CIEMAT

Dept. of Technology

Structure

CIEMAT

A Governmental Lab. (Research Public Institution of the Ministry of Science and Tech)
1300 engineers, researchers and staff
100 M€ budget

Scientific Depts.

- Energy Department
- Environment Department
- Basic Research Department
- National Fusion Laboratory
- Technology Department

Management Depts.

- Secretary-General
- Institutional Relations and Knowledge Transfer
- Safety and the Facility Improvement Department

Centers

PSA

One of the most important European Centers on CSP (Concentrated Solar Power).

CEDER

Centre for Development of Renewable Energies (CEDER), mainly based on the use of biomass energy.

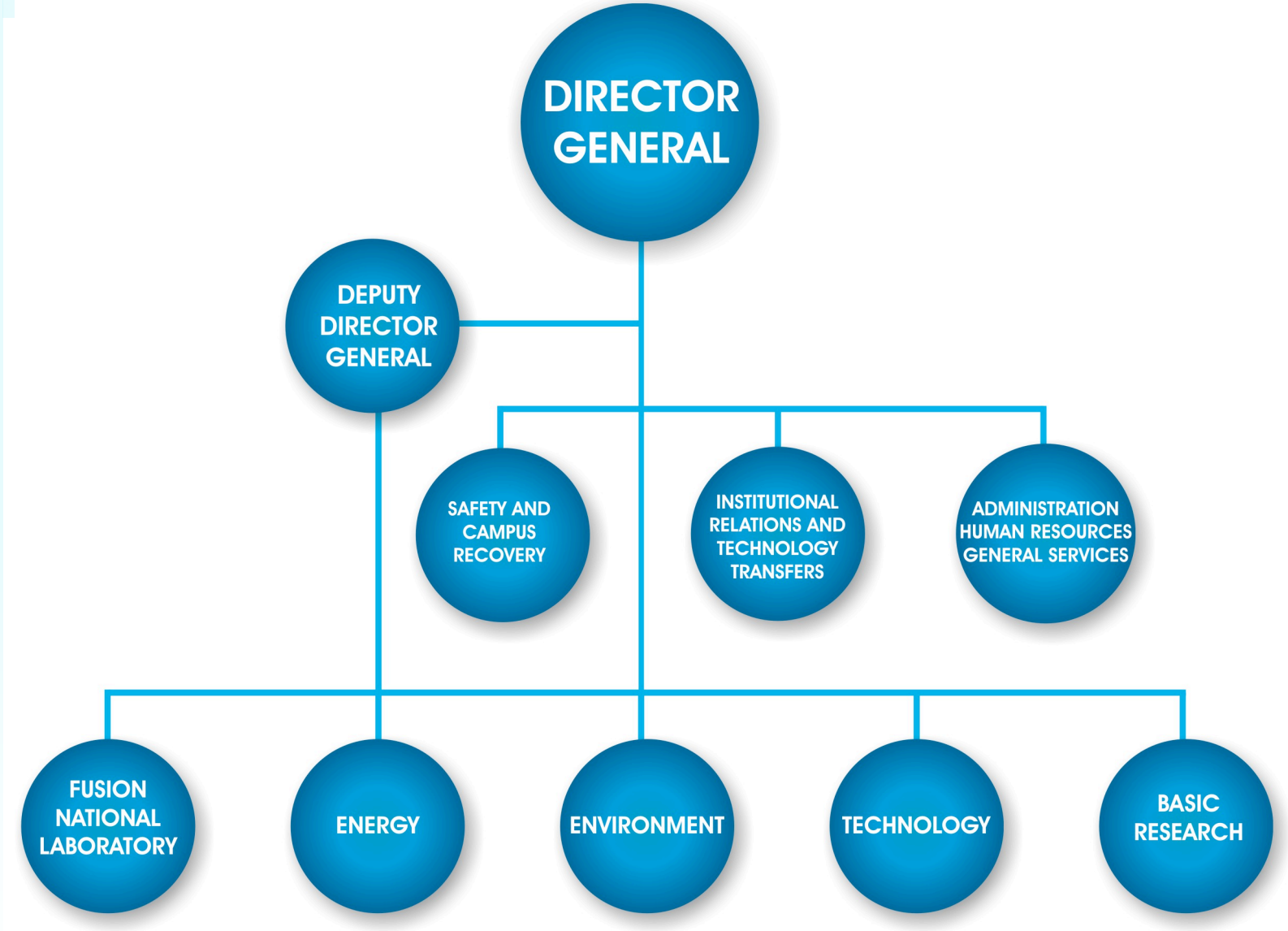
CISOT

Social dimensions of risk and safety in the energy, environmental and technological domains.

CETA

Computing (grid) technologies.

Organization



CIEMAT sites

Activities

Energy. Energy sources and production.

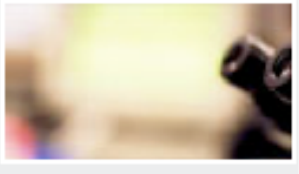
Environment. Impact of the energy over the human being and the Environment.

Technology.

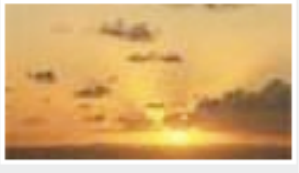
Basic Research. Experimental physics research in HEP and molecular biology

Fusion by Magnetic Confin Scientific use of the TJ-II Stellerator device.

Knowledge Transfer. Information resources management, technology transfer and education.



Safety and Decommissioning. Integrated Plan for Improvement of CIEMAT Facilities.



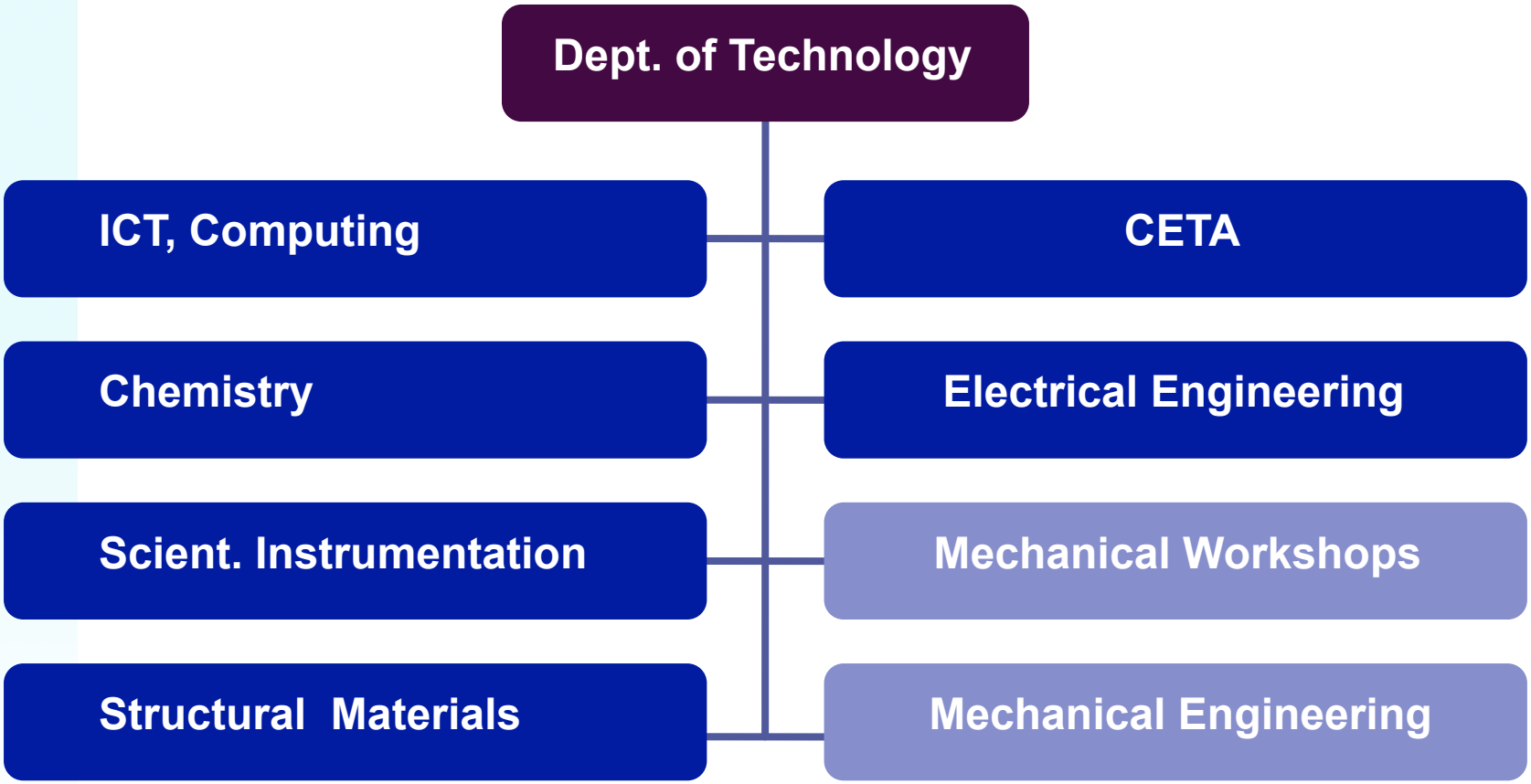
Radiation Protection. Surveillance and control of the ionizing radiations in CIEMAT.

Accredited and Reference Labs. National Metrics and dosimetric magnitudes.

Dept. of Technology

AIM

- Horizontal activities to strengthen CIEMAT activity in research projects providing technical resources
- Carry out own research projects on technological related subjects



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Cumplir los procedimientos administrativos > CMI, ..

G. económica y administrativa de recursos TIC

Tienda Informática

Control de equipos *informáticos y distribución*

Control de **acceso a los recursos TIC Secretaría**

Calidad de servicio

Canales de comunicación

G. de e incidencias

*Normas de seguridad – **ENS y LOPD***

Tecnologías de la Información y las Comunicaciones (TIC)

F.Blanco

Apoyo técnico

CAU - Centro de Atención a Usuarios y Seguridad

Sist. Informáticos de Gestión

M.A. López-Cerón

Desarrollo SICO70

- *Sistemas Administrativos*
- *Sistemas Econo-financieros*
- *Sistemas de RRHH*

DBA – Arquitectura SI

Prod. y explotación de SI

Arquitectura Informática

J.A. Fábregas

Sistemas

- *Plataformas cálculo científico*
- *Servidores generales*

Redes y comunicaciones

Arquitectura **CENIT**

Operación e **instalaciones**

Soporte al puesto (HelpDesk) en Hw y Sw

Supercomputación y Desarrollo Grid

A. Roldán

Supercomputación

Computación Clusters y GRID

Modelización

Participación en proy. científicos

Códigos para I+D y Gestión del Conocimiento

C. González Giralda

Prototipos informáticos para proyectos I+D

Portales y aplicaciones Web

Aplicaciones departamentales

Sistemas de gestión documental

Sistemas para la Admon electrónica

DISTRIBUTED RESOURCES

CETA-CIEMAT (Trujillo)

Model	Num of nodes	GB / node	Cores / node	GB / Core	Clock Freq	Total Cores	TFlops Pico	Node Interconn.
DELL PE 1855	100	4 GB	4	1 GB	3,2 GHz	400	1,24	Gigabit ethernet
DELL PE 1955	20	4 GB	4	1 GB	2,0 GHz	80	0,64	Gigabit ethernet
DELL PE 1850	5	4 GB	4	1 GB	3,2 GHz	20	0,06	Gigabit ethernet
DELL PE 1850	7	4 GB	2	2 GB	3,2 GHz	14	0,04	Gigabit ethernet
DELL PE 1950	5	4 GB	4	1 GB	2,0 GHz	20	0,16	Gigabit ethernet
BULL Novascale B260	42	8 GB	4	2 GB	1,86 GHz	168	0,62	Gigabit ethernet
BULL Novascale B260+	98	16 GB	8	2 GB	2,66 GHz	784	8,43	Gigabit ethernet
BULL R422-E1	10	16 GB	8	2 GB	2,5 GHz	80	0,80	Gigabit ethernet
					TOTAL	**1486**	**13,53**	

CIEMAT-TIC (Moncloa)

Model	Num of nodes	GB / node	Cores / node	GB / Core	Clock Freq	Total Cores	TFlops Pico	Node Interconn.
DELL PE 1955	30	8 GB	4	2 GB	3,2 GHz	120	1,44	Gigabit ethernet
HP BL25p	56	4 GB	4	1 GB	2,0 GHz	224	0,90	Gigabit ethernet
					TOTAL	**344**	**2,34**	

SUPERCOMPUTING

CETA-CIEMAT (Trujillo). GPU

Model	Num nodes	Cores CPU /	Mem / Node	GHz CPU	Cores GPU / node	Mem GPU / node	GHz GPU	Total GPU Cores	TFlops Pico (32	TFlops Pico (64	Interconn. of nodes
Nvidia TESLA S1070 – BULL R422E2	22	8	24 GB	2,26	480	8 GB	1,44	10560	45,55	3,79	Infiniband
Nvidia TESLA C1060 – BULL R425E2	1	8	96 GB	2,93	480	8 GB	1,3	480	1,87	0,16	Infiniband
Nvidia TESTLA S2050 – BULL R422 E2 *	16	8	24GB	2,26	896	6 GB	1,55	14336	33,04	16	Infiniband
							TOTAL	**25376**	**80,46**	**19,96**	

CETA-CIEMAT (Trujillo). Shared Memory

Model	Num nodes	Cores CPU / Node	Mem / Node	GHz CPU	Cores GPU / node	Mem GPU / node	GHz GPU	Total GPU Cores
BULL S6030 *	2	512 GB	32	16 GB	2 GHz	**64**	**1 TB**	SMP

CIEMAT-TIC (Moncloa). Clúster

Model	Num nodes	Cores CPU / Node	Mem / Node	GHz CPU	Cores GPU / node	Mem GPU / node	GHz GPU	Total GPU Cores
DELL M610	240	16 GB	8	2 GB	3 GHz	**1920**	**23,00**	Infiniband

STORAGE

CETA-CIEMAT (Trujillo).

Model	Num of servers	TB Storage / Server	TB Total
IBM Disk Server (Lustre)	11	11 TB	121 TB
IBM Tapes Server (Lustre)	1	160 TB	160 TB
Bull Disk Server (Lustre)	3	1,8 TB	5,4 TB
Super Micro Disk Server (Lustre)	10	24	240 TB
Netapp Disk Server (Lustre)	12	13	168 TB
		TOTAL	**694,4 TB**

CIEMAT-TIC (Moncloa)

Model	TB Total
SAN NFS	38 TB
Almacenamiento Nodo de Supercomputación (Lustre)	120 TB
TOTAL	**158 TB**

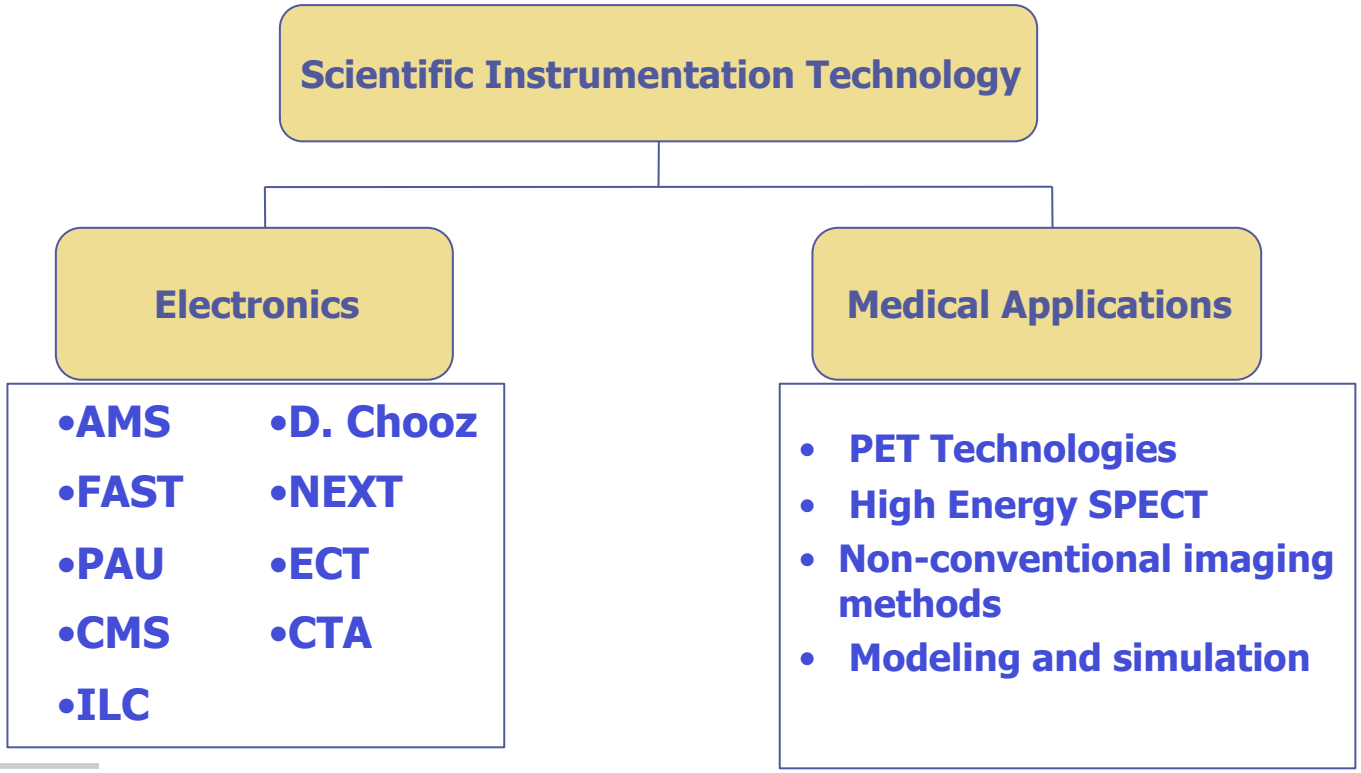
PERSONNEL

Location	Unit	Function	Num of pers.
CETA (Trujillo)	Unidad de Sistemas y Explotación	Mantenimiento y operación infraestructura hardware	5
CETA (Trujillo)	Unidad de Arquitectura de Aplicaciones	Proceso de desarrollo y control de calidad de software	4
CETA (Trujillo)	Unidad de Ciencia y Tecnología	Prospección tecnológica, paralelización y gridificación aplicaciones	4
CETA (Trujillo)	Unidad de Administración y Servicios	Administración y mantenimiento instalación civil	5
CIEMAT (Moncloa)	TIC	Desarrollo y Soporte de Aplicaciones Científicas	5
CIEMAT (Moncloa)	TIC	Sistemas de Computación Científica	4

Division of Scientific Instrumentation

Main activities:

- **Electronics developments within R&D projects in collaboration with other groups at CIEMAT**
- **Radiation detectors and instrumentation for Medical Applications**

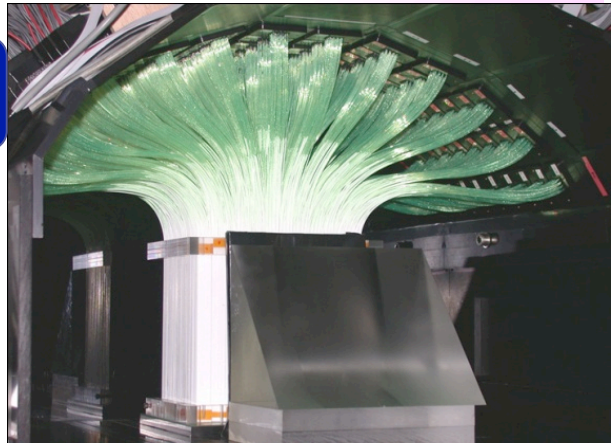


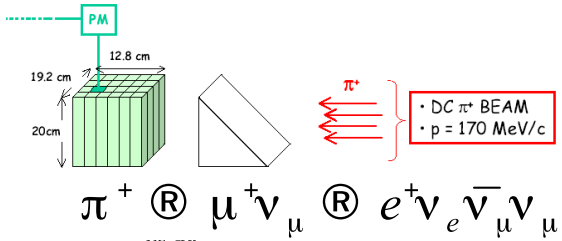
FAST experiment

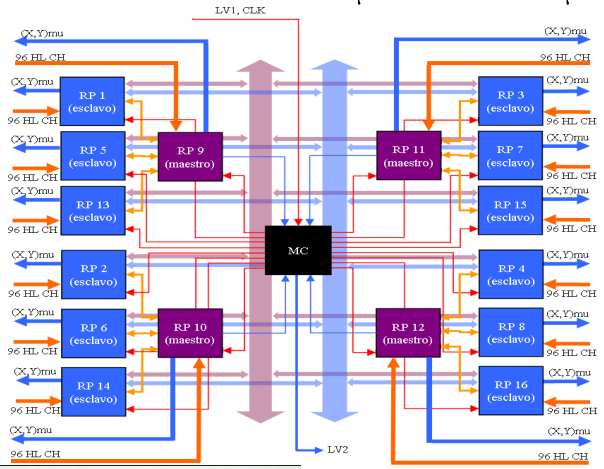
- Determination of Fermi coupling constant (G_F) with 1ppm precision
- Experimental measurement of muon lifetime with 4 ps precision with FAST detector, installed at PSI
- The experiment is at final stage, successful data taking periods have been carried out:
  - 2006: > 10^{10} events
  - 2008 y 2009: ~ 4.5 10^{11} events
- Final data analysis in progress. The accumulated statistics lead to a determination of G_F near the goal uncertainty

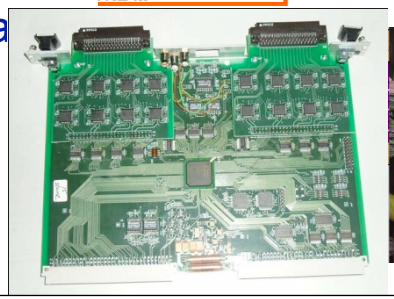
- **Contribution to electronics: development of the second level trigger system of the experiment.**

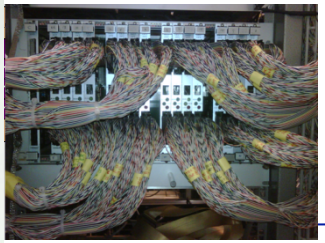
  - Fully digital trigger, low cost FPGA-based
  - Processing of the output signals of 1536 pixels in order to perform data reduction by event selection a Region-of-interest identification









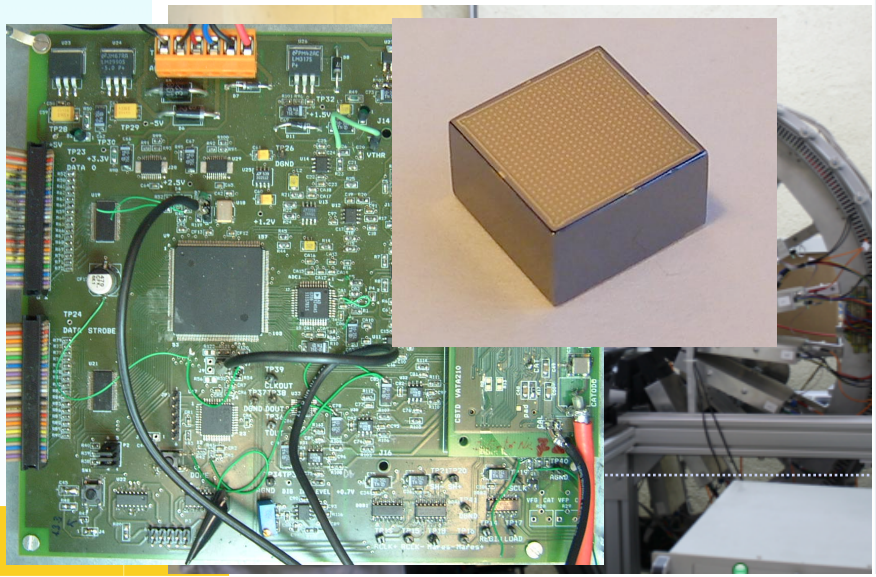


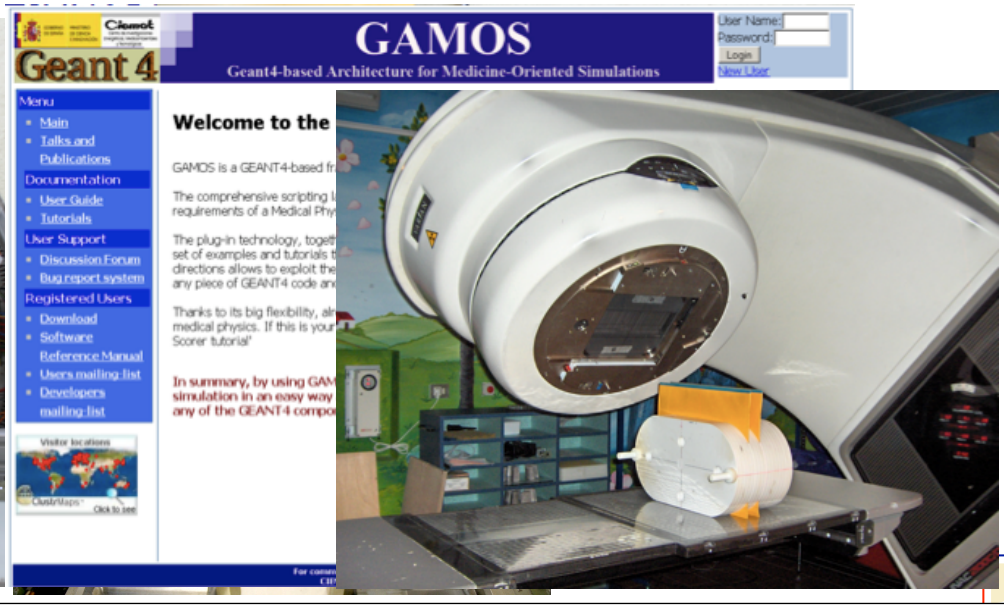
Medical Application Unit

The Medical Applications Unit (AM) of CIEMAT was created in 2009. It heritages the experience of the former Radiation Detector Unit. It is composed by 12 researchers and staff.

Activity lines

1. R&D on **new image systems** (BrainPET, Compton, PixelPET, new isotopes)
2. **Non conventional** radiation detectors: CZT, monolithic scintillator blocks, liquid gases. Member of the CCC collaboration.
3. **Simulation** of radiation-matter interaction in complex systems. Member of the Geant4 collaboration.
4. Computation and experimental studies related to *radiotherapy*





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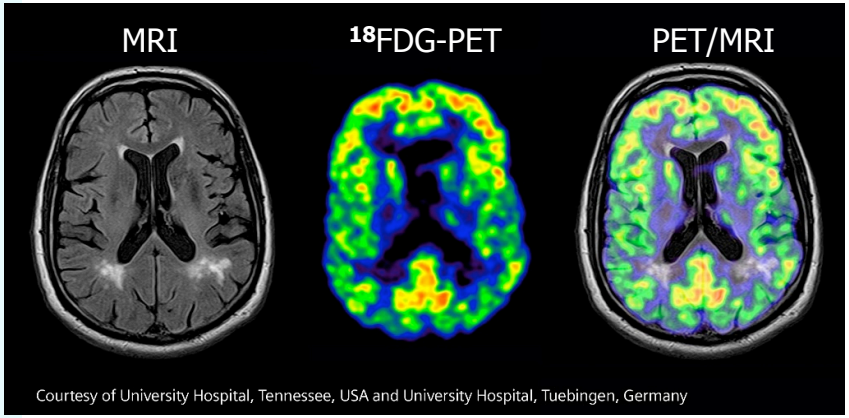
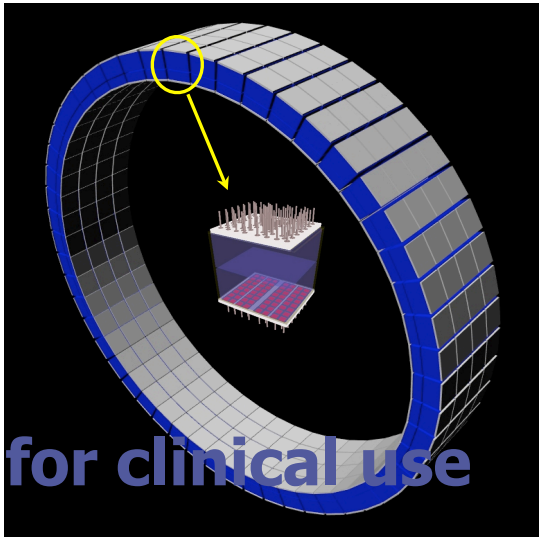
BrainPET Project

New generation PET equipment for functional studies of the human brain



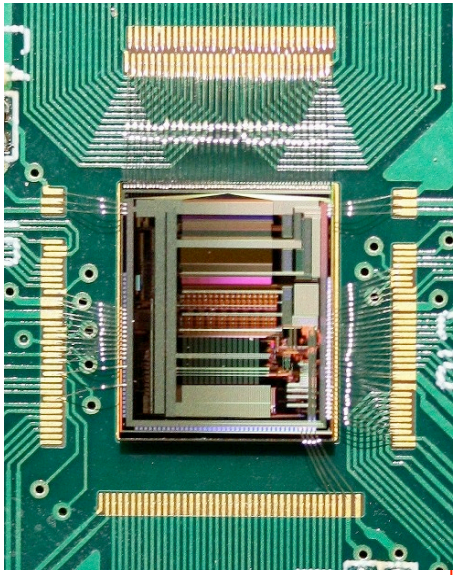


Objective: Development of a prototype for clinical use

Collaboration with Puerta de Hierro Hospital – Majadahonda

Positron Emission Tomography + Magnetic Resonance

- Functional and Anatomic Imaging
- Reduced dose to the patient
- Better contrast for soft tissues



Technological advances

- Compatibility with magnetic fields
- LYSO:Ce Monolithic Scintillators
- Integrated ASIC electronics readout

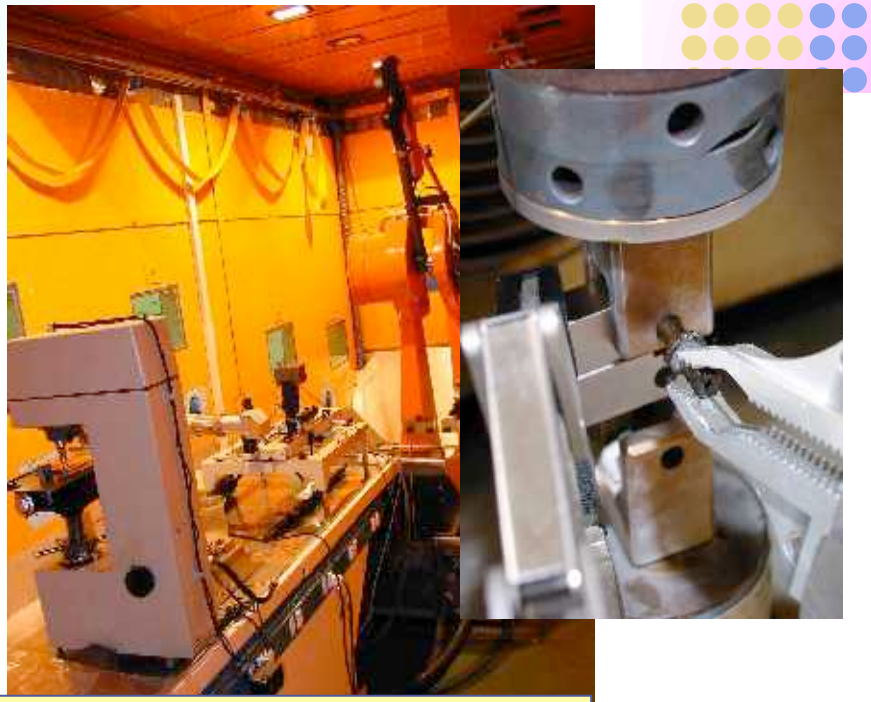
Structural Materials Division

- The Structural Material Division is focused on structural materials behaviour in energy production systems:
  - Nuclear power plant in operation (light water reactors)
  - Future nuclear power plant (Gen IV)
  - Renewable energies
    - Concentrated thermal solar (CTS): Energy Storage
    - Biomass
  - Coal fired power plant
    - Advance materials
- Through research projects of long duration, technical support activities and active participation in international forums, working and expert groups

Structural Materials Division

Facilities for mechanical tests

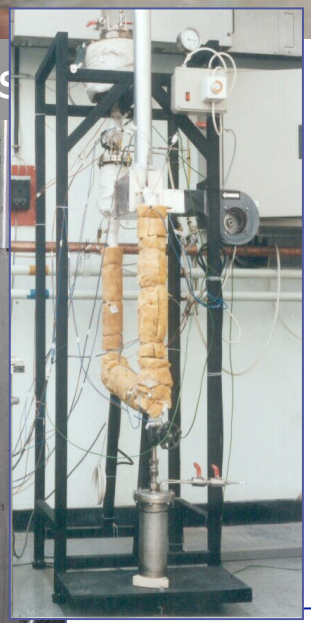
- Servohydraulic testing machines (-200ºC to 800ºC)
- Impact pendulum (300 J and 50 J)
- Creep (up to 800ºC)
- Nanoindenter
- Small Punch device



Radioactive facility

Structural Materials Division

Facilities for corrosion and stress corrosion



Structural Materials Division

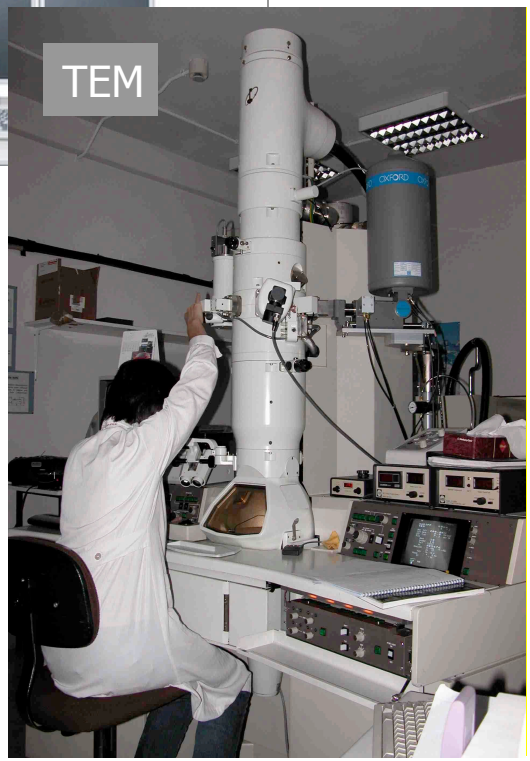
Microscopy and surface analysis

Radioactive facility

FEGSEM-EBSD

AUGER

TEM



XPS

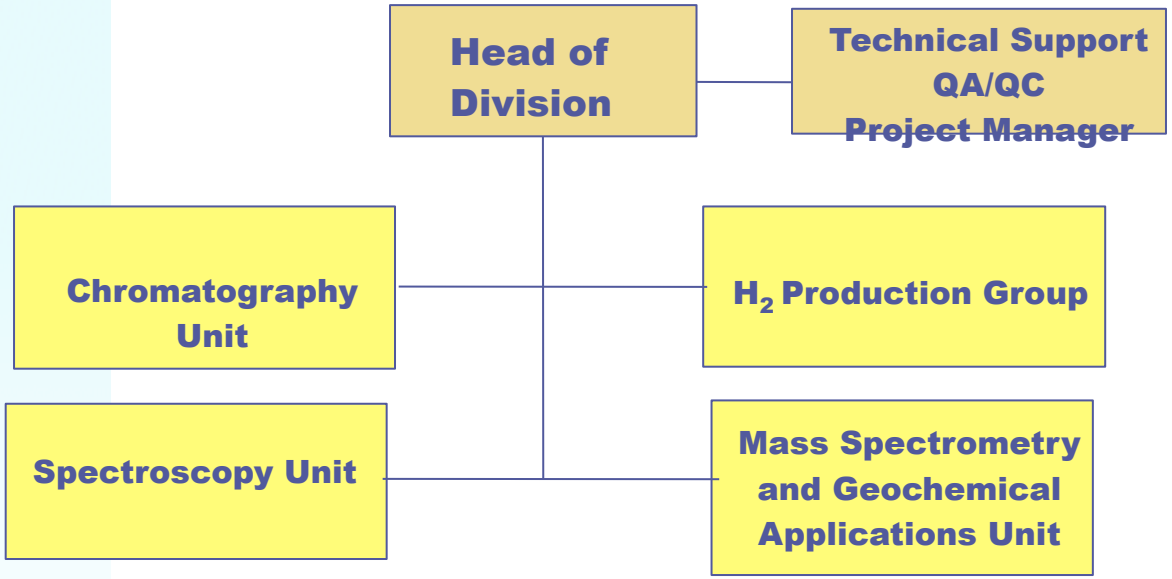
SEM-EBSD

Chemistry Division

Aim

Assure the availability and application of methods, techniques and strategies of Analytical Chemistry in the field of energy resources and their effects in the environment,

- Scientific and technological developments
- R&D in Analytical Chemistry and related topics
- Quality of analytical data and their traceability to international standards.



Staff

- 9 PhDs in Chemistry
- 10 Chemists or Chem. Eng.
- 2 PhD fellows
- 14 technicians

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Spectroscopy Unit

ATOMIC ABSORPTION (AAS)
- Graphite furnace (GFAAS)
- Cold vapor generation (CVAAS)
- Mercury Analyzer (DMA)

ATOMIC EMISSION (ICP-AES, FAES)
Previous separation by:
- * Ion change chromatography
- * Liquid-liquid extraction

ATOMIC FLUORESCENCE (AFS)
- Hydride generation (HG AFS)
- Cold vapor generation (CV AFS)

X RAY DIFFRACTION (XRD)
Chemical and Structural Characterization of crystalline phases

X RAY FLUORESCENCE (XRF)
Multielemental Analyses in a short period of time (% or ppm)

Spectrometry Unit

MASS SPECTROMETRY (MS)
- Thermal ionization (TIMS)
- ICP source (ICP-MS)
- Clean rooms

ION CHROMATOGRAPHY (IC)
- Conductimetry detector
- Amperometric detector

ELEMENTAL ANALYSIS (EA)
- C, N and S for macrosamples
- C, N, S and H for microsamples

SPECTRAL TECHNIQUES
- UV-Vis spectrophometry
- Laser induced kinetic phosphorescence

CLASSICAL METHODS
- Titrimetry
- Polarography
- Thermal analysis (DTA/TG)

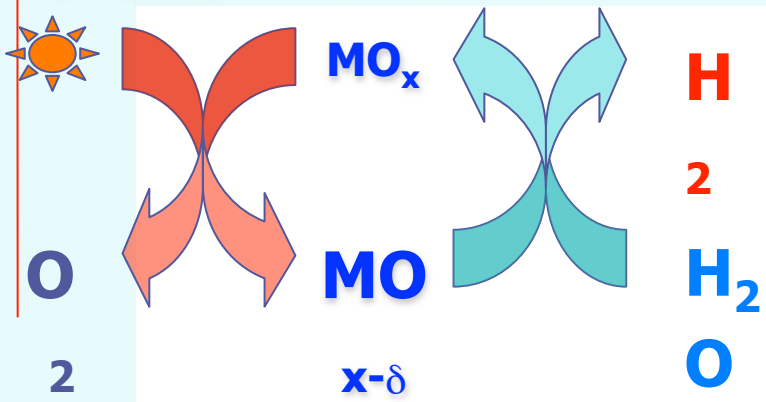
Chromatography Unit

GAS CHROMATOGRAPHY (GC)
- Flame ionization detector (FID)
- Mass spectrometry detector (MSD)
- Thermal desorption

LIQUID CHROMATOGRAPHY (LC)
- Diode array detector
- Fluorescence detector

GOBIERNO DE ESPAÑA · MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD · Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

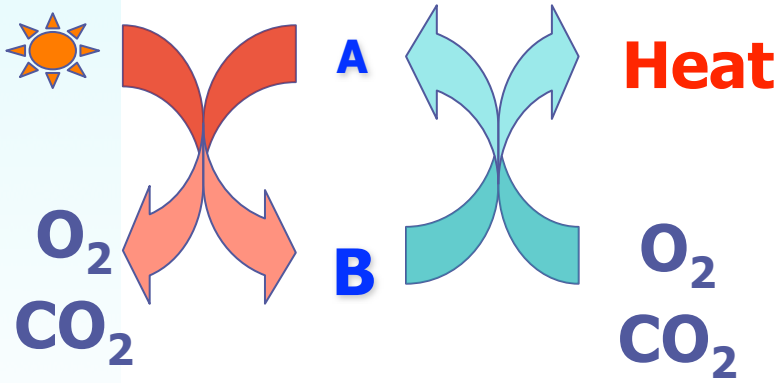
HYDROGEN PRODUCTION FROM WATER THROUGH THERMOCHEMICAL CYCLES



- **CONSOLIDA (CENIT: Hynergreen-CDTI):** CIEMAT, URJC, IMDEA, INTA, Hynergreen, CIDAUT, ITC, MC2.
- **SOLGEMAC (Regional government of Madrid):** CIEMAT, URJC, IMDEA, INTA, UAM, TORRESOL, Hynergreen.

MO_x : Synthetic and commercially available ferrites: $M_xMe_yFe_2O_4$. M y Me : Ni, Co Mn.

THERMOCHEMICAL CYCLES FOR SOLAR ENERGY STORAGE



- **CIC-ENERGIGUNE – CIEMAT (low T, cylinder parabolic CSP)**
- **HITCYEN (Spanish Ministry of Science and Innovation):** CIEMAT **(high T, tower CSP)**

A : Synthetic and commercially available oxides or carbonates

Electrical Engineering. Accelerators

Research lines

Development of electrical, electronics and mechanics for R&D projects.

- **Magnet, mainly superconducting**
- **RF devices (*kickers*, *acceleration cavities*, *bunchers*)**
- **Power electronics**
- **Control electronics**
- **Next aim: small accelerators**

	KNOWLEDGE AREA	SCIENTIFIC COLLABORATIONS	INDUSTRIAL COLLABORATIONS
	POWER SUPERCONDUCTIVITY	* CERN (CH) * DESY (D) * GSI (D) * MIT (USA) * SLAC (USA) * CEA-SACLAY (F)	* Elytt Energy (E) * Neureus (E) * ANTECSA (E)
	RF FOR ACCELERATORS	* CERN (CH) * INFN Frascati (I) * SINP (Russia) * GANIL (f) * UPC, Barcelona (E) * INTE, Barcelona (E)	* Utillajes Huerta (E) * Aimen (E) * CERN * Bodycote (E) * DMP (E)
	APPLIED ELECTROMAGNETISM	* TEKNIKER (ES) * ROBOTIKER (ES)	* Elytt Energy (E) * Neureus (E) * ANTECSA (E) * WEDGE (E) * ADIF (E) * ASSYCE (E)
	POWER ELECTRONICS	* UPM (ES) * Universidad Sevilla (ES) * IMDEA Energía (ES)	* Green Power (E) * Enertrón (E) * ADIF (E) * SEMIKRON (E)
	CONTROSL ELECTRONICS	* UPM (ES) * Universidad Sevilla (ES) * DESY (D) * ESS-Bilbao (ES)	* Beckhoff (D) * Green Power (E) * SEDECAL (E)
	MECHANICAL TECHNOLOGY AND DESIGN	* DESY (D) * CERN (CH) * SINP (RusSia)	* Utillajes Huerta (E) * INDEX (E) * Trinos Vacuum Projects * Ramem (E) * DMP, Cryovac

On going activities

ACCELERATOR COMPONENTS FOR LARGE FACILITIES		APPLICATIONS TO ENERGY	SMALL ACCELERATORS
HEP	CLIC	**Storage**	MICROTRON
	ILC	SA^2VE	Miniciclotrón PET
	SUPER-LHC	ACEBO	
Lasers	XFEL	**Generation**	
Nuclear Physics	FAIR	WEDGE	
Fusion	IFMIF	MgB_2	
ESS			

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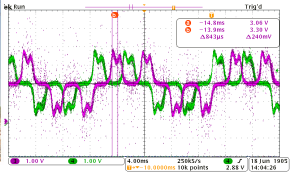
ALMACENAMIENTO DE ENERGÍA

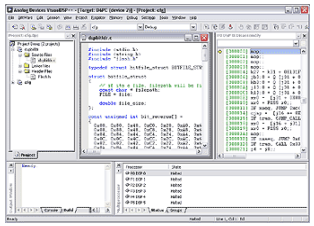
Aplicaciones a transporte ferroviario

Sistemas de Almacenamiento AVanzado de Energía

SA²VE

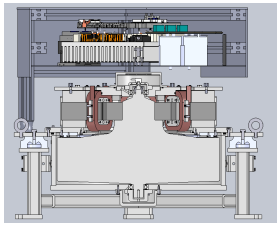
Utilización de la energía de frenado de los trenes para reutilizarla en la posterior aceleración.

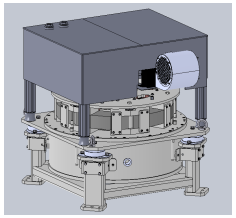


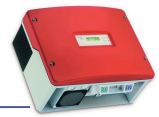


Aplicaciones a generación eléctrica a partir de energías renovables

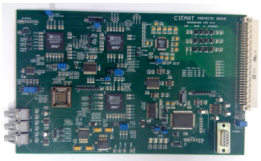
ACEBO







Mejora de la eficiencia energética en plantas solares y en parques eólicos, sobre todo en redes débiles.



Otras aplicaciones

-Almacenamiento en ascensores y gruas
-Funcionamiento como UPS, asociado a baterías
-Reducción del uso de generadores Diesel

Diseño electromagnético, diseño mecánico, electrónica de potencia, electrónica de control, algoritmos de control, prototipado en laboratorio e instrumentación

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