

Engineering and study office

SC LINAC

- R&D contribution (MYRRHA, ESS, SPIRAL2, LHC)
- Industrialization and project management
- AI for reliability of Linear SC accelerators

CRYOGENICS

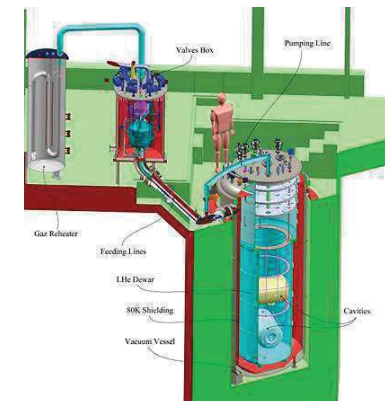
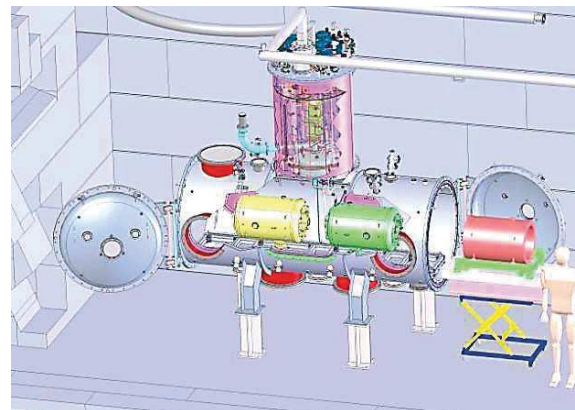
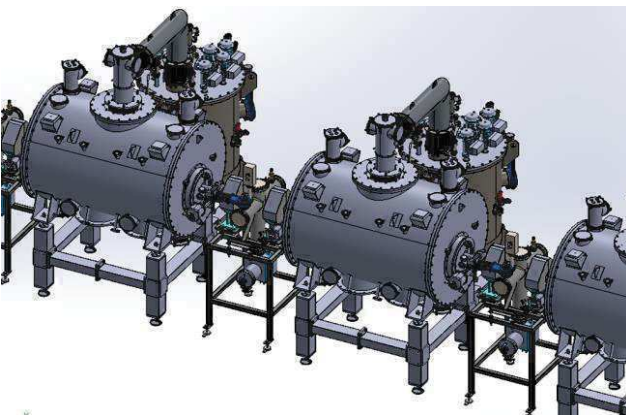
- Design and study
- Fabrication and installation follow-up
- Commissioning
- Horizontal and vertical cryostats
- Cryogenic distribution
- Control systems



ACCELERATORS AND CRYOGENIC SYSTEMS



UPPSALA
UNIVERSITET



Engineering and study office



ACCELERATORS AND CRYOGENIC SYSTEMS

Calculations

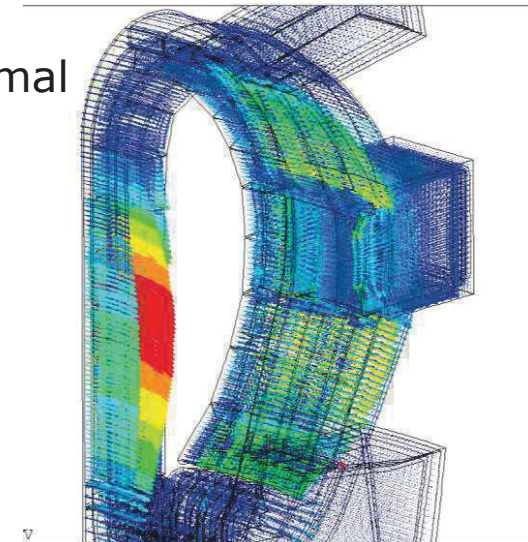
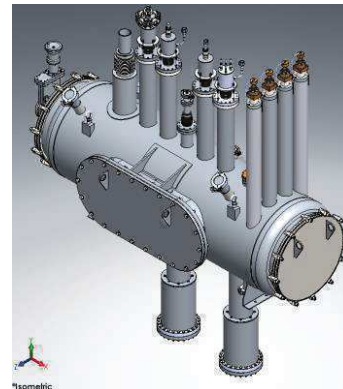
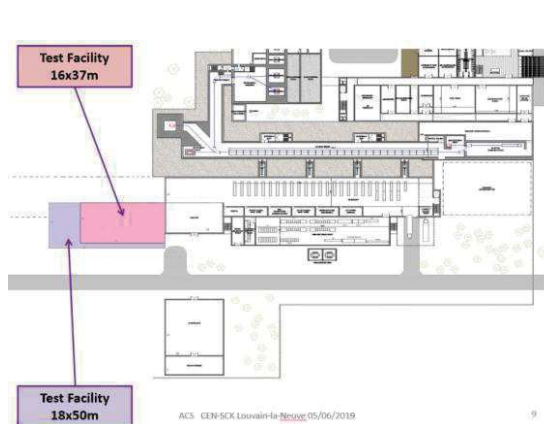
- Electromagnetic studies of plasma disruption effects into the ITER vacuum vessel and diagnostic ports
- 3D modelling of electromagnetic fields

IDOM



Mechanical and thermal studies

- Interface and component integration studies
- Mechanical analysis (FEM) of electromagnetic and thermal effects



ALCEN



from **technologies** to **innovations**

ALCEN
Grands Instruments
Scientifiques



Une large gamme de solutions et services offerts par diverses filiales pour les Grands Instruments Scientifiques

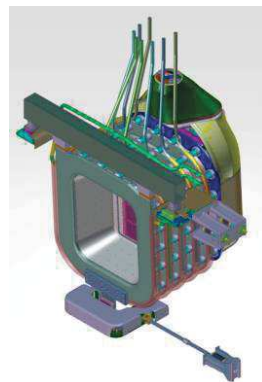
- Composants pour lignes de faisceaux
- Composants mécaniques et opto-mécaniques
- Composants et systèmes rayons X
- Composants et systèmes RF & HT
- Cryogénie
- Equipements sous vide et ultra-vide
- Maintenance
- Robotique
- Simulation de phénomènes multi-physiques
- Structures accélératrices et accélérateurs clés en main
- Systèmes complexes
- Systèmes de contrôle commande
- Travaux d'assemblages en salle blanche
- Travaux d'installations sur site
- Usinage et assemblage de matériaux exotiques



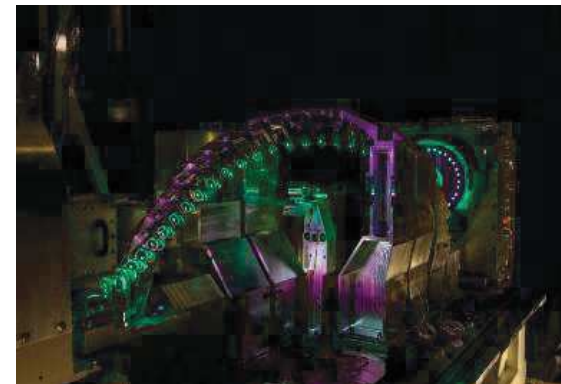
Accélérateurs de particules : Références



Assemblage des cryomodules XFEL



Prototype de source d'ions ITER

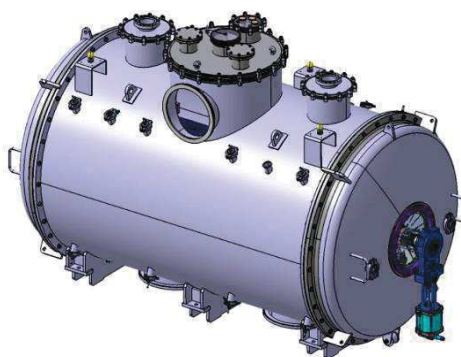


Système d'interaction électrons-photons (source gamma ELI-NP)

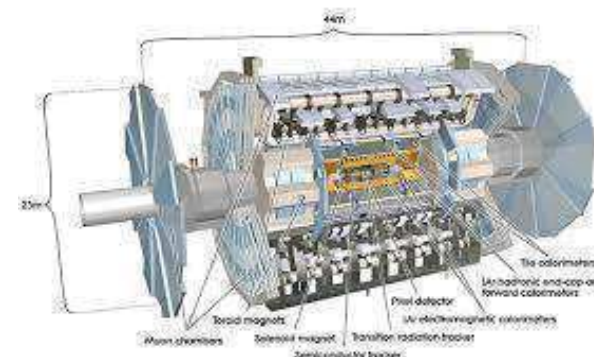
ALSYMEX
ALCEN



Cellules accélératrices AIRIX



Enceintes des cryomodules Spoke ESS



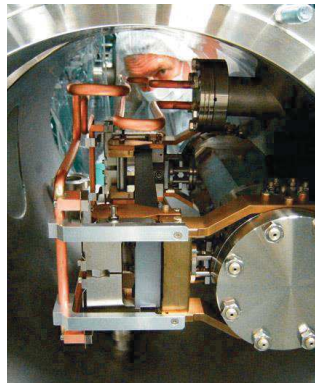
Usinage de barres du détecteur ATLAS

ALCEN

Accélérateurs de particules : Références



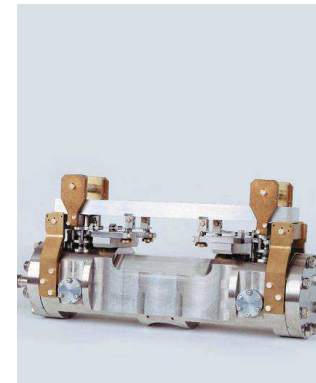
Système de miroirs de
haute stabilité



Système Kirkpatrick-Baez

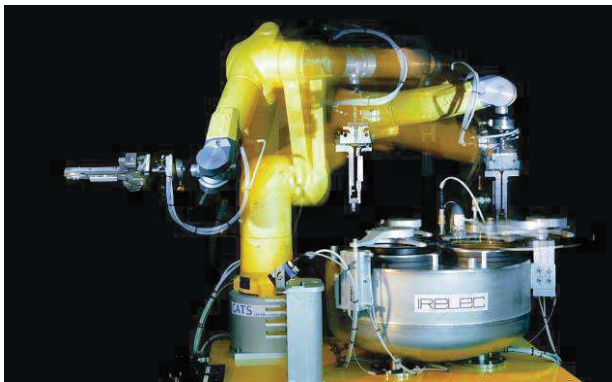


Monochromateur



Système courbeur

IRELEC
ALCEN



Système de transfert
cryogénique automatisé

ALCEN



Robot d'inspection



Composant neutronique

Accélérateurs de particules : Références



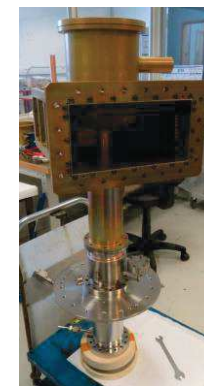
Guide rayons X



Structure accélératrice



Coupleurs RF ESS



PMB
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Cyclotron pour application médicale



Fenêtre RF



Canon à électrons

ALCEN



bergoz

INSTRUMENTATION

SFP – Roscoff Octobre 2019

Qui sommes nous ?

- PME Française, créée en 1981, reprise en oct-18
- Au pied du Jura, à côté de Genève
- 9 personnes en R&D, production, ventes et support
- Exportation à plus de 95% dans le monde entier
- 38 ans de savoir-faire



Notre mission

Fournir des solutions de mesures non destructives dans les courants et les charges faibles

- Transformateurs de courant, passif ou actif; Cartes électroniques
- Produits sur catalogue et personnalisation si besoin
- Conseil en amont, support en aval

Grande Vitesse, haute precision, courants faibles, charges très basses, du DC au GHz

Transformateurs de courant

- Fast CT
- Integrating CT



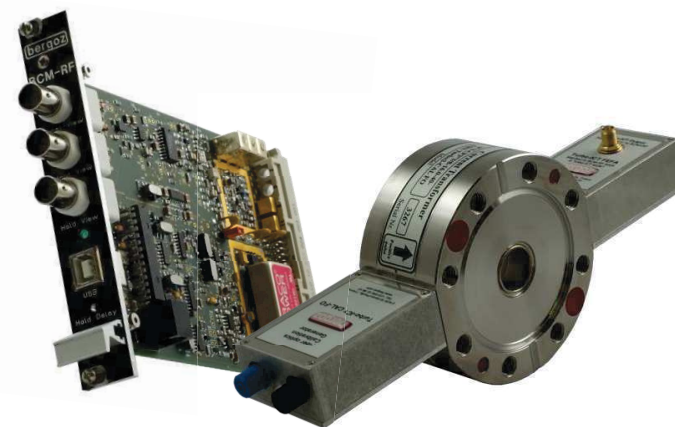
Electroniques

- Beam Charge Monitor
- Beam Position Monitors



Transformateurs de courant & électroniques:

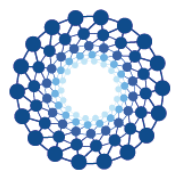
- New Parametric CT (DCCT)
- Integrated Parametric CT
- Turbo-ICT & BCM-RF
- ACCT & ACCT-E-RM
- Continuous Wave CT & BCM-CW-E



- **Synchrotron Light Source**
ESRF (Grenoble), Soleil (Saclay), LNL-II (Brookhaven)
- **Neutron Spallation Source**
ESS (Lund), CSNS (Dongguan)
- **Free Electron Laser**
PSI (Villigen), PAL (Pohang)
- **Laser Plasma Wakefield**
LOASIS (Berkeley), ELI-Beamlines (Prague)
- **Oncologie**
IBA (Louvain-la-Neuve), NIRS (Chiba)
- **Accelerator Driven System**
MYRRHA (Louvain-la-Neuve), ADS project (Lanzhou)
- **Accélérateurs Protons et Ions**
GANIL (Caen), Fermilab (Chicago)

Merci pour votre attention!





PIGES

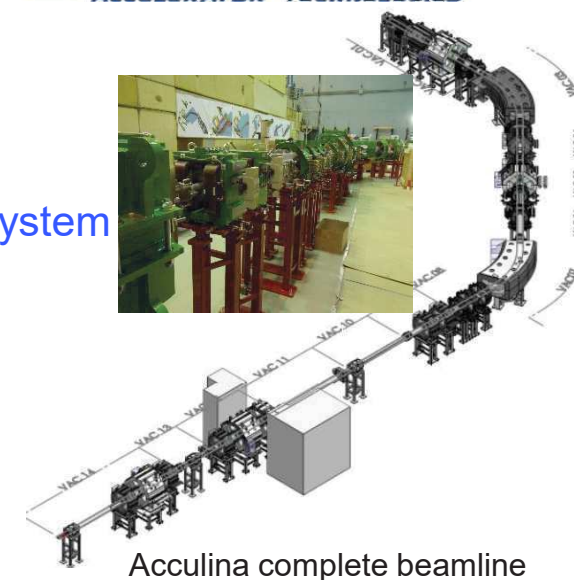
❖ Turnkey systems for particle accelerators

Particle beamlines

- from optics to installation and alignment
- magnets, power supplies, vacuum, diagnostics, control system



Installation at Tohoku University

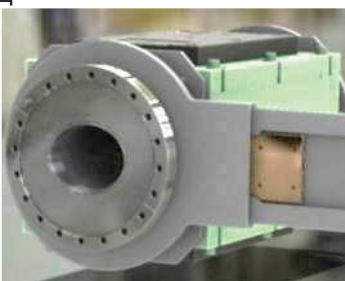


Acculina complete beamline

Fast Injection/extraction systems



CRYRING Kicker magnet and pulser 3500A, 200 ns

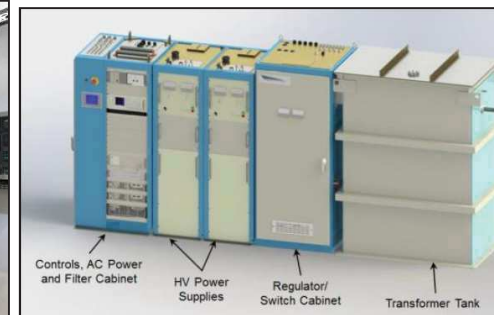


Ultra High Vacuum Septum for Soleil

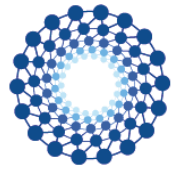
RF sources



RF amplifier for FZD
10kW @1.3 GHz



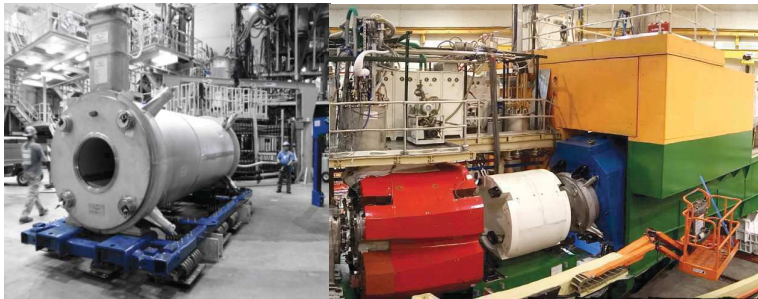
Klystron modulator for
IPN Orsay 115kV / 50A



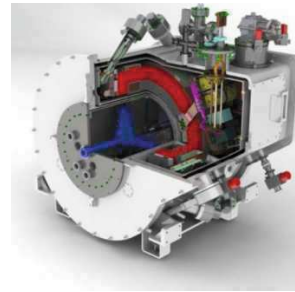
PIGES



❖ Superconducting magnets



4.2T dipole and quads for JLAB

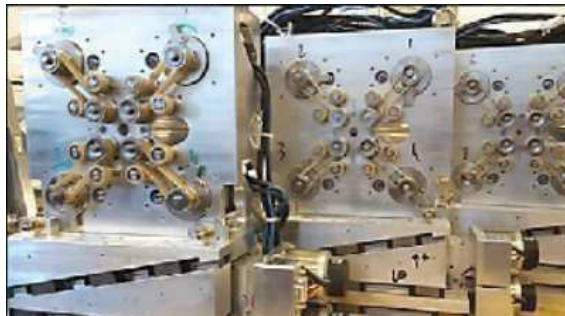


He free SC cyclotron



MgB2 solenoid

❖ Permanent magnets



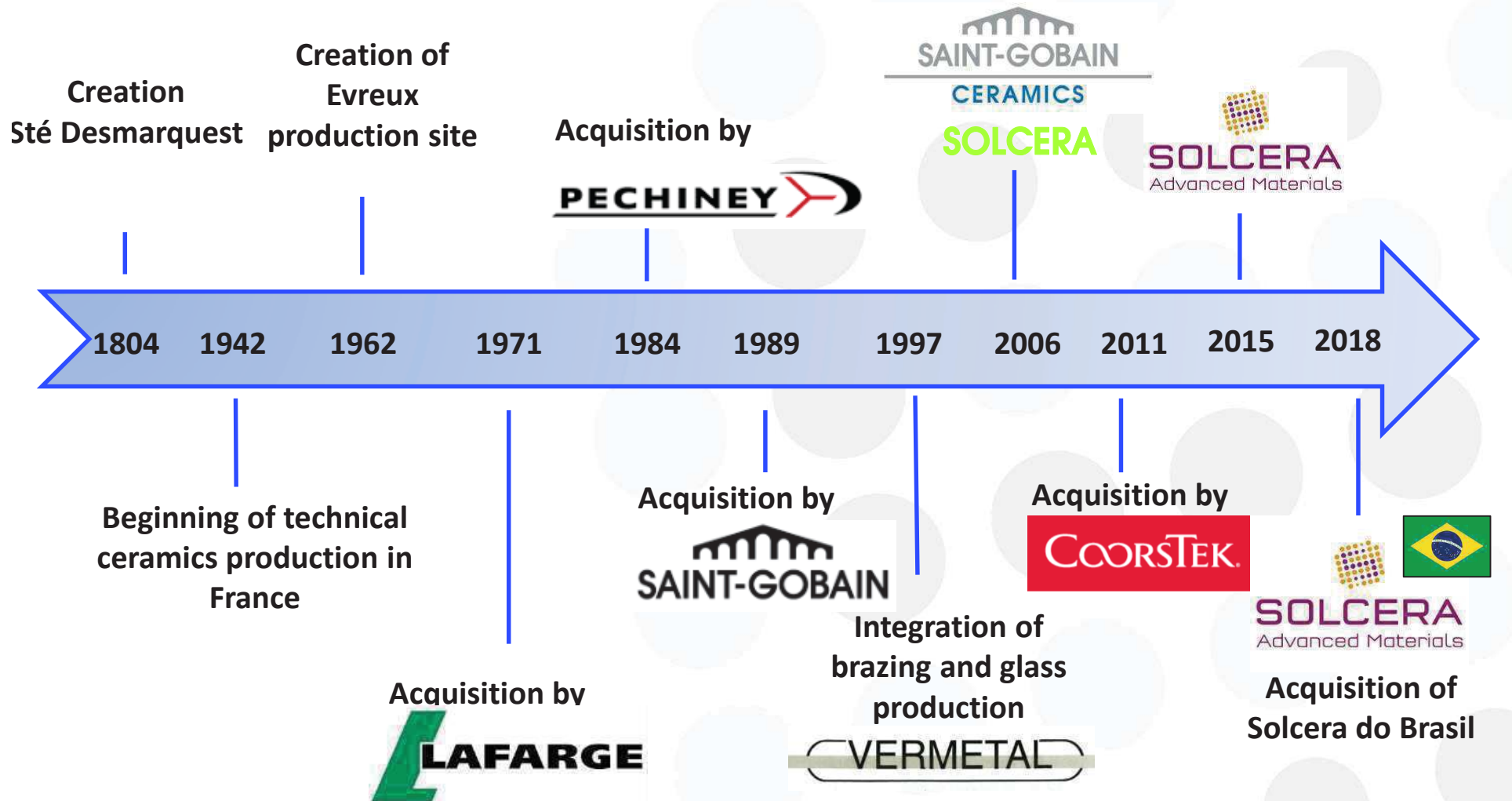
Variable gradient quadrupoles



Quadrupoles For ELI (INFN)



1.4 T dipole for LOA



Two production facilities in France

Ceramic Solutions

Evreux Normandy (Headquarters)

- Unique materials platform and ceramic technology in France
- 110 employees
- Plant surface: 6 500 m² + 2500 m² (planned 2019)



Assembly Solutions

Moissy-Cramayel, South East Paris

Ceramic-to-metal and glass-to-metals assemblies,
flash lamps, ceramic precision grinding

- 30 employees
- Plant surface: 1 900 m²



ISO 9001 ; 14001 v2015; OHSAS 18001 certified
Restricted access classification

Markets and applications

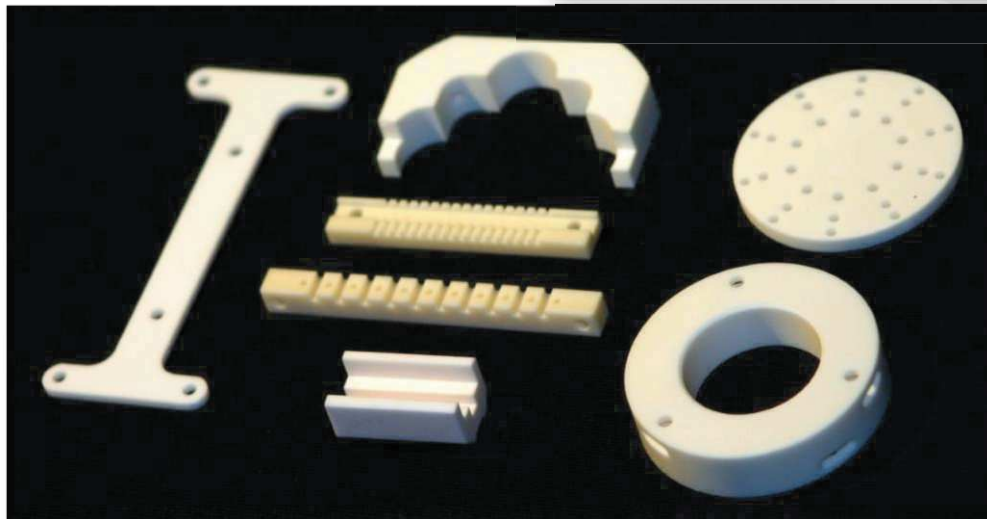
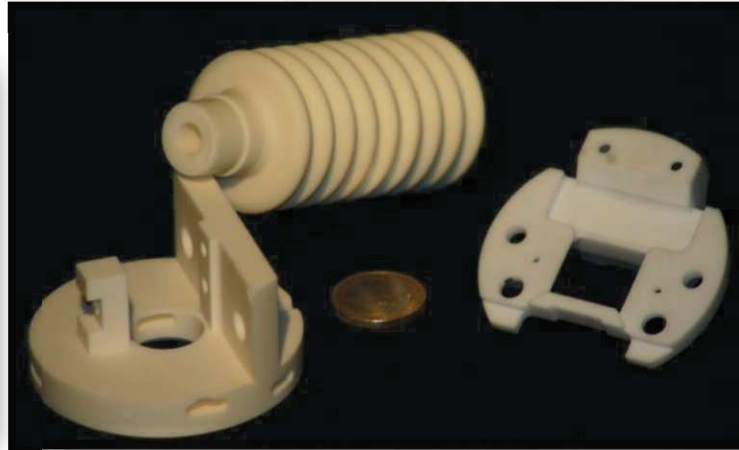
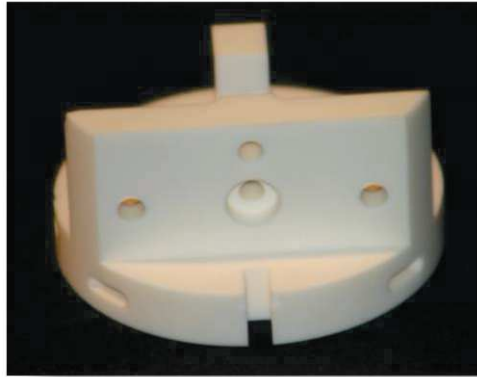
- **Focus on co-development**, technical support
- **International oriented** : export sales 50%
- **Markets diversity**: highly technical niche markets
- **Capacity for innovation**: > 5 % of turnover from R+D activities



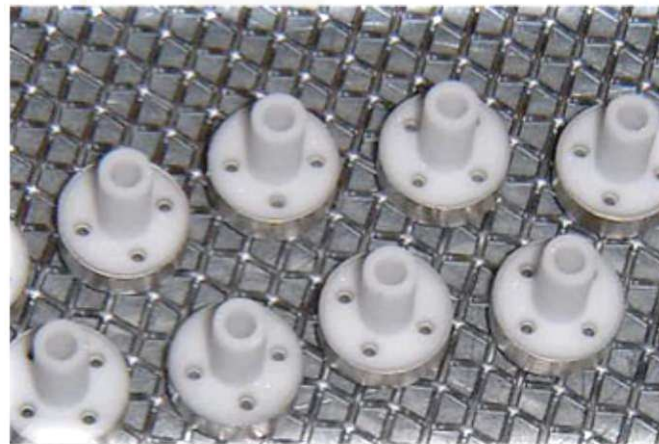
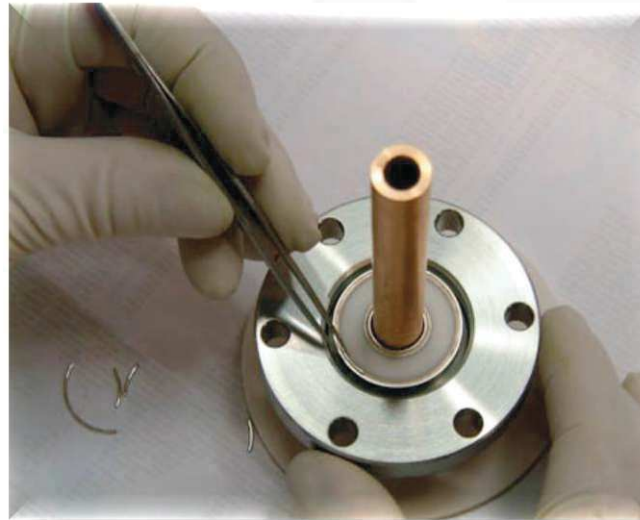
Materials portfolio

Al_2O_3	Hardness, low cost, metallizable
ZrO_2 - Mg	Thermal insulator, high TSR, ion conducting
ZrO_2 - Y	Very high mechanical resistance at low temperature
ZTA	Bending strength, hardness
Si_3N_4	Low coefficient of friction, bending strength at high temperature
B_4C	Extreme hardness, low density, neutrons absorber
Spinnelle	Optical transparency
ZnS	Infrared 8 – 12um transparency
MgF_2	Infrared 3 - 5um transparency
SiO_2	Electromagnetic transparency
HfO_2	High temperature resistance (2300°C)
MgO	Corrosion and High temperature resistance (2700°C)

Ceramic machining



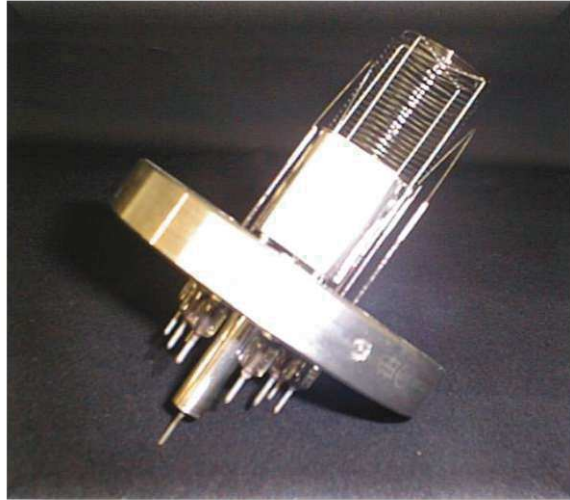
Ceramic-to-metal brazing



Glass-to-metal assemblies



Filament - Gauges



Viewports



50 ohm feedthroughs

Pick up



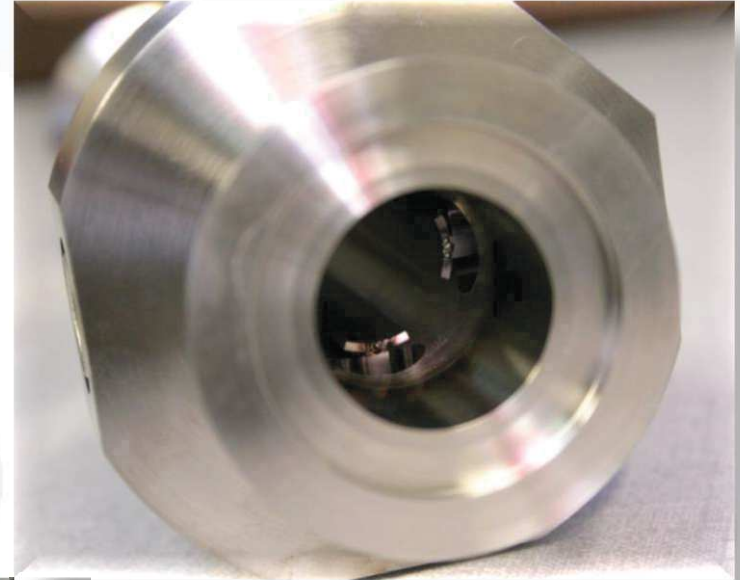
Beam position monitor sub-assembly



Beam position monitor assembly



Beam position monitor assembly



Some examples of our production



Some examples of our production



A large, stylized yellow lightning bolt graphic on the left side of the slide, pointing downwards.

TECHNIX

HV DC POWER SUPPLIES

Les Journées Accélérateurs 2019

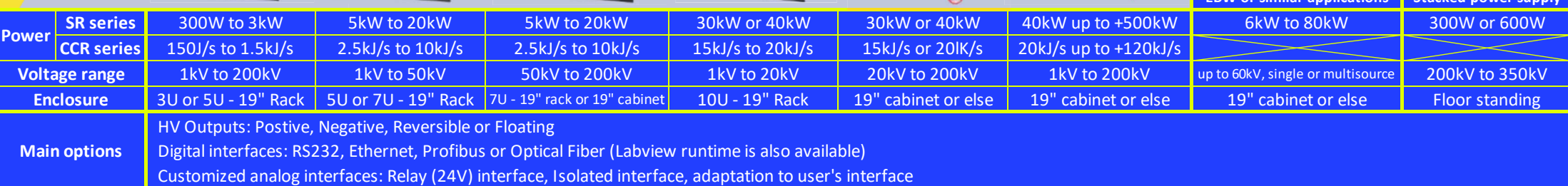
Technix generators are used all around the world, in many famous industrial groups and important research laboratories.

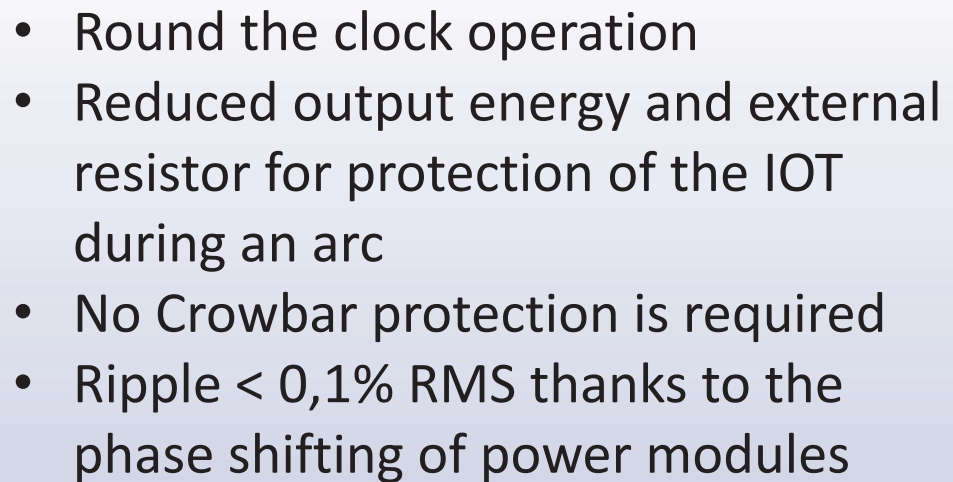
Based on the zero current switching (ZCS) resonance technology, the modular design and the wide range of options allows Technix to propose flexible and customized solutions, while keeping high reliability and fast delivery time.

Parallel operation allows to easily increase the max power available with Technix range of products.

The new design includes a 4½ digit display and a Voltage limitation function.

For more information, please feel free to visit our website: technix-hv.com





CERN : SR260KV-780W (P) ELECTROSTATIC SEPTUM



- Compact and mobile design
- Customized HV connector for easy installation in existing facility



CERN : CCR4.2KV-16.5KJ (P) PROTON BEAM SOURCE

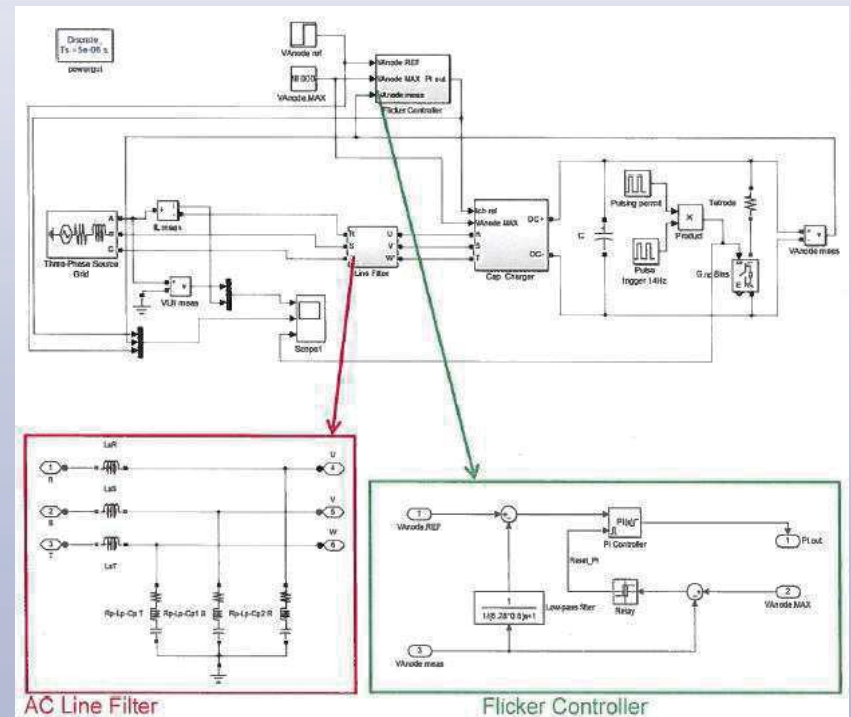


- LINAC 4 accelerator
- Modular design with two identical capacitor chargers
- Parallel operation through Control Unit
- New solution since 2018 :
Parallel operation is possible without a control unit (available on demand)

ESS & INFN : SR18KV-40KW (P) RF STATION (400KW)



- 26 units
- Partial discharge operation
- Customized design suitable for flicker control (THD compensation system)



GANIL : SR12KV-13.2KW (N) KLYSTRON

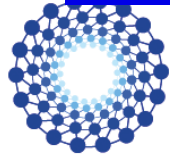


- Asymmetric floating
- Adjustable settling time
- Remote interface : 24V relay

A large, stylized yellow lightning bolt graphic on the left side of the slide, pointing downwards and to the right.

THANK YOU

Please do not hesitate to visit our website: technix-hv.com



PIGeS

THALES



Services

- System Architecture & Engineering
- Industrialization based upon Customers' specification or design
- Realization, integration, Commissioning
- Servicing & Support of operation

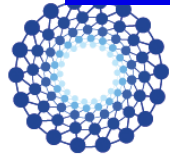
Sub-Systems

- Complete RF Chain
- Power amplifiers
- Test and conditioning benches
- Accelerator sub-assemblies
- Mechanical Infrastructures in highly constrained environment
- Control and Command and automated systems
- Instrumentation and Diagnostics sub-systems

RF Components

- Electron tubes
- Cryogenic couplers
- Solid-state drivers
- RF Windows
- LLRF

Example of Recent References



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THALES



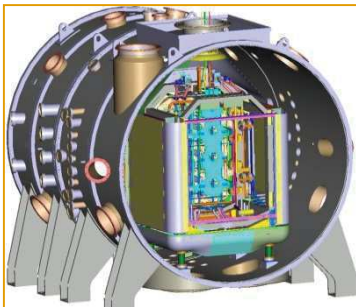
Laser Mega Joule (LMJ)

Supply of many sub-assemblies: supporting elements of the experience hall, chamber nose, the Mechanics System, first plasma diagnostics and energy bank.



CEA-DAM (SIMULATION Program)

Modification, new Control-Command System design and geographical Transfer of the AIRIX Accelerator with production and qualification monitoring of sub-systems.



ITER/F4E

Realization and integration of the Neutral Injection Heating sub-assembly and a prototype of the system (SPIDER).



ITER-India

Prototype amplifier for the Ion-Cyclotron Resonant Heating (ICRH).



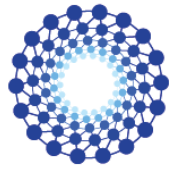
Industry

Study, supply and installation of an high-speed production line of electric bulbs.



Cryogenic RF Couplers

1.3 GHz couplers for the XFEL accelerator with associated conditioning bank.



PIGES



ACCELERATORS AND
CRYOGENIC SYSTEMS



AIR LIQUIDE

ADVANCED TECHNOLOGIES

Fields of expertise of PIGES Members:

- ❖ Projects & Programs Management
- ❖ Technical Engineering and certification
- ❖ Particle accelerator engineering
- ❖ Nuclear safety
- ❖ Advanced materials
- ❖ Metallurgy and Superconductivity
- ❖ Opto Mechanical optronics
- ❖ Optical beam
- ❖ Electrical Engineering, Electronics
- ❖ Magnetism
- ❖ Microwaves
- ❖ High Pulsed Power
- ❖ High voltage, high current
- ❖ Power Electronics
- ❖ Vacuum & Ultra-high Vacuum
- ❖ Cryogenics
- ❖ Precision Mechanics Engineering
- ❖ Micro positioning
- ❖ Assembling Technologies
- ❖ Integration in a clean environment
- ❖ Metrology and non destructive testing

ALCEN



Bodycote

ENIM

Innovate and Act

MECACHROME

SIGMAPHI
ACCELERATOR TECHNOLOGIES

SDMS
la chaudronnerie blanche®

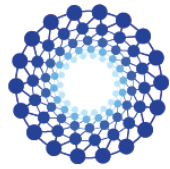
SODERN

Enabling your ambitions

sominex
Défense • Energies •
Industries • Sciences •

Symétrie

THALES



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AIR LIQUIDE

TM

❖ Helium liquefaction and refrigeration systems (1.8K – 80 K) :

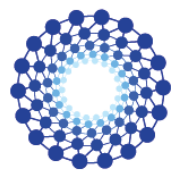
- Liquefiers : 20 l/h to 8 000 l/h
- Refrigerators : 100 W to 30 kW
- Cryogenic storages
- Cryogenic transfert lines
- Gas driers and purifiers





- ❖ Helium liquefaction and refrigeration systems (1.8K – 80 K) main references :
 - LHC, Atlas, CMS at CERN
 - Tore supra, IPR, KSTAR, and now building JT60SA, and ITER Cryoplants
 - Qatar I and II plants: 28% of the helium production World Wide (purification and liquefaction for export)
 - SOLEIL, Diamond, SSRF, NSRRC, NSRC
 - ILL, ISIS, SNS





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Brazing RFQ IPHI

1. *Cleaning CEA*

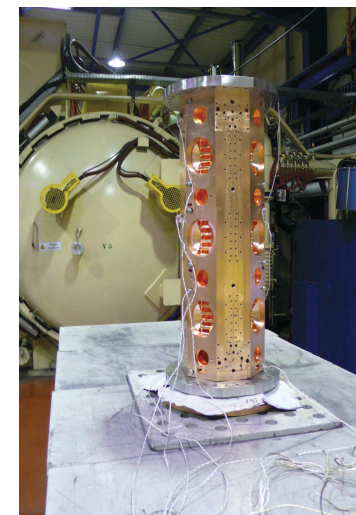
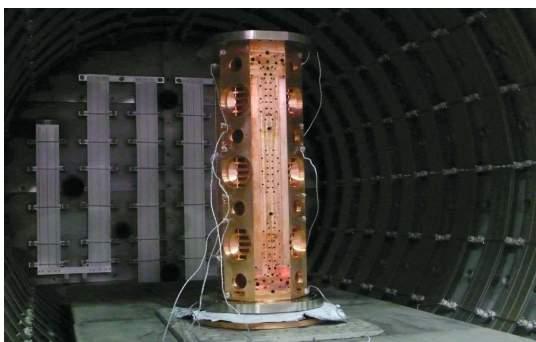
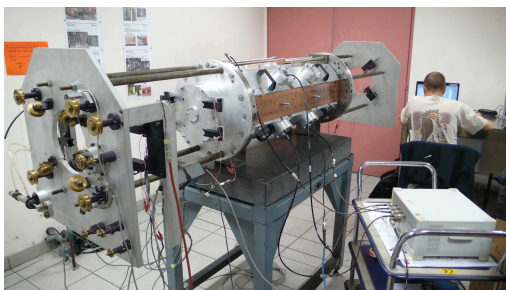
2. *Assembling Mecachrome*

3. *Dimensional measurement
Mecachrome*

4. *Radio frequency measurement
Bodycote*

5. *Vacuum brazing Bodycote*

Bodycote





Brazing CLIC: Accelerating structure



*Assembling and Brazing in
BODYCOTE plant*



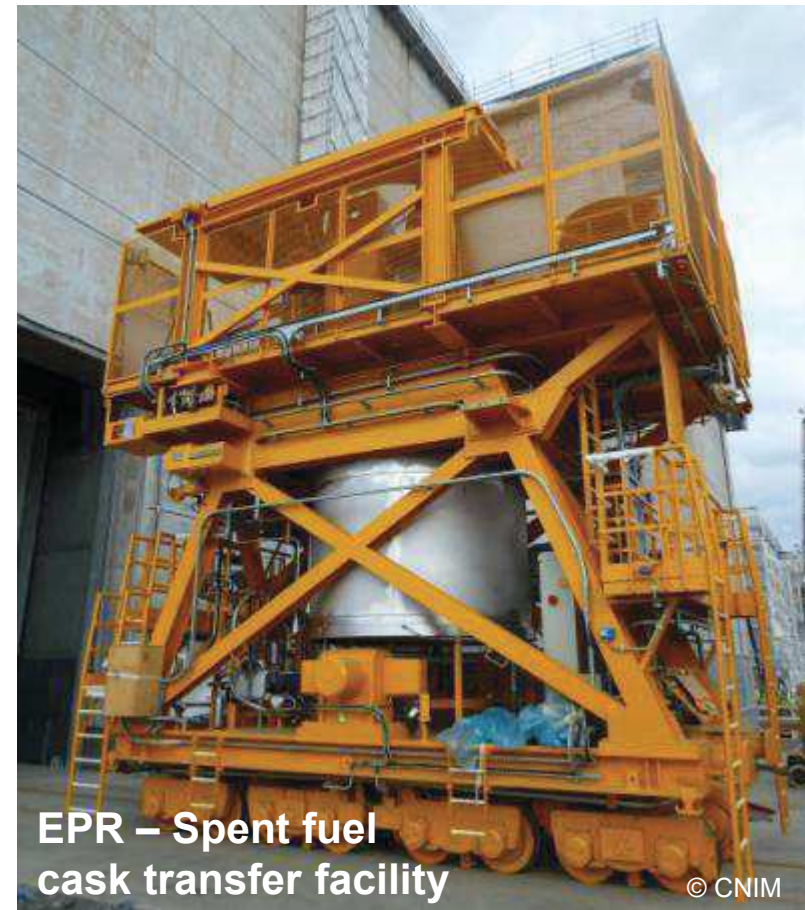
Positionning in CERN

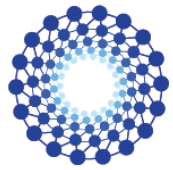
Manufacturing of large mechanical components

- Expertize in Electron Beam welding process
- Big size components machining
- Large facilities located at La Seyne-sur-Mer, with sea access



Design, manufacturing & installation of complex systems

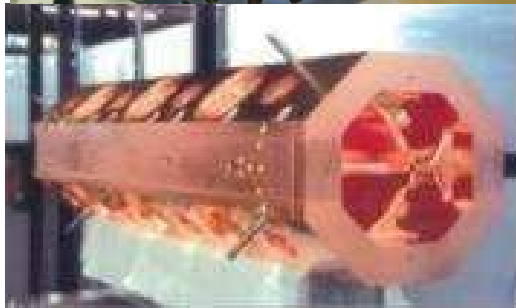
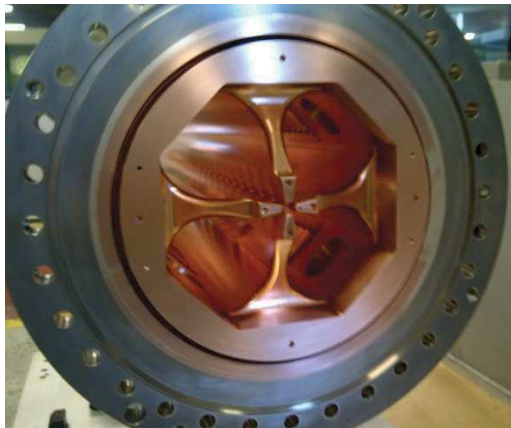




PIGES



❖ High precision Machining



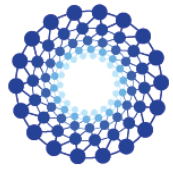
Radio Frequency
Quadrupole RFQ
Project CEA SACLAY



Radiotelescope NOEMA
Project IRAM



Tanks for spatial
applications



PIGES

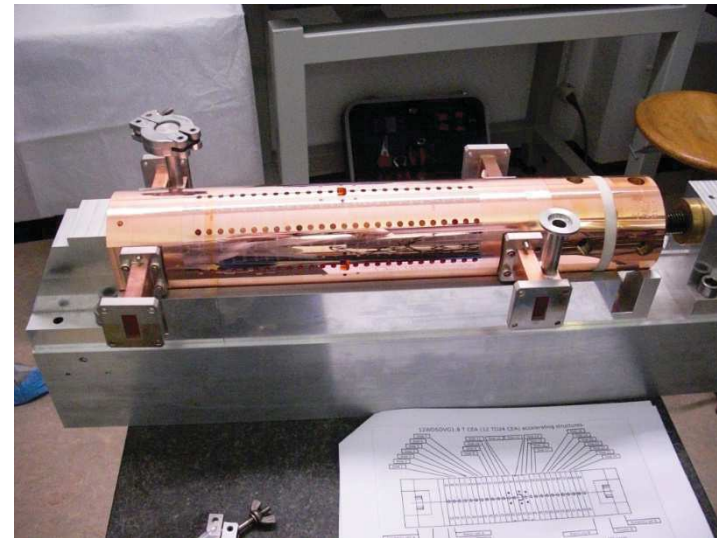


❖ Sub micronic Machining

- CLIC cavities
- Coupleurs



Disk Ø 65, Ra : 2 nm



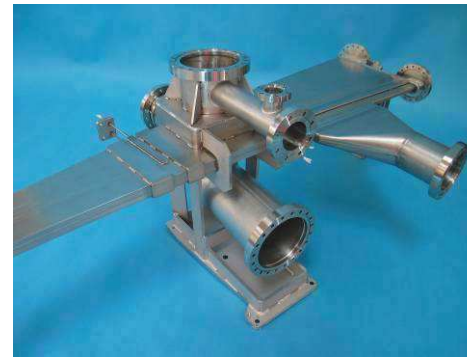
Cavity

CNC Nano-machining at common
R&D center CEA / MKA – Vibraye (72)

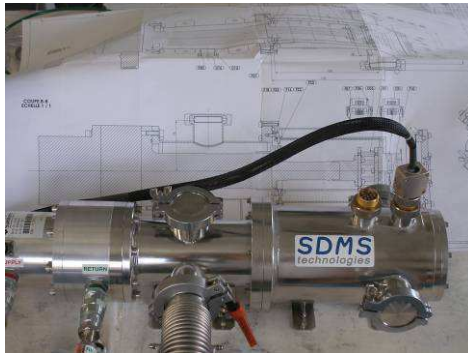


Manufacturing of welded mechanical boilermaking metalwork assemblies and components from noble materials (SS, copper, aluminum, niobium, titanium & nickel alloys,...)

❖ Vacuum & UHV Chambers and Equipment



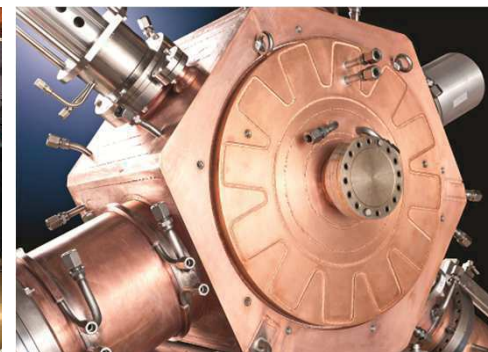
❖ Cryogenic Systems & Components



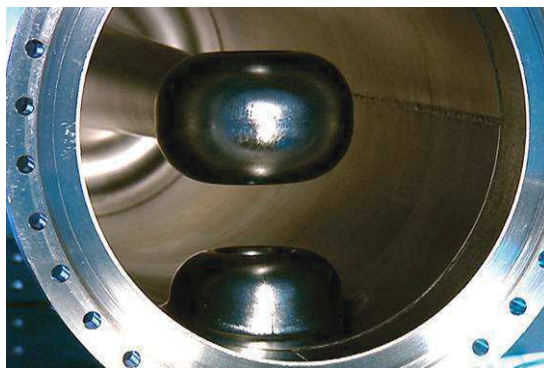


Manufacturing of welded mechanical boilermaking metalwork assemblies and components from noble materials (SS, copper, aluminum, niobium, titanium & nickel alloys,...)

❖ Normal RF Accelerating Cavities



❖ Niobium superconducting RF Accelerating Cavities





Vacuum chamber in the course of manufacturing
(Synchrotron SOLEIL)



Onduleur (Synchrotron SOLEIL)

Supplier of vacuum
chambers and
precision engineering
for particle
accelerators.

Design,
Manufacturing,
Weld,
Assembly,
Integration,
Programming,
Wiring,
Helium test
Vacuum drying
And RGA



Absorber copper/stainless steel
(Synchrotron ESRF)



sominex

Défense • Energies •
Industries • Sciences •



ECR source bench (Pantechnik / BARC, India)
Magnetic elements SIGMAPHI

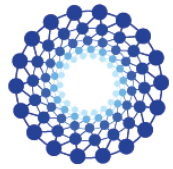


Some references :

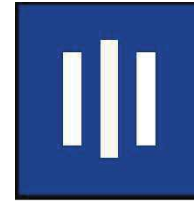
- CERN
- Synchrotron SOLEIL and ESRF
- CEA Saclay
- IPN Orsay
- GANIL

Located in Bayeux
(Normandie)
90 peoples
5500 m² workshops
ISO 9001
ISO 14001
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PIGeS



Symétrie

❖ High precision hexapods and diffractometers

Positioning samples, mirrors, polarimeters, magnets...

Typical resolution: $0.1 \mu\text{m}$ or $0.5 \mu\text{rad}$

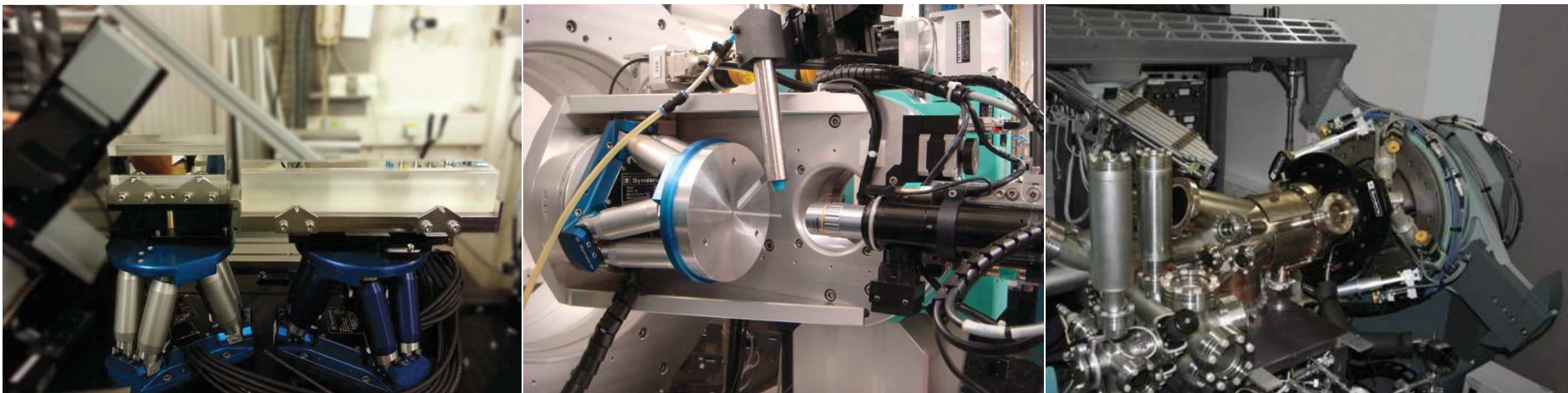
Vacuum compatibility in option



DLS: GI-SAXS

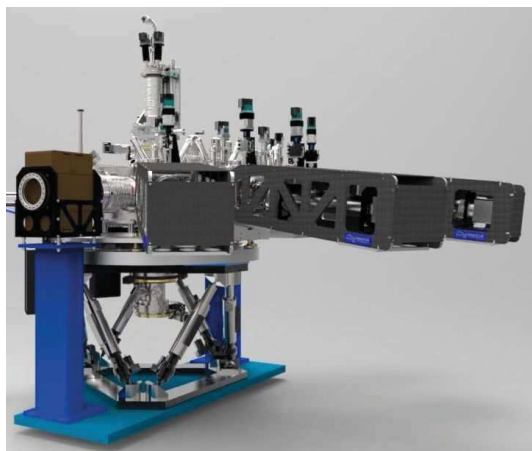
❖ Synchrotrons references

APS - Australian Synchrotron - CEA - ESRF - LBL - MAX-LAB - SLAC - SOLEIL

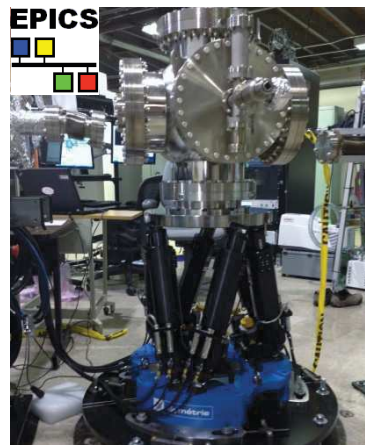


ESRF

❖ Examples of hexapods and diffractometers



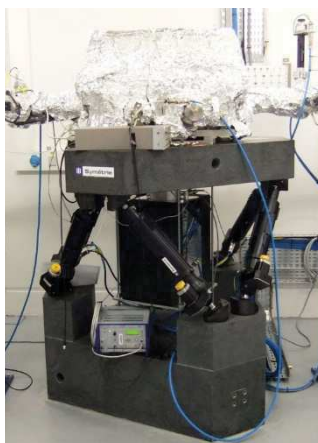
LBL: qRIXS experiments (3200 kg payload)



SLAC



APS



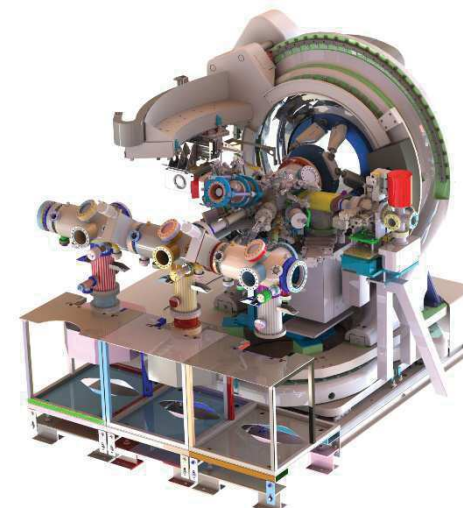
ESRF



Australian Synchrotron

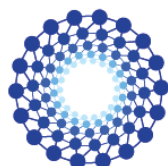


CEA: diffractometer to study nanostructures growth





❖ <https://www.youtube.com/embed/ZxKs9i5lQOQ>



PIGES

Marty Consultants SARL

Objet

- ☐ Conseils en ingénierie, assistance et organisation aux entreprises dans les domaines de la science et la technologie,
- ☐ Services et conseils en matière de communication dans ces domaines.

Champs d'activités

Fusion thermonucléaire,
Fission nucléaire.

Clients

- ☐ CEA,
- ☐ Agence Iter France,
- ☐ Onet Technologies, Comex Nucléaire,
- ☐ CS Systèmes d'Information,
- ☐ Institut pour la Maîtrise des Risques (IMdR),
- ☐ Development of Advanced Engineering Solutions (DAES SA).

Marty Consultants SARL au capital de 1 000 Euros

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