Spanish R&D Network Towards the ILC

SiD LoI preparation workshop, SLAC 2nd March 2009

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Outline

- Introduction to the R&D Network
- Activities on Accelerator's R&D
- Activities on Detector's R&D
- Short term plans

Caveat: talk focused on tracking R&D activities

Introduction to the Network

- In 2005, the seed of the present network was approved under the supervision of J. Fuster and J. Terrón.
- The Spanish institutions were already collaborating on European projects on linear accelerators or/and detectors
- Also, interest of phenomenological theory groups
- After the ILC workshop in Valencia (Nov . 2006) a streamlined coordination of the ILC related R&D activities started with the creation of detector R&D "thematic" network funded by the Spanish Particle Physics National Program until 2011 (A. Ruiz)
- During 2008 the network activities started to speed up:
  - Santander's workshop in January ´08
  - Santiago's workshop in October ´08
- Next workshop at Barcelona in May (you are welcome).

Members and R&D lines

IFCA (Santander)
TRACKING; mechanics alignment; uStrips.

USC (Santiago de Comp.)
VTX; TRACKING, 3D sensors, DEPFET

CNM, UB, URL (Barcelona)
VTX;TRACKING; sensors, R/O electronics; DEPFET

IFIC(Valencia)
ACCEL, VTX, TRACKING; BPM, mechanics, DEPFET

CIEMAT (Madrid)
ACCEL; CALO; mechanics, RPC R/O

International collaborations

EUDET European detector R&D for ILC

IFCA (partner), CNM, IFIC(associates)

DEPFET (R&D active pixel detector)

IFIC, UB, URL, CNM, USC

SiLC (Generic R&D on silicon tracking)

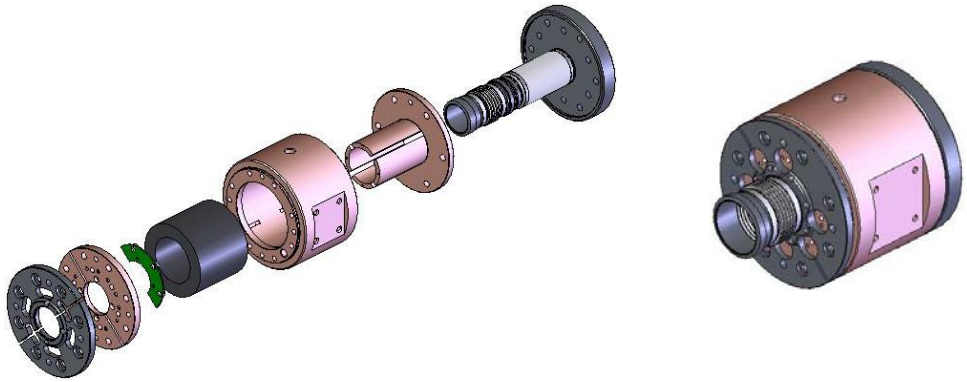
CNM, IFIC, IFCA, UB, URL, USC

R&D on calorimetry

CIEMAT

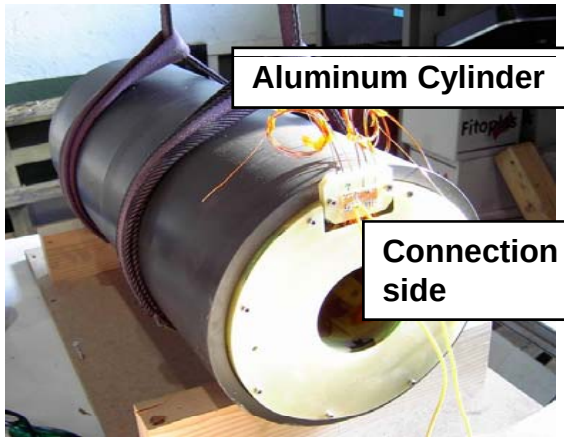
Accelerator R&D - IFIC

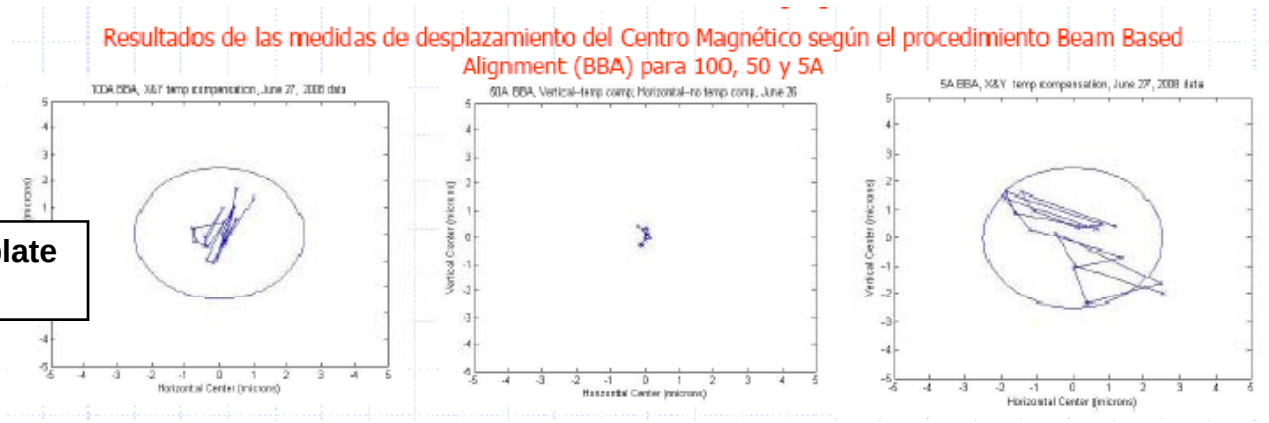
- ***ATF-ATF2***: Beam Instrumentation design and construction:
  - BPM's supports with micromovers for FONT4 (KEK, JAI)
  - multi OTR (KEK, SLAC)
- ***ILC***: BDS instrumentation studies
- ***LHC***: non-linear collimation options for sLHC (SPS experiments) (EUCARD)
- ***IFIMED:*** Imaging and Accelerators applied to Medicicine
  - Monitoring of secondary beams (beam position and size) (CERN; LLR, CNAO)
  - Cyclinacs applications (TERA, CTF3) CABOTO: Carbon Boster for Therapy in Oncology



Accelerator R&D (2) – CIEMAT/CEDEX

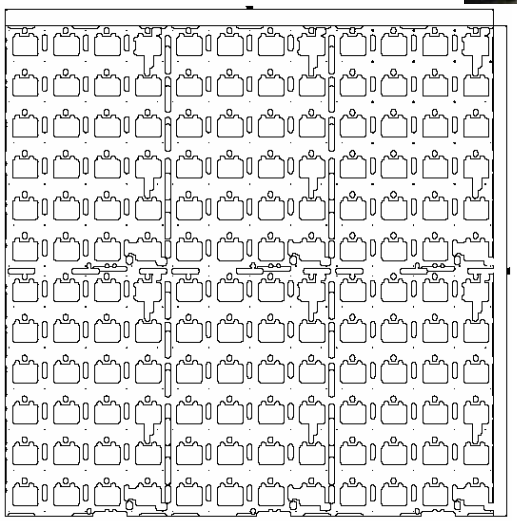
- Until 2003, the CIEMAT contributed to the TESTLA500 project providing a SC magnet prototype
- TESLA500 tested recently in SLAC (starting point ILC activities)
- Submision EoI and ILC Cuadrupole magnet proposal.
- Ciemat is currently participaty on CLIC/CTF3 facility

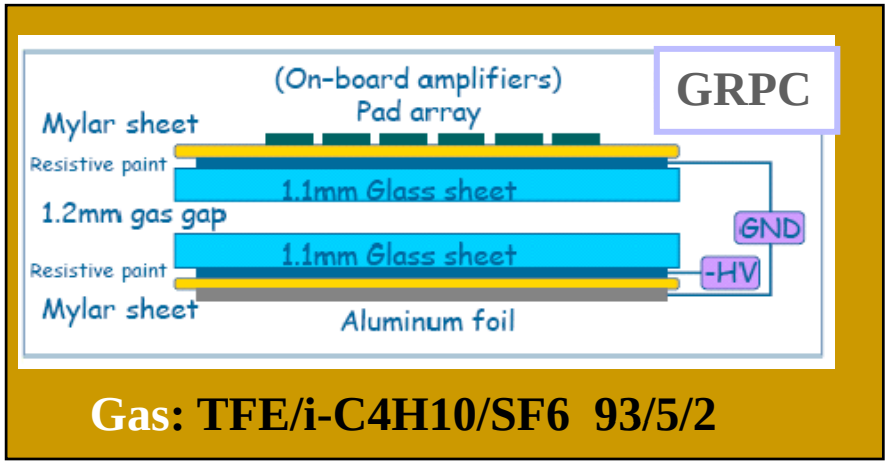




R&D on Calorimetry, CIEMAT

- Contribution to the DHCAL 1m3 prototype with GRPC r/o

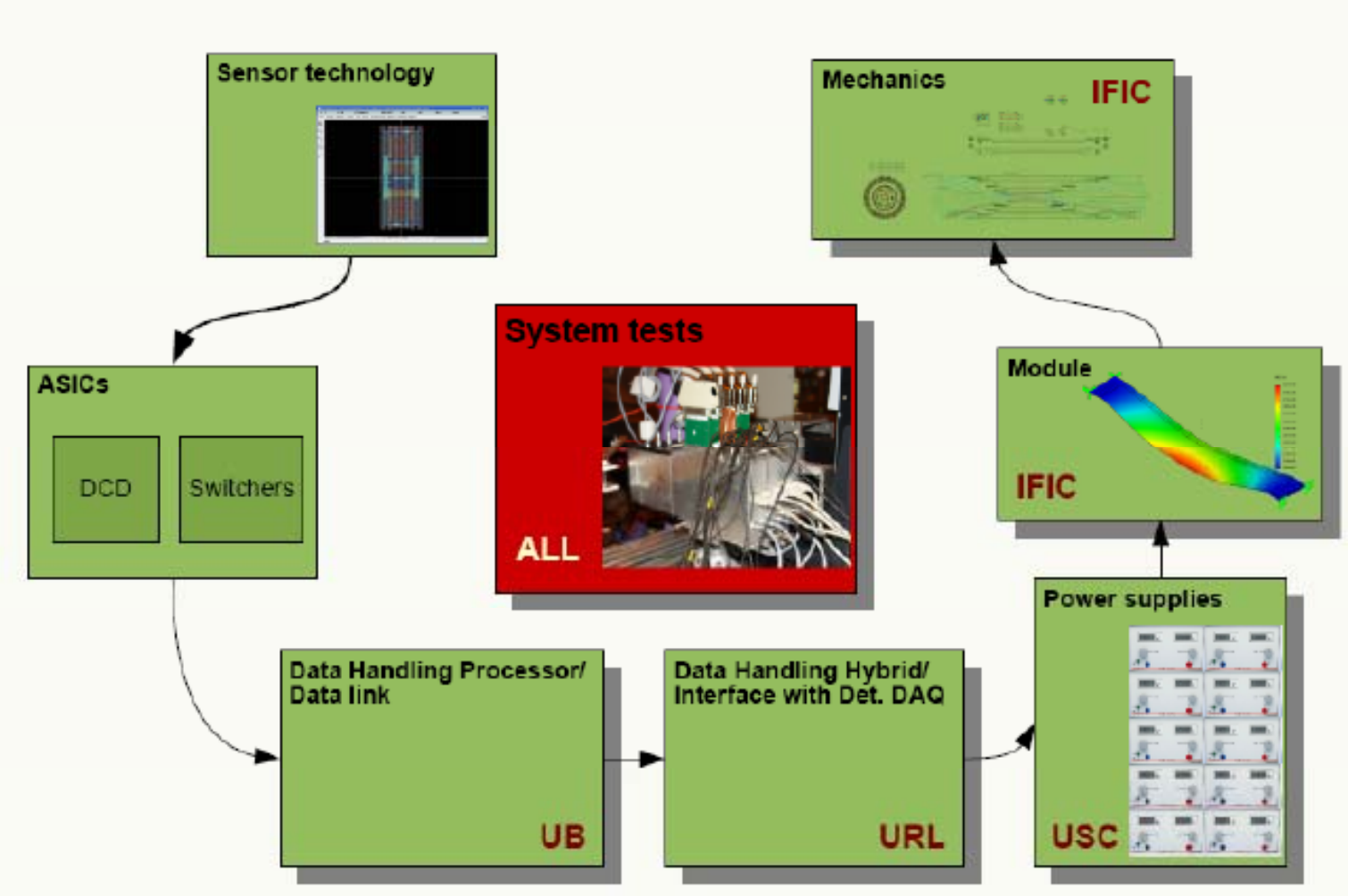




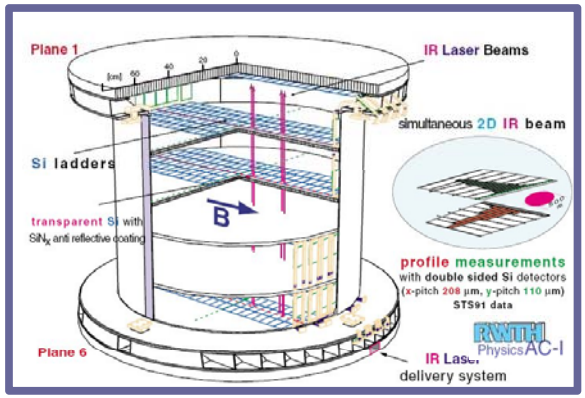
R&D on Detectors

- The bulk of R&D detector activity focused on silicon Traking and vertexing.
- Covering:
  - R&D on sensors: DEPFET pixels, 3D sensors, thinned microstrips, semitransparent microstrips.
  - R&D on FE electronics, development of DSM r/o chip.
  - R&D on mechanics: deformation and thermal analysis.
- So far, quite “ILD driven” community...
- ... and “forward physics” oriented.

Pixels - DEPFET IFIC, UB, URL, USC



Microstrips - IR Transparent CNM, IFCA



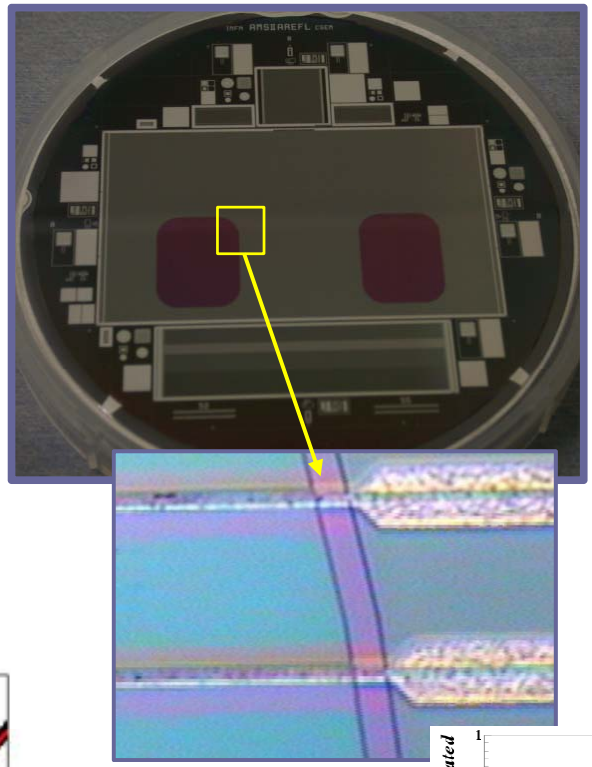
AMS-01 innovation (W. Wallraff)

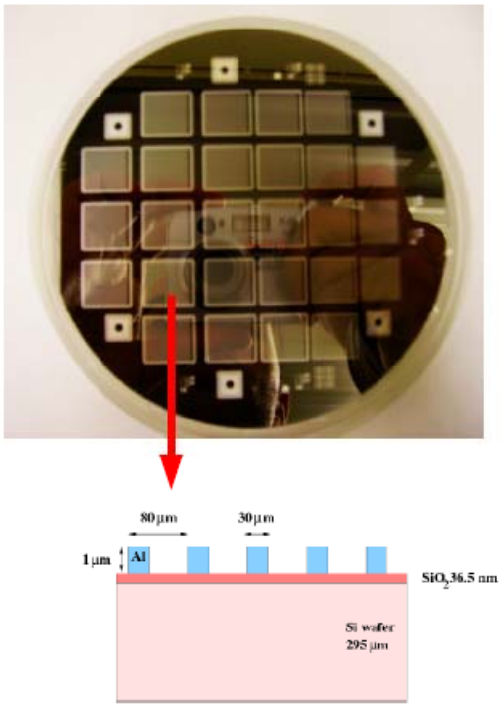
λ = 1082 nm

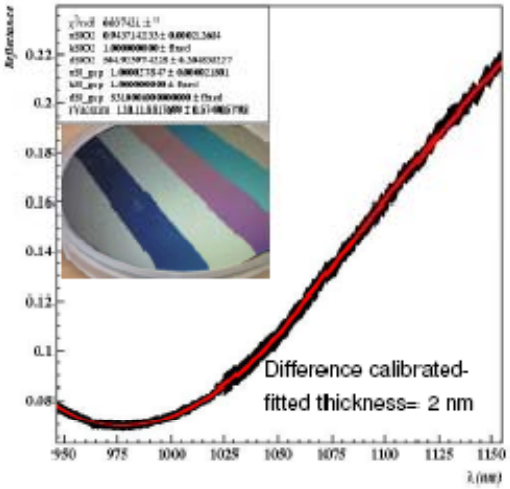
IR "pseudotracks"

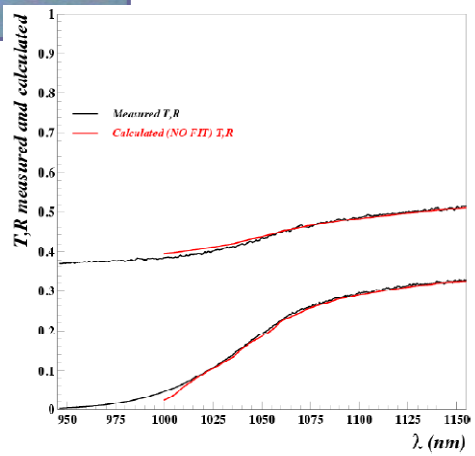
1-2 µm accuracy obtained

Transmittance~ 50%







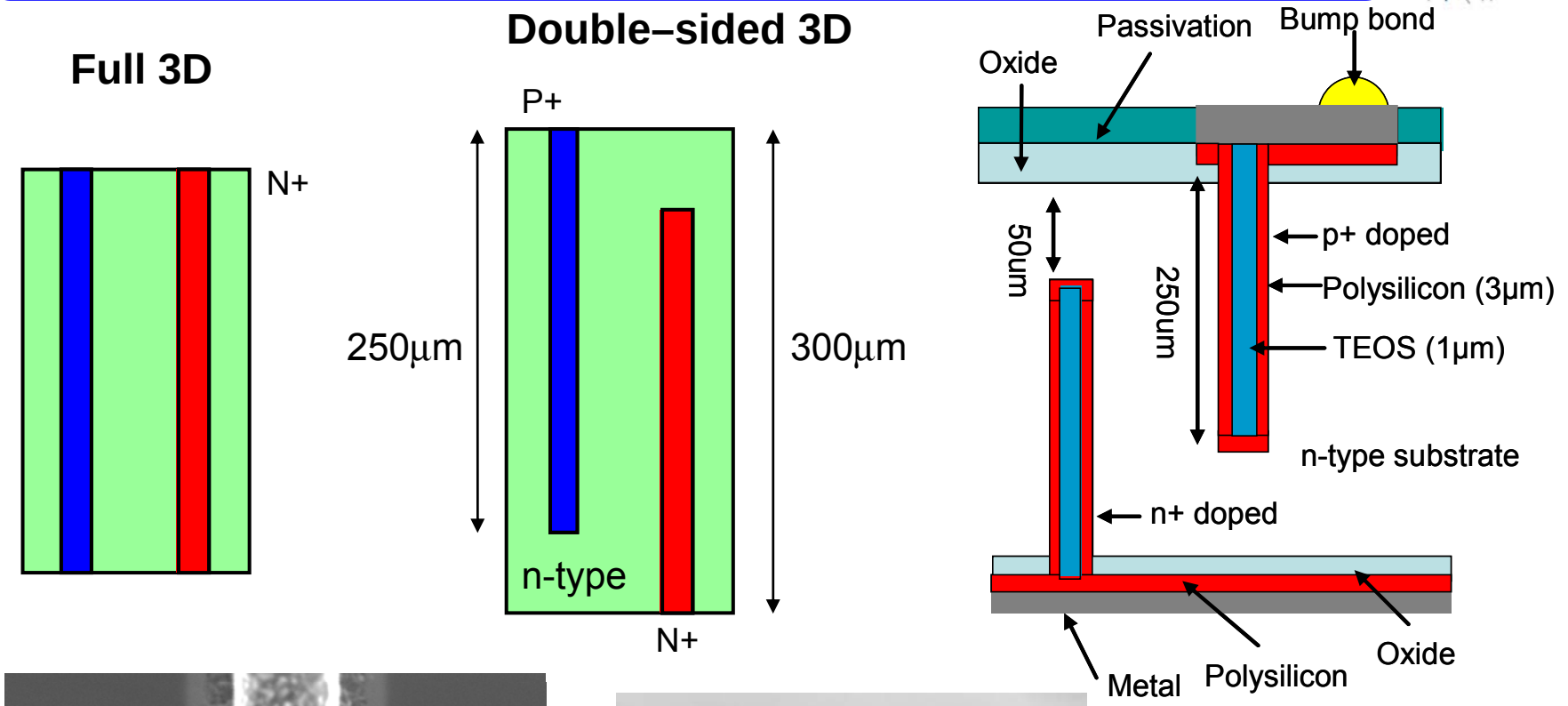


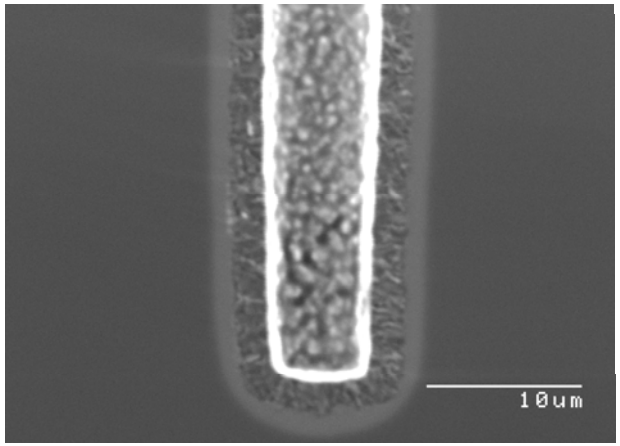
Reflectance and transmittance of wafer 5 matched. No fits involved!!

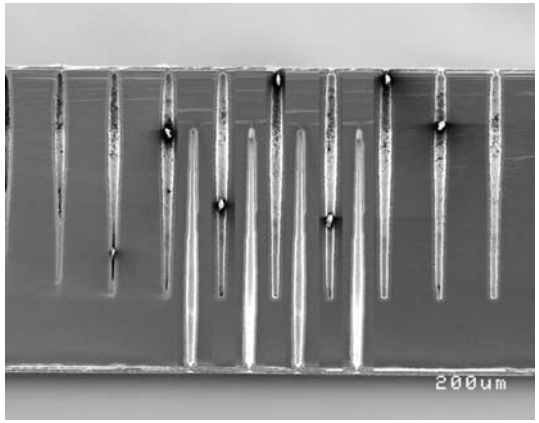
Compatible with 45 nm roughness of Al surface

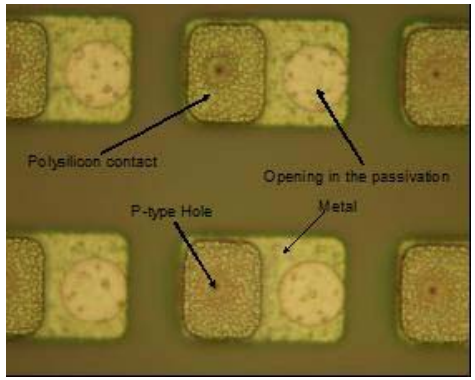
Is this real? We need to measure the wafer roughness. I think it is possible to be done at CERN.

3D sensors – CNM, UB







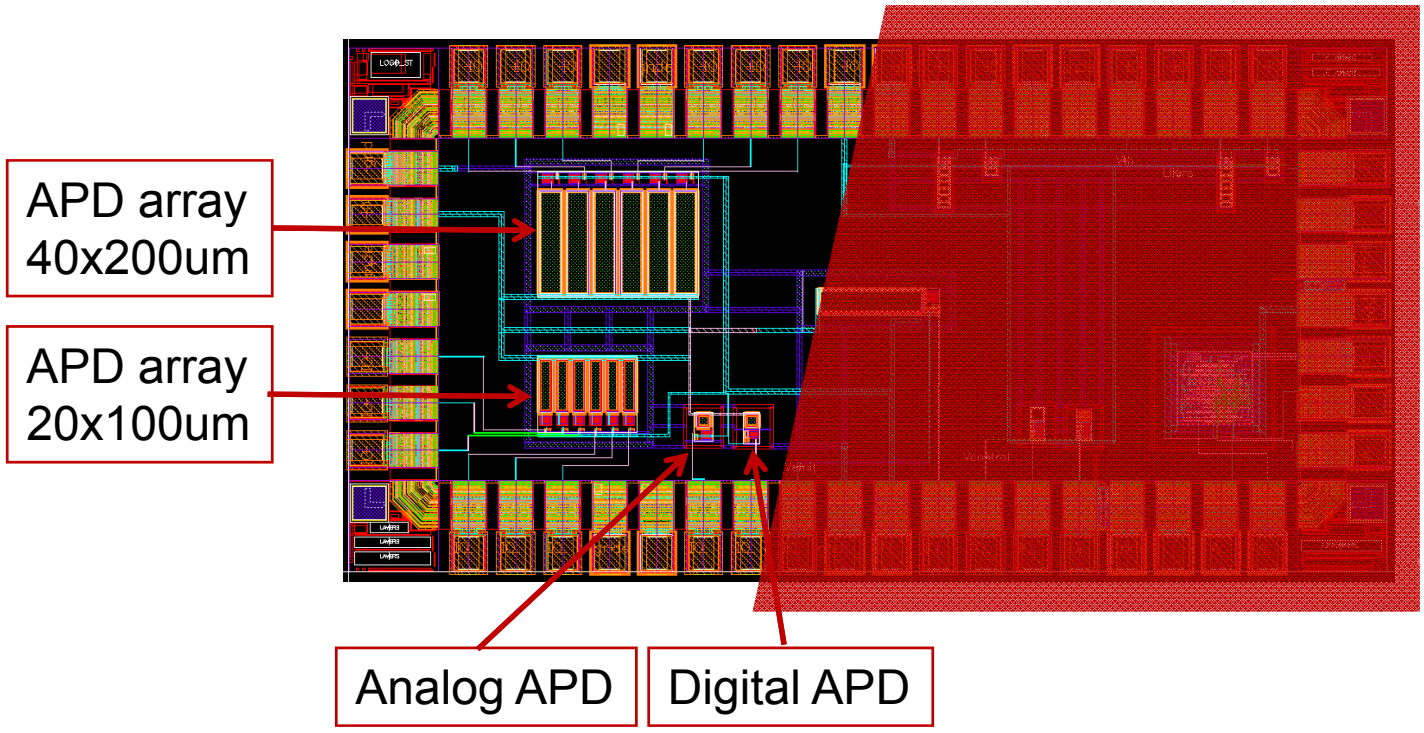


Digital GAPD– CNM, UB, URL

…on design of sensors for future trackers

Integrate electronics and sensors using industrial CMOS processes
Reduce analog readout electronics by using high sensitivity devices

STMicroelectronics CMOS 130nm

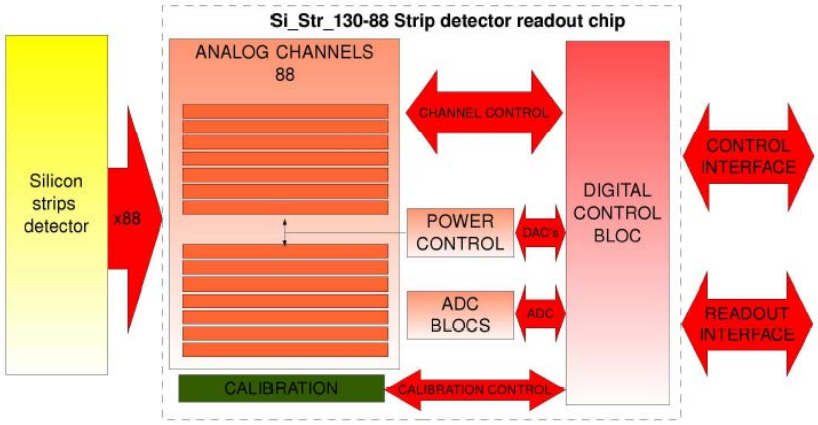


R/O Electronics – CNM, UB, URL

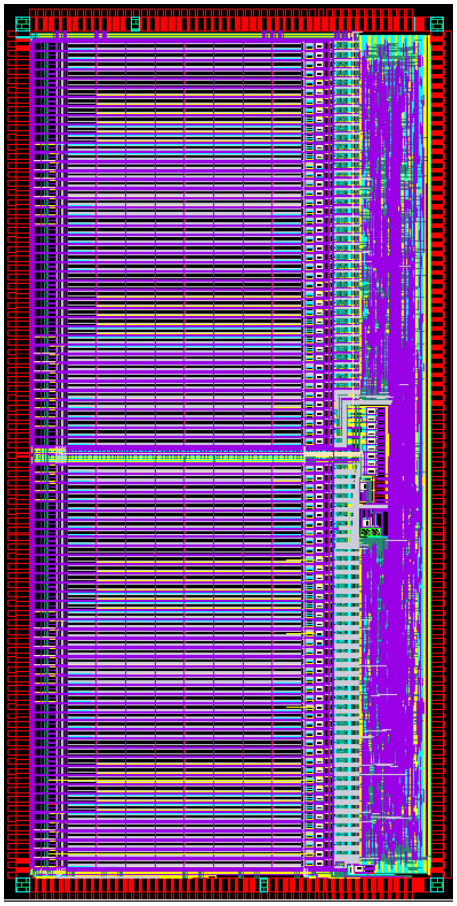
UMC CMOS 130nm
ASIC received first week of October'08

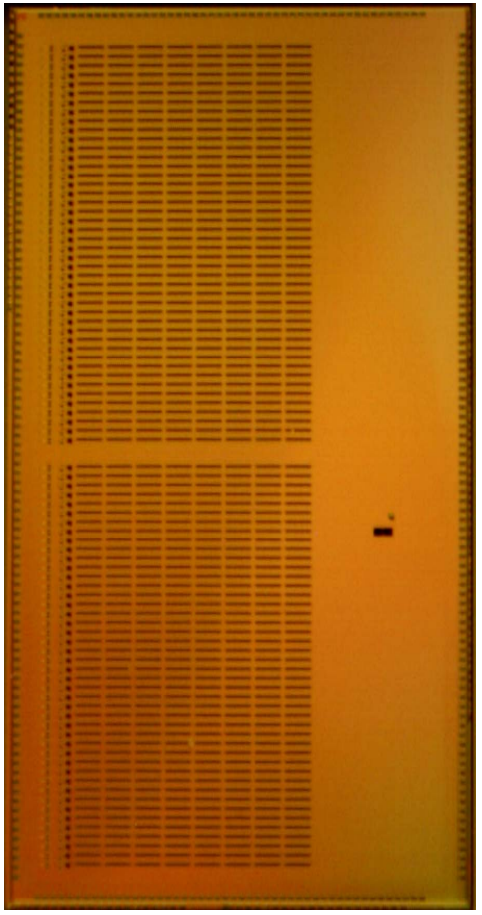
Mixed signal ASIC for readout of
Si strip sensors in ILC

Analog part designed by IN2P3
Digital part designed by UB



88 channels

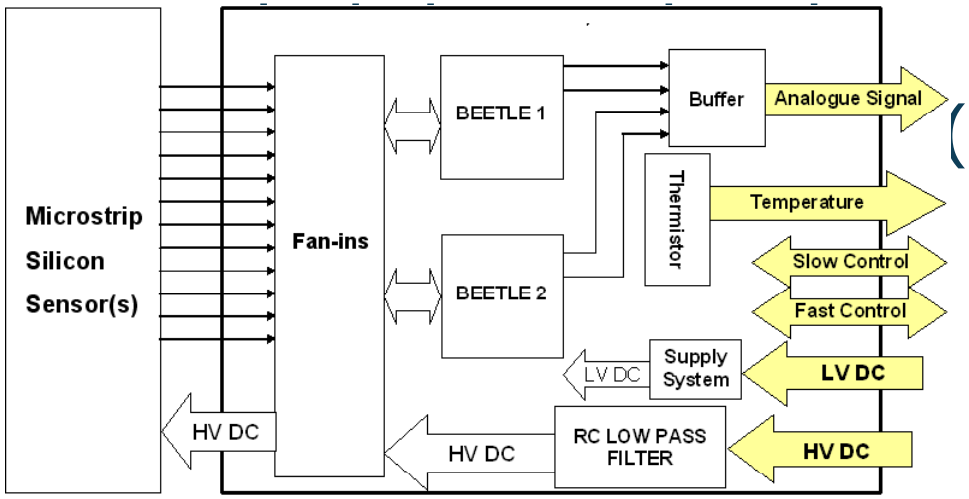




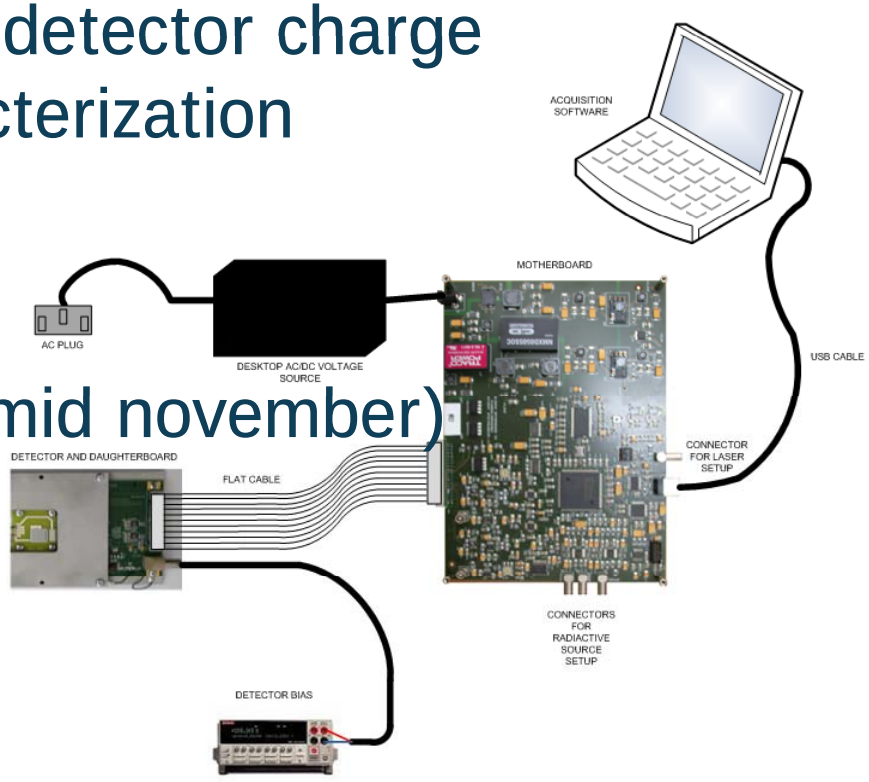
Electronics (2) - CNM, UB, URL

ALIBAVA: A readout system for microstrip silicon sensors

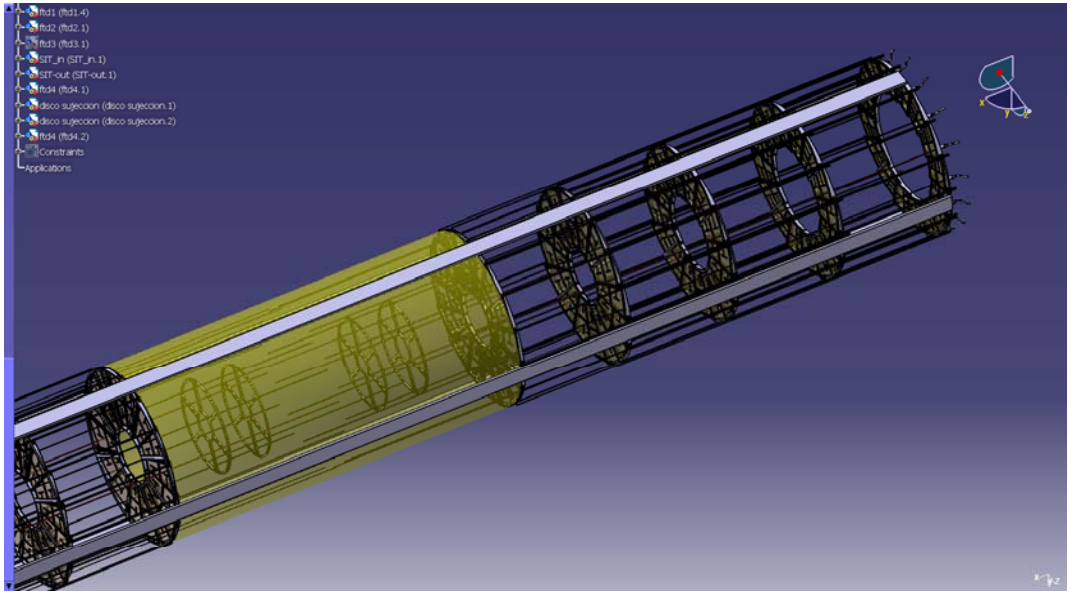
- Joint development of Liverpool Univ., IFIC-Valencia and CNM-Barcelona
- Simple and cheap system for detector charge collection performance characterization

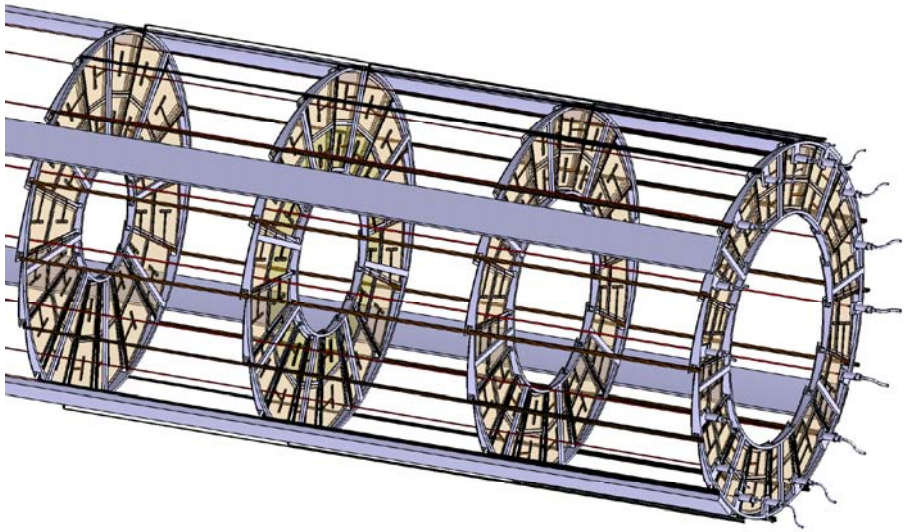


(mid november)



ILD Forward Tracking Disks IFCA, IFIC

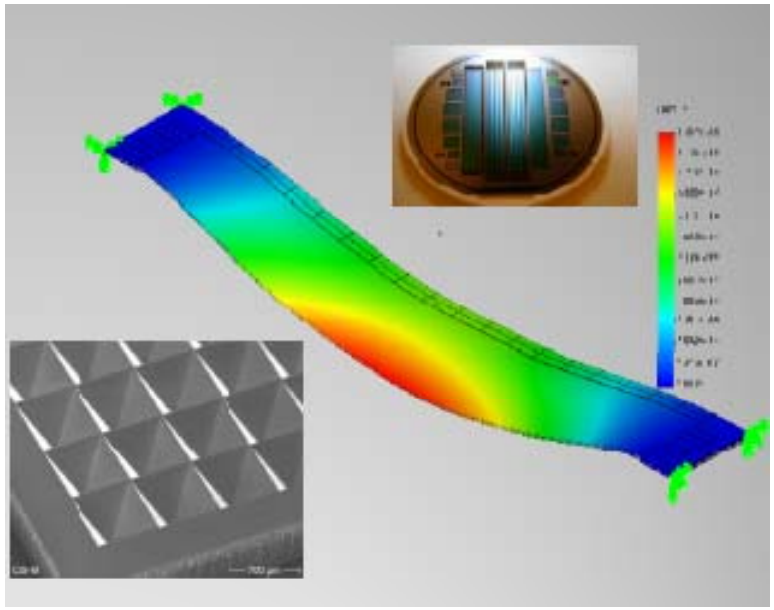


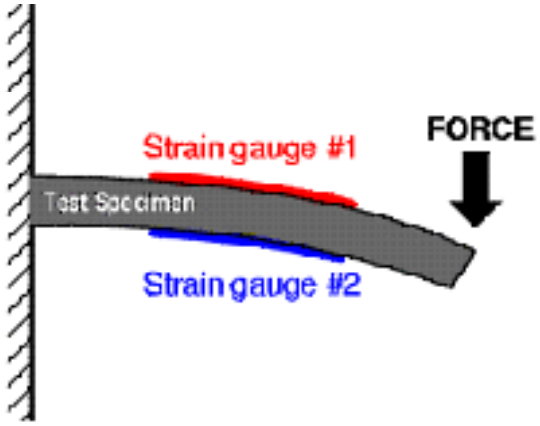


Three inermost disks pixels

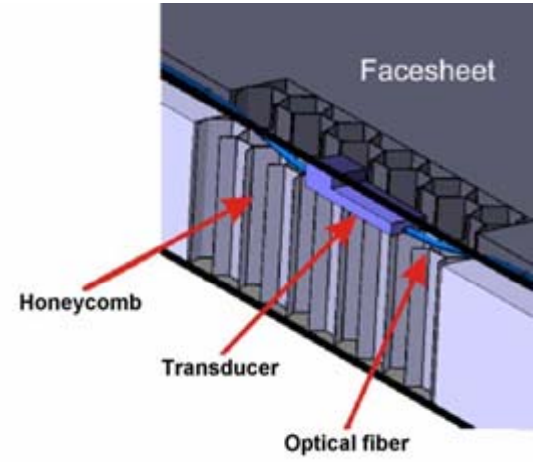
Four outermost disks microstrips

Mechanics – IFIC, IFCA





- For the Track structure would be interesting to use a embedded fiber optic sensor.
  - more precise and reliable data
- It could be use 2 side solution
  - Better understanding of the results
  - Useful to quantify the termical strain



From the ILC Detector R&D Panel recommendation:

"... it will be vital that the tracking system should for the first time perform as well in this (forward) region as in the central region.[...] there is a serious risk that the forward tracking may under-perform badly, as has happened in all previous energy-frontier detectors (LEP, SLC and the Tevatron), which would do major damage to a broad range of ILC physics. The Committee recommends that the R&D programme of the ILC tracking community."

Why is forward tracking performance important?

There is a series of very relevant physics processes where final state particles are predominantly emitted at small polar angle

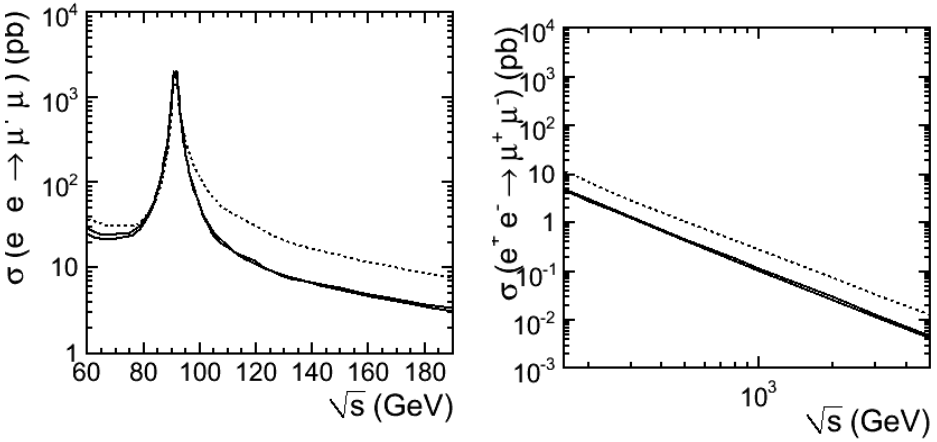
Mostly electrons, but also muons, t, b- and c-jets

Forward Physics Case (2)

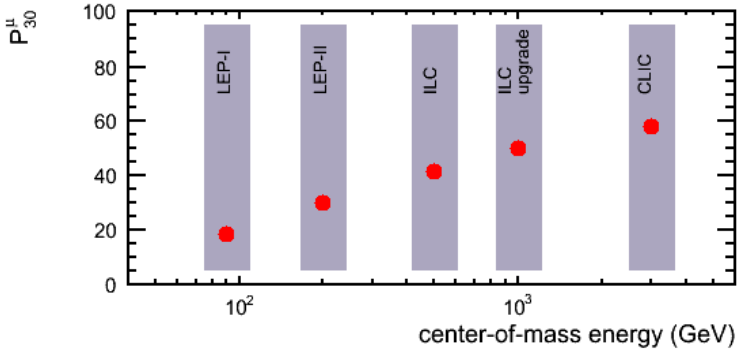
From LEP-I to the ILC (to CLIC)

$e^+e^- \rightarrow Z/\gamma^* \rightarrow \mu^+\mu^-$

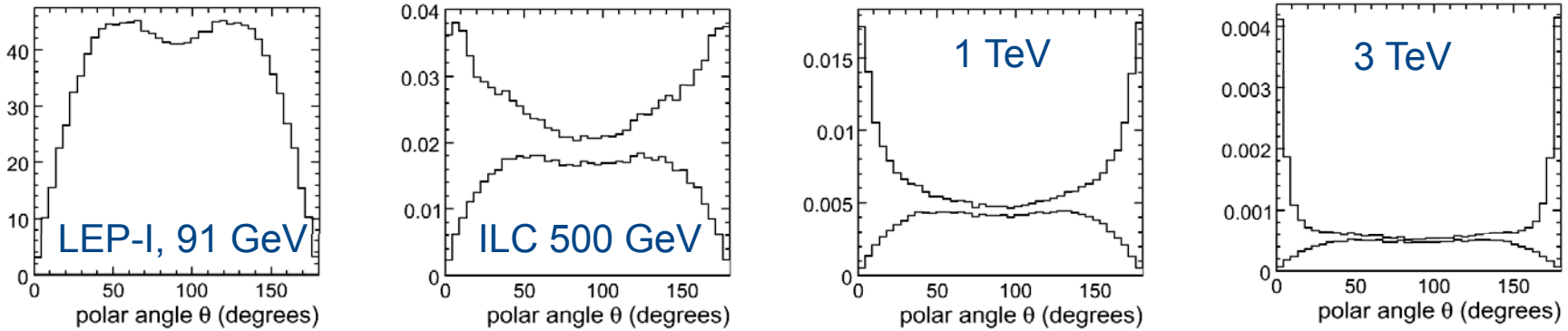
with(----) / without(- - -) ISR



P^X_{30}: Probability that final state product X is emitted at a polar angle of < 30º



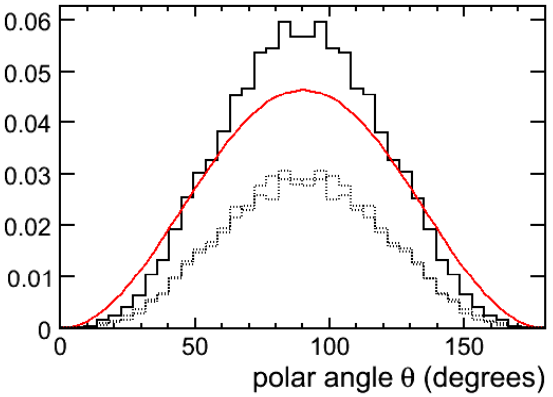
Determine the relevance of the forward region in several key processes for a number of scenarios increasing center-of-mass energy

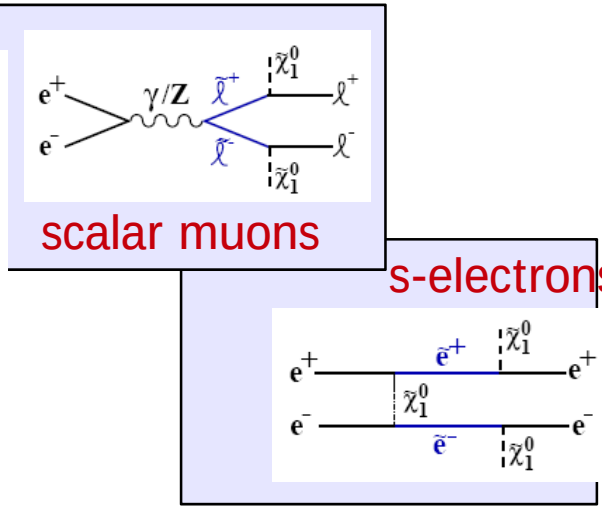


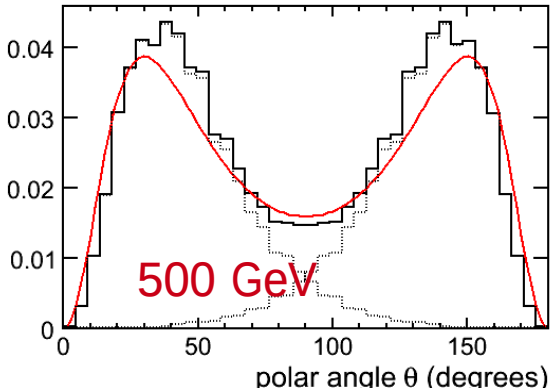
Forward Physics Case (3)

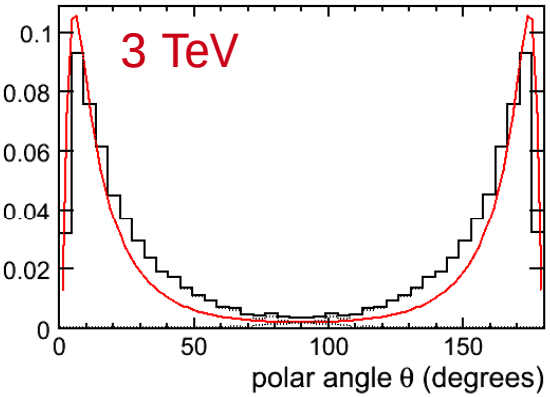
The importance of the t-channel

polar angle distribution for s-lepton production









Products from t-channel prefer the forward region (and increasingly so with higher center-of-mass energy)

Fraction of forward s-electrons (q < 30º) for s-electron pair production in SPS1a

@ 500 GeV **24 %** **@ 1 TeV** **50 %**

Forward Physics Case

Forward tracking requirements at the next e^+e^- collider
part I: the physics case for forward tracking

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[s] IFCA Santander

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February 12, 2009

Abstract

In this note we explore the detector requirements of the forward tracking region for a future e^+e^- collider with a center-of-mass energy in the range from 500 GeV to 3 TeV. The relevance of the forward region is explored for a wide range of physics processes.

Little guidance from standard benchmark reactions (cos q < 0.95)

In this document some physics cases are explored that are particularly relevan for this detector region.

Summary

- Spanish group expertise covers a great number of current R&D highlights.
- Increasing coordination between groups
- High involvement on International R&D collaborations.
- Good opportunity to find common synergies and projects to contribute to the SiD design.

May 8th-9th Barcelona Workshop