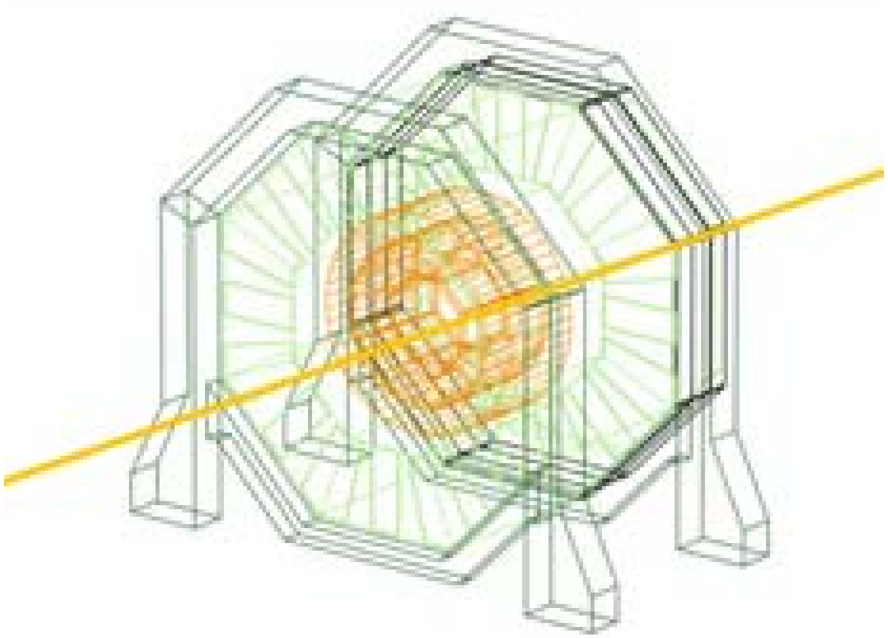
SiD Tracking
What's Next?



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For the SiD Tracking Group

SiD Workshop
RAL, April 14-16, 2008

Current Participants

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1. Argonne
2. Brown University
3. Caltech
4. Fermilab
5. Kansas State University
6. LPNHE Université de Paris 6/IN2P3-CNRS
7. Oxford University
8. Rutherford Appleton Laboratory
9. SLAC
10. UCSC
11. University of Colorado
12. University of New Mexico
13. University of Oregon

apologies to those we forgot

Ratio of number of participants and FTE's is about 5, but is increasing!

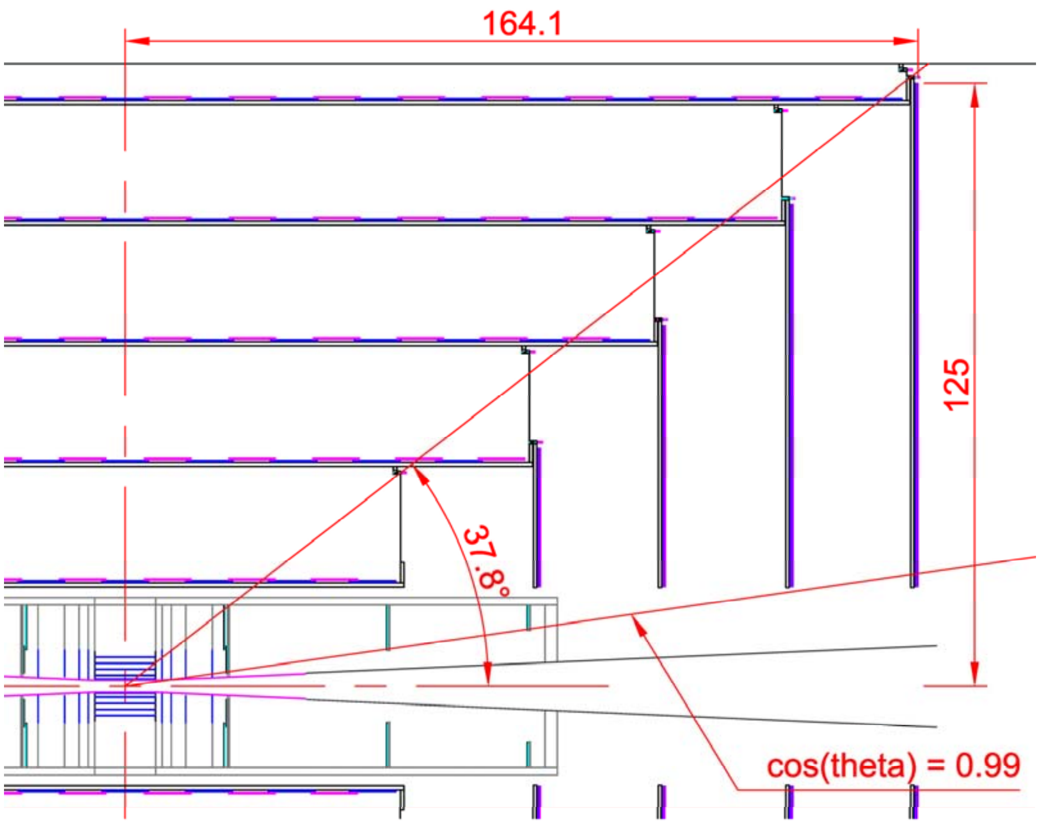
How it will evolve in the (near) future is hard to predict.

My own prediction is that it will not decrease.

This is a stringent boundary condition which has to be respected

Tracker Mechanical Design

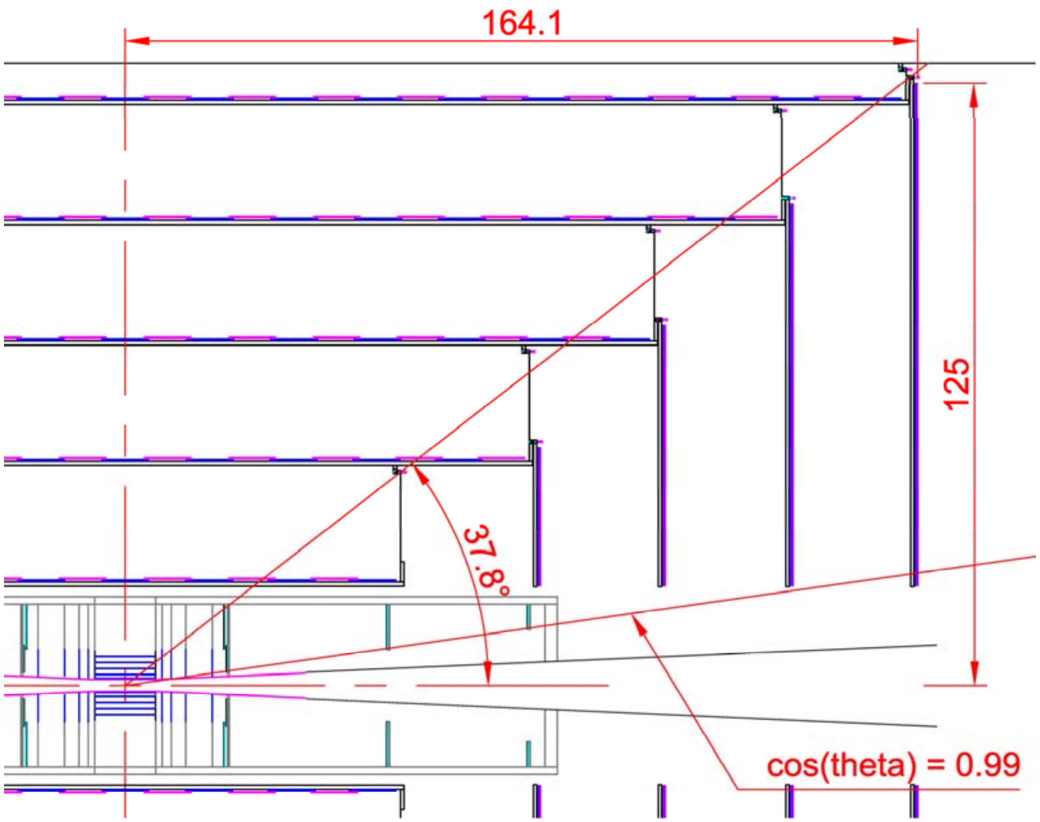
- 5-Layer silicon strip outer tracker, covering R_{in} = 20 cm to R_{out} = 125 cm
- Barrel – Disk structure: goal is 0.8 % X_0 per layer



- Support
  - Double-walled CF cylinders
  - Allows full azimuthal and longitudinal coverage
- Barrels
  - Five barrels, measure Phi only
  - 10 cm z segmentation
  - Barrel lengths increase with radius
- Disks
  - Four double-disks per end
  - Measure R and Phi
  - varying R segmentation
  - Disk radii increase with Z

What is the Goal for the LOI?

- One of the main areas where SiD differentiates itself from the other concepts is the tracker
- SiD has adopted a nested barrel-disk design for the tracker
- Therefore, the focus should be on justifying the design, especially in the forward region where the bulk of the physics is!



- Establish the tracking in the barrel
  - TPC has better momentum resolution at low momenta
- Establish the performance of the forward region

Classification of Current Work

- **For the sake of focus – and given our boundary conditions – we might want to limit ourselves to three areas**
  - **Delivery of the software tools for simulation**
    - Characterize the performance of the detector
    - Quantify the physics capabilities
    - Optimize the design
  - **Delivery of the hardware projects**
    - Committed projects
      - Characterization of the SiD sensors with double-metal and kPix readout
      - Charge division sensors
      - LSTFE-chip
      - Alignment
    - Projects addressing perceived weaknesses of the design
      - Carbon fiber support and air cooling
  - **Development of ideas – individually or by new groups – which enhance the current design or are beyond the baseline of the SiD concept**
    - Development of double-sided silicon

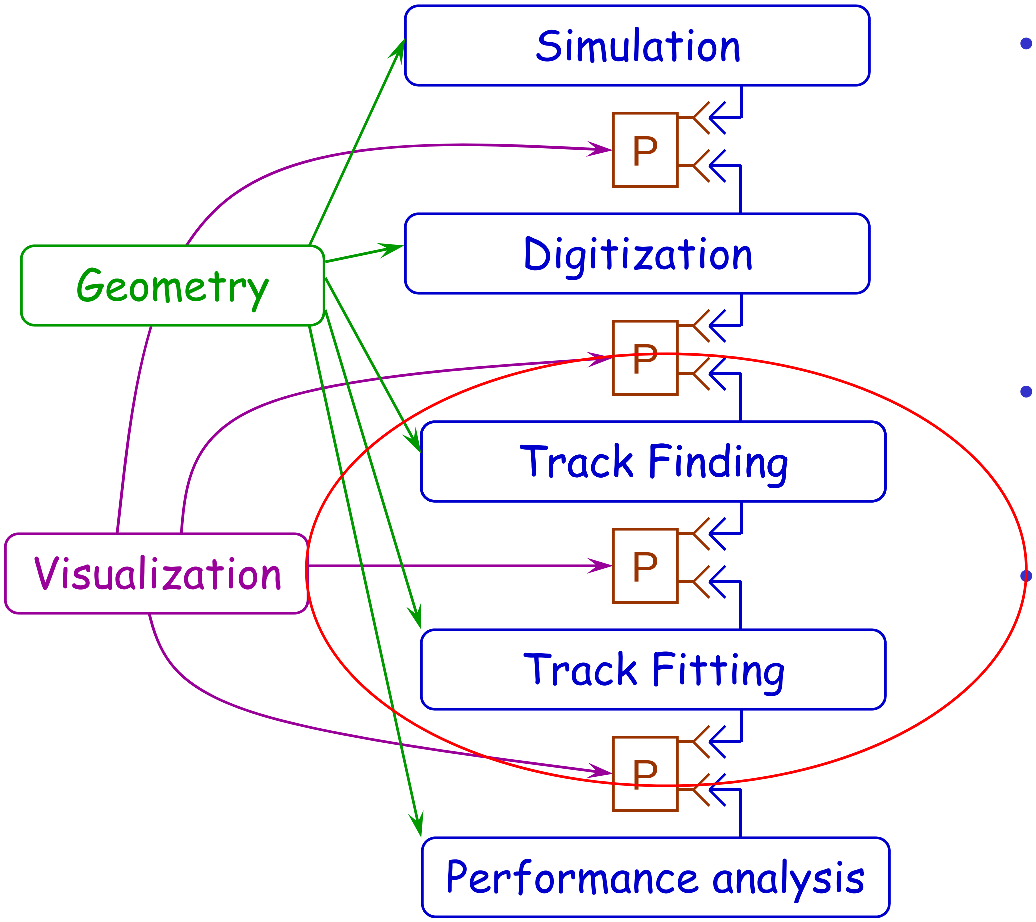
Software Tools

- Very good progress developing the tools for the tracking; development of physics tools carried out in both org.lcsim (and Marlin frameworks)
  - Full planar geometry description
  - Virtual segmentation with hit generation and digitization
  - Pattern recognition code almost complete
  - Full Kalman filter almost complete

- Two branches have developed
  - Virtual segmentation
  - Planar detector geometry

Tracking Software

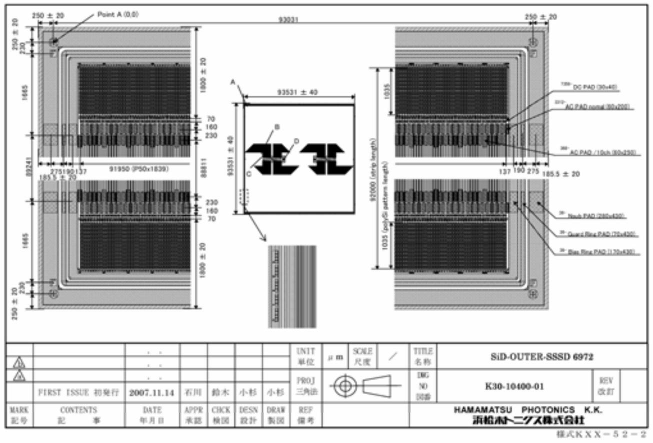
- **Virtual Segmentation / Planar Geometry**



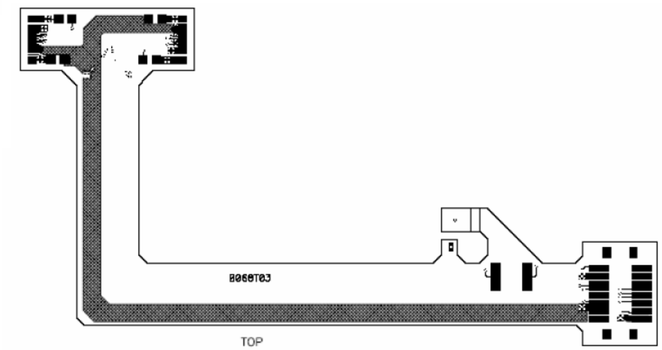
- **Virtual Segmentation**
  - **Nearly complete in all areas**
  - **First pass available for track finding and fitting**
- **Planar Geometry**
  - **Under development**
- **Resources need to be shared between these two paths. How to optimize this?**

Hardware Projects: Sensors

- Sensors from Hamamatsu in hand
  - 20 full-size sensors
  - 40 kPix test structures
  - 40 charge division sensors
- We believe sensor characterization and readout with various readout configurations to be relatively straightforward and a must.
- Resources are (us usual) a problem



- Sensor characterization plan developed
  - Probe measurements at UNM, SLAC, UC Santa Cruz (Fermilab backup)
- Review of cable design planned

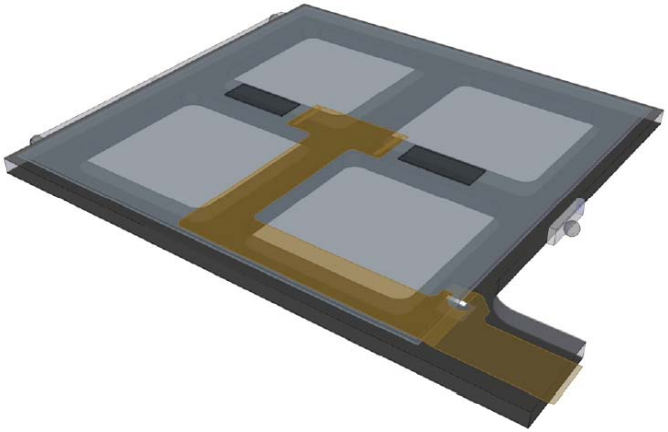


- May want to develop a hybrid to readout sensors with different readout chips
  - kPix, LSTFE (UCSC), SiTR (LPNHE/Paris)

- Is a timescale of a year for completion/publication reasonable?

Hardware Projects: Supports

- **Module support**
  - **Minimal frame to hold silicon flat and provide precision mounts**
    - CF-Rohacell-Torlon frame w/ ceramic mounts
    - CF-Torlon clips glue to large-scale supports
  - **Ease of large scale production, assembly and installation/replacement**



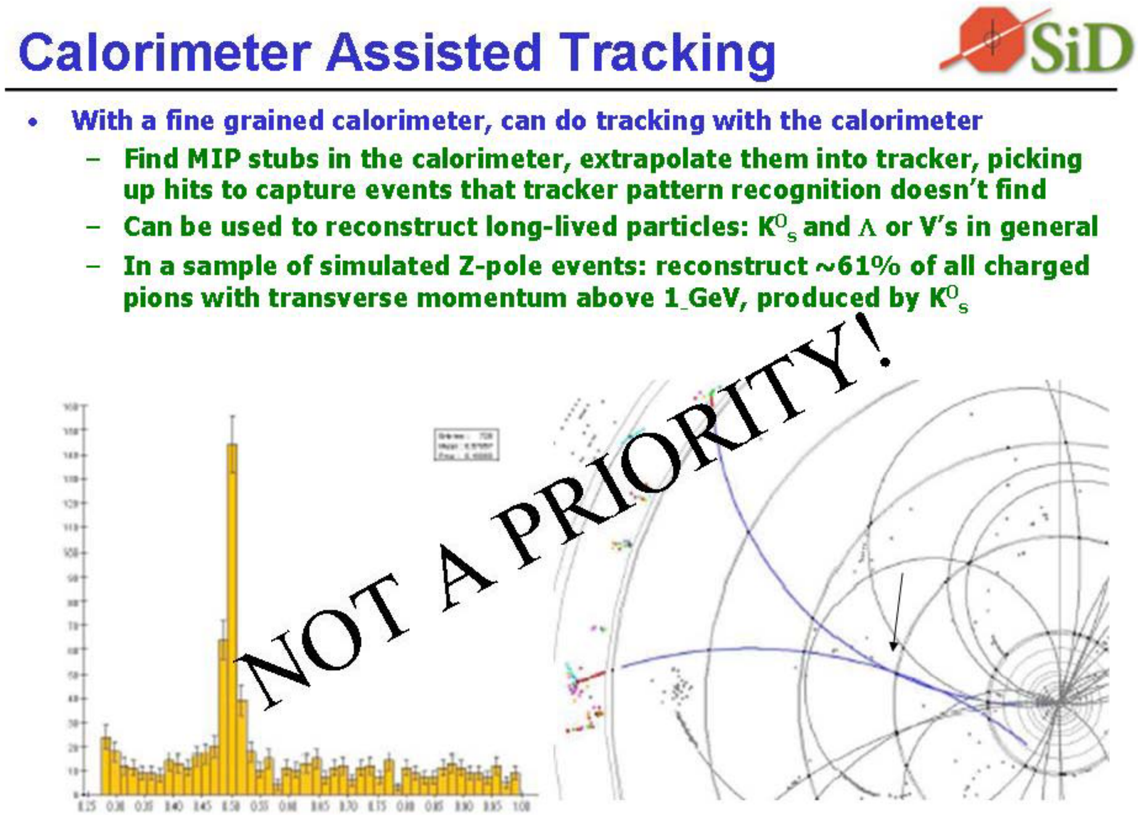
- **Mechanical support structure**
  - **Risks associated with a lightweight structure operating with pulsed power (50 kW peak!) in an unusually high magnetic field.**
  - **Have all issues related to gas cooling been laid to rest?**
  - **Could move to building a full-scale support structure for disks and/or barrels**

- **How critical are these issues for the LOI?**
- **To what extent do we want to pursue them?**
- **What resources are available?**

New and Old Ideas

- **Development of new ideas are healthy and should be encouraged given they don't take away from the base effort**

- **Some of the new ideas are not that new anymore; the principle has been established; results have been obtained and taking it to the next level might require resource that are not available**

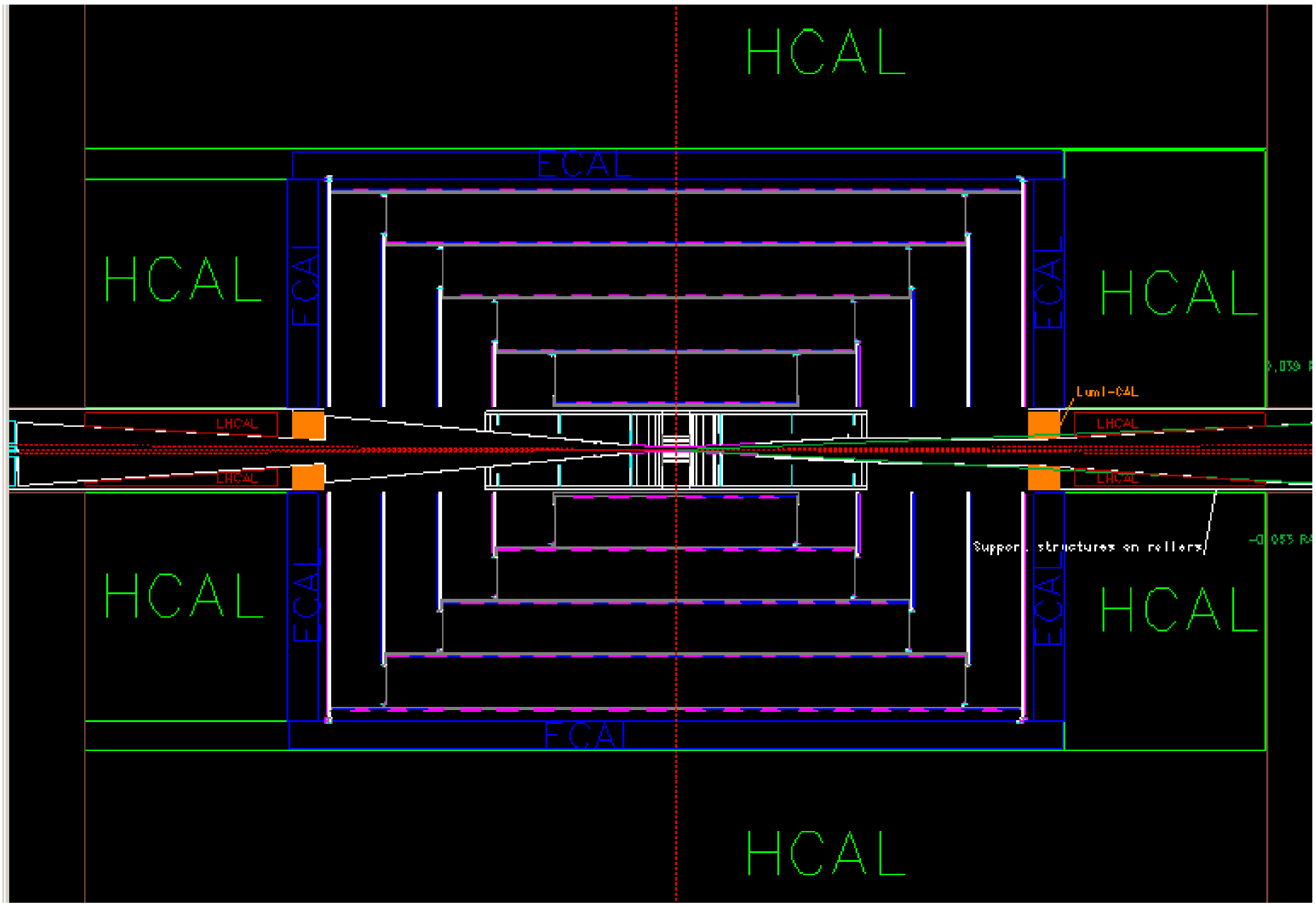


- **Great work**

- **Good enough for an LOI!?**

MDI

- There are a couple of beam tube proposals.
- We need to decide which one to use for the simulation studies based on forward physics arguments



Concluding Remarks

- SiD should be pro-active in defining what an “LOI” means
  - It’s a balance, but reality tell us that it is going to be a while before a TDR will get submitted
- I think we should aim low and focus on those areas
  - where SiD differentiates itself
  - which have not been quantified/optimized to date
  - these are areas of general interest
- With the momentum we have now and the ratio of participants/fte’s we do have a chance if we limit our scope to those issues that are within reach.
- We strongly support a “change control” process for the detector geometry
- We should freeze the detector geometry and not monkey around with it anymore
- Focus on finishing a full set of digitization, pattern recognition and track fitting tools

- With that in hand – with the frozen geometry, different from other concepts – get a reference point for its performance; that, we believe, should be our priority