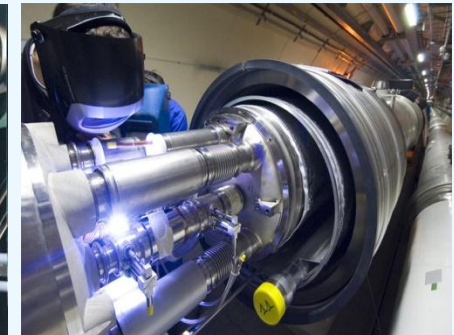


Activities of the industrial sector for accelerator R&D

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TIARA GENERAL MID-TERM MEETING
14 June 2012



Paloma Dorado
CDTI (Centre for the Development of Industrial Technology)
Spanish Industrial Liaison Officer for CERN, ESRF and ILL
Spanish Expert on the FP7 Research Infrastructures Programme Committee

Overview

- Role of CDTI at Research Infrastructures
- Accelerator Infrastructures: A global market for industry
- Collaborative R&D: mutual benefits for research infrastructures and industry
- How to facilitate the involvement of industry in the accelerator R&D?
- Spanish Industry in developments for accelerators. Some examples
- Conclusions

Role of CDTI at Research Infrastructures

Who we are

CDTI (Centre for the Development of Industrial Technology) is a public entity, **under the Spanish Secretariat of Research, Development and Innovation**, that supports the industrial research and innovation of the Spanish companies since 1977.

- 320 employees
- Headquarters in Madrid
- Network of offices abroad: EEUU, Japan, China, Korea, India, Brazil, Mexico, Chile, Morocco
- SOST (Spain Office of Science and Technology), in Brussels

Goal in research infrastructures

To facilitate the interaction and **involvement of companies in RI**, specially in projects of high technological value:



CDTI HQ office, Madrid

Role of CDTI at Research Infrastructures

Activities

- **Opportunities:** information on opportunities for Industry, support in procurement procedures, identification of cases of technology transfer
- **Funding:** targeted to R&D projects for research infrastructures
- **Collaborations:** support to R&D collaboration agreements between firms and research organizations

- **Spanish Delegations:** Advisor to Spanish Delegations in Finance, Administrative, Purchasing and in-kind Committees of the RI
- **Industrial Liaison Officer (ILO):** Official contact point between the national Industry and the research organization.

CDTI joined the Spanish Delegation to CERN in 1983.

Nowadays, CDTI is the Spanish ILO for **CERN, ESRF, ILL, XFEL, FAIR, F4E and ESO**



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Accelerator Infrastructures: A global market for industry

- **Budgets increase or unchanged despite the economic crisis:** Annual budget for existing RI increased 5.5% year on average during 1998-2008 (ERID Watch).

Currently, the increase is more modest, but the market is not suffering the same dramatic situation as other sectors

- **Important investments in the coming years:** In the next 15 years, great investments are committed in accelerators for research: particle physics, synchrotron light sources, neutron sources, free electron lasers and materials irradiation for fusion projects (aprox. 15.000 M€)

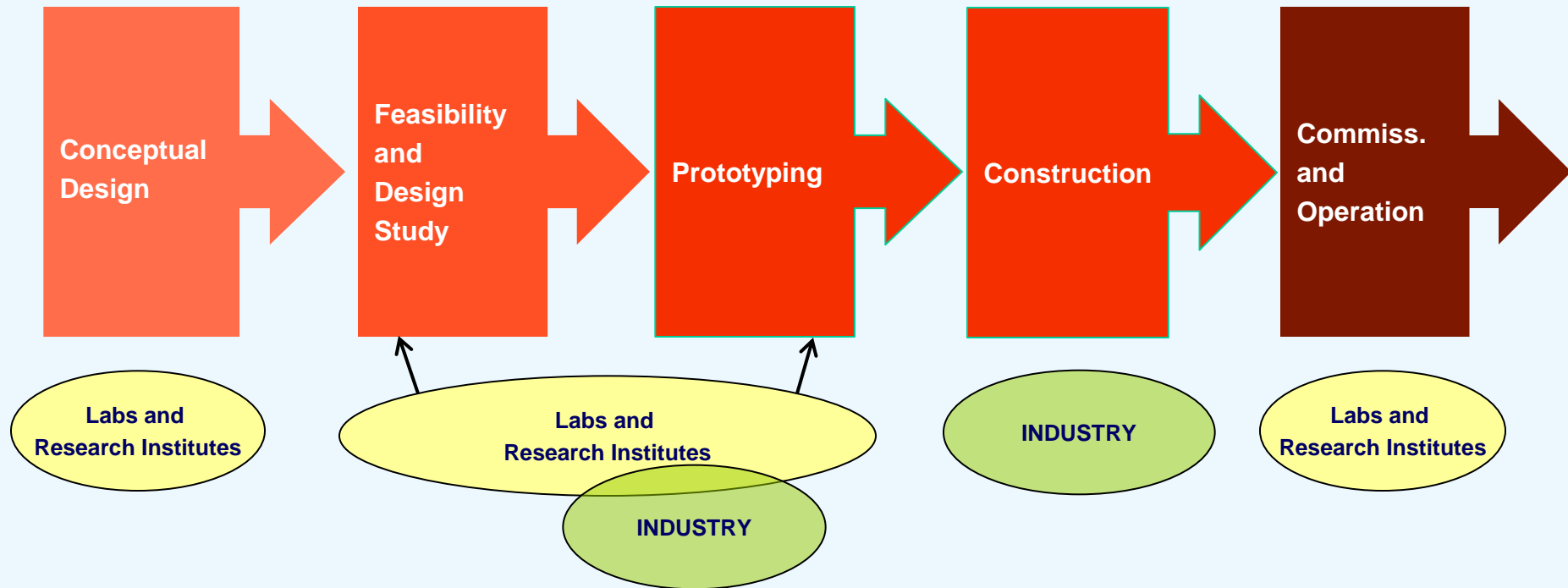
- **Supporting the internationalization:** regardless of its origin, European companies have accessed to a global market. National (in the case of Spain eg. ALBA Synchrotron, ESS-Bilbao), European (eg. ESS, XFEL), International (future Linear Collider)

- **A steady market:** Most of the technologies are common for several RI (sc magnets, vacuum, cryogenics, RF, etc). Projects in different phases (definition, design phase, construction, operation) are compensated with each other, providing continuity to Industry

An attractive market for Industry but... a difficult access

Accelerator Infrastructures: A global market for industry

HOW AND WHEN INDUSTRY ACCESS INTO THE MARKET?



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Collaborative R&D: mutual benefits for research infrastructures and industry

Developing a trusting relationship with industry, involving companies in the early design stages, would help to coordinate efforts and reduce risks in the future construction phases

Benefits for the accelerator infrastructure:

- Optimization of the construction process, anticipating main manufacturing stoppers
- Efficiency in the technological development of key components, through the simultaneous adaptation of the industrial capacities
- Contribution to the supporting of the innovation in the European Research Area, as one of the role of a public RI



PETS for CTF3.
CIEMAT

Benefits for Industry

- Relevant references for future procurements in the accelerator area
- Company activities in other market segments have benefited from technologies first developed for accelerator infrastructures
- Building-up of competences - develop capacities for delivering complete systems, in stead of specific components

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How to facilitate the involvement of industry in the accelerators R&D?

Major difficulties of the industry to access to the accelerators R&D

- Challenging performances at the limit of the available technologies are required
- Unique developments or small series (most common in instrumentation)
- Important investment needed
- High risk - difficulties to return and leverage the investment through commercial contracts in the market

How to facilitate the involvement of industry in the accelerators R&D?

Some measures that would attract industry to accelerator R&D

- ✓ Sharing the risk: applying together to EU funds for joint development of critical technologies
- ✓ Identifying critical technologies and components and creating “enabling technologies programs”
- ✓ Analyzing, since an early stage of the project, a policy of industrial collaborations and the associated **pre-commercial procurement strategy**
- ✓ Standardizing the procurement rules of the accelerator infrastructures as far as possible (ILOs usually report on most encouraging practices and procedures for Industry from one infrastructure to another in their regular meetings and forums)
- ✓ Helping to expand the market: avoid at-home developments if commercial solutions are available with the same performance
- ✓ Communicating the needs of accelerator infrastructures through dedicated “Industry Days” and workshops

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Spanish Industry in developments for accelerators

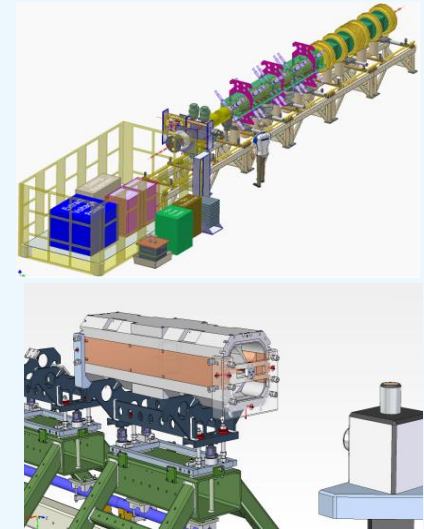
Some examples

Joint developments: Company involved in the R&D and definition phase

RFQ for the Front End Test Stand at (RAL)

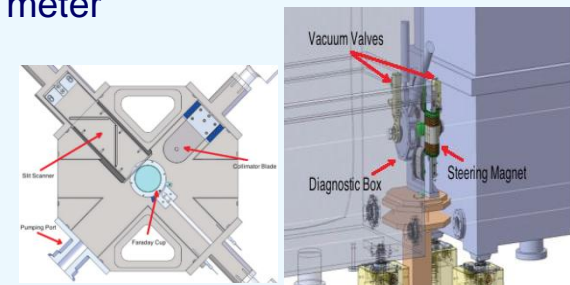
RFQ is fed by a 324 Mhz Klystron to accelerate protons from 65 KeV to 3 MeV

- Company: AVS.
- Task: Mechanical design of RFQ and alignment system
- Collaboration: RAL-ISIS, Imperial College.



Beam instrumentation for the HIE-ISOLDE LINAC at CERN

- Companies: SCIENTIFICA, AVS
- Task: Mechanical design and prototyping of the beam diagnostics system, including intensity, position and transverse profile monitors and a emittance meter
- Collaboration: CERN-HIE-ISOLDE.



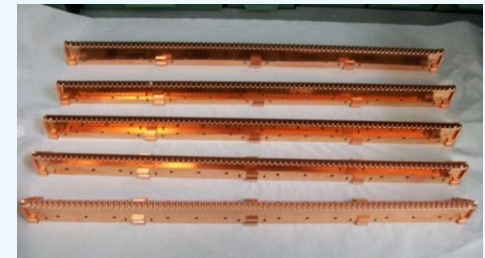
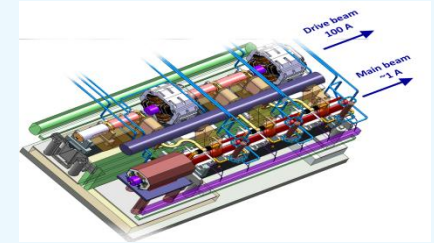
Spanish Industry in developments for accelerators.

Some examples

CLIC Power Extraction and Transfer Structures (PETS)

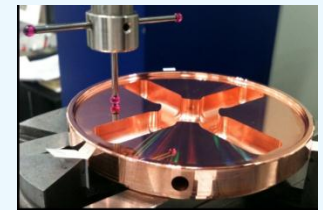
PETS function: to extract power from the drive beam and transfer to the main beam. They are composed of 8 bars milled with $15\ \mu\text{m}$ shape accuracy in 520 mm length (first CLIC module)

- Company: DMP
- Tasks: CIEMAT: Engineering, assembly and Low power RF tests;
DMP: Prototyping and manufacturing services
- Collaboration: CIEMAT, CERN (CTF3 and first CLIC module)



Accelerating structures for CLIC

- Company: DMP
- Tasks: Prototyping of disks for CERN validation and manufacture of a entire structure (committed). Design of the machining strategy, acquiring the necessary tools (especially the mono-crystal diamond ones).
- Collaboration: CERN



Spanish Industry in developments for accelerators. Some examples

Design and prototyping of permanent magnets quadrupoles (PMQs)

PMQs: magnets with no power consumption within the linac drift tube

- Company: ELYTT ENERGY
- Task: Design and manufacturing of permanent quadrupole magnets to be used as focusing elements in the drift tube of the ESS-Bilbao Linac
- Collaboration: ESS-Bilbao

This type of PMQs have been also selected by LINAC4 project at CERN



Spanish Industry in developments for accelerators.

Some examples

14 Mw long-pulse Klystron modulator

- Company: JEMA
- Collaboration: ESS-Bilbao, SNS
- Task: Design and manufacturing of a solid state HV klystron modulator

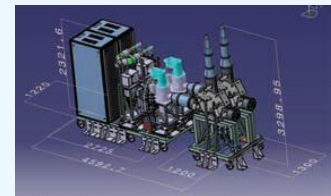
Specifications: The modulator is rated 85 kV 160 A for 1.5 ms pulses and 60 Hz maximum repetition rate. The maximum powers obtained are 14 MW peak and 1.2 MW average.



IFMIF-EVEDA RF Power Amplifier Module

- Companies: INDRA, TTI
- Collaboration: CIEMAT- LNF (Fusion National Laboratory)
- Task: Develop and manufacturing of a RF power amplifier module prototype for the RF power system

The RF Power System will feed the IFMIF-EVEDA accelerator cavities which demand 18 RF Power inputs at 175 MHz



Spanish Industry in developments for accelerators.

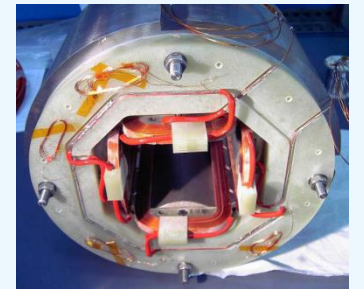
Some examples

Long series and large components

Combined Superconducting magnet for XFEL LINAC

Total production: 82 + 20 superconducting magnets

- Companies: Consortium: ANTEC (sc magnets) + TRINOS VACUUM PROJECTS (Cryostats)
- Collaboration: CIEMAT, XFEL
- Tasks: CIEMAT: Design, prototyping and following the production
Companies: Prototyping , manufacturing and assembly

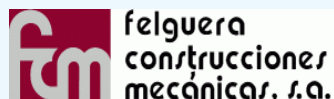


Cryomodules for the LHC Cryogenic distribution line (QRL)

Total production: 106 cryomodules

Company: FCM (Felguera Construcciones Mecánicas)

Tasks: Manufacturing and testing



Spanish Industry in developments for accelerators.

Some examples

Technology and Knowledge Transfer

- SRB ENERGY: 

Spanish company of renewable energy. Develops and manufactures flat and high energy evacuated solar collectors based on CERN's ultra-high vacuum technologies

Last large contract: Geneva International Airport's main terminal building. 300 flat solar panels covering an area of 1.200 m².



GNUBULIA 

Spanish software and service company. Develops cloud applications for healthcare (medical imaging), banking, etc, based on their own technology (G platform)

Origin: Grid Technology developed at CERN. Proyect MamoGrid.

Spanish Industry in developments for accelerators.

Some examples

Industry as users of accelerators infrastructures

ALTER TECHNOLOGY GROUP



Spanish company specialized in the engineering and testing of high reliability electronic components, mainly for the space sector

User of accelerator infrastructures for reproducing the **space radiation environment and testing its effects**



Testing facilities

•**Centro Nacional de Aceleradores (CNA) – Sevilla, Spain.** Initial characterization of some EEE parts to assess the performance under low energy. Tests performed at the CNA cyclotron - protons up to 18MeV



•**University of Louvain (UCL) – Belgium .** Single event studies using heavy ions. Louvain-la-Neuve cyclotron - HIF beam line

•**Paul Scherrer Institute (PSI) – Switzerland.** Proton irradiation facility, with two radiation sites for tests in high and low energy regions



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Conclusions

- Accelerator infrastructures: a growing and attractive market for Industry
- Clear benefits of an early stage R&D collaboration for both: research organizations and companies
-But difficult access: technological barriers, non-repetition, important investments of high risk (difficult return)
- Room for new measures to facilitate the Industry approach.
In the framework of TIARA, the identification of KARAs would be very useful to show Industry the future challenges and prepare “enabling technologies programs”
- ILOs Networks could be very helpful as links between a large variety of companies and accelerator infrastructures
- Clear successful examples of collaboration between Spanish companies and accelerator infrastructures. In some of them, national accelerator groups as the one in CIEMAT and ESS-Bilbao has been clearly the driving force for improving the capacities in the industry

Thank you for your attention

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