Status of stable beam at the ALTO facility

SAID ABDELHAKIM

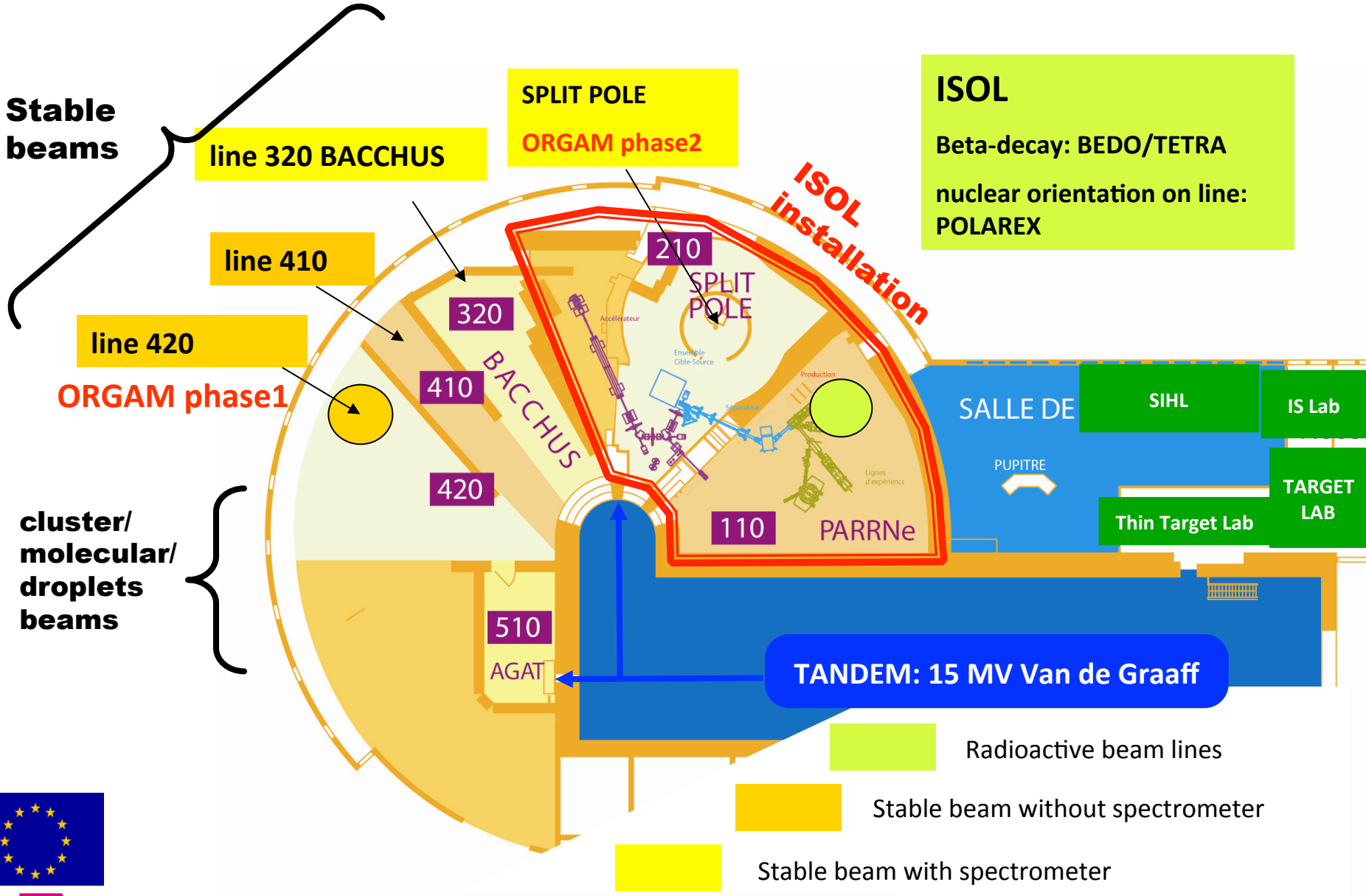
TNA FACILITY

AIMS

- Providing both stable & radioactive ion beams with technical support to experiments
- Developing ion sources and thick actinide targets for the production of RIB
- Developing stable and radioactive thin targets for experiments

Support for experiments:
30 engineers and technicians,
5 physicists

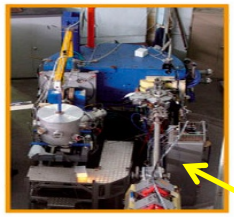
Tandem/ALTO general layout

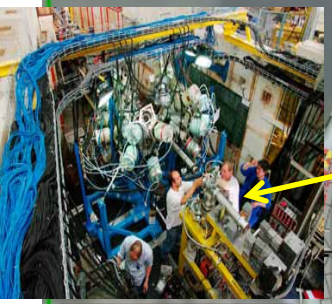


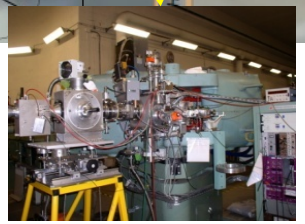
A complex facility with many scientific equipment, 2 accelerators, 2 separators one off line and one on line, 2 spectrometers high-resolution, 8 beams line and a laboratory for the manufacturing of the uranium carbide targets UCx

IPN
INSTITUT DE PHYSIQUE NUCLÉAIRE
ORSAY

ALTO
Accélérateur Linéaire et Tandem à Orsay







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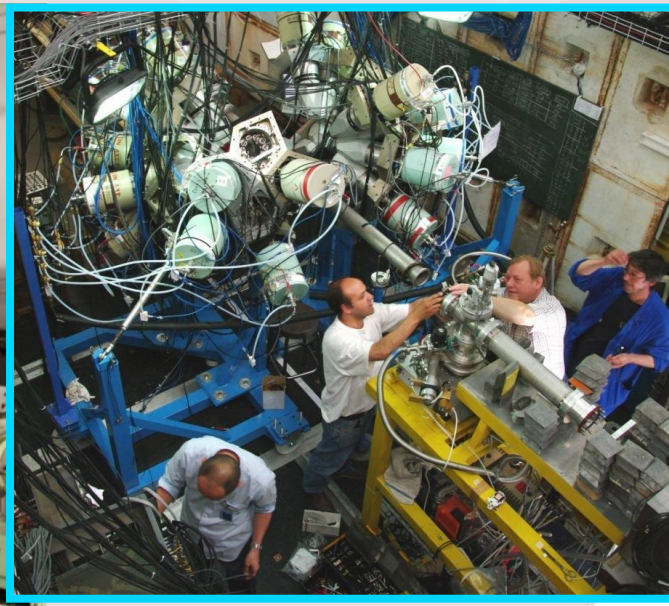
STABLE BEAMS

- 3 ion sources:
  - -Duoplasmatron
  - -Sputter ion sources
  - -Liquid Metal Ion Source: Au_n

Bench for testing ion sources

- 6 beam lines:
  - -Split-Pôle
  - -Bacchus
  - -ORGAM
  - -AGAT
  - -SIFAGA
  - -Free beam line 410

- Acquisition room



OPERATION OF THE TANDEM

For the two accelerators: 33 weeks (4000 H)

- **Tandem 27 weeks**
- **Linac 6 weeks**
- **Produced Beams: p, D, ^{3}He, ^{4}He, ^{7}Li, ^{12}C, ^{13}C, ^{14}C, ^{24}Mg, ^{31}P, ^{32}S, ^{40}Ca, ^{48}Ca, ^{127}I, Cn, CnHm**
- **60% of heavy ions**
- **45% of pulsated beams**
- **Terminal voltage: over 10MV for 65% of time and 13,5-14,7 for 12% of the time.**

We compensated the time of the breakdowns by additional time, one working the weekend

Tandem/ALTO beam schedule Bilan	
Time of scheduled and realized functioning (h) Number of week	3624 27
Conditionning(h)	240
Tests ^{40}Ca , ^{48}Ca (h)	120
Time attributed)to the physics(h)	3284
Breakdowns (h)	260
Number of operators	7
Management of the breakdowns, additional Time (h)	260
Ion beam on Target (h) %	3024 100%

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OPERATION OF THE TANDEM

The failure rate 8%:

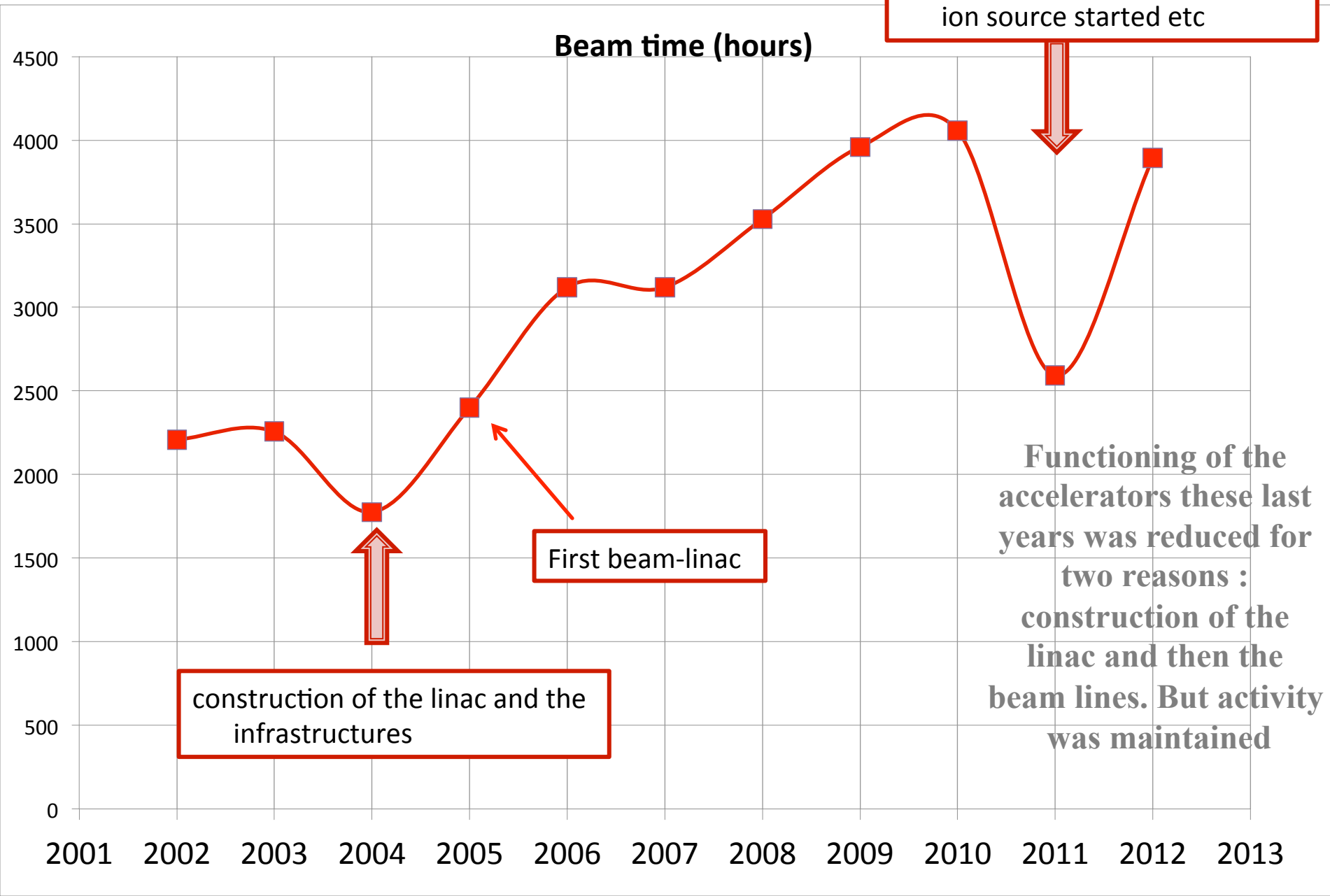
77 % were due to failures of the accelerator
23 % to failures of the injector

Concerning the accelerator, the tank had to be opened 4 times:

problem with the bearings of the laddertron wheel at the terminal, rupture of the alternator belt on two occasions, problem with the ion source Orion.

The failures on the injector were mainly due to the ageing of the optical fibers and of the electrical connections.

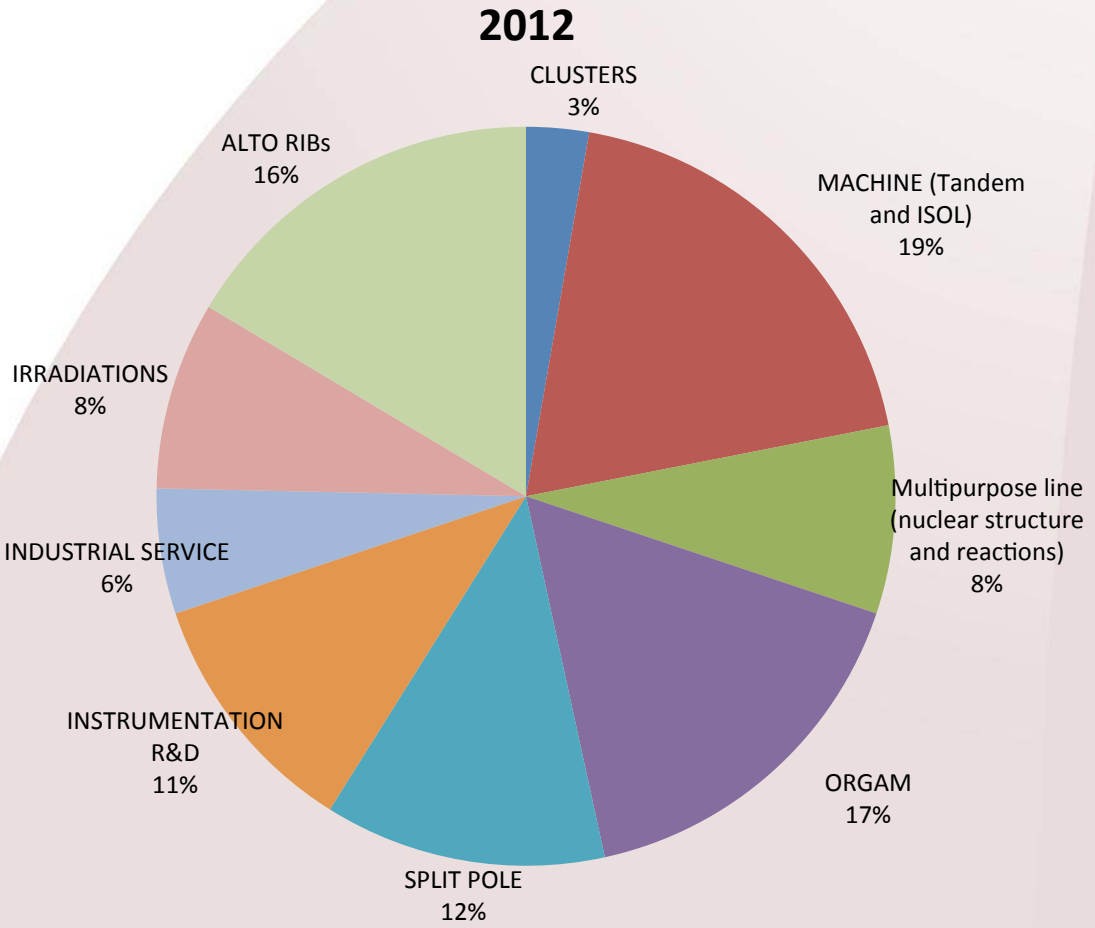
—beam provided —



EXPERIMENT

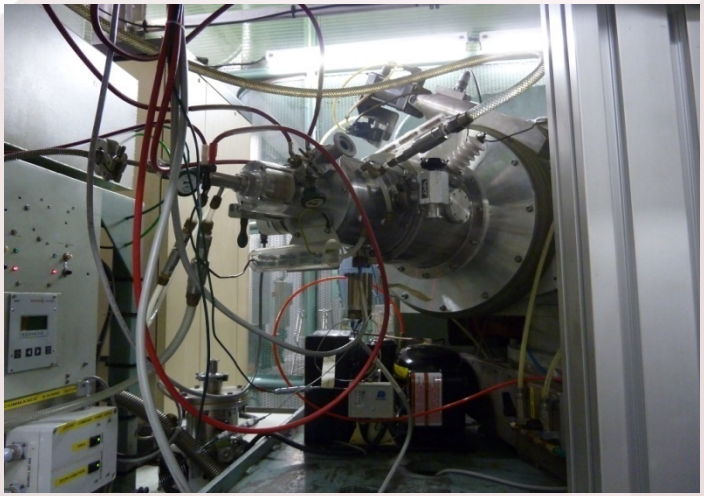
Users

- ✓ **250 researchers from 26 foreign institutions and 15 national ones.**
- ✓ 33% Nuclear Physics/ Astro-Physics
- ✓ 15% Clusters/Astro-Chemical
- ✓ 19% Instrumentation and other applications
- ✓ 13% Material irradiations
- ✓ 20% R&D improvement/ development



the topics of the experiments are very multi-field, with always a dominate for the nuclear physics

Development on ion beams



Installation of new high intensity ion source for Clusters and ^{48}Ca

- Fullerene beams are produced by bombarding a target made of compressed fullerene with a 20 keV cesium beam
  - *Production of 10^7 C^{3+}_{60}/s at 48 MeV*
- Cs sputter ion source (type 860C) was tested off line in order to produce C_{60} ions and ^{48}Ca
  - The results showed that the new source produced 10 times more beam (^{12}C = 100 µA instead of 10 µA)
  - Next test with fullerene and ^{48}Ca targets underway (2014)

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Development on ion beams

^{14}C Beam

Objective : intense beam of ^{14}C :

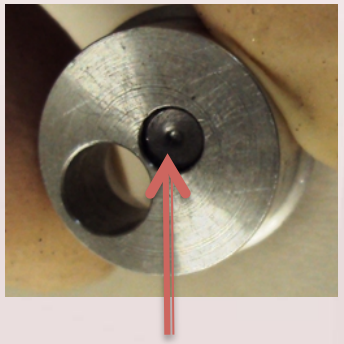
Previous experiments at Tandem with radioactive FeC paste :
initial activity = 25 mCi or 2.59 GBq
This experiment with a mixture of Carbon 14 and 12 in powder :
initial activity = 70 mCi or 7.25 GBq

Preparation of the target of ^{14}C in a gloves box : *Images of preliminary tests with only ^{12}C*

17 of ^{14}C + 53 of ^{12}C :
70 mg of carbon

Filling the target
with a spatula

Pressing to compact
the powder



^{14}C target

Assembly operation under extraction hood :

The ^{14}C target is placed in the source

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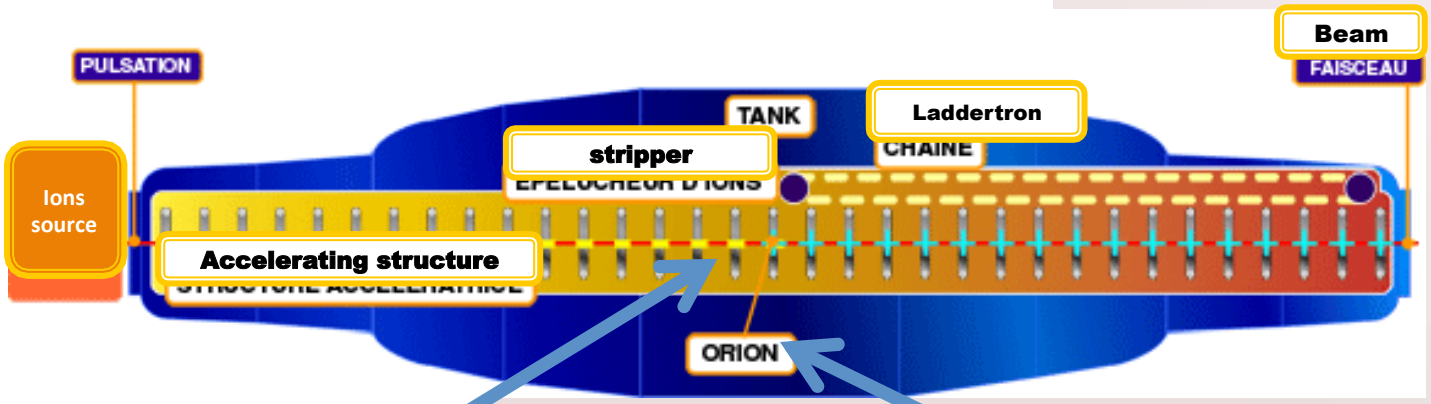
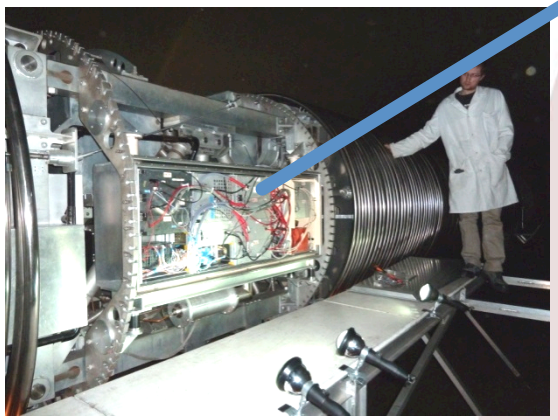
New method to produce the targets of **^{14}C** , we obtained an analyzed current of 100nA. Multiplied by 3

INSTALLATION OF AN AUTOMATON SYSTEM IN THE TERMINAL OF THE TANDEM

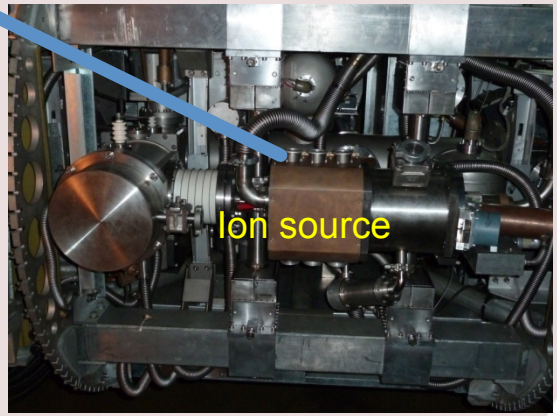
the decision develop a new C&C and to install an automaton inside the accelerator at the terminal 15MV. Support the pressure of SF6 and the Sparks - first successful test for the Tandem





The control and command system installed in the terminal

Orion: Beams of heavy gold cluster Produced by liquid metal ion source (LMIS)



Seen through the bottom

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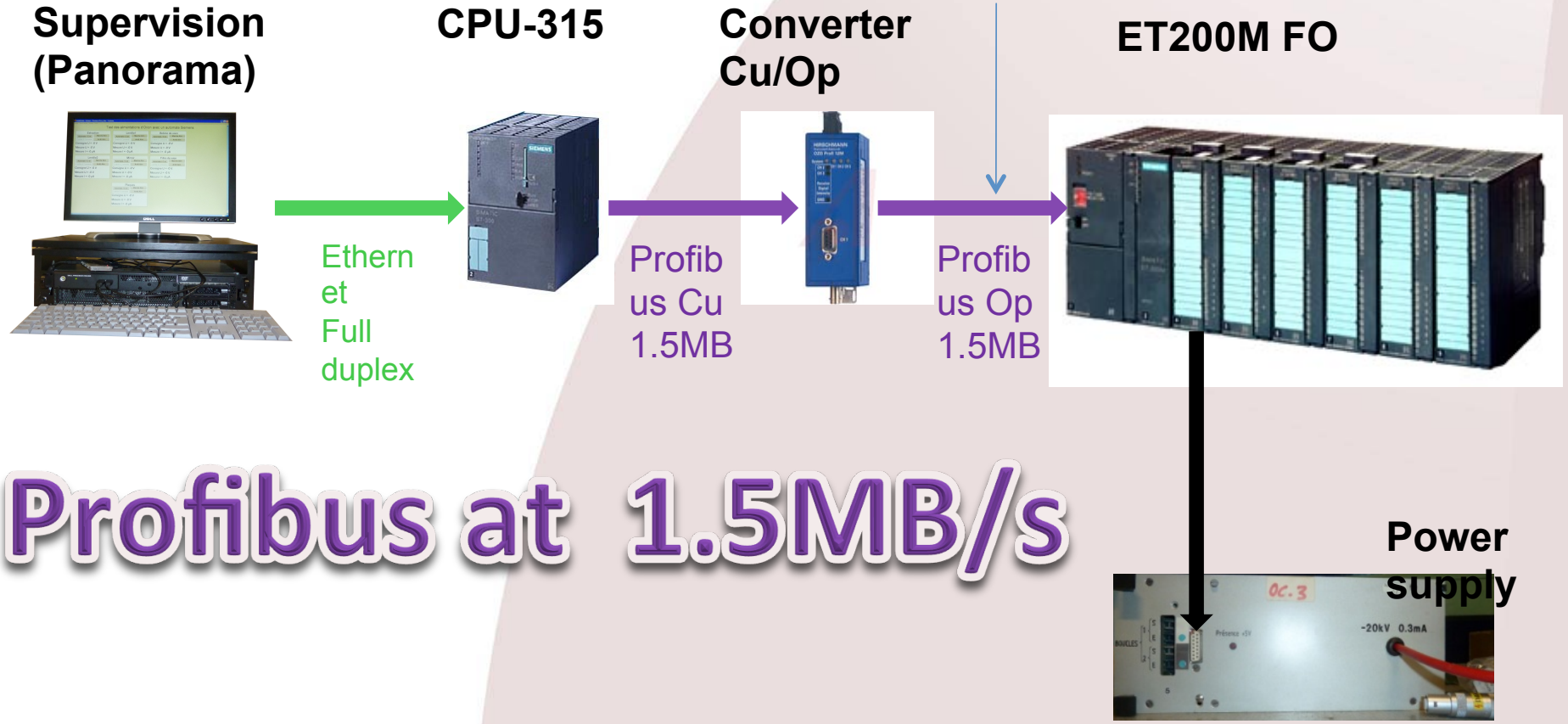
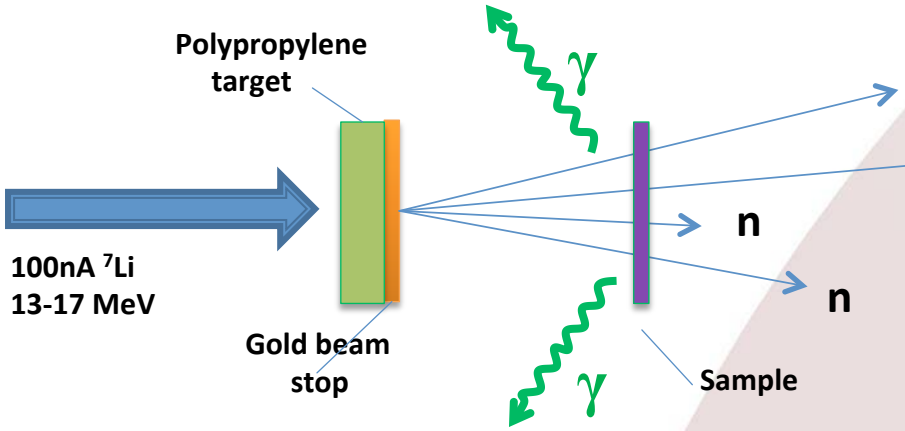
Development on automaton

Principal plan of the system based on automaton



Lithium Inverse Cinematiques ORsay Neutron source

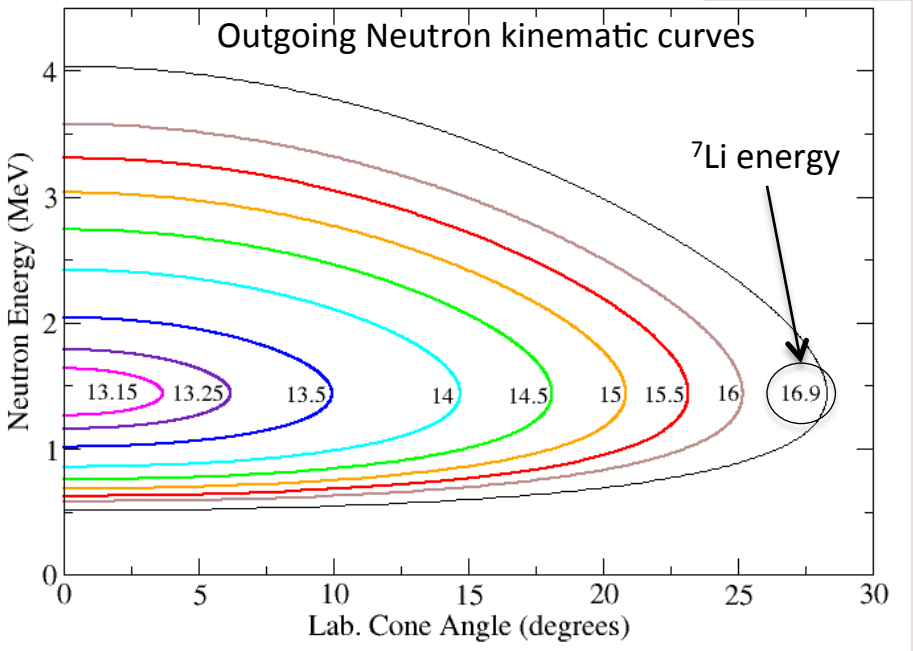
In september 2012, an experience has been performed using the 7Li ion beam produced by the TANDEM of the ALTO facility. The purpose of this experience was to test the possibility to produce neutron using the lithium on proton reaction. The test was successful and neutron fluxes up to 10^7 n/s/steradian were measured.From now on, the ALTO facility also propose neutron beam of energy between 0.5-4 MeV.



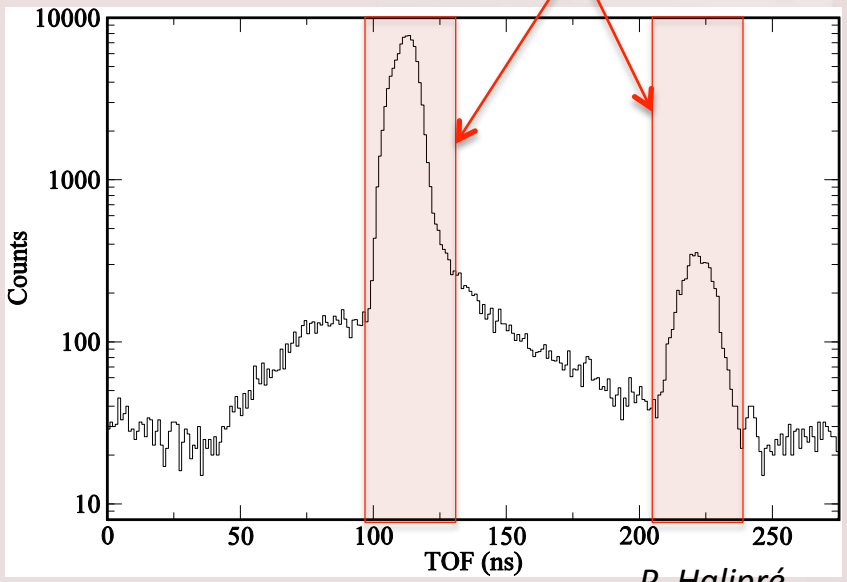
Intense focused monoenergetic neutron source:
10^7 n/s/steradian

Part of the European program ERINDA

E_n=0.5 – 4 MeV



Time of flight spectrum
For LICORNE Neutrons
(^{7}Li@15 MeV)



P. Halipré

Applications for the industrial ones

Tests of embarked instruments and irradiations of components

Program JUICE

For the impact study of radiations on Schottky diode manufactured with the LPN or by UMS for space program JUICE of the ESA (mission of class L). The LERMA is responsible for the delivery of several circuits using of the Schottky diode for the submillimeter instrument heterodyne receiver SWI which will observe Jupiter starting from 2030 (launching 2022).

Satellite Planck

Irriadiation of embarked measuring instruments :

HFI : detectors bolometric, multiple cooling systems, and electronics with weak noise

Beam line dedicated to the industrial ones