ILC Interaction Region Engineering Design Workshop 17, 21 Sep. 2007 @ SLAC

The Mounting Procedure for BeamCal
W. Lohmann

BeamCal:

- ensures hermeticity of the detector to smallest polar angles

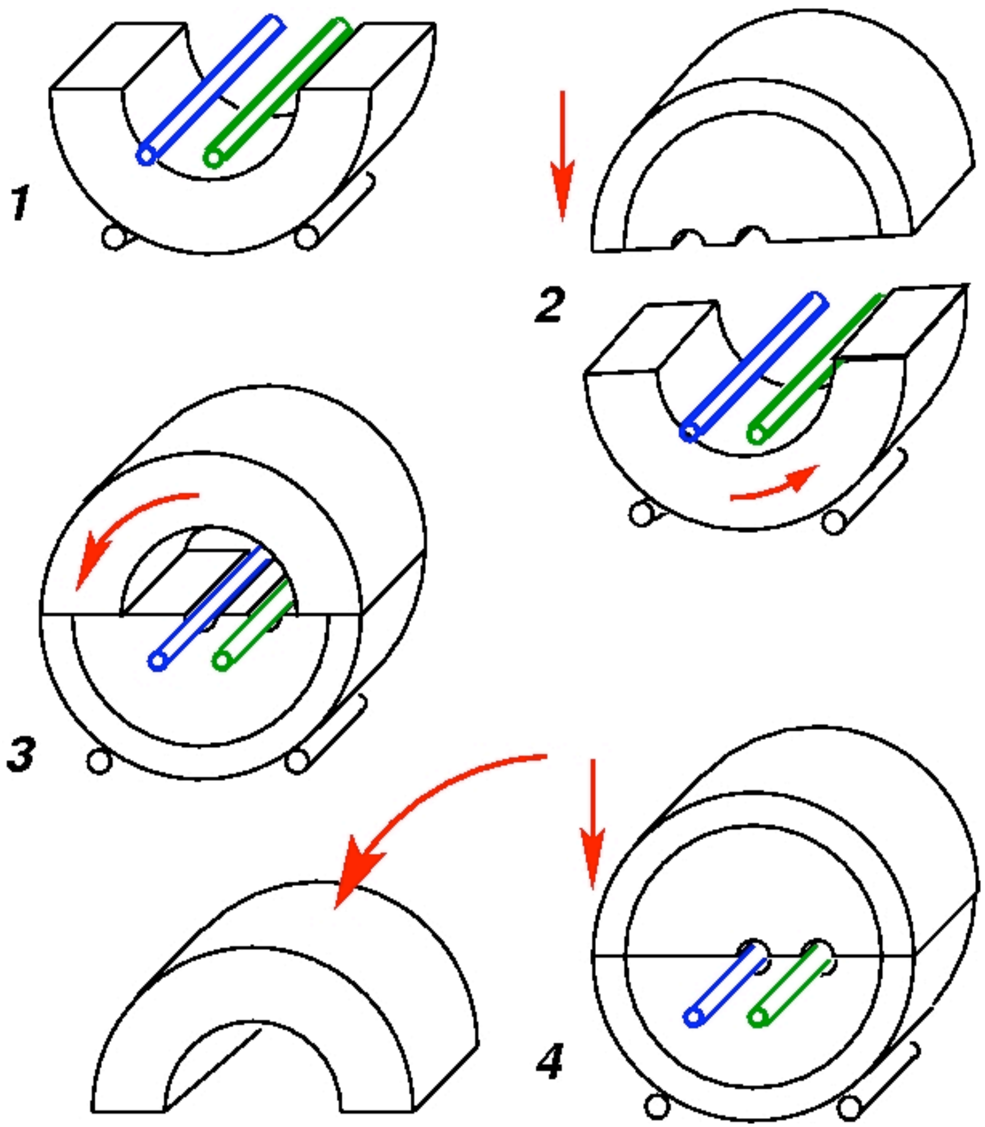
-important for searches

Serves as a feedback system for Lumi-optimisation

and beam diagnostics

-supports maximum Luminosity

The Mounting Procedure for BeamCal
W. Lohmann



Installation and disassembly must be possible without opening the vacuum!

1 montage of an auxiliary structure

2 montage of the first half barrel

3 Turn the barrel and bring the first calorimeter half barrel in final position

4 remove the auxiliary structure

5 montage of the second half barrel

To perform this procedure the upper half of the shielding tube has to be removed

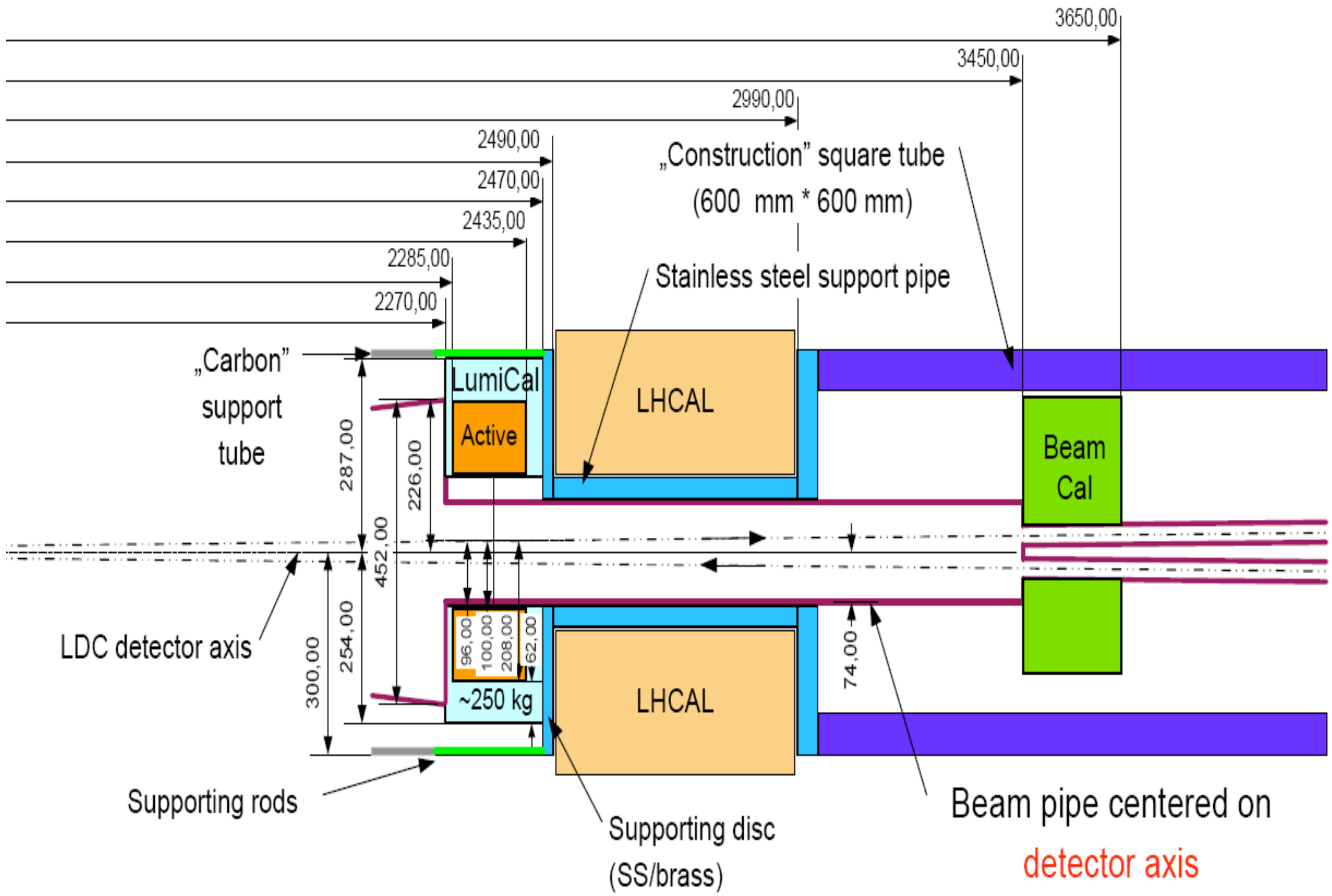
The Mounting Procedure for BeamCal
W. Lohmann

BeamCal (example LDC)

- Length in z: 15 cm bare calorimeter
  ~10 cm graphite in front (reduction of backscattered electrons).
  ~10 cm space at the rare side (electronics, connectors)
- Inner and outer instrumented radius: 20 – 165 mm
- Full outer Radius: 200 mm
- Outer radius including support: 220 mm
- Total weight: ~200 kg
- Upper part of the shielding tube must be removable
- Crane operation necessary for montage/demontage

-Details of FE ASICs not yet fixed, but there will be connectors, power and signal cables.......

LumiCal mechanical design, integration Wojciech Wierba



Solution not convenient for BeamCal and vacuum (to small pipe diameter)

LumiCal mechanical design, integration
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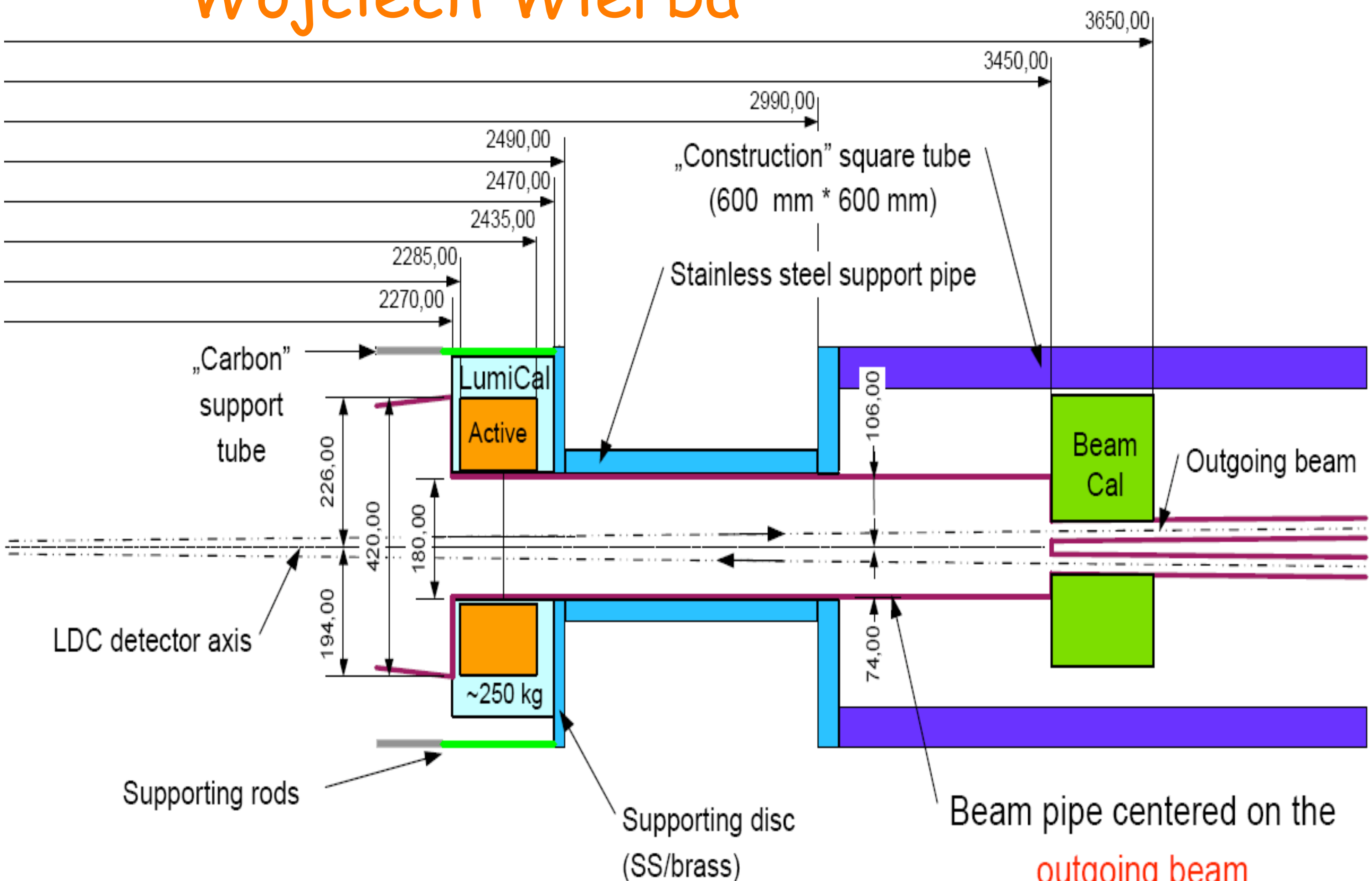


Better for BeamCal and vacuum, the LHCal has to be centered on the outgoing beam. The beam pipe diameter between LumiCal and BeamCal has to be discussed more carefully.

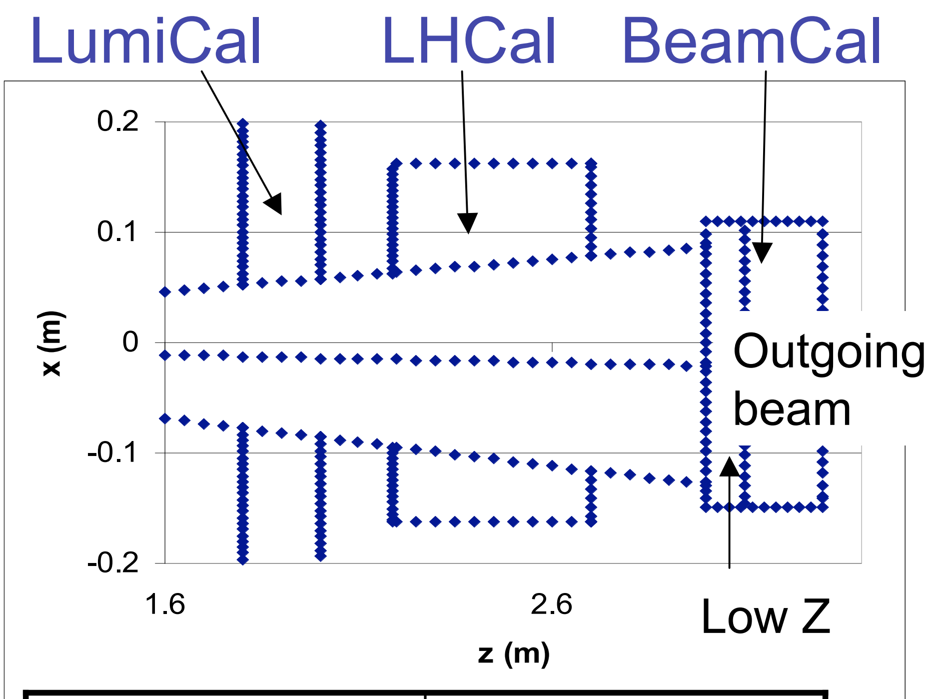
LumiCal mechanical design, integration
Wojciech Wierba

- It is not necessary to open and take out LumiCal for Vertex and TPC maintenance.
- But, to pull out TPC, it is necessary to disconnect cables and cooling pipes.
- Need space for connectors and access to cables and pipes.
- For LumiCal maintenance (beam pipe exchange) it is necessary to install temporary support with movable cars.

- LumiCal x, y position with respect to the beam (incoming) should be known with accuracy better than ~700 μm (better ~100-200 μm) (LumiCal's will be centered on outgoing beam)
- Distance between two LumiCal's should be known with accuracy better than ~60-100 μm (14 mrad angle)

LumiCal, LHCal, BeamCal, GamCal
W. Morse

- LumiCal – precision integrated luminosity measurement (Bhabhas), and hermeticity
- dL/L <10-3 for √s = 0.5TeV
- dL/L <2´10-4 for GigaZ – very challenging!
- LHCal – ID muons behind LumiCal
- BeamCal – instantaneous luminosity optimization (beam-strahlung pairs) and hermeticity
- GamCal - instantaneous luminosity optimization (beam-strahlung g detector at z »190m)



Cal	Mass
LumiCal	≈325 kg
LHCal	≈270 kg
BeamCal	≈130 kg

LumiCal, LHCal, BeamCal, GamCal
W. Morse

Instantaneous Luminosity

- Bethe-Heitler $e\gamma \rightarrow eee$
- $N_{ee} \propto N_o N_\gamma / A_o$ so $N_{ee} / N_\gamma \propto N_o / A_o$
- N_o and A_o are for the overlap part only
- for the positrons for the left detectors (N_{o+})
- and electrons for the right detectors (N_{o-})
- Instantaneous luminosity:
- $L \propto N_{o+} N_{o-} / A_o$

LumiCal, LHCal, BeamCal, GamCal
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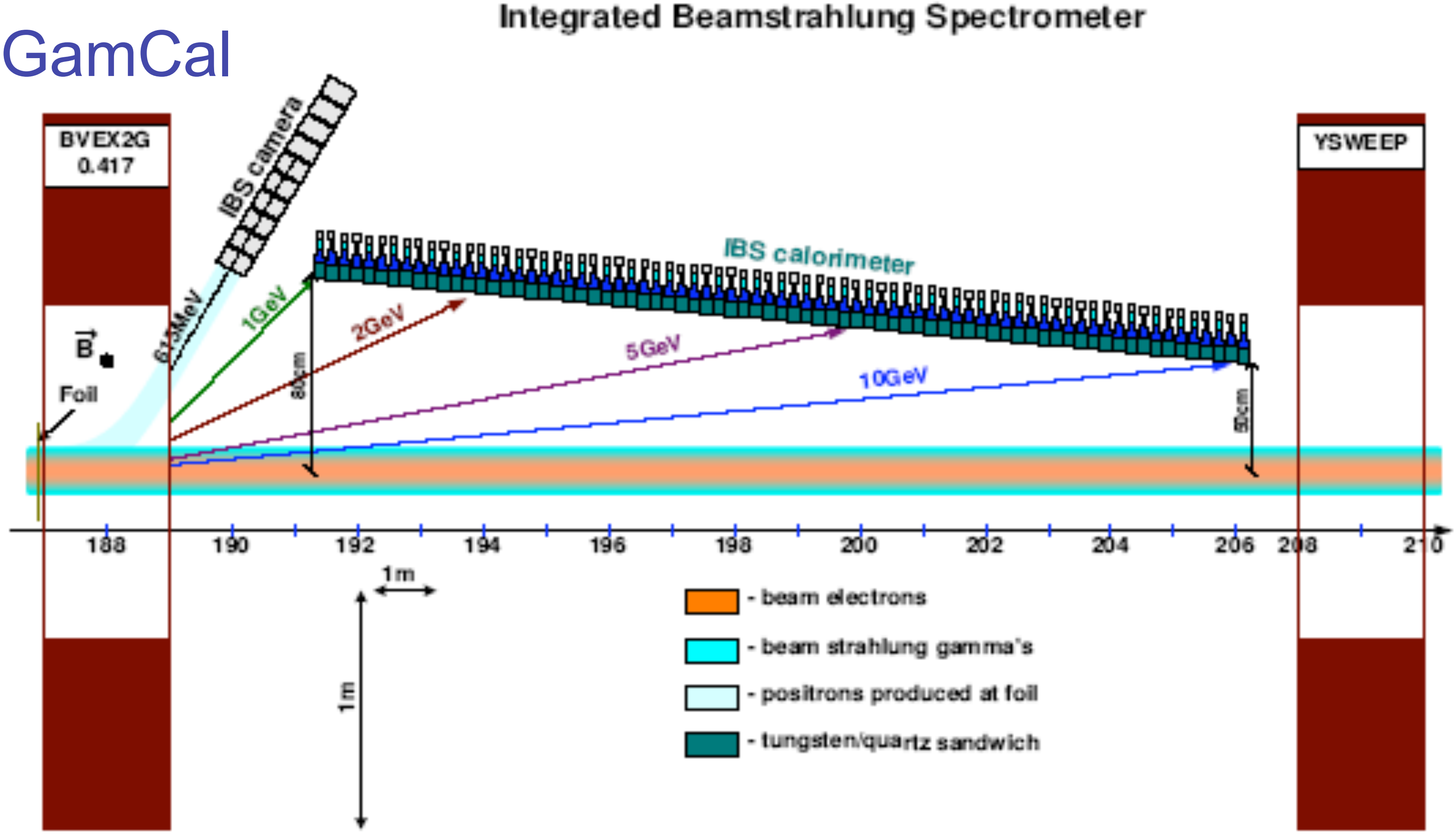
GamCal



LumiCal, LHCal, BeamCal, GamCal
W. Morse

Conclusions

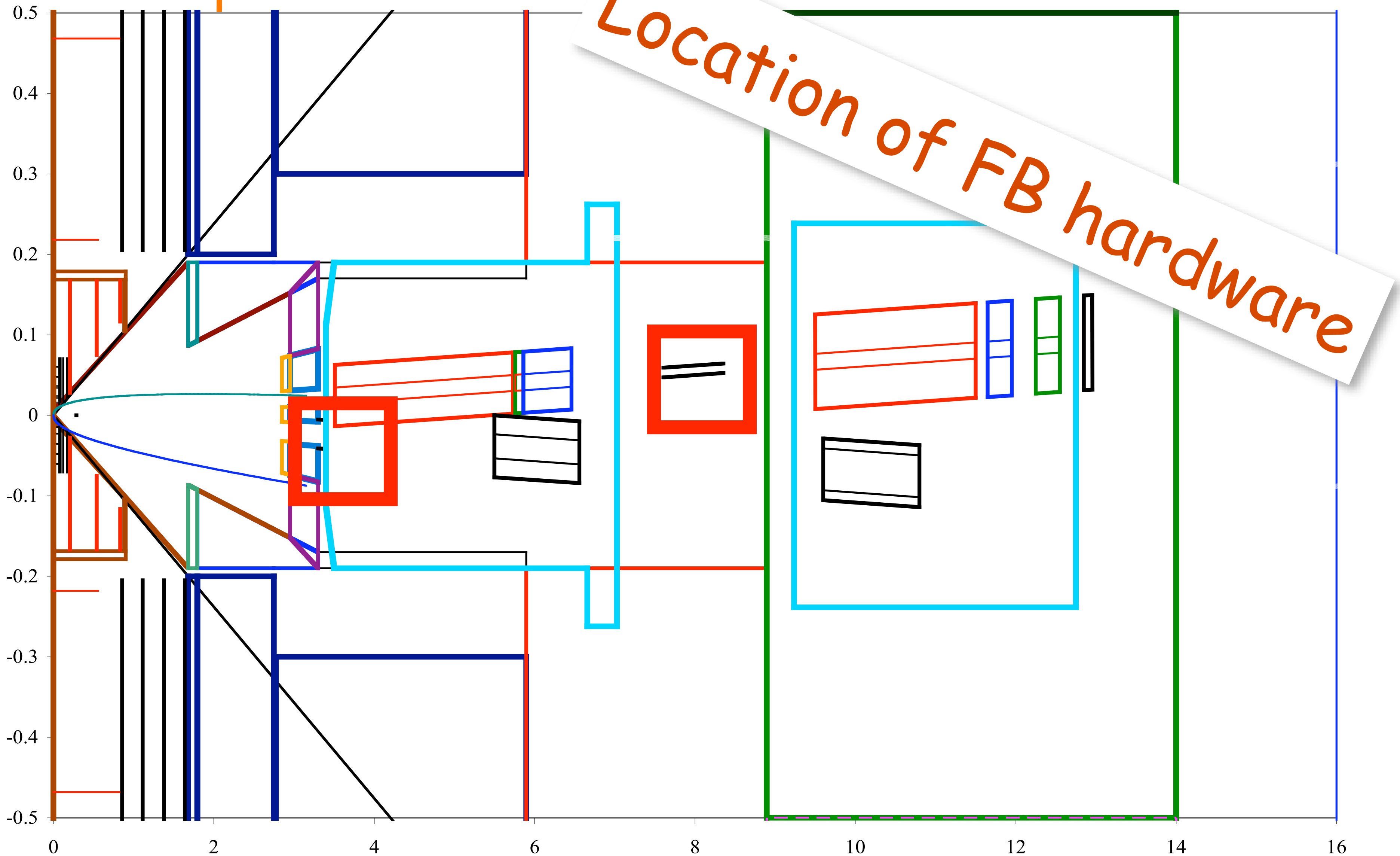
- GigaZ LumiCal physics requirement dL/L < 2´10-4 is very challenging.
- BeamCal will be statistically challenged at low beam current for instantaneous luminosity feedback.
- GamCal gives complementary info and will have good statistics.

LumiCal, LHCal, BeamCal, GamCal
W. Morse

Neutrons

- BeamCal produces $\approx 2\times10^{14}$ neutrons per year at design luminosity.
- $z \approx 3$m.
- ILC beam dump produces $\approx 4\times10^{22}$ neutrons per year.
- $z \approx 3\times10^{2}$ m.
- How many of these will scatter back into the vertex detector?
- Neutrons are hard to collimate!

Engineering issues for IP intra-train feedback
Philip Burrows



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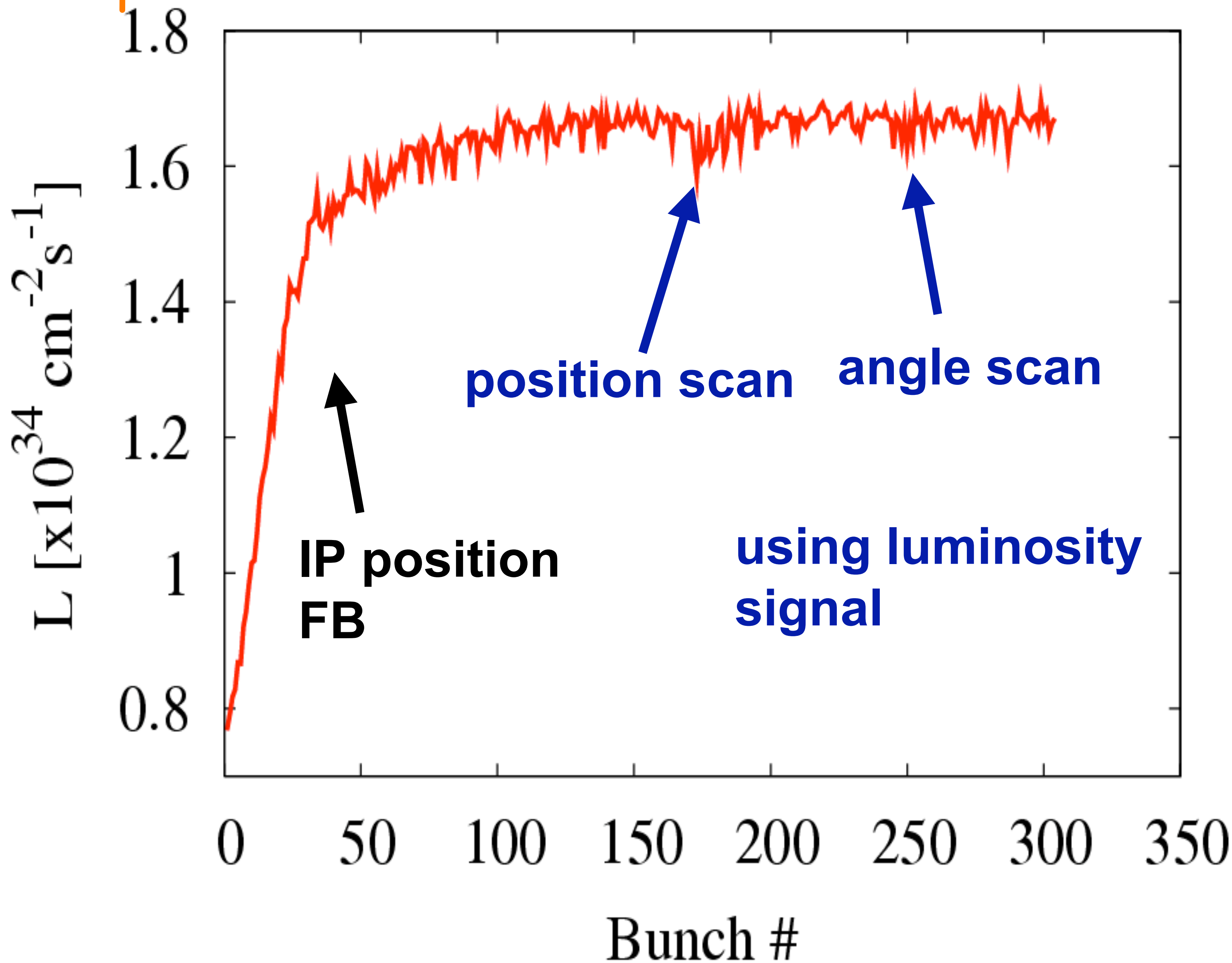
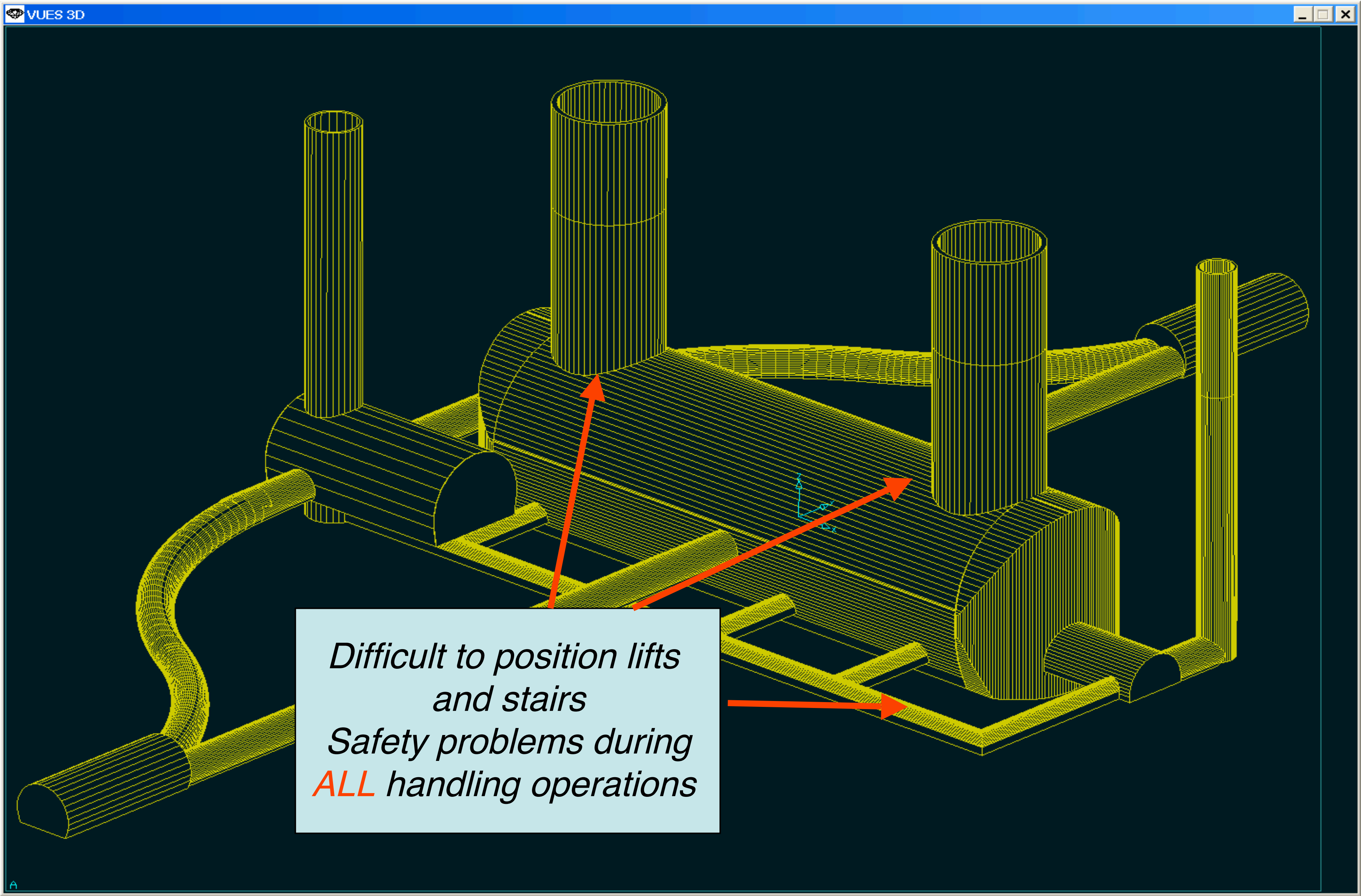


Options for IR hall and tunnels layouts
Alain Herve



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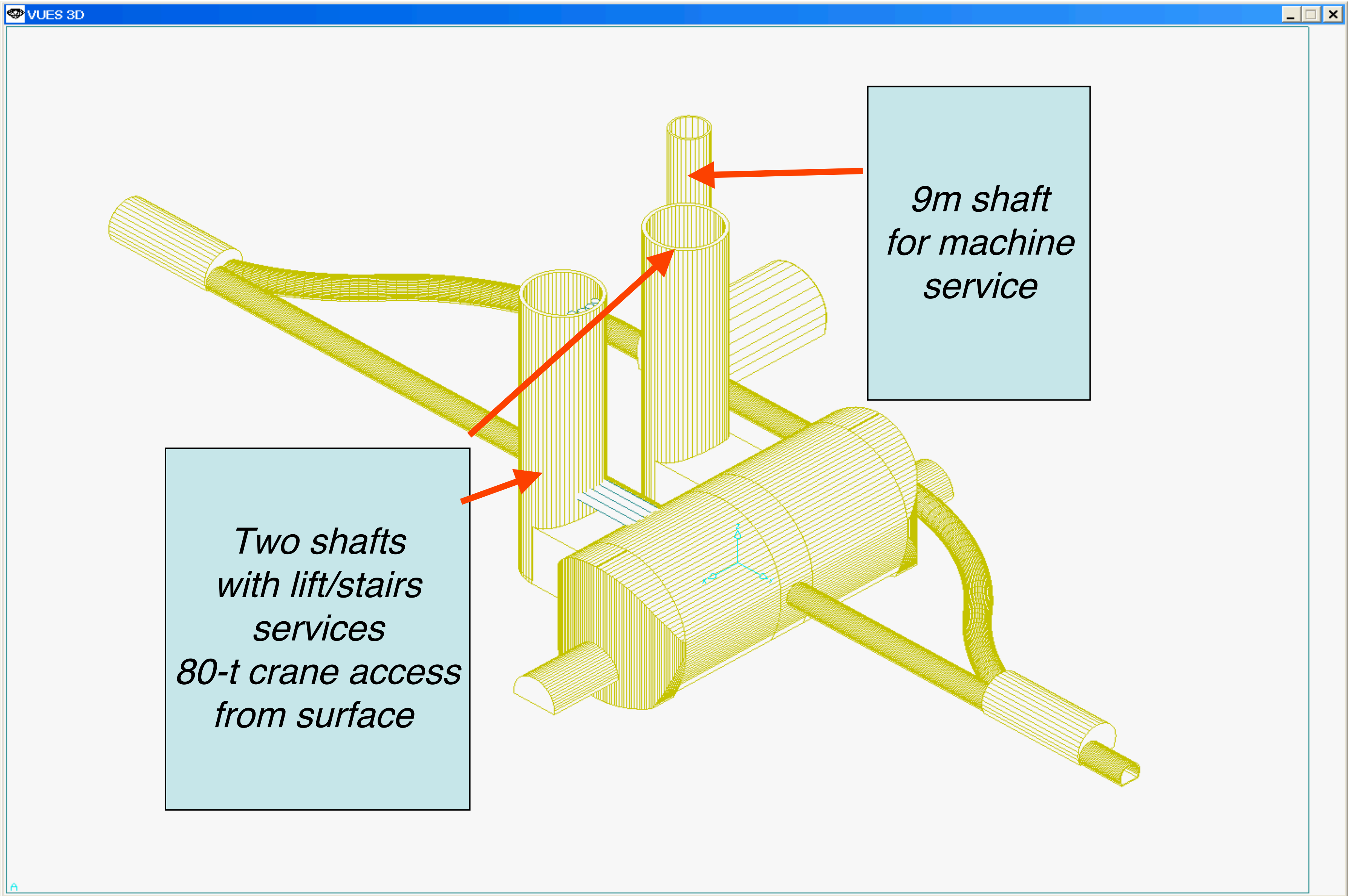

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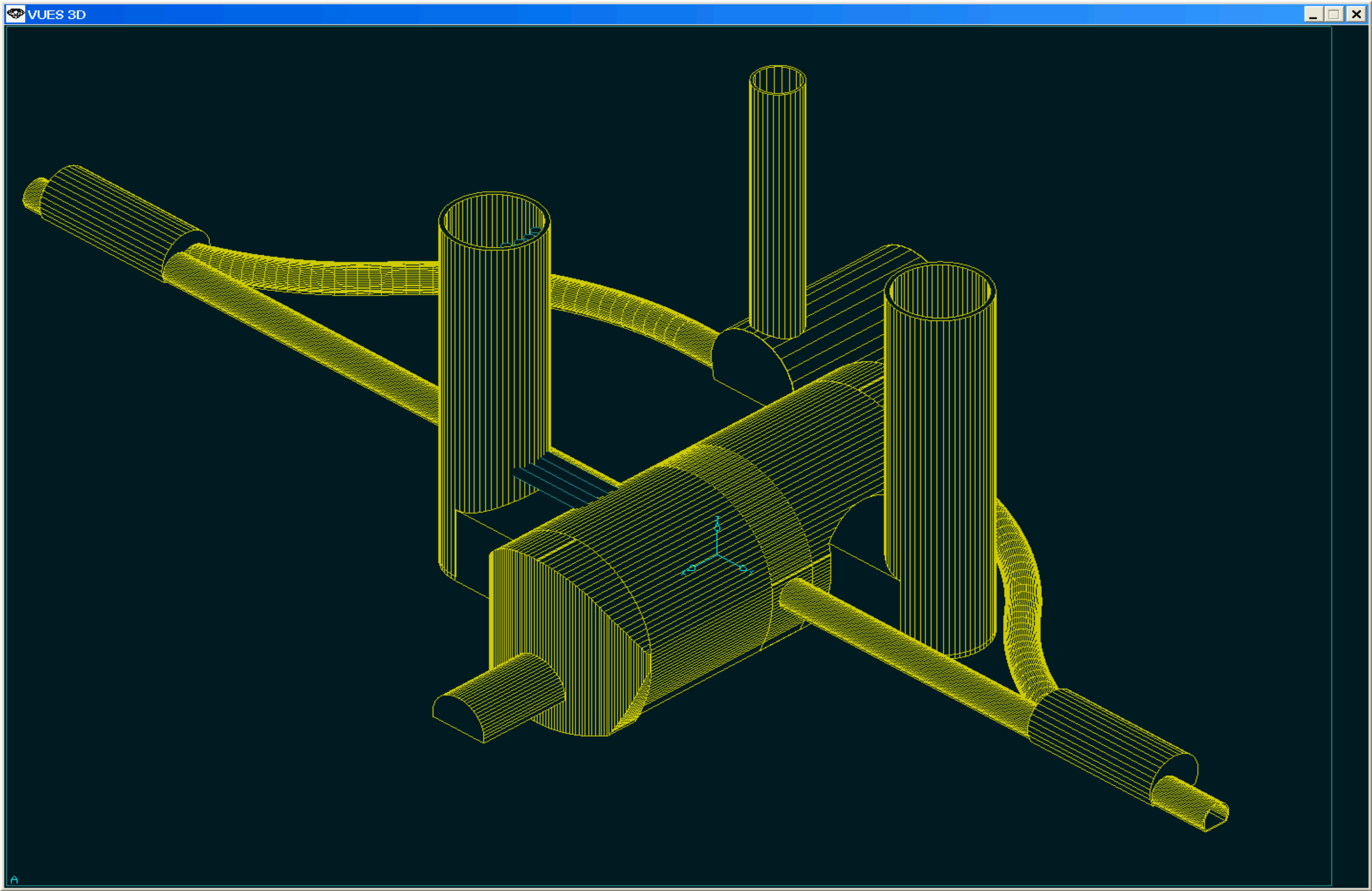

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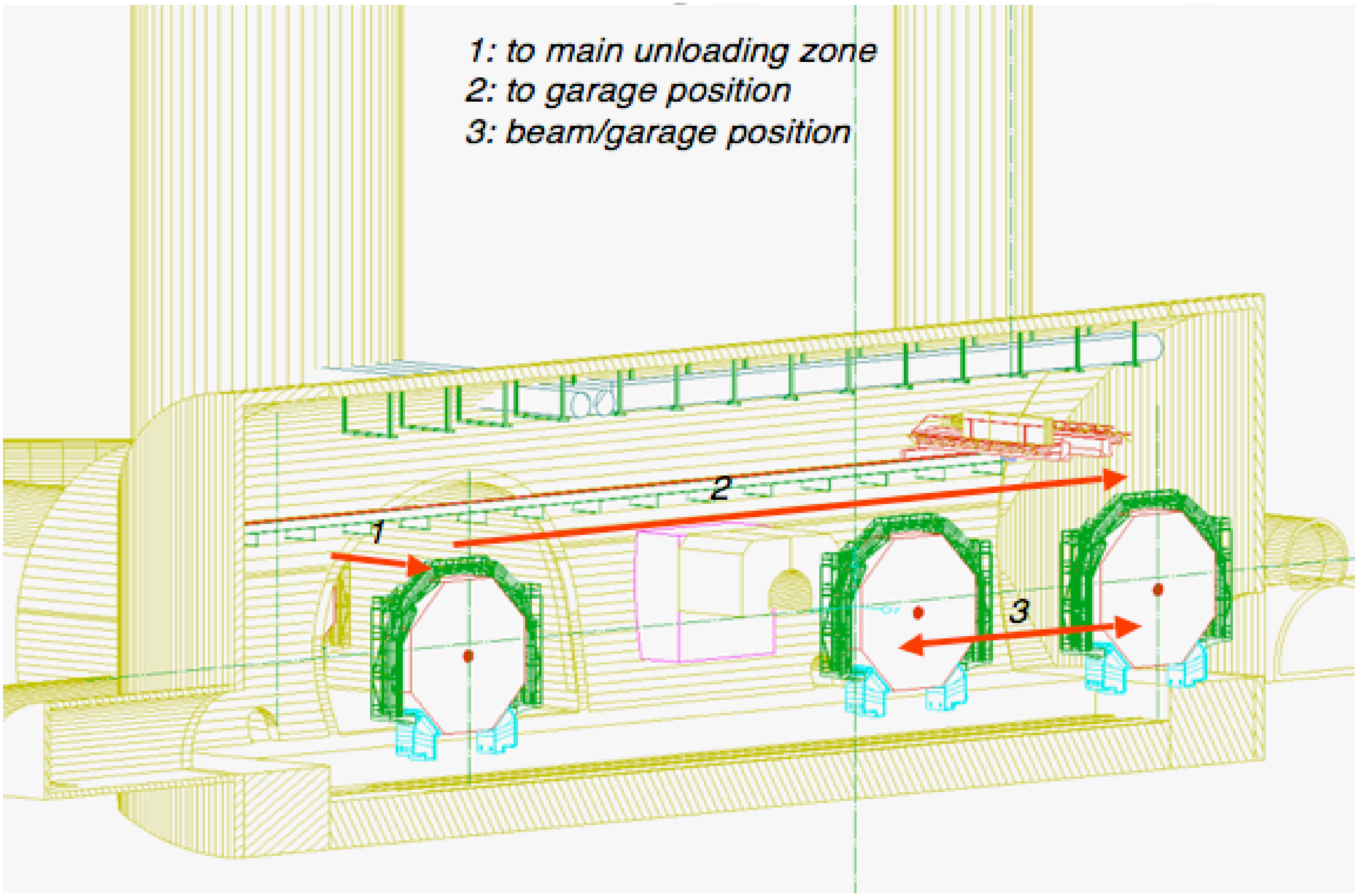

Options for IR hall and tunnels layouts
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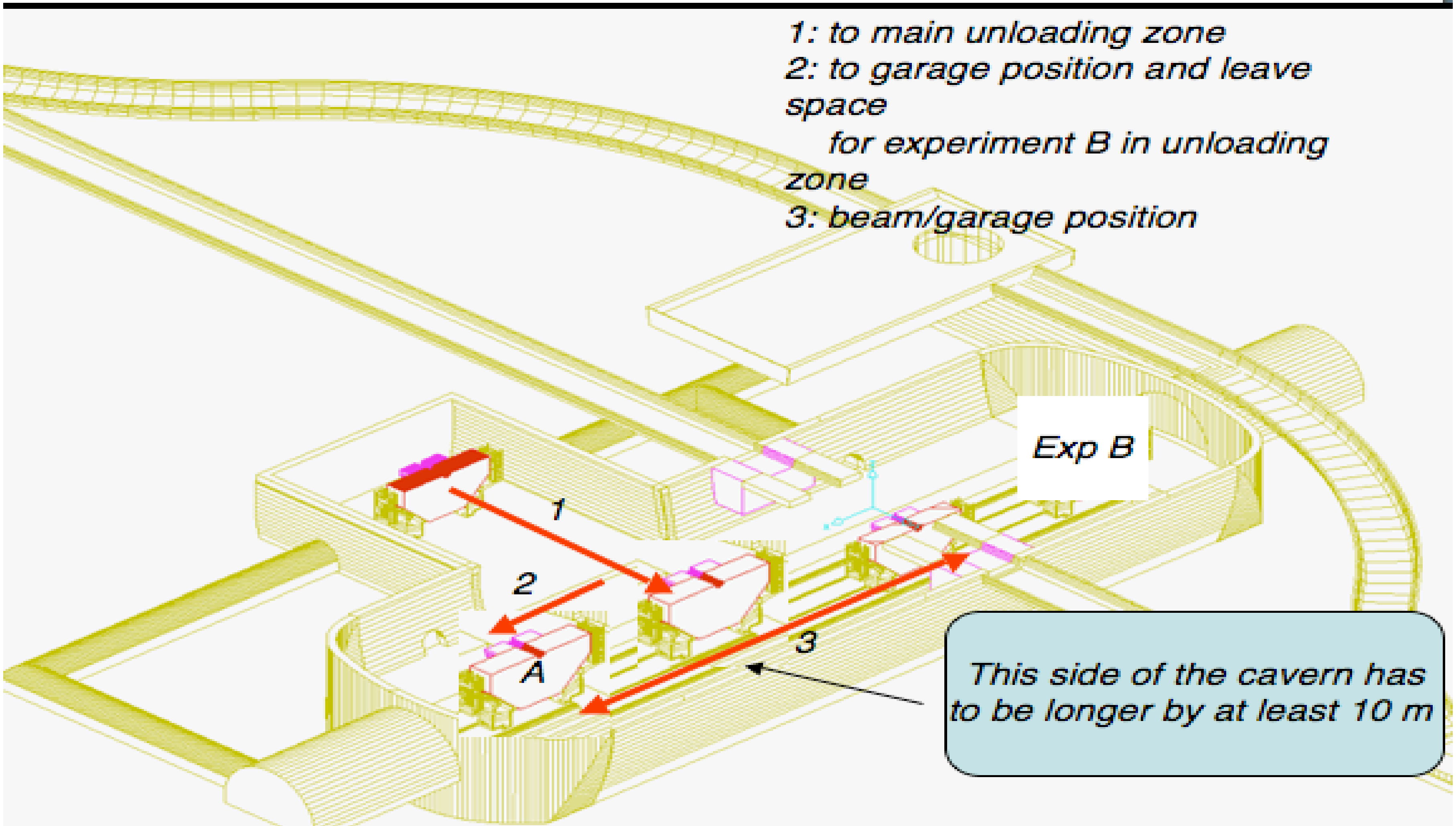
Movements of Experiment A



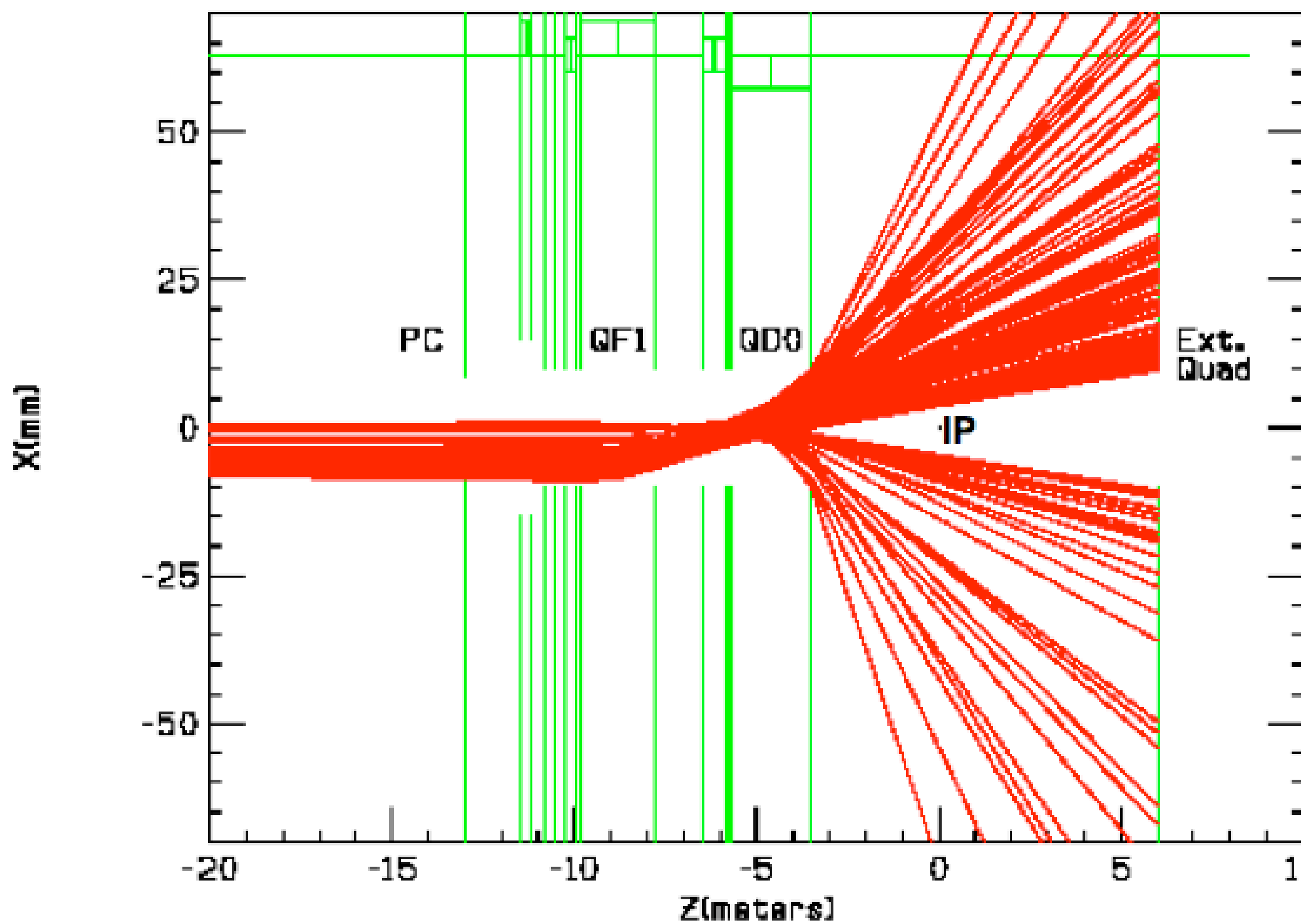
Beam-Gas Bremsstrahlung Electrons
Lew Keller

Beam-Gas Bremsstrahlung Electrons Hitting Beyond the Final Doublet

Cut: Outside 10 mm at entrance to 1st extraction line quad

Average Energy = 100 GeV

Origin is inside 200 m from the IP



Beam-Gas Bremsstrahlung Electrons
Lew Keller

Scattering Rates, 10 nT

1500 m, "SLC" gas: 62% H_2, 22% CO, 16% CO_2 => $X_0 = 5 \times 10^{13}$ m @ 10 nT

- **Compton scattering on thermal photons (irreducible): 1.1/bunch**
- **Beam-gas bremsstrahlung (αZ^2): 2.9/bunch**
- **Coulomb (αZ^2): 2.3/bunch**
- **Moller (αZ): 0.3/bunch**

Beam-Gas Bremsstrahlung Electrons

Lew Keller

Summary for 10 nTorr:

1. Within the IP region there are 0.02 - 0.04 hits/bunch (3-6 hits TPC)
   at an average energy of about 100 GeV/hit originating 0–200 m from the IP. Therefore 1 nT from 0–200 m is conservative.

2. On the FD protection collimator there are 0.20 charged hits/bunch (33 hits TPC) at an average energy of about 240 GeV/hit and 0.06 photon hits/bunch (9 hits TPC) at an average energy of about 50 GeV/hit originating 0–800 m from the IP.Therefore 10 nT from 200–800 m.

3. Beyond 800 m from the IP the pressure could conceivably be at least
   an order of magnitude higher than 10 nT, pending look at BGB background in the Compton polarimeter and energy spectrometer.

4. Need feedback from the detector groups on the effect of these hit rates on their detectors.

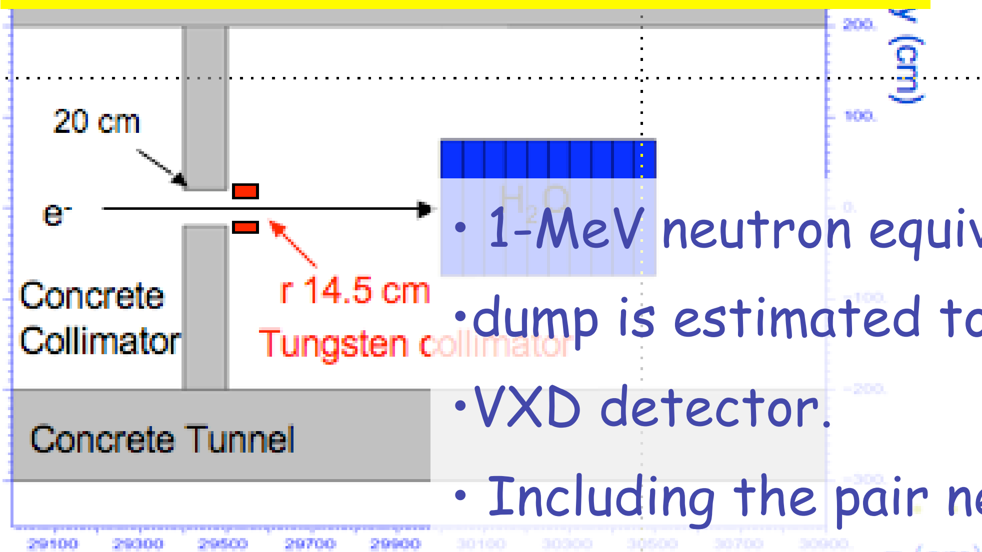
Neutron and Photon Backscattering ILC Beam Dump

Takashi Maruyama

- The IP has a direct line-of-sight from the beam dump.
- Neutrons and photons produced at cosq ~ -1 will reach the IP, and no shielding is possible.
- What is the IP flux?

FLUKA was used for neutrons.
FLUKA and EGS5 were used for photons.

Pacman is a good shield.
But Pacman has 1 m$^{\phi}$ hole.
neutrons into this hole
is 1.3×10^{15} n's/ year.
Need additional shield.



- 1-MeV neutron equivalent fluence from the beam
- dump is estimated to be 1.1´109 n's/cm2/year at the SiD
- VXD detector.
- Including the pair neutrons, the total 1-MeV
- neutron equivalent fluence is 2´109 n's/cm2/year.
- Photon backscattering from the dump is negligible.

How to proceed

Andrei close out

- Work before the IRENG07 workshop
  - was very important
- Work at the workshop
  - A lot of extremely useful information
  - Many options for design optimization
  - In many cases suggestions of plans for further studies were discussed
- Further work
  - develop interface document (s) to describe parameters, solutions, responsibilities
  - to develop plans for EDR work to carry out studies needed to improve the design
  - keep working together on these studies Thanks!