from EUDET to the future

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Outline:

- Structure and main achievements of EUDET
- Summary on EUDET
- From EUDET to AIDA
- Proposed structure of AIDA
- Conclusions

Structure and main achievements of EUDET

(Courtesy: authors of EUDET mid-term report)

EUDET detector R&D towards the International Linear Collider

- EUDET is an "Integrated Infrastructure Initiative (I3)" within the **EU funded** "6th framework programme"
- Support improvement of **infrastructure for detector R&D** with larger prototypes - but not the R&D itself

- EUDET is **not a collaboration**
  - Other institutes can contribute and exploit the infrastructure
  - Infrastructure can be re-located

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
Heidelberg 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

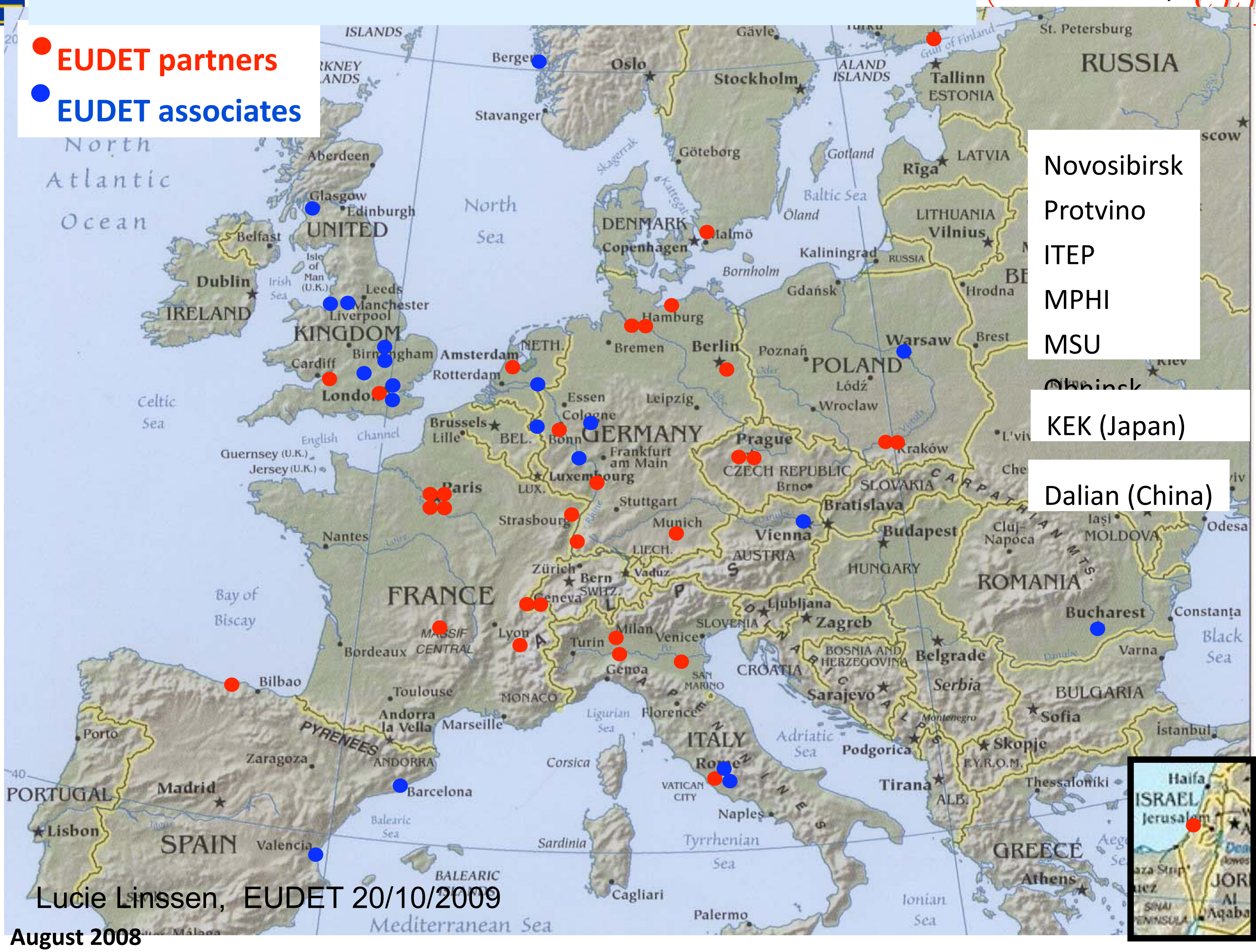
Lund University

CERN Geneva
Geneva University

Bristol University
UCL London

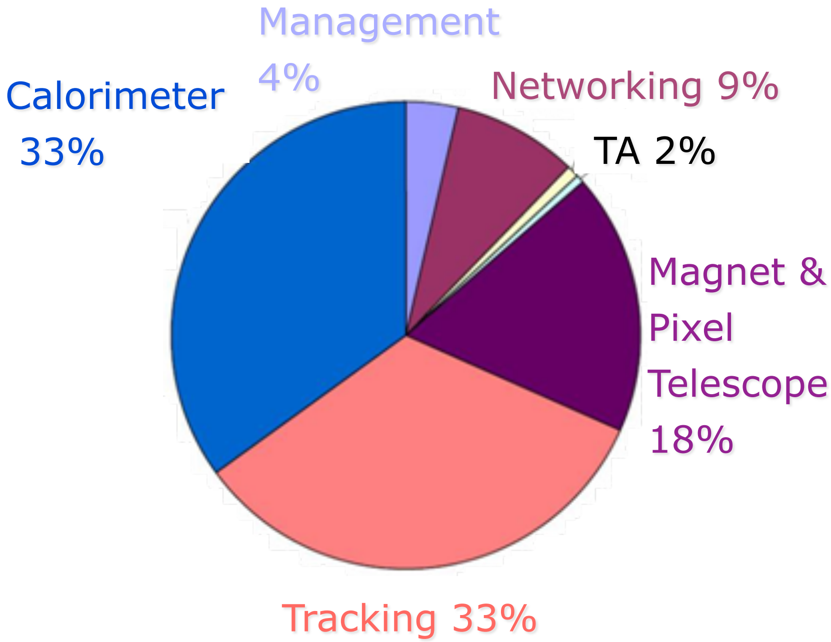
+ 27 associated institutes

EUDET map



EUDET partners
EUDET associates
Novosibirsk
Protvino
ITEP
MPHI
MSU
Obninsk
KEK (Japan)
Dalian (China)
August 2008

EUDET budget



- 21.5 million EUR total
- 7.0 million EU contribution

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

- most of the resources for the development of the infrastructures

- Duration of 4 years (originally)
- Extension by 1 year until end 2010 to exploit infrastructures to gain more time for the exploitation of the infrastructures

EUDET Structure

- **EUDET**
  - Network
    - Management
    - Detector R&D Network
  - Transnational Access
    - Access to DESY Test Beam
    - Access to Detector R&D Infrastructures
  - Joint Research Activities
    - Test Beam Infrastructures
    - Tracking Detectors
    - Calorimeter

JRA1: Test beam Infrastructure

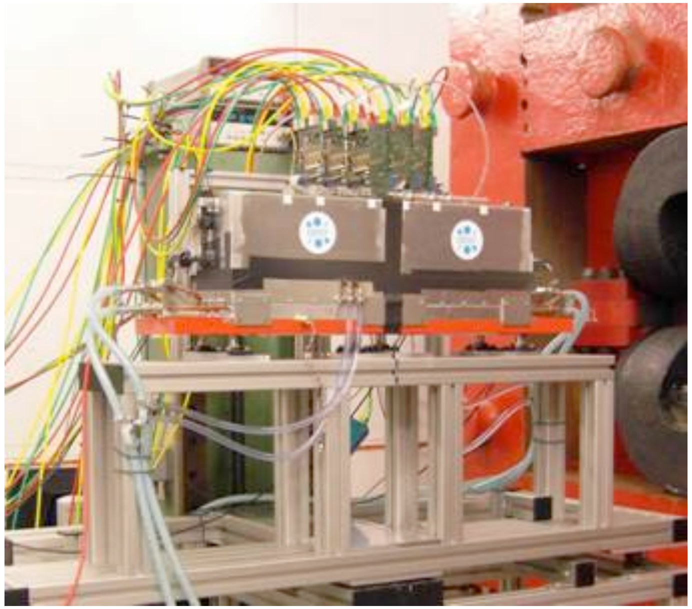
Large bore magnet:

- 1Tesla, Ø≈85 cm, stand-alone He cooling, supplied by KEK
- Infrastructure (control, fieldmapping, etc.) through EUDET
- Magnet fully instrumented at DESY and ready for use

Magnet arrival at DESY

Pixel beam telescope:

- 6 layers of Monolithic Active Pixel Sensor (MAPS) detectors
- DEPFET and ISIS pixel detectors for validation
- DAQ system
- Demonstrator telescope in use since summer 2007



EUDET telescope at DESY test beam

JRA2: Infrastructure for Tracking Detectors

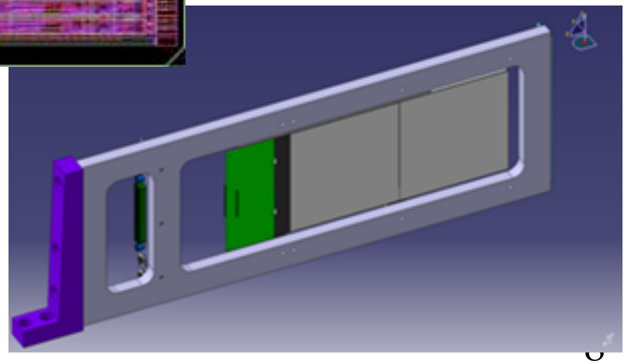
- Integrate the efforts of European groups working on tracking detectors for the ILC
- For ILC gaseous and silicon based tracking detectors are under study

TPC Development Facility:

- Low mass field cage (for JRA1 magnet)
- modular end plate system for large surface GEM & μMegas systems
- development of prototype electronics for GEM & μMegas

Si-TPC based monitoring System:

- Development MediPix → TimePix
- TPC diagnostic endplate module incl. DAQ

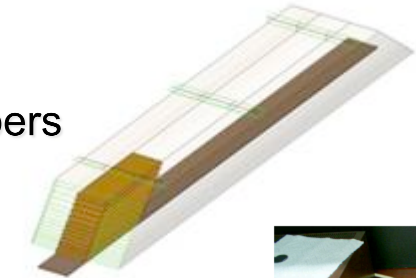


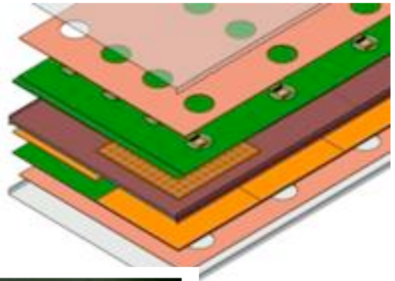
Silicon tracking:

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

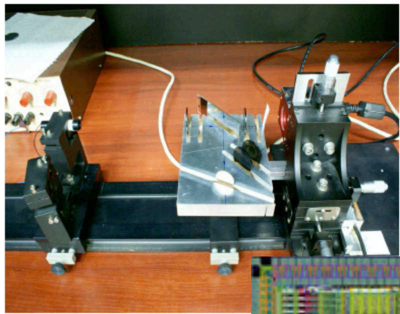
JRA3: Infrastructure for Calorimeters

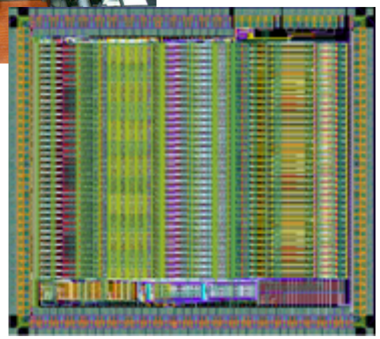
- For ILC high granularity calorimeter needed -> „particle flow“ calorimeter
- Provide complete infrastructure for testing novel schemes for a granular calorimeter modules, including a versatile calorimeter stack, a readout system and a data acquisition system.





- **ECAL:**
  - scalable prototype with tungsten absorbers
  - Si-sensors & read-out 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 DAQ system for the calorimeters**





EUDET networking activities

Information exchange

- www.eudet.org
- Annual workshops (open to everyone)

Computing and analysis

- Grid based computer cluster
- Common software for test beams and ILC simulations
- Embedded in ILC software & simulation effort, already used

Shower simulation

- Support from Geant4 team
- Feedback of calorimeter testbeam results

Deep sub-micron rad-hard electronics

- Access through CERN contracts

1st EUDET Annual workshop

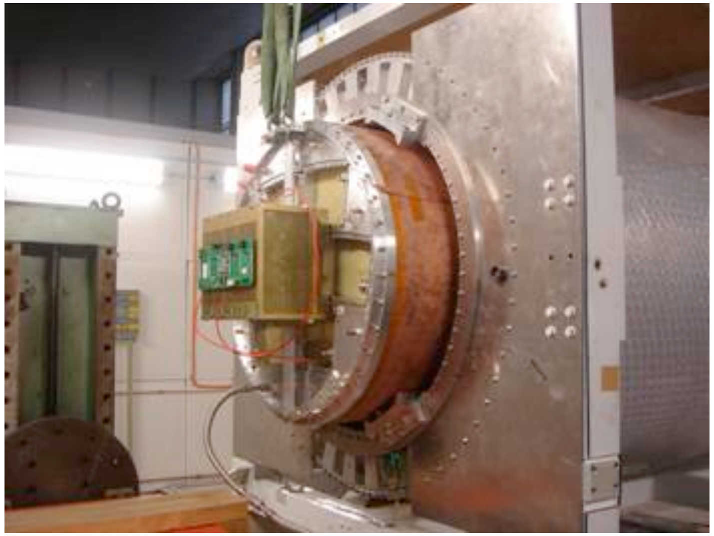
Munich

EUDET Transnational Access

- Testbeam was refurbished and is regulary booked by users
- Groups entitled for TA submit proposals for TA1 for the use of the DESY testbeam

- Pixel Telescope ready as TA2 infrastructure since summer 2007
- By now 10 groups used it within TA2

- TPC field cage ready since fall 2008 and first users arrived in December



Summary on EUDET

Summary on EUDET

At the time of the EUDET proposal (2005):

•Detector development of ILC **spread out** over many institutes; little coordination

•Main technical concern: **feasibility demonstration of proposed technologies** for ILC

Principal achievements of EUDET

•**Community building**

•Genuine **working-together on common parts of R&D infrastructures**

- •Facilities at the test beam
- •Common exchangeable peripheral elements of detector technologies under study

•**Broad use of transnational access**

•Allowed to successfully **demonstrate the ILC-compatible performance of the technologies** under test

From EUDET to AIDA

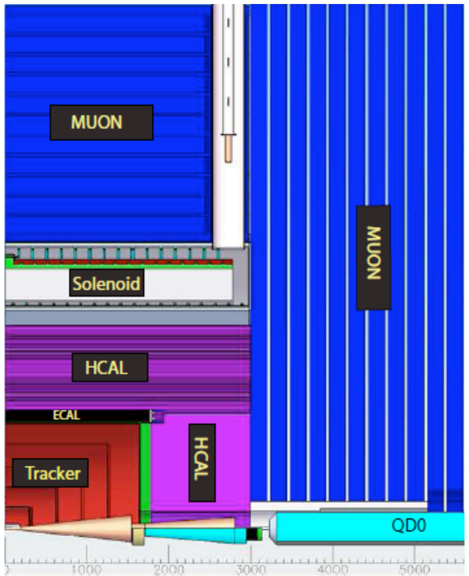
Next steps for linear collider detectors (1)

Where do we stand with ILC detectors in 2009?

Much progress with demonstration of feasibility of proposed detector technologies for ILC.

In 2009 two ILC detector concepts have been validated by an international review:
ILD and SiD

SiD



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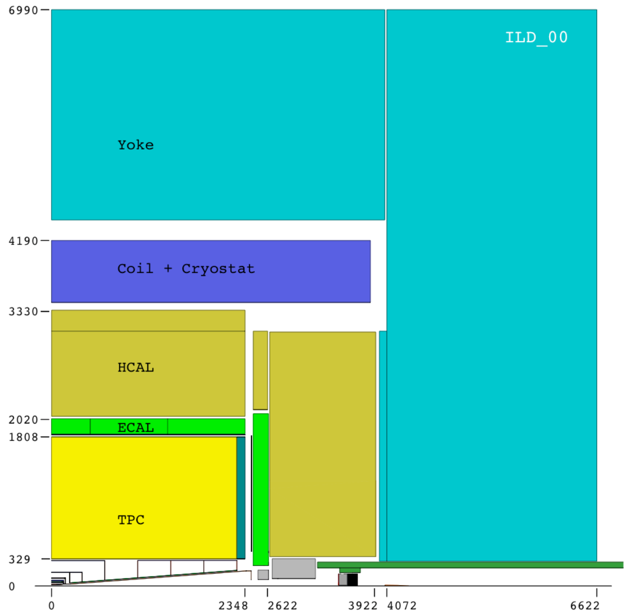
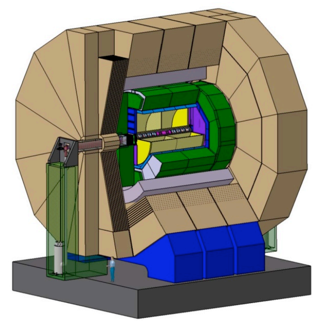


ILD



Next steps for linear collider detectors (2)

What is needed for the next phase:

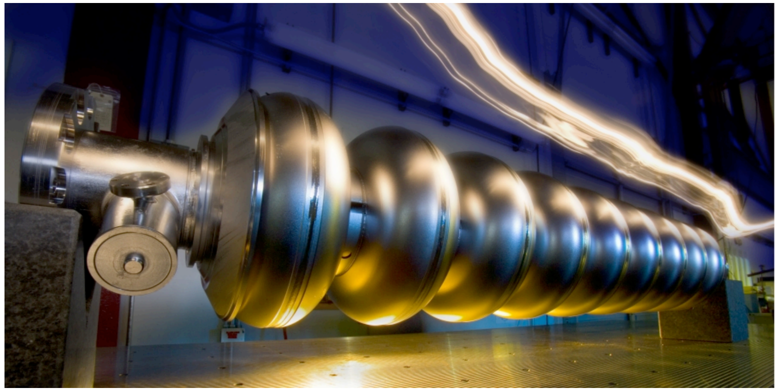
- **Demonstration of full integration of the proposed technologies in the detector concepts:**
  - Can achieved performance on the small scale also be maintained at the large scale?
  - Combined tests at optimised test beam infrastructures
  - Improved common Software and DAQ systems
  - Compact detector integration including:
    - Low material budget
    - Detector cooling
    - Power pulsing
    - Calibration systems and alignement
    - etc.
  - Industrialisation

- **Adaptation of the ILC detector technologies to CLIC**

- **Profit from synergies with developments in other particle physics communities**

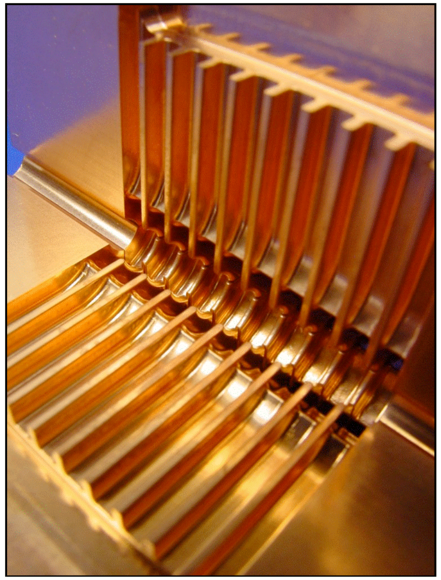
ILC and CLIC in a few words…

linear collider, producing e^+e^- collisions



ILC

CLIC



•Based on superconducting RF cavities

•Gradient 32 MV/m

•Energy: 500 GeV, upgradeable to 1 TeV (~200 GeV ZZ is also considered)

•Detector studies mostly done for 500 GeV

Luminosities: few 10^{34} $cm^{-2}s^{-1}$

•Based on 2-beam acceleration scheme

•Gradient 100 MV/m

•Energy: 3 TeV, though will probably start at lower energy (~0.5 TeV)

•Detector study focuses on 3 TeV

2010 FP7 call for support to existing research infrastructures

- Call identifier: FP7-INFRASTRUCTURES-2010-1
- Date of publication / submission: 30 July 2009 / 3 December 2009
- Activity: 1.1.1 Integrating Activities (IA)
- "Targeted" call for IA projects: only projects in 35 pre-selected topics. Only one project proposal per topic expected.
- Topics in Physics Astronomy and Particle Physics
  - INFRA-2010-1.1.32: Research Infrastructures for Nuclear Physics
  - **INFRA-2010-1.1.33: Detectors for future accelerators**
  - INFRA-2010-1.1.34: Research Infrastructures for dark matter search, neutrinos, gravitational waves
  - INFRA-2010-1.1.35: Research Infrastructures for high energy astrophysics

ECFA recommendation: **one single proposal for particle physics detectors, covering projects described in the "European strategy for particle physics"**

Covering: sLHC, Linear Colliders, neutrino physics, flavour physics

AIDA: Advanced Infrastructure for Detectors at Accelerators

Organisation of AIDA proposal preparation

Preparation Team

sLHC
L.Serin (IN2P3)
C. Shepherd (RAL)

Linear Collider
T.Behnke (DESY)

Neutrino Facilities
P.Soler (U.Glasgow)

B-Physics
F.Forti (INFN)

Admin and Integration
M.Capeans (CERN)
S. Stavrev (CERN), H.Taureg (CERN)

"Advisers" and WP authors
L.Linssen (CERN), S.Stapnes (Oslo), + WP leaders

Endorsed by ECFA committee (European Committee for Future Accelerators)

Working together with:

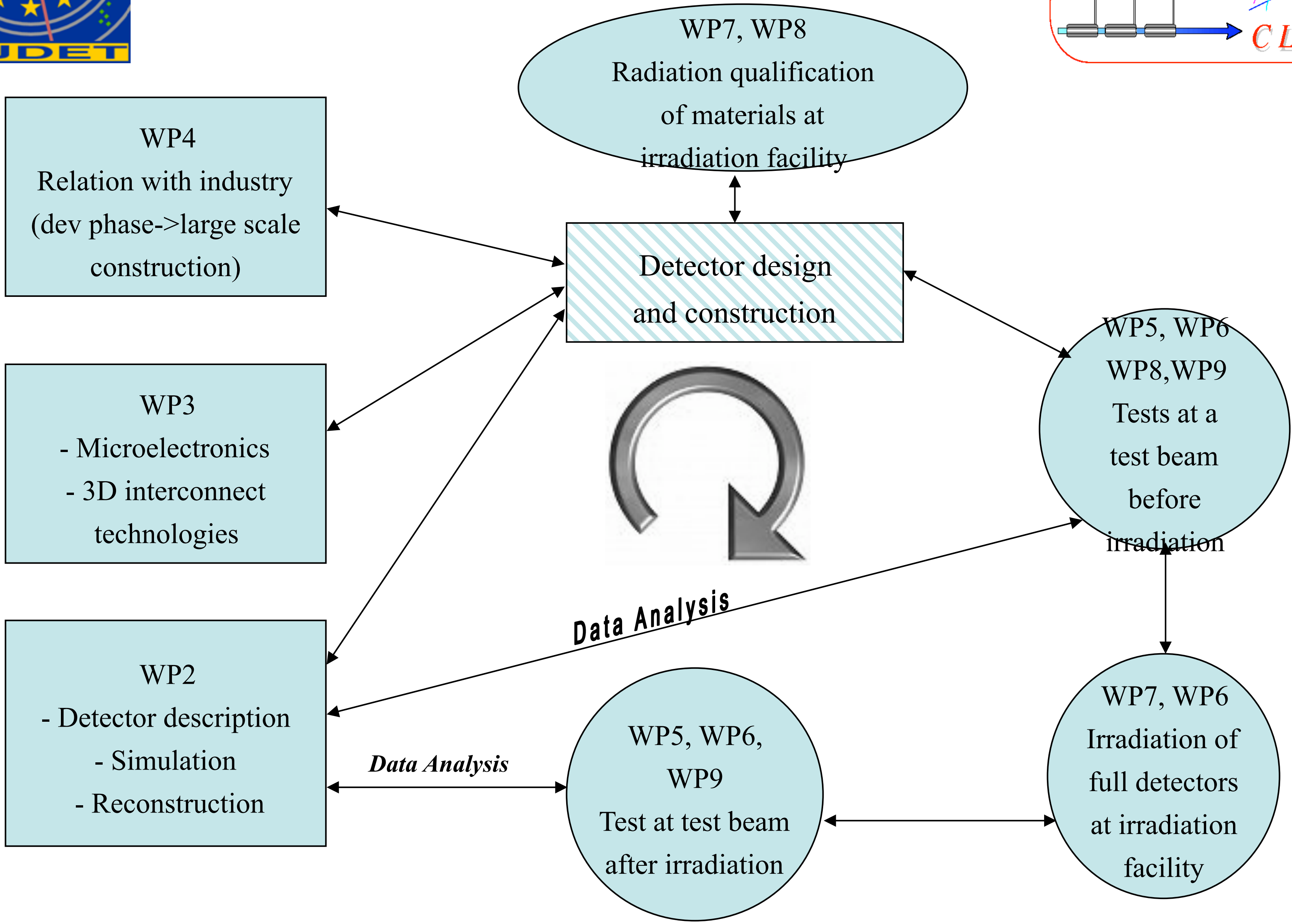
- National contacts
- Work Package coordinators

National contacts

Country	Names
Switzerland	Martin Pohl
Germany	Lutz Feld
Slovakia	Miroslav Pikna
Spain	Carlos Lacasta Ivan Vila
Portugal	Paula Bordalo
Netherlands	Els Koffeman
Israel	Giora Mikenberg
Czech Republic	Vaclav Vrba
Poland	Filip Zarnecki Marek Idzik
Austria	Manfred Krammer
Finland	Kenneth Osterberg Eija Tuominen
Hungary	Gyorgy Bencze
Sweden	Richard Brenner
Norway	Steinar Stapnes
Denmark	Peter Hansen
Italy	Chiara Meroni
UK	Ken Long
Belgium	Gilles de Lentdecker
Bulgaria	Jordan Stamenov
France-IN2P3 France-IRFU	Vincent Boudry P. Colas
Greece	Evangelos Gazis Theodoros Alexopoulos
Malta	Nicholas Sammut
Slovenia	Marko Mikuz

Proposed structure of AIDA

Global view of AIDA



AIDA work package breakdown

WP#	Type	Task	Description	WP Editors
1	MGT		**Project managemement and communication**	S. Stavrev
		1,1	Project managemement and administration	L. Serin
		1,2	Communication, documentation and outreach	
2	COORD		**Development of common software tools**	F. Gaede
		2,1	Geometry toolkit for HEP	P. Mato
		2,2	Reconstruction toolkit for HEP	
3	COORD		**Microelectronics and detectors/electronics integration**	H-G Moser
		3,1	3D Interconnection of microelectronics and semiconductor detectors	V. Re
		3,2	Shareable IP blocks for HEP	
4	COORD		**Relation with industry**	S. Stapnes
		4,1	Coordination	P. Sharp
		4,2	User/topical working groups (to be defined)	
5	SUPP		**Transnational access DESY**	I. Gregor
		5,1	Test beams	
6	SUPP		**Transnational access CERN**	H. Taureg
		6,1	Test beams and irradiation facilities	
7	SUPP		**Transnational access European irradiation facilites**	M. Mikuz
		7,1	Facility 1	
		7,2	Facility 2	
		7,3	Facility 3	
		7,4	Facility 4	
		7,5	Facility 5	
8	RTD		**Improvement and equipment of irradiation and beam lines**	E.Gschwendtner
		8,1	Test beams at CERN and Frascati	H. Taureg
		8,2	Upgrade of proton and neutron irradiation facilities at CERN	
		8,3	Qualification of components and common database	
		8.4	General beam and irradiation lines equipment	
		8.5	Coordination of combined beam test	
9	RTD		**Advanced Infrastructure for for detector R&D**	H. Videau
		9,1	Gas detector facilities	M. Vos
		9,2	Precision pixel infrastructure	
		9,3	Granular calorimeter studies infrastructure	
		9.4	Common DAQ infrastructure	

WP2: Development of common software tools (NA)

Goal: develop core software tools that are useful for the HEP community at large and in particular for the next big planned projects: sLHC and Linear Collider (ILC/CLIC)

1) develop generic HEP - geometry toolkit :
   - Description of complex shapes, materials etc
   - Interfaces to full simulation (Geant4, Fluka…) and reconstruction
   - Visualization tools (ROOT, VRVL…)
   - etc

2) develop – detector independent - reconstruction tools
   - Generic alignment tool, state of the art tracking and vertexing toolkit (GSF, Kalman, Hough transform…)
   - Working in pile-up environment,
   - Generic particle flow algorithm…

WP3: Microelectronics and 3D electronics/detector integration (NA)

Goal : The main objective of this work package is to establish a network of groups working collaboratively on advanced microelectronics and 3D integrated detector/electronics concepts.

1) 3D Interconnection of microelectronics and semiconductor detectors

- Demonstration of the feasibility of 3D interconnection for applications in Particle Physics (using "vias last" technology)

2) Shareable IP Blocks for HEP

- In130 nm CMOS technology and BiCMOS SiGe for low noise application.

WP4: Relations with industry (NA)

Goal :

for sLHC, ILC/CLIC, neutrino physics, B-physics:

- Technology needs, specifications, trends in several area (5-10 years?)
- Interactions with industry in development phase and during (large scale) constructions phase (industrialisation process)
- Transfer to industry, industry related spin-off, and collaboration with other fields where this is relevant.

Deliverable :

Create WEB overview and report covering in a matrix key technologies and specs (x-axis) versus the four projects mentioned (y-axis).
Industry can link to these nodes describing their capacities.

WP5/WP6 : Transnational Access to DESY test beam and CERN test beam and irradiation facilities (TA)

- Access to DESY test beams
  - Low-energy, easy access, well suited for debugging phase

- Access to CERN PS and SPS test beams
- Access to CERN PS irradiation facilities
  - Proton beam
  - Mixed field (mainly neutron) irradiation
- Access to GIF ++
  - Gamma irradiation with high-energy beam

Set up a selection panel covering both DESY and CERN

EU funds mostly used for travel/subsistence to people from associate partners

WP7: Access to irradiation facilities (TA)

Will cover access to 4-5 European irradiation facilities (proton, neutron, gamma irradiations)

Mainly required for sLHC detector studies

Facilites have to fulfill sLHC needs (fluence, particle, sample size)

Selection of facilities ongoing

Set up a selection panel common to all facilities.

Possibility to occasionally send uses to another facility?

EU funds mostly used for travel/subsistence to people from associate partners.

WP8: improvement and equipment of irradiation and beam lines (RTD)

Group all communities needs about primary improvement & equipment of beam and irradiation lines (RTD)

CERN test beam infrastructures (all)

- Enlarge particle choices, particle identification, ILC spill structure

Frascati test beam infrastructures (B-physics)

-beam line for electrons and photons, beam instrumentation

Upgrade of proton & neutron irradiation facilities at CERN (sLHC)

- Second beam line, scanning infrastructure, detector thermalisation

Qualification of components and common database (sLHC)

Diagnostics infrastructure for test beams and irradiation facilities (all)

-Tracking telescope, trigger, TASD target (neutrino), muon spectrometer

Coordination of combined test beam (linear collider)

WP9: Advanced infrastructures for detector R&D (RTD)

Similar to EUDET JRA's: common peripheral infrastructure elements supporting core R&D developments

1) Gaseous tracking facilities (sLHC, LC)

TPC field cage and magnet infrastructure, end plate integration, power pulsing infrastructure

Infrastructure development enabling development of large MPGD sizes

2) Precision pixel infrastructure (sLHC, LC)

Integration aspects: cooling, power pulsing, thin mechanical construction, alignment

Towards large-area coverage

3) Granular calorimeter infrastructures (LC)

ECAL integration and industrialisation studies

Dense HCAL studies: integration of various technologies (scintillator and gas-based)

Dense Forward calorimetry integration

Reference tracking in silicon technology

4) Common data Acquisition for test beams (LC)

Summary

EUDET project has been a great success in:

- Community building
- Strong collaborative effort in common elements of core R&D
- Broad use of transnational access
- Generating strong technology progress

Through the upcoming AIDA project, this experience is transported to:

- Wider community comprising sLHC, LC, neutrino physics and B-physics
- Involving a broader coverage of infrastructures and facilities
- Cross-fertilisation between communities
- Stronger involvement of industry

Priority-setting based on European Strategy for Particle Physics