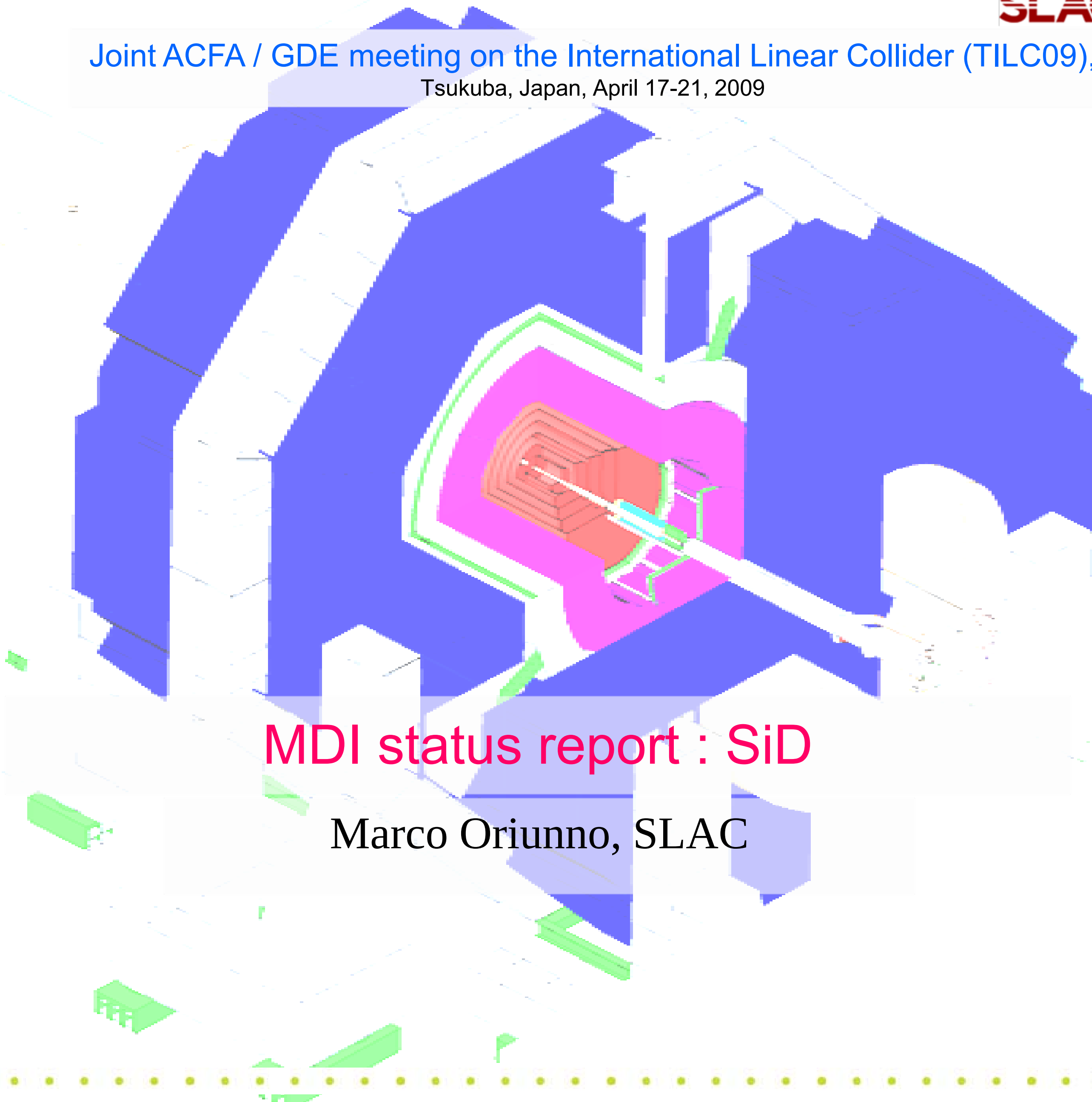
Joint ACFA / GDE meeting on the International Linear Collider (TILC09),
Tsukuba, Japan, April 17-21, 2009

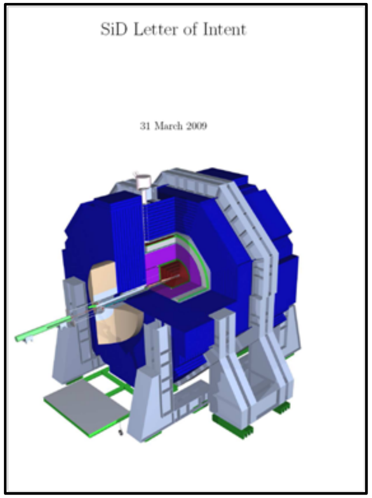


MDI status report : SiD

Marco Oriunno, SLAC

Recent Events vs. MDI

- Submission of the *Letter of Intent*



SiD Letter of Intent

31 March 2009

http://silicondetector.org/display/SiD/LOI

- Release of the *Functional requirements Interface Document*

ILC-Note-2009-050
March 2009
Version 4, 2009-03-19

Functional Requirements on the Design of the Detectors and the Interaction Region of an e^+e^- Linear Collider with a Push-Pull Arrangement of Detectors

B.Parker (BNL), A.Mikhailichenko (Cornell Univ.), K.Buesser (DESY), J.Hauptman (Iowa State Univ.), T.Tauchi (KEK), P.Burrows (Oxford Univ.), T.Markiewicz, M.Oriunno, A.Seryi (SLAC)

Abstract
The Interaction Region of the International Linear Collider [1] is based on two experimental detectors working in a push-pull mode. A time efficient implementation of this model sets specific requirements and challenges for many detector and machine systems, in particular the IR magnets, the cryogenics and the alignment system, the beamline shielding, the detector design and the overall integration. This paper attempts to separate the functional requirements of a push pull interaction region and machine detector interface from any particular conceptual or technical solution that might have been proposed to date by either the ILC Beam Delivery Group or any of the three detector concepts [2]. As such, we hope that it provides a set of ground rules for interpreting and evaluating the MDI parts of the proposed detector concept's Letters of Intent, due March 2009. The authors of the present paper are the leaders of the IR Integration Working Group within Global Design Effort Beam Delivery System and the representatives from each detector concept submitting the Letters Of Intent.

INTRODUCTION
The Reference Design Report (RDR) [1] of the International Linear Collider (ILC) specifies that the site will have one interaction region (IR) with the facilities to support two independent detectors that time-share the interaction point (IP) in a so-called push-pull arrangement. Three detector concept study groups (named ILD, SiD and 4th) have submitted expressions of interest (EOI) to the ILC Research Director (RD) and have agreed to supply the director with Letters of Intent (LOI), describing their detector concept and its physics measurement potential. These are to be evaluated by the International Detector Advisory Group (IDAG).

Thus, in addition to the usual handshake required between the accelerator and detector design, the machine detector interface (MDI), the ILC will need to provide the physical and administrative infrastructure to allow two competing teams of physicists with differing detector designs fair and equal access to beam collisions with minimal down-time overhead. At this point in the life cycle of the ILC, the site, the time scale for construction, and the final selection of detector concepts have not been made. In order to proceed, the RD has appointed a panel comprised of two MDI representatives from each of the three detector concepts and three representatives of the ILC's Beam Delivery System (BDS) which is charged with the design of the IR. These are the authors of this report.

This document is meant to be the mechanism by which the four groups involved mutually define the MDI and Detector-to-Detector Interface (DDI) requirements by which the relevant parts of their respective LOIs can be evaluated. While the unknowns mentioned above, as well as the lack of engineering resources to date, preclude any definitive decisions, all parties involved see the merit in having the current set of agreed-to assumptions, goals and requirements documented. These should be as minimal as possible. It is neither the purpose of this report to prescribe the technology to be used [2] to achieve the requirements nor to list the myriad site-dependent safety requirements (O_2 deficiency, adequate emergency egress, non-flammable materials, etc.) to which the detectors must conform. Collaboratively developed technical solutions and interfaces between the final two detectors will be developed in the post-LOI time frame.

http://ilcdoc.linearcollider.org/record/21354/files/

IDAG requests for the LoI vs. MDI

IDAG wishes the proponents of the 3 LOI's to address the following points in their LOI document:

(1) Sensitivity of different detector components to machine background as characterized in the MDI panel.

(2) Calibration and alignment schemes.

(3) Status of an engineering model describing the support structures and the dead zones in the detector simulation

(4) Plans for getting the necessary R&D results to transform the design concept into a well-defined detector proposal.

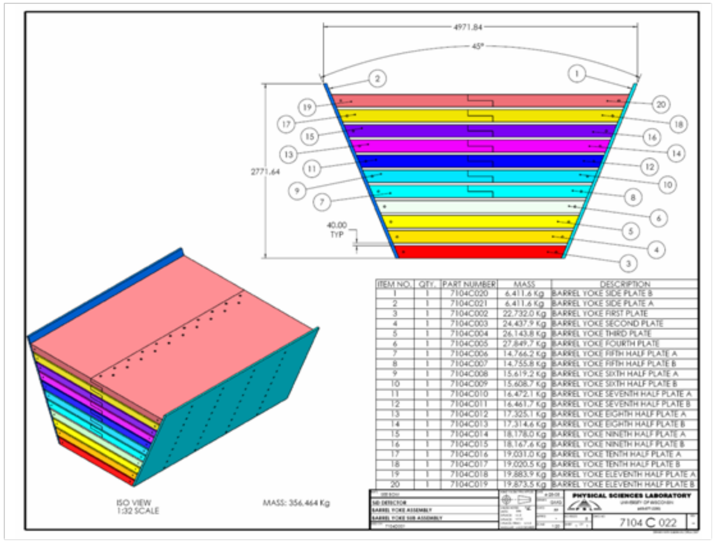
(5) Push-pull ability with respect to technical aspects (assembly areas needed, detector transport and connections) and maintaining the detector performance for a stable and time-efficient operation.

(6) A short statement about the energy coverage, identifying the deterioration of the performances when going to energies higher than 500 GeV and the considered possible detector upgrades.

(7) How was the detector optimized: for example the identification of the major parameters which drive the total detector cost and its sensitivity to variations of these parameters.

The MDI chapter provides a complete set of answers.

Iron Barrel Yoke layout



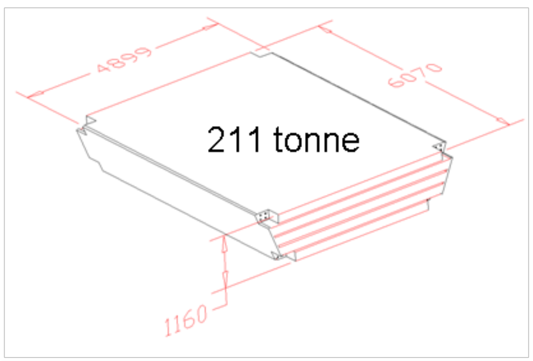
ITEM NO.	QTY.	PART NUMBER	MASS	DESCRIPTION
1	1	7104C020	6,411.6 Kg	BARREL YOKE SIDE PLATE B
2	1	7104C021	6,411.6 Kg	BARREL YOKE SIDE PLATE A
3	1	7104C002	22,732.0 Kg	BARREL YOKE FIRST PLATE
4	1	7104C003	24,437.9 Kg	BARREL YOKE SECOND PLATE
5	1	7104C004	26,143.8 Kg	BARREL YOKE THIRD PLATE
6	1	7104C005	27,849.7 Kg	BARREL YOKE FOURTH PLATE
7	1	7104C006	14,766.2 Kg	BARREL YOKE FIFTH HALF PLATE A
8	1	7104C007	14,755.8 Kg	BARREL YOKE FIFTH HALF PLATE B
9	1	7104C008	15,619.2 Kg	BARREL YOKE SIXTH HALF PLATE A
10	1	7104C009	15,608.7 Kg	BARREL YOKE SIXTH HALF PLATE B
11	1	7104C010	16,472.1 Kg	BARREL YOKE SEVENTH HALF PLATE A
12	1	7104C011	16,461.7 Kg	BARREL YOKE SEVENTH HALF PLATE B
13	1	7104C012	17,325.1 Kg	BARREL YOKE EIGHTH HALF PLATE A
14	1	7104C013	17,314.6 Kg	BARREL YOKE EIGHTH HALF PLATE B
15	1	7104C014	18,178.0 Kg	BARREL YOKE NINETH HALF PLATE A
16	1	7104C015	18,167.6 Kg	BARREL YOKE NINETH HALF PLATE B
17	1	7104C016	19,031.0 Kg	BARREL YOKE TENTH HALF PLATE A
18	1	7104C017	19,020.5 Kg	BARREL YOKE TENTH HALF PLATE B
19	1	7104C018	19,883.9 Kg	BARREL YOKE ELEVENTH HALF PLATE A
20	1	7104C019	19,873.5 Kg	BARREL YOKE ELEVENTH HALF PLATE B

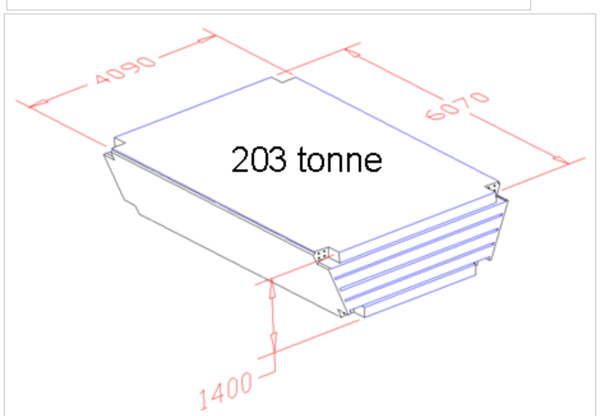
Bolted assembly, 144 plates 200 mm thick, 40mm gap

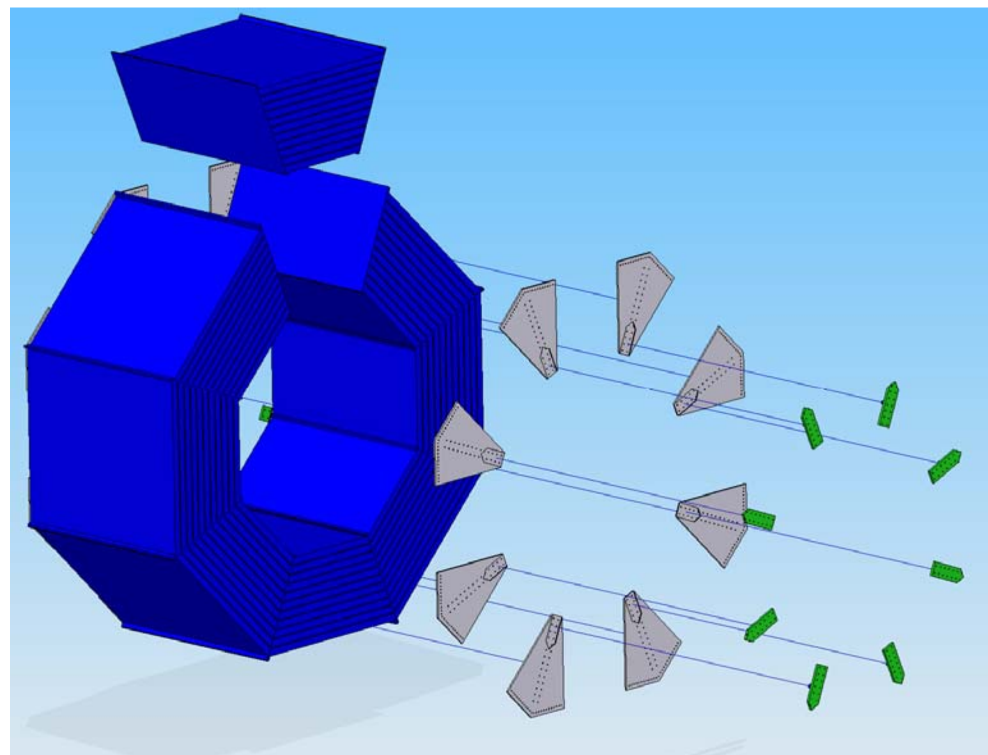
Opportunity to make blank assembly at the factory before shipping

Preliminary Contacts with Kawasaki Heavy Industries

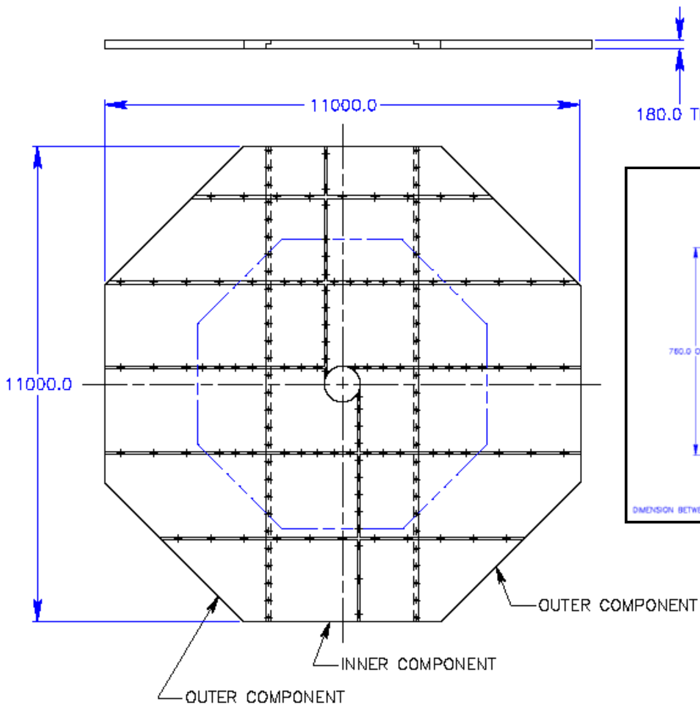
- Plate thickness tolerance for each: 0.1mm
- Plate flatness: 4mm (in a plate)
- Fabrication (assembling & welding) tolerance: 2mm
- Full trial assembly: capable (but need to study)

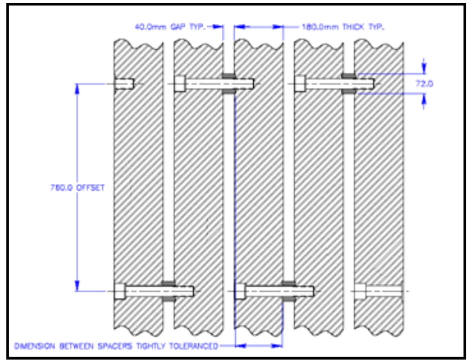


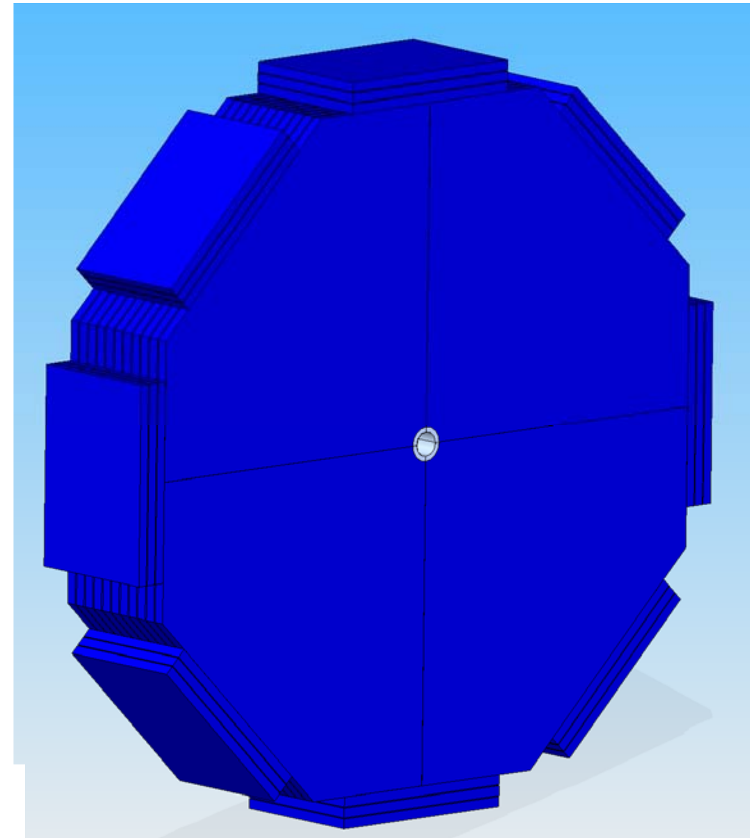


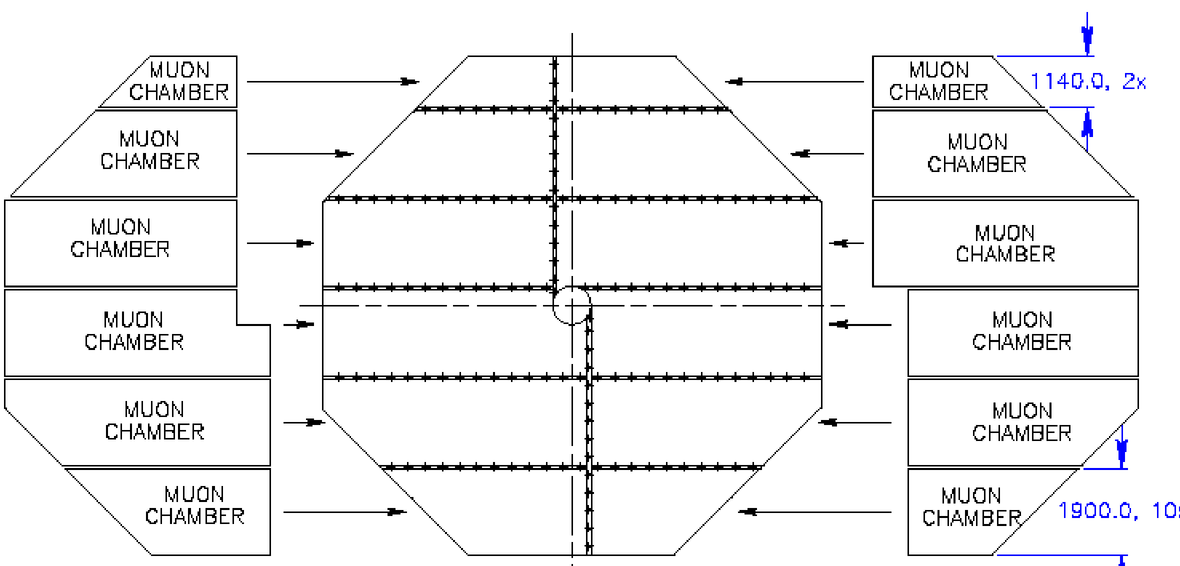


Iron Door Yoke, Bolted assembly, no vertical split







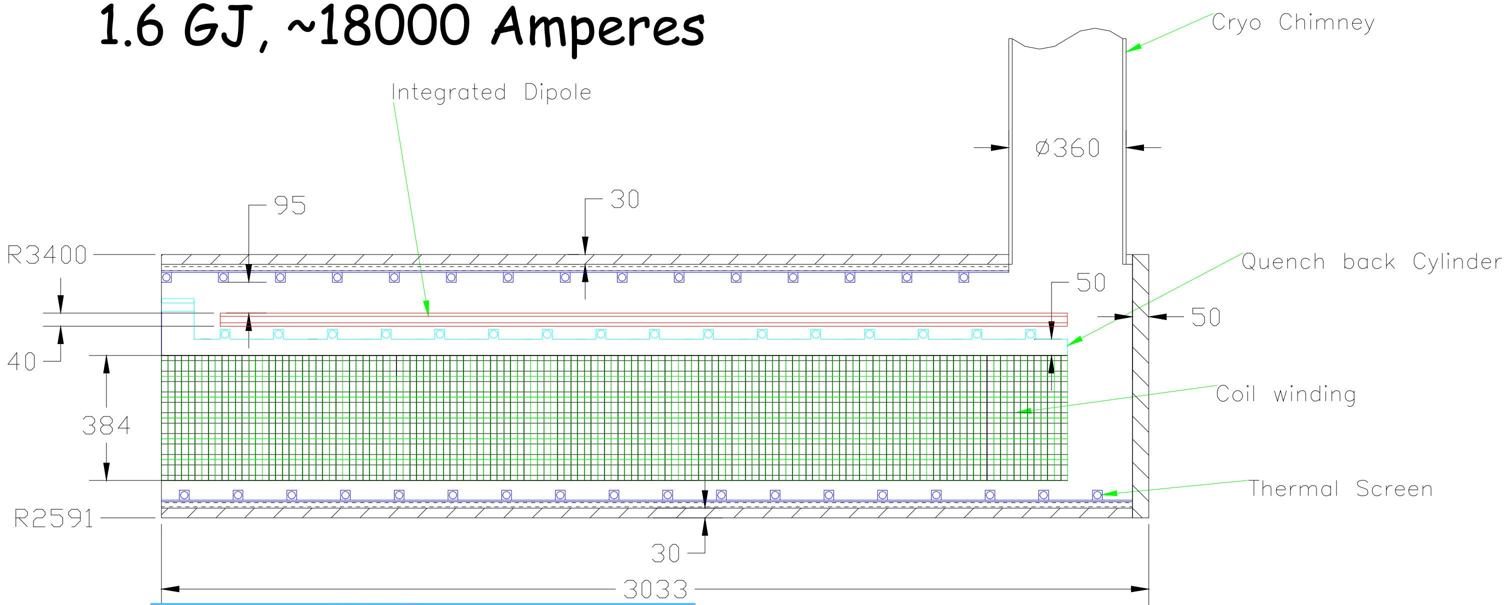


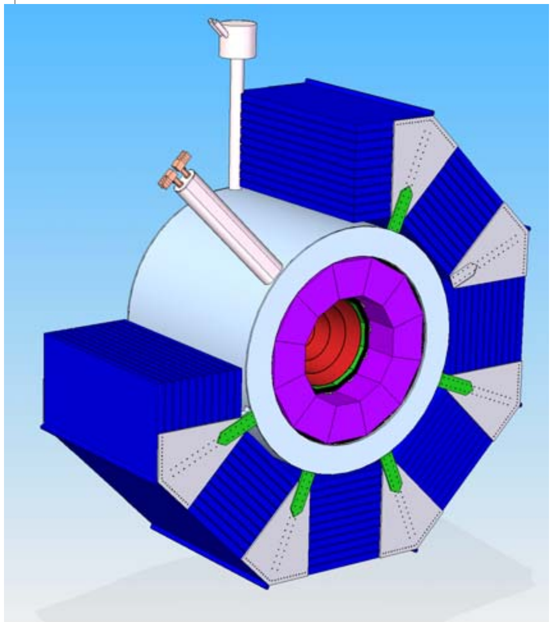
- Uses continuous cast steel plates rolled to 200 mm thickness
- 40mm gaps for muon identification chambers
- Plate-to-plate spacers are staggered for better muon identification coverage
- Bolted construction
- 100mm thick inner support cylinder

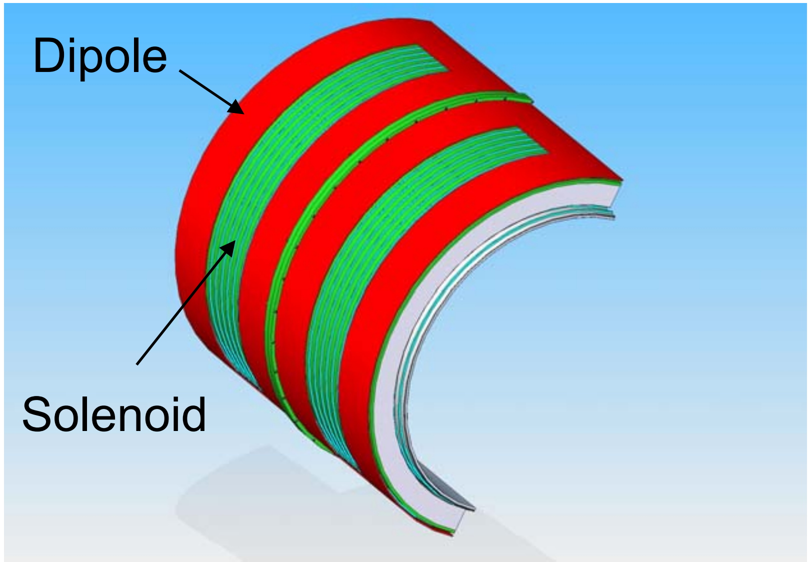
Solenoid with integrated dipole

Baseline design: 6 layers CMS conductor

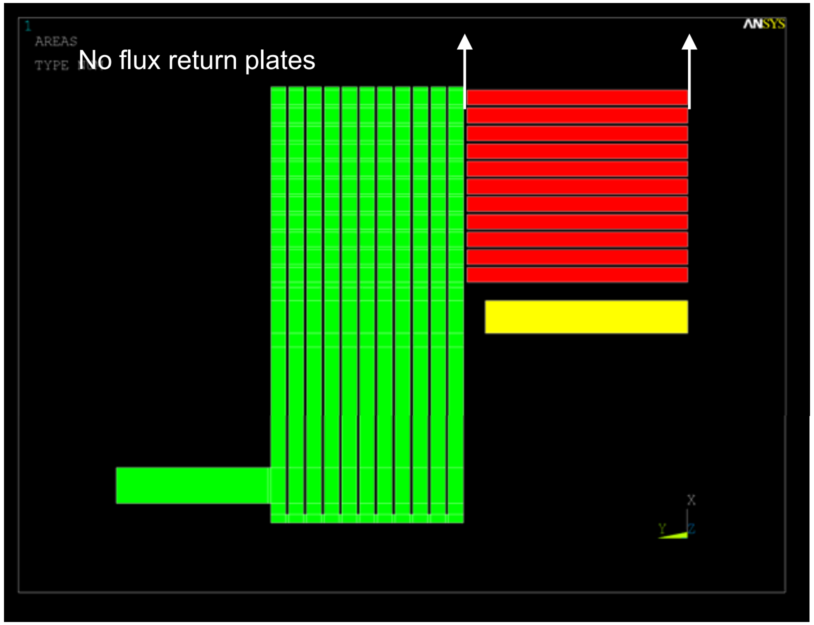
1.6 GJ, ~18000 Amperes

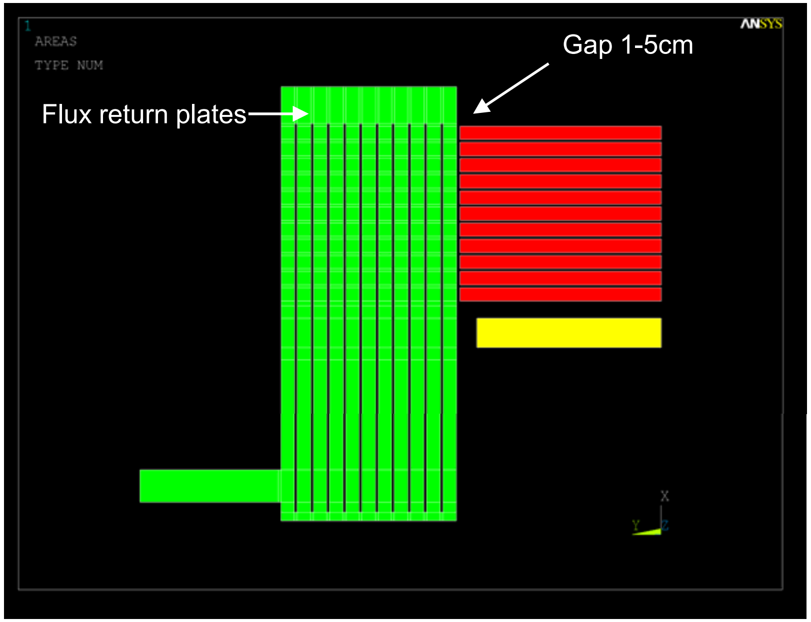


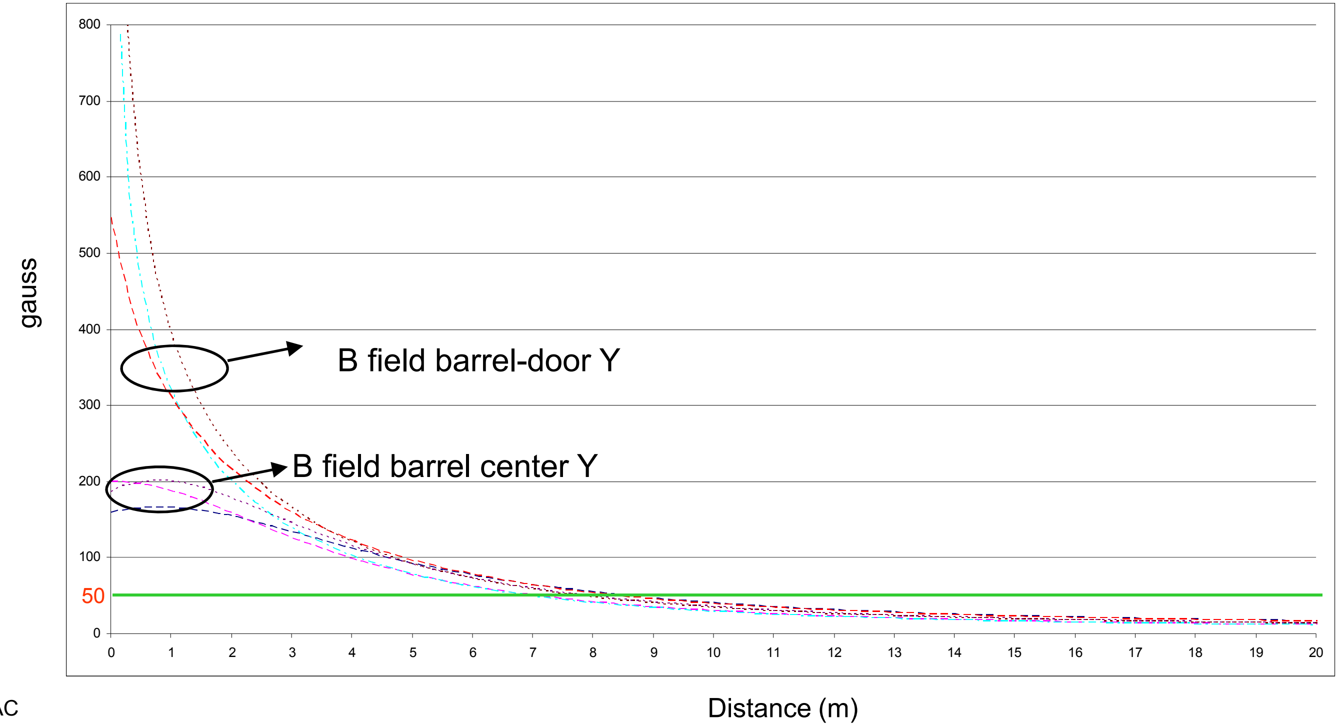




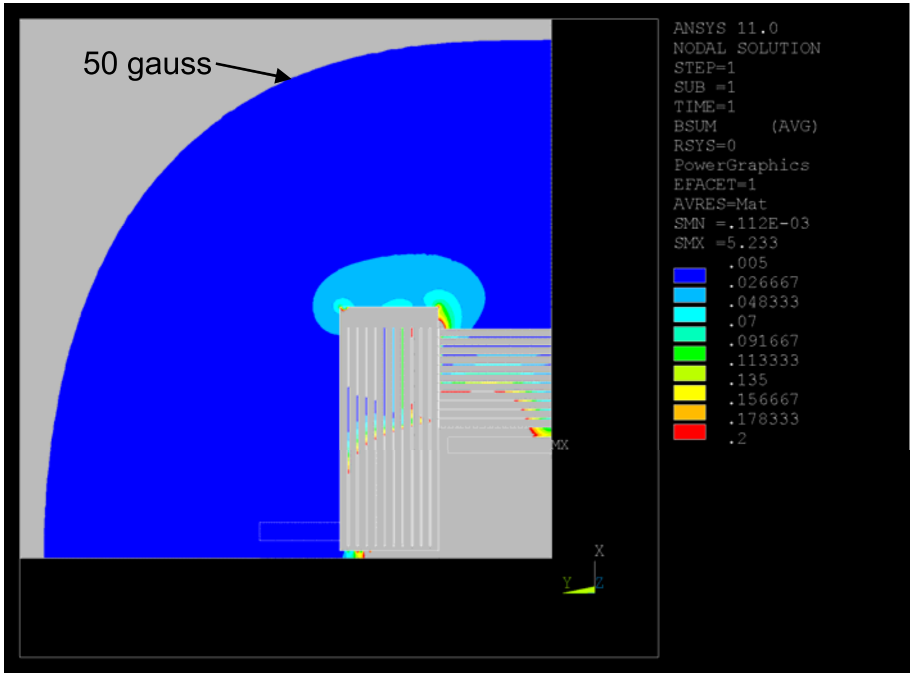
B Field optimization



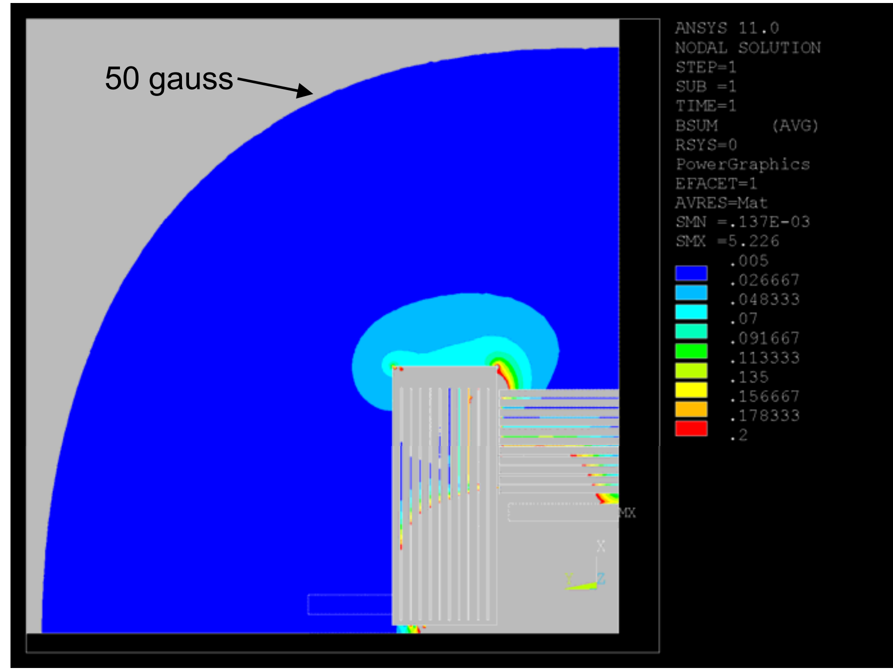




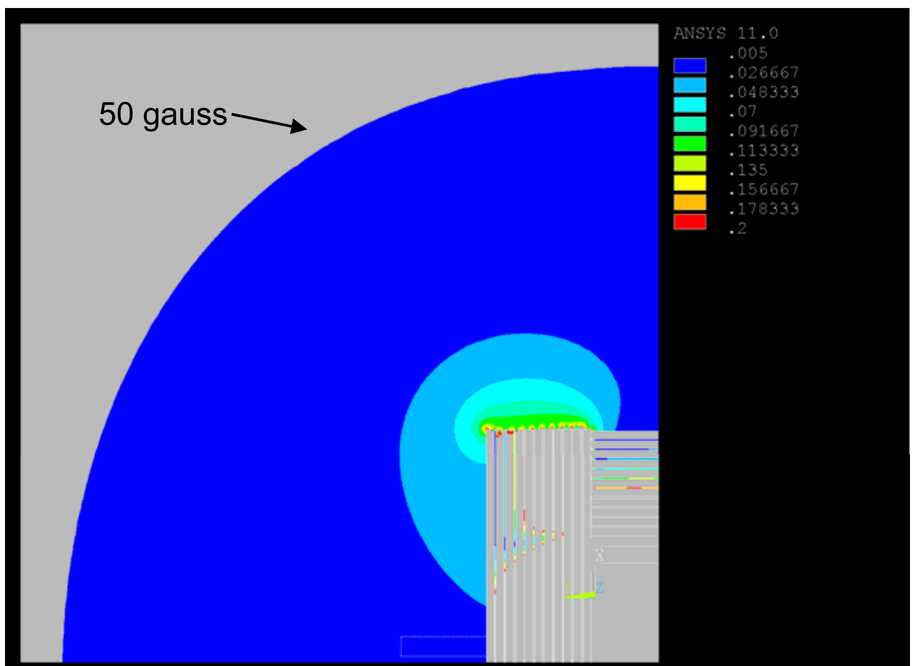
B Field optimization



Gap 1cm, flux return plates



Gap 5cm, flux return plates



Gap 1cm, no flux return plates

Magnetic environment (requirements)

The requirements on the magnetic field outside of detector operating on the beamline will define the amount of iron in the detector

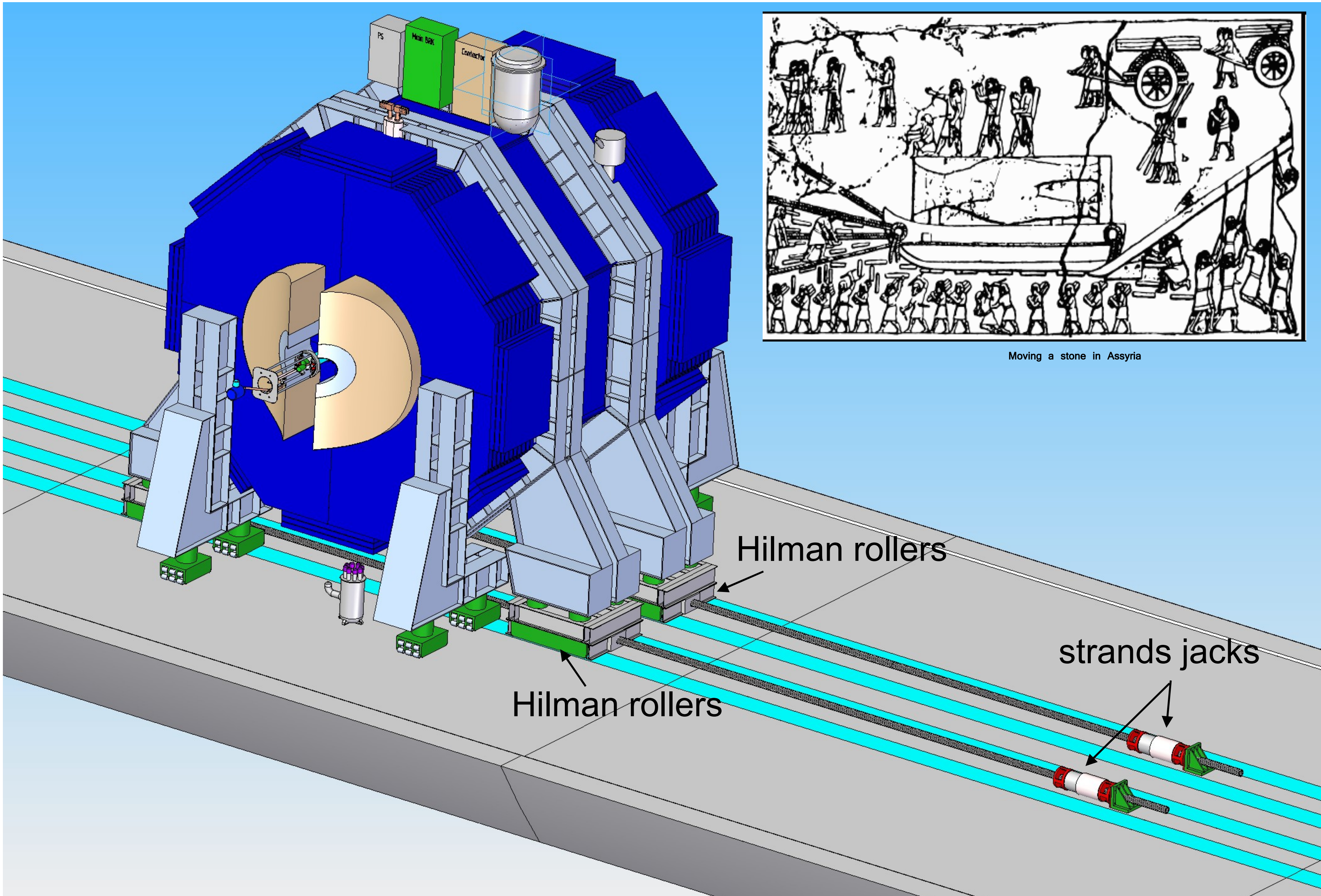
We agree to base our working numbers for the upper limits for personal safety on the values in force at CERN:
• 5 Gauss (0.5 mTesla) for people wearing pacemakers
• 100 Gauss (10 mTesla) for the general public
• 2000 Gauss (200 mTesla) for occupational exposure.

The magnetic environment in the *garage area* housing the off beamline *detector* must be limited to 50 Gauss and individuals wearing pacemakers will be excluded.

We assume that effects of any static field outside of detector on the *beamline* can be corrected.

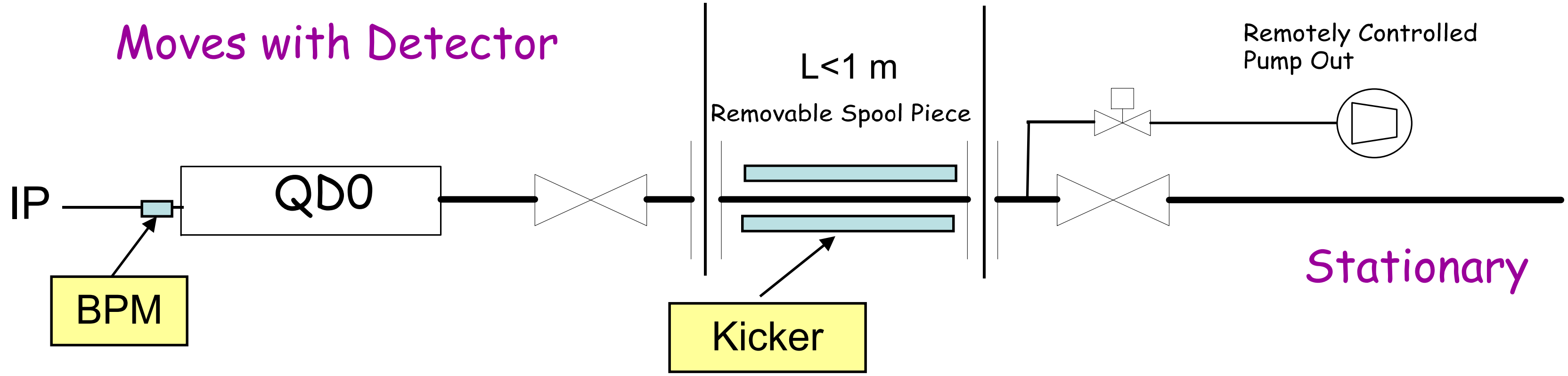
The area around the on-beamline detector
• Human Safety: 2000 Gauss, with denial of access for people with pacemakers and the
general public
• Operation of magnetically sensitive equipment: at the complete discretion of the detector group

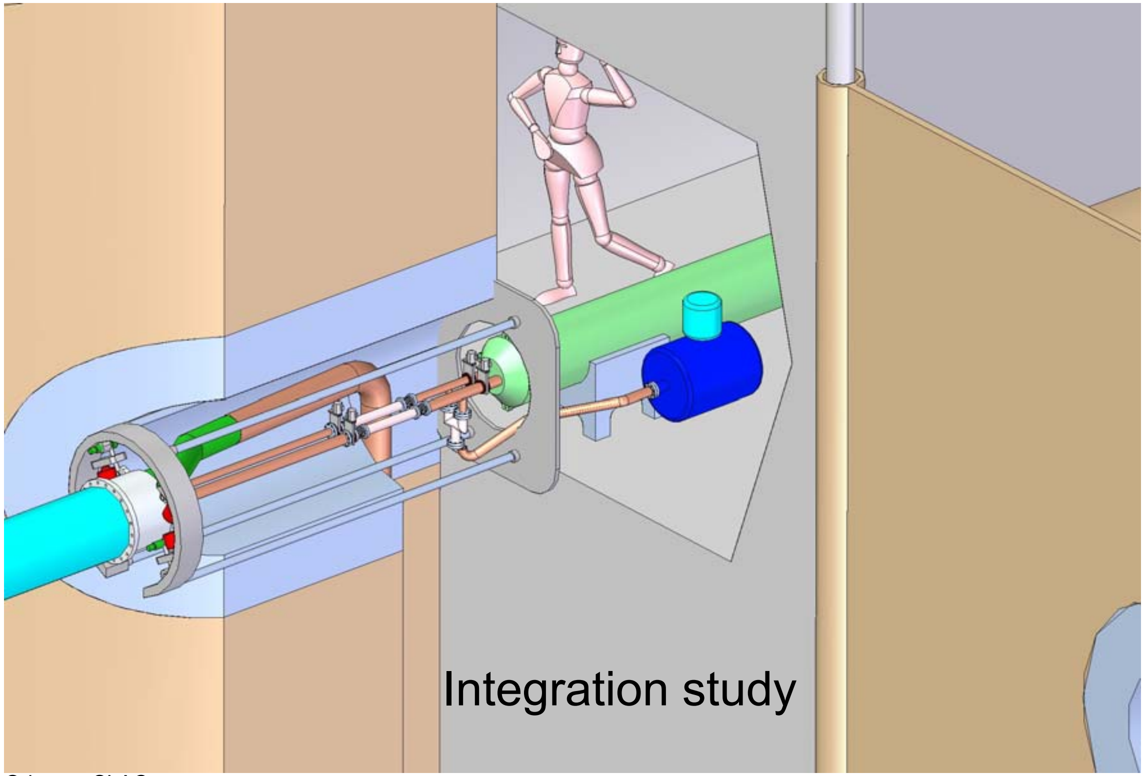
Push/pull locomotion
Dedicated session in this workshop



Moving a stone in Assyria

FeedBack Instrumentation & Vacuum Design and Push Pull





Present vacuum requirements :

P < 1nT in the BDS

P < 100nT in the experimental region

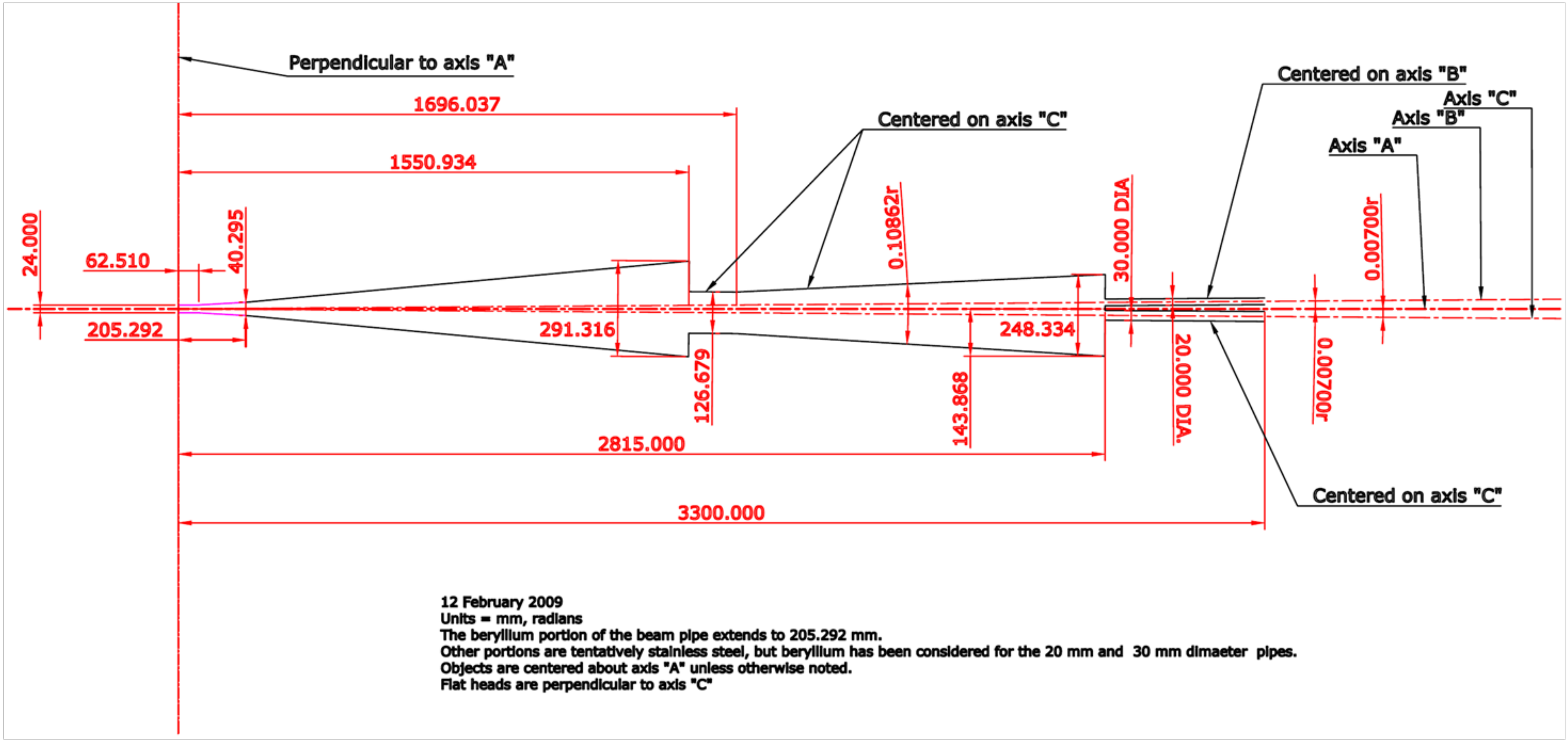
- We may rely on the cryopumping from QD0
- We do not need extra pumps
- We do not need periodic bake out *in situ.*

Open point :

- The beam instrumentation required
- Shut-off valves

IP Beam Pipe Design

(B.Cooper, FNAL)



QD0 support and alignment (requirements)

The detector-carried QD0 cryostat must be adequately aligned and stable.

The detector brings the QD0 magnet close enough to the BDS beam line, as defined by a line through the stationary QF1 magnets,

Detector axis alignment accuracy: ± 1 mm and 100 μrad from a line determined by QF1s

Detector height adjustment range: +/- several cm, tbd after site selection and geologic study

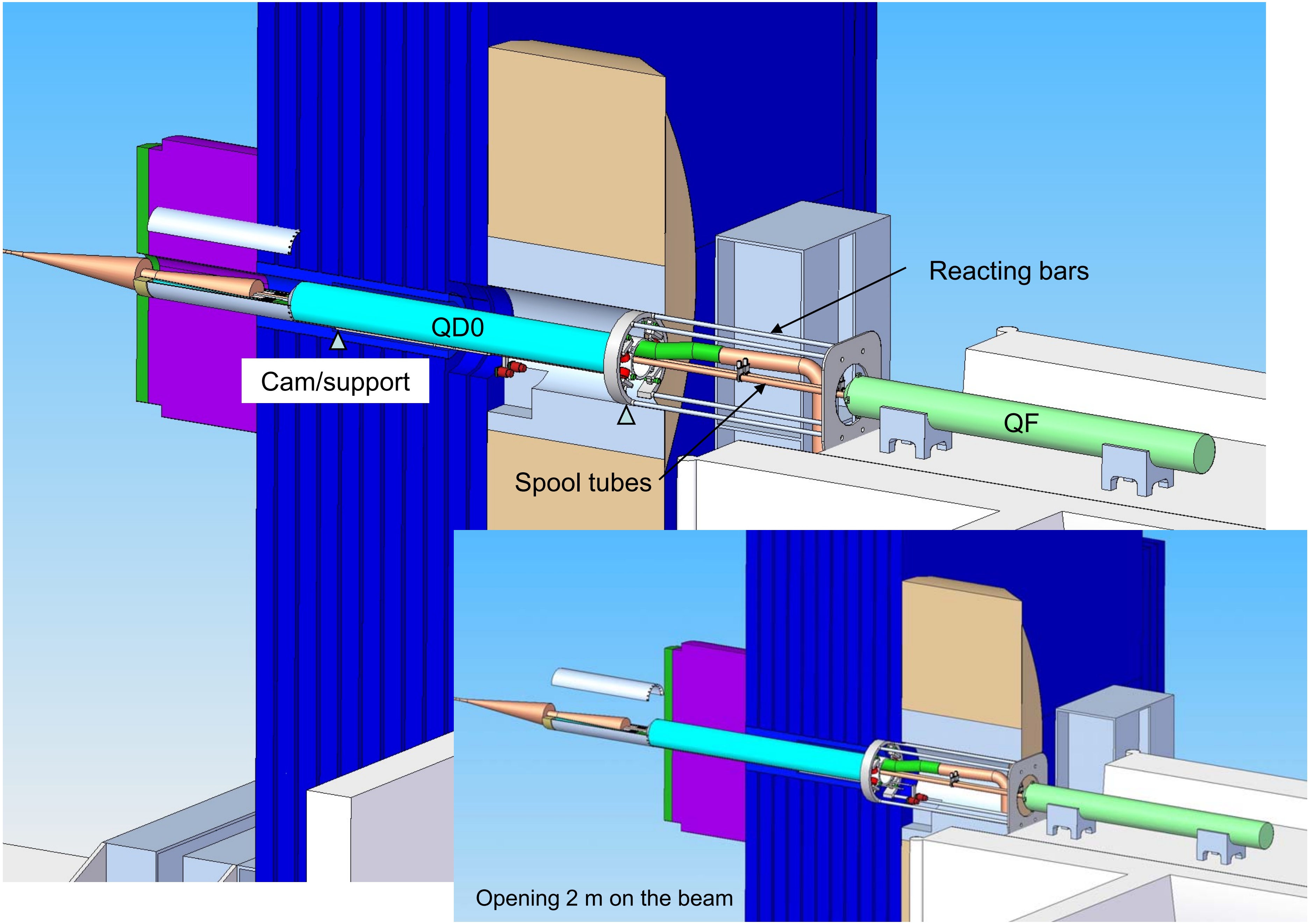
The detector provides a means to finely adjust the QD0 package using the beam to bring it within the capture range of the inter-bunch feedback

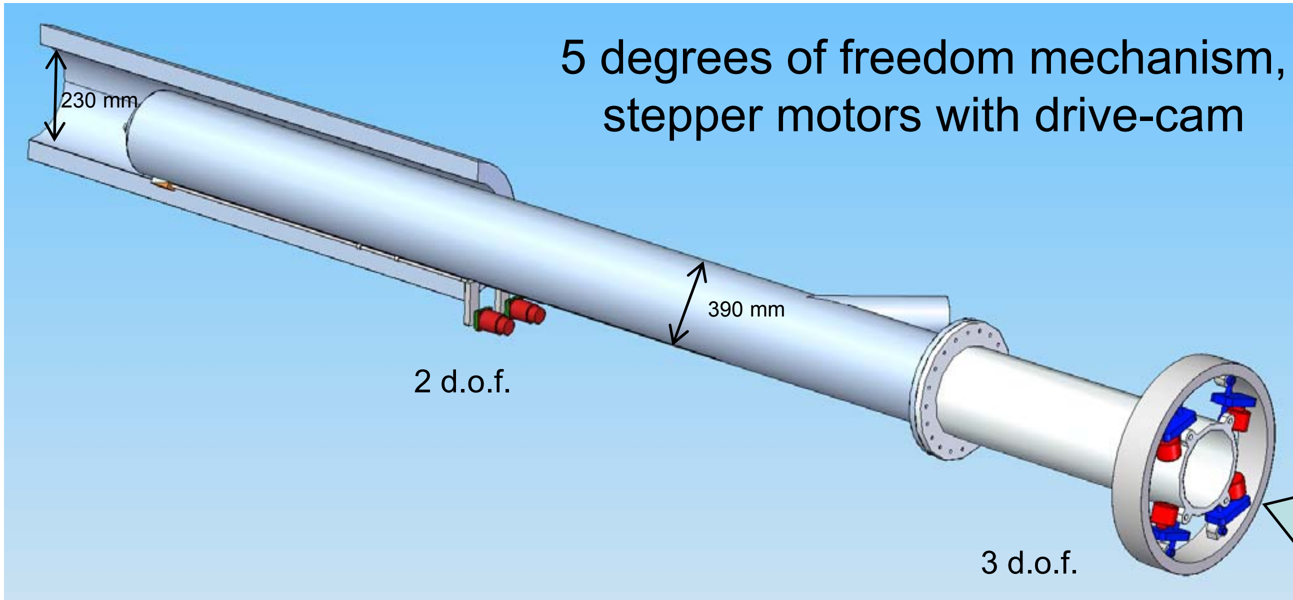
- Number of degrees of freedom: 5 (horizontal x, vertical y, roll α, pitch φ, yaw ψ)
- Range per x,y degree of freedom: ± 2mm
- Range per α,φ,ψ degrees of freedom: ± 30 mrad (roll), ±1 mrad (pitch and yaw)

The control of the movers will remain under control of the BDS system during operation. The movers may be periodically adjusted during a run to keep luminosity at its maximum value.

It is assumed that each detector will provide a means of verifying the alignment of the QD0 cryostat to the stated accuracy before low current beam operations begin.

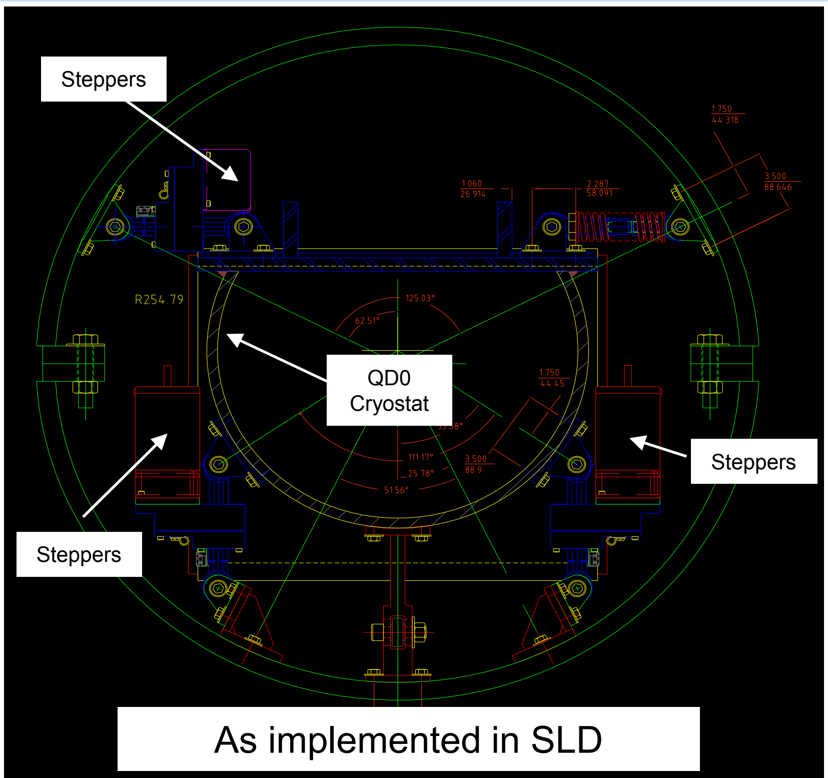
QDO support/adjustment

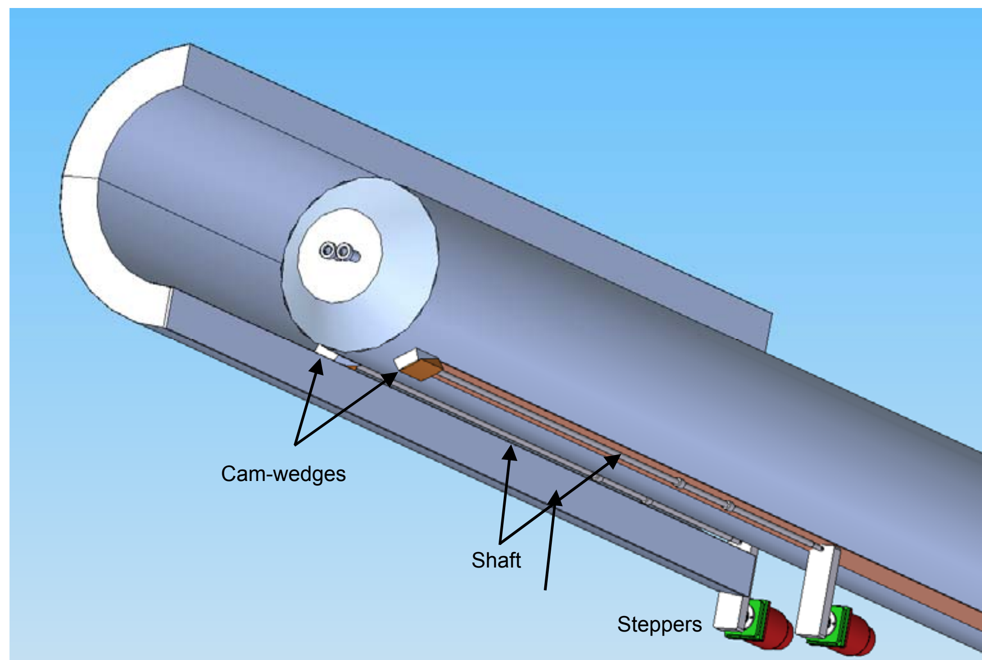




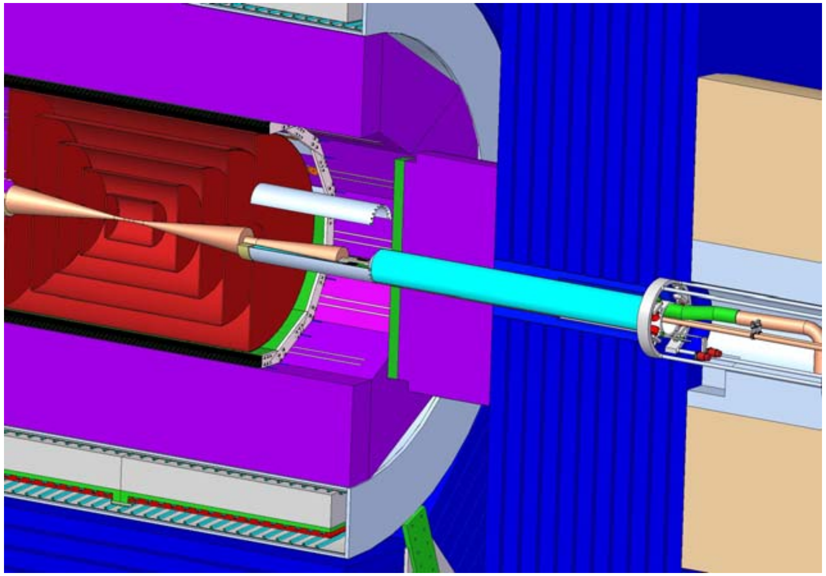
Identical mechanism developed for FFTB and the LCLS undulators

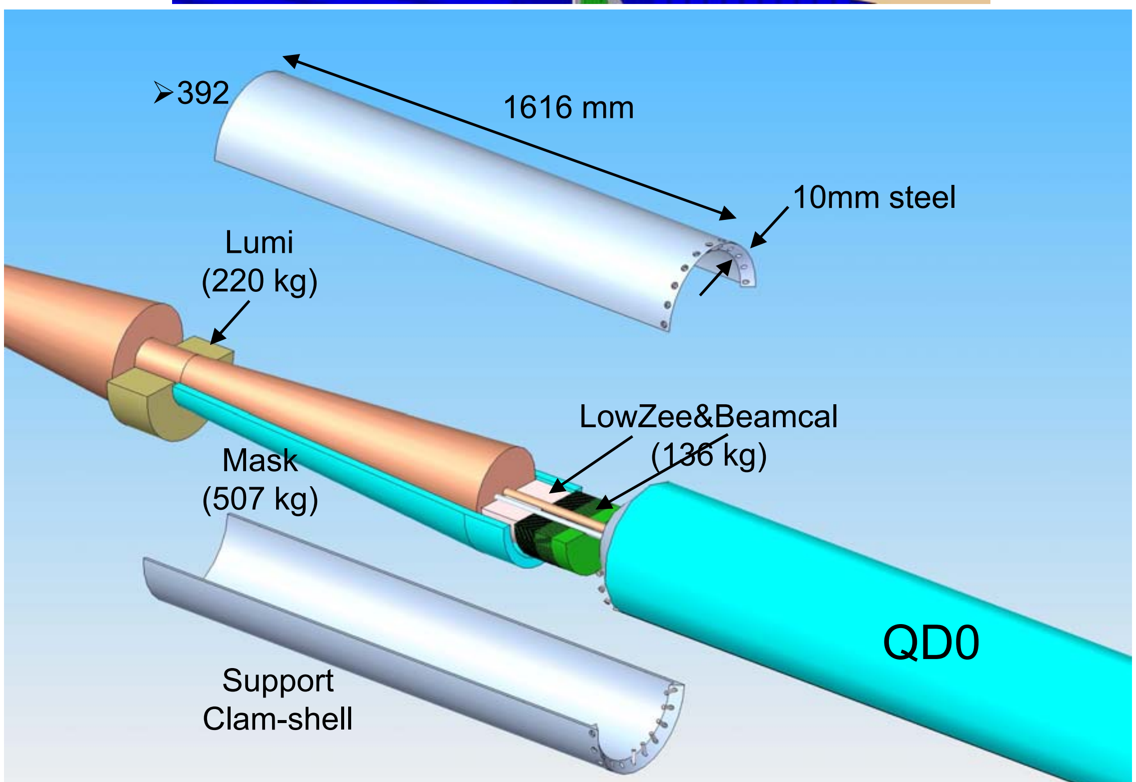
View A-A

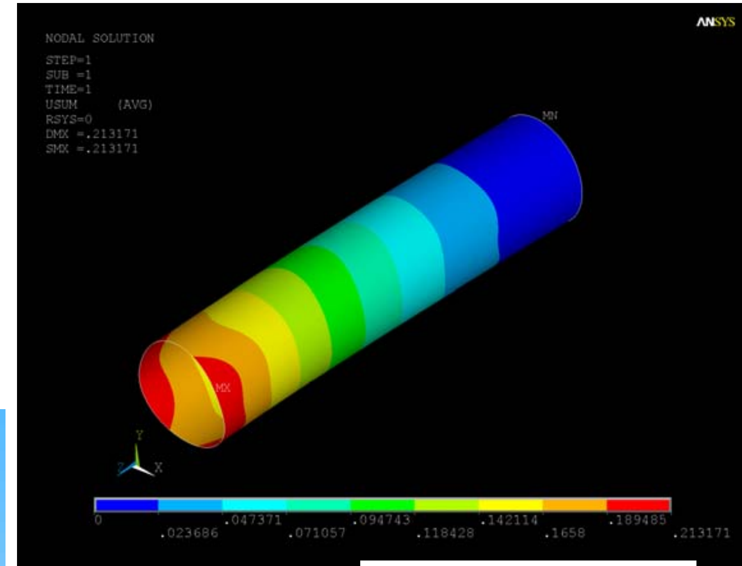




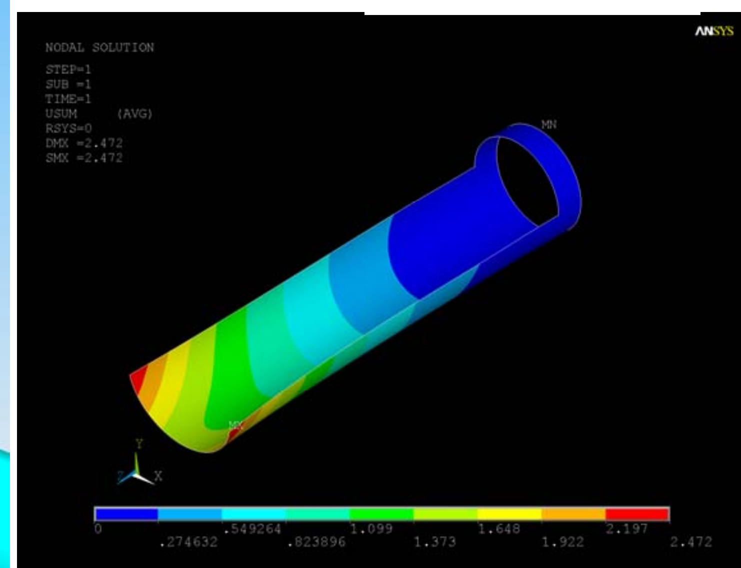
Forward Integration







Deformations in mm



Radiation Environment (requirements)

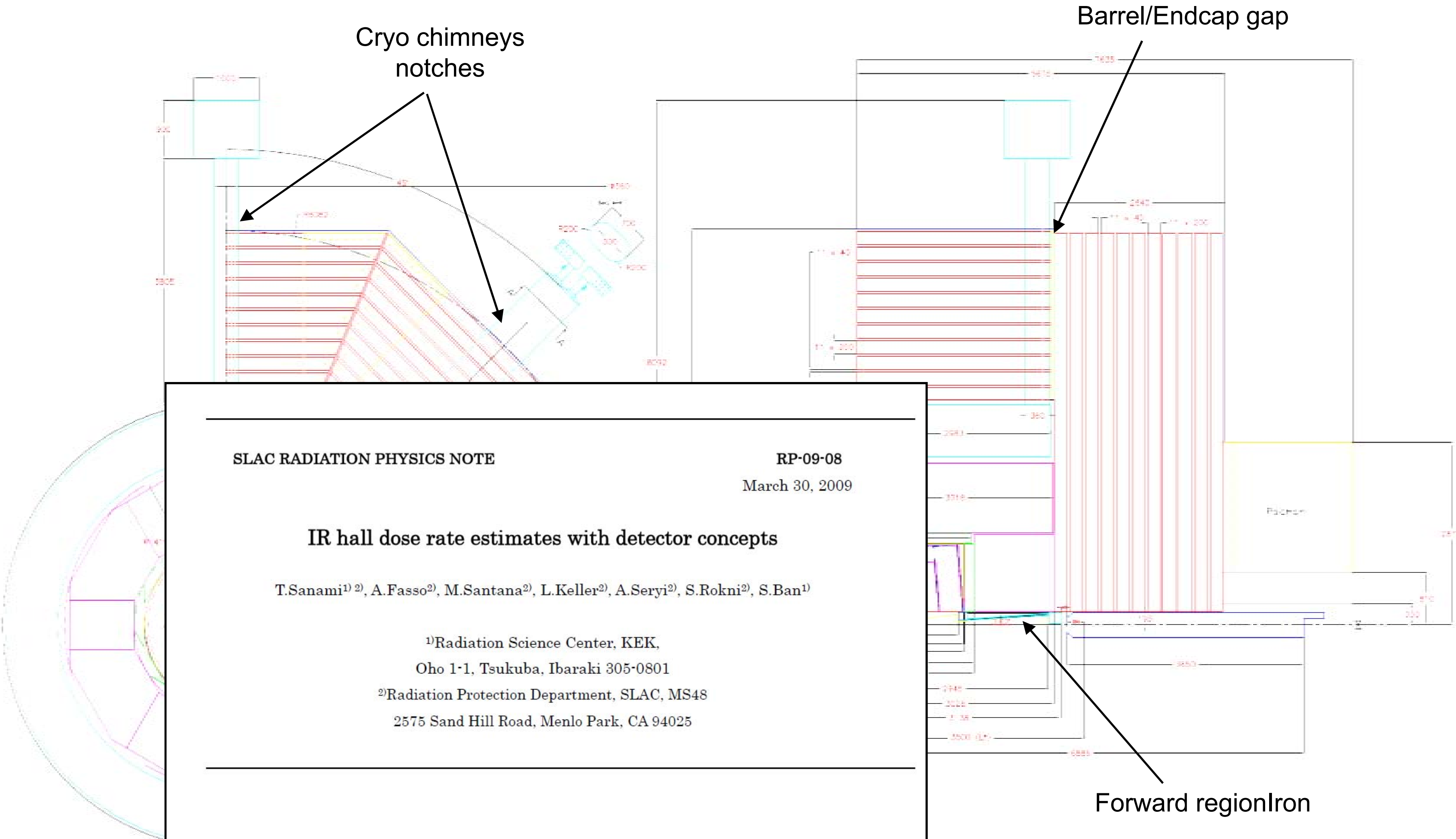
Radiation shielding is essential with two detectors occupying the same Interaction Region hall.

The criteria of the shielding design for the LoI are the following :

• ***Normal operation***: the dose anywhere beyond the 15m zone housing the off-beamline detector should be less than 0.5 μSv/hour.

• ***Accidental beam loss***: simultaneous loss of both e+ and e- beams at 250 GeV/beam anywhere, at maximum beam power. In that case, the dose rate for occupational workers in zones with permitted access should be less than 250mSv/h and the integrated dose less than 1mSv per accident.

Parameters drawing in use for the Radiation simulation



SLAC RADIATION PHYSICS NOTE RP-09-08

March 30, 2009

IR hall dose rate estimates with detector concepts

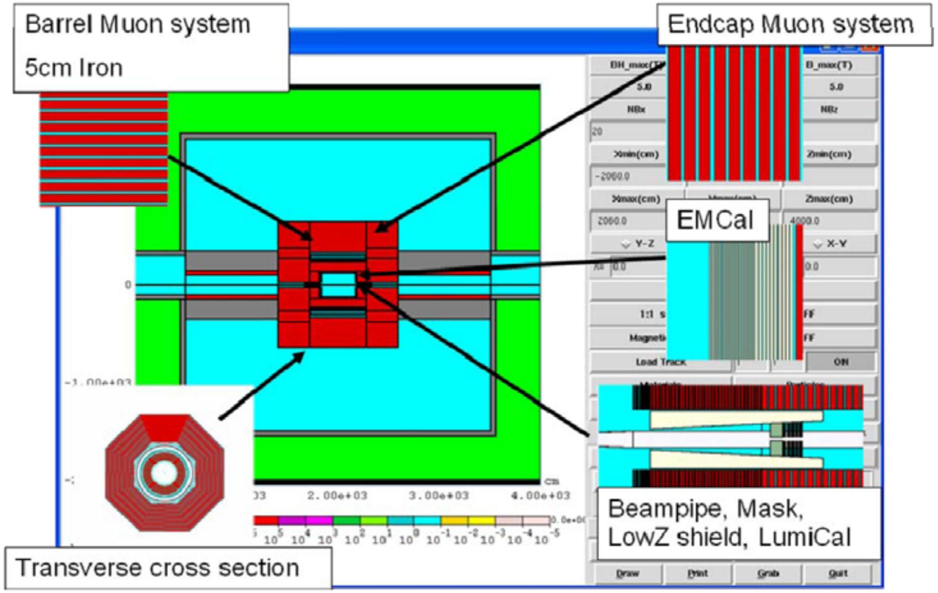
T.Sanami[1) 2)], A.Fasso[2)], M.Santana[2)], L.Keller[2)], A.Seryi[2)], S.Rokni[2)], S.Ban[1)]

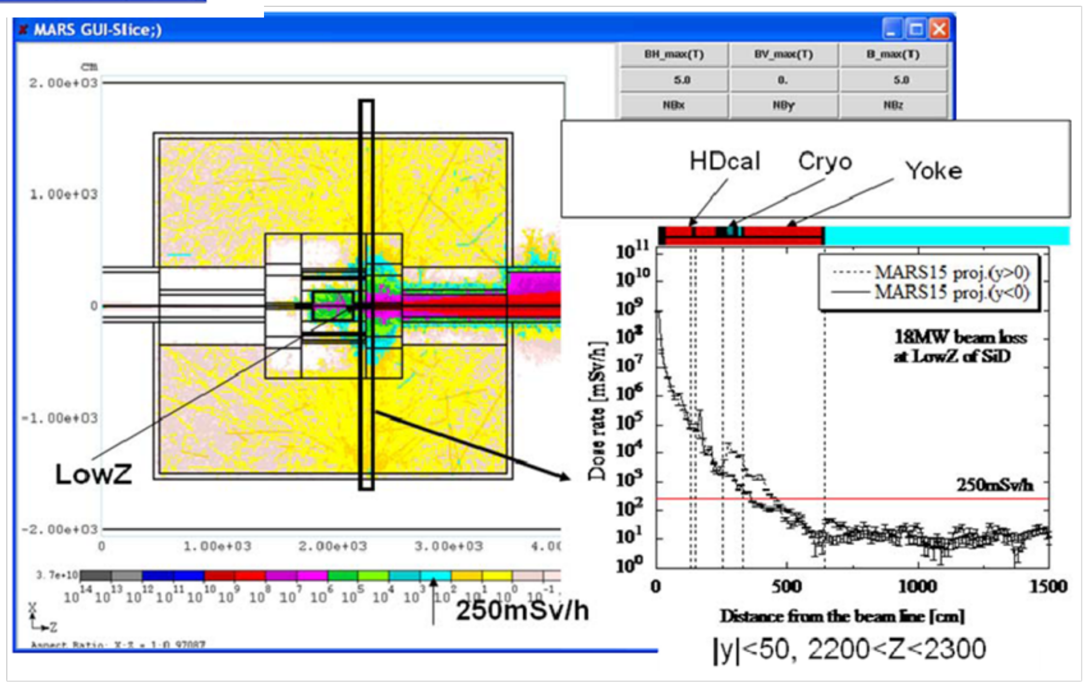
[1)]Radiation Science Center, KEK,
Oho 1-1, Tsukuba, Ibaraki 305-0801
[2)]Radiation Protection Department, SLAC, MS48
2575 Sand Hill Road, Menlo Park, CA 94025

Abstract

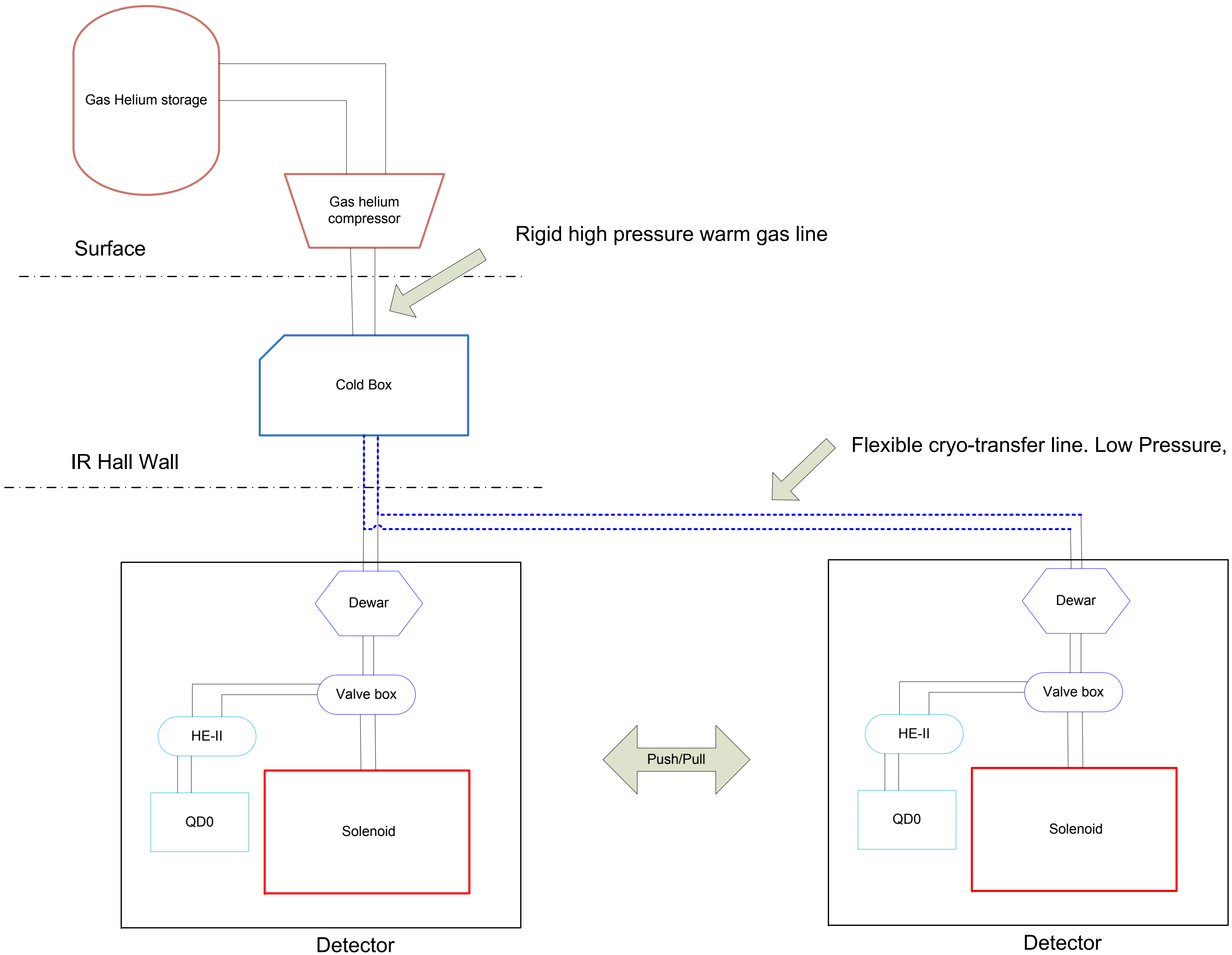
Dose rates in IR hall are estimated with several kinds of designs of detector, shielding walls and pacmans. The obtained dose rates are evaluated in comparison with existing criteria for area classification of radiation safety aspects.

Radiation Environment



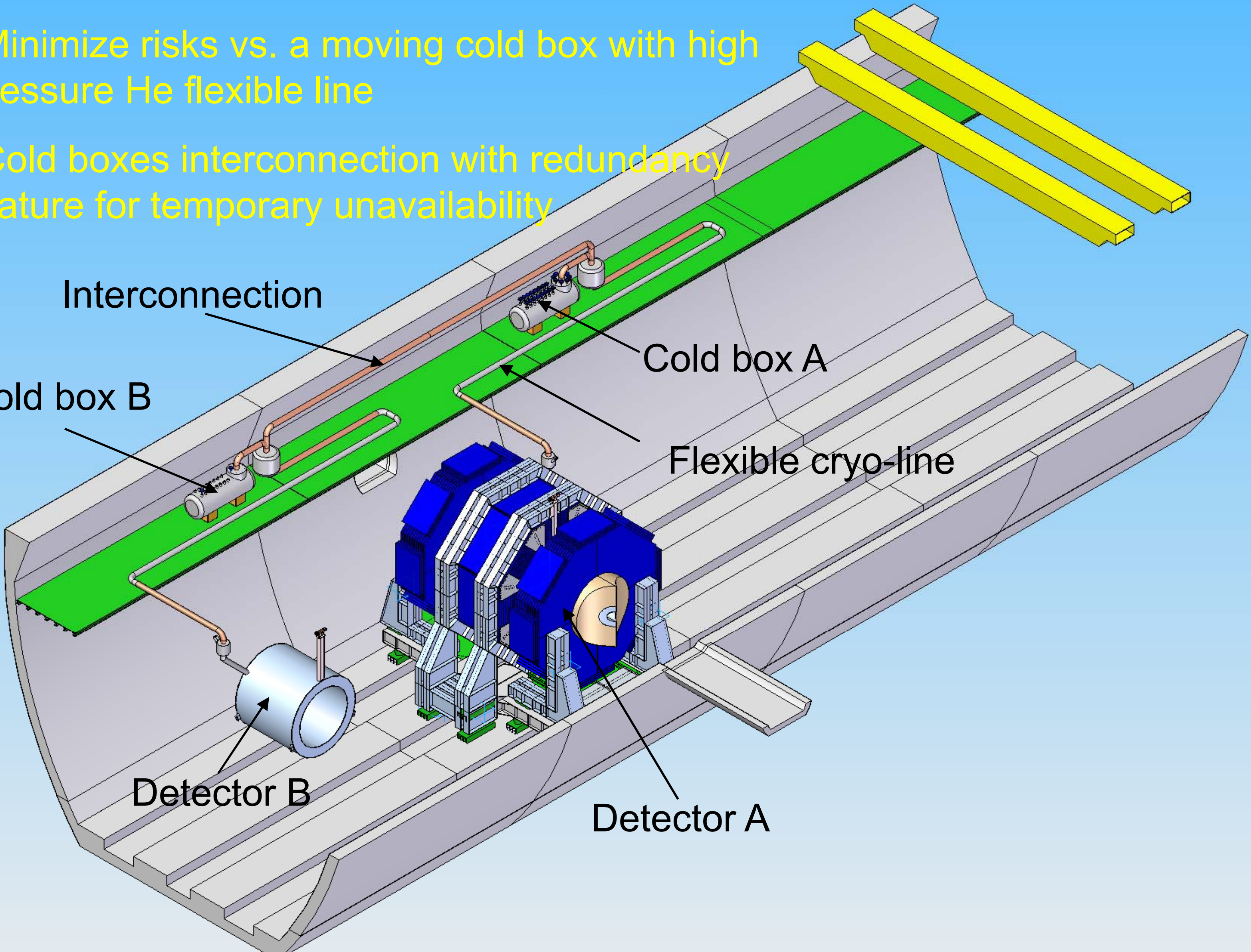


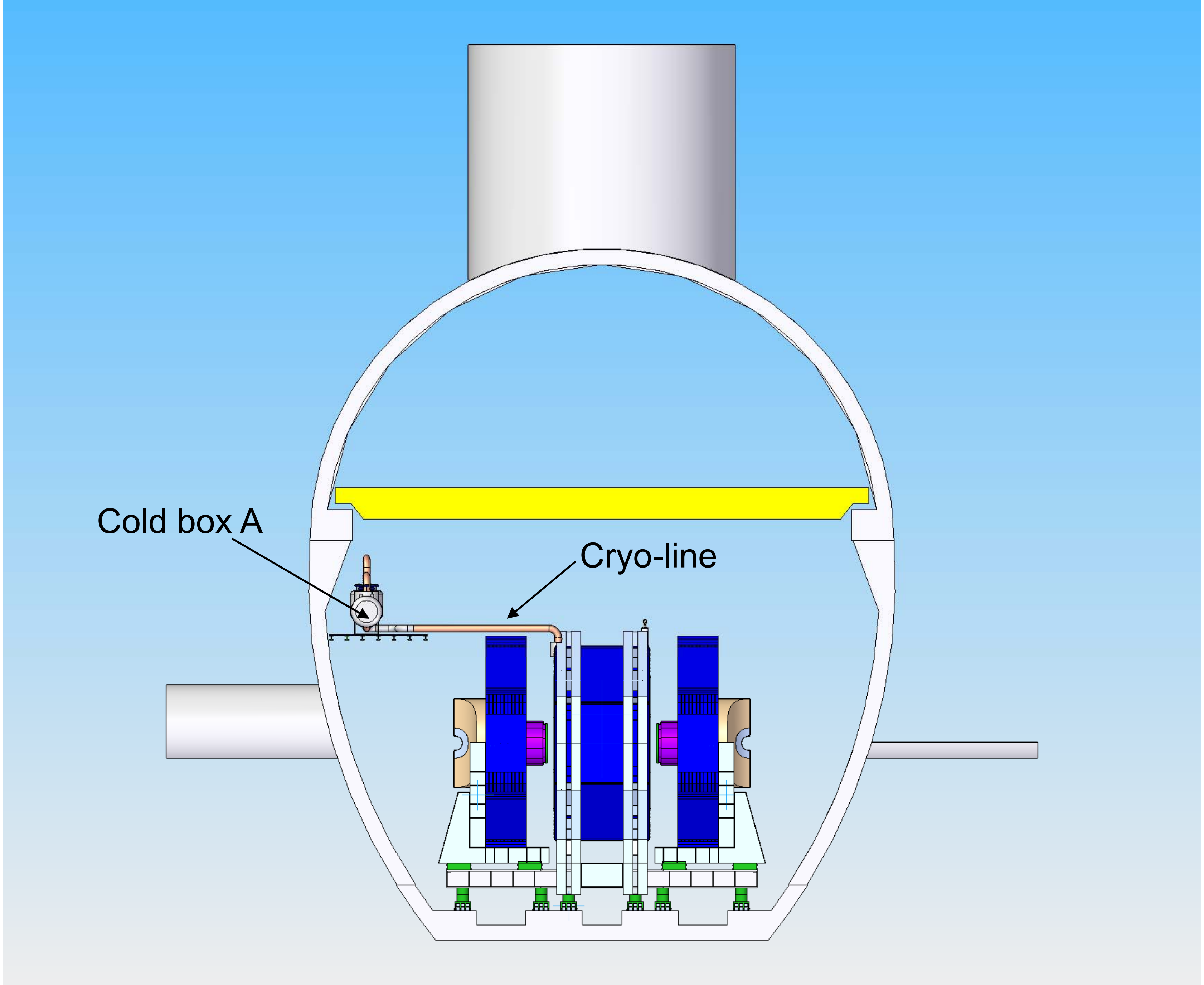
Cryogenics layout



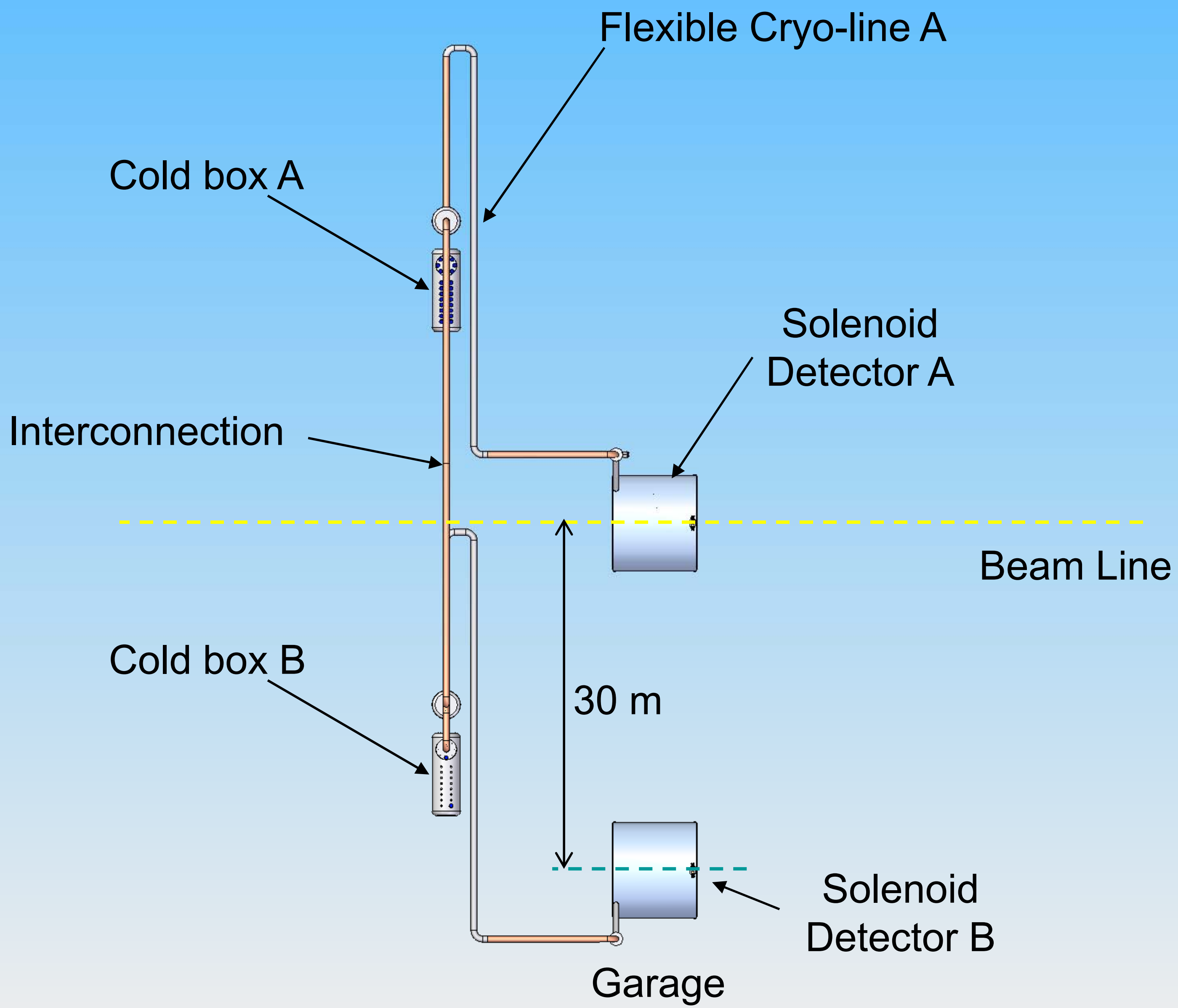
Cryogenics system design for push-pull

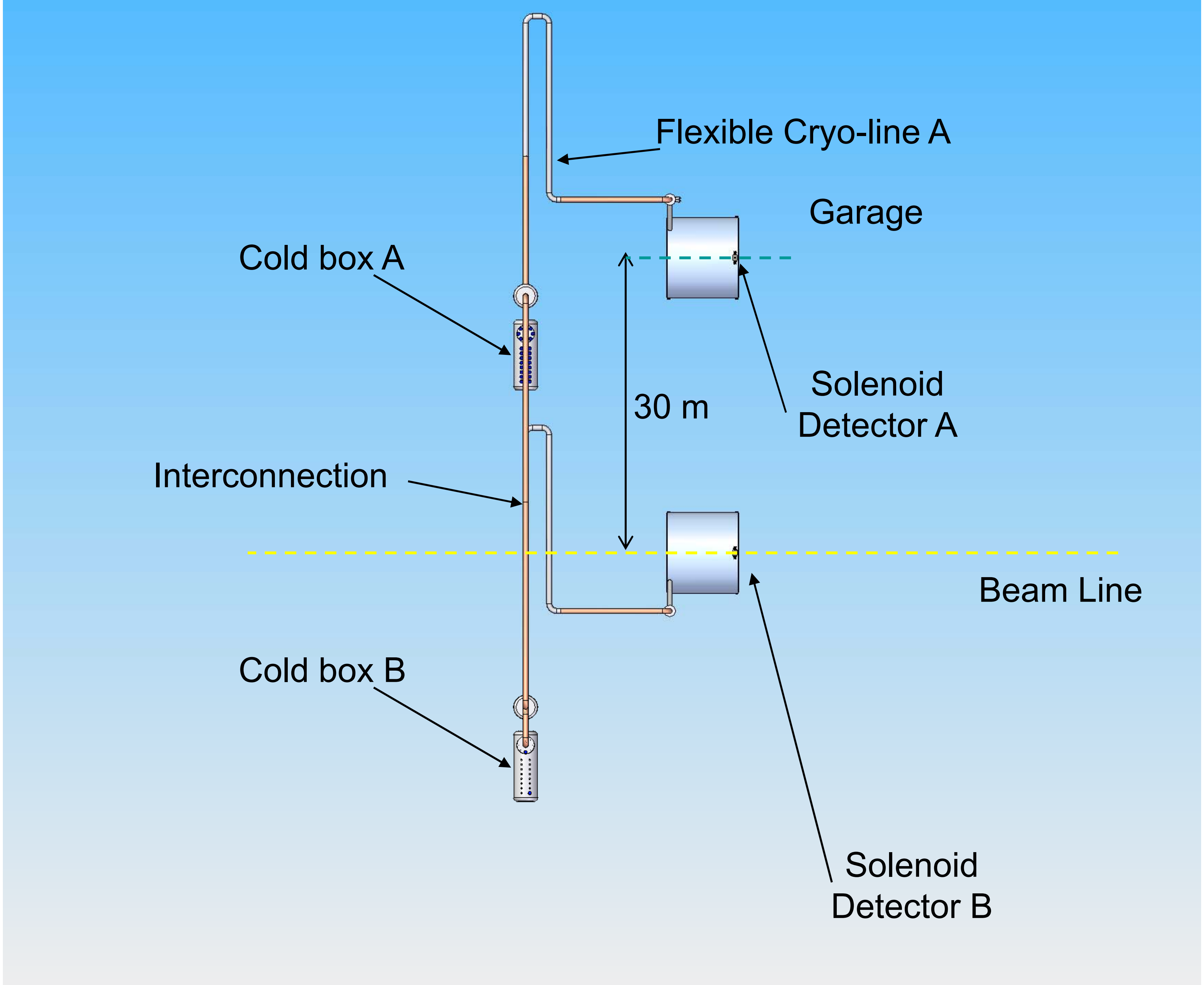
- Stationary cold box with flexible cryo-transfer line
- Minimize risks vs. a moving cold box with high pressure He flexible line
- Cold boxes interconnection with redundancy feature for temporary unavailability





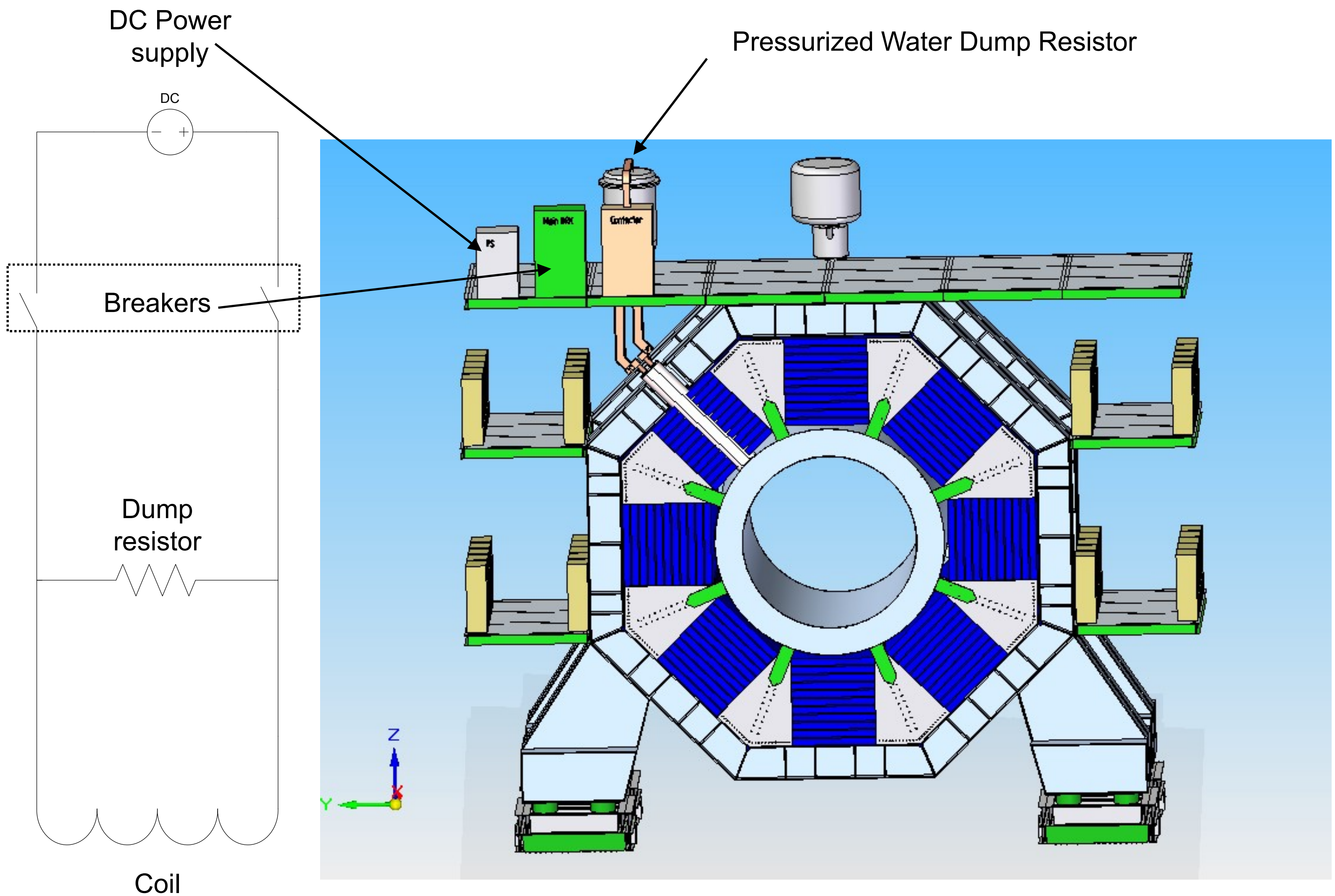
Detector open on the beam line


Flexible Cryo-line A
Cold box A
Solenoid
Detector A
Interconnection
Beam Line
Cold box B
30 m
Solenoid
Detector B
Garage

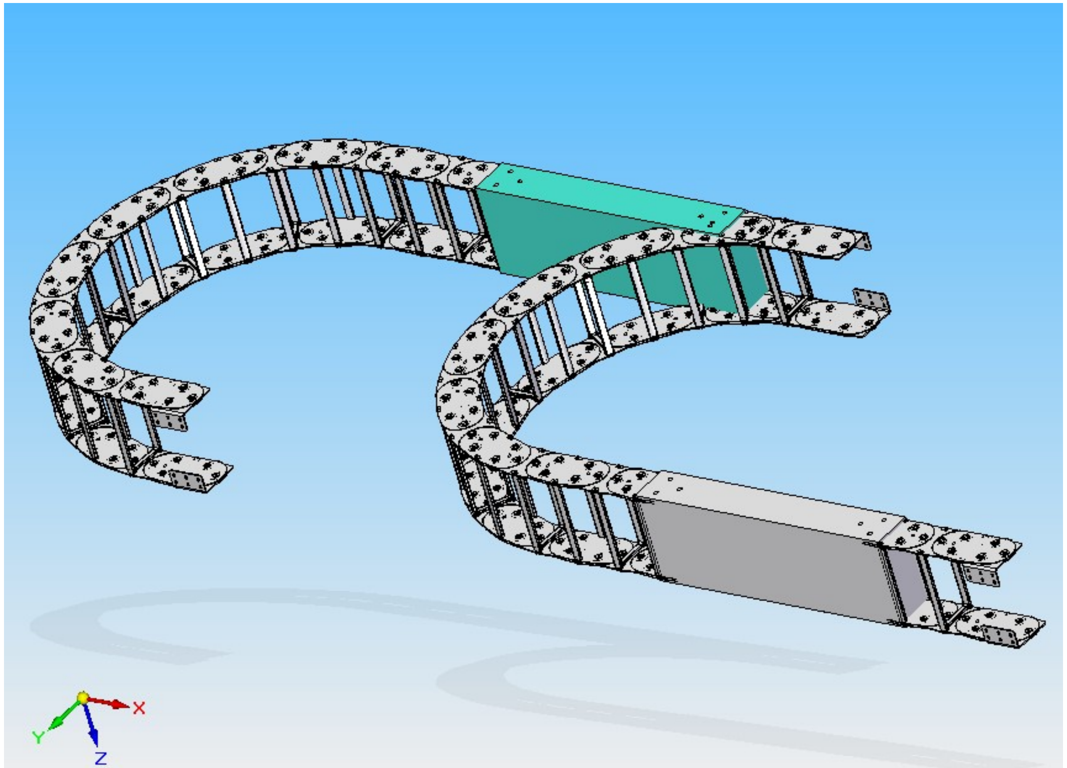


Flexible Cryo-line A
Garage
Cold box A
30 m
Solenoid Detector A
Interconnection
Beam Line
Cold box B
Solenoid Detector B

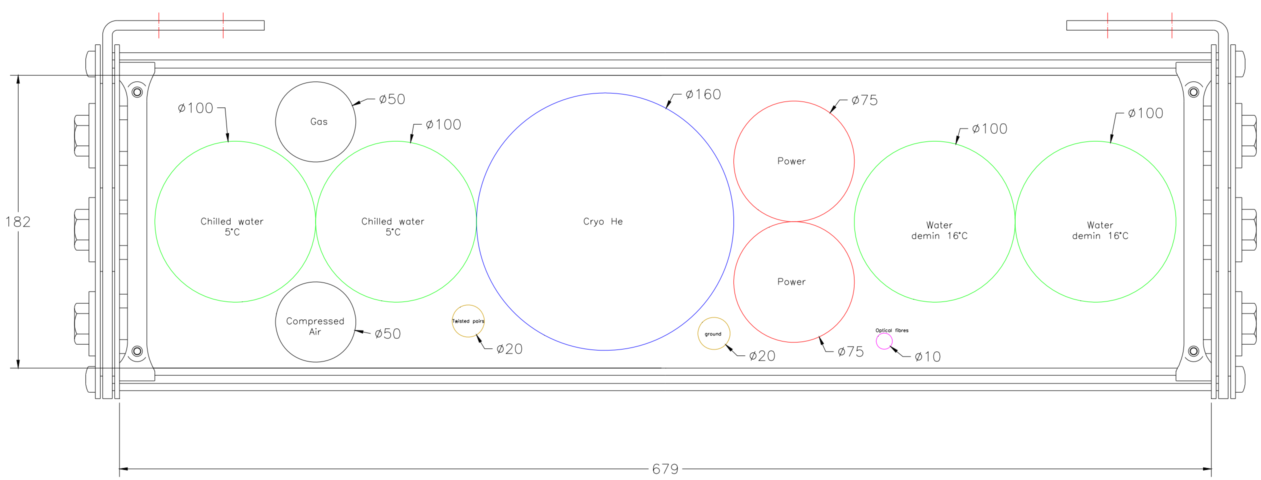
Solenoid electrical circuit



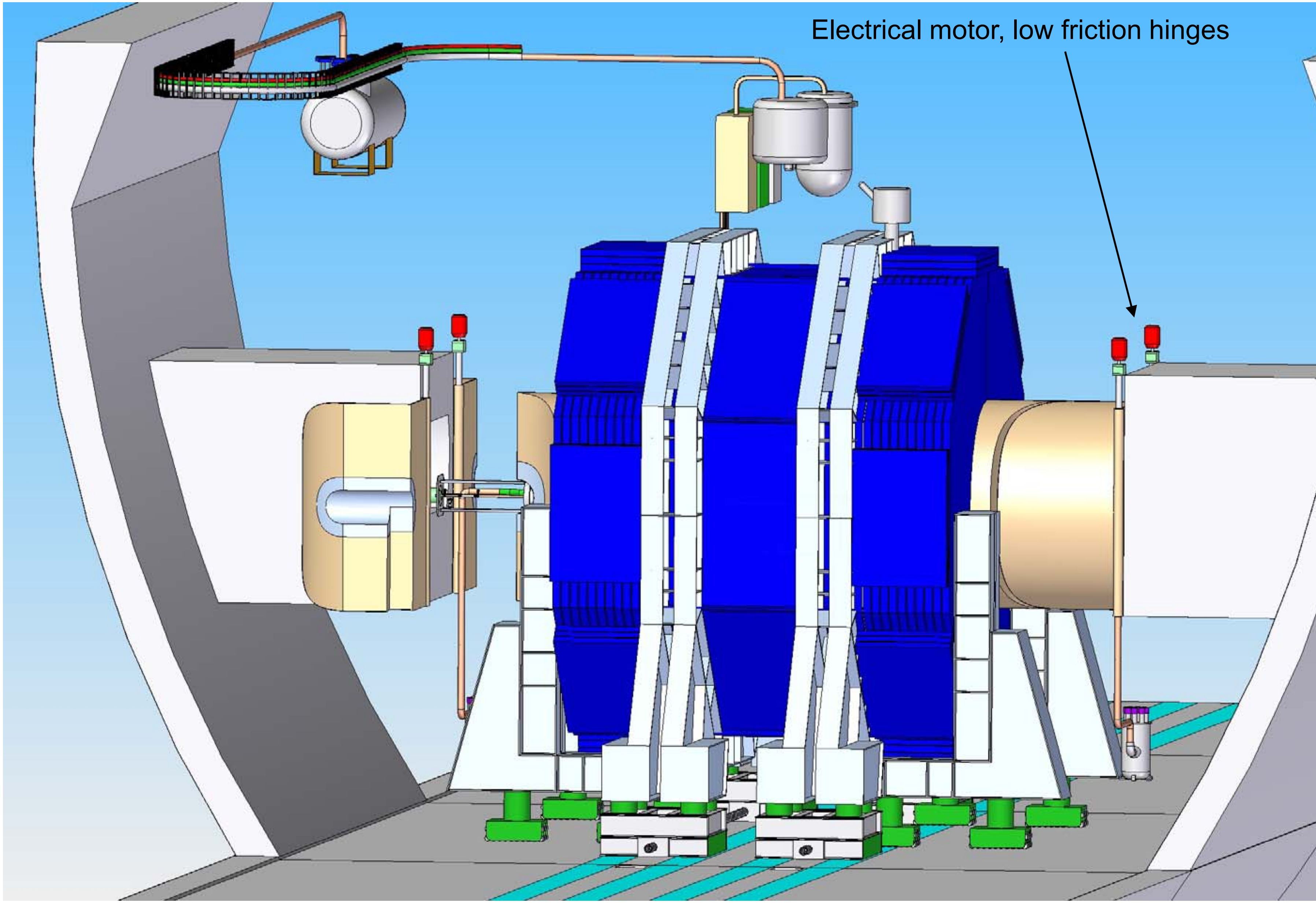
Cable chain



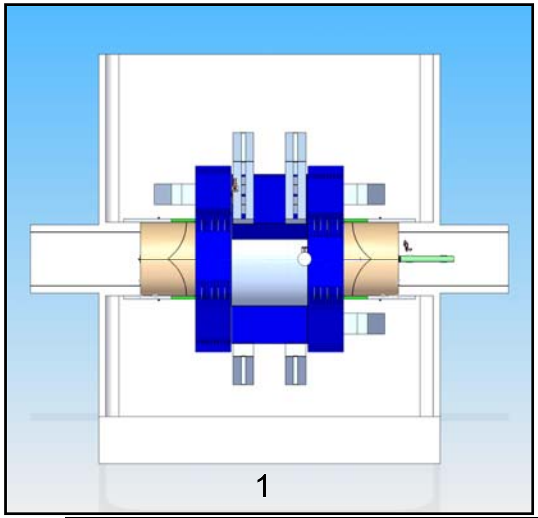
	Qty	OD mm
Cryogenics	1	160
Demin. Water 16°C	2	100
Chilled Water 5°C	2	100
Power	2	75
Gas Mix	2	50
Compressed Air	1	50
Twisted Pairs	1	20
Ground	1	20
Optical fiber	1	10



Rotating Pacmen



Detector opening on the beam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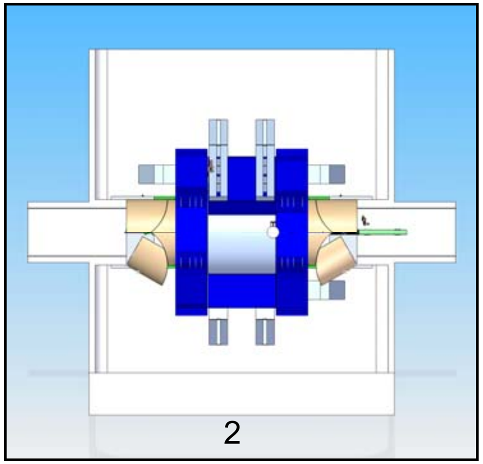
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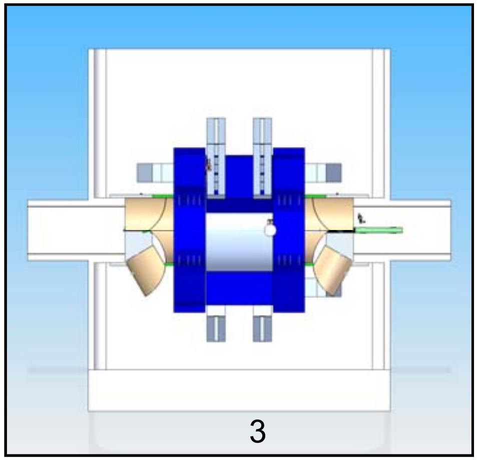
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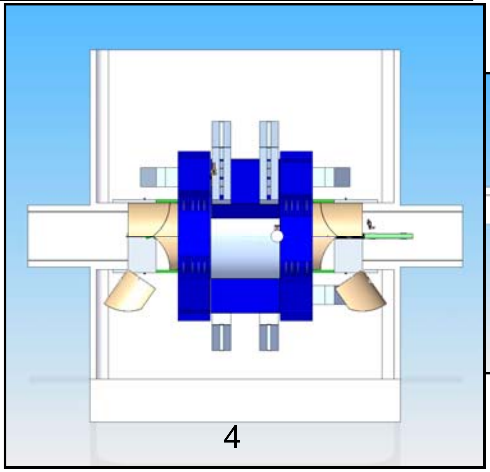
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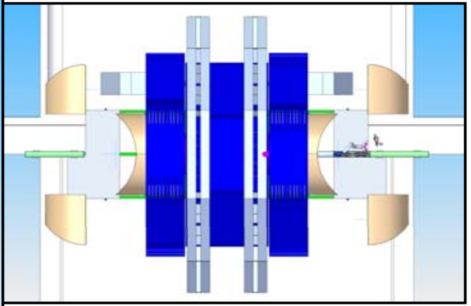
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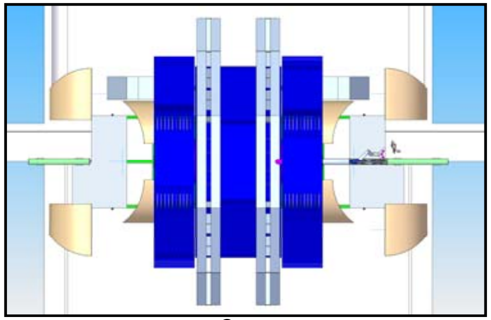
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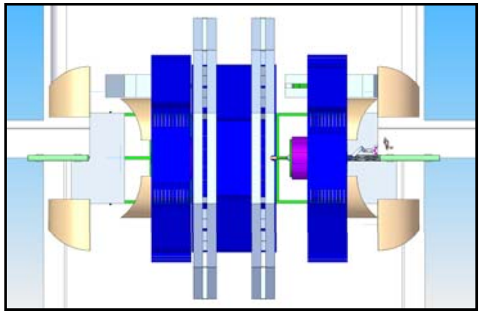
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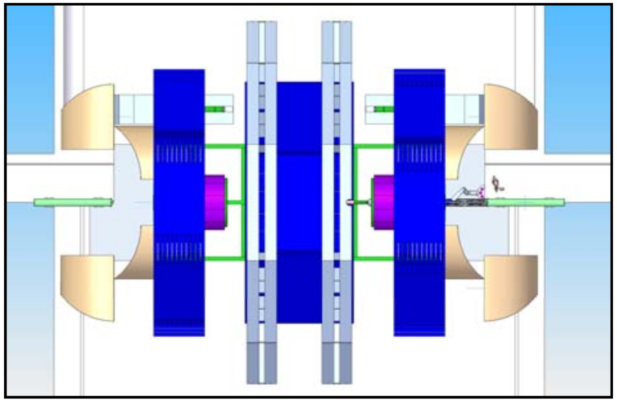
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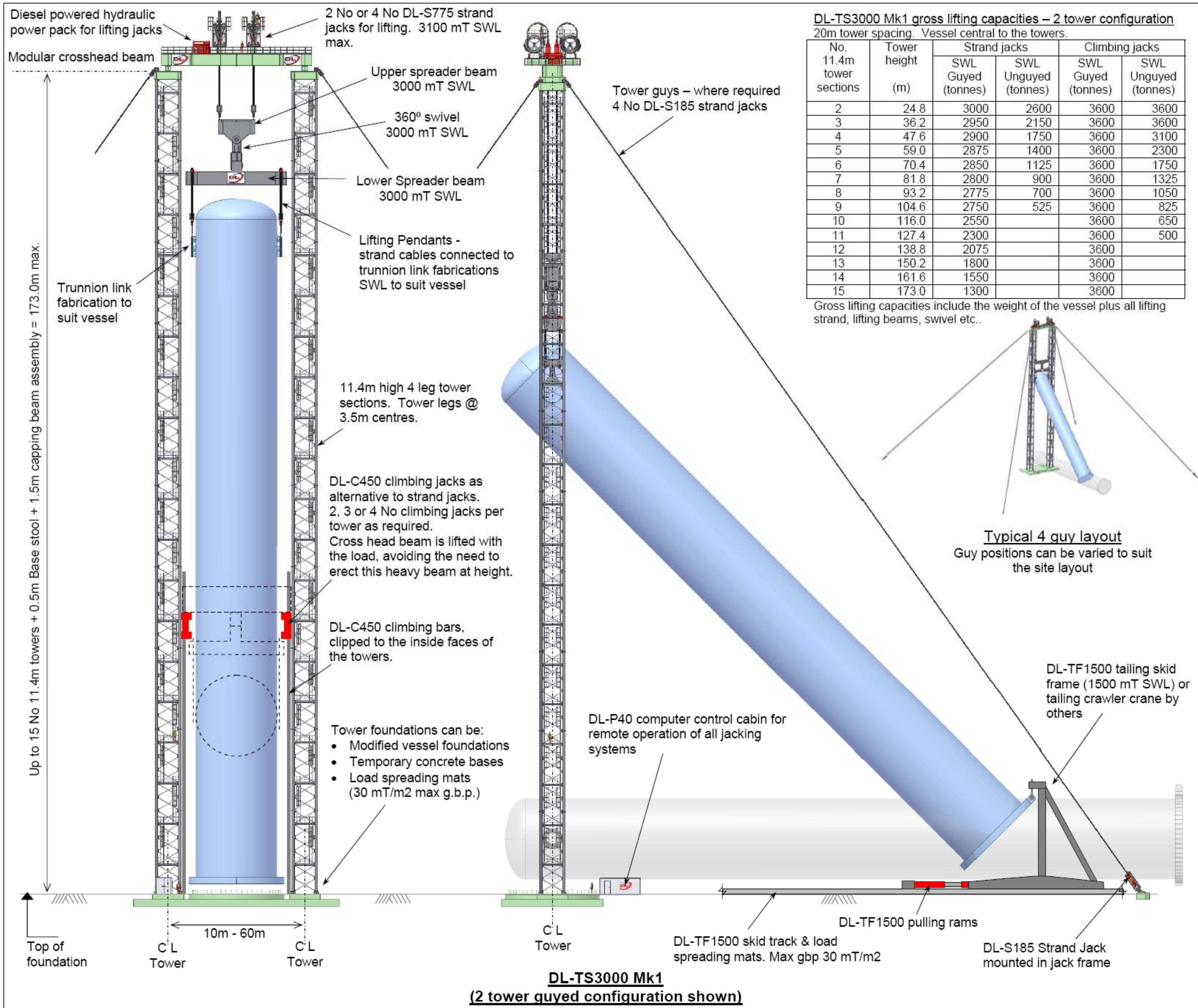
Assembly Scenarios

- There appears to be a debate between surface and below ground assembly.
- However:
  - The major detector modules will be assembled elsewhere. This obviously includes the VXD, Tracker, EMCal, and HCal.
  - The muon detectors can be loaded into the iron elsewhere.
  - The solenoid will be wound elsewhere.
  - The amount of cabling and services on SiD is tiny compared to the LHC detectors.
- Therefore, we can choose among:
  - Assemble the barrel and doors above ground and lower the ~4Ktonne barrel and two ~2Ktonne doors.
  - Final assembly of the major steel components below ground. Depending on steel design, components might weigh 100-500 tonnes. The solenoid with calorimeters weighs ~700 tonnes, but calorimeters could be inserted later.
- Actual strategy depends on details of site and schedules

Gantry Crane for the surface assembly option



DL-TS3000 Mk1 gross lifting capacities – 2 tower configuration

20m tower spacing. Vessel central to the towers.

No. 11.4m tower sections	Tower height (m)	Strand jacks		Climbing jacks	
		SWL Guyed (tonnes)	SWL Unguyed (tonnes)	SWL Guyed (tonnes)	SWL Unguyed (tonnes)
2	24.8	3000	2600	3600	3600
3	36.2	2950	2150	3600	3600
4	47.6	2900	1750	3600	3100
5	59.0	2875	1400	3600	2300
6	70.4	2850	1125	3600	1750
7	81.8	2800	900	3600	1325
8	93.2	2775	700	3600	1050
9	104.6	2750	525	3600	825
10	116.0	2550		3600	650
11	127.4	2300		3600	500
12	138.8	2075		3600	
13	150.2	1800		3600	
14	161.6	1550		3600	
15	173.0	1300		3600	

Gross lifting capacities include the weight of the vessel plus all lifting strand, lifting beams, swivel etc..

Notes:

General

The DL-TS3000 Mk1 can be used in 2 tower or 4 tower configuration, guyed or unguyed, and using either strand jacks or climbing jacks for lifting. The system can self erect and self dismantle to avoid the need for a large tower erection crane. Vessels can be lifted, skidded laterally and rotated as required to suit delivery position. All jacking systems are monitored and controlled from ground level by a single operator using the DL-P40 computer control system. All items are transported in standard shipping containers.

Specification

Lifting capacity:	See table
Lifting speed:	10-30 m/hr
Max tower spacing:	60m
Max lifting wind speed:	20 m/sec
Max storm wind:	40 m/sec @ 10m
Operating temp:	-20 to +50 deg
Foundation options:	see drawing
Guys:	4 x 185 mT SWL

Unguyed towers can only resist 40 m/sec storm winds up to 6 towers high with cross beam at top for strand jacks and 7 towers high where no top cross beam used, i.e. in climbing jack configuration.

The information provided on this drawing is intended for initial evaluation purposes only. DLT will provide a detailed proposal for each project giving more specific information.

Rev	Date	Status	Description	By
A	20/03/07	INF	First issue	TB

Dorman Long Technology

www.dormanlongtechnology.com

Project: DL-TS3000 Mk1

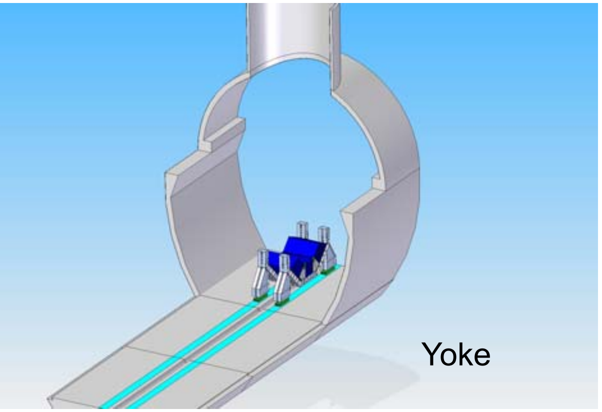
Drawing Title: DL-TS3000 Mk1 General arrangement and duty charts for guyed and unguyed configurations

Design Eng: GG	Checking Eng: PW
Drawn By: DD	Project Eng: MO

Drawing Status: INFORMATION

Drawing No.	Sheet.	Rev.
DL-TS3000/001		A

Assembly sequence



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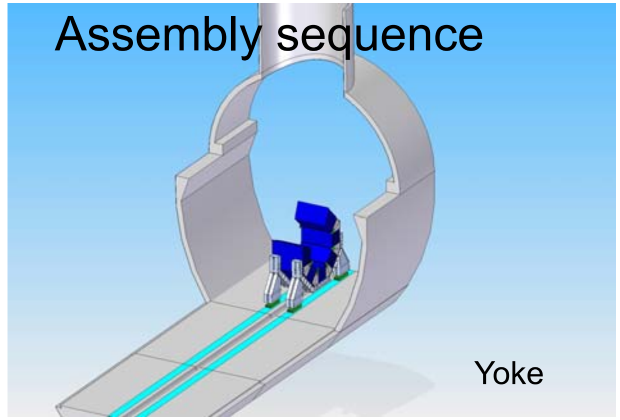

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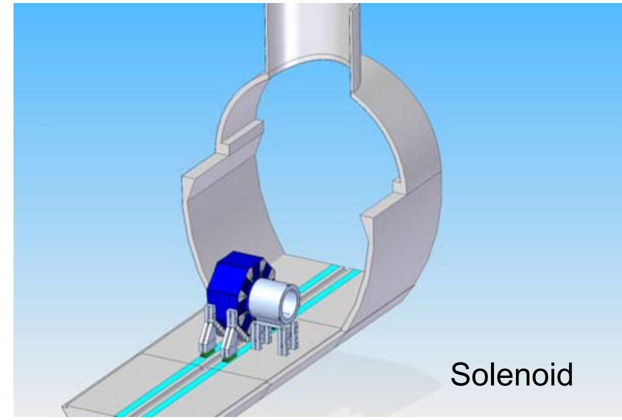

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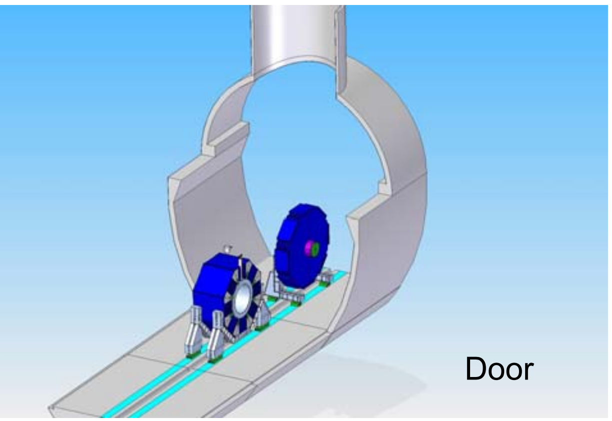

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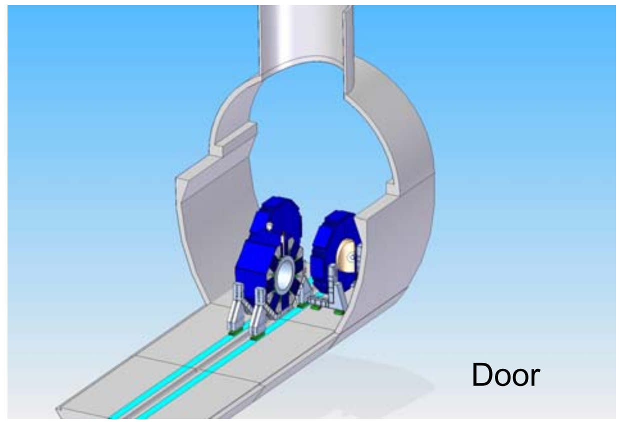

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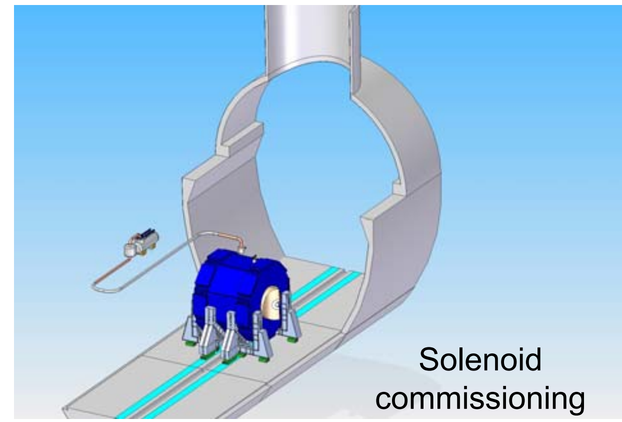

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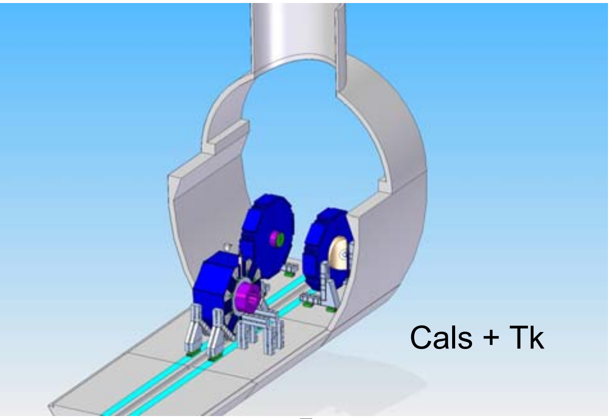

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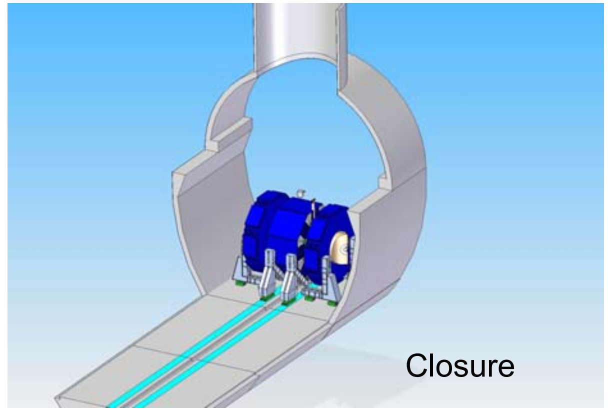

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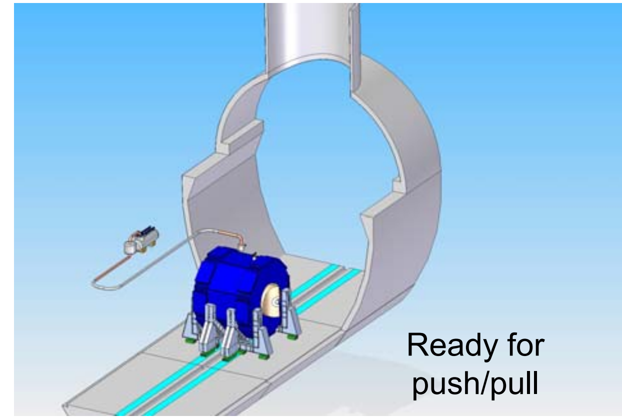

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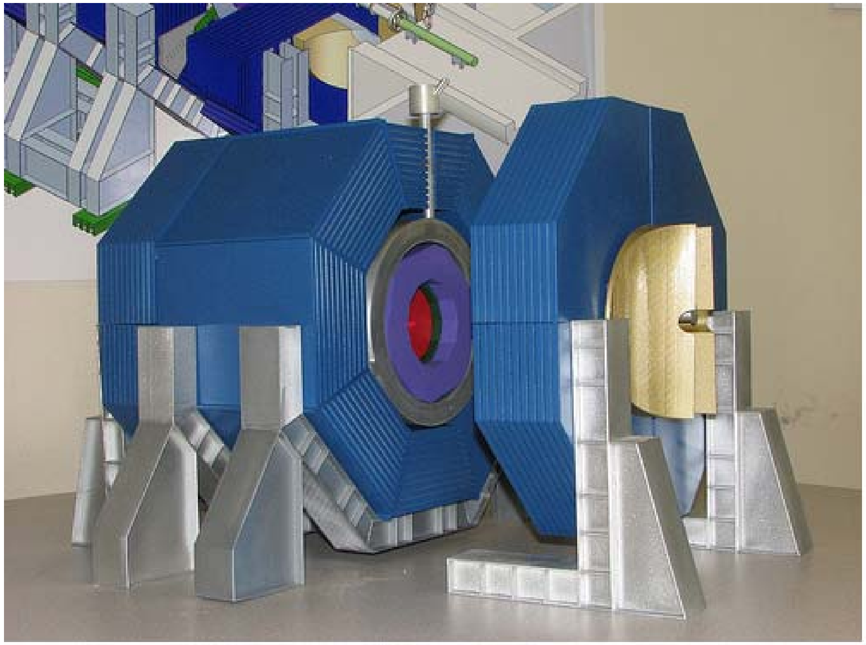
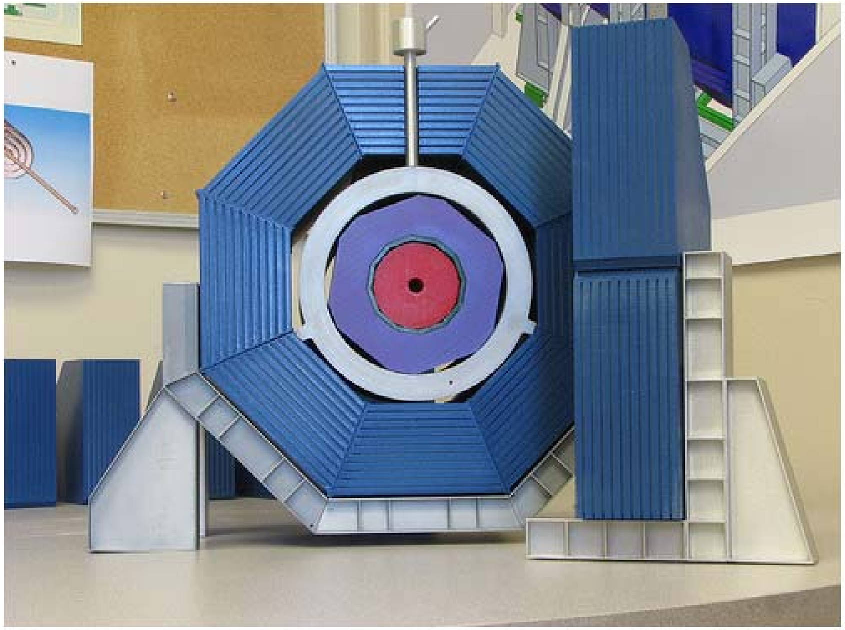
Rapid prototyping plotter for assembly and Integration studies





Comments

To progress in many of these areas a degree of mutual cooperation and discussion between pairs of detectors who propose to share the IR is required.

Where different, technical solutions adopted by the detector concepts need to be developed and brought at the level sufficient to make a comparison, e.g. platform and QD0 supports

The ILD and SiD concepts which present themselves as "self-shielded" need to discuss which elements of their shielding mate, e.g. rotating vs. sliding pacmen