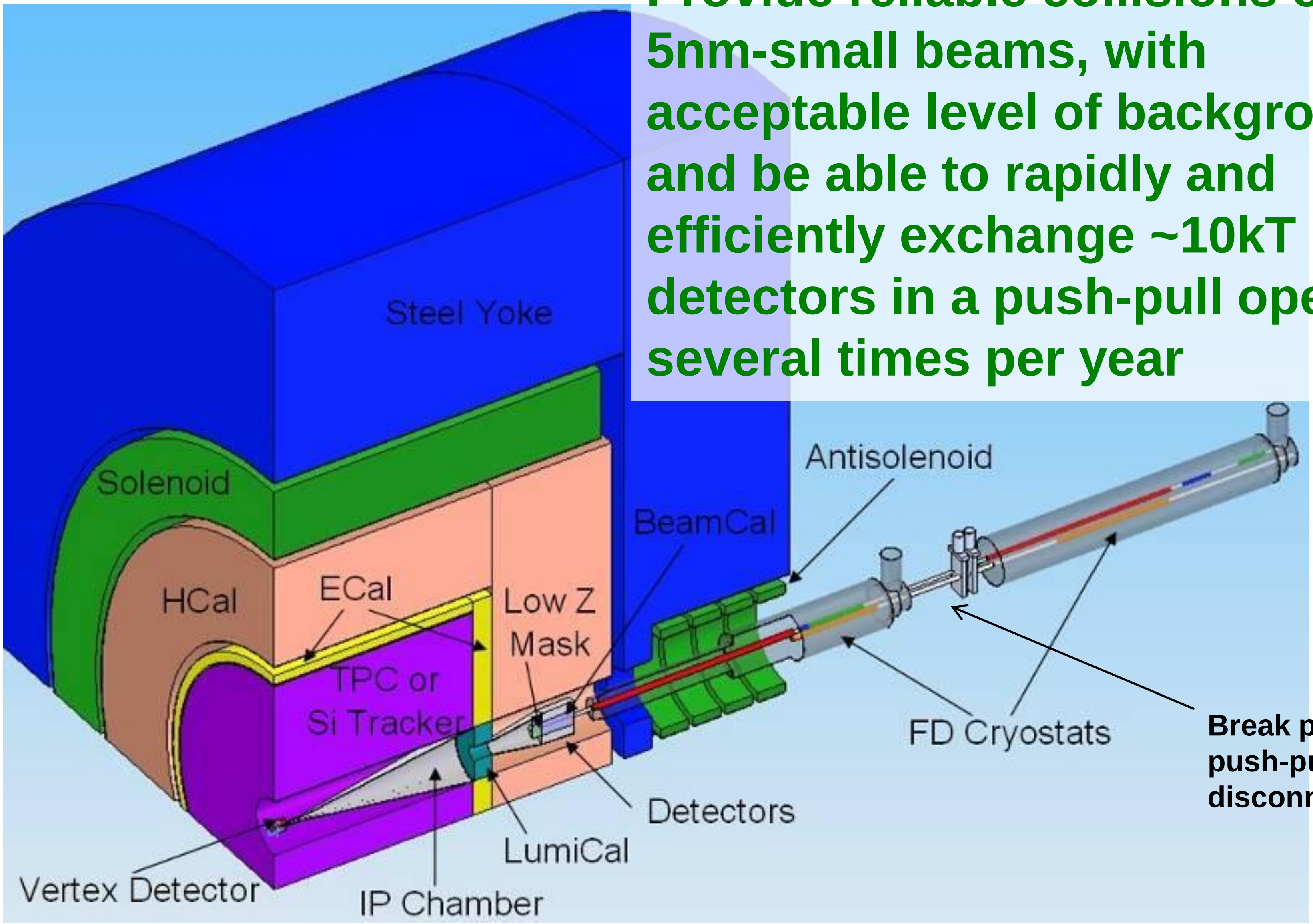
IWLC 2010 Parallel Sessions (Beam Delivery / Detector Interface - *MDI*)

- **Integration between detector and machine**
  - 'Push / Pull'
- **Civil engineering design**
  - esp. in 'mountainous regions' (i.e. Japan)
  - cavern construction schemes
  - detector utility requirements

- **(WG9 1600 Tuesday /**
- **WG 5 + 9 0830 Wednesday)**

Interaction Region challenge

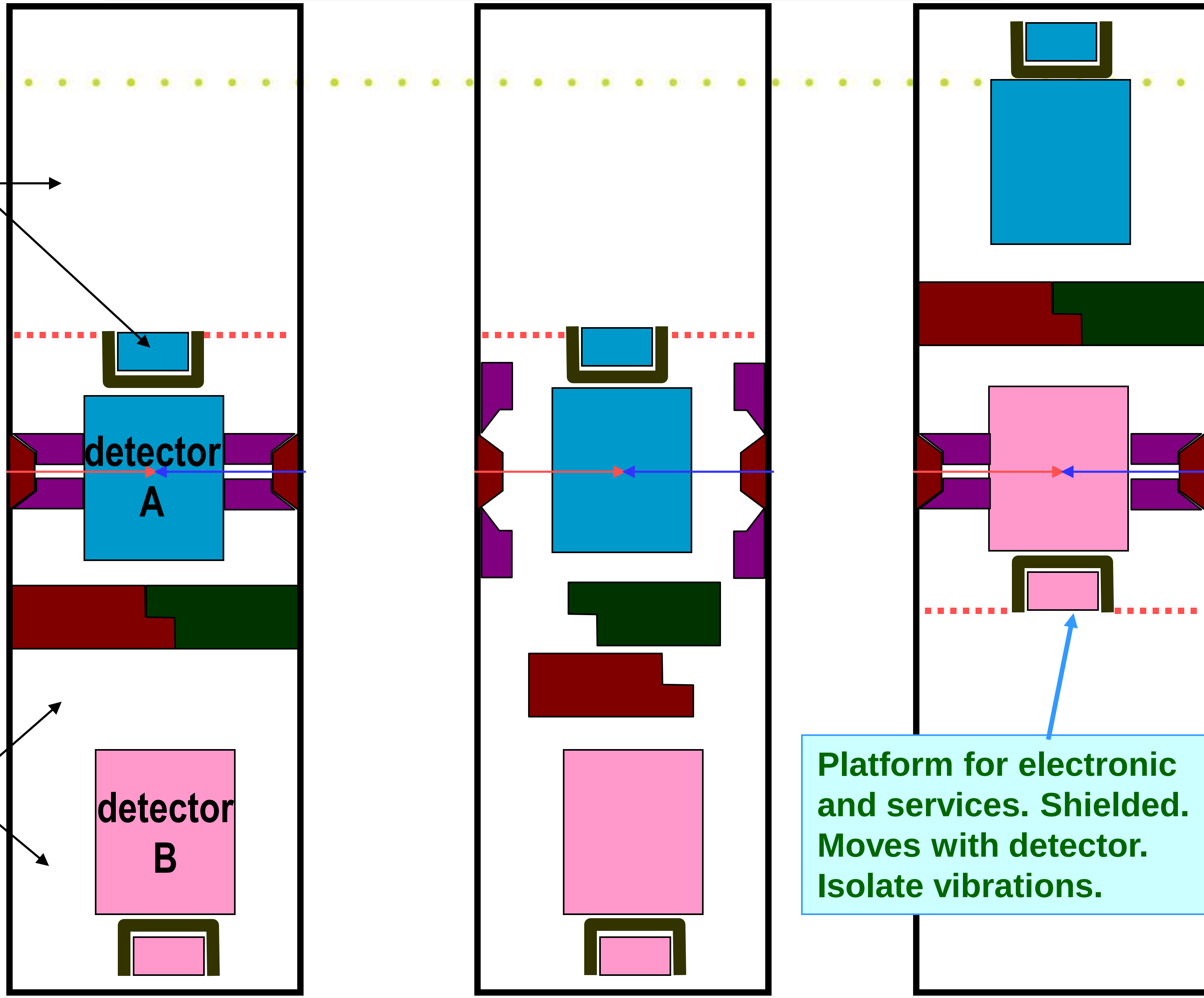
Provide reliable collisions of 5nm-small beams, with acceptable level of background, and be able to rapidly and efficiently exchange ~10kT detectors in a push-pull operation several times per year



Starting point push-pull concept

may be accessible during run

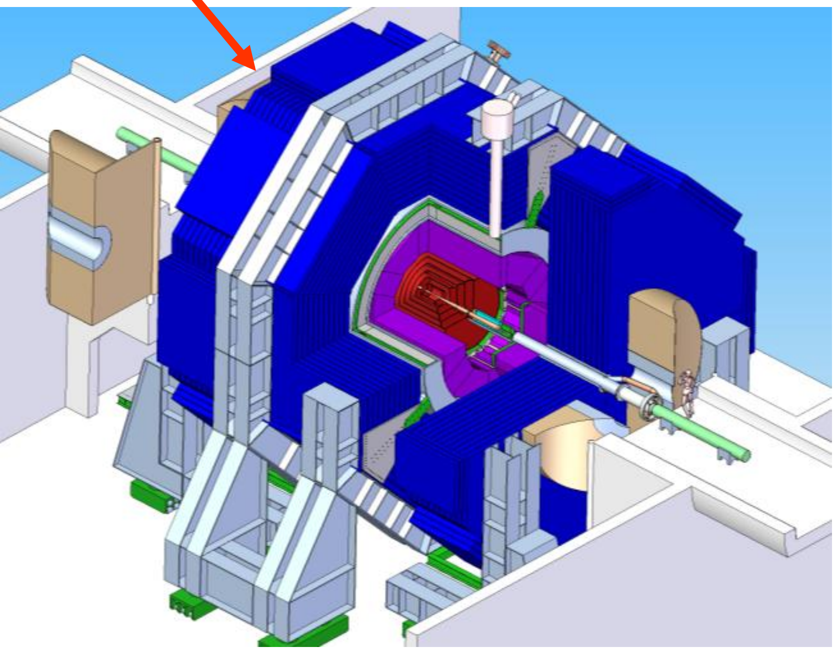
accessible during run

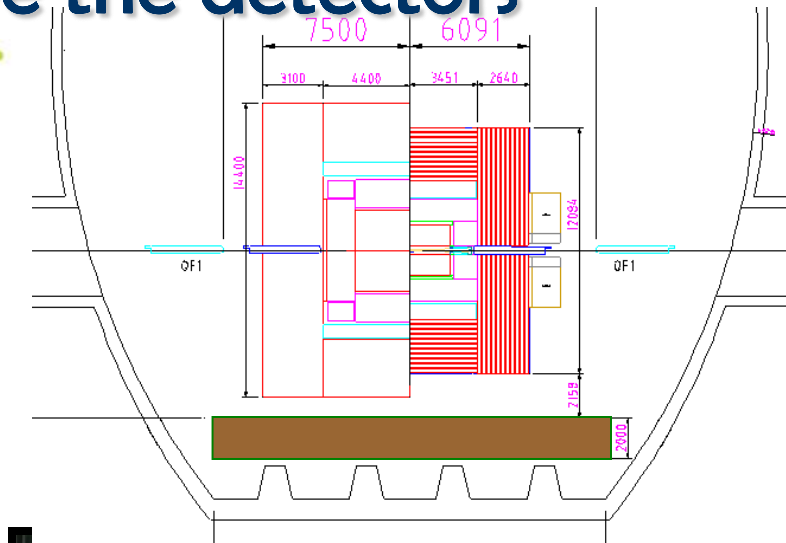


Platform for electronic and services. Shielded. Moves with detector. Isolate vibrations.

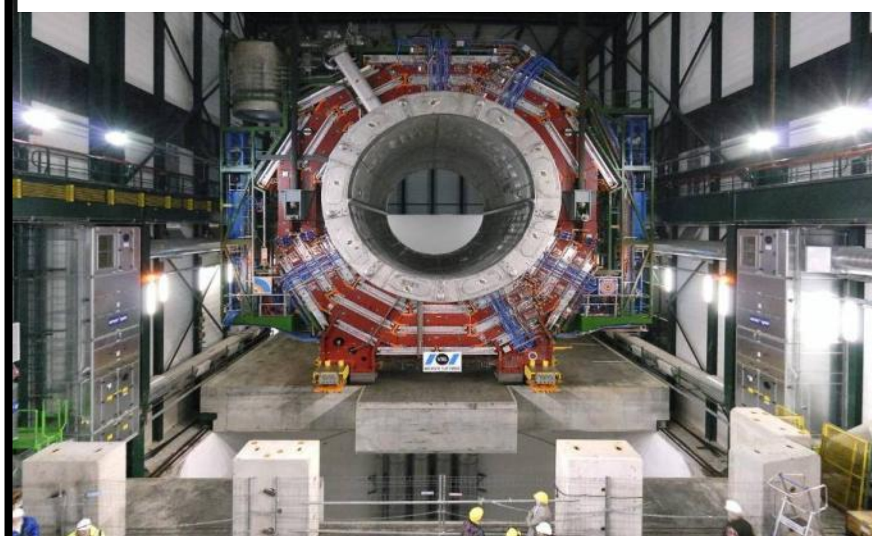
Example of design progress to date: how to move the detectors

Detector motion system with or without an intermediate platform



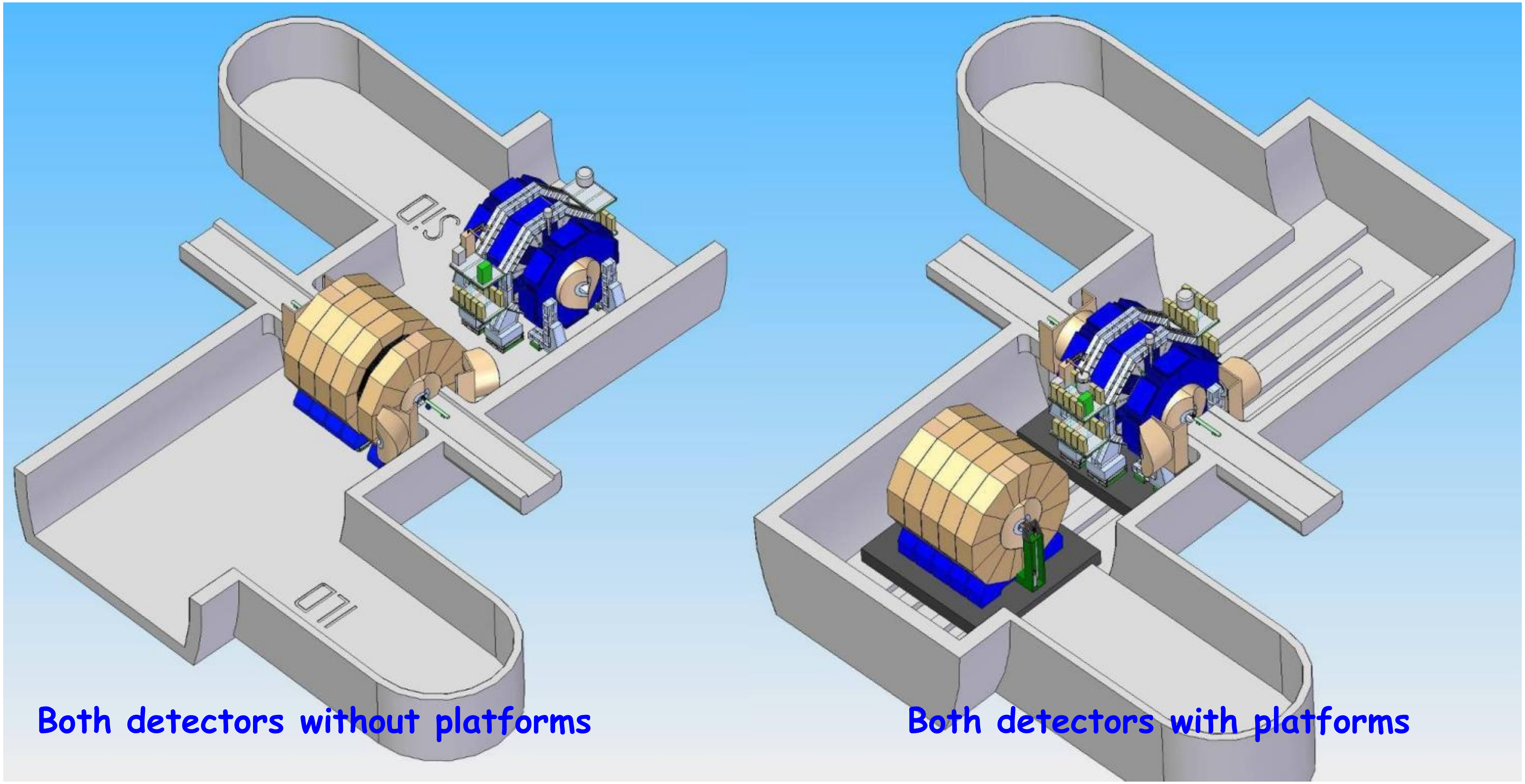


CMS platform – proof of principle for ILC



Two different approached for detector motion are considered: with and without a platform

Push-Pull:
Stability and detector motion system

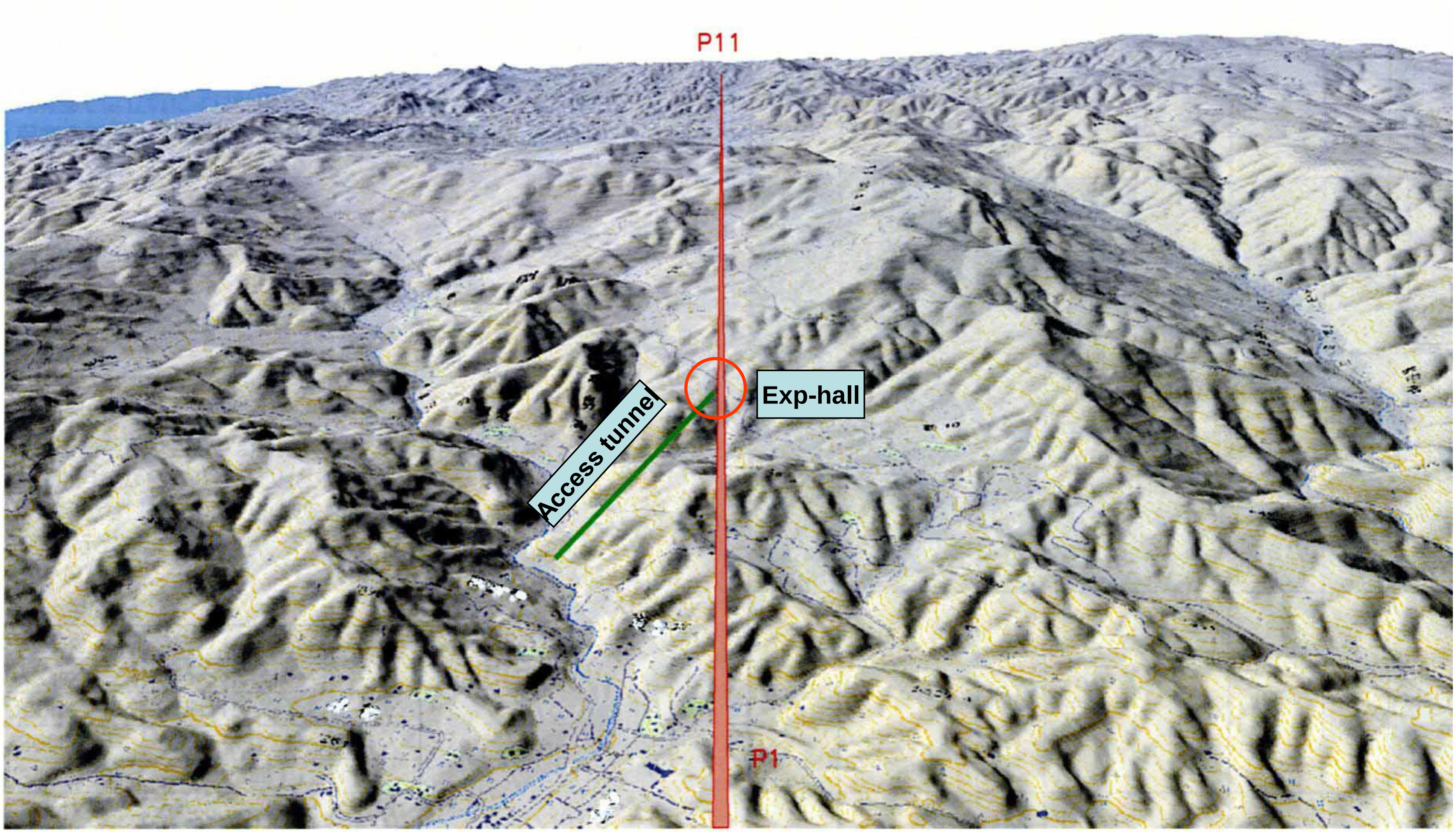


Both detectors without platforms

Both detectors with platforms

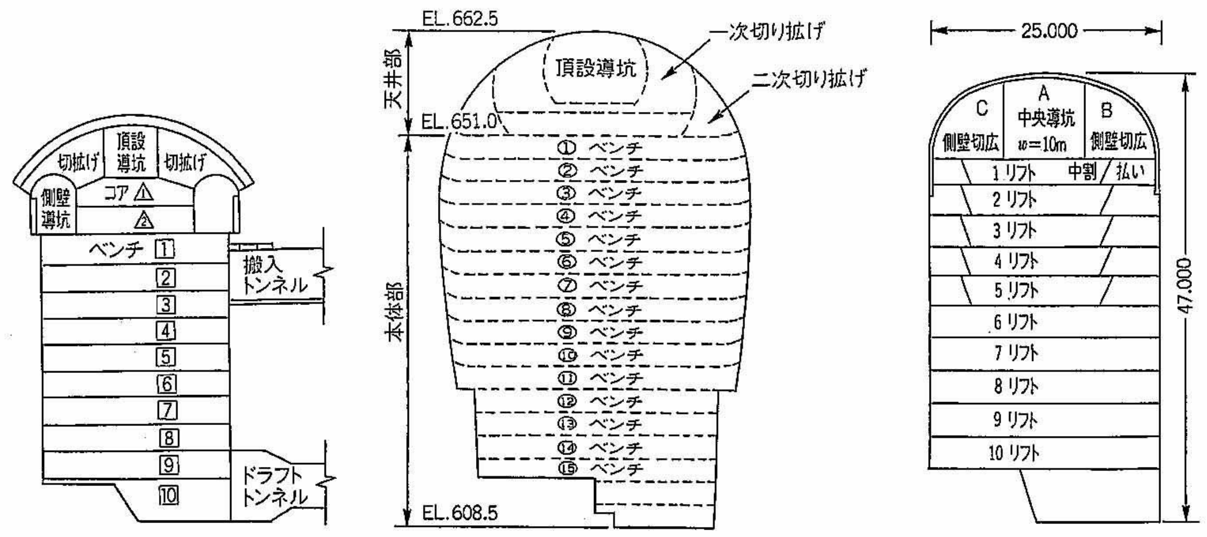
- **Vibration stability will be one of the major criteria in eventual selection of a motion system design**

Detector Hall Civil Engineering: An example of Asian mountain site



Huge caverns in Japan

- **More than 20 huge caverns with access tunnels have been constructed in Japan for hydroelectric power plants**
- **A 25m(W)x47m(H)x130m(L) (94,000m³) cavern can be excavated only in 14 months, and a 34mx54mx210m (250,000m³) was excavated in 21 montl**

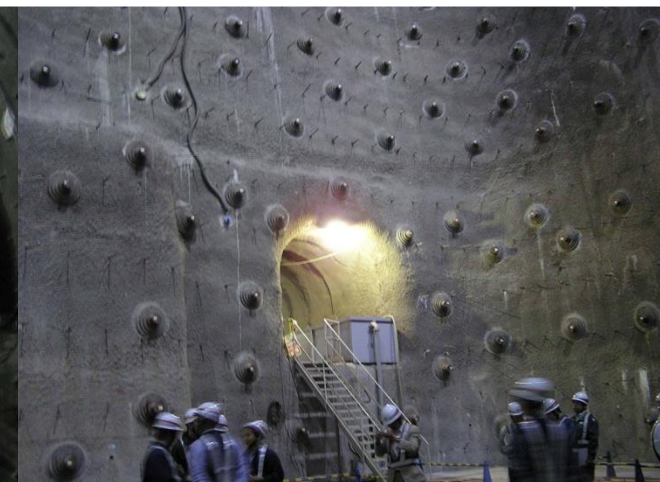


(a) 奥美濃発電所 (きのこ形)　(b) 葛野川発電所 (卵 形)　(c) 奥多々良木発電所増設 (弾 頭 形)

Example of a cavern

- **Underground hydroelectric power plant in Japan (Kannagawa power plant)**
- **Cavern size: 33m(W)x51.4m(H)x215.9m(L) in hard sedimentary rocks**
- **Construction (excavation) period: ~1y for arch, ~1y for bench**
- **Depth: d~600m → Heavy components of generators were carried into the cavern through access tunnels**






RDR to TDR: 2007 to 2010 - 12

Near Term Milestones:

- **Publication of 'Interim Report' 03.2011**
- **Summarize R & D; contributions from across GDE**
- **to complement biannual R & D Plan (08.2010)**

2011 / 2012: Development of the TD Baseline

- **Preparation of the Technical Design Report (12.2012)**

This talk:

- **e- source:** ***Matt Poelker, JLab***
- **e+ source:** ***Jim Clarke, Cockcroft/ Daresbury, Jeff Gronberg / Tom Piggott, LLNL***
- **HLRF Kly Cluster:** ***Chris Nantista, SLAC***
- **HLRF Dist RF:** ***Shigeki Fukuda, KEK***
- **Single Tunnel, Surface Buildings:** ***Tom Lackowski, FNAL and Atsushi Enomoto, KEK***
- **MDI:** ***Andrei Seryi, John Adams/Oxford, Yasuhiro Sugimoto, KEK***

- ***Thank you***