

# **EUDET**

## **Detector R&D towards the International Linear Collider**



## **Status and Plans**

**Joachim Mnich**

**CLIC Workshop**

**CERN October 2007**

# 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:

- $\approx 57$  FTE total (= 230 man years)

- $\approx 17$  FTE funded by EU

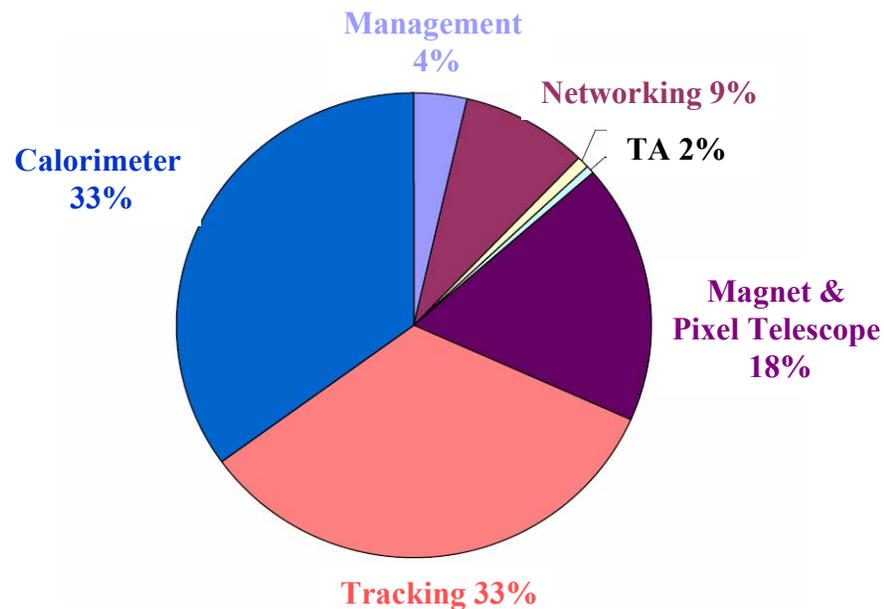
- 23 (31) partner institutes in Europe

provide own commitments & receive EU funds

- 27 associated institutes worldwide

contribute to design & construction of infrastructures

interested in later exploitation



# 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**

**+ 27 associated institutes**

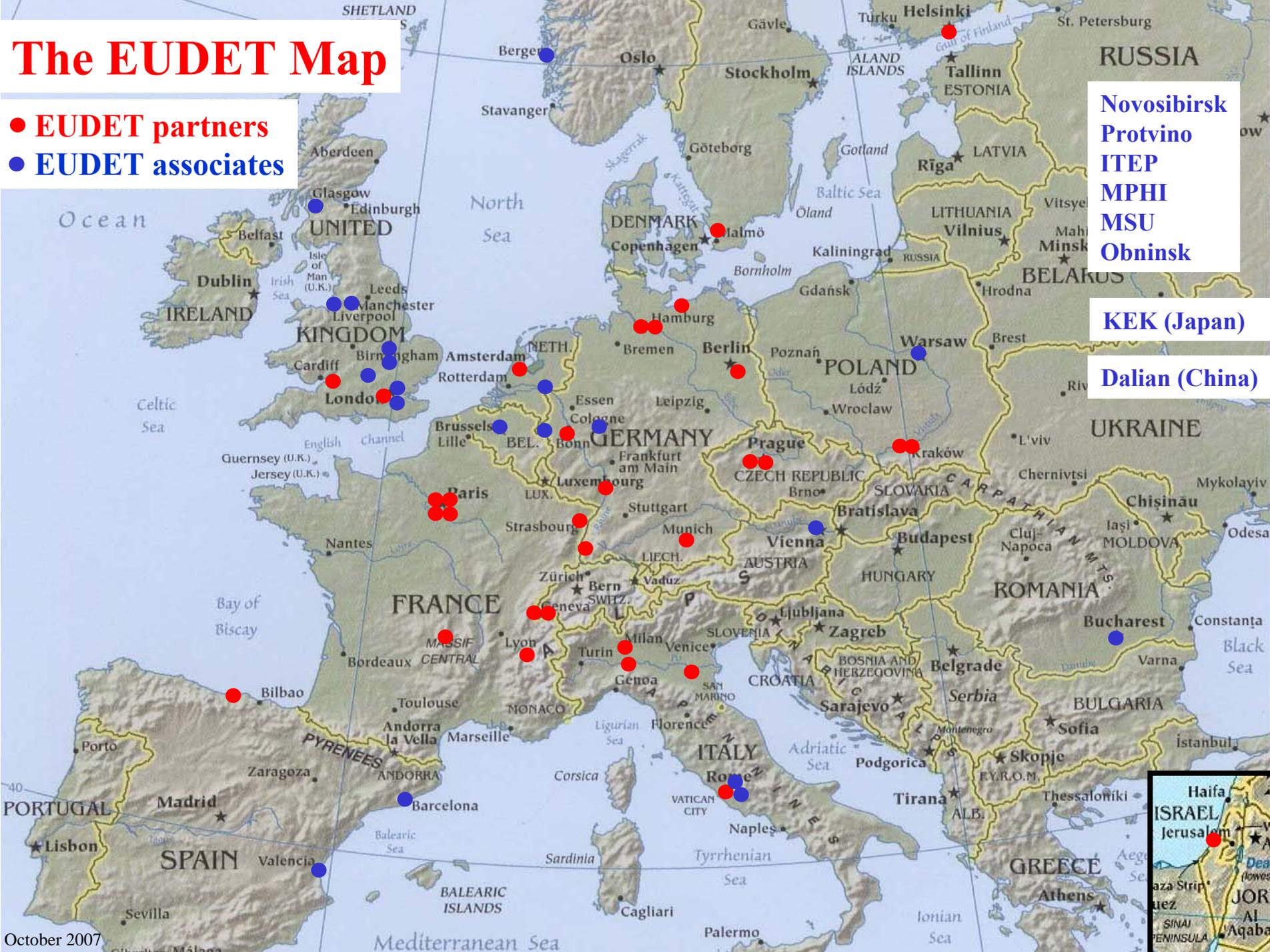
# The EUDET Map

- EUDET partners
- EUDET associates

Novosibirsk  
Protvino  
ITEP  
MPHI  
MSU  
Obninsk

KEK (Japan)

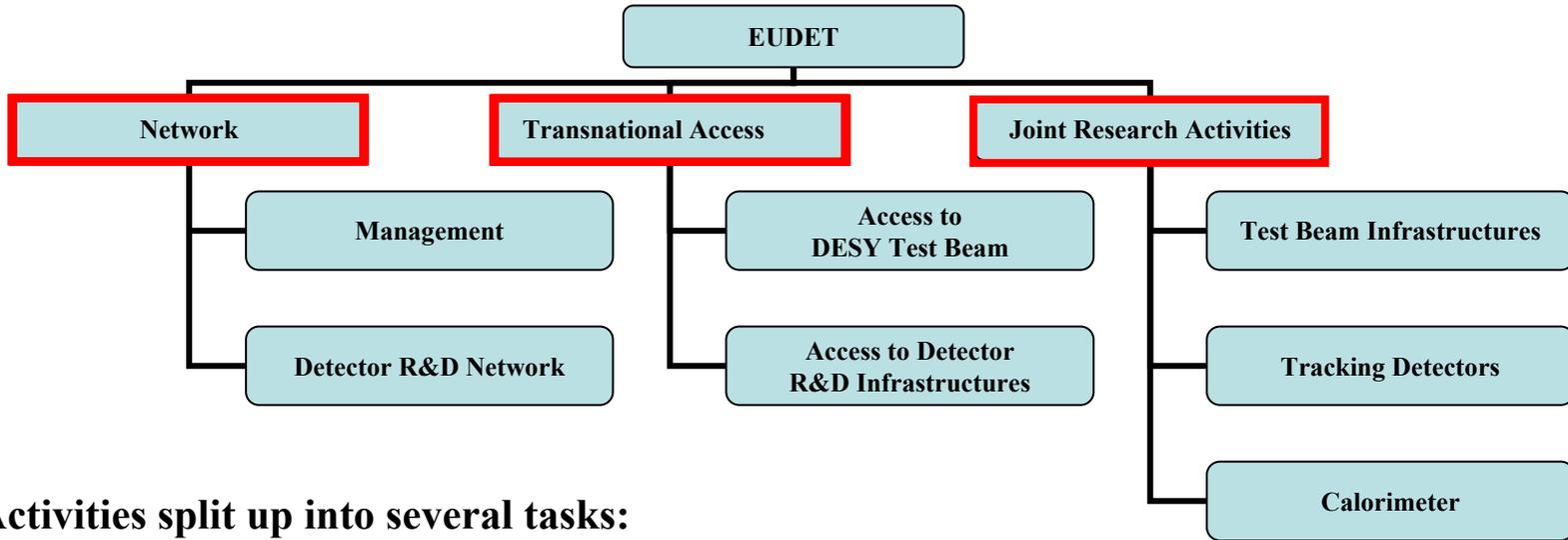
Dalian (China)



# 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**

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

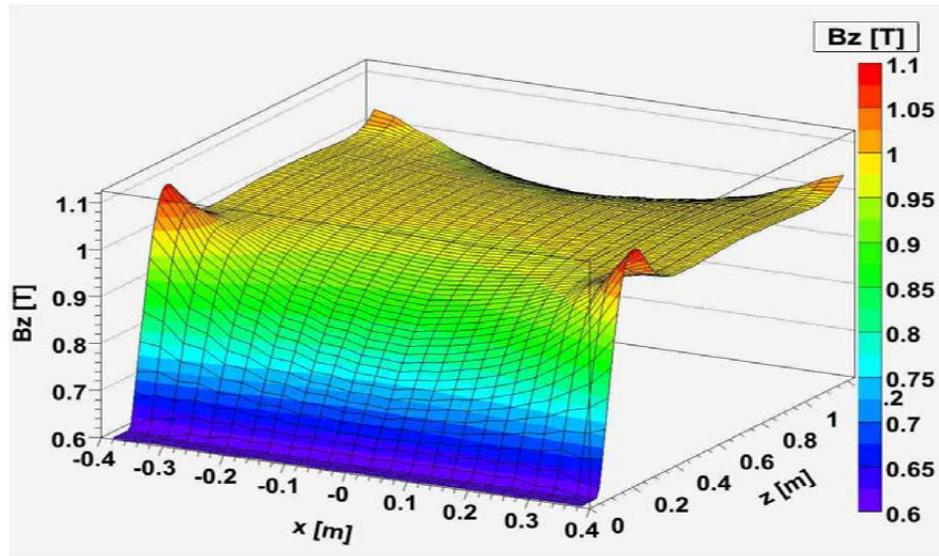
### **Note: all EUDET infrastructures are movable**

- 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:  $10^{-4}$



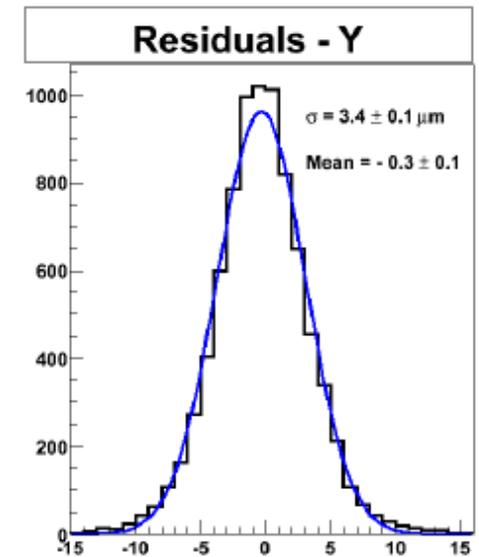
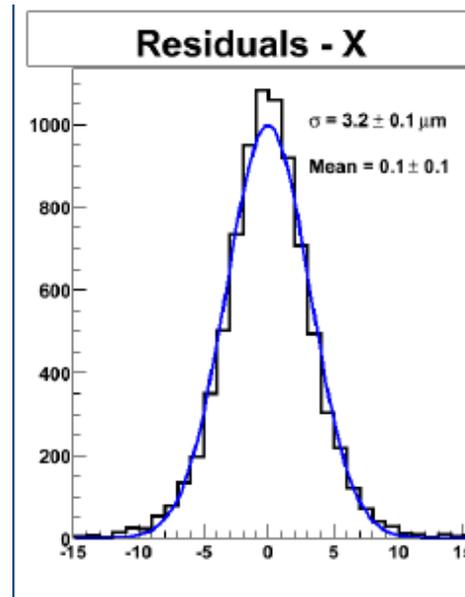
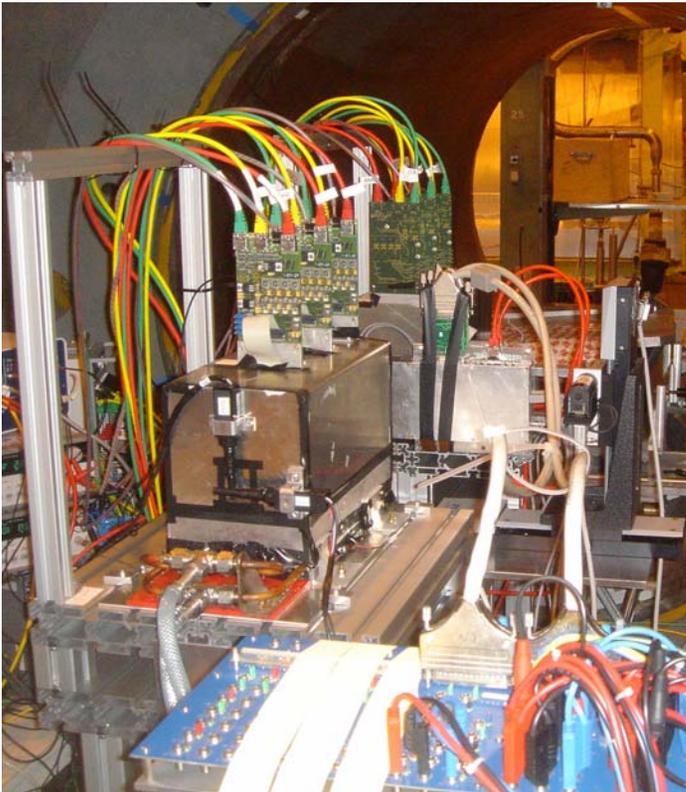
# Beam Telescope



- **1<sup>st</sup> version of pixel beam telescope:**
  - analogue readout, reduced speed
  - tested & commissioned at DESY
  - now in CERN testbeam
- **2<sup>nd</sup> version in preparation**
  - digital readout

- **Performance:**

- test with DEPFET detectors
- 3.4  $\mu\text{m}$  resolution (intrinsic + telescope)
- in good agreement with expected DEPFET resolution (3  $\mu\text{m}$ )



# Joint Research Activities



## JRA2: Tracking Detectors

### ▪ Large TPC prototype:

- low mass field cage (for JRA1 magnet)
- modular endplate system for large surface GEM &  $\mu$ Megas systems
- development of prototype electronics for GEM &  $\mu$ 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

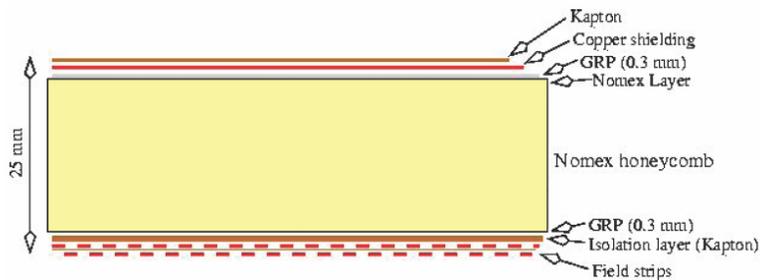


# TPC

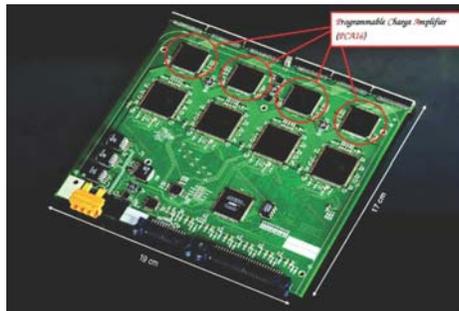
- Fieldcage design based on light small prototype TPC

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

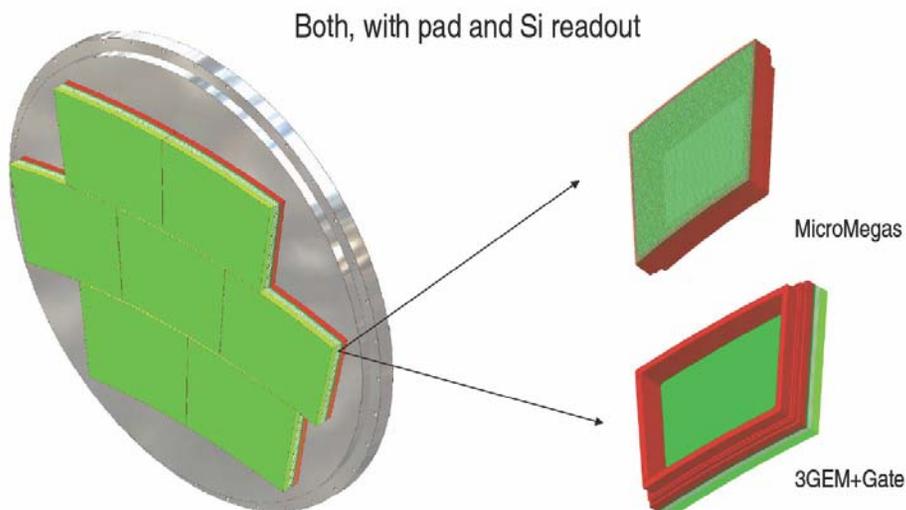
- Well defined interfaces to readout plane
  - mechanics
  - electronics



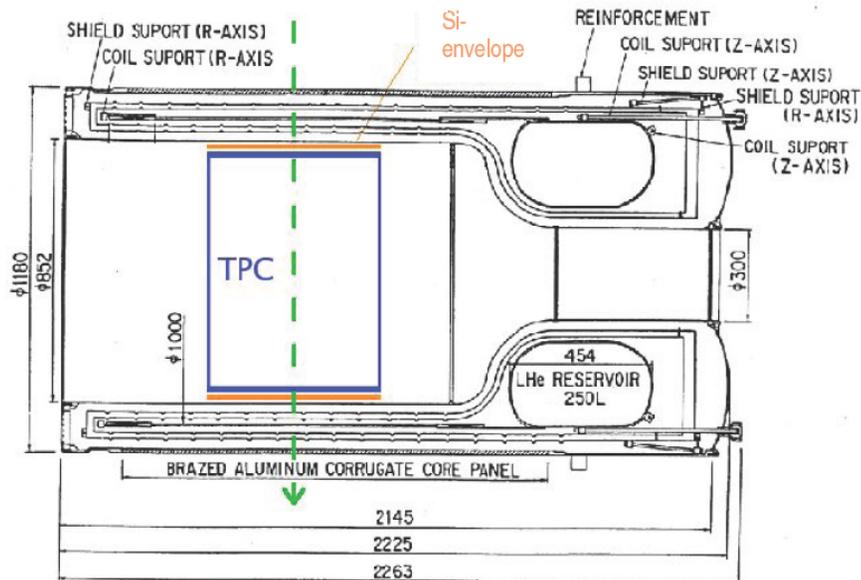
- dimensions:
  - 60 cm length
  - 80 cm diam.



- few 1000 channels under construction

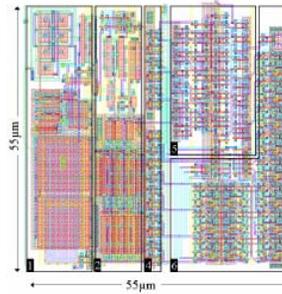


## TPC in PCMAG



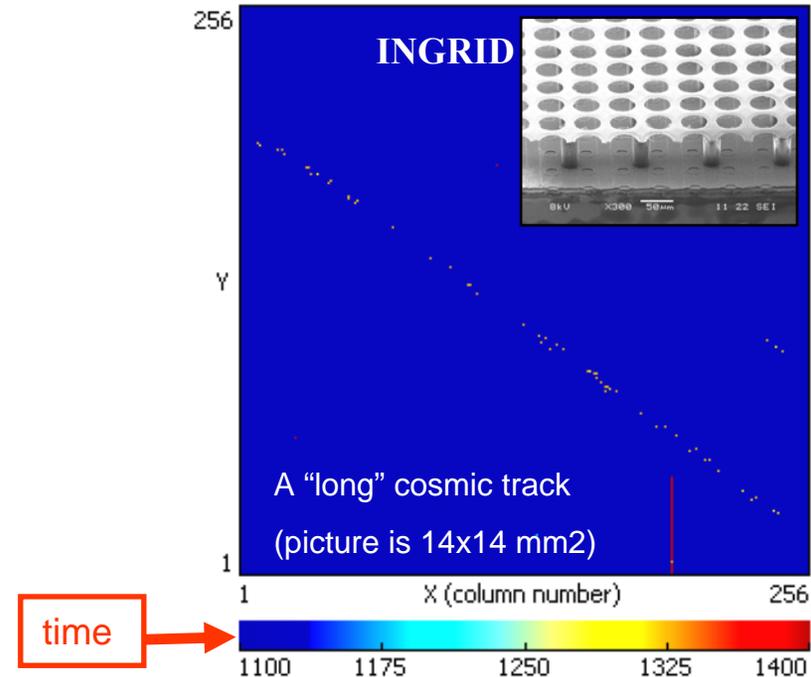
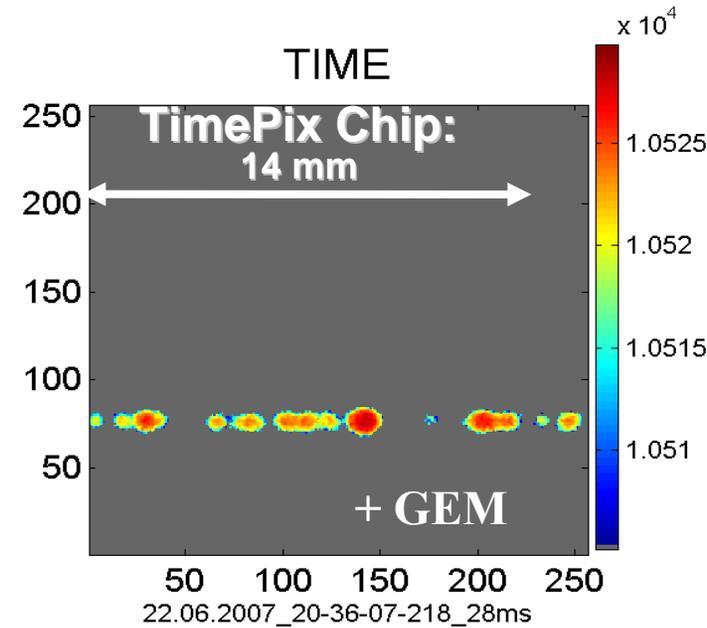
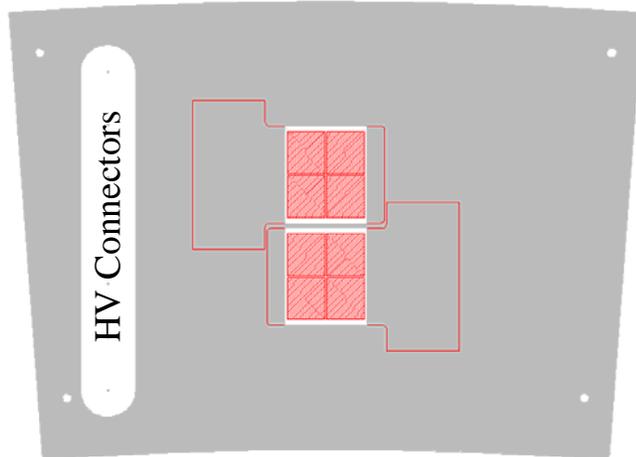
# TimePix

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



- Postprocessing of chips
  - “add” µMegas grid (→ INGRID)

- Future:
  - Development of a TPC diagnostic endplate module (incl. DAQ)  
O(100) chips = 200 cm<sup>2</sup>



# Joint Research Activities



## JRA3: Calorimeter

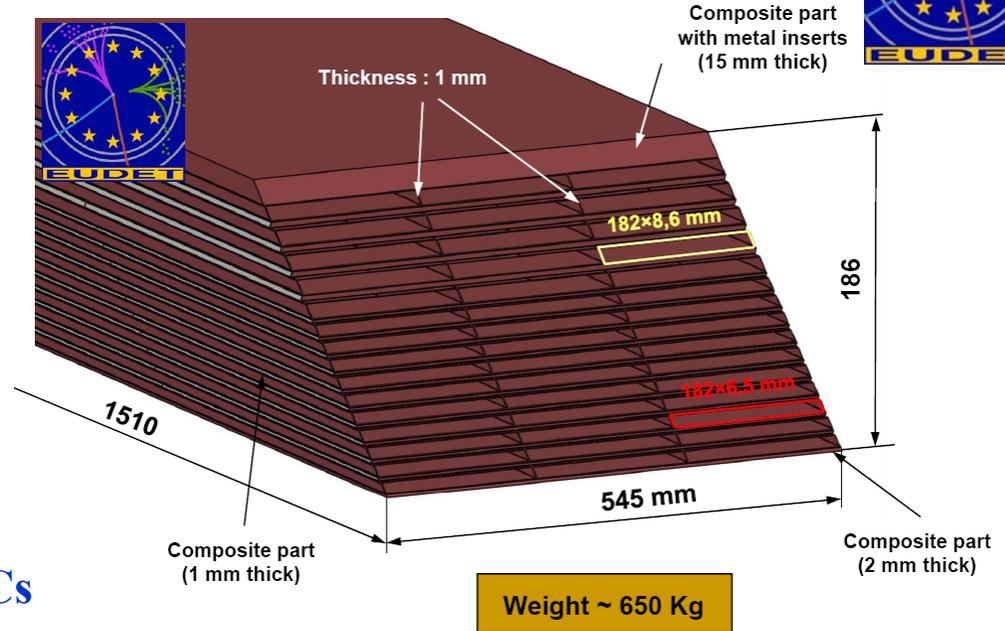
- **ECAL:**
  - scalable prototype with tungsten absorbers
  - Si-sensors & readout chips
  
- **HCAL:**
  - scalable prototype
  - multi-purpose calibration system for various light sensing devices
  
- **Very Forward Calorimeter:**
  - laser-based positioning system
  - calibration system for silicon and diamond sensors
  
- **FE Electronics and Data Acquisition System for the calorimeters**

# Calorimeter



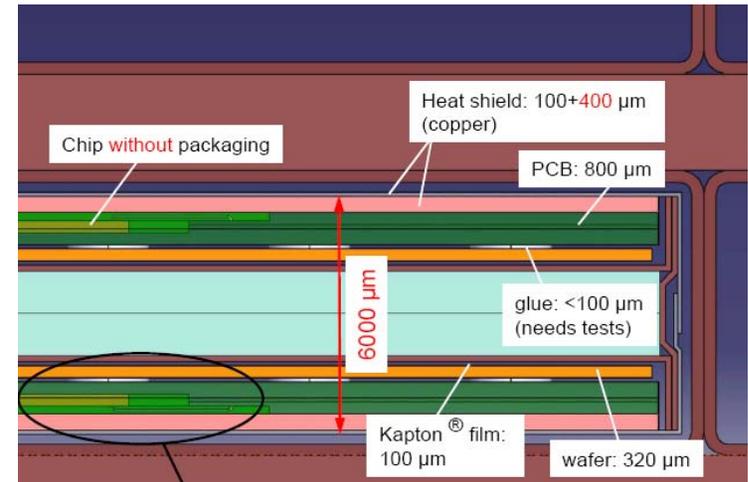
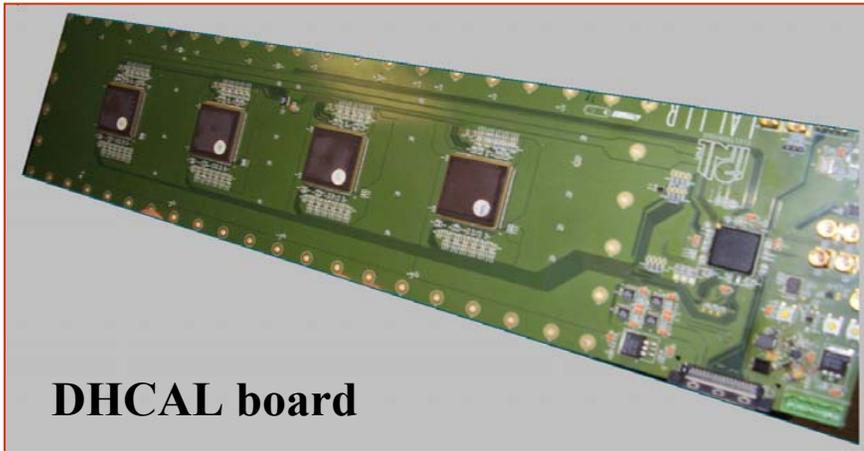
- **Design of the EUDET module**

- ECAL (see right)
- and HCAL



- **Design and prototypes of readout ASICs**

- ECAL, DHCAL & AHCAL



# 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

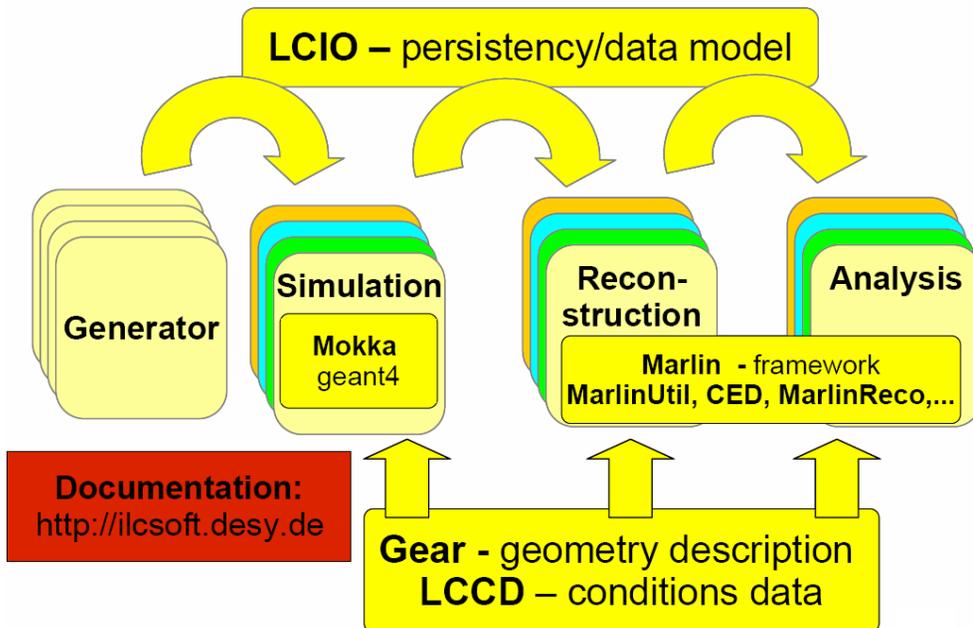
▪ **Deep submicron radiation-tolerant electronics:**

- access through CERN contracts
- customized design kit
- training courses

# Simulation and Analysis Framework

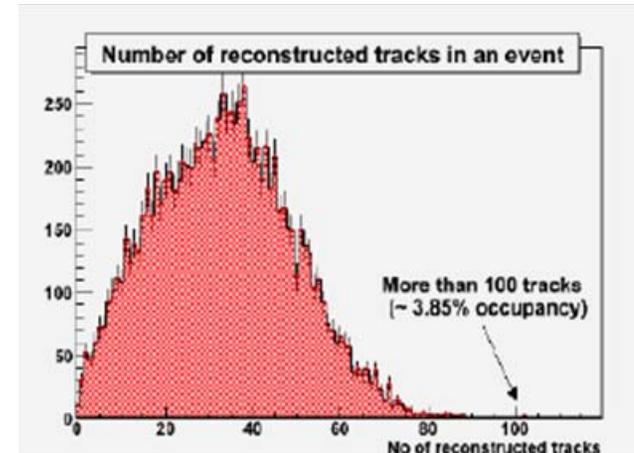
- Common software framework for ILC
- Development supported by EUDET
- First version exists & operational
- Used by all EUDET activities
  - e.g. CALICE and pixel telescope
  - testbeams analysed on Grid

## EUDET/LDC SW-framework

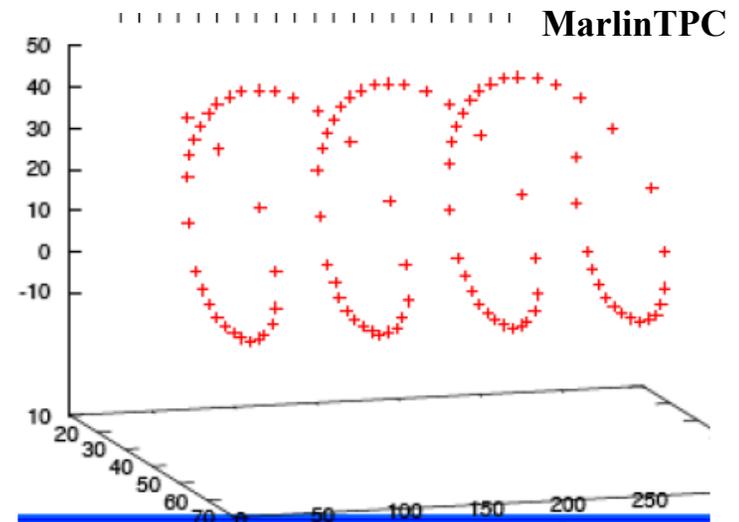


## Examples:

- 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



- **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](mailto:joachim.Mnich@desy.de)
  - + some forms to fill ...



**EUDET** Detector R&D towards the International Linear Collider

## 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 mid-term**
  - project is on track with major milestones achieved
  - more exciting work ahead of us
  - still open for contributions from new interested groups