EUDET

Detector R&D towards the International Linear Collider

Status and Plans

Joachim Mnich

VLCW06

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Introduction to EUDET

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

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

- **Follows EU projects which support ILC machine R&D:**

2003 CARE: **Coordinated Accelerator Research in Europe**
Integrated Infrastructure Initiative (I3)

2004 EUROTeV: **European Design Study Towards a Global TeV Collider**
Design Study

2005 EUDET: **Detector R&D towards the International Linear Collider**
Integrated Infrastructure Initiative (I3)

Introduction to EUDET

EUDET

- is NOT a detector R&D programme in its narrower sense

but provides a framework for ILC detector R&D with larger prototypes

- does NOT cover all future needs (financial & human resources)

additional resources required, e.g. to exploit EUDET infrastrutures

- is NOT a closed club

other institutes (European & non-European) are invited to

- contribute to the development of the EUDET infrastructure and to exploit it

- a few examples below

Introduction to EUDET

Project start:

- **January 2006, for a duration of 4 years**

Budget:

- **21.5 million Euro total**
- **7.0 million Euro EU contribution**

Manpower:

- **≈ 57 FTE total**
- **≈ 17 FTE funded by EU**

- **31 partner institutes in Europe**
  provide own commitments & receive EU funds
- **22 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

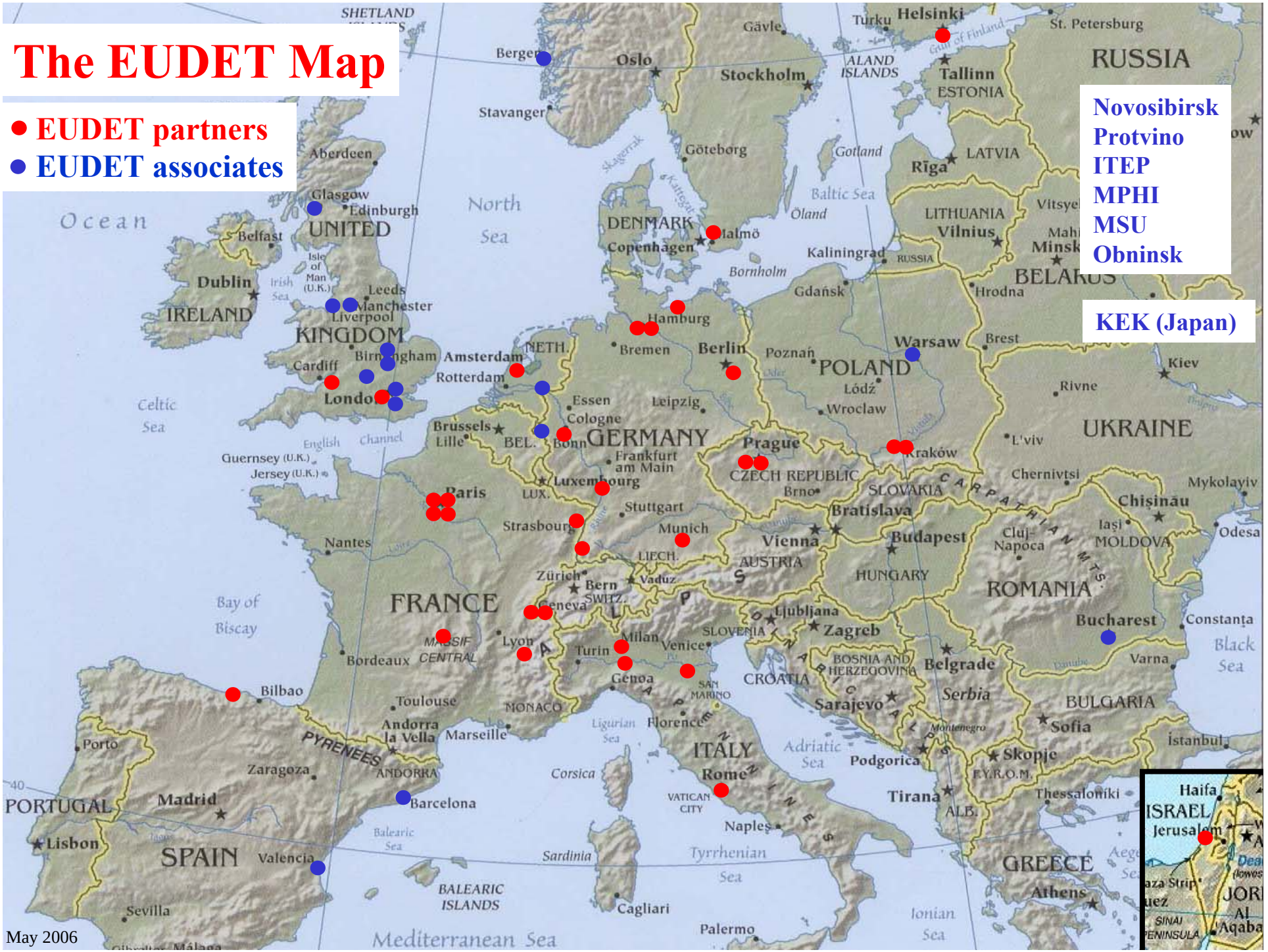
+ 22 associated institutes

The EUDET Map

- EUDET partners
- EUDET associates

Novosibirsk
Protvino
ITEP
MPHI
MSU
Obninsk

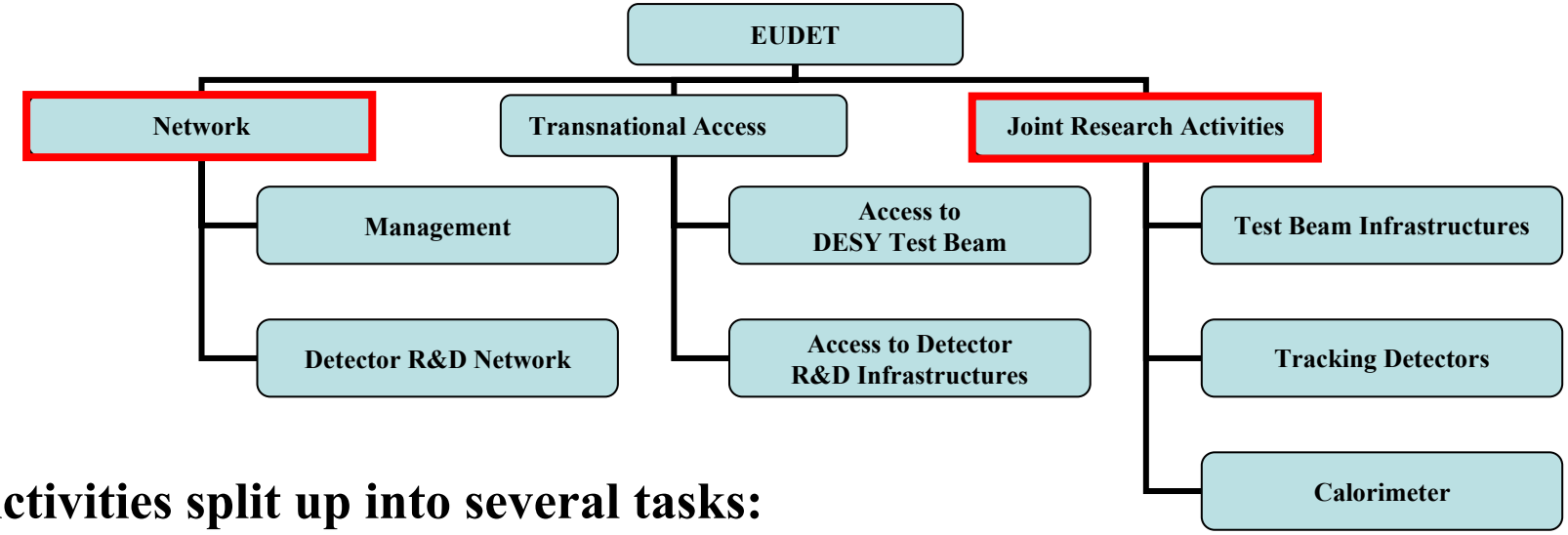
KEK (Japan)



May 2006

EUDET Struture

I3 projects based on three pilars (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

Test Beam Infrastructure:
- Large bore magnet
- Pixel beam telescope

Tracking Detectors:
- Large TPC prototype
- Silicon TPC readout
- Silicon tracking

Calorimeter:
- ECAL
- HCAL
- Very Forward Calorimeter
- FE Electronics and Data Acquistion System

Joint Research Activities

JRA1: Testbeam Infrastructure

- **Large bore magnet:**
  - **1.5 Tesla, Ø ≈ 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 infrastructure is movable

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

Joint Research Activities

JRA2: Tracking Detectors

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

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

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

Joint Research Activities

JRA3: Calorimeter

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

- **HCAL:**
  - **scalable protoype**
  - **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 Acquistion System for the calorimeters**

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:**
  - **e.g. Geant4 shower simulation**

- **Deep submicron radiation-tolerant electronics:**
  - **access through CERN contracts**

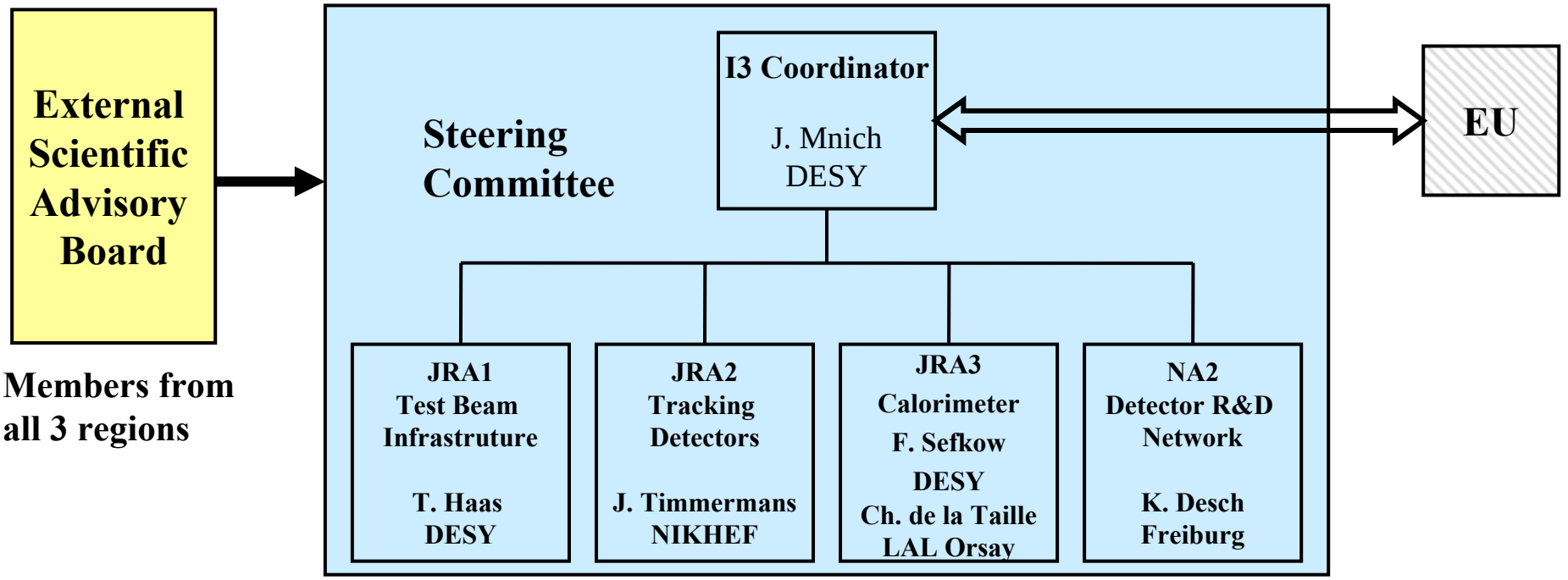
Transnational Access

- **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:

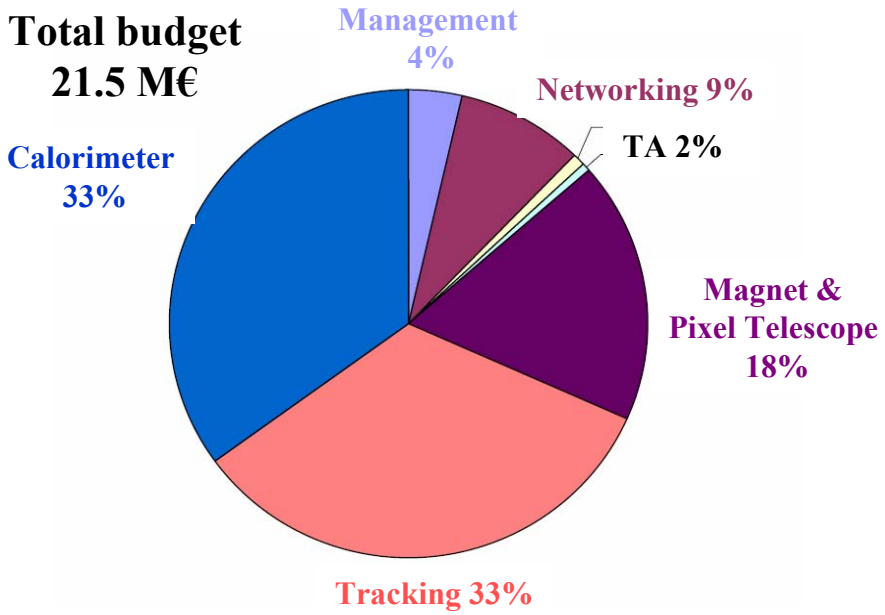
- **some travel support for European groups**
  - **using the DESY testbeam (as of 2006)**
  - **using the EUDET infrastructures (as soon as available):**
    - **beam telescope**
    - **TPC**
    - **Si TPC**
    - **Si tracking**
    - **calorimeter**

EUDET Management

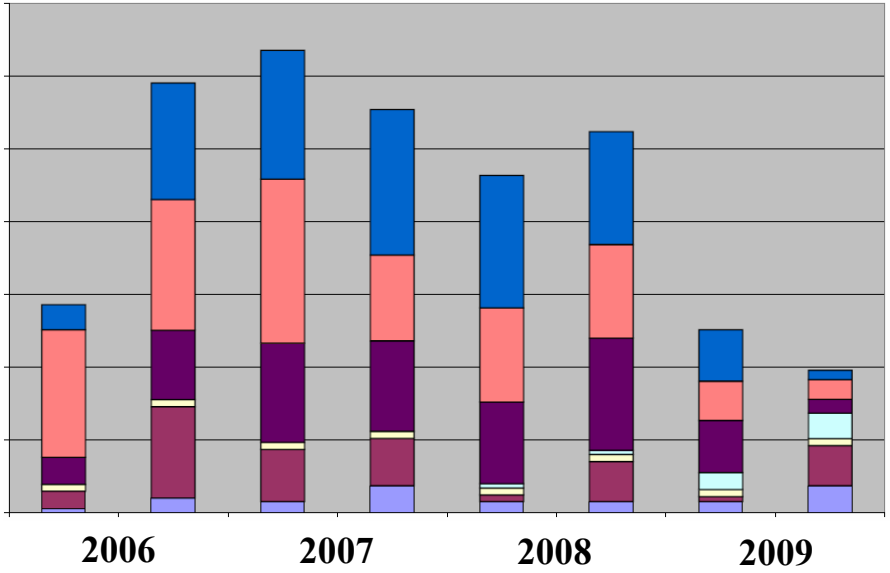


- Task leaders have been assigned for the various work packages
- Annual EUDET meetings and workshops

EUDET Budget and Time Profile



- most of the resources for the development of the infrastrutures

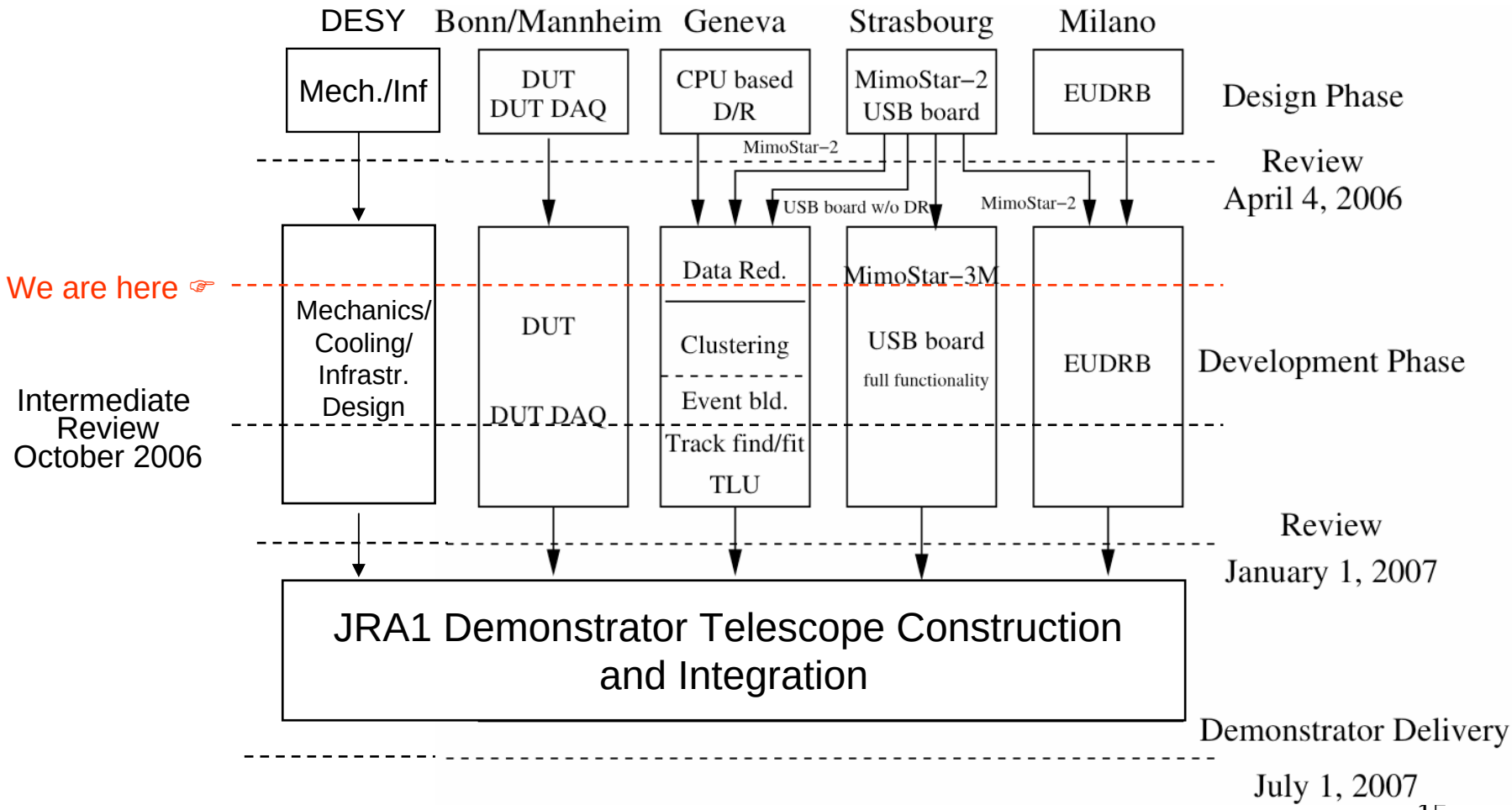


- ramp-up first half 2006
- full swing activities for 2.5 years
- last year: phase-out and exploitation of infrastrutures

EUDET Status

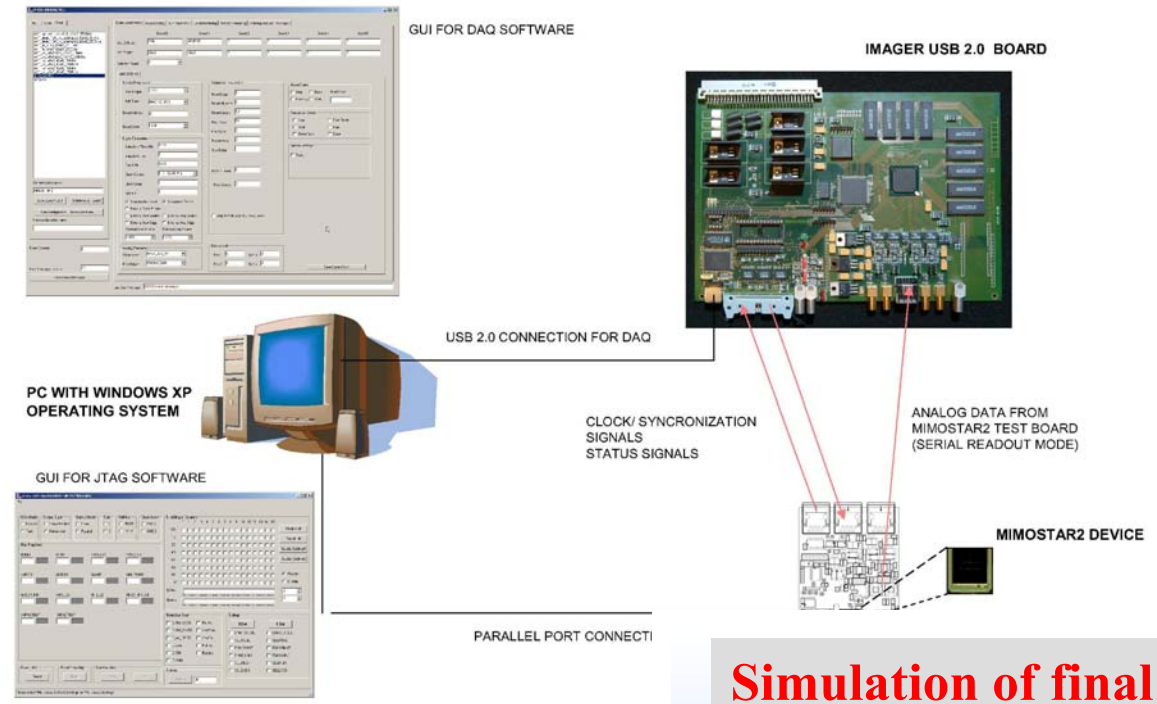
A few examples on the work going on

- **Work plan for pixel beam telescope:**

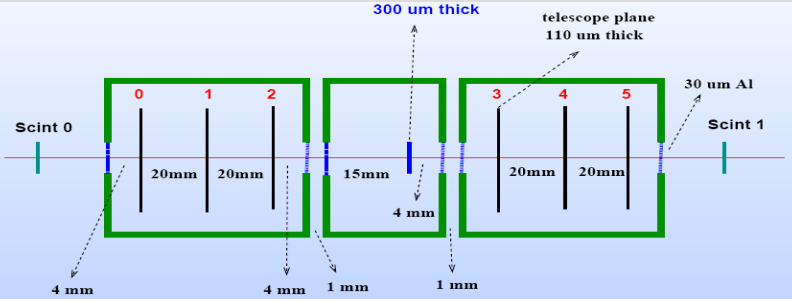


EUDET Status

- **Testbench existing (Mimosa chip, DAQ board & software):**



Simulation of final beam telescope:

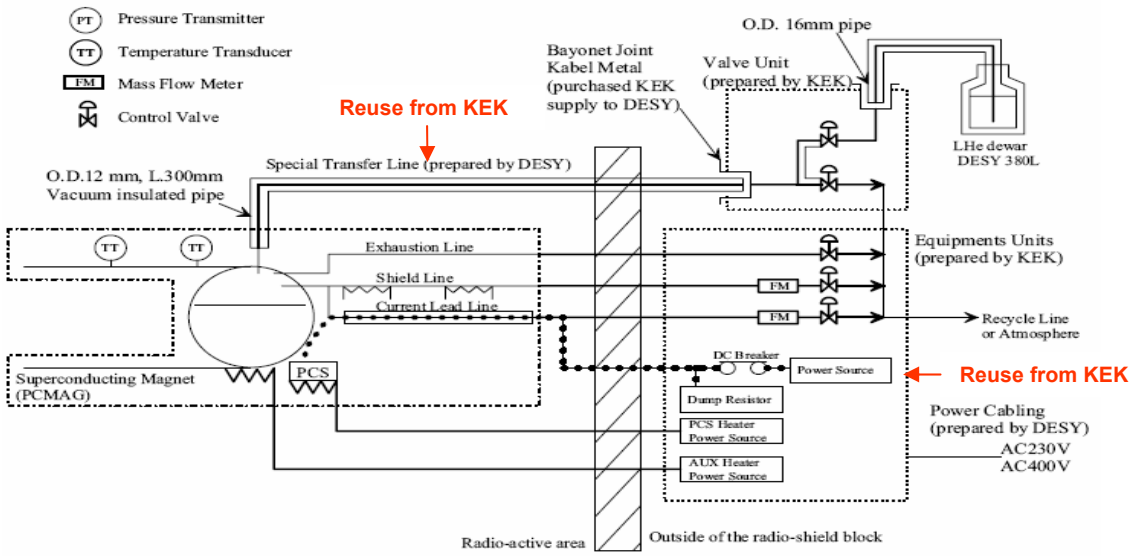


Testbeam Magnet

- **Magnet supplied by KEK (PCMAG)**
  - low mass coil, stand-alone He cooling, 1 Tesla
  - transport to DESY scheduled for August 2006

- **Infrastructure (power, control, He)**
  designed and work started
  close collaboration
  KEK & DESY

- **DESY testbeam line**
  under preparation



Silicon TPC Readout

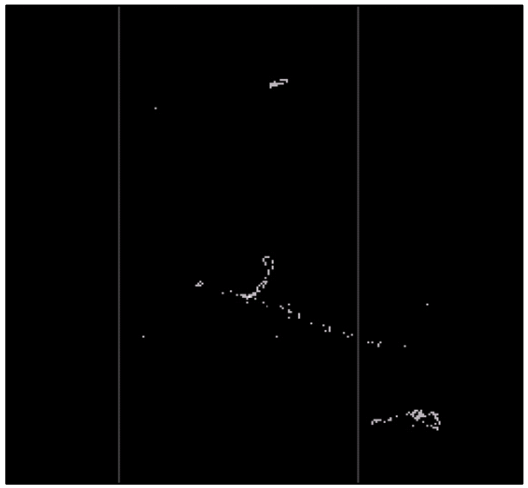
Freiburg, Saclay, CERN, NIKHEF (+ Bucharest as associate)

Sofar 2-d readout with

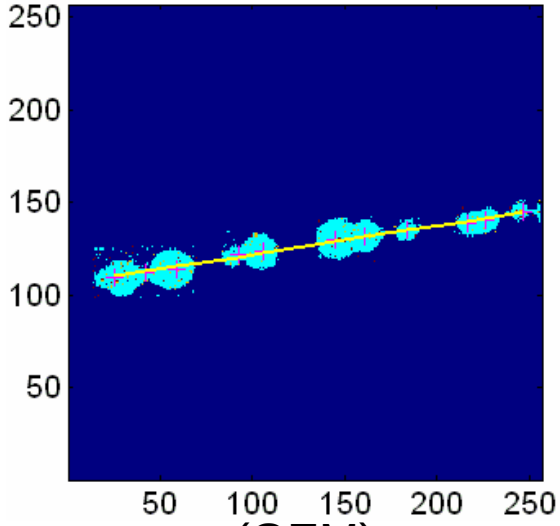
Medipix2 0.25 µm CMOS:

256x256 pixels

55x55 µm^2



(Micromegas)



(GEM)

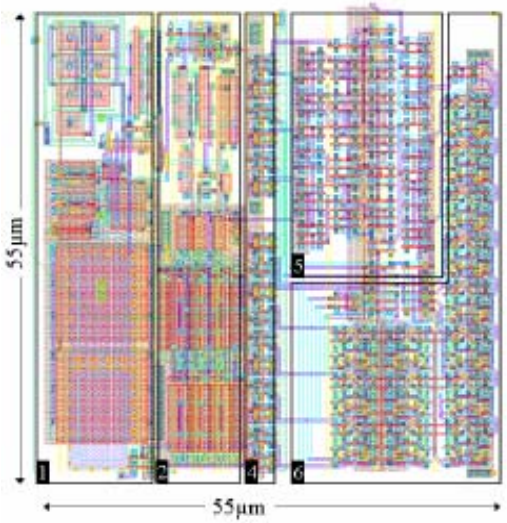
- **Development Medipix (2-d) → TimePix (3-d)**

  50-150 MHz clock to every pixel

  1st full reticle version submitted (July 2006)

- **TPC diagnostic endplate module (incl. DAQ)**

  available by 1/2009

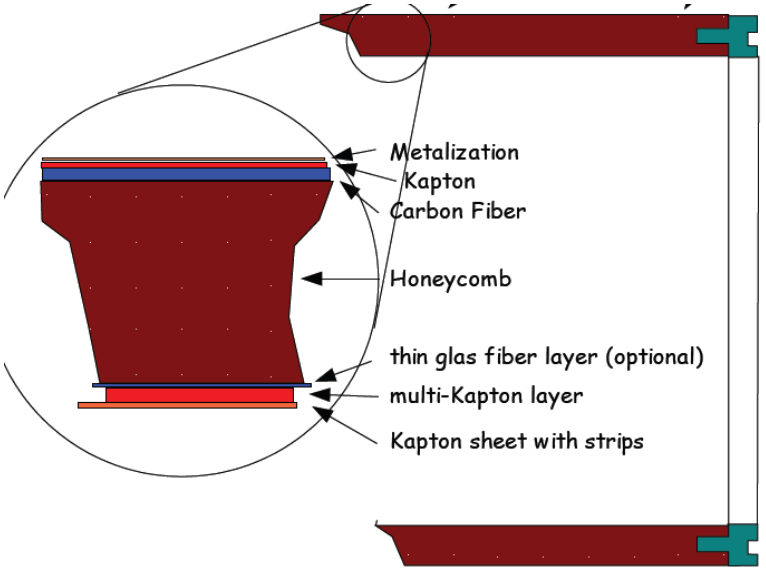


TPC

- fieldcage design
  based on light small prototype TPC

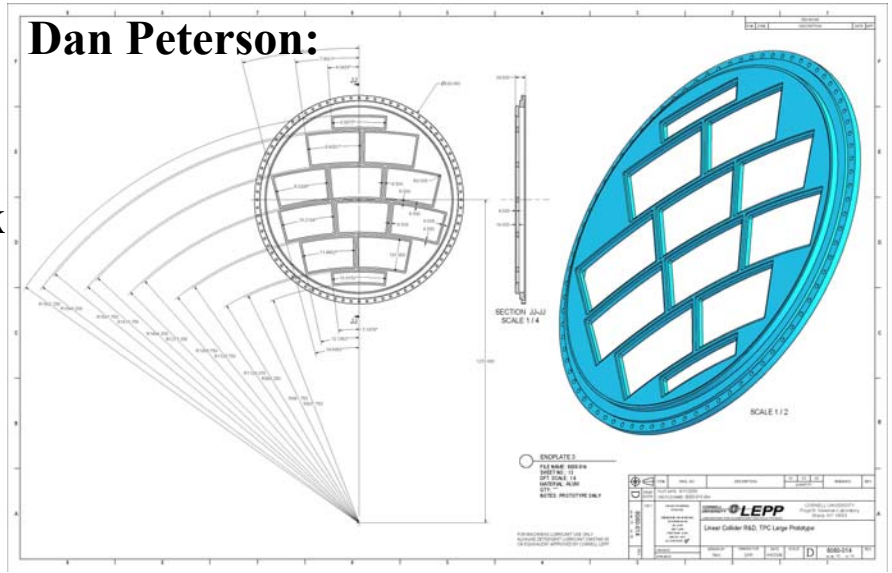
- prototype electronics
  - FADC based on ALTRO
  - TDC type readout

- well defined interfaces to readout plane
  - mechanics
  - electronics



60 cm length
80 cm diam.

Dan Peterson:



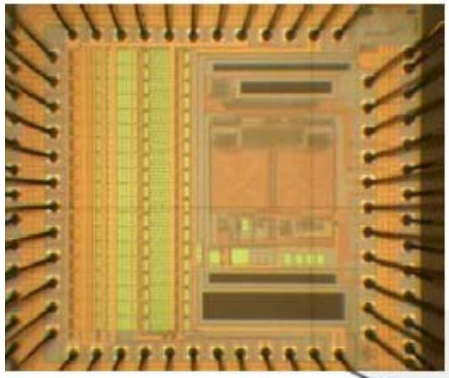
Design of readout planes will be complex
Need input now from all potential users

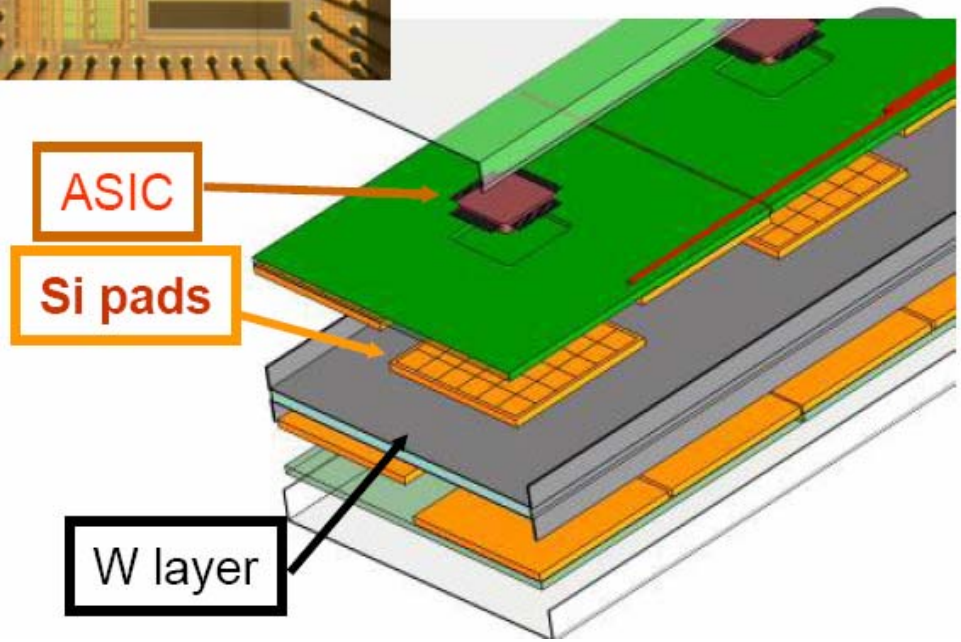
Good example for close collaboration with other regions in LCTPC:

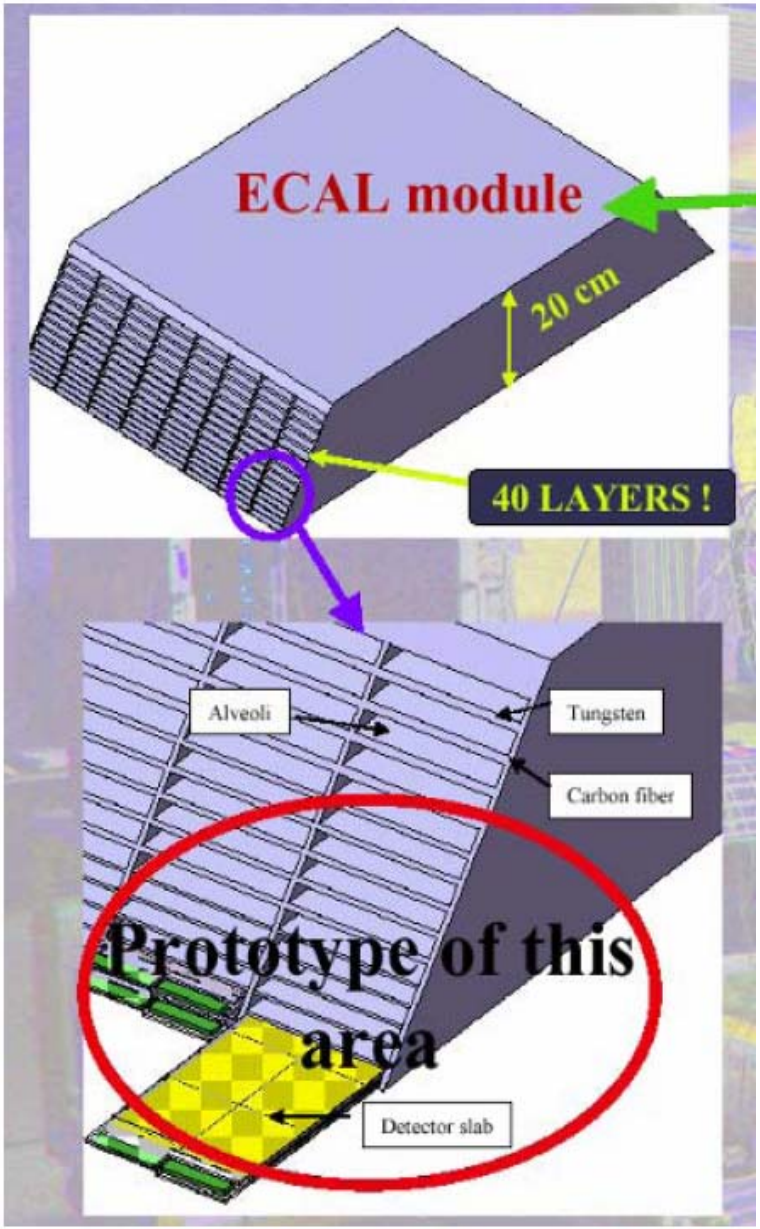
JRA3 : EUDET ECAL calorimeter module

- **Front-end ASICs embedded in detector**
  - Includes power pulsing, zero suppress and internal ADC over 16 bits dynamic range
  - 4,000 ch/slab, minimal room, access, power

Prototype ready summer 2006

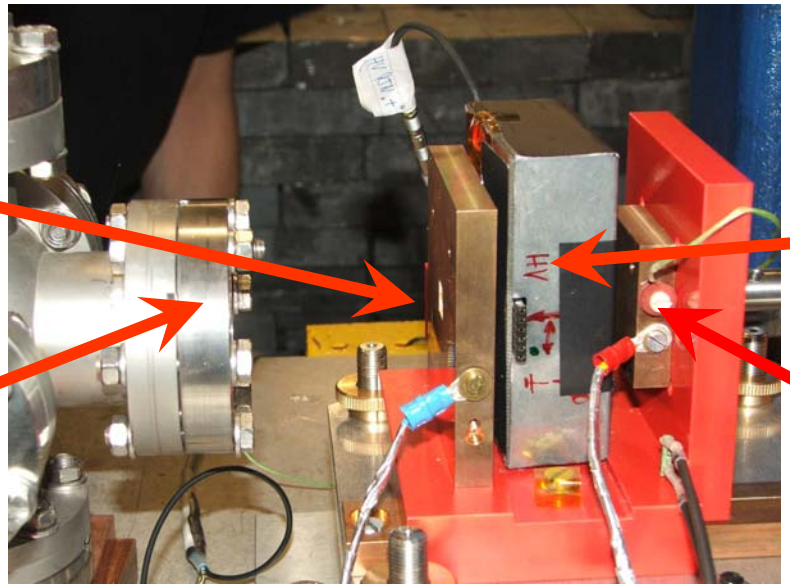




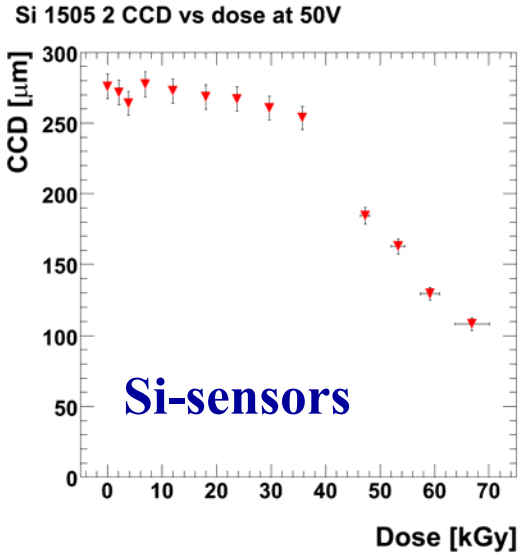


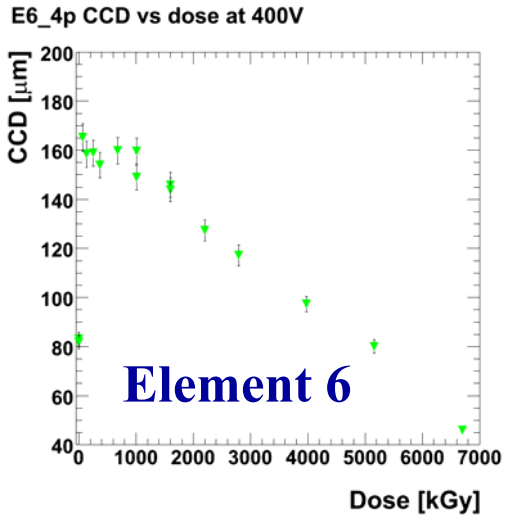
Very Forward Calorimeter

Sensor tests in 10 MeV beam DALINAC Darmstadt



Prelim. Results on radiation Hardness:





EUDET in the ILC Universe

Should be fully incorporated in the ILC detector R&D

- Make optimal use of EUDET resources on international scale

- Avoid unnecessary duplication

Special attention:

- EUDET is a contract between the partner institutes and the EC with well defined milestones and deliverables, e.g. for 2006

Activity	Deliverable Nr.	Deliverable title	Workpackage /Task Nr.	Lead Contractor(s)	Delivery date	Nature
JRA1	JRA1-D1	SDC prototype 1	C	CNRS-IReS	9	Prototype
NA1	NA1-D1	1st Annual Report		DESY	12	Report
NA2	NA2-D1	Version 1.0 of electronic information system	C	TAU	12	Web page
NA2	NA2-D2	Proceedings of 1st EUDET workshop	F	DESY	12	Report
JRA2	JRA2-D1	Preamplifier prototype	A	CERN,ULUND, UROS	12	Hardware
JRA2	JRA2-D2	TimePix chip	B	CERN,FOM/NIKHEF	12	Prototype
JRA3	JRA3-D1	Conceptual report	A,B,C,D,E	DESY,CNRS-LAL	12	Report
JRA3	JRA3-D2	DHCAL ASIC	E	CNRS-LAL	12	Prototype

- Need for some independent structures managements, meetings, …

- Somewhat reduced flexibility

EUDET in the ILC Universe

My personal view on EUDET and the relation to other ILC activities (in the language of particle physicists)

- **consider EUDET as sort of (large) virtual institute**

- **which is part of an even larger collaboration the ILC detector R&D**

- **EUDET provides resources to and takes responsibilities in the collaboration which must be carefully synchronised with the other collaborators**

  e.g. with collaborations as CALICE, FCAL, SILC, LCTPC

- **EUDET has a well defined program**
  framework set by funding agency (European Union)

EUDET Status and Plans

- **EUDET Kick-off Meeting**
  February 15th - 17th at DESY
  - define plans
  - invited talks from America and Asia

- **EUDET Annual Meeting**
  October 18th - 20th at MPI Munich
  - review of the project to prepare Annual Report
  - also in context of the international detector R&D efforts
  - workshop program & registration in preparation

- **EUDET web page**

www.eudet.org

with many more details on the project, meetings etc.

Conclusions

- **EUDET is latest example for the high recognition of ILC at the EU**

- **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 can help to raise additional funds at national agencies**
  - **if successful, prepare future collaboration with the EU on the ILC detector**

- **Additional funds are needed**
  - **to create and exploit the infrastructures**
  - **everyone is invited to participate**

- **Coorperation on international scale is mandatory and highly welcome**
  synchronize with R&D collaborations

EUDET is an ambitious programme with a lot of exciting work ahead of us