VTX TB requirements

ILC vertex detector test beam requirements

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a user's vision on what's needed for VTX R&D progress,
very biased by our own experience

VTX options

A large variety of options:

CCD – FPCCD, CPCCD, ISIS

MAPs (3T, DNW)

DEPFET

CronoPix

Vertically Integrated (VIP)

Complemented by ILC tracker R&D:

Micro-strip detectors (SiLC, SiD)

And by LHC and sLHC R&D:

Hybrid Pixels (ATLAS, CMS, ALICE, LHCb)

3D sensors

A lot of TB

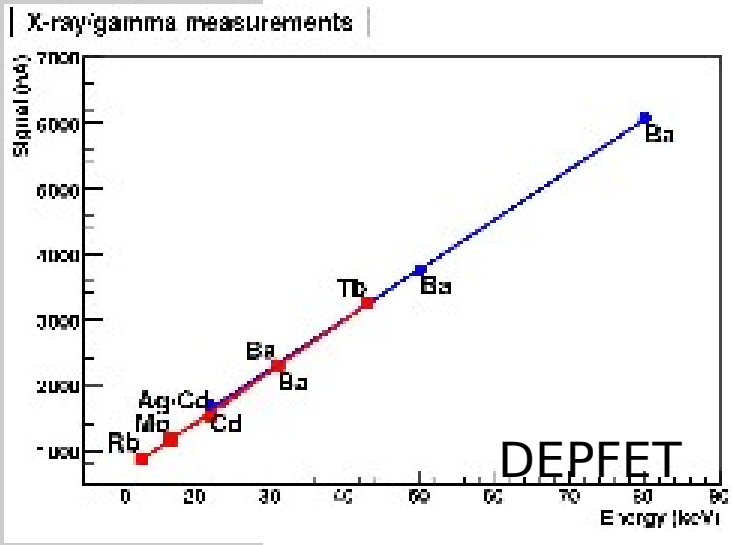
Test beam periods for R&D on silicon tracking & vertexing during summer 2009 in the CERN SPS North Area (includes LHC upgrade work)

May 18 – june 3:	*3DSi*
May 25 – May 31:	*MonoPix*
June 7 – June 20:	*SiTRD*
June 18 – June 25:	*RD42*
June 20 – June 26:	*ATLAS - gossip*
June 25 – July 1st:	*ATLAS diamond*
June 29 – July 13:	*CMS Si-Upgrade*
July 23 – 5 August:	*EUDET*
August 5 – August 12:	*DEPFET*
Augst 12 – August 19:	*LCFI*
August 19 – August 30:	*SiLC*
September 7 – Sep 13:	*ATLAS diamond*
September 14 - :	*MediPix*
September 24 – Oct 1st:	*RD42*
October 22 – Nov. 4:	*ATLAS 3DSi*
November 4 – Nov. 12:	*MonoPix*

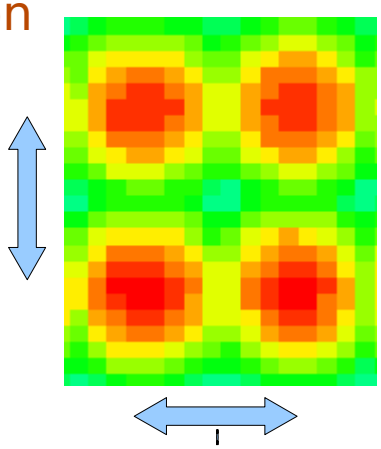
Further beam tests at DESY, FNAL,

Test beam: do we really need them?

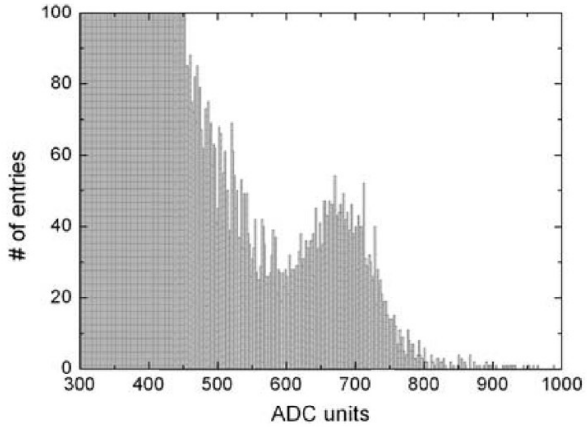
characterization using infra-red laser and gamma-sources in laboratory yields very valuable information



Absolute calibration using (fully absorbed) X- and gamma rays



Fine-focus infra-red laser to study charge collection. “seed” pixel signal vs. position, DEPFET

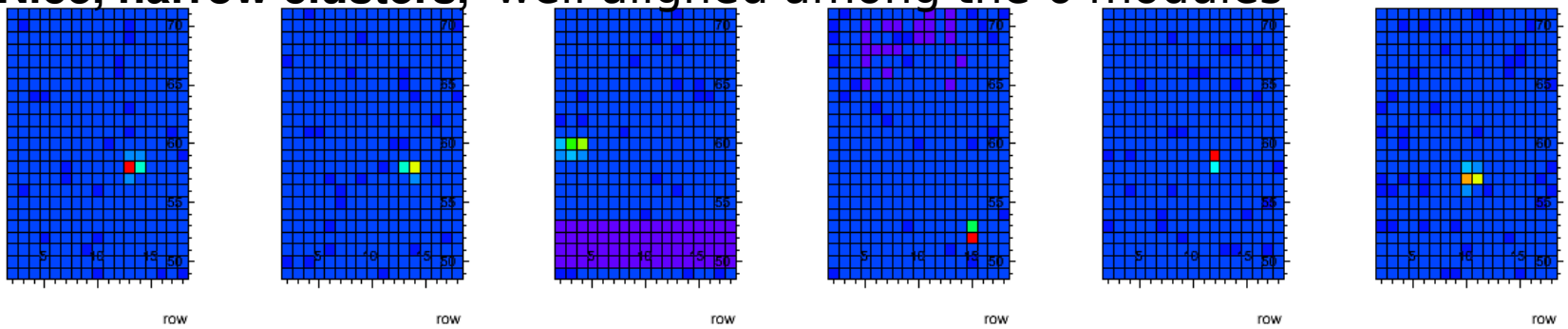


Fe55 peak in seed pixel signal. CMOS MAPs, IEEE Trans. Nucl. Sc. Vol 54 No 1.

TB is useful for measurement of response to MIPs, spatial resolution, time structure, two-track resolution, Lorentz angle, ...
Also: don't forget psychology, collaboration building, etc.

Silicon detectors are well-understood?

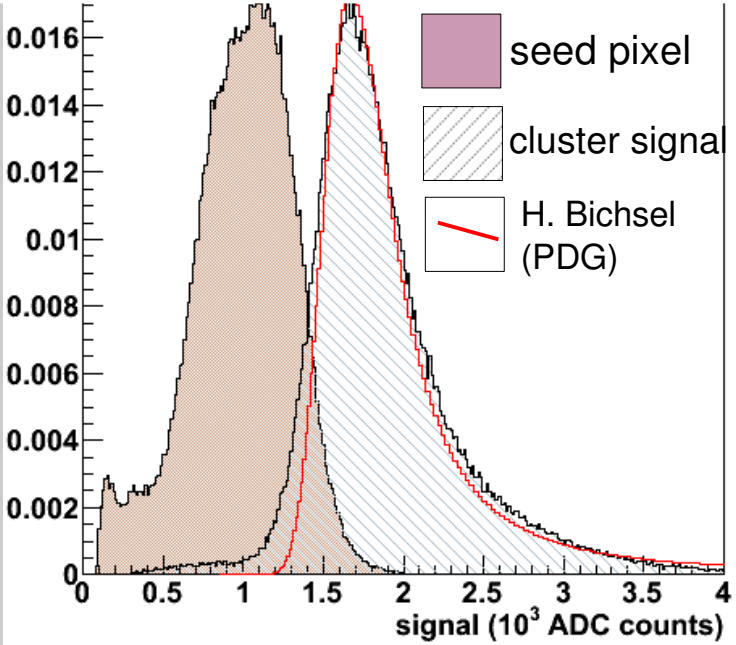
Nice, narrow clusters, well aligned among the 6 modules

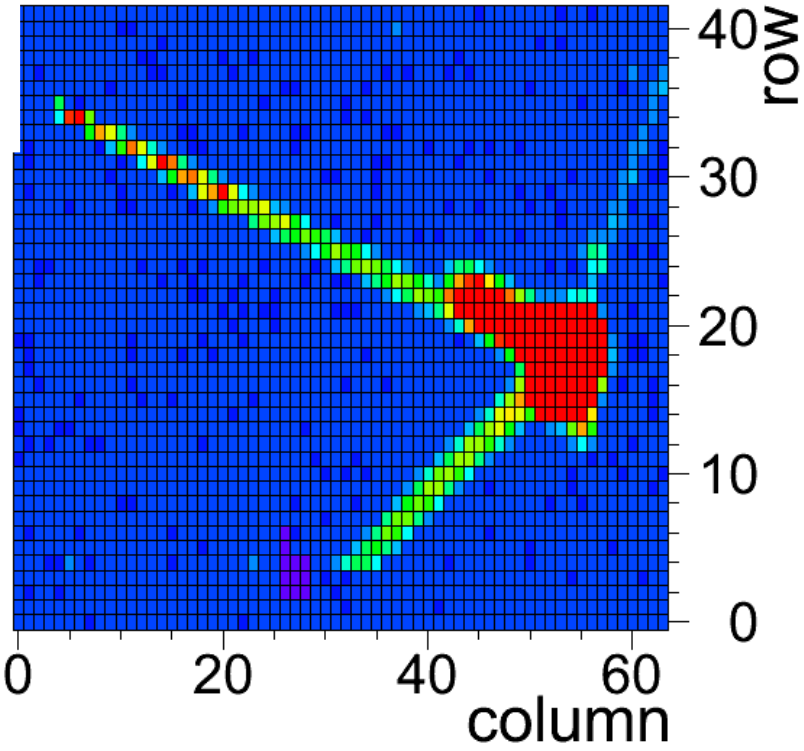


A perfectly understable signal distribution

DEPFET TB2008, 120 GeV pions @ H6

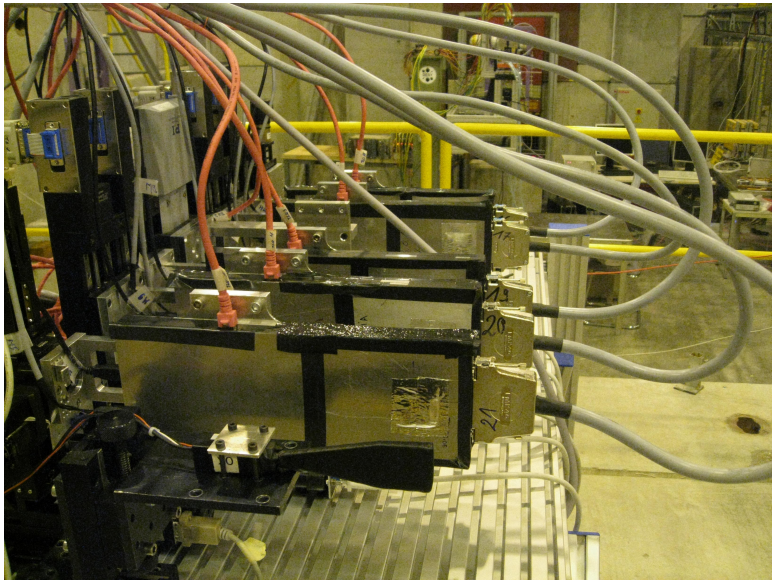
Perpendicular incidence, 24 x 24 μm^2 DUT.





EUDET or Bring-Your-Own?

EUDET: Detector R&D towards the International Linear Collider, http://www.eudet.org/.



DEPFET telescope 2009

Requirements for future TB I, continuity

Several colleagues have stated that they “simply” want to continue the traditional test beam programme: EUDET telescope in high-energy beams

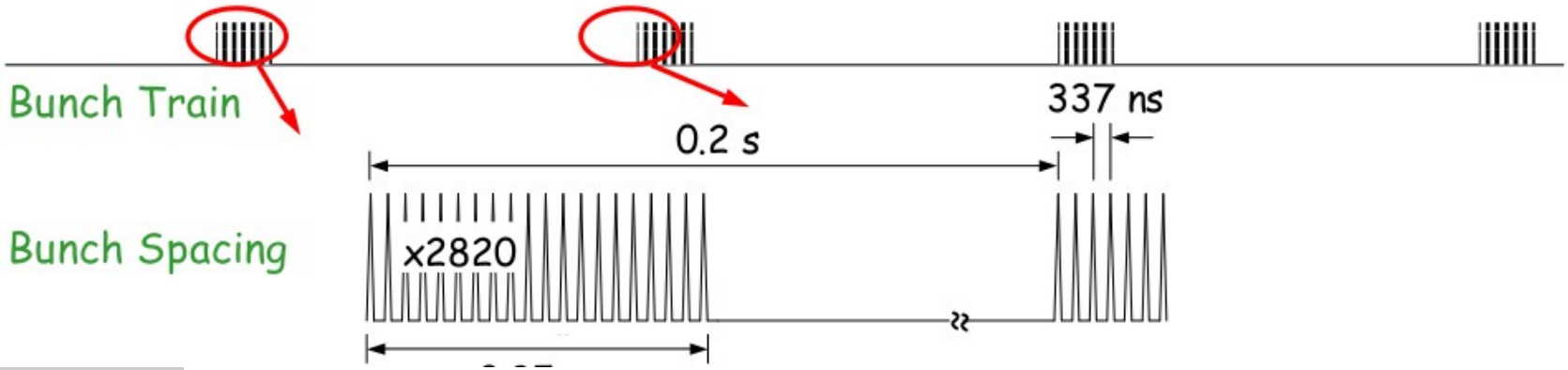
Integration in EUDET DAQ has worked for many users (to different levels)

EUDET has provided “Eutelescope” an extensive suite of analysis software within the ILC software framework
- standard data format (LCIO)
- core functionality (Marlin)
- processors for all standard analysis steps
  - Pedestal/noise calculation, Clustering, Alignment (MilliPede II), Track fit
  - Analysis

Users only need to provide some code to decode their proprietary raw data format
+ some software to analyse the results

Comparison with MC (i.e. Mokka GEANT4, digitizer) is in principle straightforward

Requirements II, bunch structure



Needed to test pulsed-power/read-out scenarios

- A well-established request (see, for example Ingrid Gregor, LCWS08), but never done

Can we find a (cheap) work-around?

- In-time particles can be identified using a TDC measuring the trigger phase wrt ILC clock (at a large loss in statistics)
- Bunch-trains could be mimicked fairly easily in a continuous beam by some simple trigger logic

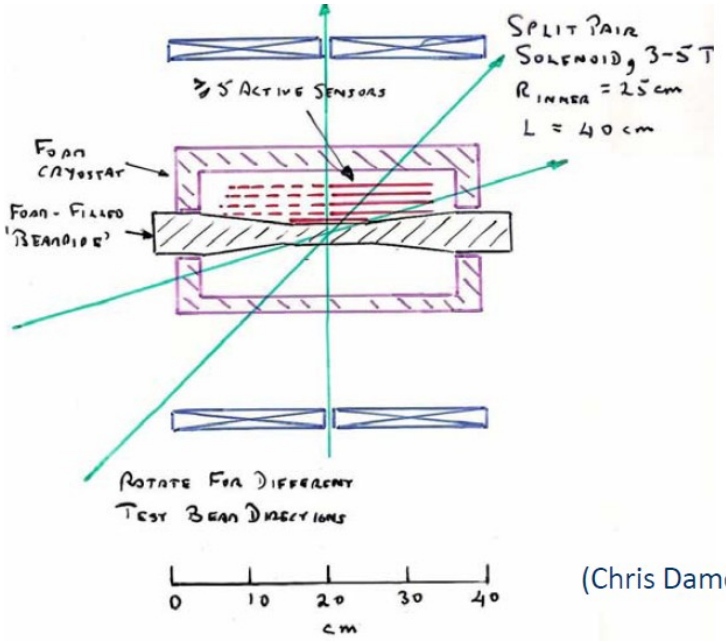
Requirements III, B-field

Needed to understand the effect on the spatial resolution (Lorentz angle)

Needed to measure standalone tracking performance

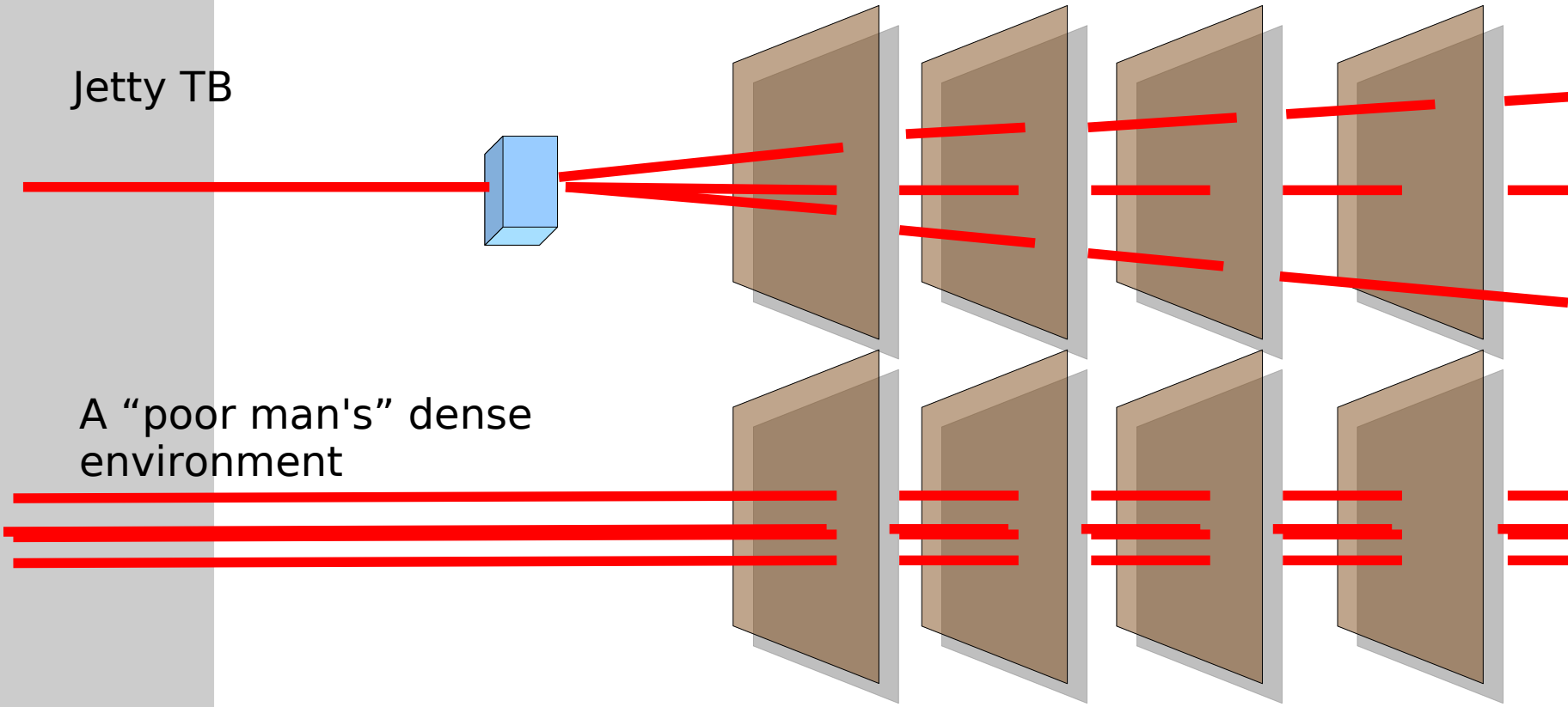
A 1.25 Tesla magnet (PCMAG) has been installed in DESY and is used by the LCTPC community

VXD community needs higher field, but can live with smaller bore



(Chris Damerell)

Requirements IV, dense environment



Dense environment to study two-track resolution

(cfg. Ingrid Gregor's proposal for jet beam tests in LCWS08)

First attempts using slow read-out and intense beam have been made. Results to be analysed.

Requirements V, small area trigger

Prototypes often cover a very small area (first version of the SiTra read-out chip had 4 channels, I tried to see a signal on few 100 μm^2 APDs once).
Typical trigger scintillators in use today are too large. The alignment of such very small areas in the beam is highly non-trivial.
A trigger setup for such prototypes, where a very small scintillator (or silicon trigger device) is pre-aligned with the device under test, could be very useful in such cases.

Requirements VI, Combined TB

Useful combinations can be (and some indeed have been) made:

- Silicon-TPC (DESY, EUDET MEMO 2007-28)
  SiLC/HEPHY Viena
- Silicon-alignment system
  SiLC/IFCA
- Full VTX-tracker slice (in magnetic field)
- VTX-Tracker-Calorimeter (Particle Flow TB)

Requires common DAQ (at some level). EUDET?
Requires significant coordination...

For comparison: the beam tests of silicon-based devices for the LHC experiments was essentially at the sub-detector level. Significant combined TB effort did not occur in ATLAS until 2004. CMS even “waited” for the magnet test. But then again, the ILC detector concepts rely much more on the integration of subdetectors.

M. Costa, W. Liebig, Test of the ATLAS inner detector reconstruction software using combined test beam data, Interlaken 2004, Computing in high energy physics and nuclear physics, 395-398

W. Adam et al. (the CMS tracker), The CMS tracker operation and performance at the Magnet Test and Cosmic Challenge, JINST 3:P07006,2008.

A. Calderón, Motions of CMS Detector structures due to the magnetic field forces as observed by the Link Alignment System during the Test of the 4 Tesla Magnet Solenoid, CMS-NOTE-2009-004

AIDA

Follow-up to EUDET and DEVDET is being organized

AIDA: Advanced European Infrastructure and Detectors at Accelerators
https://espace.cern.ch/aida/default.aspx

The AIDA project is coordinated by the RECFA Coordination Group for Detector R&D in FP7 programs and responds to the FP7-INFRASTRUCTURES-2010-1 call from the European Commission.

AIDA addresses infrastructures required for the development of detectors for future particle physics experiments. In line with the European strategy for particle physics [pdf]

Transversal = "AIDA targets User communities preparing experiments at a number of key potential future accelerators: **SLHC** (luminosity-upgraded LHC), future Linear Colliders **(ILC and CLIC)**, future **accelerator-driven neutrino facilitie**s or future B-physics facilities (e.g. **Super-B**)." (bold and slanted fonts are mine)

Deadline 03/12/2009!
List of participating institutes due on Thursday!!
You should have been informed by your national contact...

WP9

WP9 Advanced Infrastructure for detector R&D – joint research activity

Three tasks:
9.1 → gaseous tracking
9.2 → vertex detectors
9.3 → calorimetry (+ some Si tracking)

(9.4 DAQ → has been moved to 8.5, together with ILC combined beam test coordination)

Henri will tell you all about AIDA the day after tomorrow

WP9.2

Potential participants:
ILC/Belle-II - Bristol, DESY, Oxford, IPHC/Strasbourg (Geneva, Prague, Warsaw), MPI Munich, Uni Bonn, CSIC (IFIC, IFCA?)
ATLAS, IBL – CERN, NIKHEF, Wuppertal, CSIC (IFAE Barcelona)
CMS - ?
LHCb, VELO upgrade – CERN, Liverpool, CSIC (Santiago)

WP9.2

Objectives of task:

(I. Gregor, M. Winter, H. Pernegger)

Telescope:

- To build a versatile modular precision pixel telescope operated by a common infrastructure and “user configurable” reference planes to cover a wide range of sLHC and ILC relevant measurements
- Modular reference system to meet specific user requirements for ILC and sLHC users: Reference planes are based on different Pixel FE-chips (Timepix, Atlas FEI4, Mimosa)
- Telescope Station for DUT includes infrastructure for cold operation (a cold box for testing irradiated silicon structures) or alignment study box [access to CO2 cooling plant, M.V.]
- The telescope can be operated in combination with a target to be used in front or behind the telescope (high rate/ high occupancy/jet studies)

Off-beam infrastructure:

(M. Winter, I. Vila)

- Metrology, thermal characterization under realistic load

Conclusion

Plenty to learn from Test Beams
Apart from the required continuity of the standard package
– a single collaboration in a precise telescope in a high energy beam –
additional resources
– magnets, time structure, software, combined, jet-like or particle flow TB -
would enhance our understanding

Some of these resources in Europe are to be covered by the AIDA proposal (successor to DEVDET and EUDET)
Please, send your suggestions to the Work Package managers know
(these include well-known names as Ties Behnke, Ingrid Gregor, Henri Videau, M.V.)