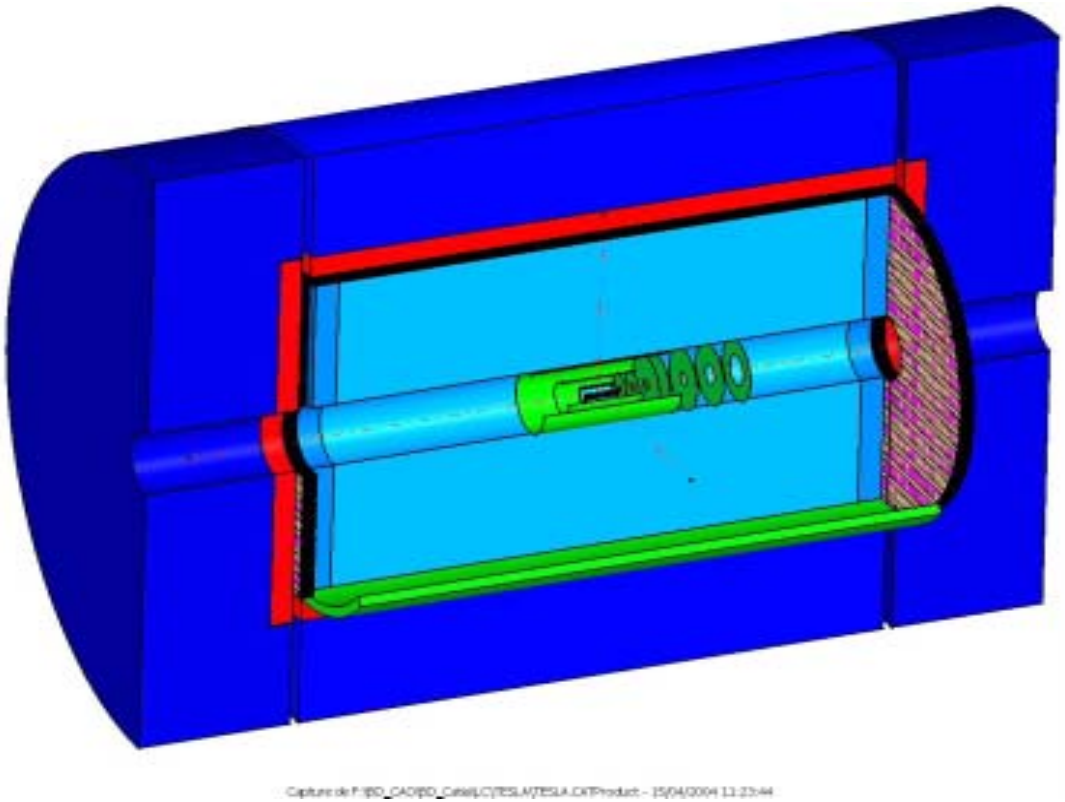
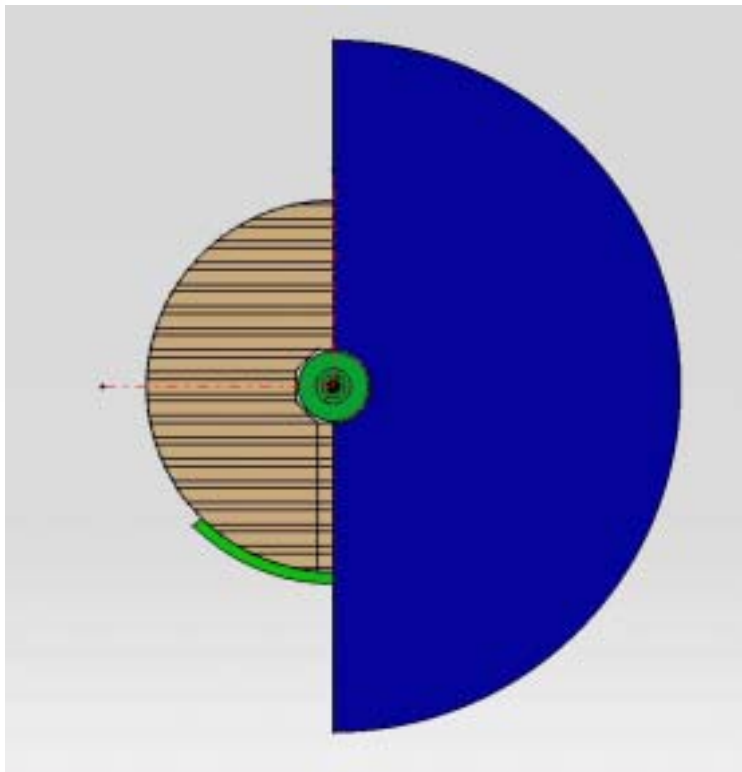
SiLC Progress Report



Latest on:

- R&D on sensors
- Results on Lab test bench
- R&D on F.E.E & readout
- R&D on Mechanics
- Integration & calibration
- Simulations



LCWS '04, Tracking session, Paris, April 19th to 23rd 2004,

Aurore Savoy-Navarro, LPNHE-Université Pierre & Marie Curie/IN2P3-CNRS

SiLC Collaboration

USA:

BNL
Wayne St.U.

U. Of Michigan

SLAC
UCSanta Cruz
-SCIPP

Proposition DOE(04-06):
UCSC+SLAC+LPNHE

Europe:

Helsinki U. (Fin)
Obninsk St. U.(Ru)
IEKP Karlsruhe(Ge)
Charles U. Prague (CZ)
Ac. Sciences.Wien(Au)
LPNHE-Paris(F)
U. de Genève (CH)
Torino U. (I)
INFN-Pisa (I)
La Sapienza-Rome (I)
CNM-Barcelona (Es)
Cantabria U. (Es)

EU contract btw. several Inst.

Asia:

Korean Institutes

Tokyo U.
HAMAMATSU

PRC Proposal on May 7th 2003 (PRC-DESY-03-02) + Addendum on Oct. 31st 2003:
Roadmap: mid 2003 to end 2006 → test beam on full prototype, by fall 2006

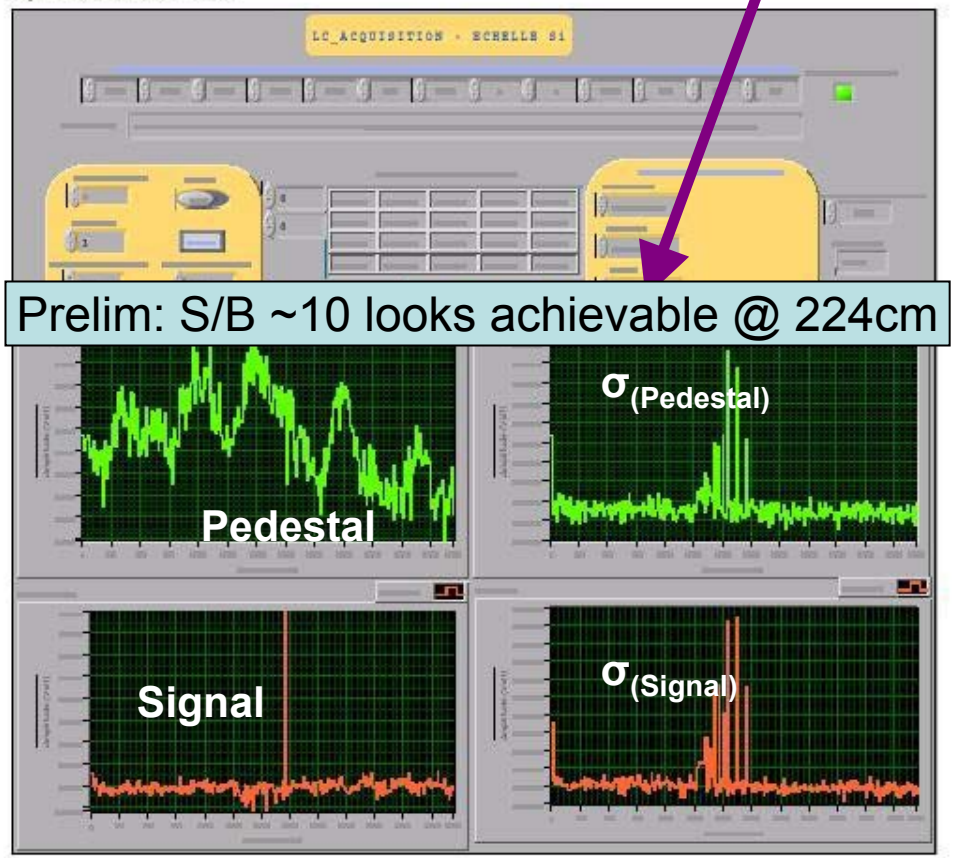
R&D applies to both: all-Si-tracking system or to Si-Envelop (Si-tracking+TPC)

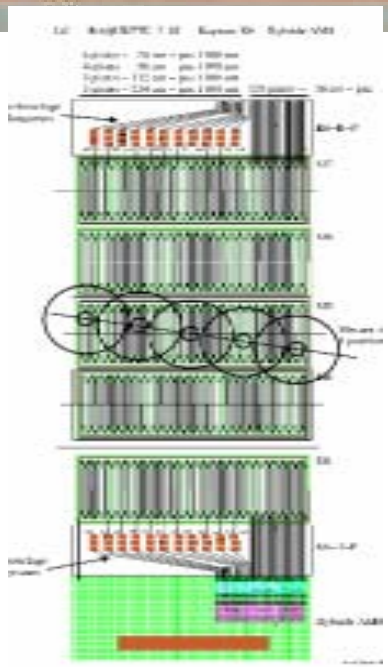
SiLC gathers worldwide expertise on Si-tracking detectors technology
Based on LEP, B-factories, Tevatron, LHC(ATLAS, CMS, ALICE), AMS et GLAST
LEITMOTIVs: HIGH PERFORMANCES, TRANSPARENCE & EASY to BUILD

R&D on sensors

Long ladder prototype (Geneva +ETHZ + Paris), read out with VA64hdr (AMS-IDEAS)

Lab test bench, Labview based (Paris)
Test with LD1060nm on 224 cm long µstrip
Latest results after redesign of the kapton





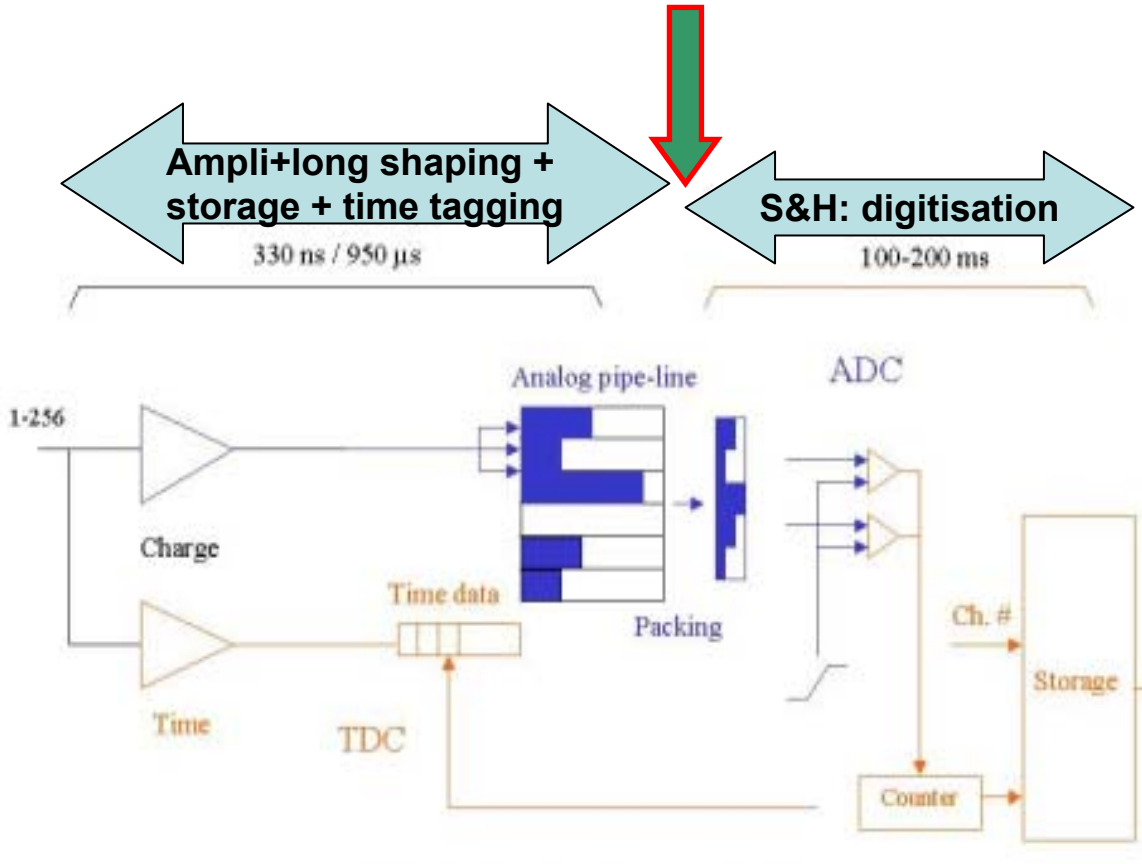
Kapton with serpentine design → 28, 56,112 & 224 cm µstrip length

Underway: Fabrication of a 2nd proto Made of 10 new Hamamatsu sensors. Each sensor will be tested in Vienna CMS test bench , no serpentine.

And work in progress on sensor R&D especially in Korea (Park's talk) & foreseen with others (ST-M or CNM, for instance)

R&D on F.E.E & readout for long ladders

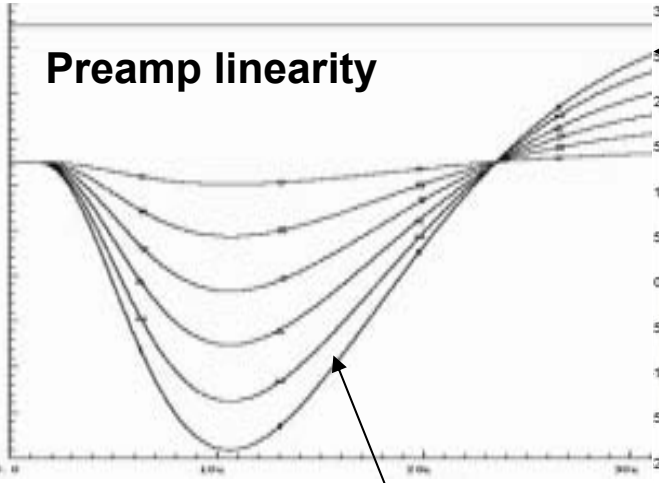
- Work in progress on new F.E.E @ SCIPP-UCSC (B Schumm's talk)
- New V.A. – IDEAS chip adapted to LC Si-tracking (IDEAS + Vienna + Karlsruhe)
- **Work in progress on new F.E.E. @ LPNHE**

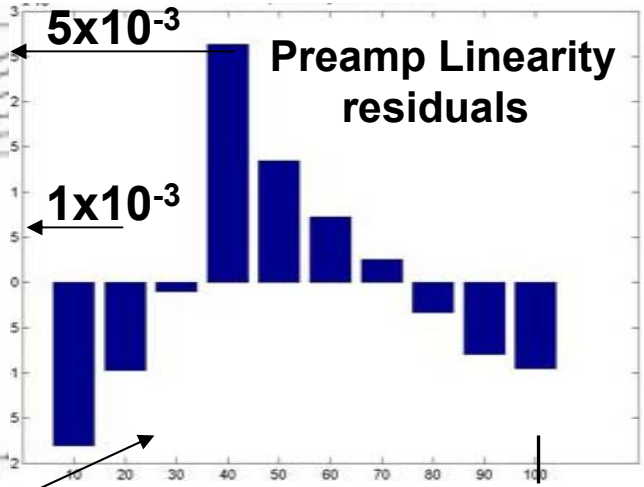


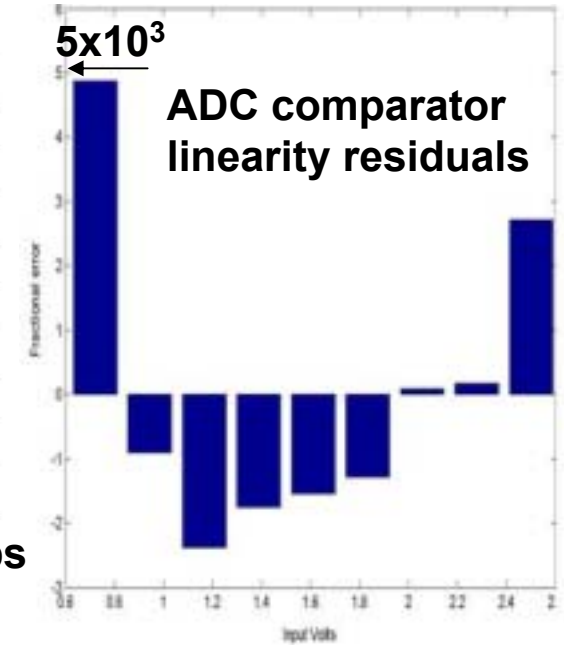
Goals:

Low noise preamp
Long shaping time
Very low power dissipation
Shared ADC/TDC
Digitisation @ sparsification
Power cycling
Compact and transparent
Choice of DSµE

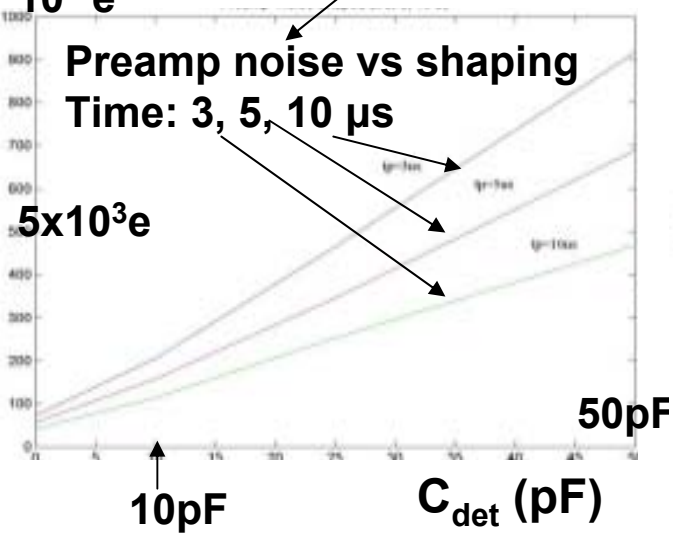
Design & Simulation of F.E.

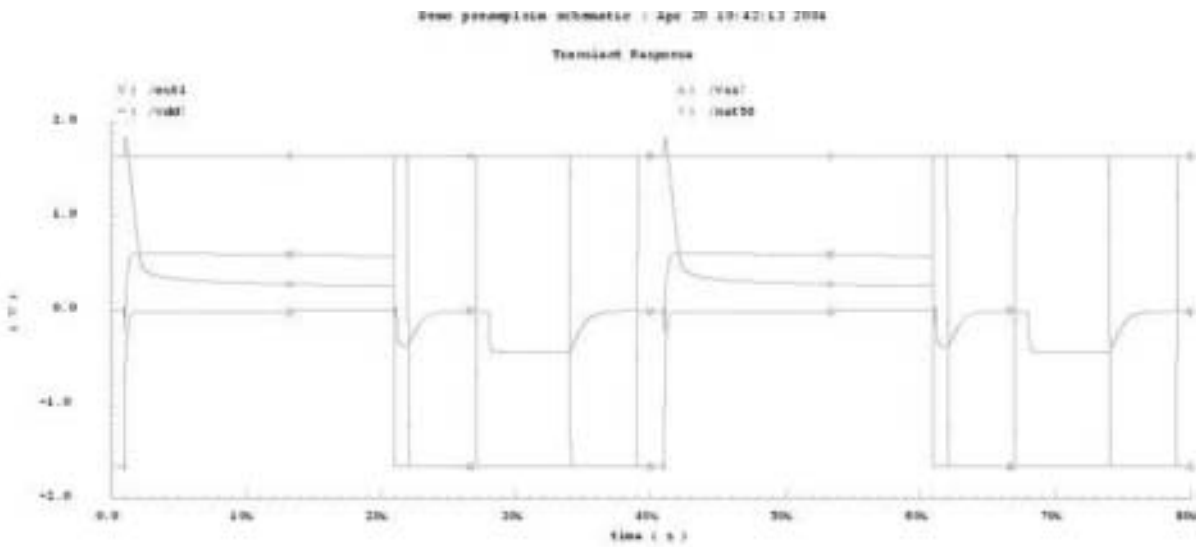






Preamp Linearity →100Mips & Noise<10³e





Simulation on power cycling: recovery time ~5-10µs

ASN, SiLC Progress Report, LCWS04

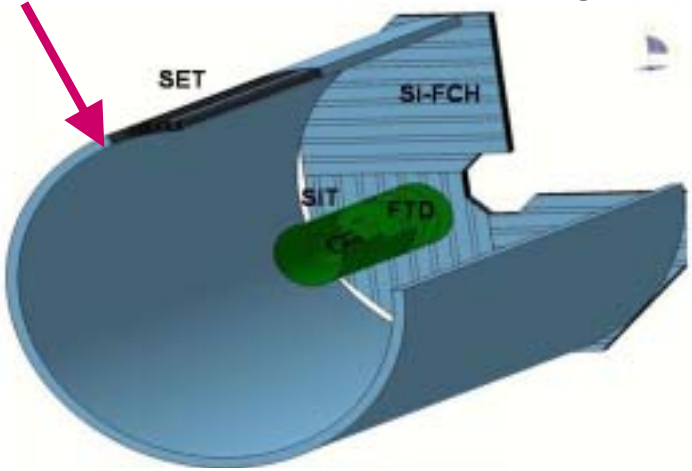
Summary of SiLC FE & Readout status (04/21/04) (@ LPNHE

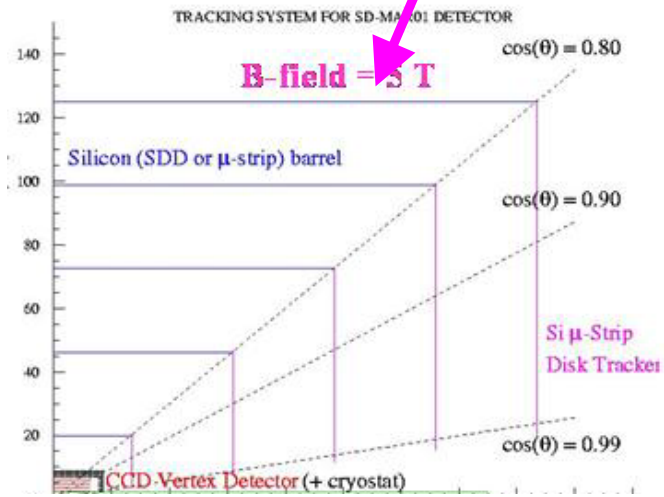
Item	Features		Status
Very Front end:			
Preamp	*Gain*:	*3,5 mV/MIP*	*Simulated*
	Noise:	*480 e- (690e-)*	
		@50pF, 10 (5)μs shaping time	
	Dynamic range:	*100 MIPs*	
	Power:	*82.5 μW*	
Shaper	*Peaking time:*	*Gain 4*	
	3-5 μs		
Sample and Hold:			
ADC	*10 bit*	*4μs*	*Comparator simulated*
	Power:	*40 μW*	

Multi-channel prototype in UMC, 0.18 μm sent to foundry by July 04
Expected to be fully tested at Lab test bench by end 04
Estimated total power dissipation per channel all included ≤ 200μW
Thus for $2x10^6$ channels → 400 Watts without power cycling

R&D on Mechanics

- CAD design of the architecture of the various elements of the Si-Envelop, but can be easily translated to the all-Si tracking case



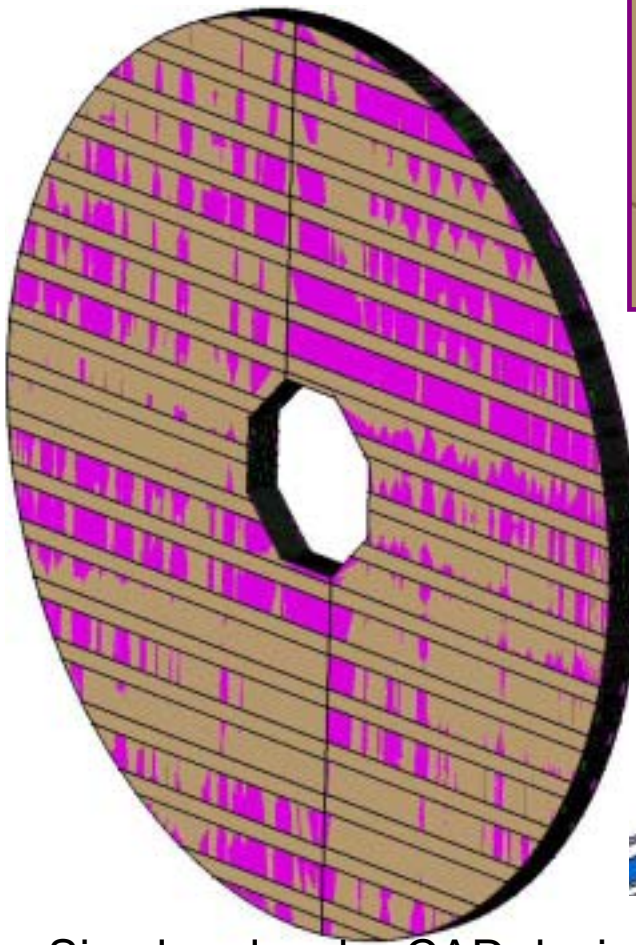


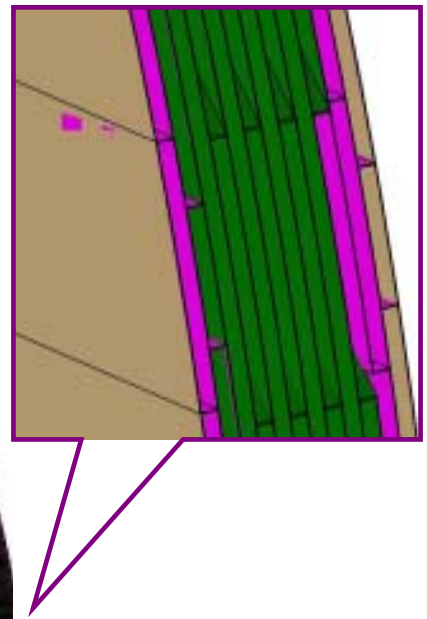
- Design and construction of a long ladder prototype
- Thermal mechanical studies
- Alignment techniques are under development at U. of Michigan and starting at U. of Cantabria (based on interferometer & LHC expertise)

Main R&D aims:

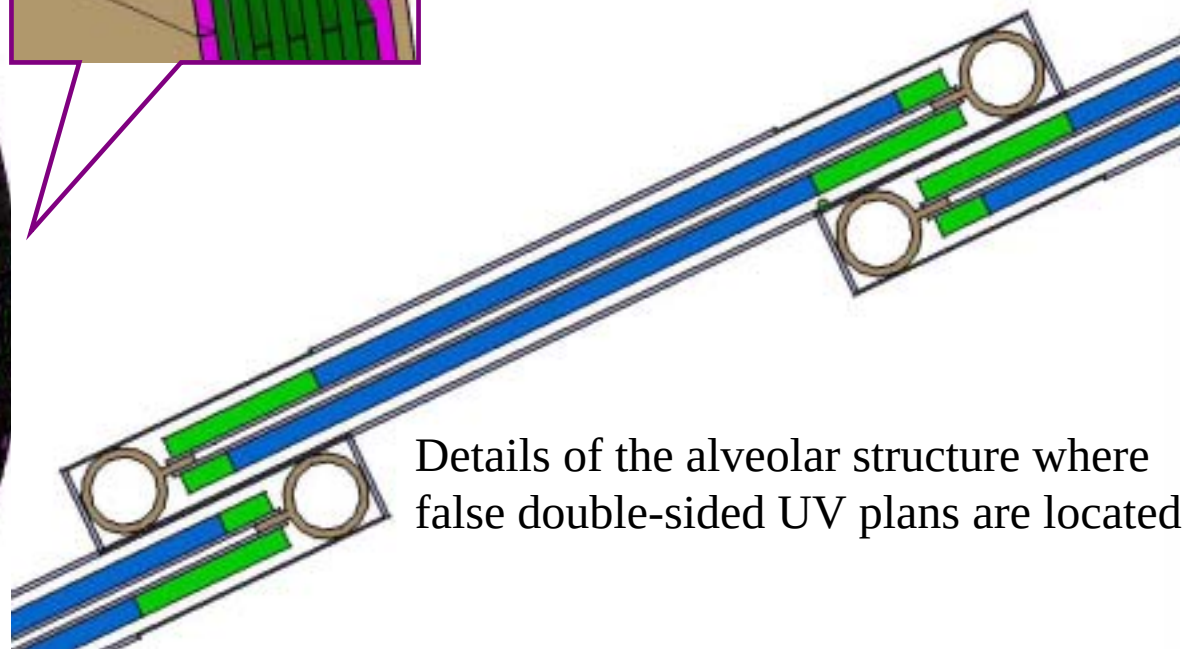
Transparency, high precision, simplicity, and easy to build

CAD design of the detector structure





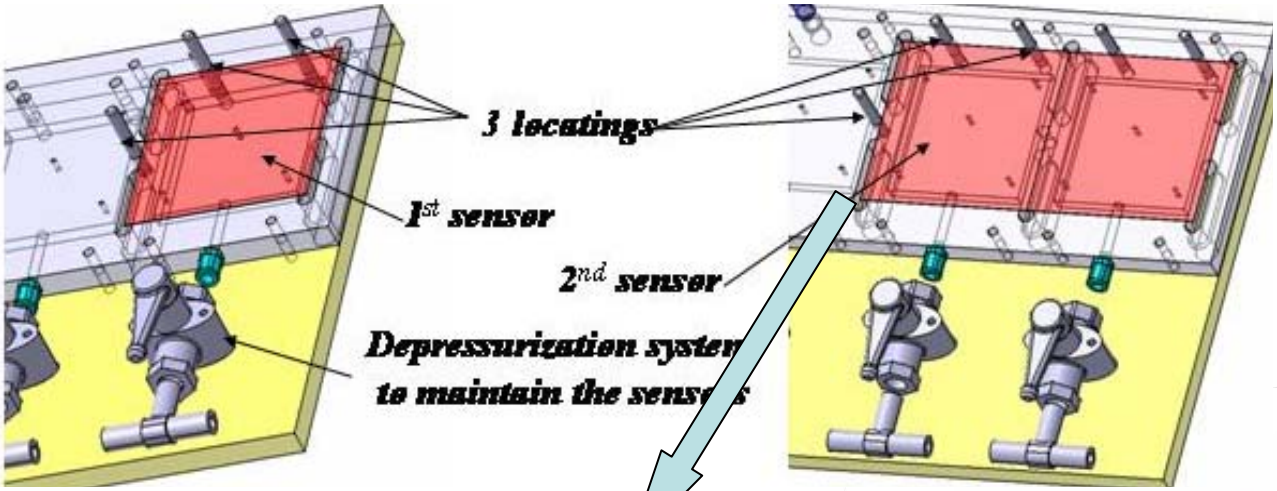
Ex: detailed CAD (CATIA) of the Si-FCH gives 4 XUV points, given by: X, UV, U, U, UV, X plans
Total width: 127 mm



Details of the alveolar structure where false double-sided UV plans are located

Simular alveolar CAD design achieved for the SET and idem for the SIT
Next step: collaboration with Industry to check feasibility vs cost of designed structure and fabrication of a mechanical prototype for further mechanical studies

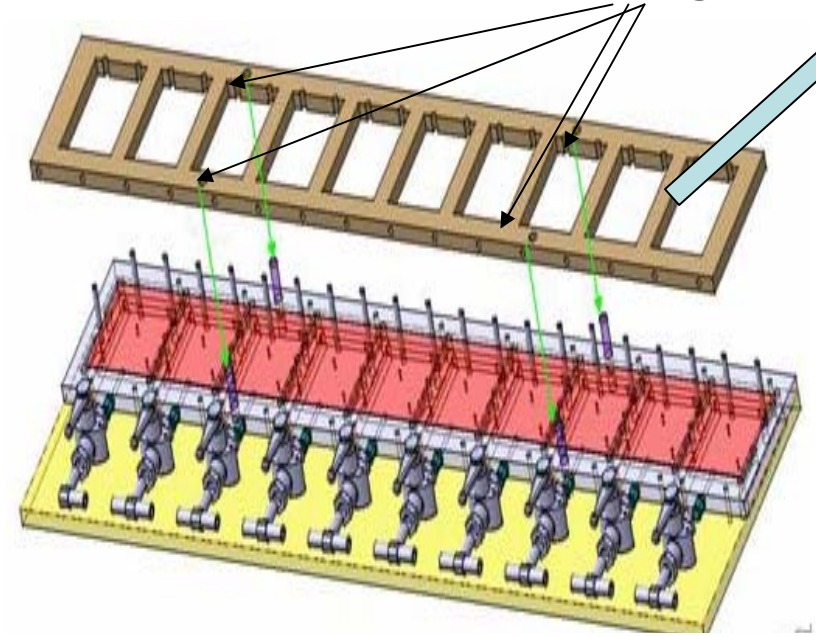
Long ladder construction:

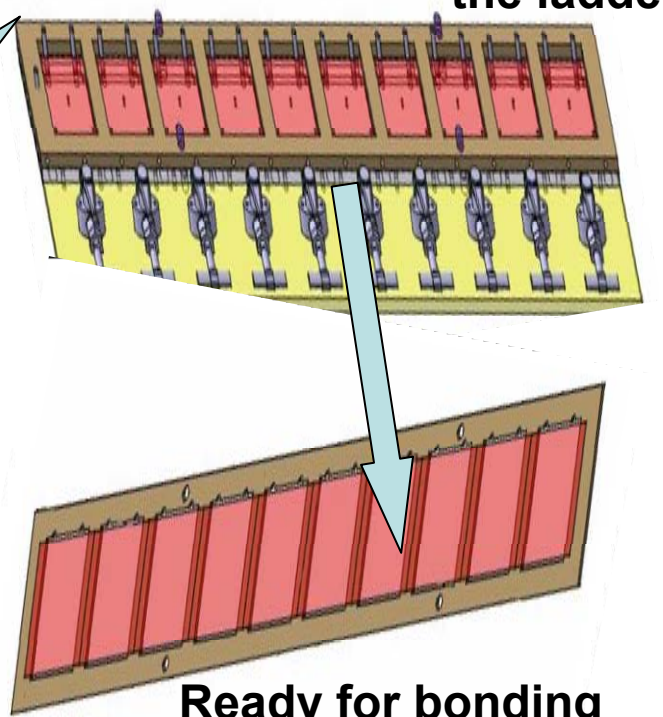


Sensors are positioned one by one on assembly frame

Gluing of the ladder

The long ladder structure is positioned on the 10 sensors with 4 locatings





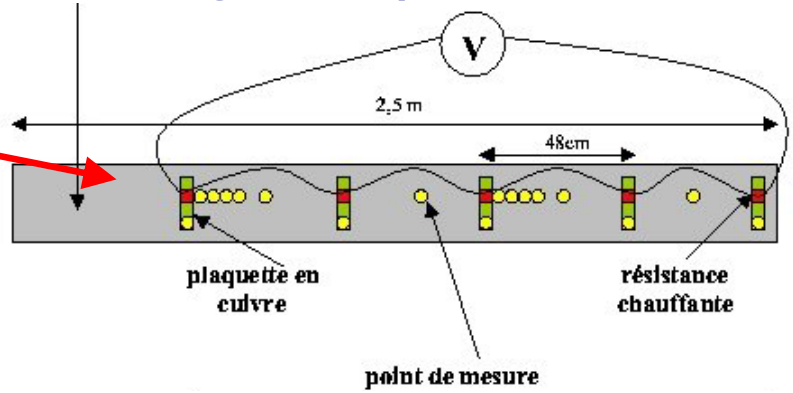
Ready for bonding

Thermal Mechanical Studies

Based on tests on a mechanical prototype:

Long drawer made of 5 ladders located in its alveolar structure

2.5 m long drawer proto



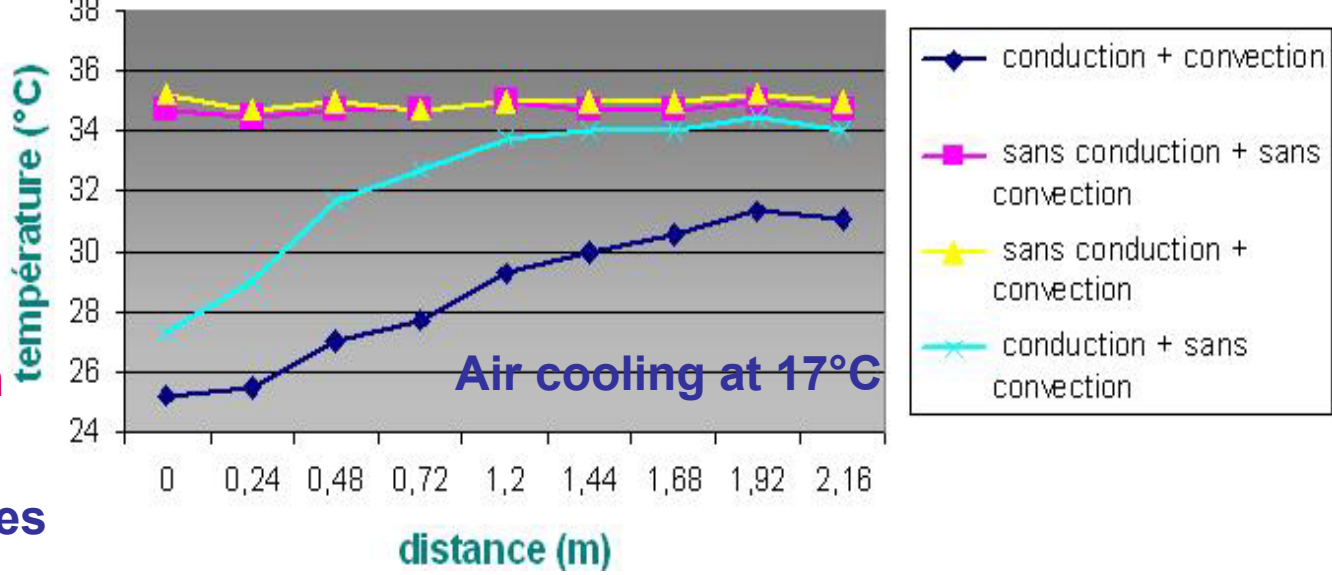
At one end of the drawer: cooling water → cooled air convection by wind turbine + conduction In the alveolar structure

The external temperature is maintained at 35°C
The simulated power dissipation per channel: 400 µW (i.e. 2 x expected one)
The goal is to maintain the temperature on the detector below 30°C, in order to avoid intrinsic noise increase.

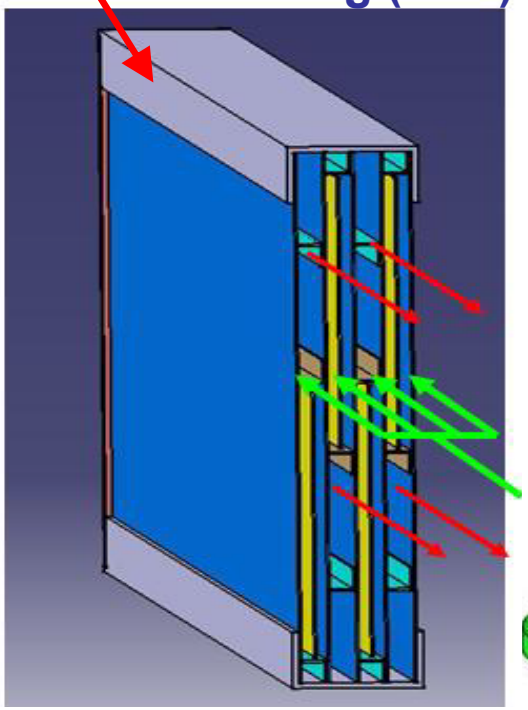
ASN, SiLC Progress Report, LCWS04

Results:

Conduction +convection by air cooling @ 6.5°C at one end of drawer
→ T < 28°C over 2.2m
Very important reduction of material budget !!!



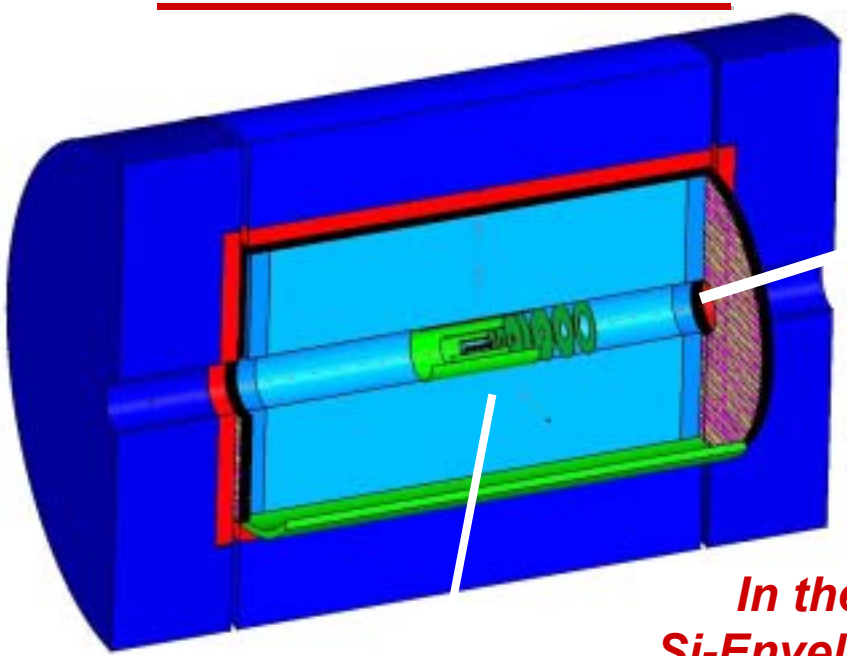
Underway: thermal studies on Si-FCH proto, drawer 2.1m long (max)

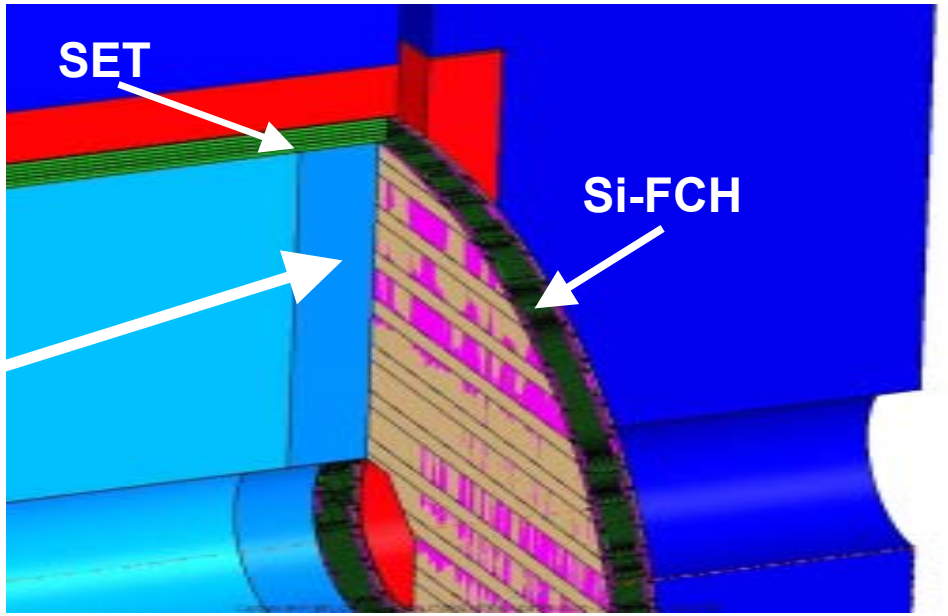


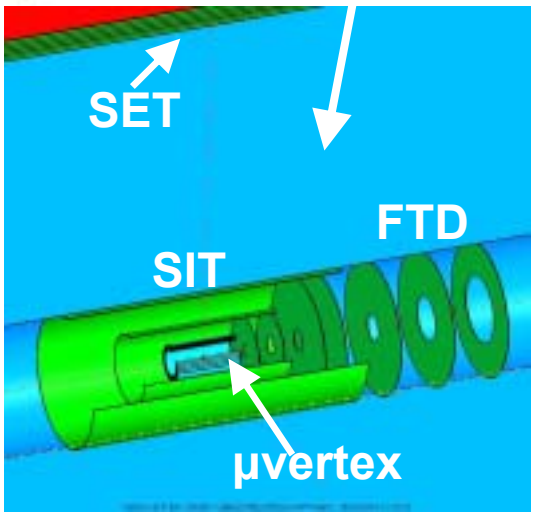
These results on prototypes are used to model the computed results from SAMCEF simulation package.

ASN, SiLC Progress Report, LCWS04

Integration studies: on Mechanical side







In the case of a Large Detector (i.e. with TPC)
Si-Envelop components are in strategic positions:

- SIT links µvertex (σ~2-3µm) with TPC (σ~100µm)
- SET links TPC with calorimetry
- Similarly in the FW region: FTD and Si-FCH.

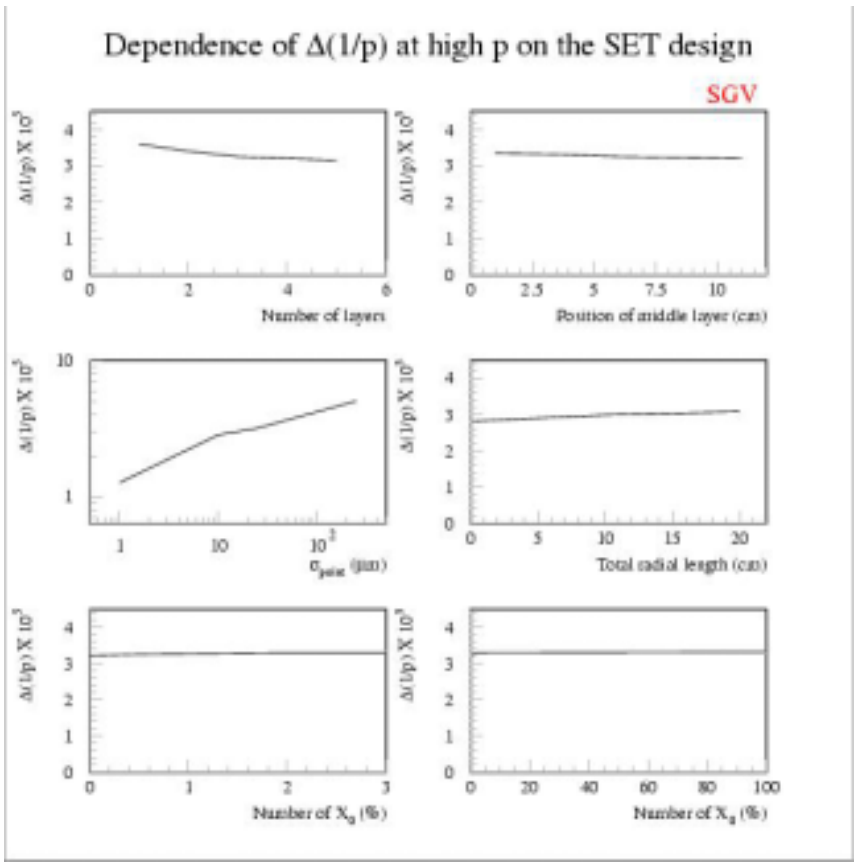
Questions to be answered:

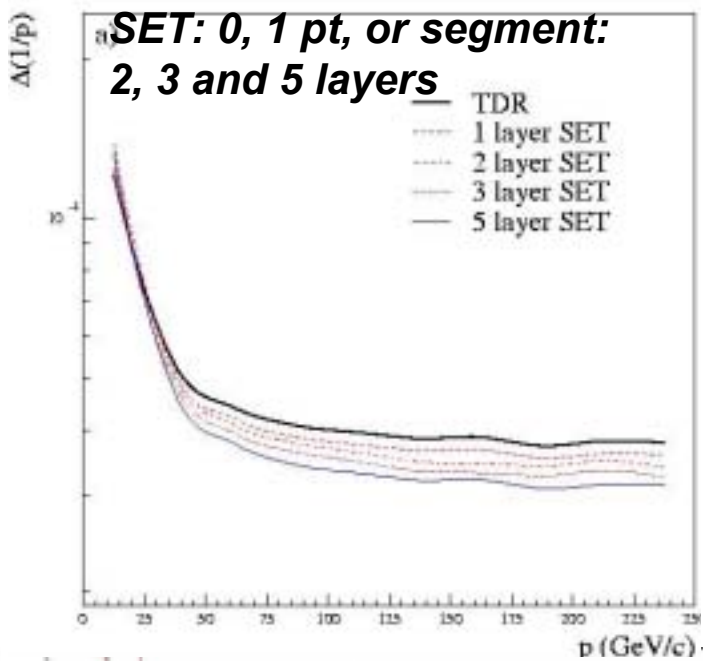
In the case of SET & Si-FCH especially:

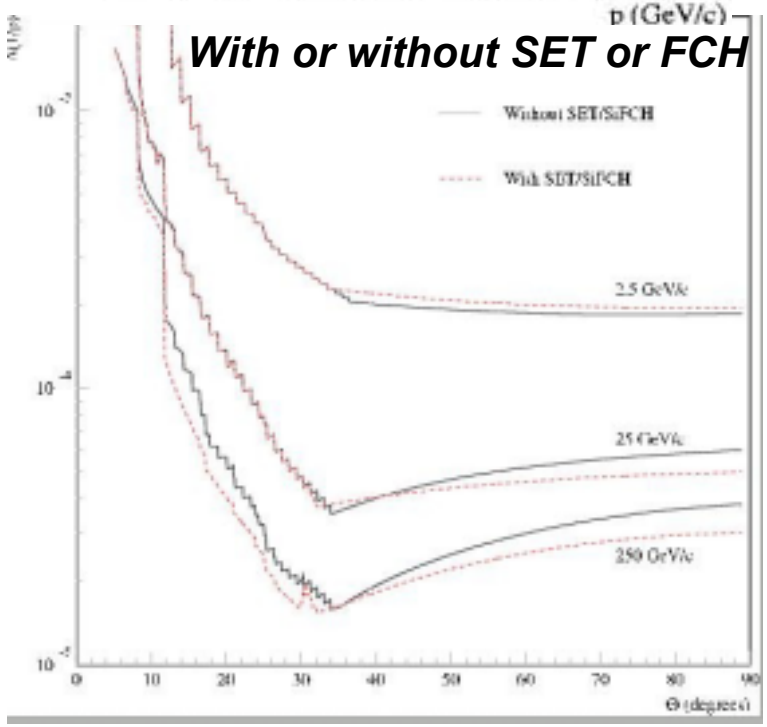
- ➢ One point? What precision?
- ➢ One segment?
- ➢ One track? (requested length of tracking level arm?)
- ➢ How this design compares with SD in central & FW?

Simulations

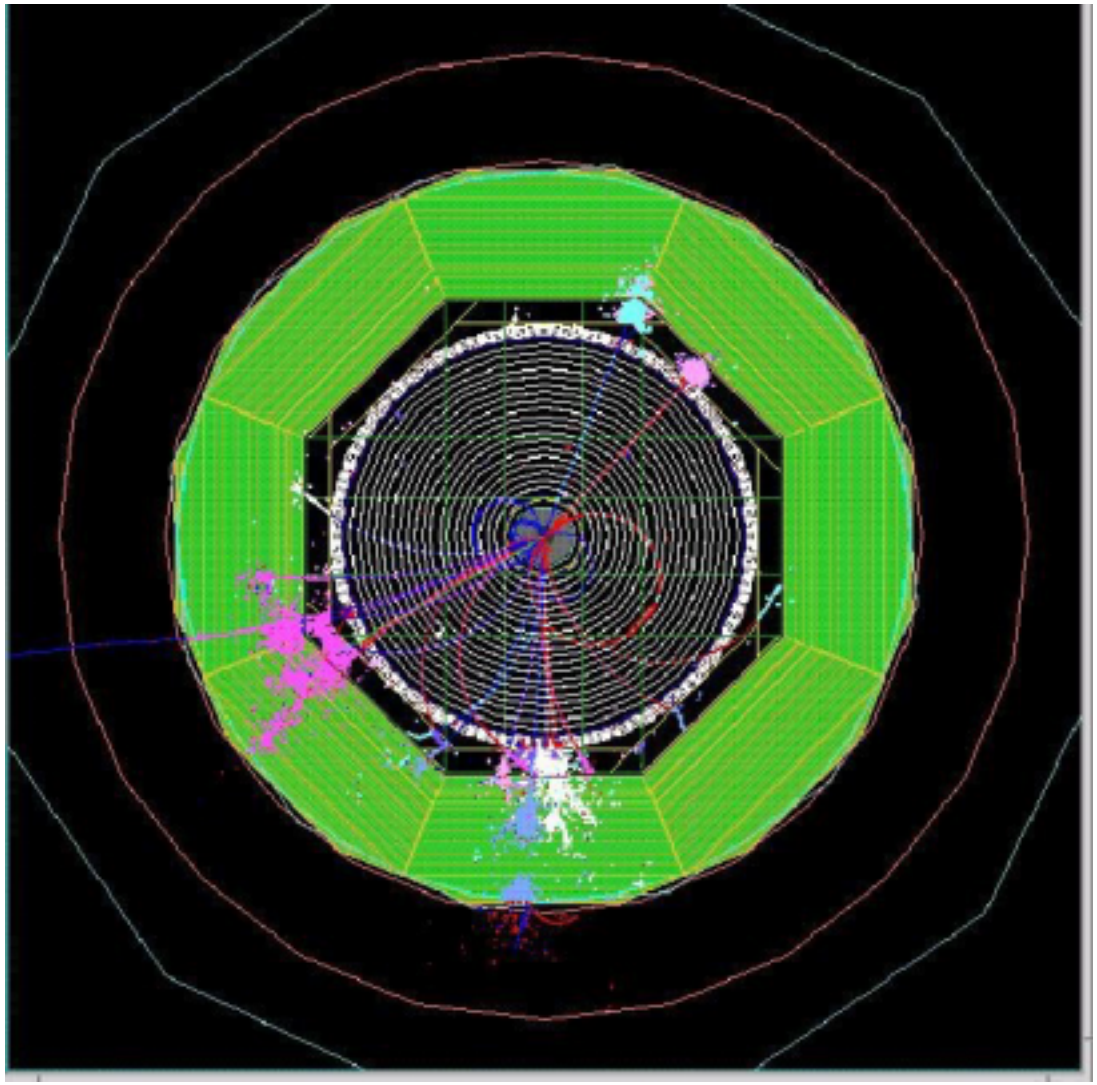
To answer previous questions and study detector performances use of SGV fast simu (LPNHE), with first answers.
And work in progress with full simu BRAHMS & MOKKA + G4







Full simulation GEANT 3 and 4 based



Fully G4 simulated H→bb Z→e+e- event including SET (detector in white) (Obninsk)

Conclusions

Important progress achieved on:

- Sensor R&D (long ladder tests)
- R&D on electronics: 2 FEE are developed & ready for foundry by July 04
- R&D on Mechanics:
  - CAD of the overall support architecture
  - Construction of long ladder
  - Thermal studies (very encouraging result)
- Alignment studies
- Simulations: setting up BRAHMS and GEANT 4

SiLC is taking speed.

↓

By fall 06: a full prototype on test beam possibly with calorimeter and/or TPC prototypes.