



Accelerator and Detector FLC Activities at Spain

A. Faus-Golfe
(IFIC)

29-11-2013

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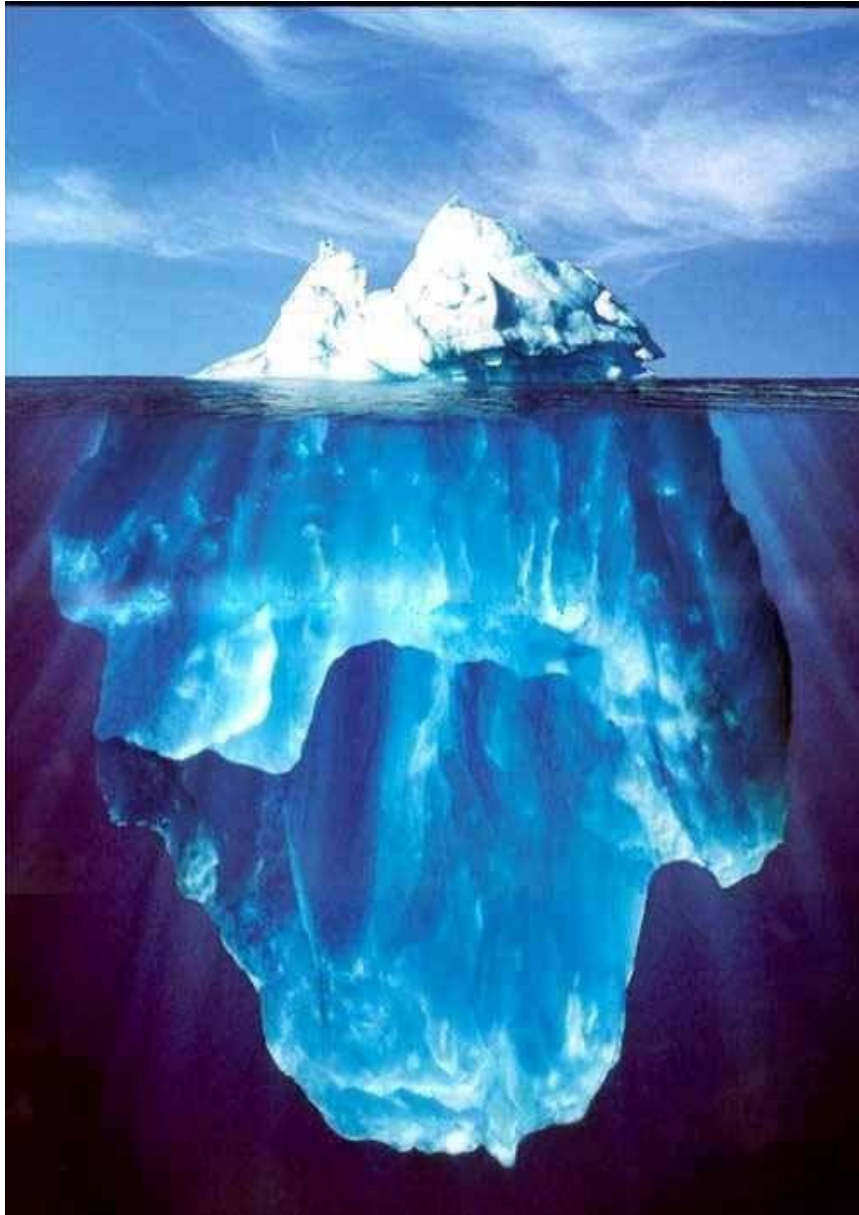
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Outline



- Organization and Structure
- Resources
- Accelerator R&D activities
- Physics and Detector R&D activities
- Theoretical activities

Outline



- Organization and Structure
- Resources
- Accelerator R&D activities
- Physics and Detector R&D activities
- Theoretical activities

- Detectors (ILC, CLIC, Belle II):
 - Tracking & Vertex, SiLC, Depfets
 - CALICE
 - Simulation, Benchmark, EndCap,
 - Elec., Mech., Cooling, Integration
- Accelerators (ILC, CLIC):
 - ATF2, CTF3
 - BPMs, BDS optics, Multi-OTR
 - PETs, Kickers, Qaudropole Movers
- Theory (ILC,CLIC, LHeC, SuperKEKB):
- Impacts, synergies and Spin-offs

Organization and Coordination at Spain

Three National Networks (one genuine, two participation):

- R&D for Future Colliders (Detectors + Accelerators + Theory, not only Large Collider)
- Flavour Physics (Detectors + Theory)
- LHC, Experiment & Theory

R&D for Detectors and Physics:

- ILC, End Cap, Colaboración DEPFET (Pixels), SiLC (Tracker), CALICE (Calorimeter)
- Belle II Colaboración DEPFET
- CLIC, Physics Benchmark, End Cap, Mechanical Structures

European Projects:

- AIDA (R&D for detectors, present)
- ENVISION-ENLIGHT (R&D for detectors, Medical Physics)

R&D for Accelerators:

- ILC: ATF2 (OTRs), XFEL (MLQ, movers)
- CLIC: DR Kickers , CTF3 (PETS, CR Kickers, BPMs)

European Projects:

- EUCARD2, HL-LHC, PACMAN (R&D for accelerator, present)
- PARTNER-ENLIGHT (medical Physics, present)
- TIARA (Accelerator Network)

Organization and Coordination at Spain

International Representation:

- FALC (Funding Agencies for Large Colliders)
- ECFA Linear Collider Study chair
- ILD Executive Board, Forward Tracker
- AIDA chair of the Collaboration Board
- Depfet Linear Collider chair of the Collaboration Board

National Coordination:

- Future Linear Collider Network Coordinator
- Flavour Network Coordinator
- Principal Investigators of projects from the National Plan



<http://ilces.ific.uv.es>

Workshop Organization and Participation:

- ECFA-ILC/GDE workshop in Valencia, November 2006
- LCWS11 workshop in Granada, 26-30 September 2011
- National Network for Future Linear Colliders workshops (twice per year)
- CPAN workshops participation as specific community

Resources: National Plan 2011-2013 (FPA)

2010 Request at National Plan (FPA), covering the period 2011-2013:

- 65 physicist/engineers in the funded projects. 30 are permanent.
- 48 FTE (73% dedication of 65). Mainly shared with LHC experimental projects and general R&D
- 4 PhD fellows were granted

A stable community over the last 5 years

Participation in the National Plan projects for the period 2006-2008

	Accelerator Particle Physics	Astroparticle Physics	Nuclear Physics	Comp./GRID	R&D + M.Phys. Detectors Accelerators
Doctors	88	67	84	17	41
PhD Students	64	33	23	4	6
Engineers, technicians, etc..	22	13	15	19	9
Collaborators	2	21	11	6	4
Total	176	134	133	45	60
Permanent Staff	50	32	48	11	28
Ramón y Cajal	9	9	4	1	3
Juan de la Cierva	5	5	6	0	1

Scientific Production & Visibility

Good presence in all LCWS

Accelerator R&D Coordination



IFIC, ILC, ATF-ATF2

- Beam Dynamics Studies and commissioning of EXT line (LAL, KEK)
- Instrumentation: New Multi-OTR system (SLAC, KEK)
- Micromovers for FONT4 (KEK, JAI)
- Collimation (LAL, KEK)

IFIC, CLIC-CTF3

- BPM's for the TBL (CERN)

IFIC-CIEMAT, CLIC

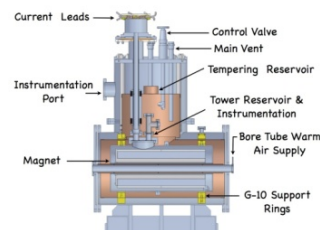
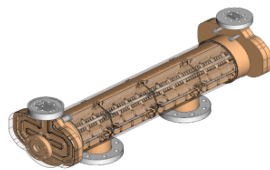
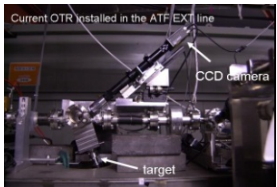
- DR Kickers (CERN)

CIEMAT, CLIC-CTF3

- Quadrupole Mover (CERN)
- PETS (CERN)
- Orbit Correctors (CERN)
- Kickers (CERN)
- Septa (CERN)

CIEMAT, ILC

- TESLA500 (SLAC)
- Cooling of Superconducting Magnets



Detectors R&D Coordination



Silicon for Large Colliders

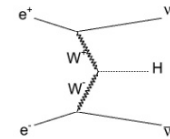
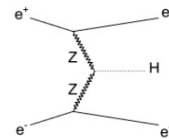
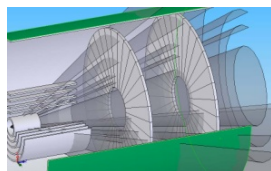
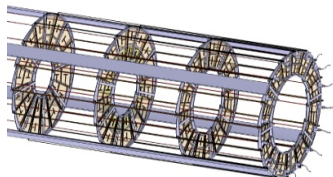
IFIC, NTC, UB, IMB-CNM, US, ITA, IFCA, INTA



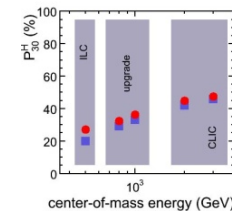
DEPFET Collaboration
IFIC, NTC, UB, IMB-CNM, IFCA

Coordinated effort :

- Regular meetings (network)
- Funding/project
- R&D interests
- Design of the Forward Region for LC detectors



CIEMAT



Physics and Theory Coordination



Theory groups in Spain involved in LC & Future Strategy Planning:

	Barca	Granada	Madrid	Santander	Valencia	Zaragoza
Phenomenology (also LC rel.)	+	+	+	+	+	+
LC specific calculations	+			+		
red ILC		+		+		
ESPP (Europe)		+	+	+		
Snowmass (USA)			(+)	+		

ESPP: European Strategy for Particle Physics
input from: CPAN, "red future colliders"

Snowmass: American strategy for the future of Particle Physics

Workshops relevant for LC (2012 - 2014):

LHC2TSP:

From the LHC to Tera Scale Physics

workshop series about the implications of early LHC data for future colliders, input for the European strategy group
co-organized by Santander theory group (2011 - 2012)
⇒ input for ESPP

Benasque workshop 04/14:

After the Discovery: Hunting for a Non-Standard Higgs Sector
co-organized by Barcelona theory group

HDays:

Higgs Days at Santander

workshop on Higgs physics at the LHC and the LC
organized by Santander theory group (annual from 2008 on)



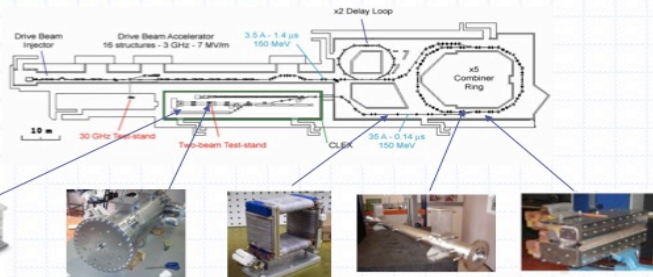
Marie Curie Initial Training Network **PITN-GA-2010-264564** (2011-2014)

EU Coordinator: G. Rodrigo
(10 countries, 30 institutions, 3 industry partners, 150 researchers)

Accelerator R&D, CIEMAT

CONTRIBUTION TO CTF3 (CLIC)

DESCRIPTION: CTF3 is an experimental facility to prove the two-beam acceleration scheme proposed for CLIC.



QUADRUPOLE MOVER



PETS



ORBIT CORRECTORS



KICKERS



SEPTA

FUNDING:

FPA2004-20954-E (2004-2006)

FPA2007-29109-E (2007-2008)

Grant Agreement 227579 (2009-2013)

FPA2010-21456-C02-02 (2011-2013) (shared with ILC activities)

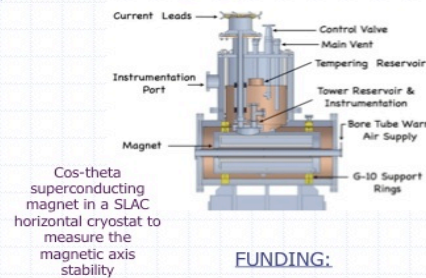
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MAGNET PACKAGE FOR ILC MAIN LINAC

DESCRIPTION:

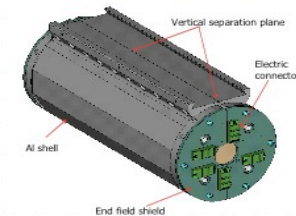
- CIEMAT developed a cos-theta type superconducting magnet package for TESLA500, which has been successfully tested at SLAC to measure the magnetic axis stability. It might be used for ILC main linac.
- CIEMAT will explore an alternative design based on indirect cooling superconducting magnets to ease the cryomodule assembly.



FUNDING:

FPA2002-00841 (2002-2005)

FPA2010-21456-C02-02 (2011-2013) (shared with CLIC activities)



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PETS TBL

First prototype assembly



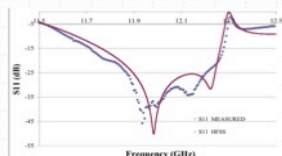
Test Beam Line (TBL)

The Test Beam Line aims to study the beam stability during deceleration.

The PETS (Power & Extraction Transfer Structure) extracts the RF power from the drive beam and transfers it to the main beam.

CIEMAT contribution consists of:

- Engineering design
- Complete fabrication and RF characterization of first prototype
- Partial fabrication and assembly of 3 units of the first series of 8.



RF characterization



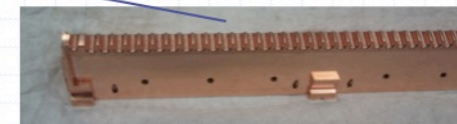
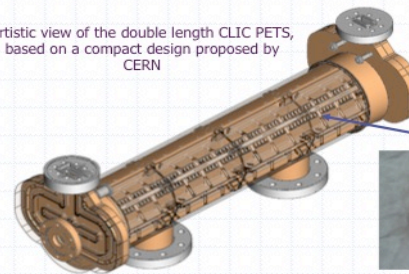
Cooling pipes and waveguides



CLIC PETS

CLIC PETS will be shorter (~250 mm) than TBL ones (~800 mm), since the drive beam current is highest than TBL one. CIEMAT is currently working on a new compact PETS design, which will be tested in a custom module in CTF3. In this module, PETS length is still twice (~500 mm) the final one for CLIC.

Artistic view of the double length CLIC PETS, based on a compact design proposed by CERN



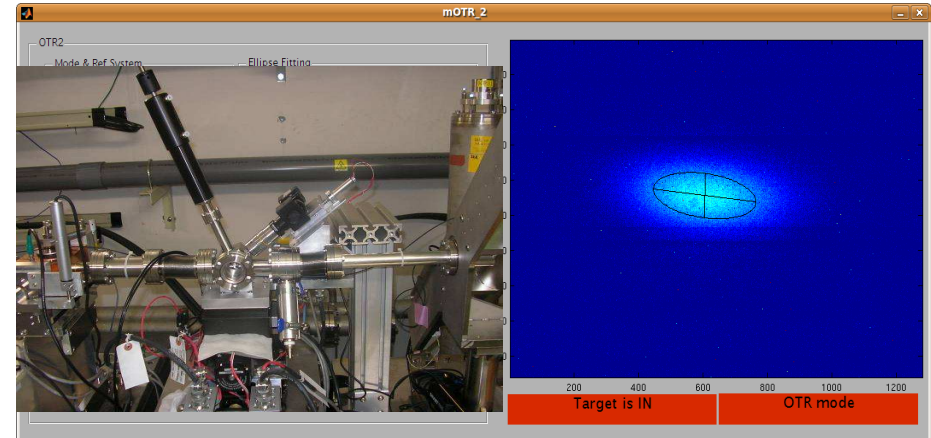
Detailed view of a real copper rod



Accelerator R&D, IFIC

RESEARCH ACTIVITIES

- Collimation systems studies for Future Linear Colliders (CLIC), halo collimation in ATF2
- Optics Design and Beam Instrumentation studies for the Beam Delivery System of Future Linear Colliders (ILC and CLIC).
- Beam Dynamics studies for the EXT line of ATF-ATF2.
- Design and Construction of Beam Instrumentation:
 - Inductive Beam Position Monitors for CTF3;
 - Stripline Beam Position Monitors for the CLIC Drive Beam.
 - Optical Transition Radiation Monitors for ATF-ATF2;
 - Stripline Kickers for CLIC Damping and Pre-Damping Rings;
 - Cyclinacs for hadrontherapy applications, high gradient studies



<http://gap.ific.uv.es/>



COLLABORATORS

PEOPLE

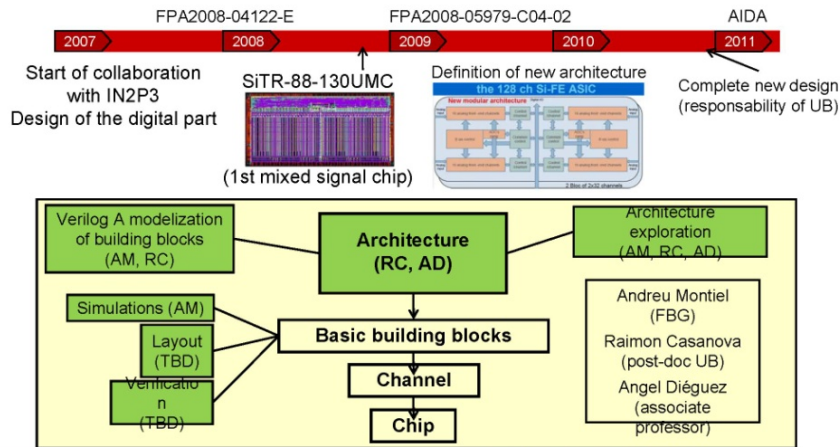
- **Dr. Angeles Faus-Golfe** (CSIC researcher)
- **Juan José García Garrigós** (Electronical engineering at CERN)
- **César Blanch Gutiérrez** (Mechanical engineering at CERN)
- **Dr. Javier Resta López** (Postdoc Juan de la Cierva)
- **Dr. Luisella Lari** (Postdoc EUCARD and HL_LHC)
- **Carolina Belver Aguilar** (PhD FPI)
- **Alfonso Benot Morell** (PhD Especialización Infraestructuras Científicas y Organismos Internacionales)
- **Núria Fuster Martínez** (PhD Student UV)



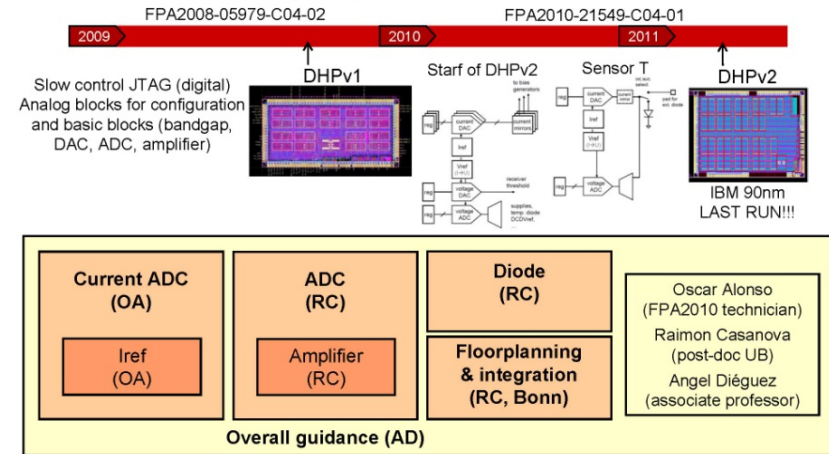
Detector R&D, University of Barcelona



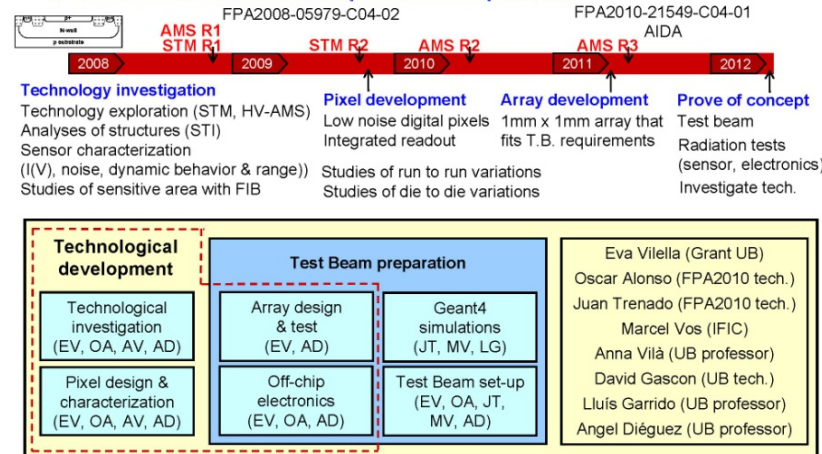
SiLC timeline and current personnel responsible



DEPFETs timeline and current personnel responsible



APDs timeline and current personnel responsible



Detector R&D, IFCA-Santander

Activities for ILD

R&D on microstrip sensors:

AC microstrips with integrated pitch adaptor (DBD baseline design).

R&D in short microstrips (striplets) sensors.

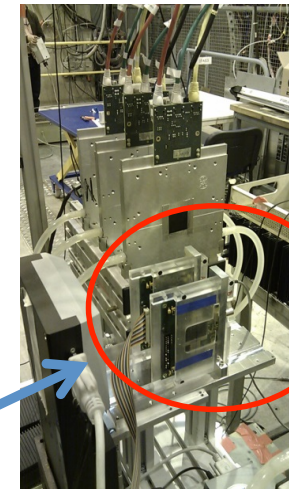
R&D on microstrips with resistive electrodes.

R&D on mechanics:

Real time structural and environmental monitoring:

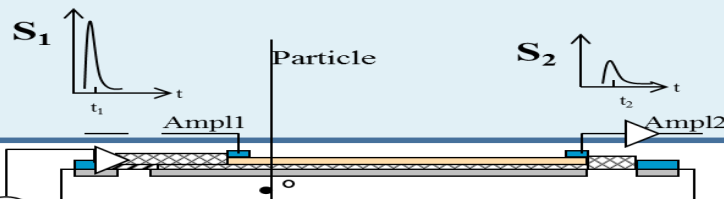
Displacement sensors based on FOS FBG sensors.

Laser-based position monitoring

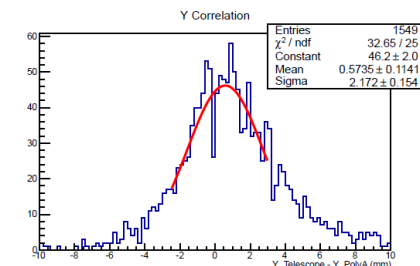
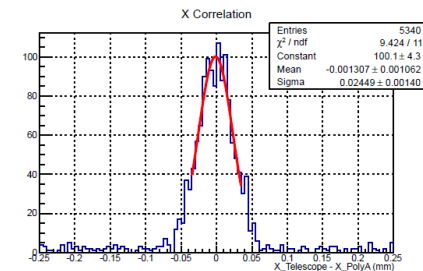


Charge division used in wire chambers to determine the coordinate along the sensing wire.

Same concept with conventional microstrips with slightly resistive electrodes (doped polysilicon)

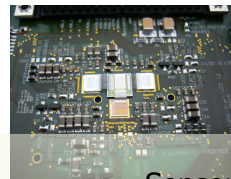
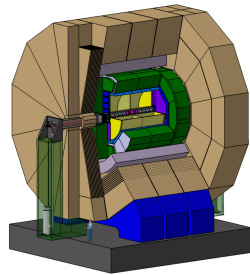


σ transversal $\sim 24 \mu\text{m}$ (80 μm pitch)
 σ longitudinal $\sim 2 \text{ mm}$ (20 mm length strips)
In agreement with SNR and sensor layout.

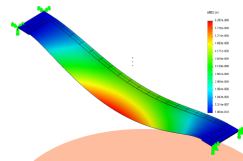
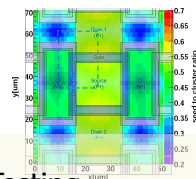


Detector R&D, IFIC-Valencia

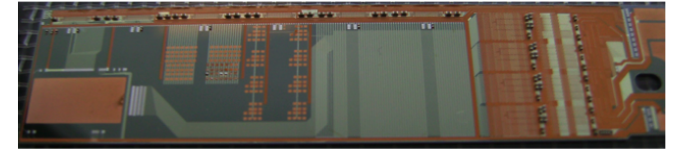
- ✓ We have been members of the DEPFET collaboration since 2003
- ✓ Initial focus was the development of a valid vertex technology for the ILC detectors
- ✓ Soon the collaboration focused on the Belle II vertex detector and so we did
 - ILC activities were kept at an adequate level



Sensor Testing



Mechanics



Encapsulation

MC simulations

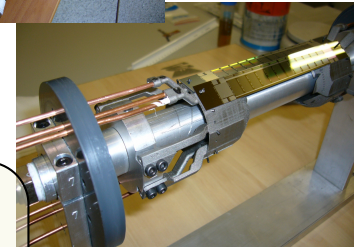
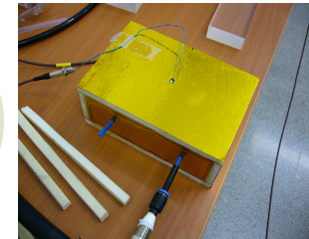
ILD DEPFET ILC

Electronics testing

Beam test (coordination)

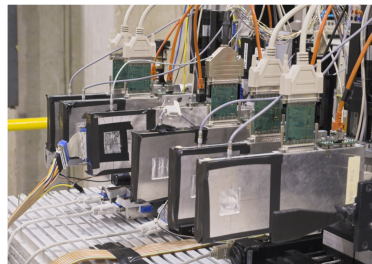
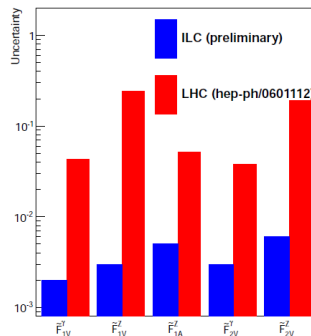
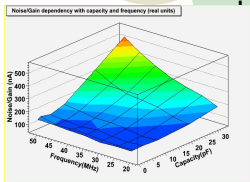
DEPFET PXD @ Belle II

PXD +SVD enclosure

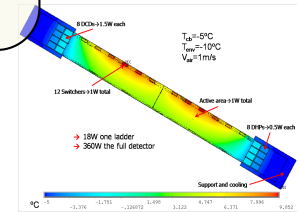
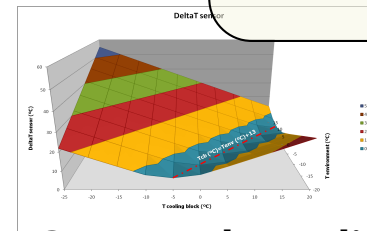


Cooling

FEA simulations
Thermal Mock-up
Validation of models



Physics studies:
Full-simulation study of the LC potential to measure the couplings of the top quark to electro-weak gauge boson



CLIC vertex: heat dissipation and thin support studies

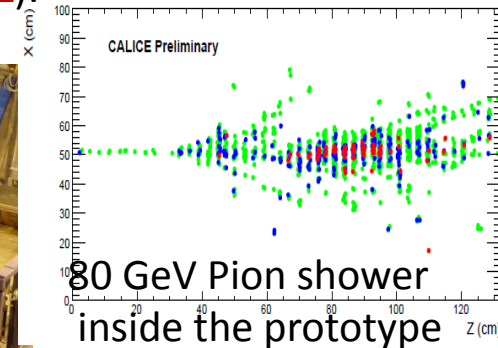
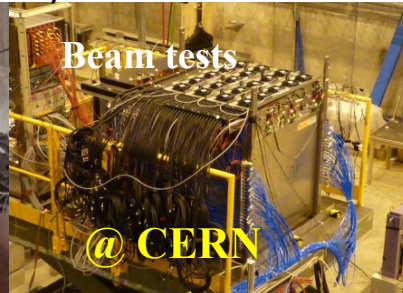
Detector R&D, CIEMAT

Member of **CALICE** (CALorimeter for Linear Collider Experiments) Collaboration since 2007



Involved in the development of a **SemiDigital Hadron Calorimeter (SDHCAL)**:

GRPC (with SemiDigital Readout) + Stainless Steel



Main work activities

Responsible of the SDHCAL mechanics:

- Mechanical design of SDHCAL
- Numerical simulations
- Precise machining & fabrication of components and quality checks
- Design and construction of tooling (for Assembly & Handling)
- Assembly

Electronics

Design and construction of SDHCAL Detector InterFace (DIF) card (to communicate the front end ASICs with the DAQ)

Test beam & Data Analysis

Projects

- FPA 2007-29117-E 1 year
- FPA 2008-02142 2 years
- FPA 2010-19836 3 years
- AIDA 4 years

- MaryCruz Fouz **Researcher (IP)**
- Jesús Puerta **PostDoc**
- Enrique Calvo **Mechanical Engineer**
- Jesús Marín **Physicist - Electronics**
- Antonio Verdugo **Electronic Engineer**
- CIEMAT Technicians

People

Summary

- In Spain, an important effort in the R&D activities for future colliders is being made for detectors, accelerators and physics studies
- This coordination is managed through a national network and coordinated projects in detectors and accelerators. It allows to have common discussions, optimize resources and find synergies
- Good participation in EU projects, AIDA, EUCARD2, PACMAN, TIARA ...

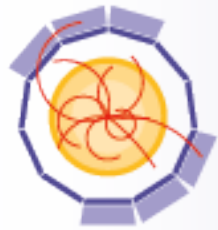
Need of recognition and understanding from the “system” for:

- **Coordination effort, responsibilities without “formal” nominations but ..**
- **R&D Detector activities, publications: not many, technical, conferences..**
- **R&D Accelerator activities, situation worse than for detectors..**

Thanks for providing material:

**A. Dieguez, J. Fuster, M.C. Fouz,
S. Heinemeyer, C. Lacasta, G. Rodrigo, A. Ruiz,
L. Garcia-Tabares, F. Toral, I. Vila, M. Vos**

Resources: AIDA 2011-2014



AIDA

Advanced European Infrastructures
for Detectors at Accelerators

<http://aida.web.cern.ch/>

- A European network to create infrastructure that will boost detector R&D for applications in future collider experiments (and accelerator-based neutrino experiments)
- Follow-up and extension of the EUDET network. Involving the whole community: ILC/CLIC, LHC upgrade, Super B-factories, accelerator-based neutrino experiment
- Start date: February 2011. Duration: 4 years
- Participants: over 80 institutes from 23 countries
- Total budget: > 25 Million € (8 Million € EU funded)
- Spanish involvement:
 - 3 Work Packages, with bulk of the effort on Si position sensitive devices
 - One WP leader (M. Vos, IFIC) and the chair of the board (I. Vila, IFCA)
 - 391K €, ~ 5 % EU contribution
 - 7 institutes (CIEMAT 26K €, IMB-CNM 50K €, IFAE 26K €, IFCA 88K €, IFIC 127K €, UB 44K €, USC 30K €)

