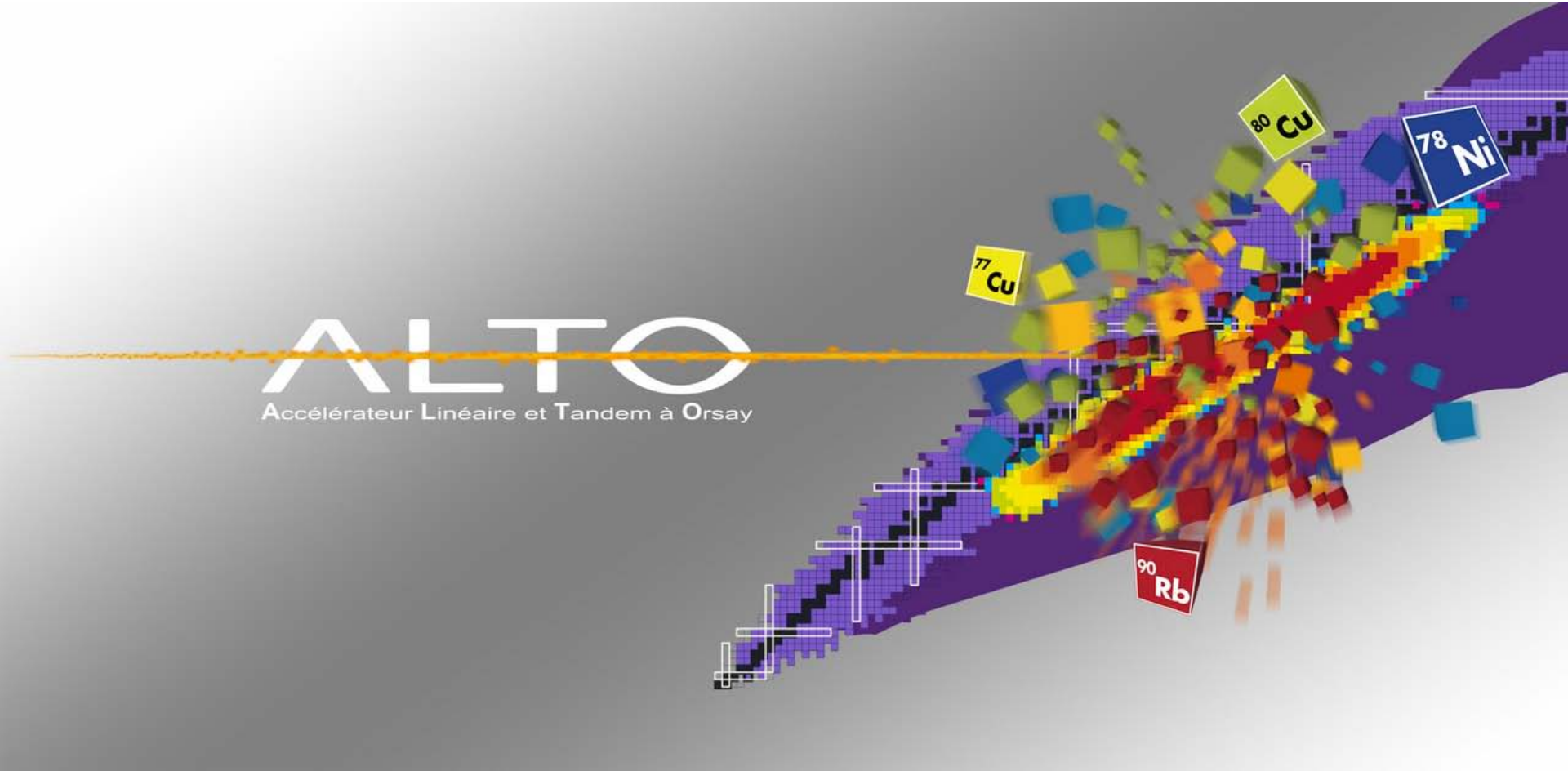
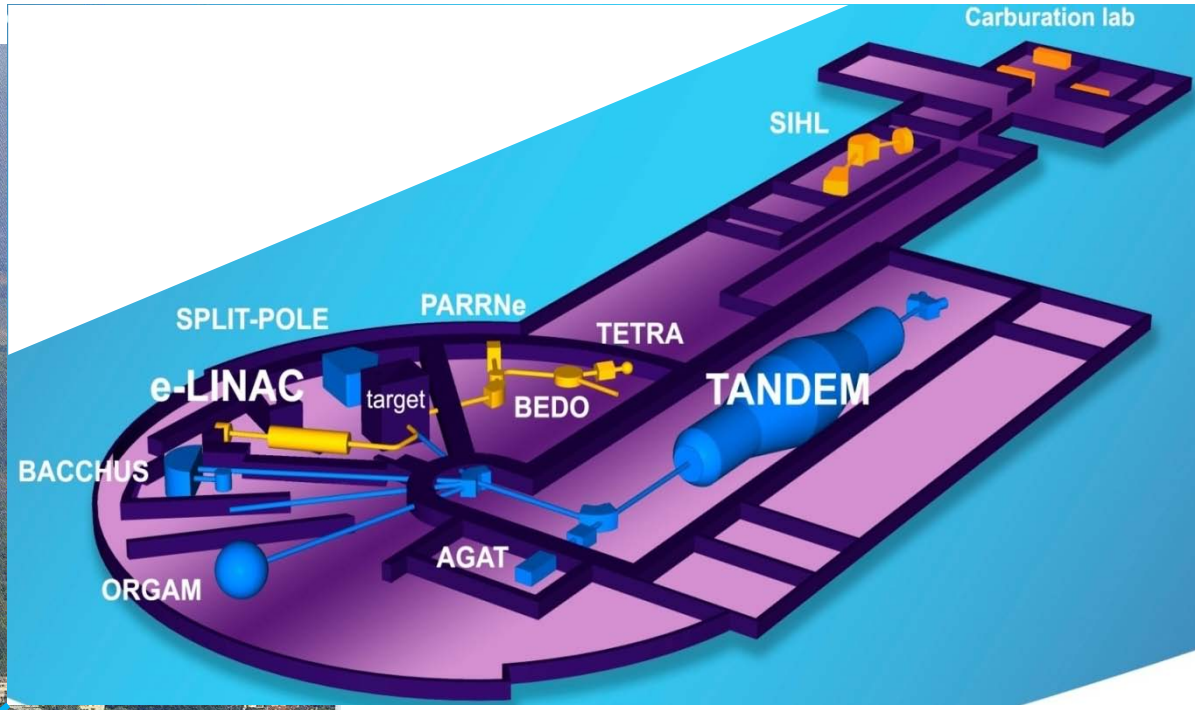
IPN
INSTITUT DE PHYSIQUE NUCLÉAIRE
ORSAY

cnrs IN2P3
Les deux infinis

UNIVERSITÉ PARIS SUD





cnrs IN2P3 Les deux infinis

UNIVERSITÉ PARIS SUD

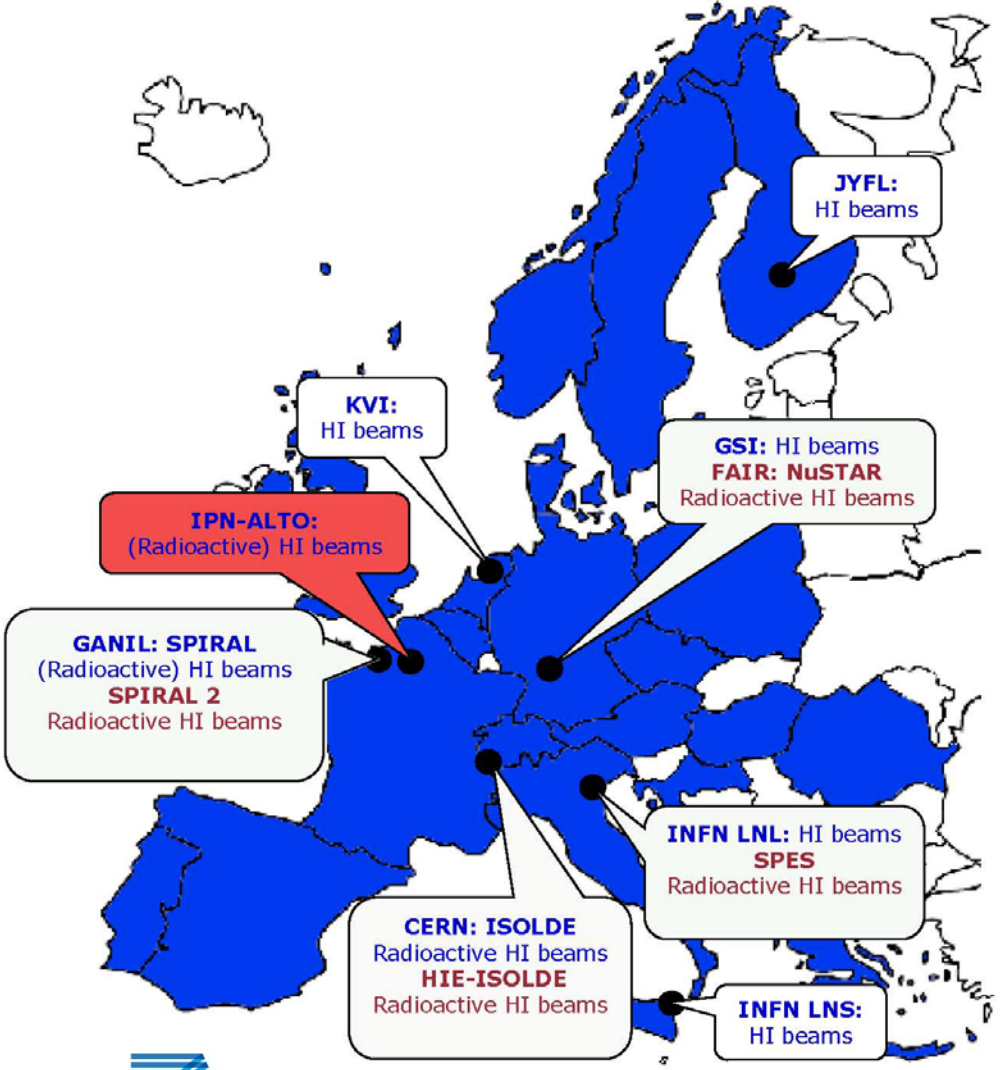
SEVENTH FRAMEWORK PROGRAMME

ENSAR

IPN ORSAY

Tandem+ISOL = 4000 h per year
Possibility to run in the future
ISOL and Tandem simultaneously
28 engineers and technicians for
Technical support

250 outside users (30 countries)/an



PAC: One/year

- R. F. CASTEN , Chair (Yale University)
- E. BALANZAT (CIMAP – Caen)
- D. BALABANSKI (Sofia – Bulgarie)
- S. GREVY (CENBG)
- E. KHAN (IPNO)
- *W. KORTEN (SPhN-IRFU-CEA)*
- B. RUBIO (IFIC Valencia)
- C. TRAUTMANN (GSI)
- A. TUMINO (LNS -Catania)
- J. C. THOMAS (GANIL)

(next PAC 23-24 of january 2014
With new people : P. Reiter and P. Regan)

SEVENTH FRAMEWORK PROGRAMME

ENSAR

ALTO:
TNA within ENSAR

IPN ORSAY

March 2012

green light from French nuclear safety authorities

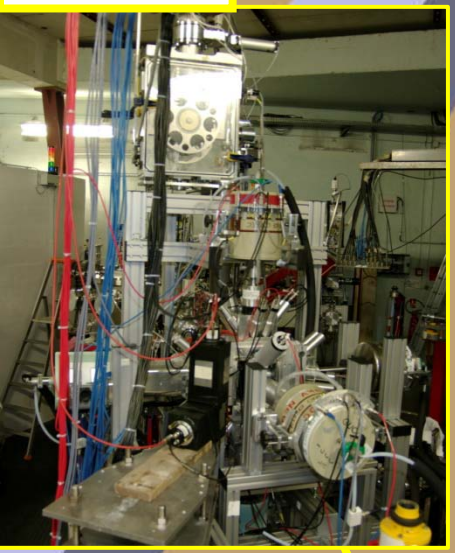
May 13th 2013 – formal inauguration

May 14-15th 2013 – Workshop on the Physics at ALTO

ALTO=ISOL installation based on photo-fission: the first of its kind in the world

e-LINAC
10 µA
50MeV
(former 1st section of the LEP injector)

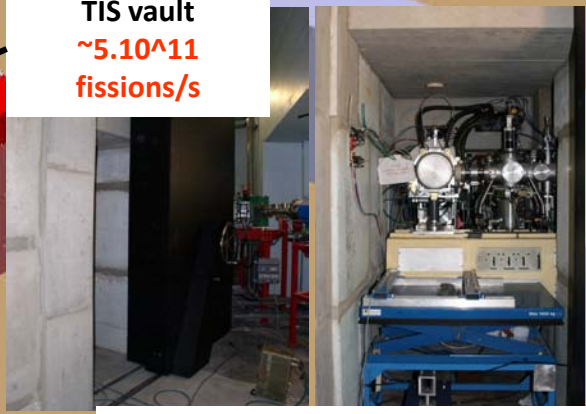
BEDO
beta decay spectroscopy



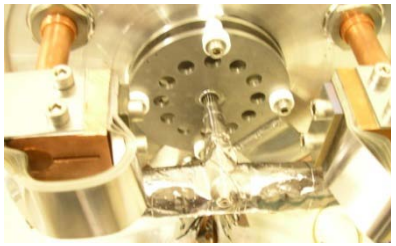
secondary beam lines

POLAREX
nuclear orientation on line

TIS vault
~5.10^11 fissions/s

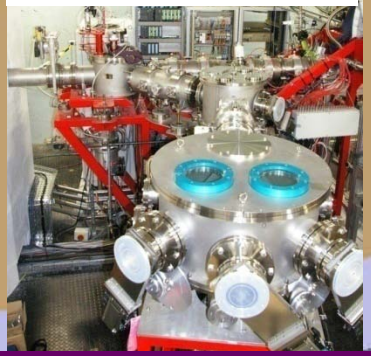


Target Ion-source ensemble



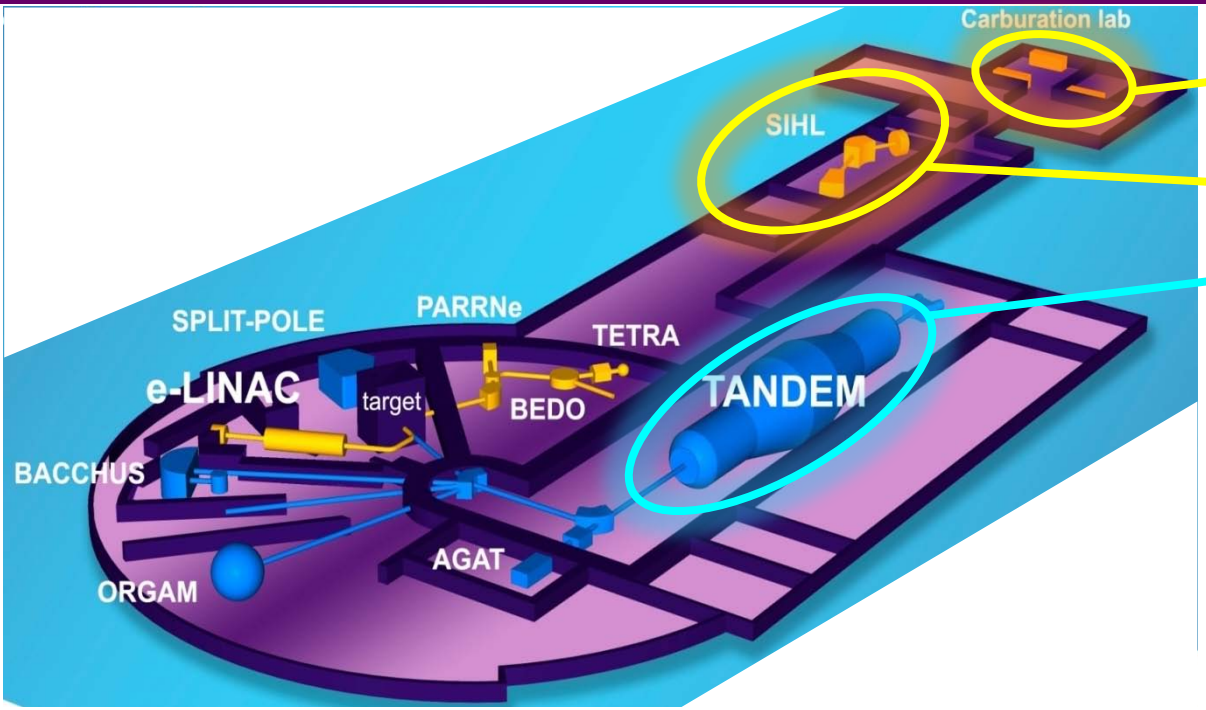
PARRNe mass separator

kicker - bender



identification station

UCx developments at IPN - ALTO



Carburation lab

SIHL off-line mass separator

15 MV MP Tandem

Strategy :
Measure the release properties of pellets after irradiation
⇨ Control and characterize :
the different parameters:
- UCx synthesis method
- porosity
- microstructure
- physicochemical properties
- …

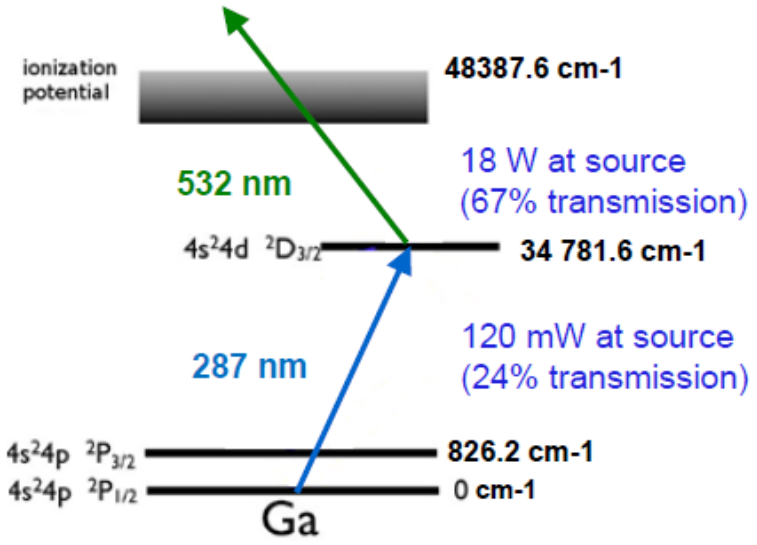
Sample	*Precursors*	*Open Porosity (%)*	*Effective density ($g.cm^{-3}$)*
PARRNe	U_3O_8 + 6 C or UO_2 + 6 C	~60	8.5
OXY	UO_2 + 3 C	~40	13.5
OXA	$U(C_2O_4)_2,2H_2O$ + 3 C	~40	13.5
COMP30	$U(C_2O_4)_2,2H_2O$ + 3 C + 30 vol.% graphite fibers	~60	10.5
ARC	U+C	~10	13

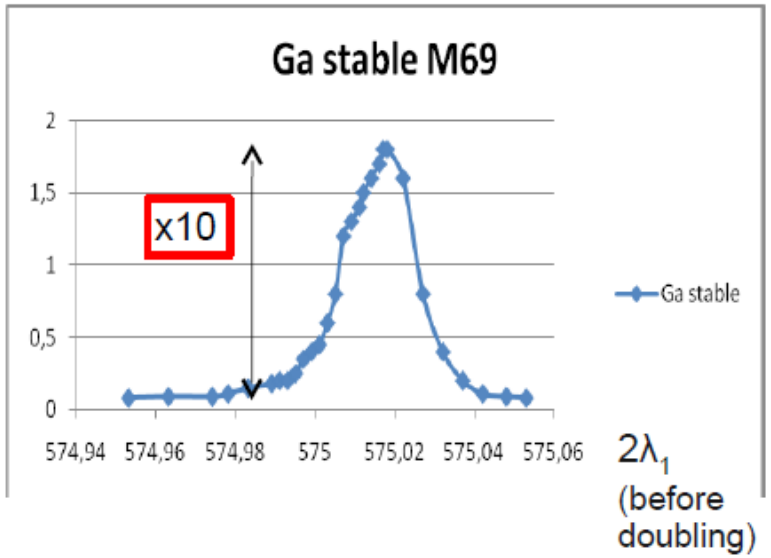
Densest samples

Porous samples

Laser ionized RIBs at ALTO

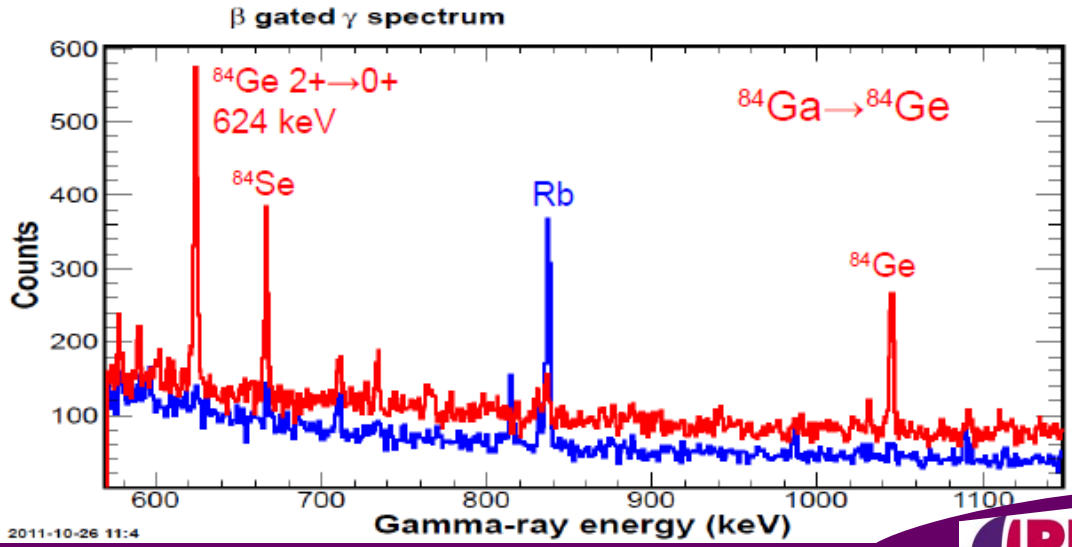
Ga isotopes on-line delivery in 2011





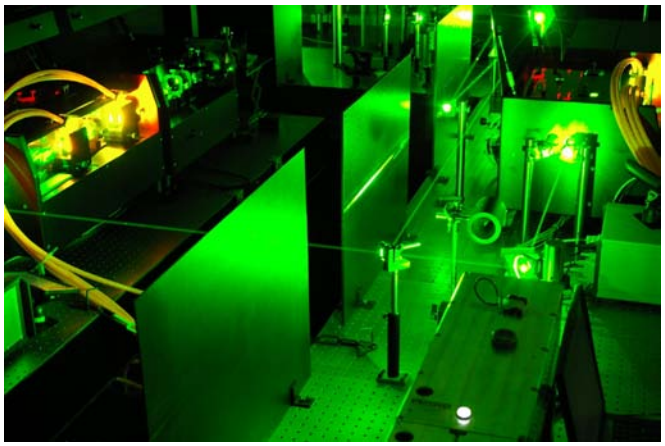
laser ionisation ε~10% (10 μA)

without laser:
surface ionisation ε~1% (1 μA)

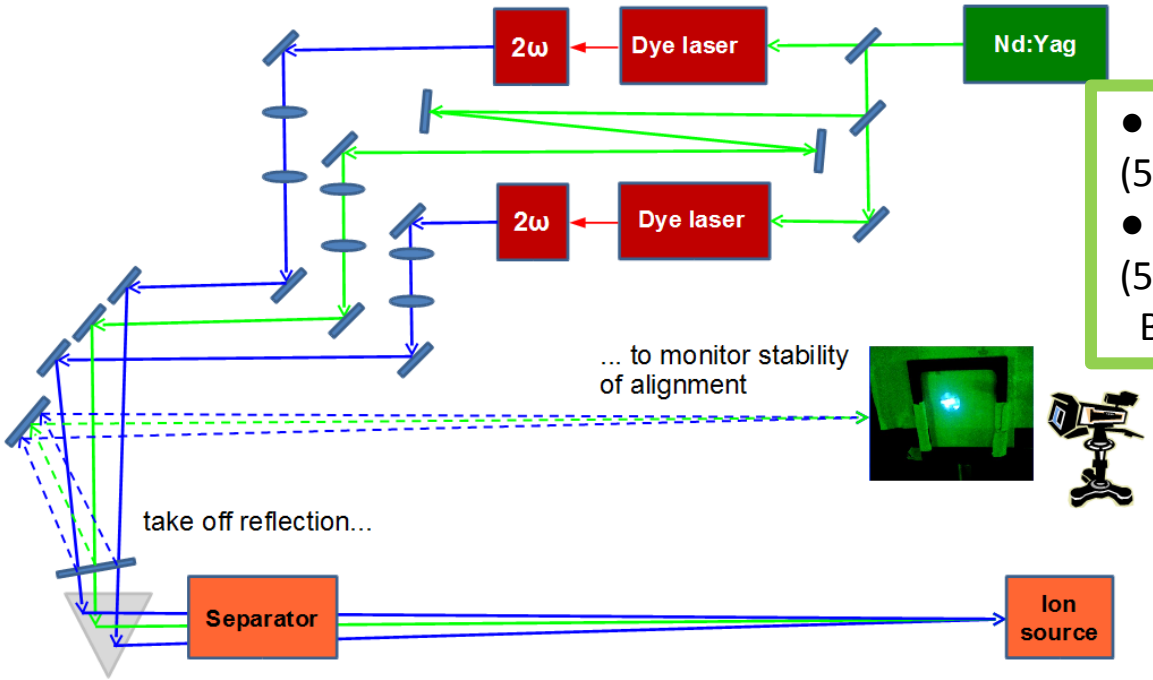


Laser ionized RIBs at ALTO

Upgrades 2012 - 2013



- Validated with Ga beams: 287/297 nm + 532 nm
- **Next run with Zn beams: 214 nm + 636 nm + 532 nm (f tripling) – starting June 17th 2013**
- Laser schemes and optics settled with the support of ISOLDE-CERN



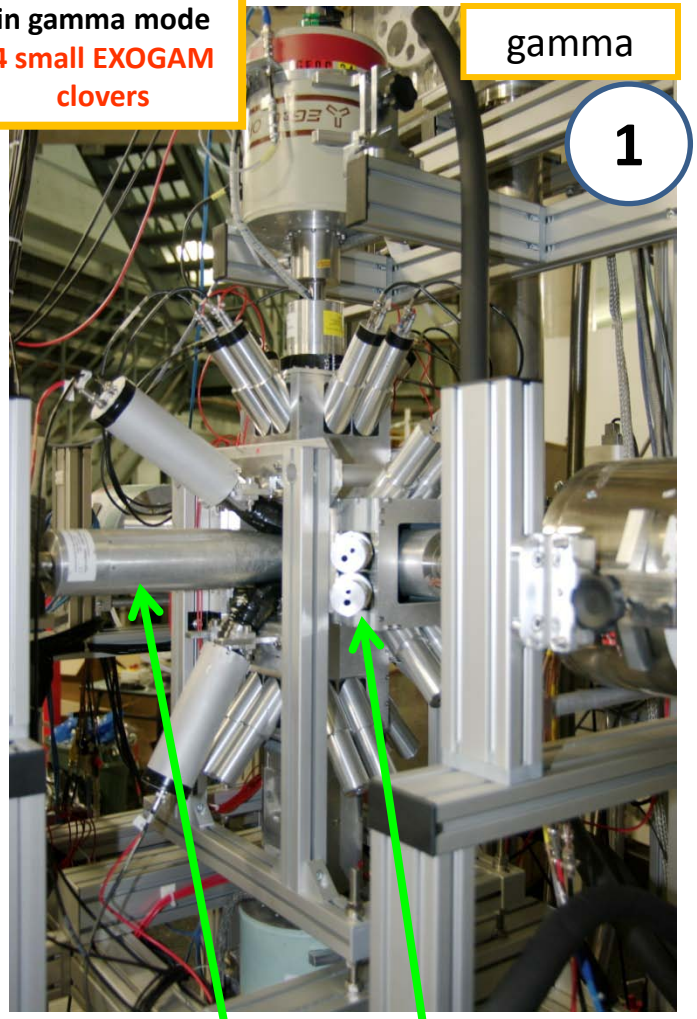
- EdgeWave pump laser (532 nm, 100 W, 10 KHz, 10 ns)
- 2 Radiant Dyes Narrowscan lasers (540 – 900 nm)
  BBO doubling units (270 – 450 nm)

BEDO : BEta Decay studies at Orsay

BEDO setup in gamma mode
4 small EXOGAM clovers

gamma

1

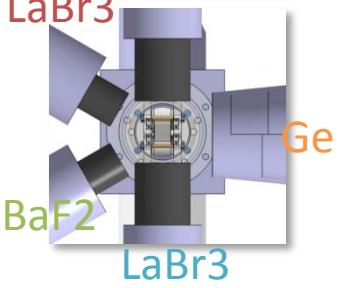


Ge detectors

BGO shields

3

fast timing mode



Distances / source :

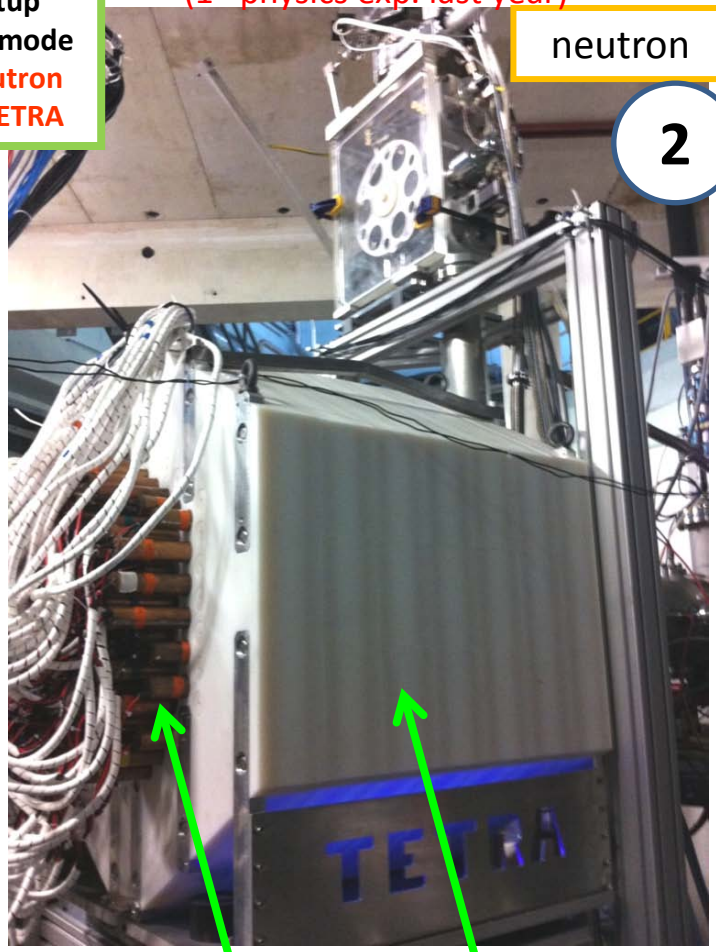
- Ge = 40 mm
- LaBr3 = 25 mm
- BaF2 et LaBr3 = 40 mm
- Plastique = 25 mm

BEDO setup in neutron mode
Dubna neutron detector TETRA

(1st physics exp. last year)

neutron

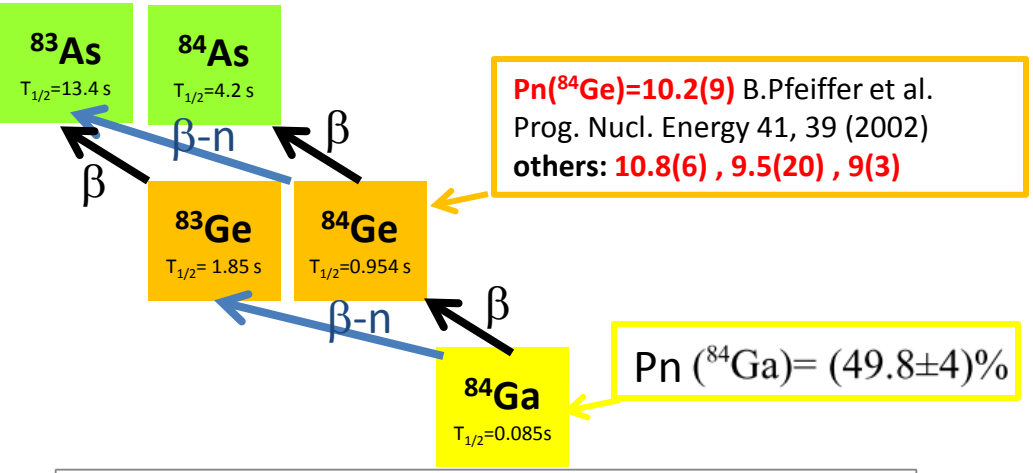
2



~90 ^{3}He tubes

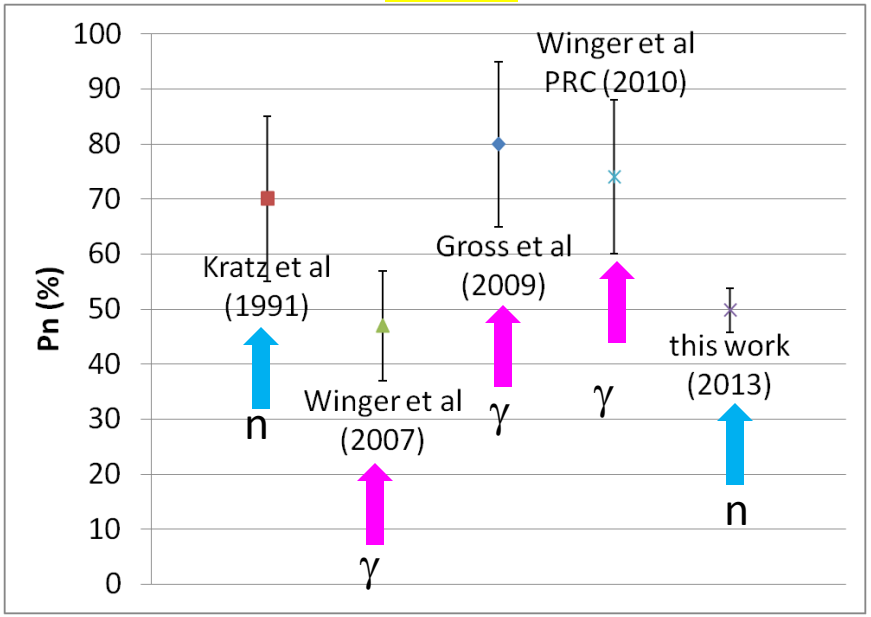
borated polyethylene shielding

Direct β-delayed neutron emission measurement of ^{84}Ga with TETRA



Pn(^{84}Ge)=10.2(9) B.Pfeiffer et al. Prog. Nucl. Energy 41, 39 (2002)
others: 10.8(6) , 9.5(20) , 9(3)

Pn (^{84}Ga)= (49.8±4)%



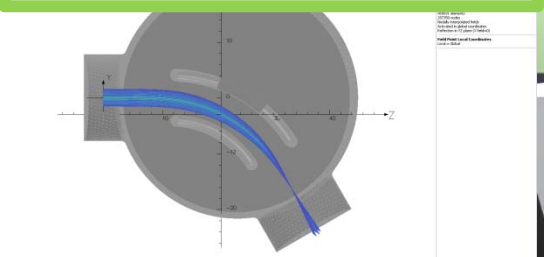
Pn=70(15) K.-L.Kratz et al. Z.Phys. A340, 419 (1991) and B.Pfeiffer et al. Prog. Nucl. Energy 41, 39 (2002)
Pn=80(15) C.J.Gross et al. Acta Phys.Pol. B40, 447 (2009)
Pn=47(10) J.A.Winger et al Proc.4th. Intern. Conf. Fission and Properties of Neutron-Rich Nuclei, Sanibel Island, Florida (2007);
Pn=74(14) J.A.Winger PRC 81, 044303 (2010)

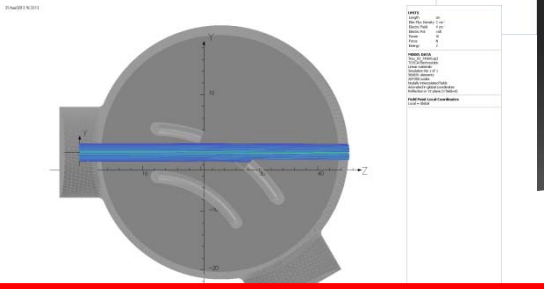
D. Testov PhD work and Orsay-Dubna collaboration
Yu Penionzhkevich, V. Smirnov and E. Sokol

TETRA detector at **BEDO** setup:
- 4Π neutron detector 90 counters ^{3}He 7 atm [measured eff. 63±5% (on line)]
- 4π beta detector
- 1 Ge detector

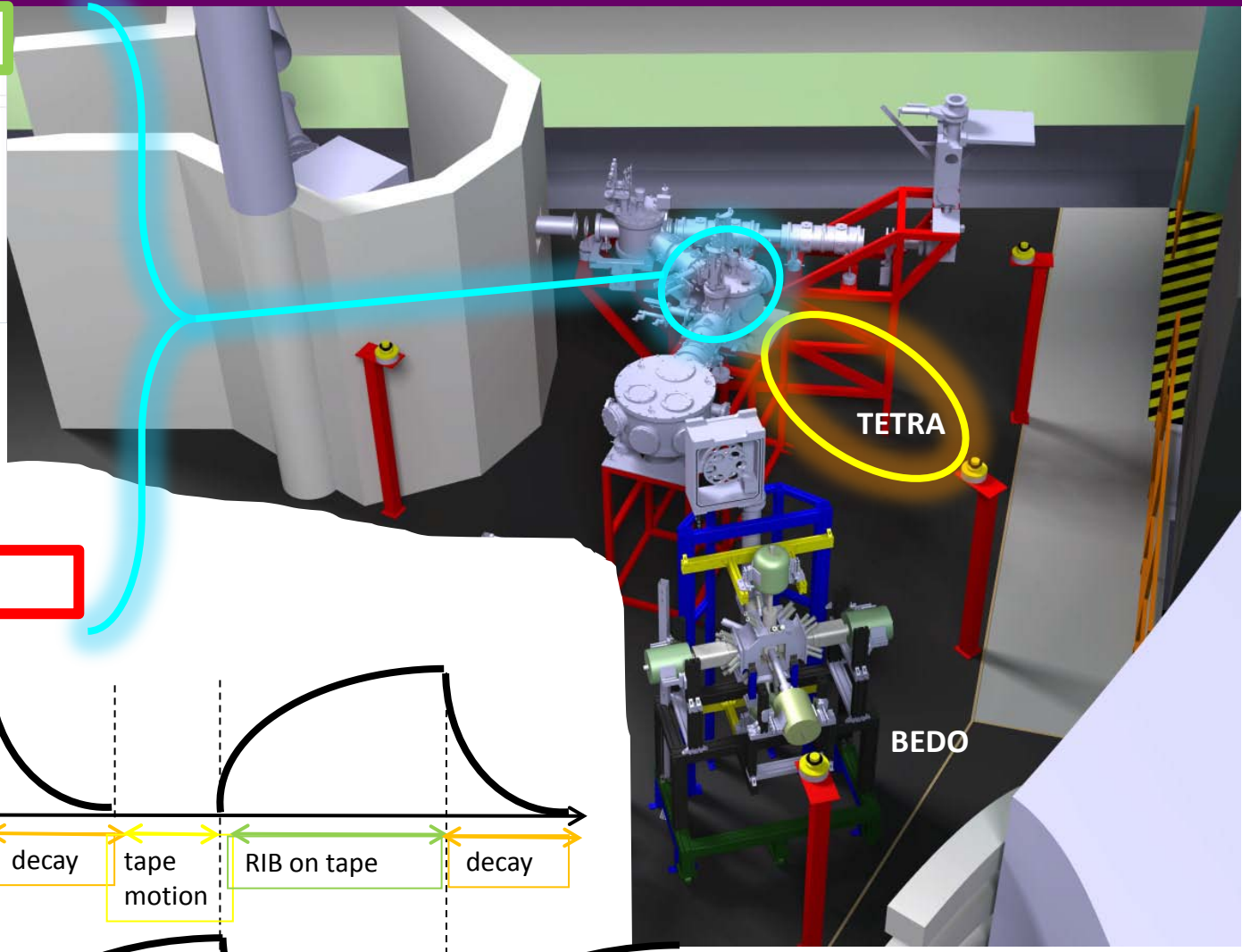
TETRA and BEDO in sequential mode

dipole ON -> towards BEDO



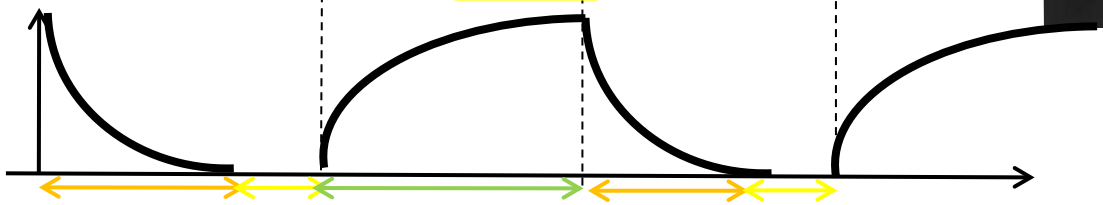


dipole OFF -> towards TETRA



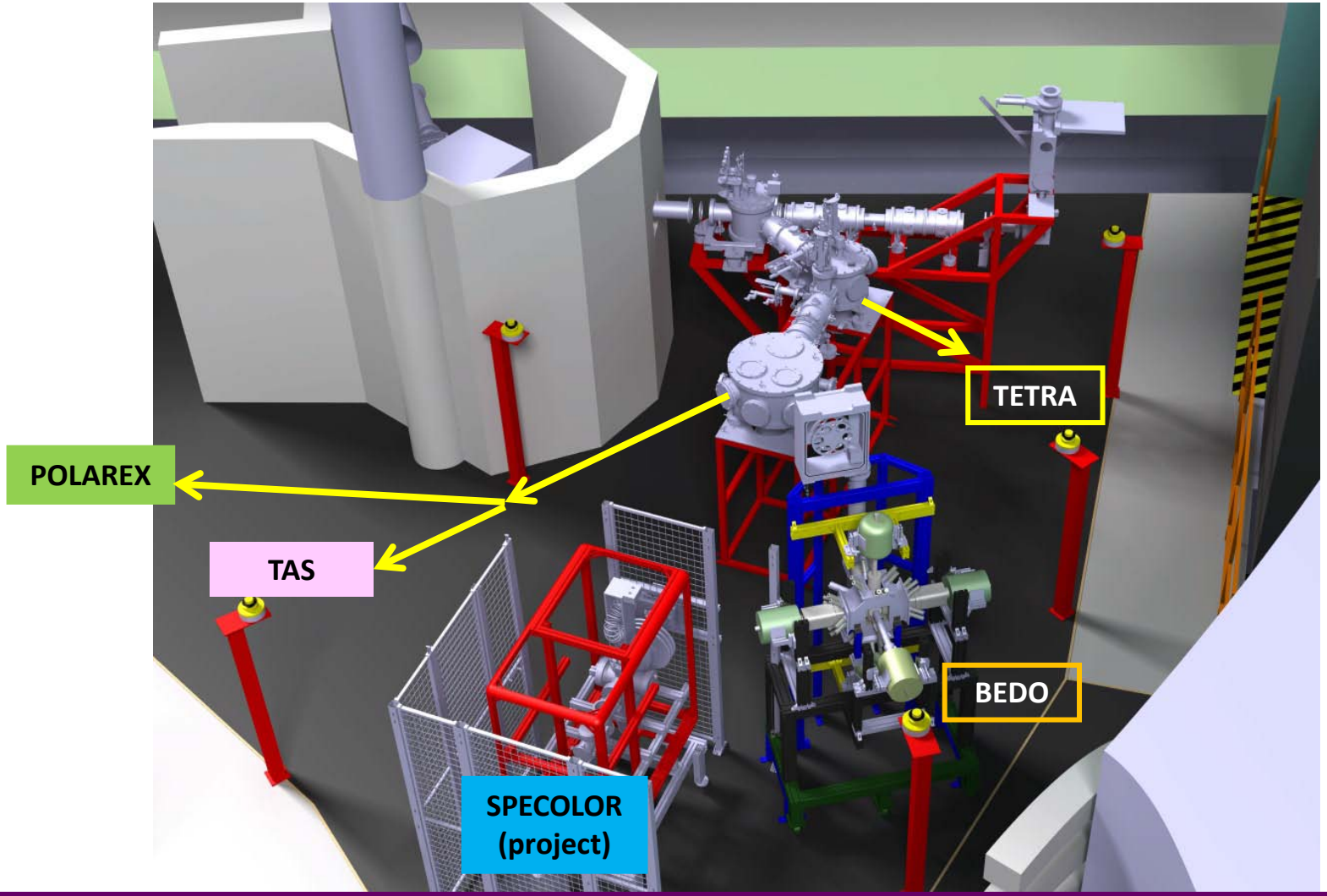
BEDO

TETRA



Expected on line
March-April 2014

Physics at the right arm of the kicker-bender



—The Orsay Gamma Array —

ORGAM

Campaign Manager: Iolanda Matea

2012
- Only LoanPool resources
- 13 BGO + 13 EUROGAM Phase 1 Ge

→ next campaign, autumn 2013
~20 detectors back from Warsaw+ LP resources

N-SI-52 : "Toward the excitation and de-excitation of nuclear isomers in plasma"
(SP: F. Hannachi, CENBG, Bordeaux, France)

Ancillaries:

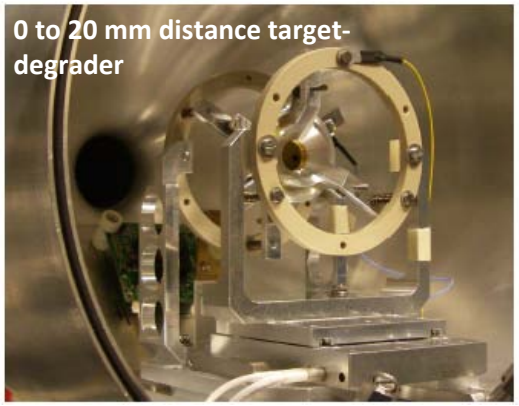
none

N-SI-48 : "Development of the Time Dependent Recoil In Vacuum technique for *radioactive-beam geometry*"
(SP: G. Georgiev, CSNSM, Orsay, France)

N-SI-50 : "Probing the boundary of shape coexistence south of Z=82: Lifetime measurements of excited states in ^{170}Os using the RDDS method"
(SP: J. Jjungvall, CSNSM, Orsay, France)

N-SI-44 : "Search for X(5) symmetry in ^{168}W nucleus"
(SP: K. Gladnishki, Dept of Atomic Phys, Faculty of Physics, Sofia, Bulgaria)

OUPS Plunger



N-SI-49 : "Study of Superdeformed Shell Structure and Beyond in A∼40 Nuclei"
(SP: E. Ideguchi, CNS, Univ of Tokyo, Japan)

Silicon Ball

→ to be continued in 2013 with the full Ge array

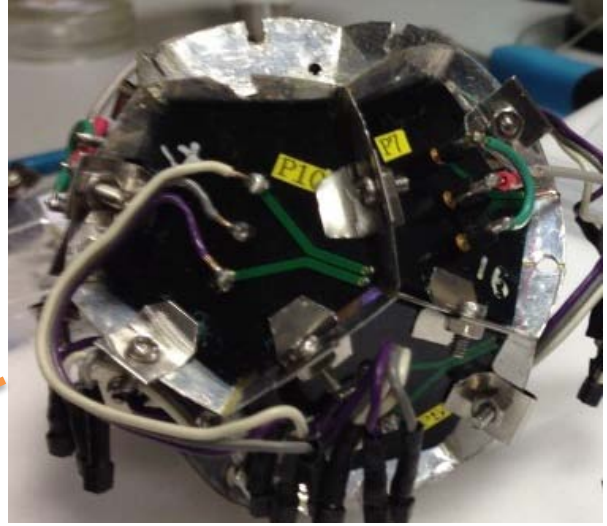
IPN ORSAY

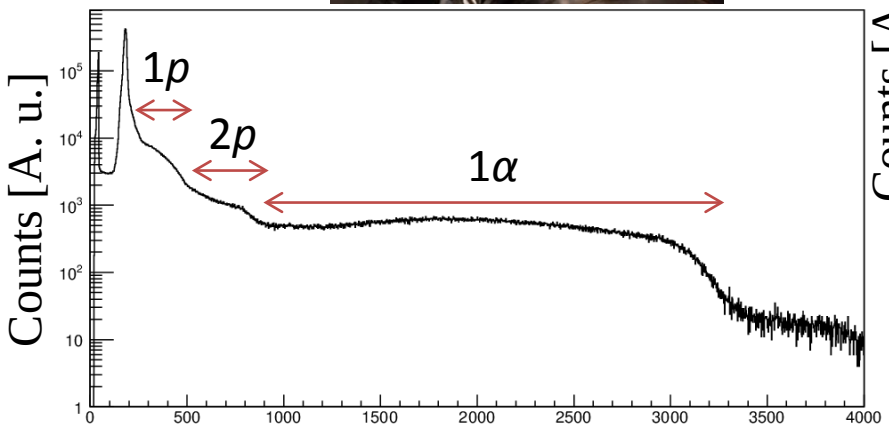
ORGAM-SiBall campaign

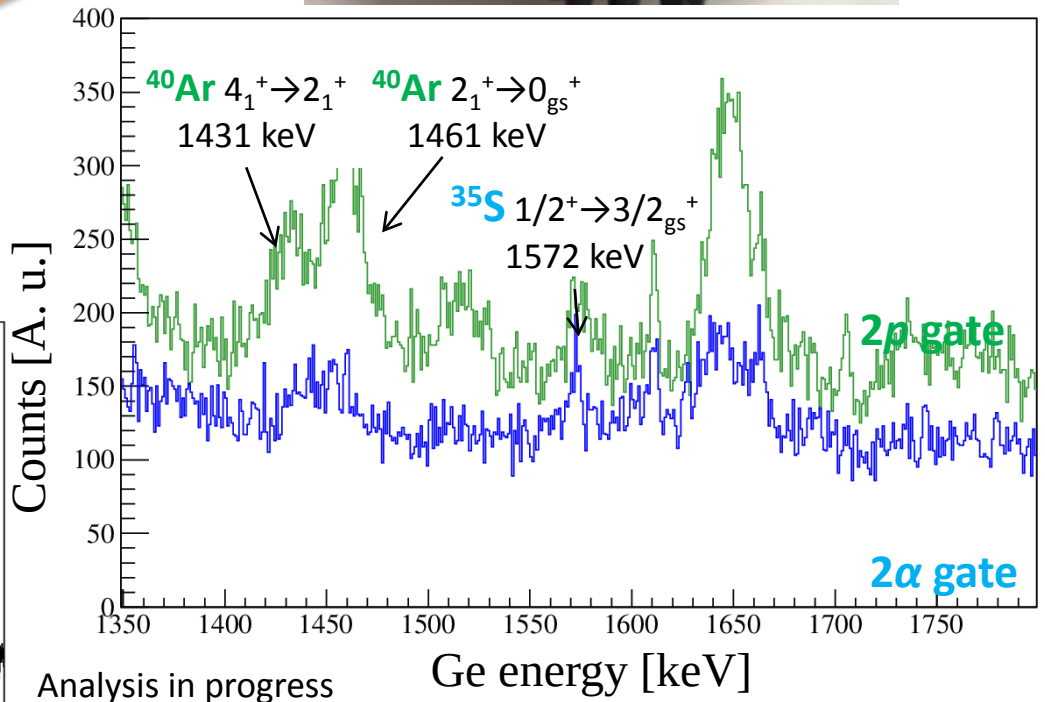
- Coordinators:

I. Matea (IPN) and E. Ideguchi (RCNP, Osaka Univ.)

- Vol. 1: N-SI-49 (E. Ideguchi, D. Verney) in Jan. 21 – 27, 2013
  - ❑ Super-deformation in ^{35,36}S, ^{40}Ar via ^{18}O + ^{26}Mg -> ^{44}Ca*





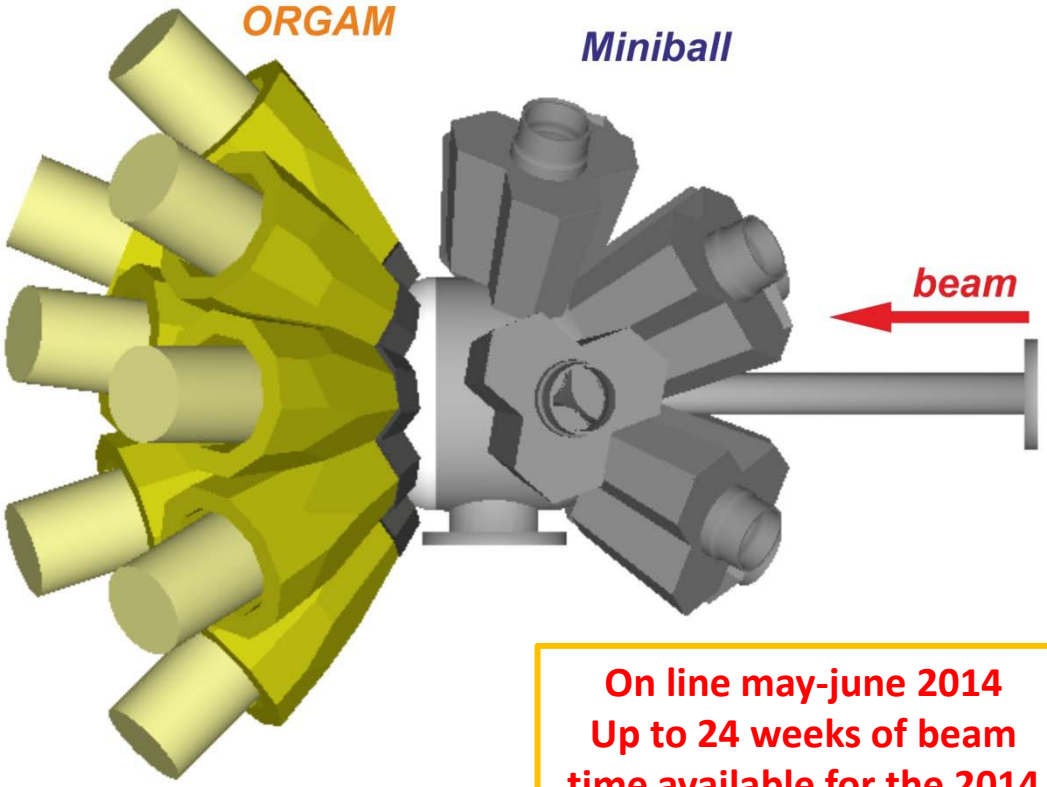


Analysis in progress
by S. Go (CNS, Univ. of Tokyo)

—The MINORCA Campaign—

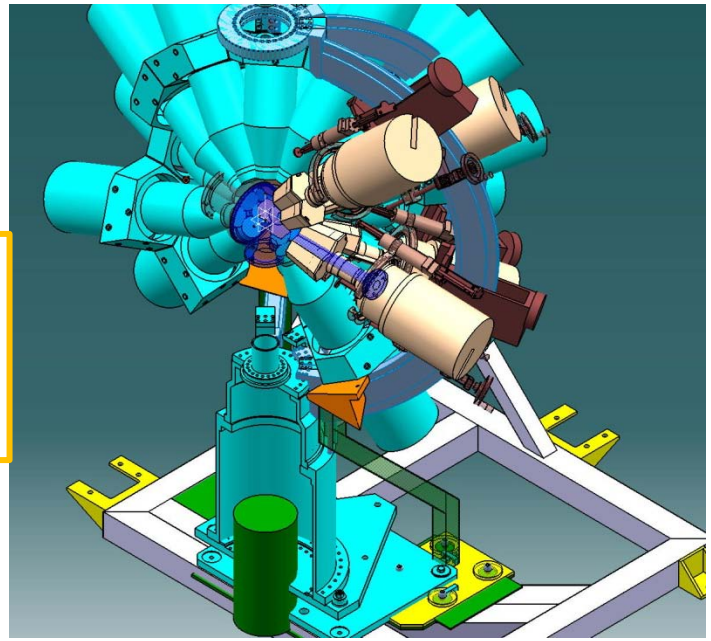
MINIBALL at Orsay coupled with ORGAM

Campaign Managers: Iolanda Matea & Georgi Georgiev



15+ ORGAM ***anti-Compton shielded*** Ge detectors x 0.1%

8 Miniball triple cluster detectors at @ 14 cm from target ***with addback*** without Compton shield



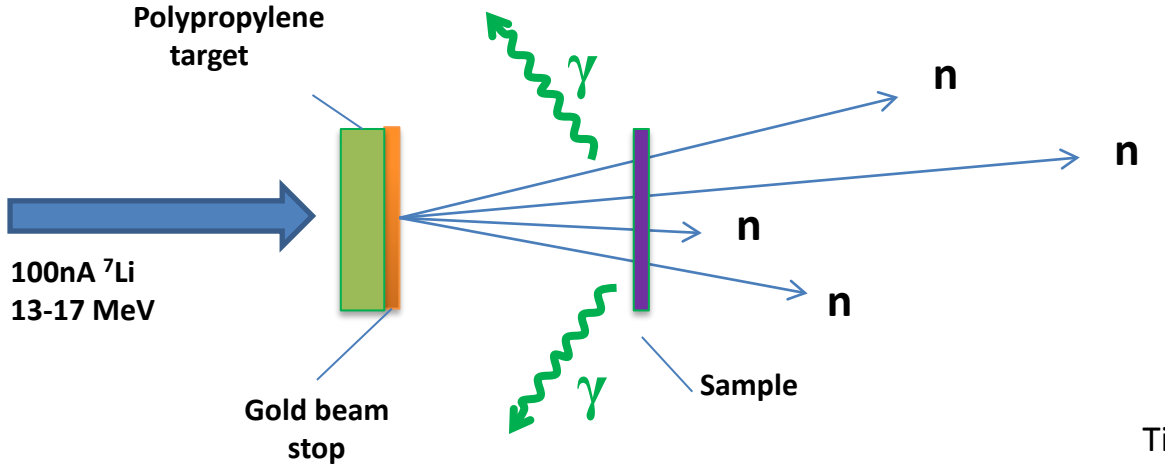
On line may-june 2014
Up to 24 weeks of beam time available for the 2014 campaign

Efficiency at 1332 keV:
6.3% - Miniball
1.8% - 15 ORGAM Ge's
TOTAL → 8.1%

—LICORNE—

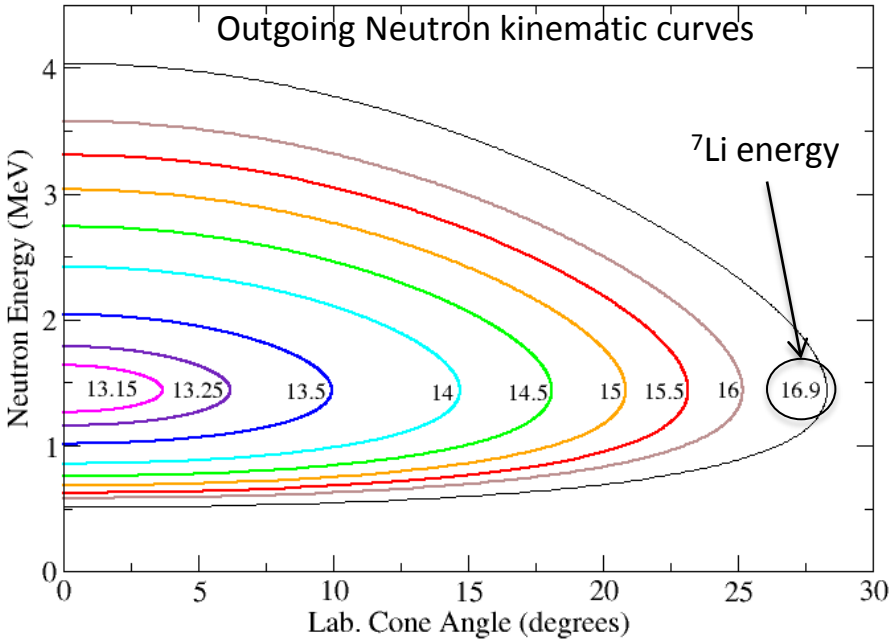
Campaign Managers: M. Lebois, J. Wilson

Lithium Inverse Cinematiques ORsay Neutron source

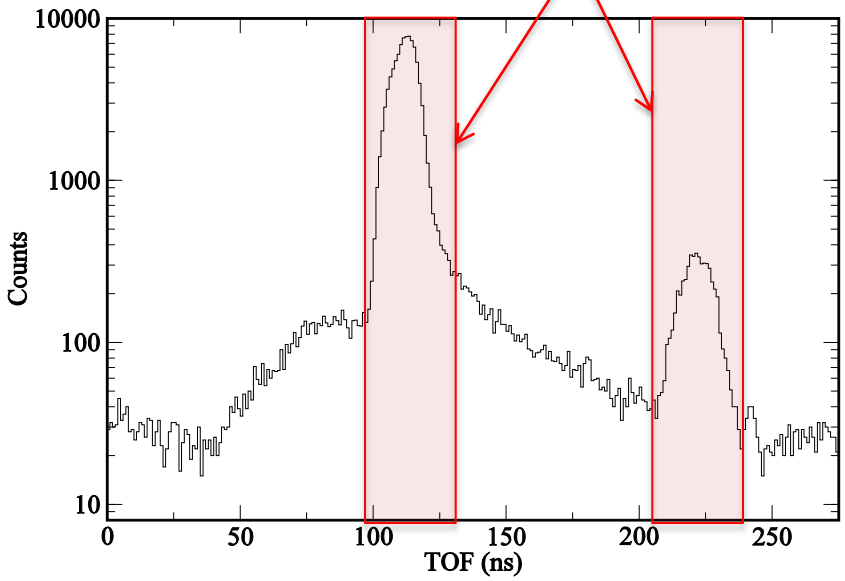


Intense focused monoenergetic neutron source:
10^{7} n/s/steradian

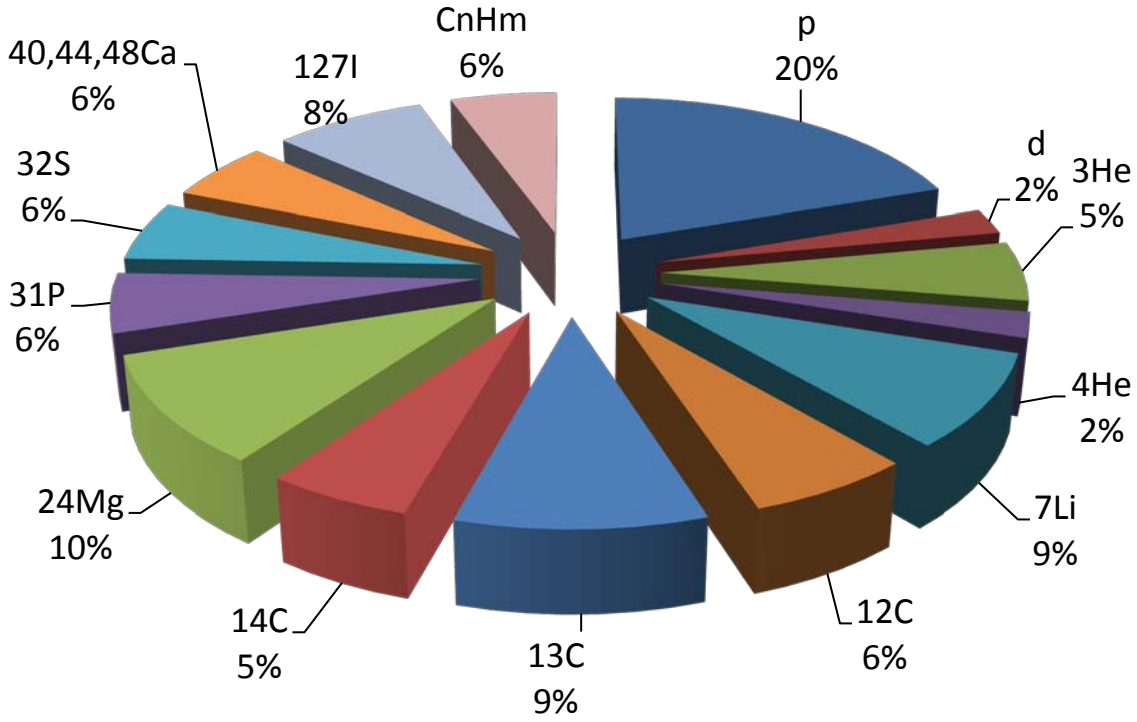
E_n=0.5 – 4 MeV



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



—beams provided in 2012—



Total light ion beams = 984h (25%)
Total heavy ion beams =1964h (75%)
Total stable beam =3928h
RIBs = 360h

Expérience	Faisceaux	Energie2	I analysé
N-SI-39	^{14}C	140	20nA
Test Split-Pôle	p	18	9nA
	d	18	4nA
	alpha	18	4nA
	^{12}C		
Test Gaspard	p	1,5	4nA
	d	5	2nA
	^{7}Li	35	5nA
I-SI-14	P	5 à 25	2 à 40nA
N-SI-36	p	18	3 à 250nA
I-SI-16	P	4	8 à 40nA pulsé
N-SI-38	^{3}He	35	
IM-SI-_B	^{127}I	200	150nA
IM-SI-10	^{127}I	200	150nA
I-SI-17	p	25	2OOpA à 5nA
N-SI-35	^{40}Ca	150 à 170	90nA
	^{44}Ca	150 à 170	2nA
	^{48}Ca	150 à 170	5nA
Lol-SI-3	^{7}Li	15	5 à 80nA
Industriels	p	10	5nA
N-SI-52	^{7}Li	20 à 35	6nA
	^{12}C	55 à 65	30nA
N-SI-51	^{13}C	72	11 à 6nA
N-SI-48	^{24}Mg	120	18nA
N-SI-48	^{32}S	171	3 à 30nA
N-SI-44	^{31}P	156	25nA
IM-CL-18	CH_2	12	10000cps

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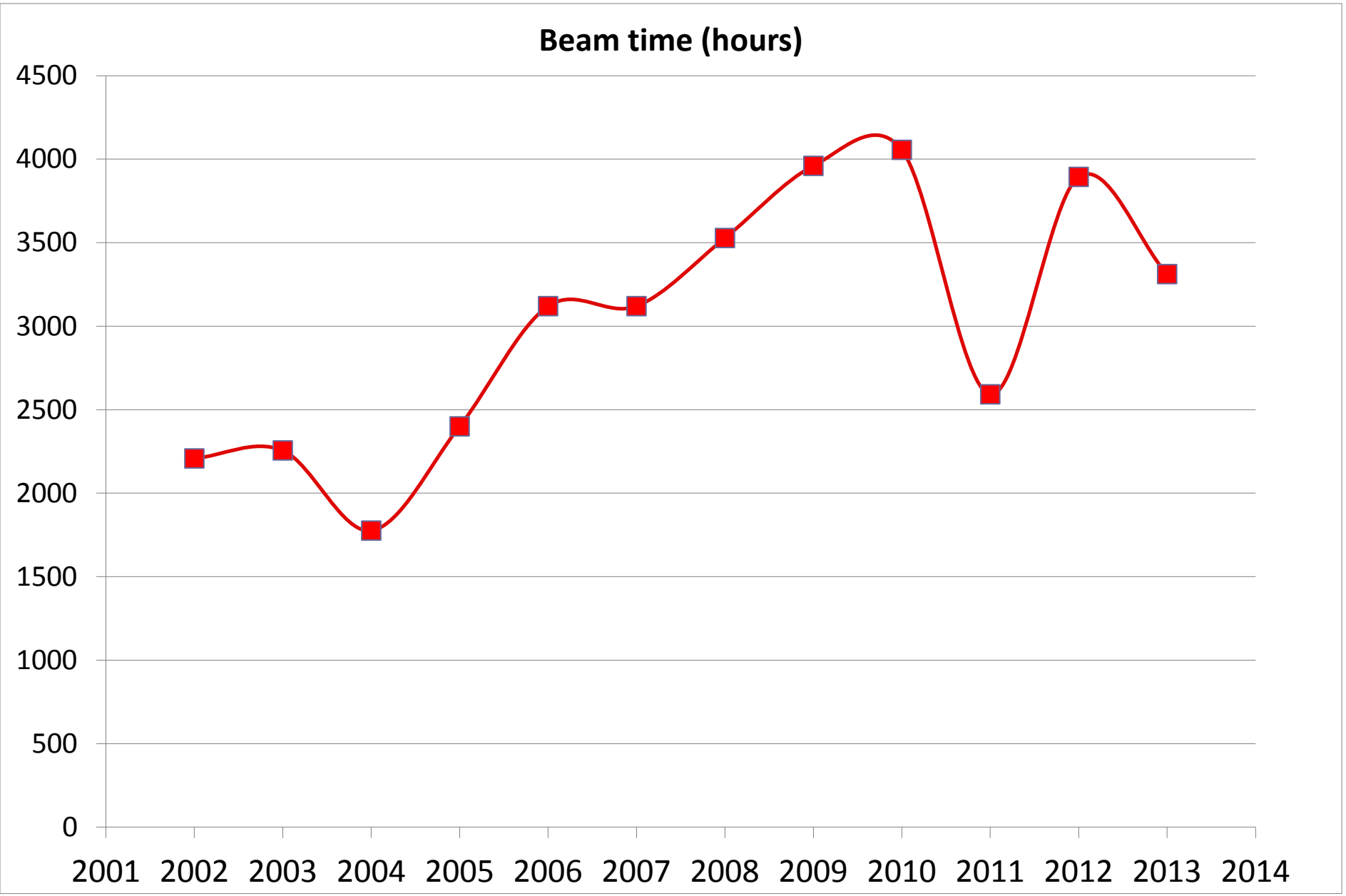
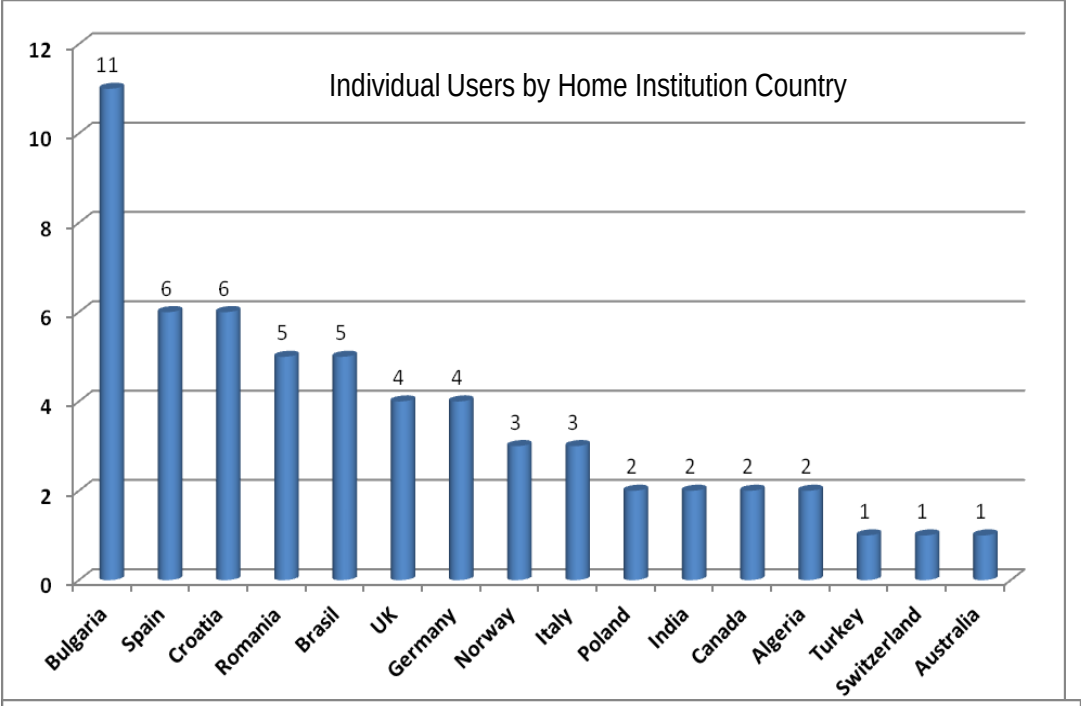
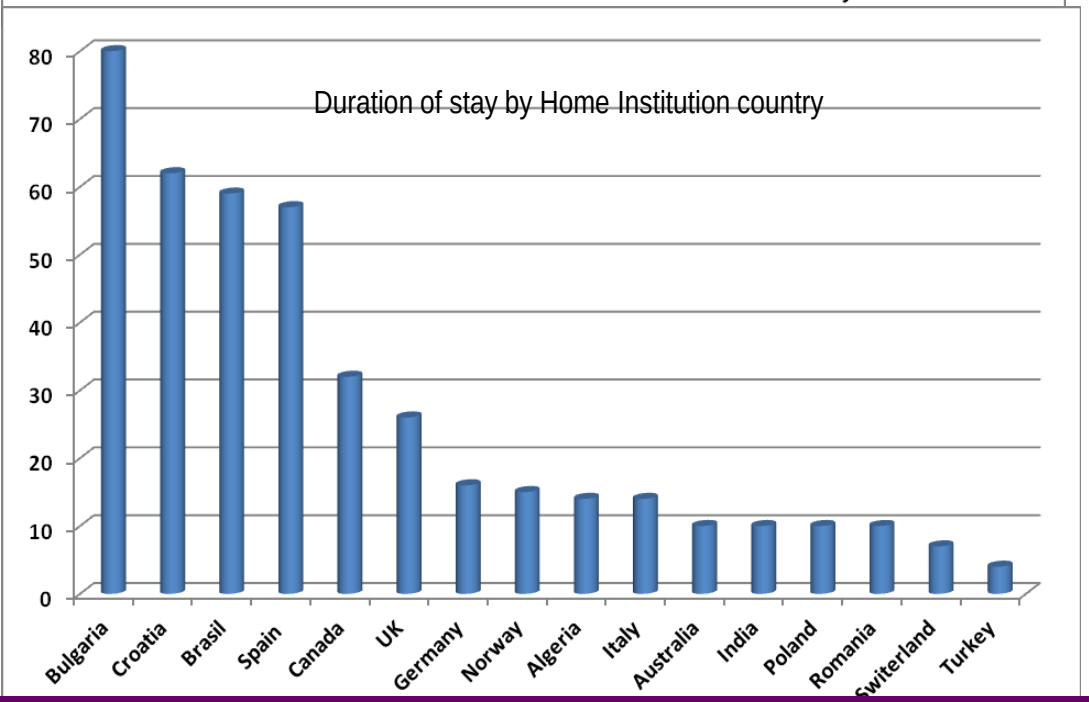

Beam time (hours)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

—publication—

peer reviewed journals

Clusters and Ion-matter int.	Nuclear physics	R&D
Beroff, K et al (2009) NIMB 267,866	Lebois M. et al. Physical Review C, 80 (2009)	B. Hy et al., Nucl. Instrum. and Meth. B288 (2012) 34
M. Chabot et al A&A524,(2010) A39	Q. T. Doan et al. Acta. Pol. B40 (2009) 725	J. Duenas et al NIMA 676 (2012) 70
M. Chabot et al; PRL104 (2010), 043401	R. Lozeva et al AIP Conf. Proc. 1224, 143 (2010)	J. Duenas et al NIMA714 48 (2013)
K. Béroff et al : PRA84 (2011) 032705	Q.T. Doan et al. Phys. Rev. C 82, 067306 (2010)	
M. Chabot et al ; Rev.Sc.Inst82(2011) 103301(high-lighted paper)	D. Curien et al. J. of Phys. CS 205 (2010) 012034	
Krauser, J. et al. New Journal of Physics (2011) 13, 083023	Freer et al. J. Phys. G: Nucl. Part. Phys. 37 (2010) 125102	
V. Wakelam et al ; APJS199 (2012) 21	D. Curien et al. Int. J. mod. Phys.E20 (2011) 219	
B. Marchand et al. Prog. Nucl. Energy vol. 57 (2012) pp. 145-149	M. Freer et al, J. Phys. G: Nuc. Part. Phys. 38 (2011) 115106.	
B.Marchand et al. Submitted to Applied Surface Science (2012)	R. Lozeva et al, Phys. Lett. B694 (2011) 316.	
B. Marchand et al submitted to Journal of Nuclear Materials (2012)	J. Ljungvall et al, Nucl. Instrum. And Meth. A679 (2012) 61.	
K. Béroff et al J. Phys. B46 (2013) 015201(high-lighted paper)	G. Boutoux et al, Phys. Lett. B712 (2012) 319.	
	D. Verney et al. Physical Review C, 87 (2013)	
	K. Kolos, accepted for publication in PRC (2013)	
	E. Crema et al submited to PRC (2013) PRC	





List of User-Projects during the second period

•IM-CL-20 :

•Fabrication of quantum dots by C60 irradiation of sandwiched ta-C layers

•Spokesperson : Ch. Trautmann (GSI, Darmstadt, Germany)

•I-SI-21 :

•Pulse shape analysis studies for Gaspard-Hyde-Trace

•Spokesperson : Duenas (Huelva, Spain)

•N-SI-56

•Study of key resonances in 19Ne relevant to the 18F(p,a)15O reaction in novae

•Spokesperson : Laird (York, UK)

•N-SI-57

•Measurement of alpha particle fusion with Pb isotopes nuclei

•Spokesperson : Wolski, (Krakow, Poland)

•N-SI-60

•Measurement of prompt fission gamma ray mean energy and multiplicity from the reaction 238U(n,f) as a function of incident neutron energy

•Spokesperson Oberstedt (Geel, Belgium)

•N-SI-62

•Nuclear moment and nuclear orientation from complete fusion and transfer reactions

•Spokesperson Marginean (Bucharest, Romania)

•I-SI-63

•Time dependent recoil in vacuum for Na like 56Fe ions

•Spokesperson : Yordanov (Heidelberg, Germany)

36 months summary for ALTO

TNA	Number of beam hours promised -full contract	Number of beam hours 01/09/2010 - 31/08/2013	Estimated number of Users - full contract	Number of Users 01/09/2010 - 31/08/2013	Estimated number of days - full contract	Number of days 01/09/2010 - 31/08/2013	Estimated number of projects - full contract	Number of projects 01/09/2010 - 31/08/2013	Total amount for T&S - full contract	Amount for T&S 01/09/2010 - 31/08/2013	Amount for other direct costs - full contract (AGATA)	Amount for other direct costs (AGATA) 01/09/2010 - 31/08/2013	Access costs - full contract	Access costs 01/09/2010 - 31/08/2013
ALTO	1470	2520	116	88	556	614	19	20	73 720€	68 764€	0€	0€	151 998€	151998

Remaining 4956€ for T&S on september 1st 2013

During the second reporting period

- 4824 experimental hours were delivered in total
- 1680 experimental hours were offered under the proposal
- 38 users were supported by the TNA
- They spent 423 person-days at ALTO
- 89% were new users

Beam time cost during second period

Participant number	**7**	**Organisation short name**		**CNRS**	
Short name of Infrastructure	**ALTO**	**Installation number**	**TNA07**	**Short name of Installation**	**ALTO**
Name of Installation				**Unit of access**	**Beam hour**

A. **Estimated direct eligible costs of providing access within the project life-time excluding personnel costs**	Describe the direct eligible costs for providing access to the installation over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible .	**Eligible Costs (€)**
	Consumables and energy (340101,66 + 129 520,37)	**469 622,03**
	Maintenance	**94 333,43**
	Other costs (depreciation,external services,logistic services,etc…) (24 665,72 + 39 877,46)	**64 543,18**
	Total A	**628 498,64**
	of which subcontracting (A')	

B. **Estimated personnel direct eligible costs needed to provide access within the project life-time**	**Category of staff (scientific and technical only)**	**Nr. of hours (1)**	**Hourly rate (2)**	**(3) = (1) x (2)**
	Scientific Staff			0,00
	Technical Staff			0,00
				0,00
				0,00
				0,00
				0,00
				0,00
				0,00
				0,00
	Total B			**1 600 000,00**

C. Indirect eligible costs = 7% x ([A-A']+B)	155 994,90
D. Total estimated access eligible costs = A+B+C	2 384 493,54
E. Total estimated quantity of access provided to all normal users of the infrastructure (i.e. both internal and external) within the project life-time	4 824,00
F. Fraction of the Unit cost to be charged to the proposal [1]	0,20918
G. **Estimated Unit cost charged to the proposal** = F x (D/E)	**103,40**
H. Quantity of access offered under the proposal (over the whole duration of the project)	972,00
I. **Access Cost** [2] **= G x H**	**100 504,80**

Does the access cost represent less than 20% of the installation cost	**4%**

Real cost of the beam : 494€/h cost charged to the proposal 103.4€/h