The ILD MDI/Integration Working Group
Status and Plans

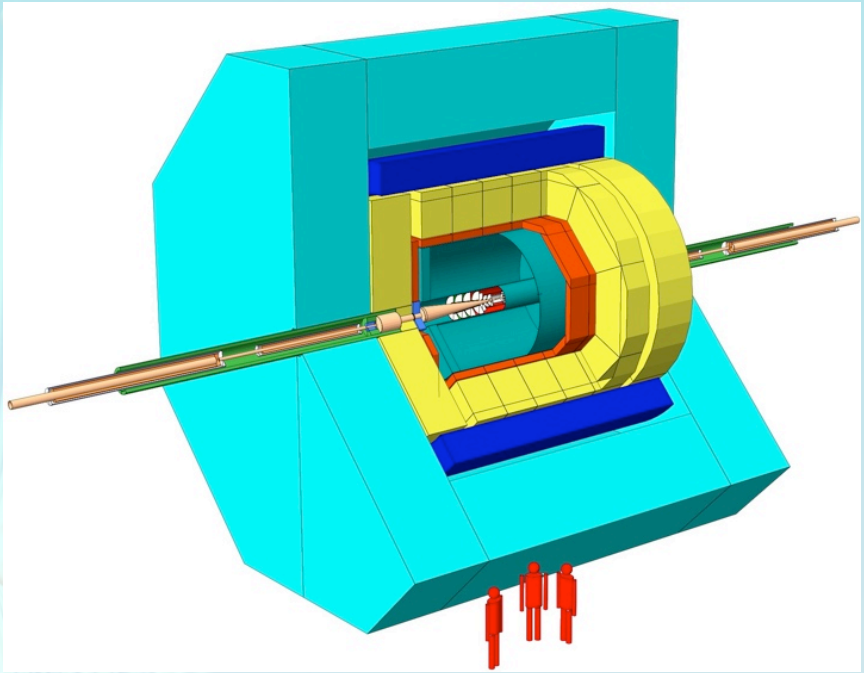
Karsten Buesser

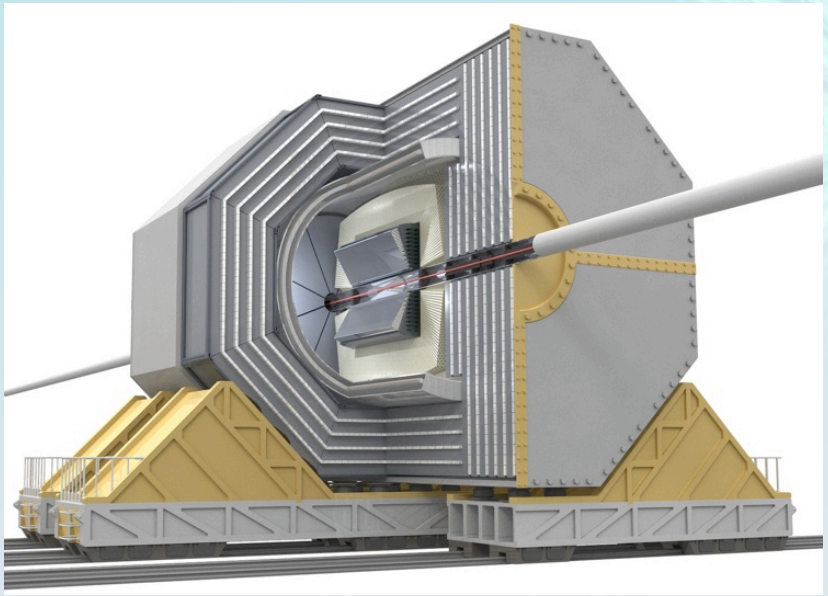
ILD Session

ALCPG'07

23. October 2007

ILD = GLD ⊕ LDC





ILD Working Structure

- Joint Steering Board supervises the common effort to find a common detector concept and design which will lead to the submission of a common LOI
- Several working groups have been set up to tackle the critical joint design efforts:
  - Detector Optimisation
    - Conveners: Mark Thomson, Tamaki Yoshioka
  - MDI/Integration
    - Conveners: Toshiaki Tauchi, KB
  - Costing
    - Conveners: Akihiko Maki, Henri Videa

Machine-Detector Interface at the ILC

- There is no common definition I know about for MDI
- „Everything in the machine which has an impact on the detector and vice versa“ comes closest
- Usually the following things are discussed under the MDI label:
  - Interaction Region Design (crossing angles, magnets, etc.)
  - Detector Forward Regions
  - Beam-induced Backgrounds
  - Diagnostics (Luminosity, Energy, Polarisation)
  - Detector Hall Design
  - Engineering Issues: e.g. Push-pull

- Basically all of these issues have been tackled at GLD and LDC in separated efforts (intense communication took always place)
- Now it is time to join the efforts and find common answers for the common LoI

Charge of the ILD MDI/Integration WG

Charge issued by the ILD Joint Steering Board:

- The MDI/working group is charged to produce a self-consistent design of the structure of the ILD detector from the viewpoint of machine-detector interface (MDI) and detector integration for the LOI that is to be submitted by October 1, 2008.
- Specifically, it covers the design of the beam pipes, magnets,iron return yoke, beam instrumentations, and their supports that require works by the detector group.
- Also, it should address general detector structure and assembly issues, where the aspects that affect the machine design will have initial priority. Beam background studies should be performed when necessary.
- The group should work closely with the machine people and the groups working on subdetectors that affect the structure of the ILD detector.
- (...)

MDI/Integration Working Plan

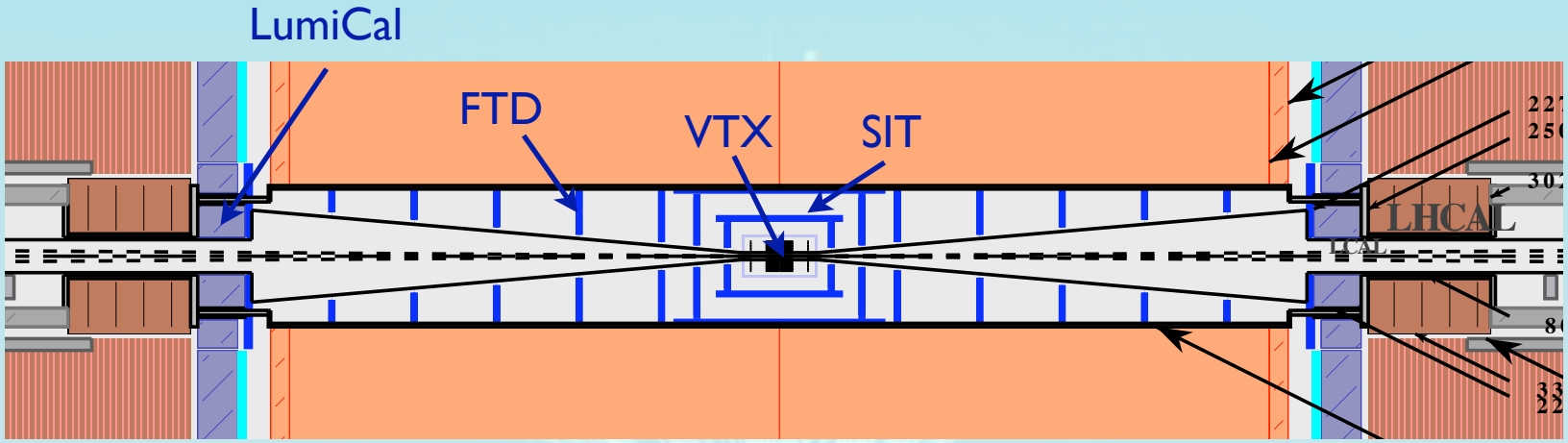
- MDI/Integration working group has started recently
- First phone meeting (4. Oct) was used to discuss the status of the detector interaction region issues
  - Interaction region designs
  - Beam pipe designs
  - Forward regions and masking
  - Backgrounds
- Next working meeting (tba) will concentrate on detector integration issues
  - Assembly procedures
  - Mechanical design
  - Detector hall design
  - Push-pull issues

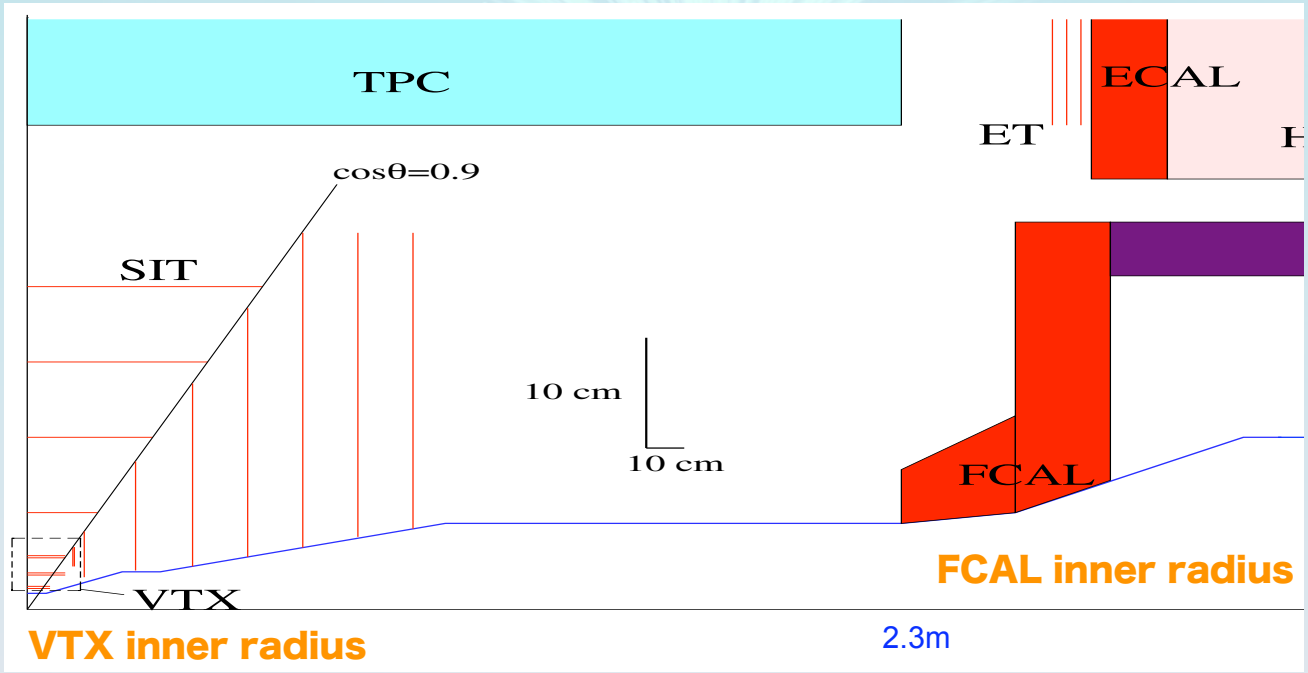
ILD MDI/Integration Communication

- All MDI/Integration WG meetings are kept on Indico:
  - http://ilcagenda.linearcollider.org/
    → Physics and Detectors
    → Detector Concepts
    → ILD
    → MDI/Integration

- A mailing list has been set up
  - Subscribe at:
    https://lists.desy.de/sympa/info/ild-detector-mdi
  - Contact list at
    ild-detector-mdi@desy.de

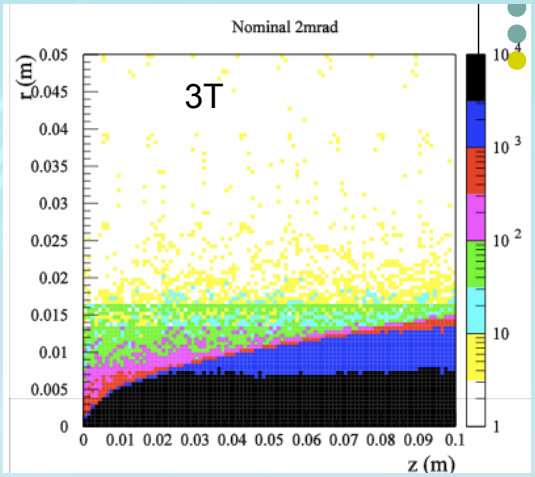
LDC/GLD Interaction Region

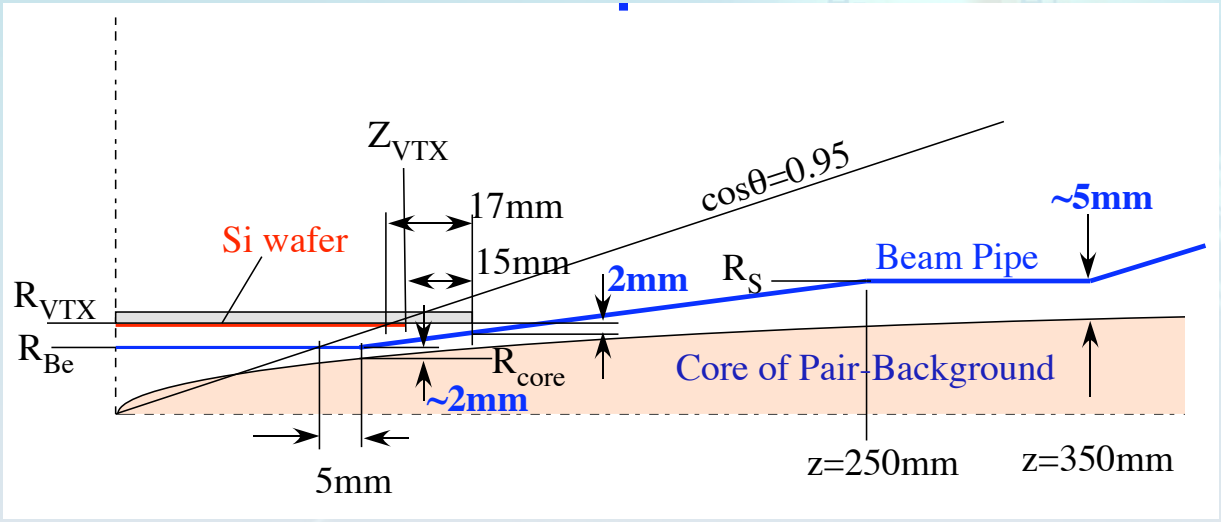


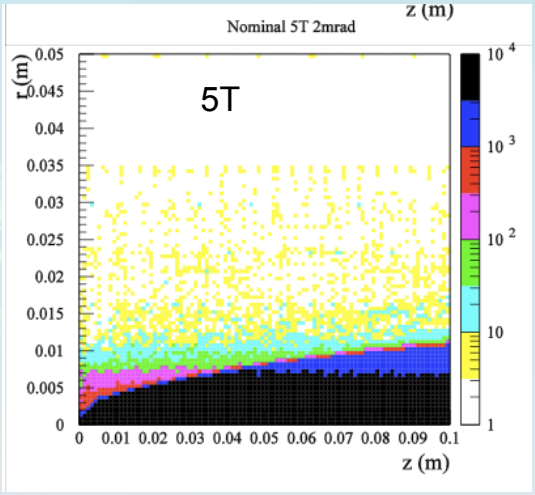


Pairs and magnetic field

- Pairs are focused by solenoidal field in the detector towards the forward region
- Pairs trajectories envelope depends on magnetic field
- Careful desing of beam pipe is mandatory

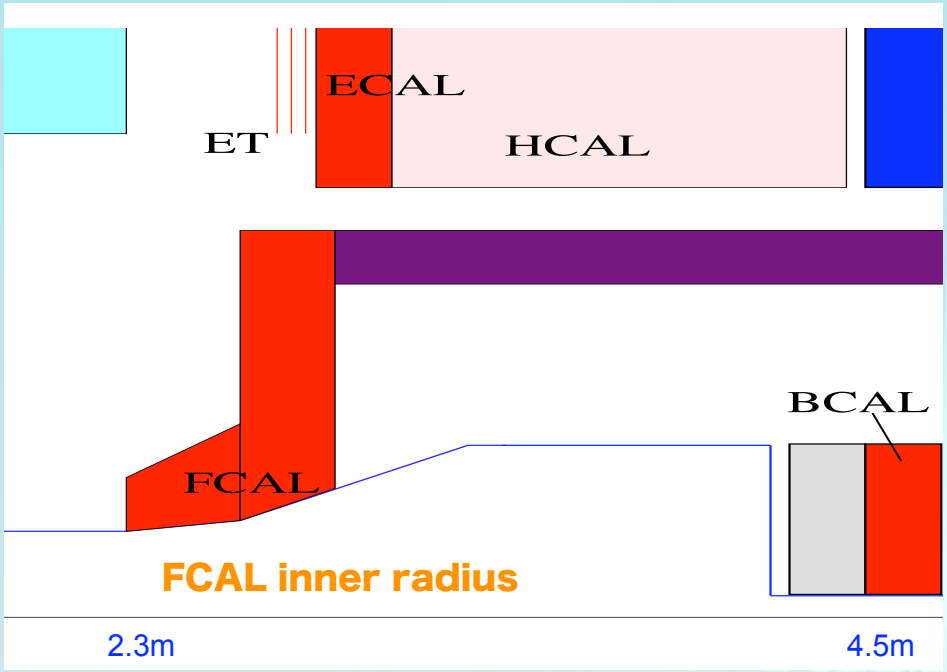


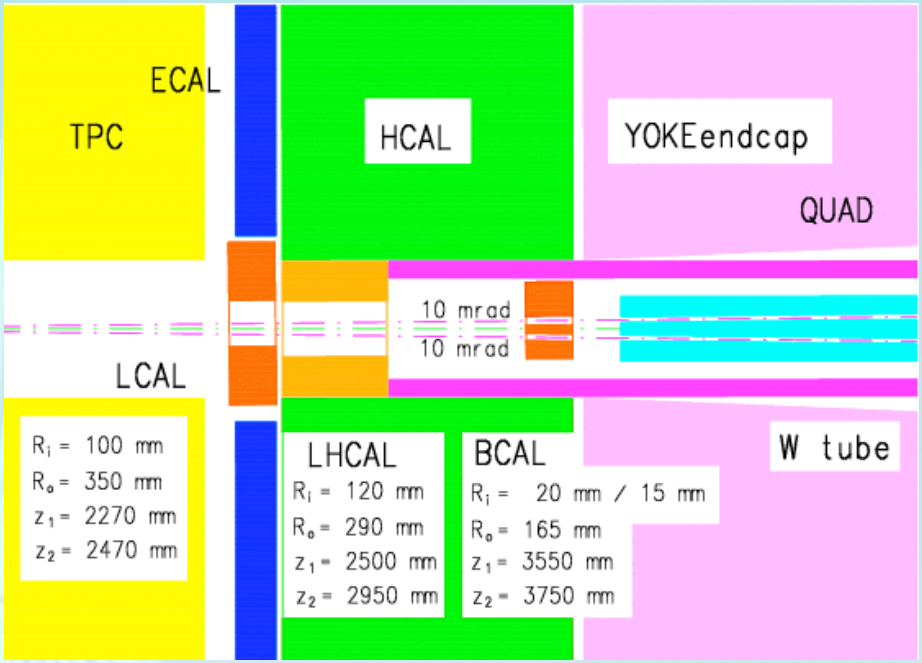




T. Tauchi

LDC and GLD Forward Regions



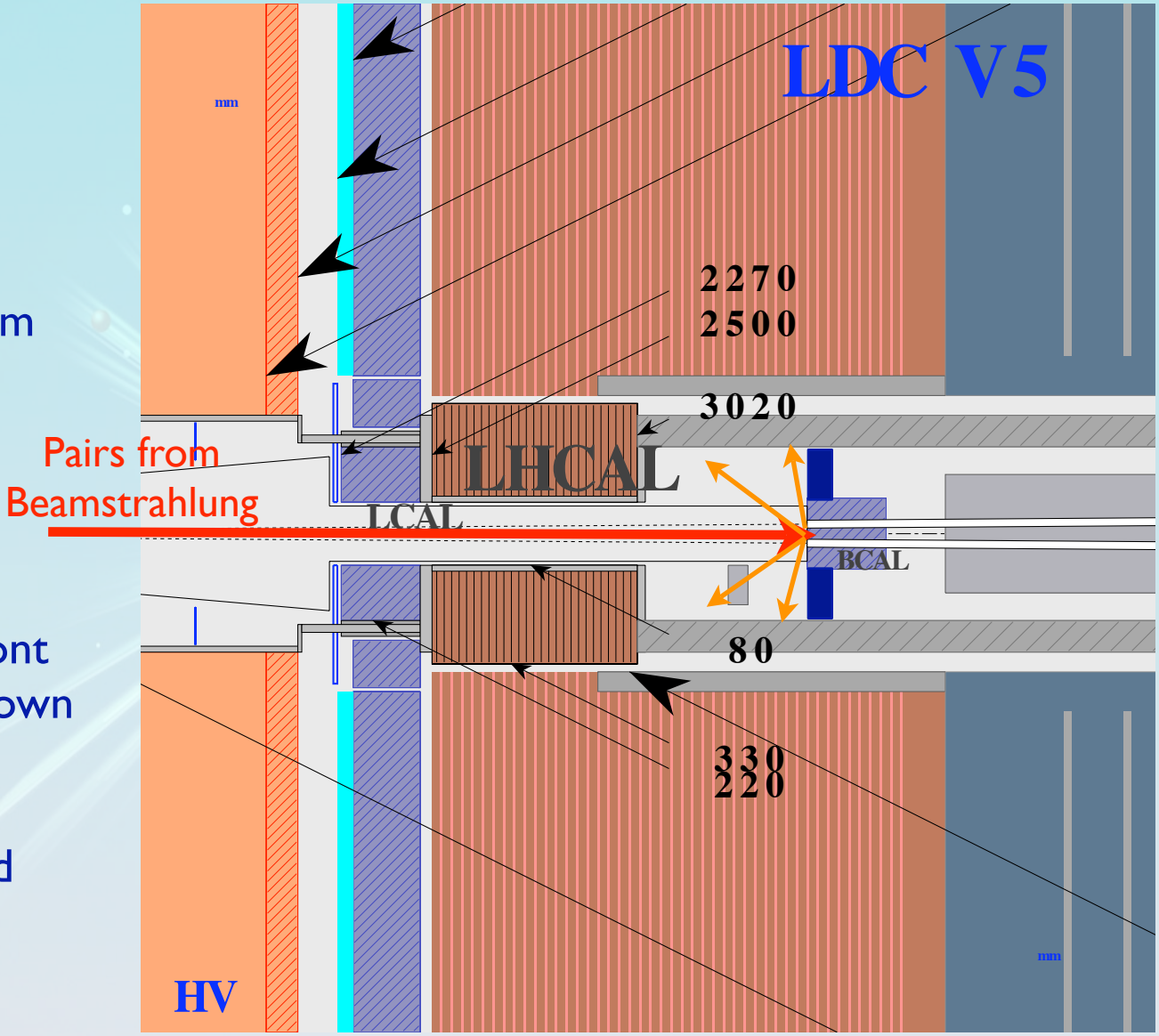


- Very similar designs:
- L*>4.05 m
- 14 mrad crossing angle
- Tungsten absorber around BCal
- LumiCal/FCAL: precision luminosity measurement via Bhabha scattering
- BeamCal: pair signal measurement, hermeticity to <5 mrad
- LowZ absorber

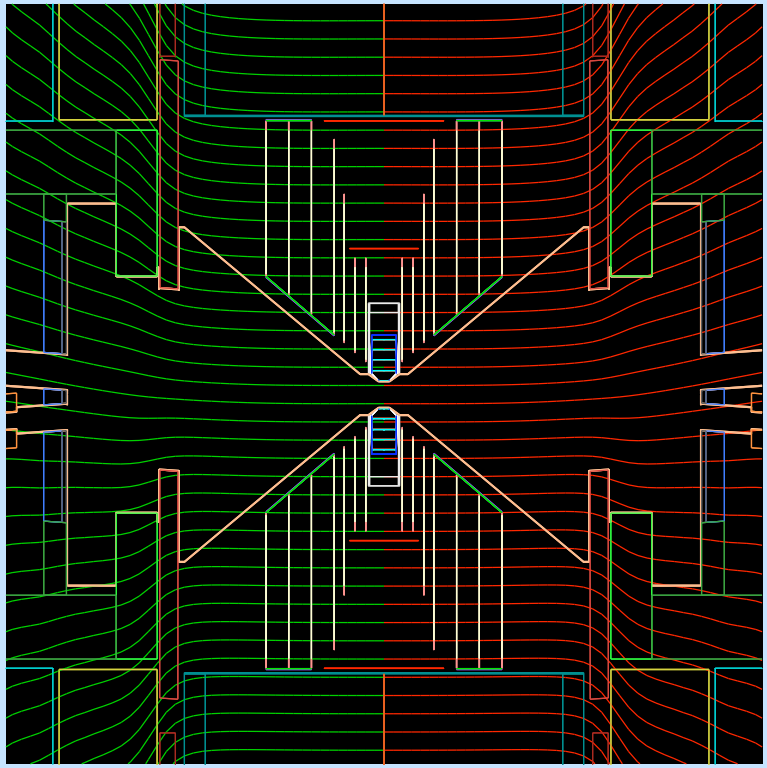
Background Suppression

Forward Region Design Principle:

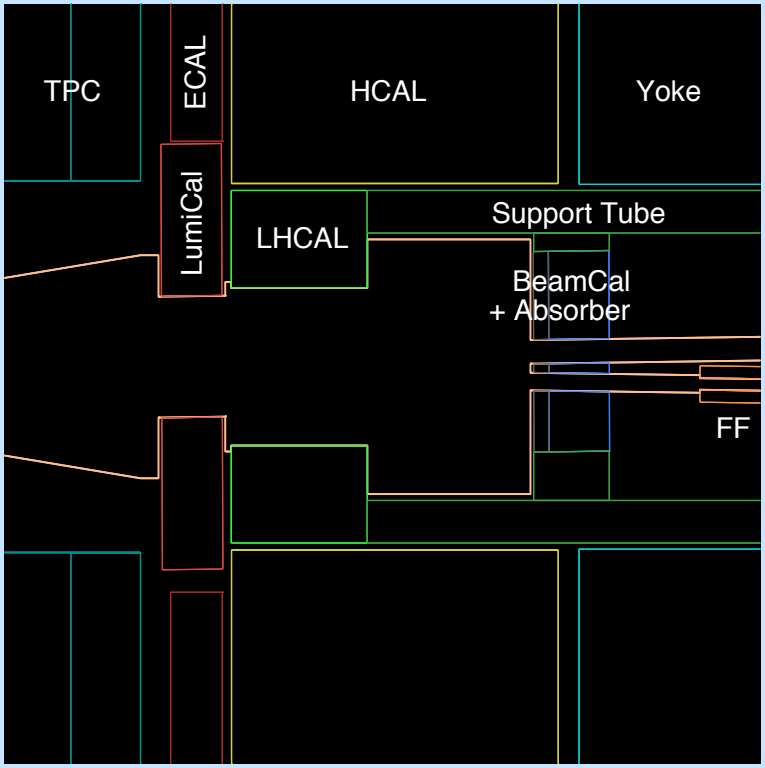
- Absorb pairs from beamstrahlung on the BeamCal and in the beam pipe
- Trap backscattered particles in the area between LHCAL and BeamCal
- Low-Z absorber in front of the BeamCal (not shown in the figure) reduces backscattering
- Tungsten shield around the hot BeamCal area



LDC 14 mrad Interaction Region in GEANT4



14 mrad crossing angle
with anti-DID field (1:10)



Forward region design
(compressed view 1:2)

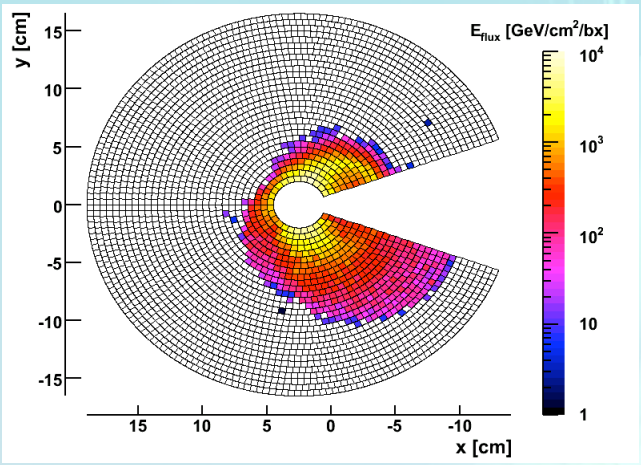
A. Vogel

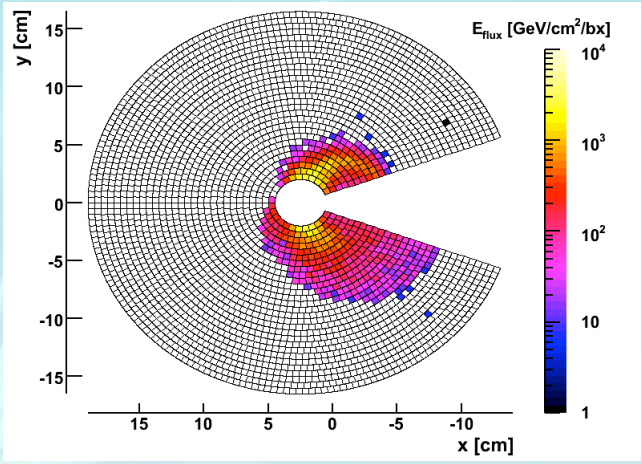
Beamstrahlung Pairs on the BeamCal

LowP

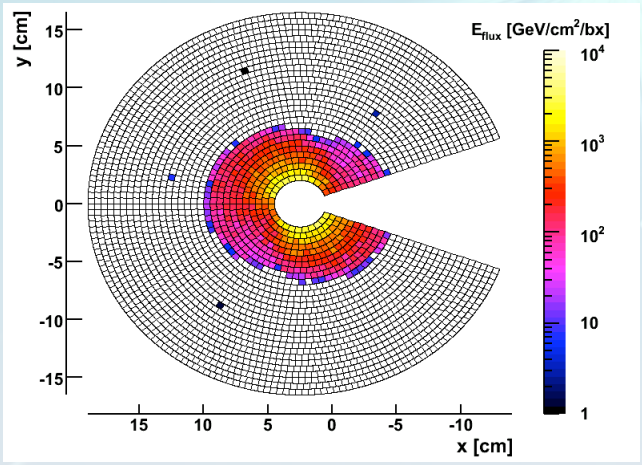
Nominal

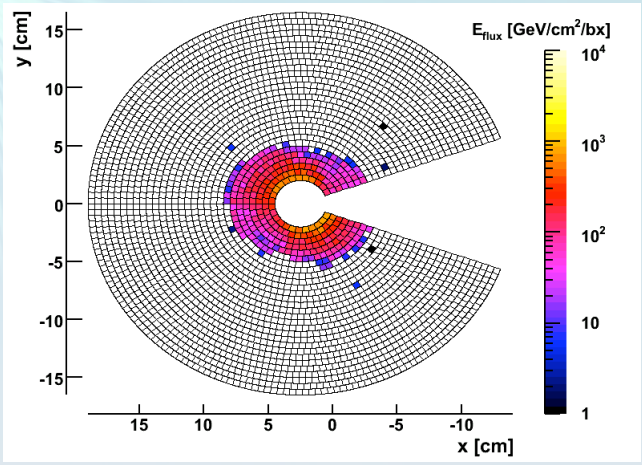
DID





Anti DID



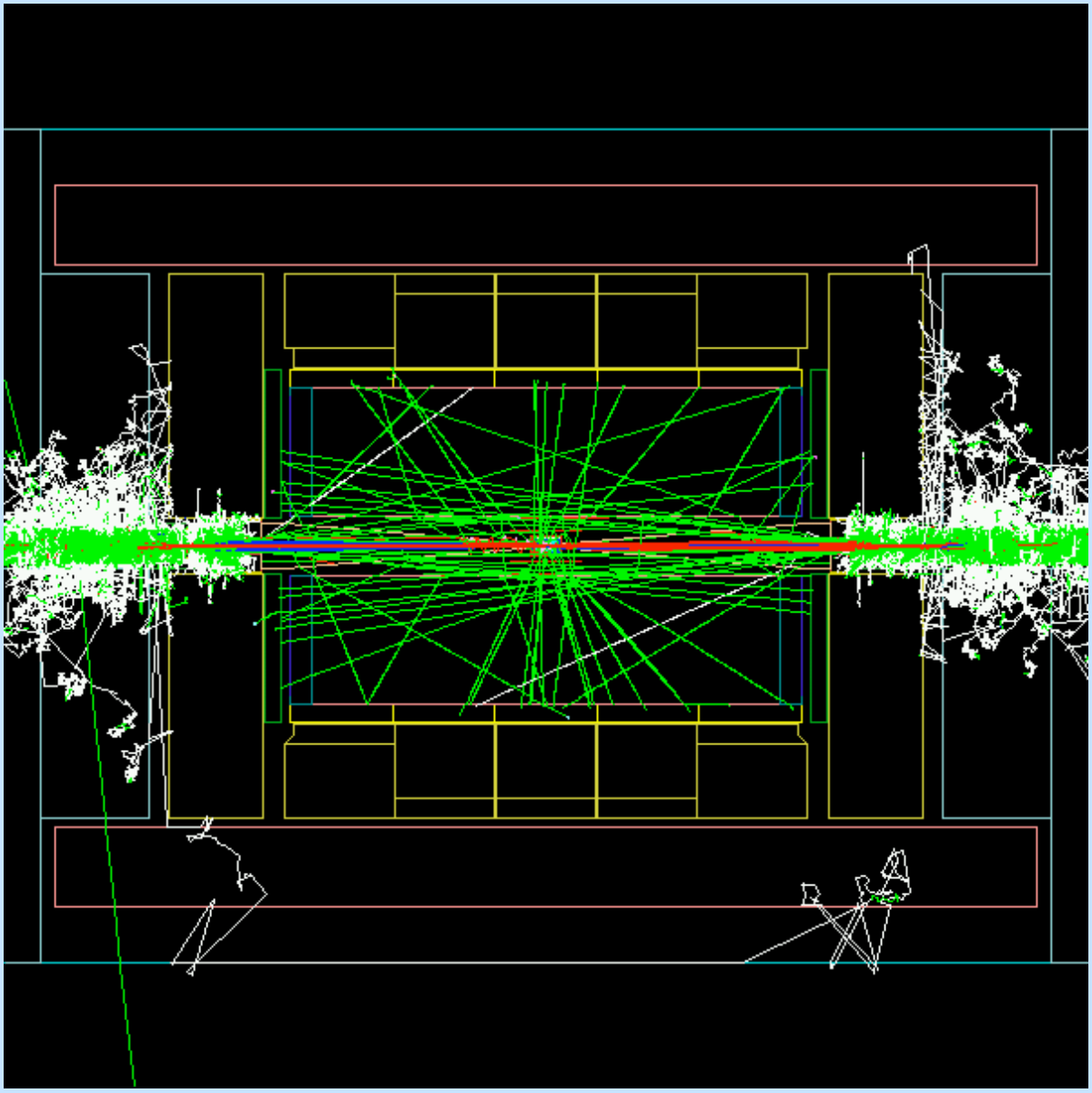


C. Grah

Larger blind area compared to 20 mrad (30° => 40°)

Pairs Induced Background

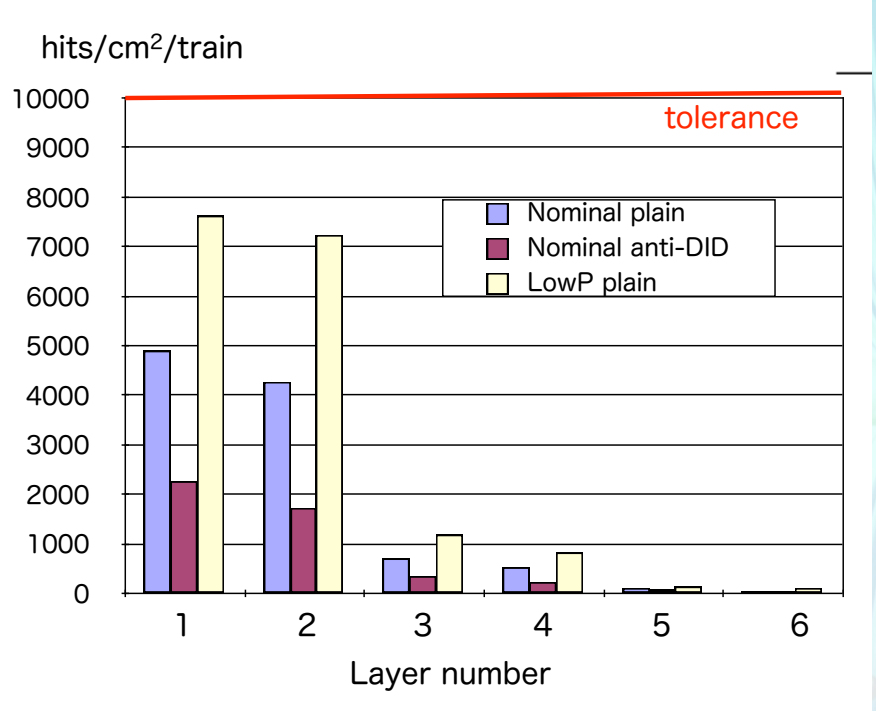
- GEANT4 simulations
- ~1/100 of one BX



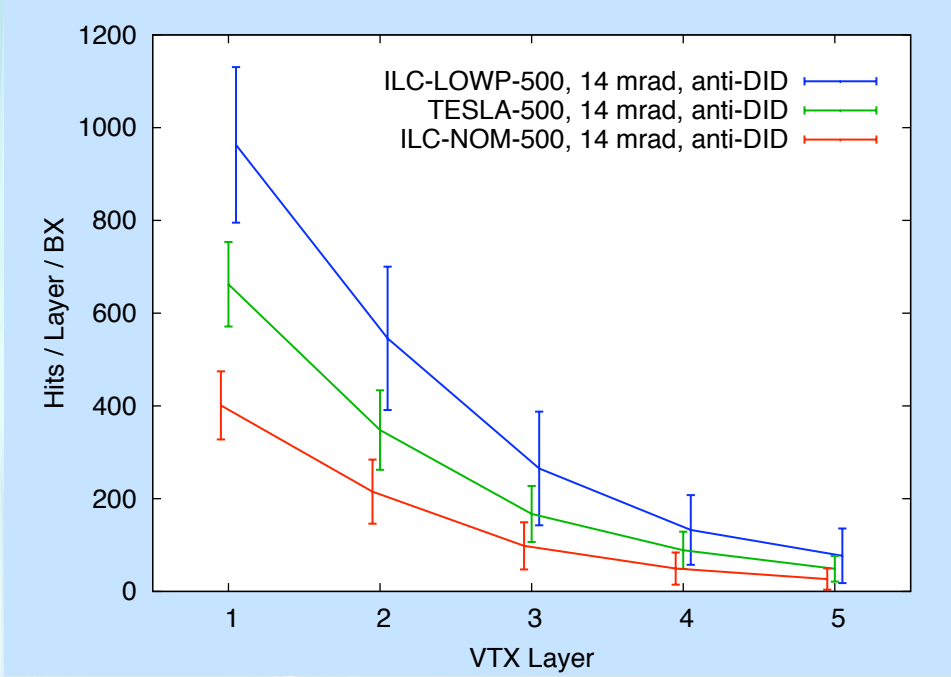
A. Vogel

VTX Hits

GLD and LDC results seem compatible



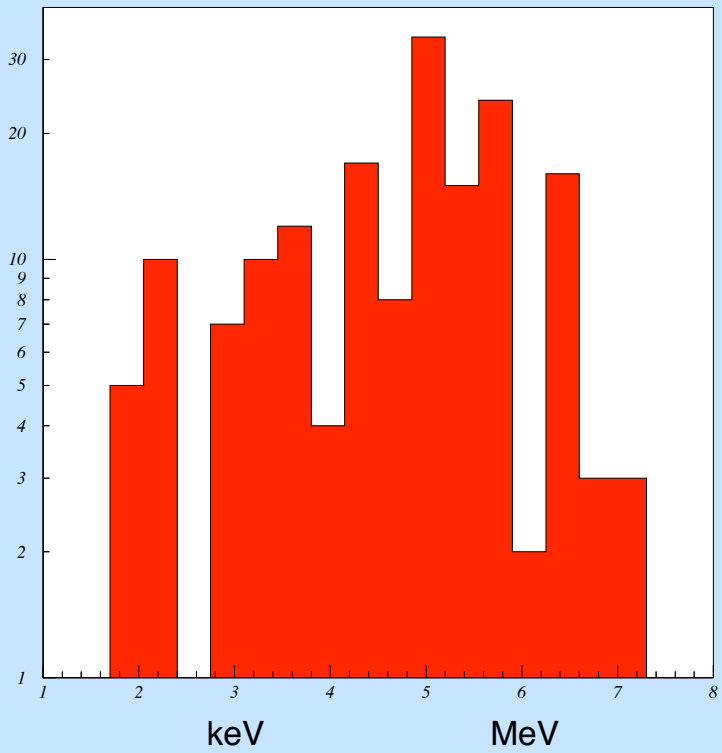
GLD



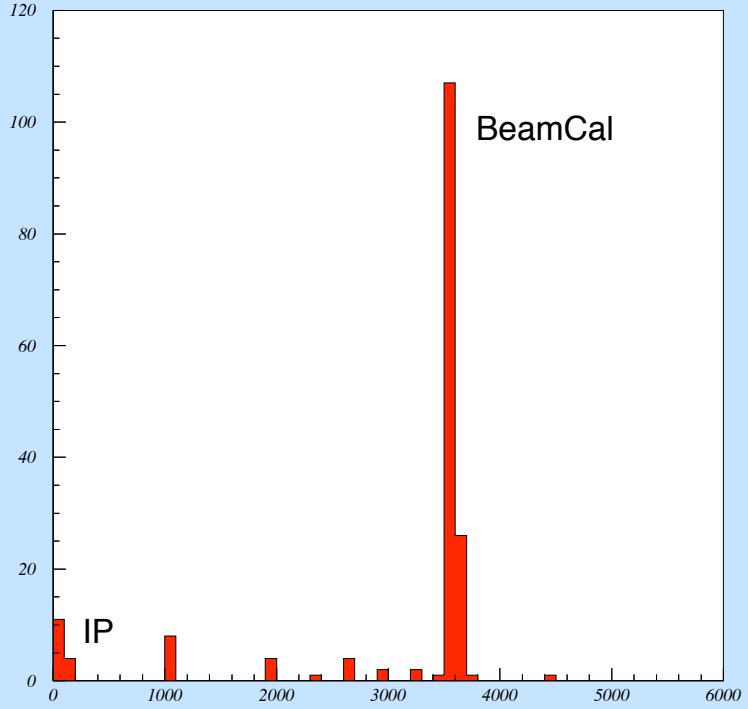
LDC

Neutrons from Pairs in the VTX

Statistics for neutrons are rather low . . .



Energy spectrum

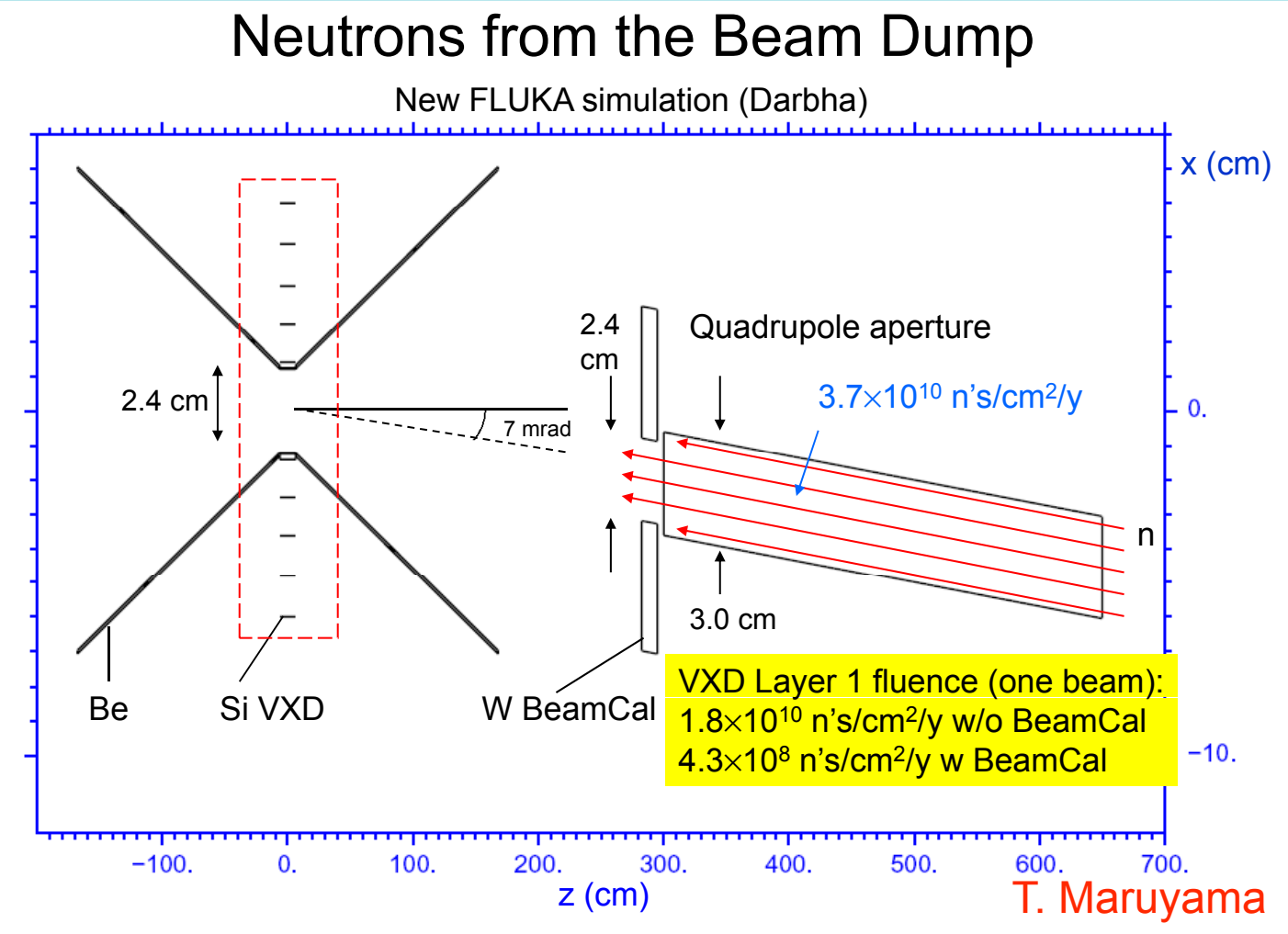


Origins of particles

Neutron fluence: 2.3 ± 4.0 x 10^8 n/cm^2/y (no NIEL scaling done)

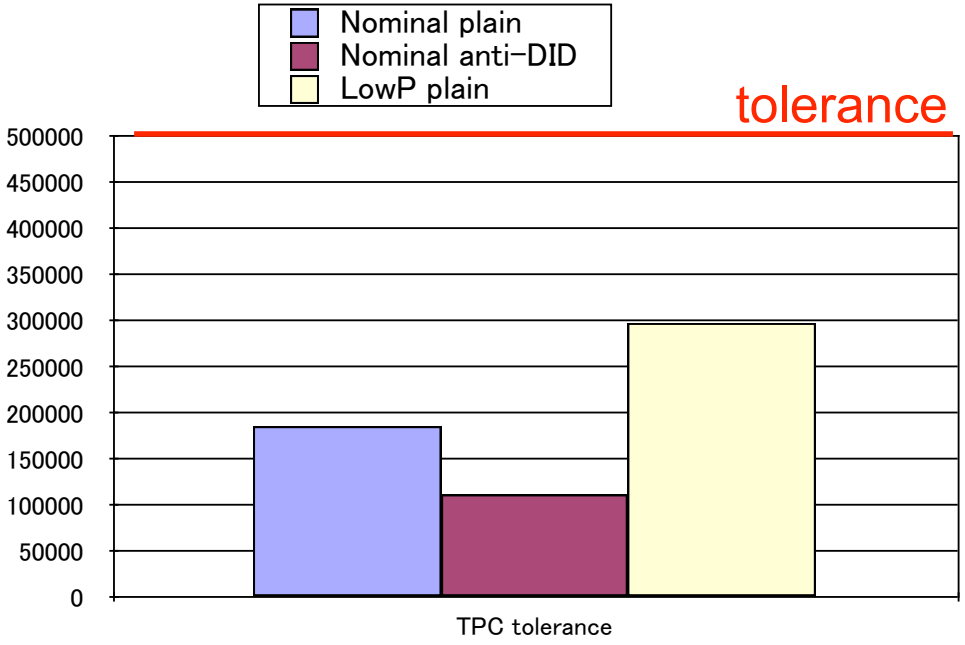
A. Vogel

Problem (?): Beam-dump Backshine

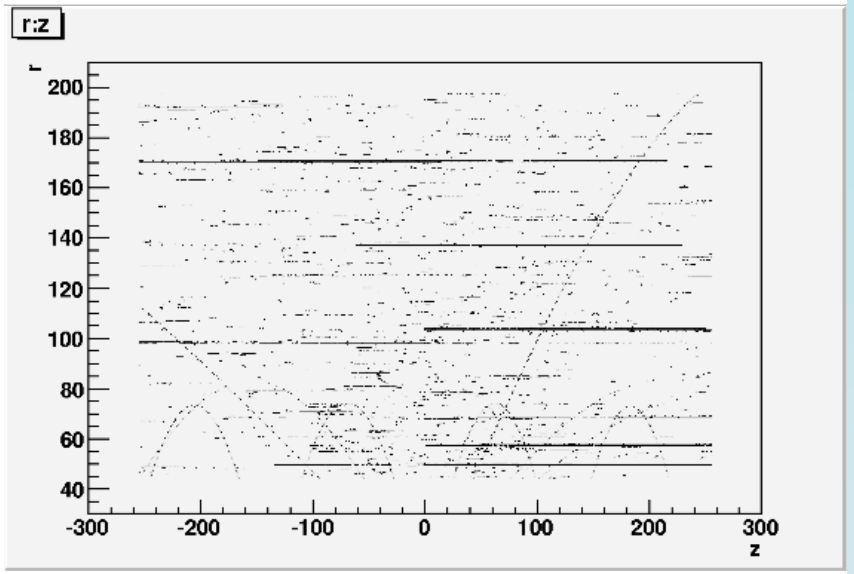


Large crossing angle problem: direct line of sight between beam dump and IP
(Beamstrahlung photons go to the same main dump as spent beam)

TPC Hits



TPC digital hits



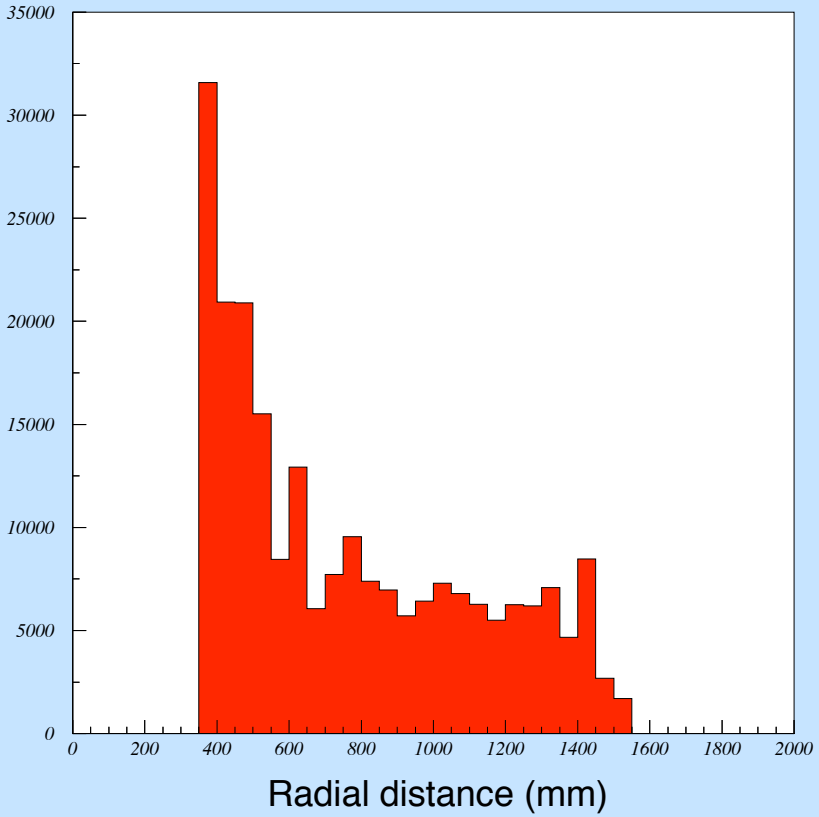
TPC Exact hits

R [cm]

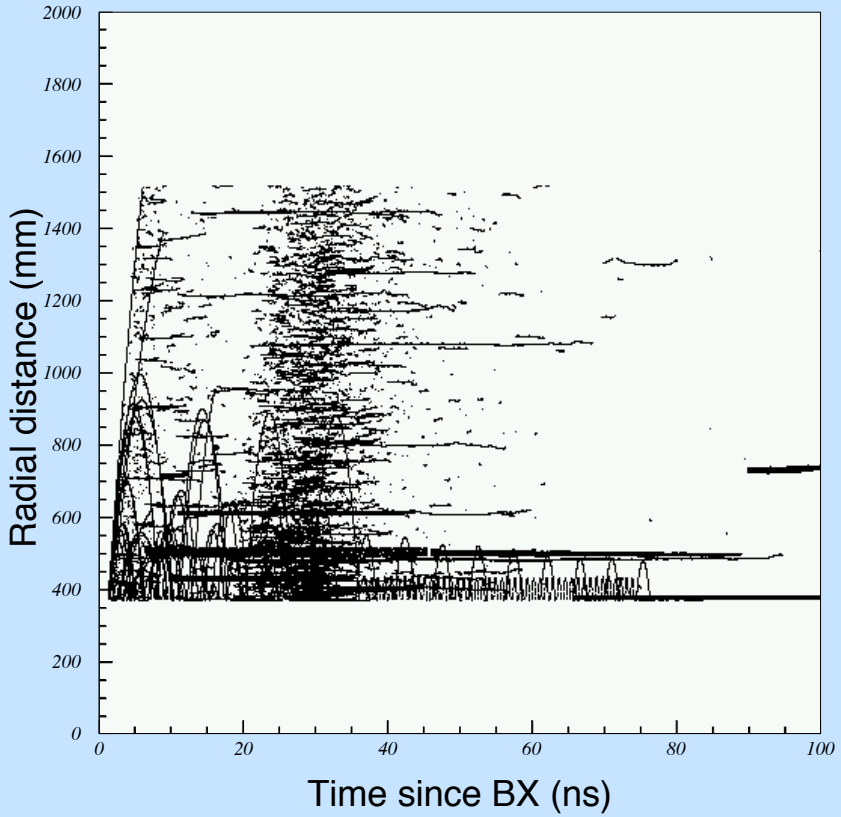
× まとめる

TPC Hits from Pairs

Mokka hits in the TPC (overlay of 100 BX)



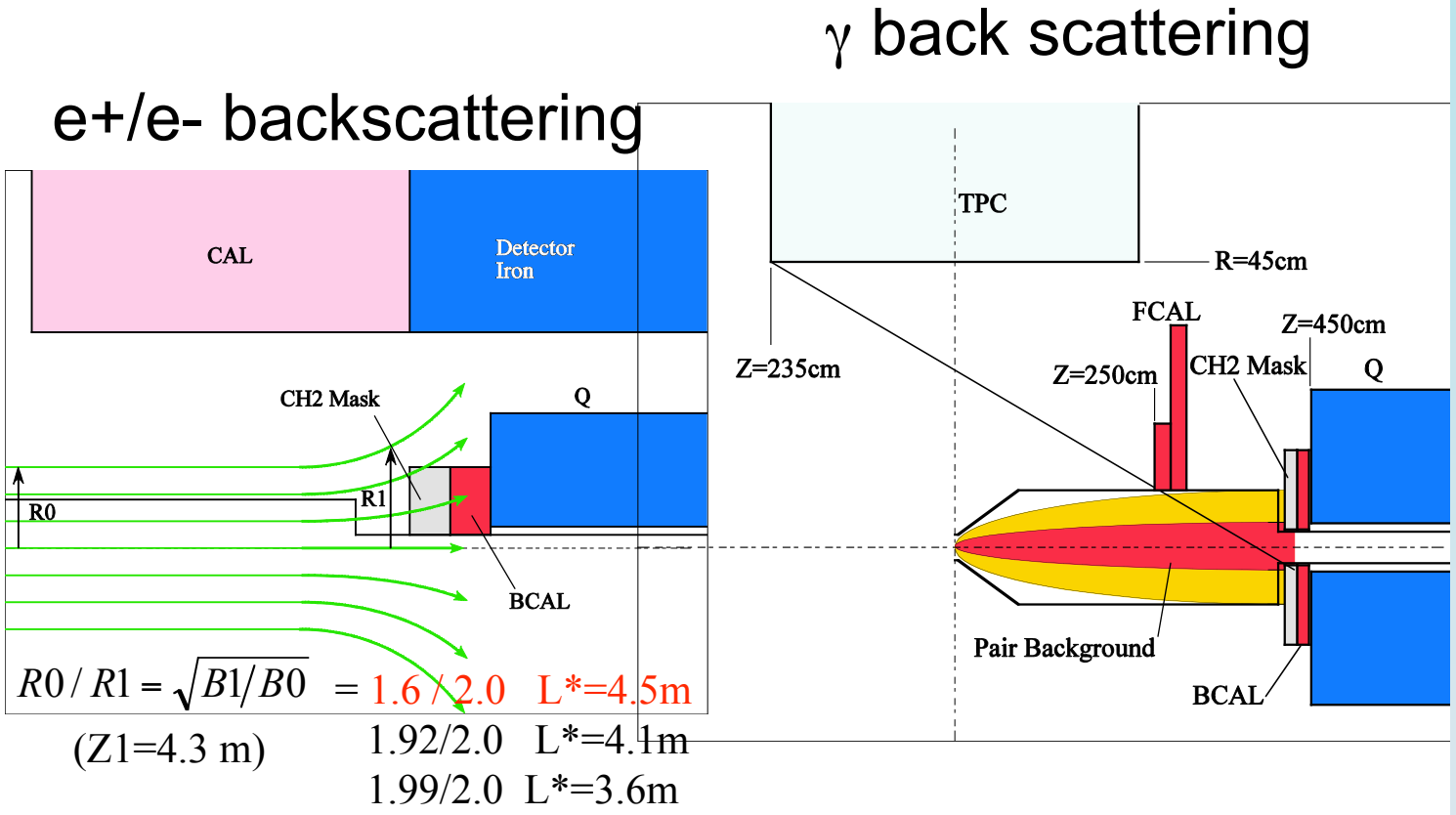
Radial distribution



Time structure

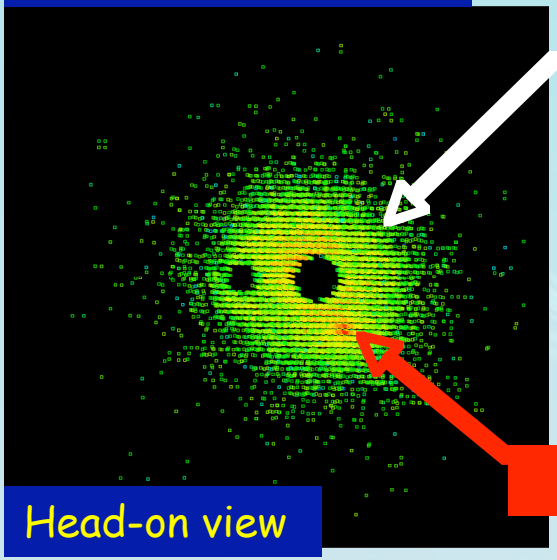
A. Vogel

GLD : Preference of L* > 4.7m



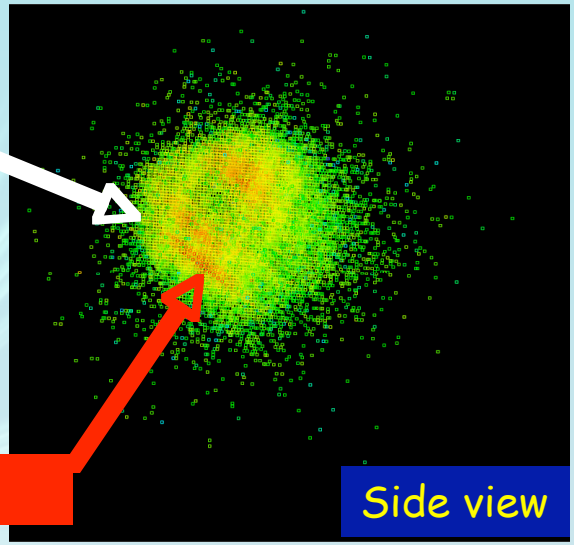
BeamCal for 2γ Veto

E.g. from UC Boulder



Head-on view

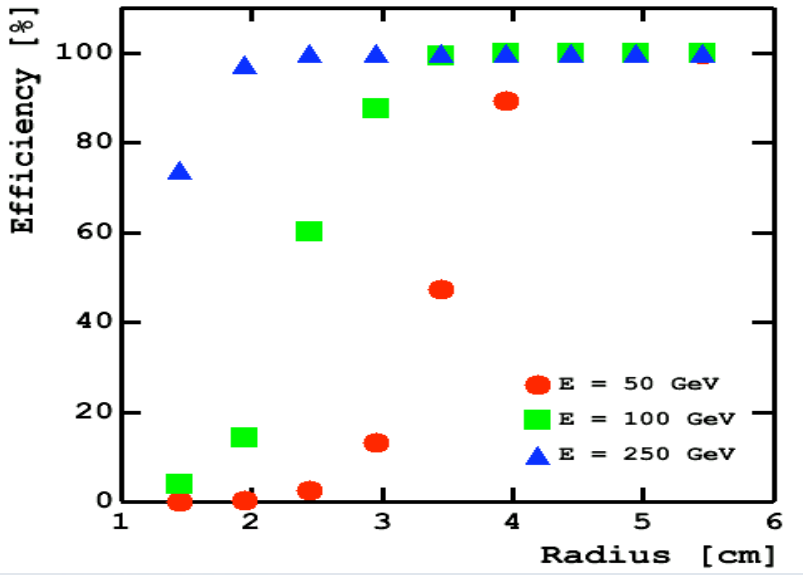
Beamstrahlung
TeV per BX



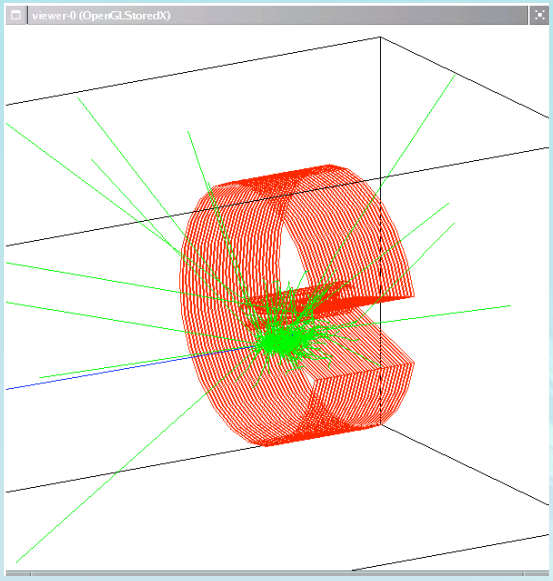
Side view

electron from 2■ process

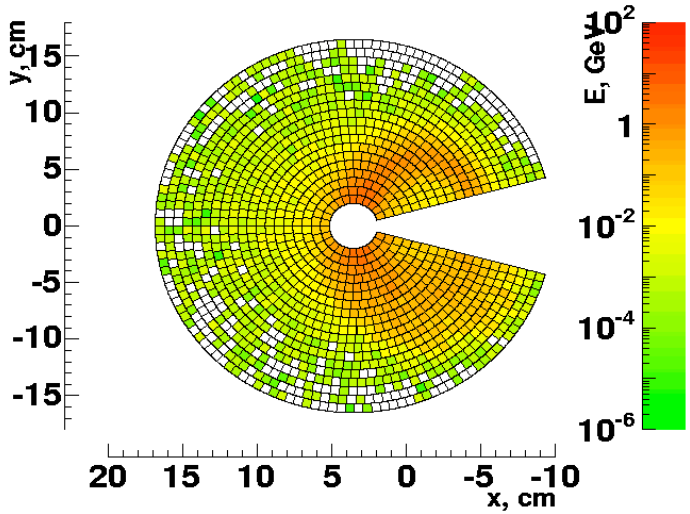
Efficient detection of high energy electrons is essential for search experiments



BeamCal as Beam Diagnostics Instrument



20 mrad, DiD Face energy distr-n:

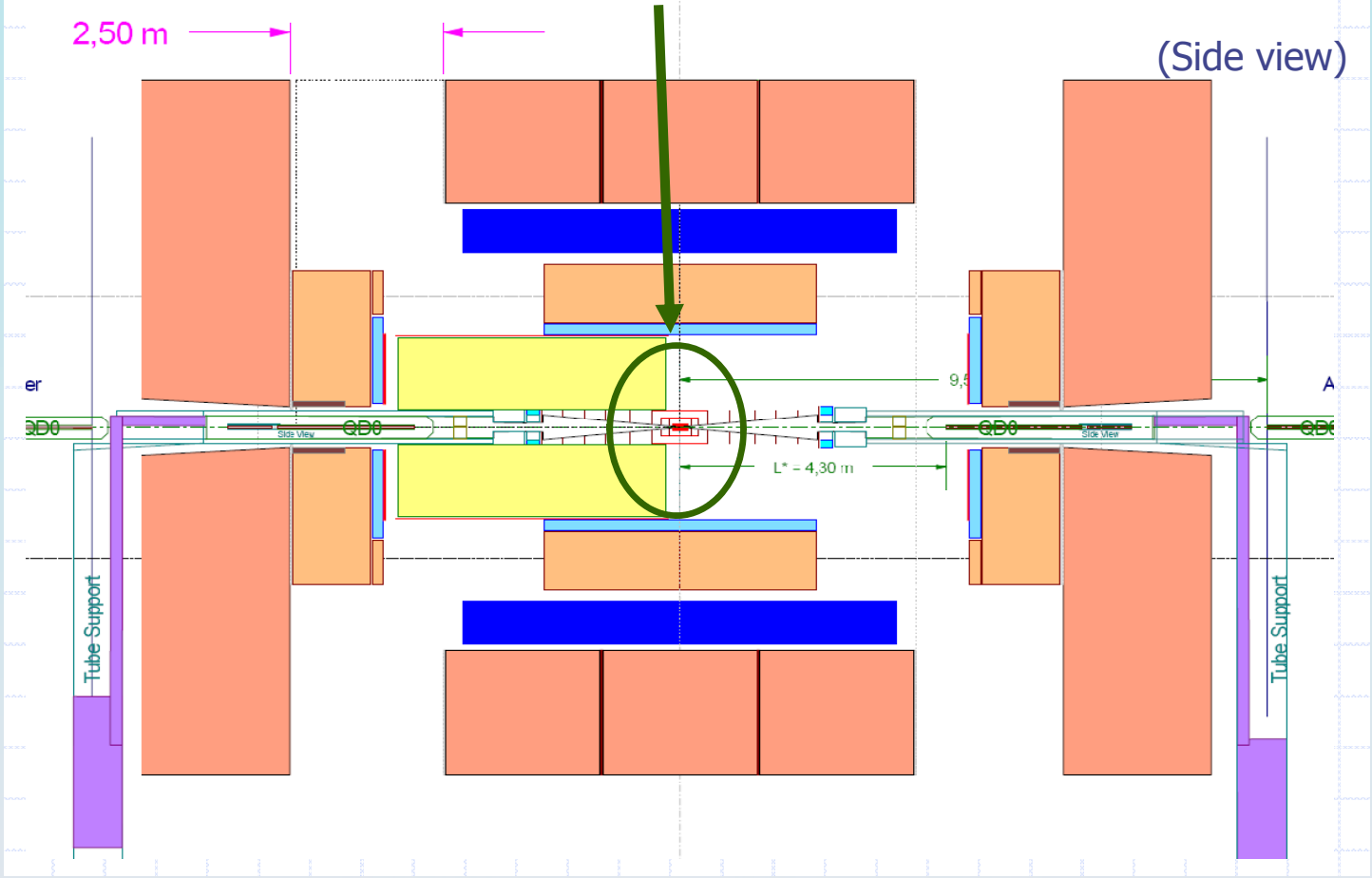


bp	unit	nom.	reconstructed 2mrad*	20mrad DiD	20mrad DiD + E_γ	14mrad antiDiD + E_γ
σ_z	μm	300	300.75 ± **4.56**	307.98 ± **4.72**	299.80 ± **1.69**	301.09 ± **1.65**
ε_x	10^{-6}m rad	10	11.99 ± **7.61**	— ± —	— ± —	9.94 ± **2.16**
Δx	nm	0	4.77 ± **14.24**	4.55 ± **8.14**	4.57 ± **8.13**	-3.84 ± **11.08**
α_v	rad	0	0.002 ± **0.016**	0.010 ± **0.025**	-0.001 ± **0.025**	-0.071 ± **0.017**

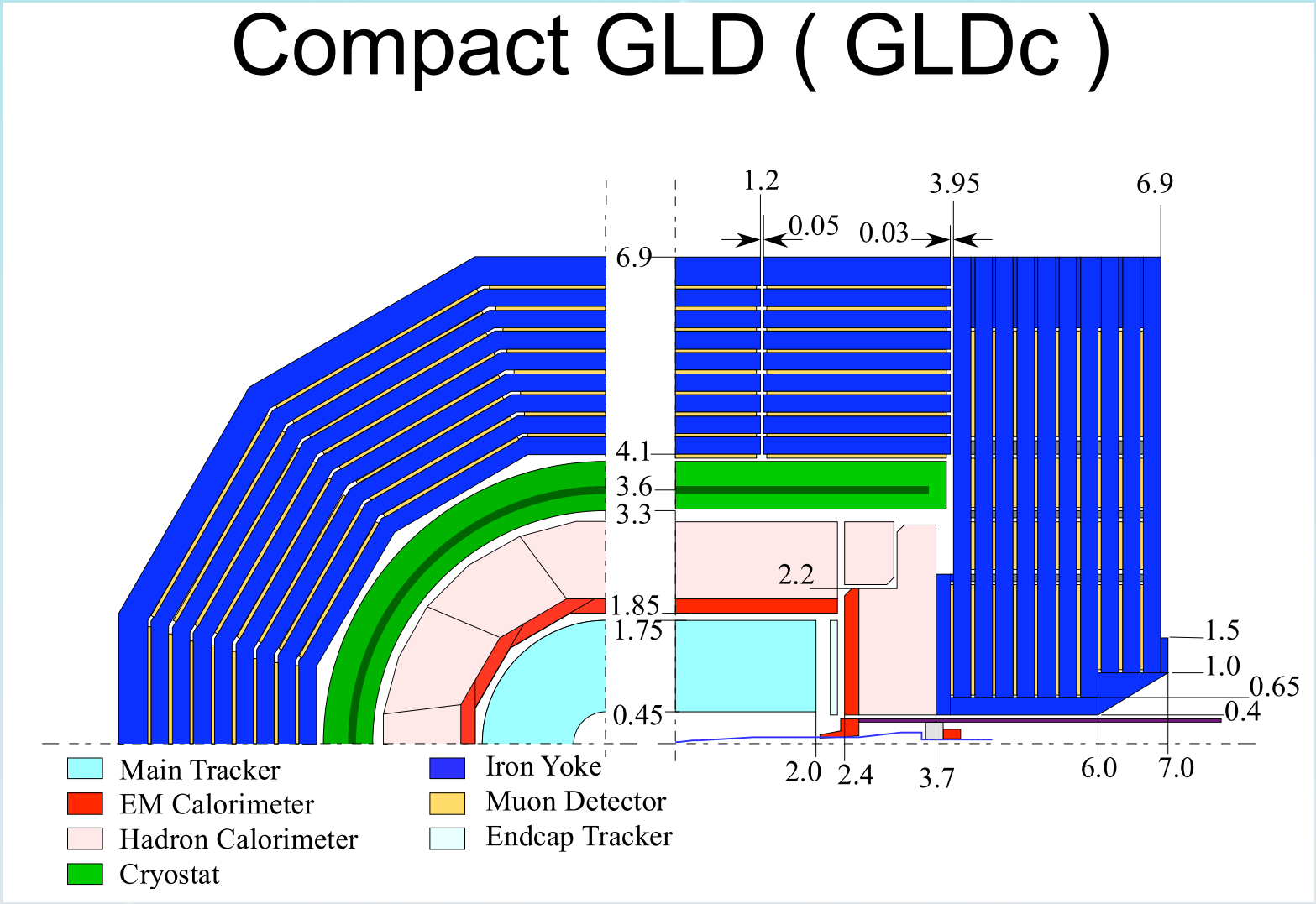
- Analysis of pairs energy distribution leads to beam parameter determination
- GammaCal (further downstream) helps with this

Detector Opening (Vertex Detector Maintanence)

2.5m detector opening would just allow to maintain the vertex detector in the garage posistion without breaking the vacuum.
(Pumping the central beam pipe is assumed to be very time consuming.)

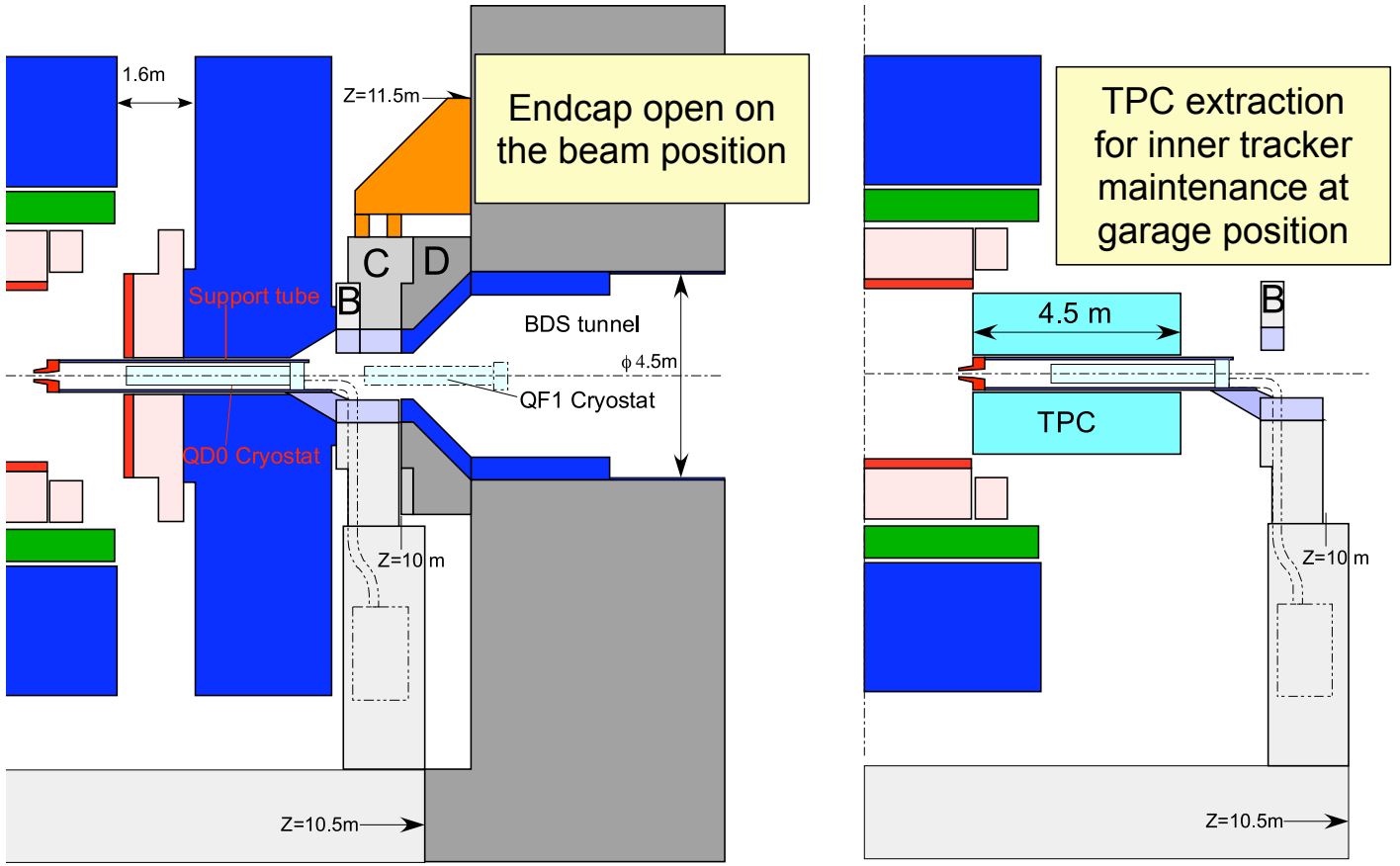


GLDc ready for CMS assembly style

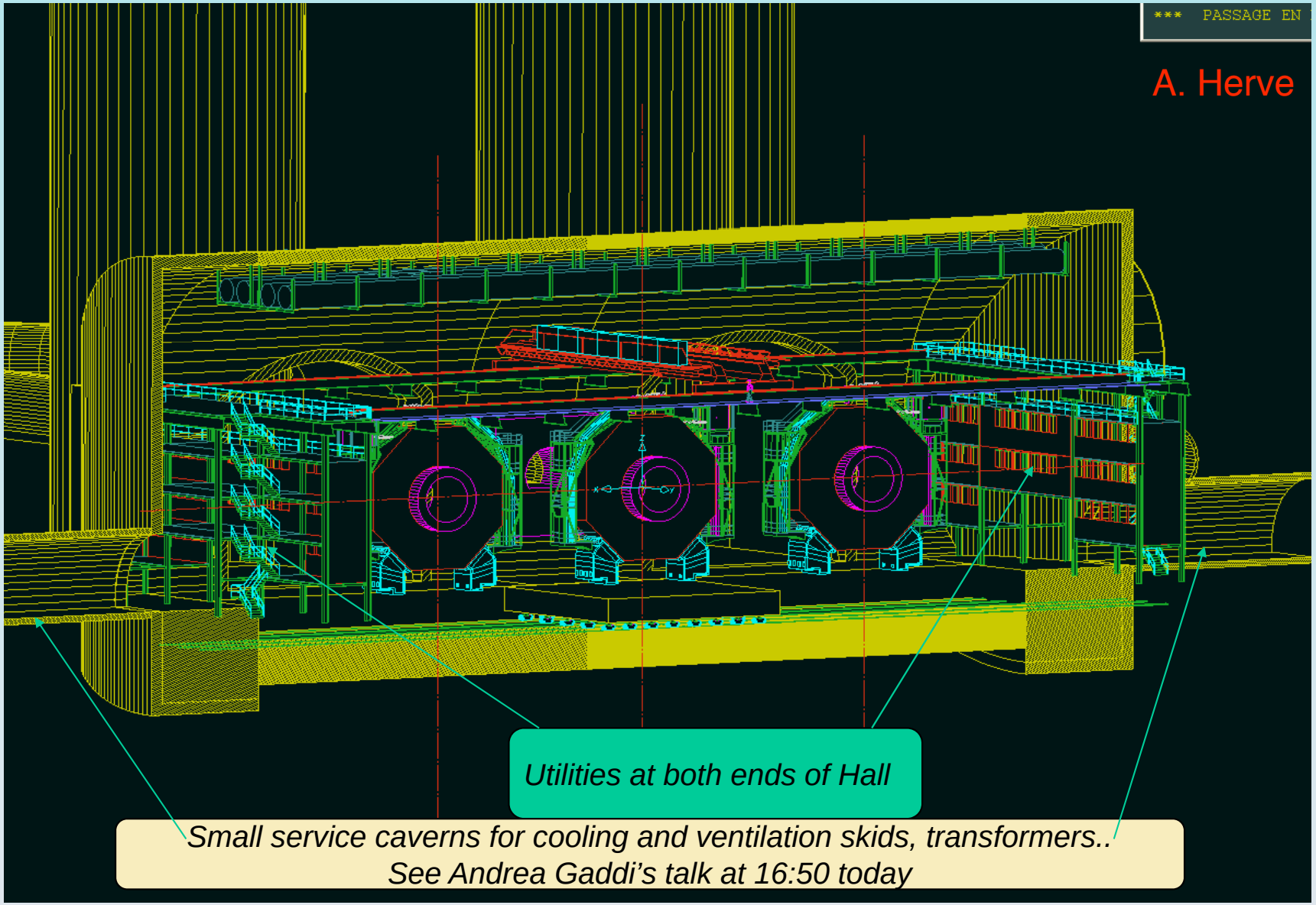


GLDc, IRENG07

Pacman design and FD support



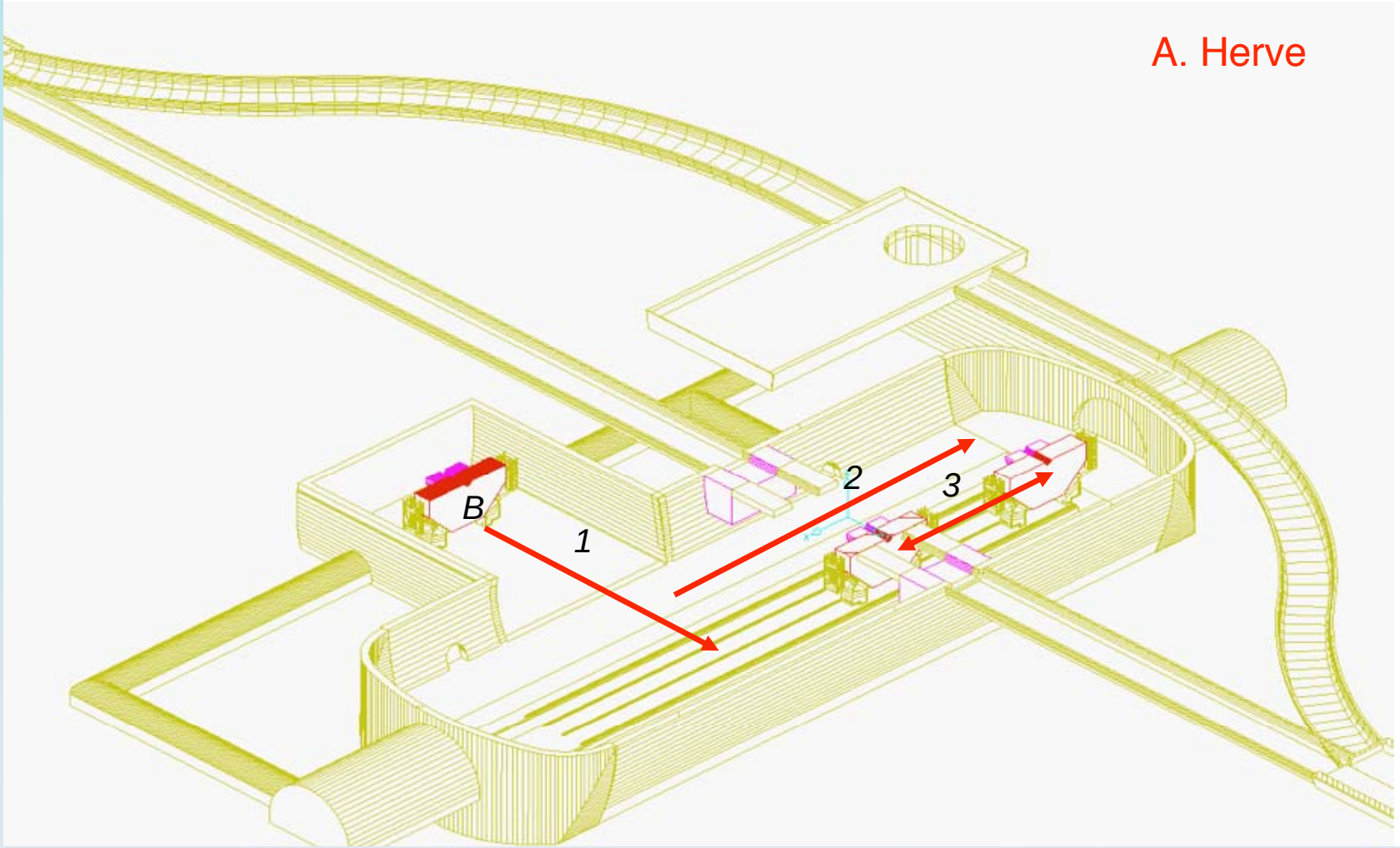
New Underground Hall Designs under Discussion



Underground hall with only one big shaft

Movements of Experiment B

A. Herve



Summary

- ILD MDI/Integration WG has started
- GLD and LDC interaction region follow similar design principles
  →background suppression works well in both cases
- Differences will be studied and tried to be understood
- Roadmap to develop a joint interaction/forward region design as soon as ILD agrees on common geometries for the detector
- Integration and detector hall questions need joint engineering effort
  - Detector hall requirements need to be defined and defended to our machine colleagues → push-pull!
  - Detector integration strategy needs to be developed and followed up as the designs of the ILD detector and its sub-components gets better defined in the coming years
- Next WG meeting will concentrate on integration topics