

EUDET

Detector R&D towards the



Status and Plans



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LAL Orsay
on behalf of the
EUDET Project(s)



4th EIC Workshop Hampton, VA May 2008

Introduction to EUDET

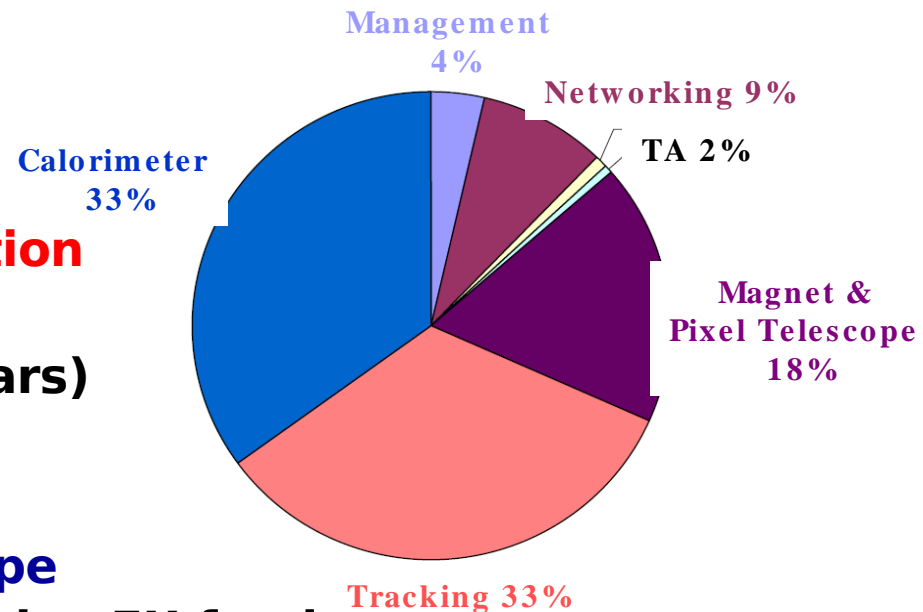


- EU funded program supporting ILC detector R&D in Europe



SIXTH FRAMEWORK PROGRAMME
Structuring the European Research Area Specific Programme
RESEARCH INFRASTRUCTURES ACTION

- **Project duration:**
 - **Jan 2006 to Dec 2009**
- **Budget:**
 - **21.5 million Euro total**
 - **7.0 million Euro EU contribution**
- **Manpower:**
 - **≈ 57 FTE total (= 230 man years)**
 - **≈ 17 FTE funded by EU**

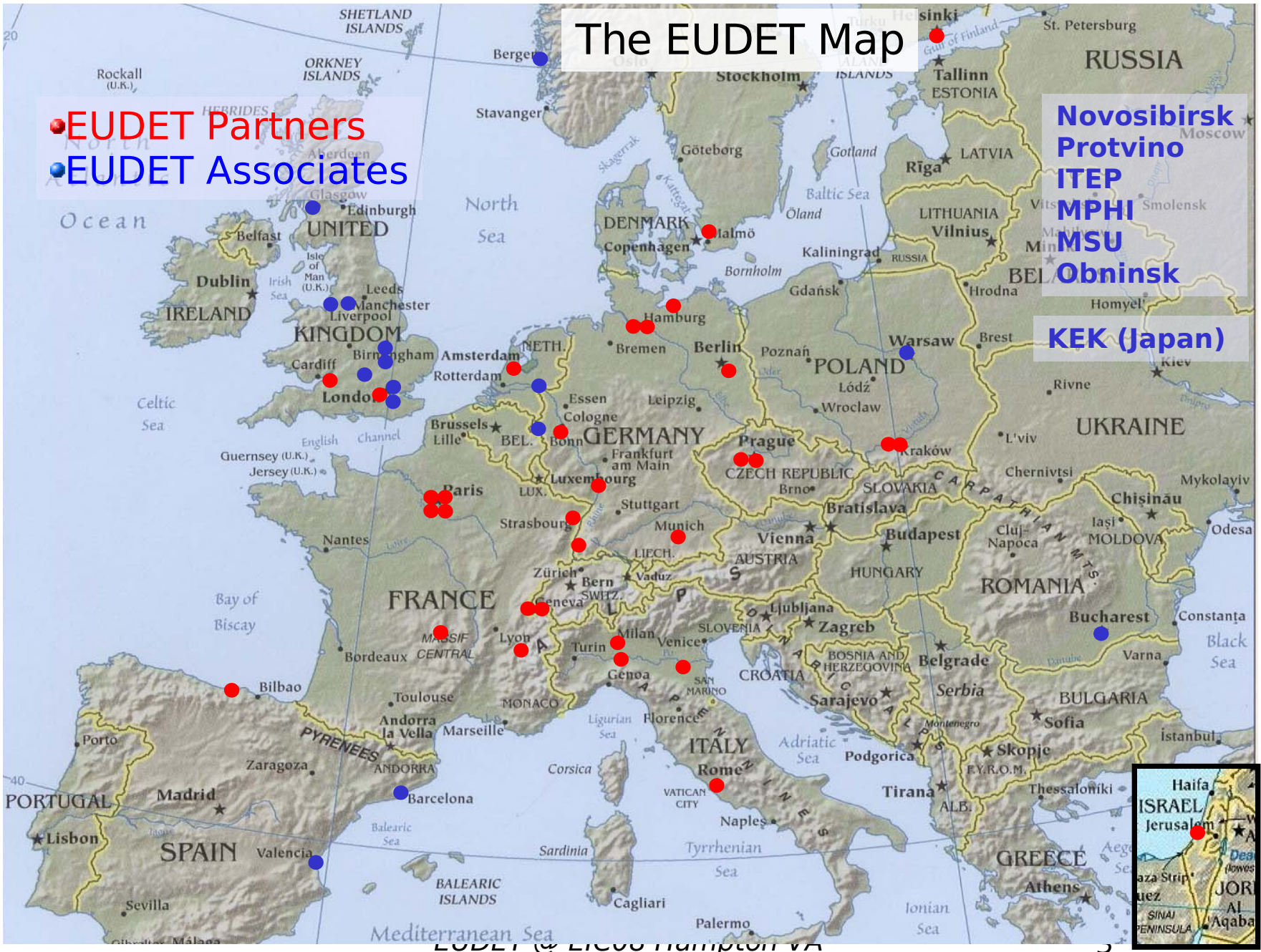


- **23 (31) partner institutes in Europe** provide own commitments & receive EU funds
- **27 associated institutes worldwide** contribute to design & construction of infrastructures interested in later exploitation

The EUDET Map

- EUDET Partners
- EUDET Associates

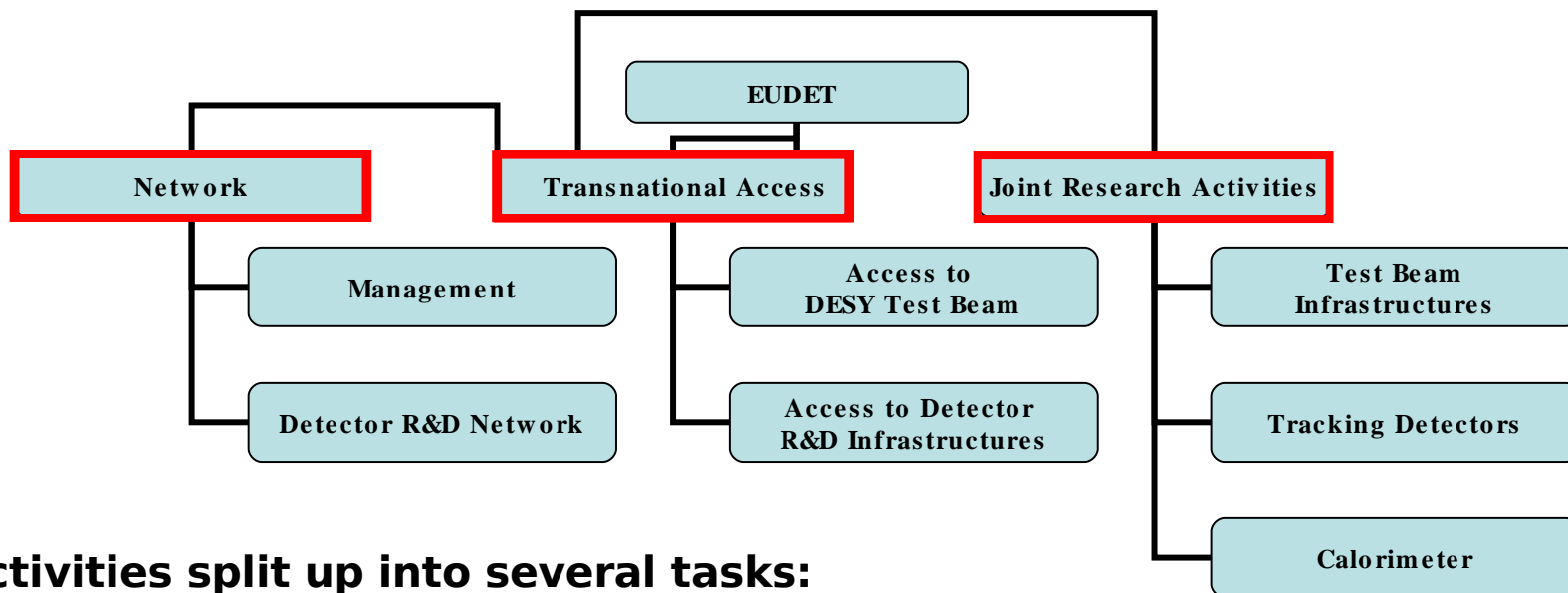
- Novosibirsk
- Protvino
- ITEP
- MPHI
- MSU
- Obninsk
- KEK (Japan)





EUDET Structure

- Integrated Infrastructure Initiative (I3)
- I3 projects based on three pillars (mandatory):



▪ Activities split up into several tasks:

Detector R&D Network:

- Information exchange and intensified collaboration
- Common simulation and analysis framework
- Validation of simulation
- Deep submicron radiation-tolerant electronics

Tracking Detectors:

- Large TPC prototype
- Silicon TPC readout
- Silicon tracking

Test Beam Infrastructure:

- Large bore magnet
- Pixel beam telescope

Calorimeter:

- ECAL
- HCAL
- Very Forward Calorimeter
- FE Electronics and Data Acquisition System

Joint Research Activities



JRA1: Testbeam Infrastructure

▪ **Large bore magnet:**

- 1 Tesla, $\varnothing \approx 85$ cm, stand-alone He cooling, supplied by KEK
- infrastructure (control, field mapping, etc.) through EUDET

▪ **Pixel beam telescope**

- 6 layers of MAPS detectors
- CCD and DEPFET pixel detectors for validation
- DAQ system

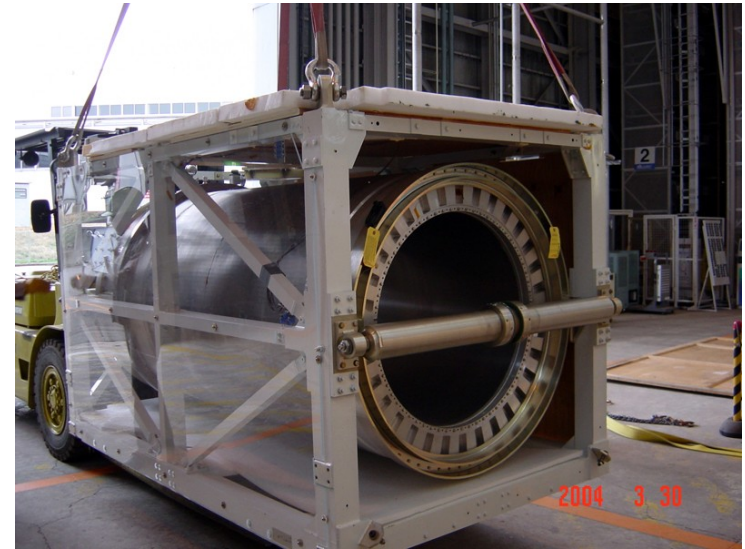
Note: all EUDET infrastructures are movable

- construction & initial tests at DESY
- later exploitation at CERN, FNAL etc. possible

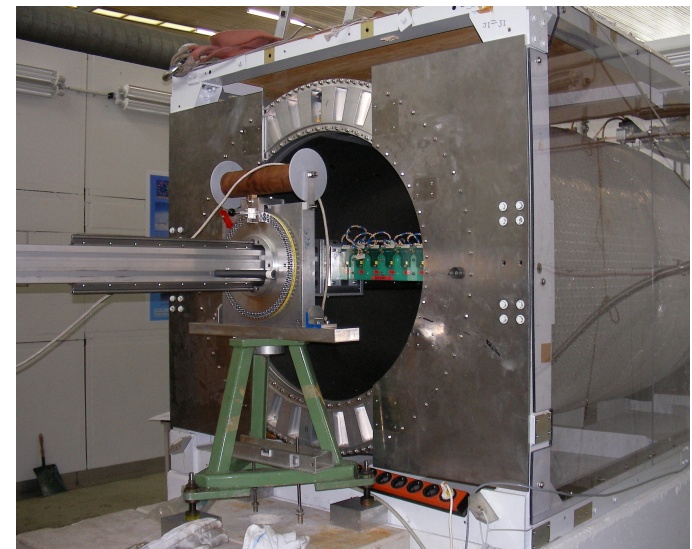
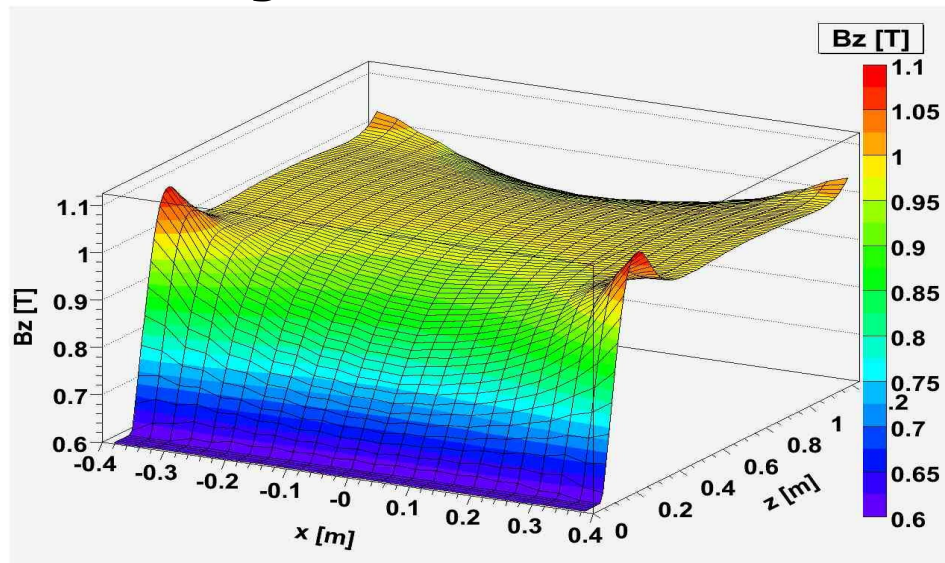
▪ **Below a few examples to illustrate the project and its status**

JRA1 Magnet

- Magnet supplied by KEK (PCMAG)
low mass coil, stand-alone He cooling,
1 Tesla
- Infrastructure (power, control, He)
designed and constructed in
close collaboration KEK & DESY
- Now operational at DESY testbeam



- First version of field map
- Precision goal: 10^{-4}



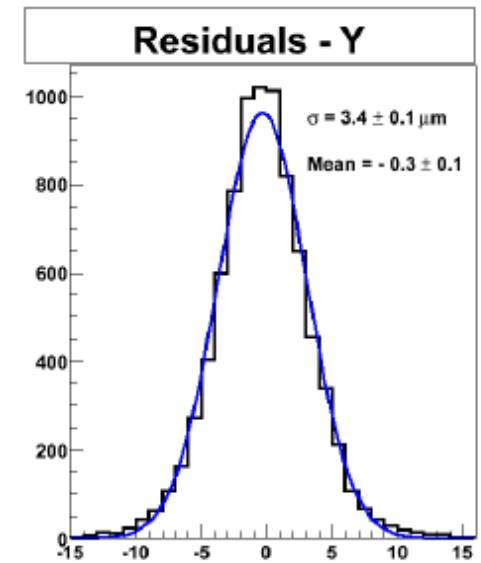
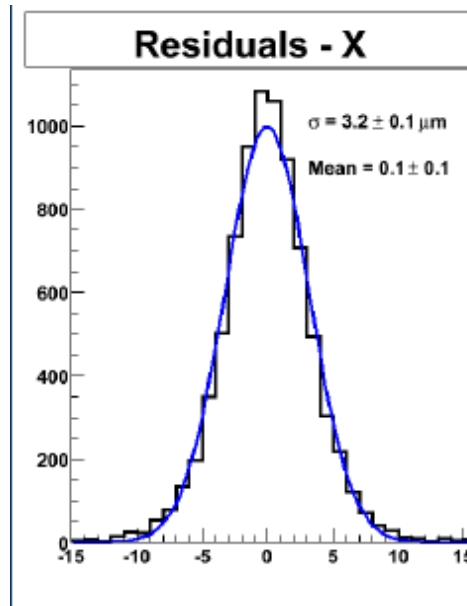
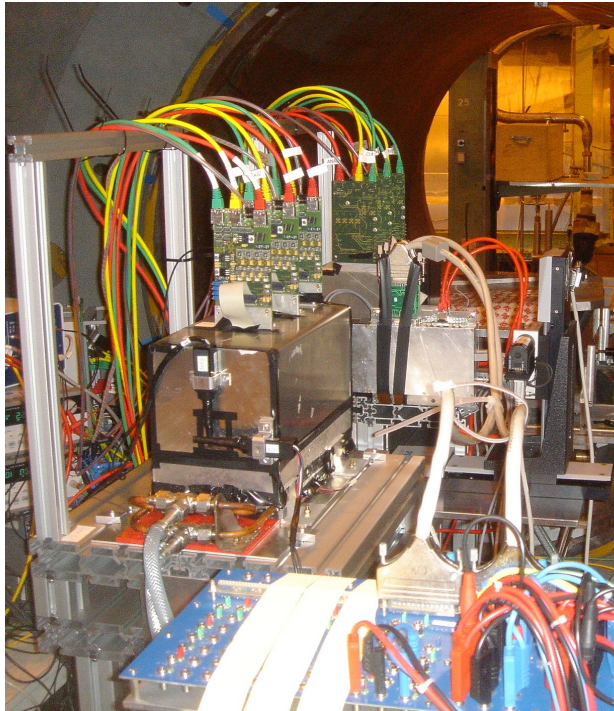
Beam Telescope



- **1st version of pixel beam telescope:**
 - analogue readout, reduced speed
 - tested & commissioned at DESY
 - now in CERN testbeam
- **2nd version in preparation**
 - digital readout and zero suppr.
 - Testbench results of new Chip
 - Promising are promising
 - Chip ready towards end of 2008

- **Performance:**

- test with DEPFET detectors
- 3.4 μm resolution (intrinsic + telescope)
- in good agreement with expected DEPFET resolution (3 μm)



The EUDET Telescope – At your Disposal

- **All-inclusive package**
 - The two arm telescope with different geometries with the possibility to add one extra high resolution sensor plane.
 - The telescope comes with all the mechanics and the cooling system.
 - Operating support: mainly remote but also local in some circumstances.
 - The DAQ system both hardware and software.
 - You can connect your device to our TLU, or (better) help is provided to integrate your R/O in our DAQ software.
 - The analysis and reconstruction software.
 - As for the DAQ, you can rely on our output track file, or integrate your device in the main analysis stream.
 - To be rented to five different user groups during 2008
 - Eligibility for usage - See later

Joint Research Activities



JRA2: Tracking Detectors

- **Large TPC prototype:**
 - low mass field cage (for JRA1 magnet)
 - modular endplate system for large surface GEM & μ Megas systems
 - development of prototype electronics for GEM & μ Megas

- **Silicon TPC readout:**
 - development MediPix \rightarrow TimePix
 - TPC diagnostic endplate module incl. DAQ

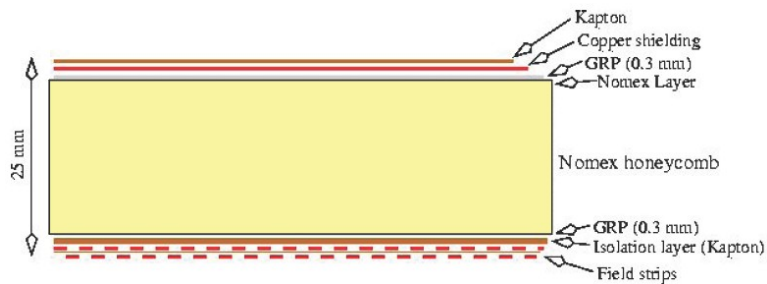
- **Silicon tracking:**
 - large & light mechanical structure for Si strip detectors
 - cooling & alignment system prototypes
 - multiplexed deep submicron FE electronics

TPC

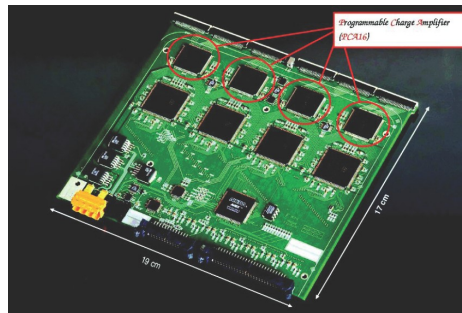
- **Fieldcage design based on light small prototype TPC**

- **Prototype electronics**
 - FADC based on ALTRO
 - TDC type readout

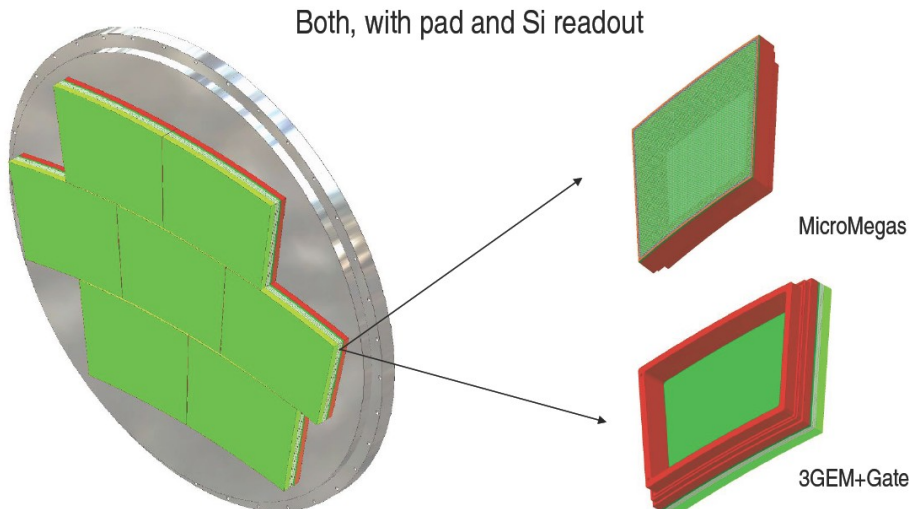
- **Well defined interfaces to readout plane**
 - mechanics
 - electronics



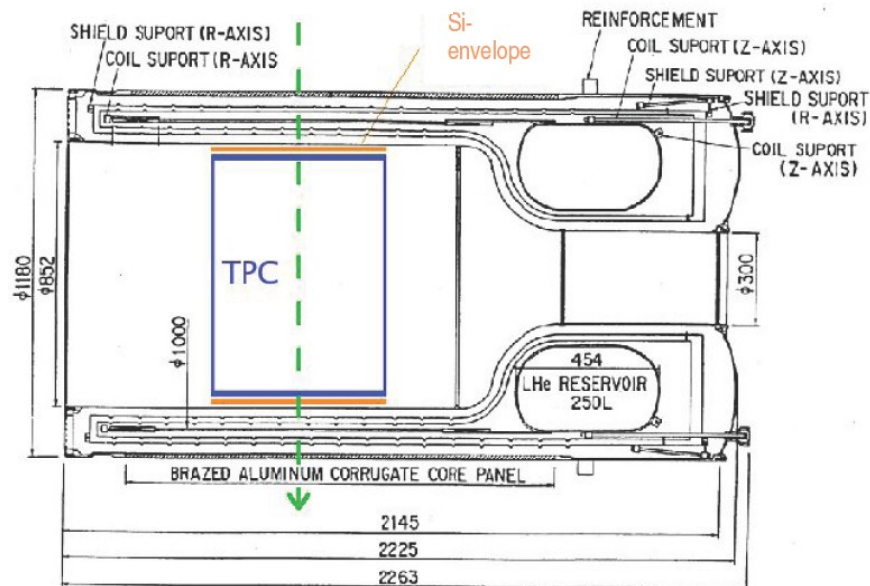
Dimensions:
60 cm length
80 cm diam.



- **few 1000 channels under construction**

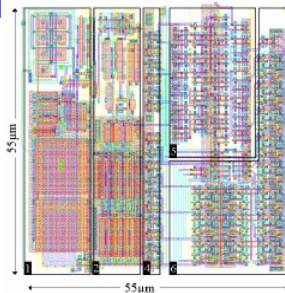


▪ TPC in PCMAG



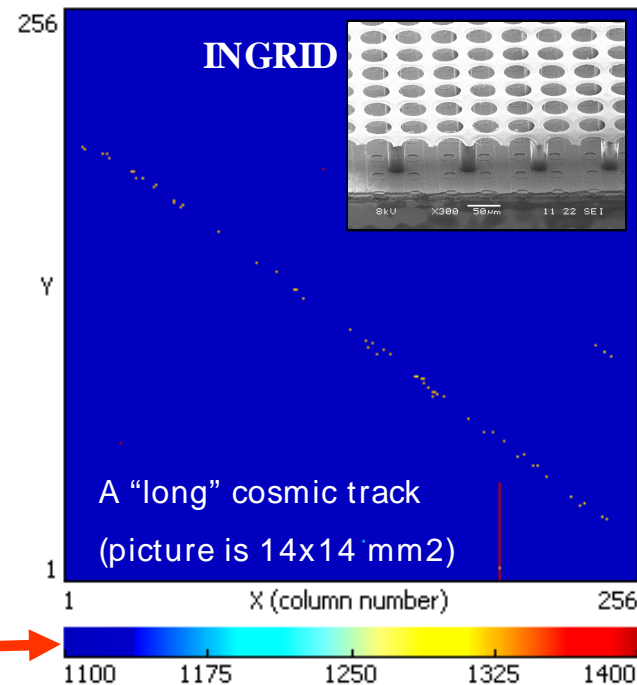
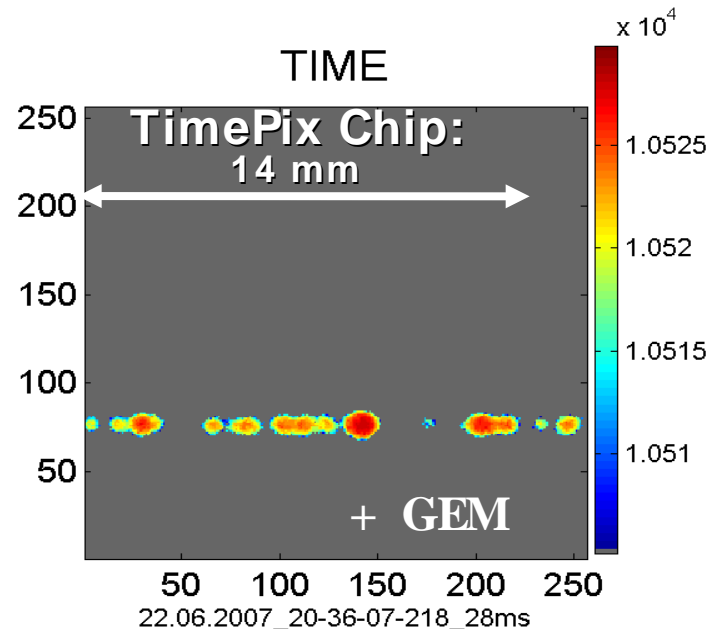
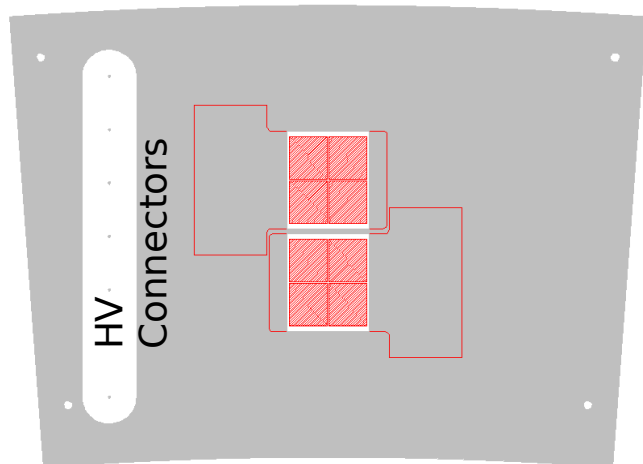
TimePix

- Development of TimePix Chip
 - Medipix (2-d) → TimePix (3-d)
 - First prototype operation since end 2006



- Postprocessing of chips
 - “add” µMegas grid

- Future:
 - Development of a TPC diagnostic endplate module (incl. DAQ)
 - O(100) chips = 200 cm²



T @ EIC08 Hampton VA

time

TimePix Modules

With
GEMs:

gas amplification:

3 standard GEMs
(60/70/140)

transfer and induction gap:
1mm

readout: 2 Quad-boards
(4 TimePix chips each)

anode plane

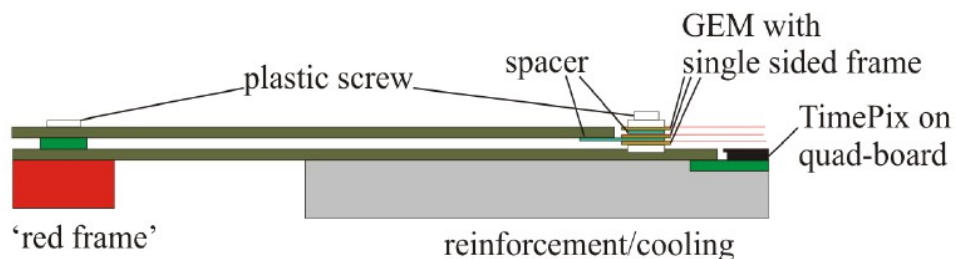
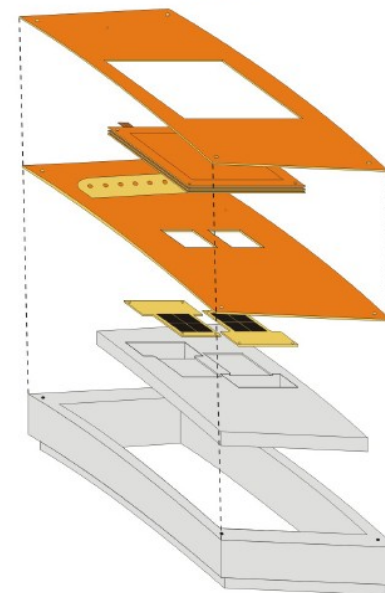
GEMs

readout plane

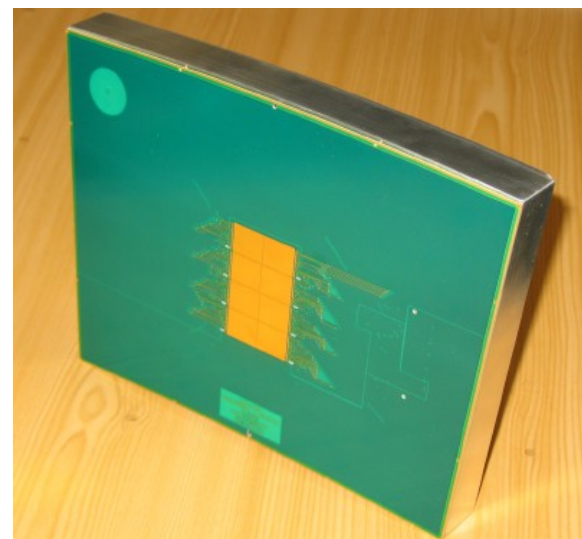
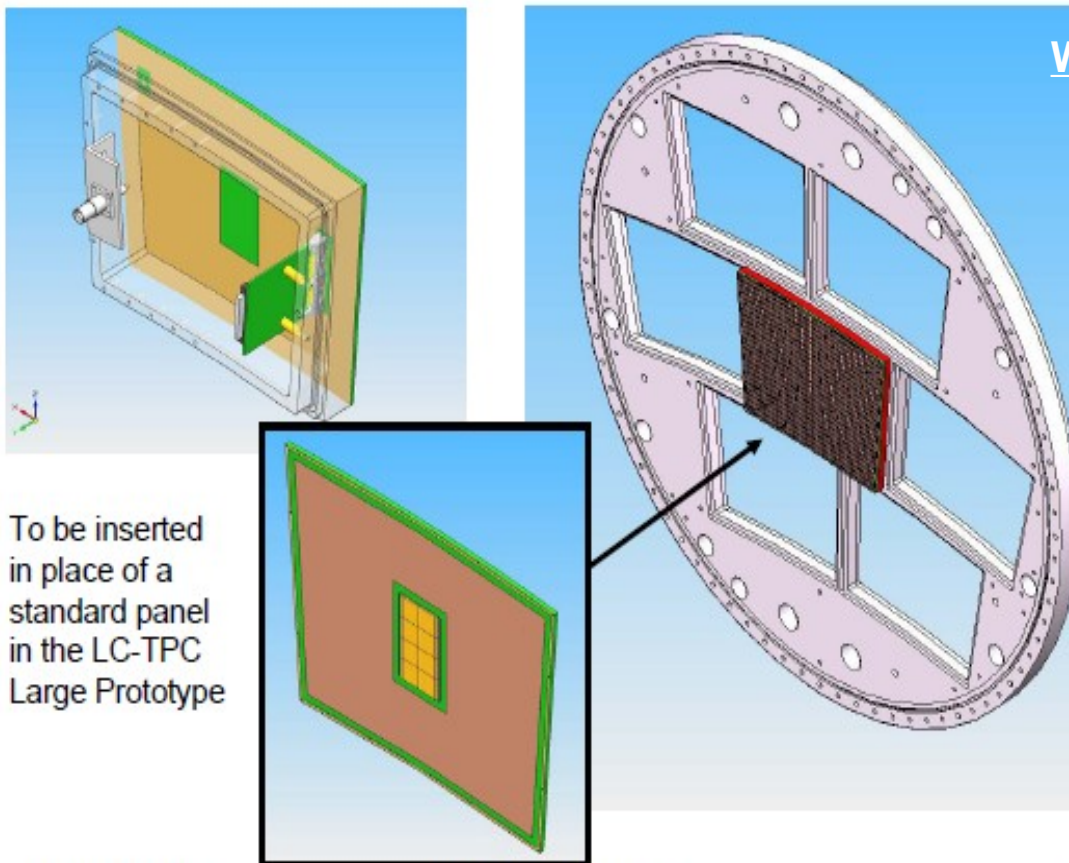
quad-boards

reinforcement of
anode plane

redframe



With MicroMEGAS (Saclay- NIKHEF)



Joint Research Activities



JRA3: Calorimeter

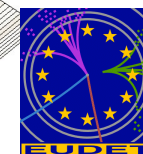
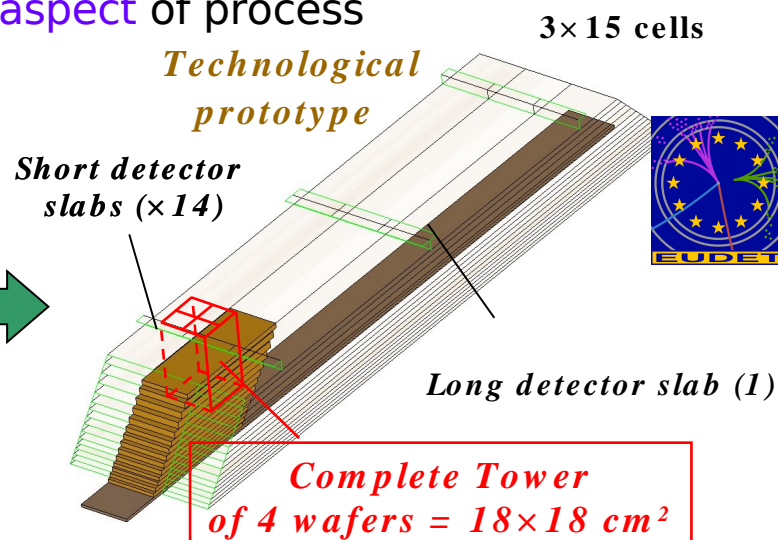
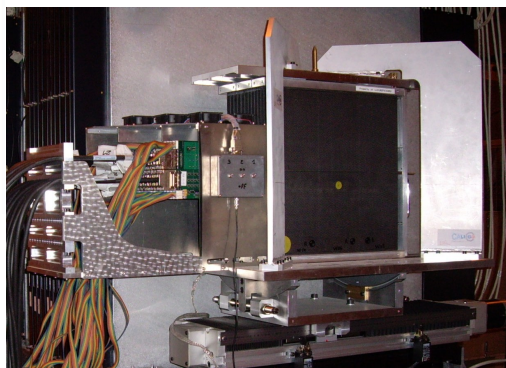
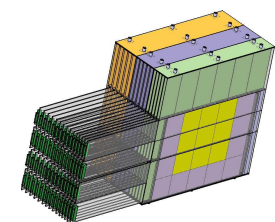
- **ECAL:**
 - scalable prototype with tungsten absorbers
 - Si-sensors & readout chips

- **HCAL:**
 - scalable prototype
 - multi-purpose calibration system for various light sensing devices

- **Very Forward Calorimeter:**
 - laser-based positioning system
 - calibration system for silicon and diamond sensors

- **FE Electronics and Data Acquisition System for the calorimeters**

- Logical continuation to the physical prototype study which validated the main concepts : alveolar structure , slabs, gluing of wafers, integration
- Techno. Proto : study and validation of most of technological solutions wich could be used for the final detector (moulding process, cooling system, wide size structures,...)
- Taking into account industrialization aspect of process
- First cost estimation of one module



- 3 structures : **24 X₀**
(10×1,4mm + 10×2,8mm + 10×4,2mm)
- sizes : **380×380×200 mm³**
- Thickness of slabs : **8.3 mm**
(W=1,4mm)
- VFE **outside** detector
- Number of channels : **9720**
(10×10 mm²)
- Weight : **~ 200 Kg**

@ EICO

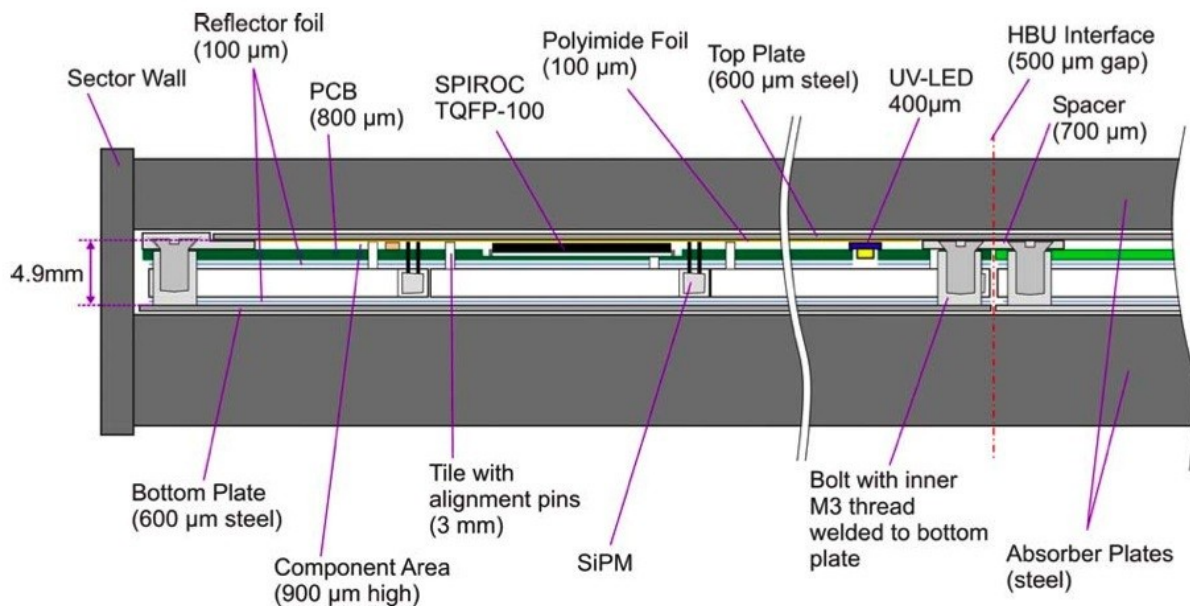
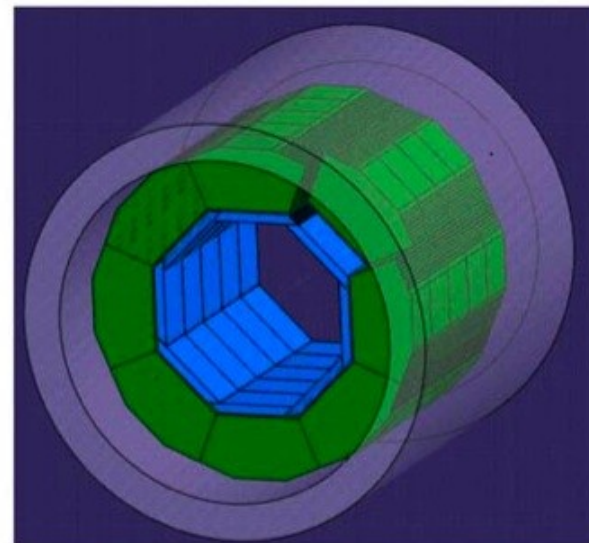
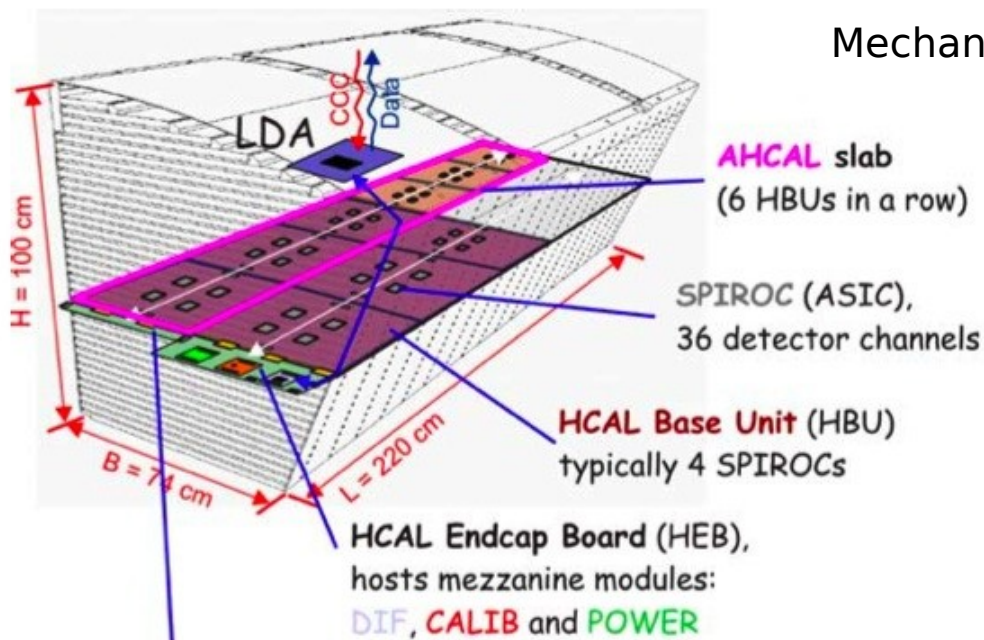
- 1 structure : **~ 23 X₀**
(20×2,1mm + 9×4,2mm)
- sizes : **1560×545×186 mm³**
- Thickness of slabs : **6 mm**
(W=2,1mm)
- VFE **inside** detector
- Number of channels : **45360**
(5×5 mm²)
- Weight : **~ 700 Kg**

Analogue Hcal

To common Calo DAQ

Calorimeters Inside Coil

Mechanical Interface between Ecal and Hcal



Large Scale Integration
 VFE Electronics
 and
 Calibration System
 Interleaved with
 Absorber

Networking Activities



Very important part of the project!

- **Information exchange and intensified collaboration:**
 - web based information system
 - annual workshops
 - open for everyone!

- **Common simulation and analysis framework:**
 - development of common software framework (testbeam analysis & ILC simulation)
 - small grid based computer cluster

- **Validation of simulation:**
 - improved GEANT4 shower simulation

- **Deep submicron radiation-tolerant electronics:**
 - access through CERN contracts
 - customized design kit
 - training courses

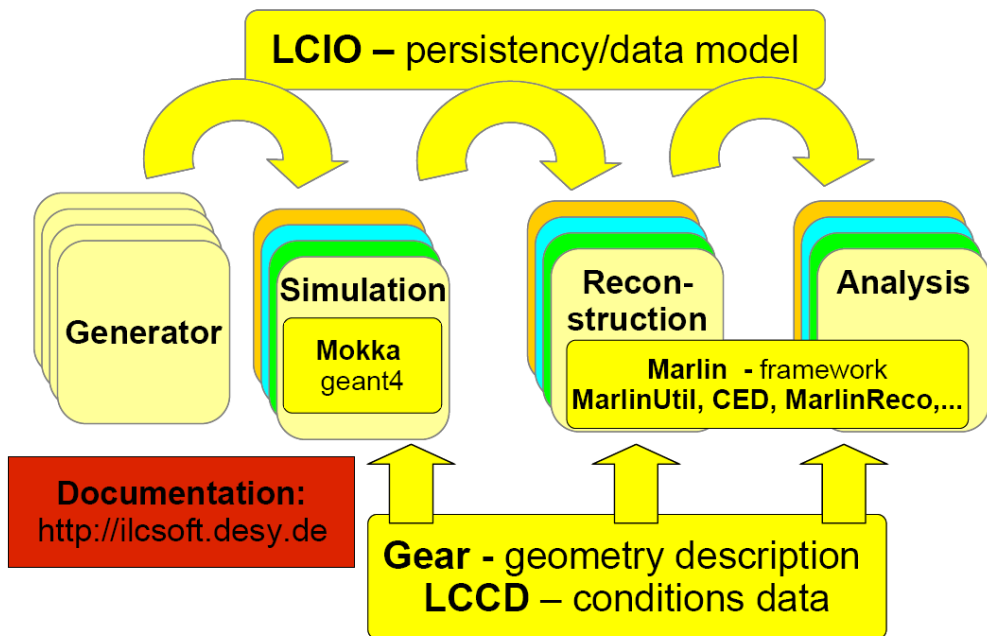


Simulation and Analysis Framework



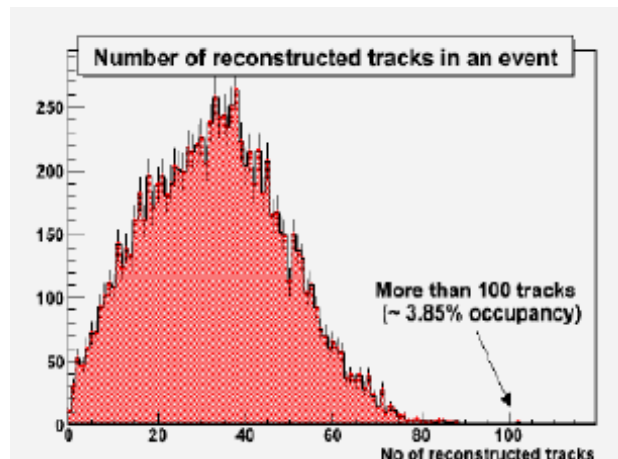
- Common software framework for ILC
- Development supported by EUDET
- First version exists & operational
- Used by all EUDET activities
 - e.g. CALICE and pixel telescope
 - testbeams analysed on Grid

EUDET/LDC SW-framework

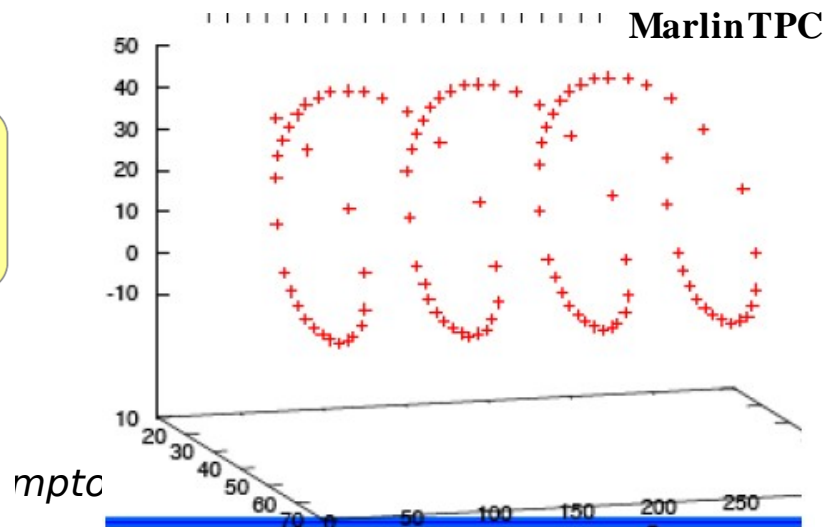


Examples:

- EUTelescope @CERN



TPC studies:



Transnational Access



- Imposed by the EU to open trans-European access to research facilities
- Not really necessary in High Energy Physics

However, we could take advantage of it:


- **Some travel support for European groups**
 - TA1: using the DESY testbeam (as of 2006)
 - TA2: using the EUDET infrastructures (as soon as available):
 - beam telescope **Started already!**
 - TPC
 - Si TPC
 - Si tracking
 - calorimeter
- **Not restricted to ILC but all kind of scientific activities are invited**

Transnational Access



CERN Courier May 2007:

- **Call for applications**
 - see advertisement in CERN courier
- **EUDET can supply travel funds**
 - for DESY testbeam
 - for use of EUDET infrastructures (beam telescope etc.)
- **Conditions & requirements:**
 - European institute
 - not from country of infrastructure
 - send short scientific proposal to Joachim.Mnich@desy.de
 - + some forms to fill ...



Transnational Access to Detector R&D Infrastructures

EUDET is a project supported by the European Union in the Sixth Framework Programme (FP6) structuring the European Research Area. This project aims at creating a coordinated European effort towards research and development for the next generation of large-scale particle detectors. EUDET comprises 23 European partner institutes and 24 associated institutes working in the field of High Energy Physics.

EUDET provides in the framework of the Transnational Access scheme travel support for groups from the EU and countries associated to FP6 using the following infrastructures:

TA1: Experiments at DESY testbeam (<http://testbeam.desy.de>)
TA2: Experiment using infrastructure developed in the EUDET project: high precision beam telescope; large, low mass TPC field cage; silicon based TPC readout system; infrastructure for development of SI-Stripdetectors; infrastructures for development of granular calorimeters.

TO APPLY FOR EC FUNDED ACCESS

visit our web site <http://www.eudet.org> to get more information about the modalities of application.

Summary & Conclusions



- **EUDET is an EU funded infrastructure programme for detector R&D**
 - well defined programme
 - embedded in international detector R&D collaborations such as CALICE, LCTPC etc.
- **Provides additional funds for European institutes**
 - to help in the next phase of ILC detector R&D from small to larger prototypes
- **Even more important**
 - EUDET fertilises collaboration between institutes („community building“)
 - EUDET can help to raise additional funds at national agencies
- **Can provide some support for other European groups**
 - Transnational Access
- **EUDET is now at 2/3 of its funding term**
 - project is on track with major milestones achieved
 - more exciting work ahead of us
 - still open for contributions from new interested groups

More information at www.eudet.org



Backup Slides

EUDET Partner Institutes:



**Charles University Prague
IPASCR Prague**



HIP Helsinki



**LPC Clermont-Ferrand
LPSC Grenoble
LPHNE Paris
Ecole Polytechnique Palaiseau
LAL Orsay
IReS Strasbourg
CEA Saclay**



**DESY
Bonn University
Freiburg University
Hamburg University
Mannheim University
MPI Munich
Rostock University**



Tel Aviv University



**INFN Ferrara
INFN Milan
INFN Pavia
INFN Rome**



NIKHEF Amsterdam



**AGH Cracow
INPPAS Cracow**



CSIC Santander



Lund University



**CERN Geneva
Geneva University**



**Bristol University
UCL London**