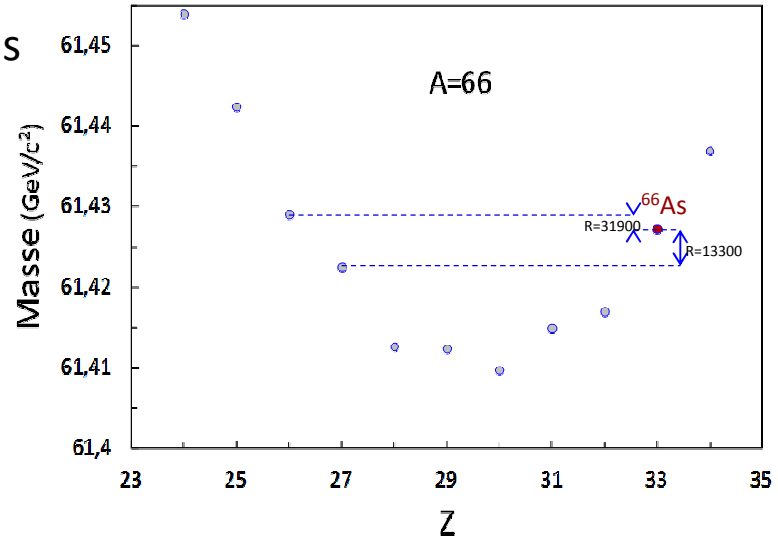
PIPERADE

PIège de PEnning pour des ions RAdioactifs à DEsir

Why ?

To purify and accumulate large samples of radioactive ions

- purify → resolving power M/ΔM ~10^5
  to separate isobars
- accumulate → up to 10^6 ions per bunch



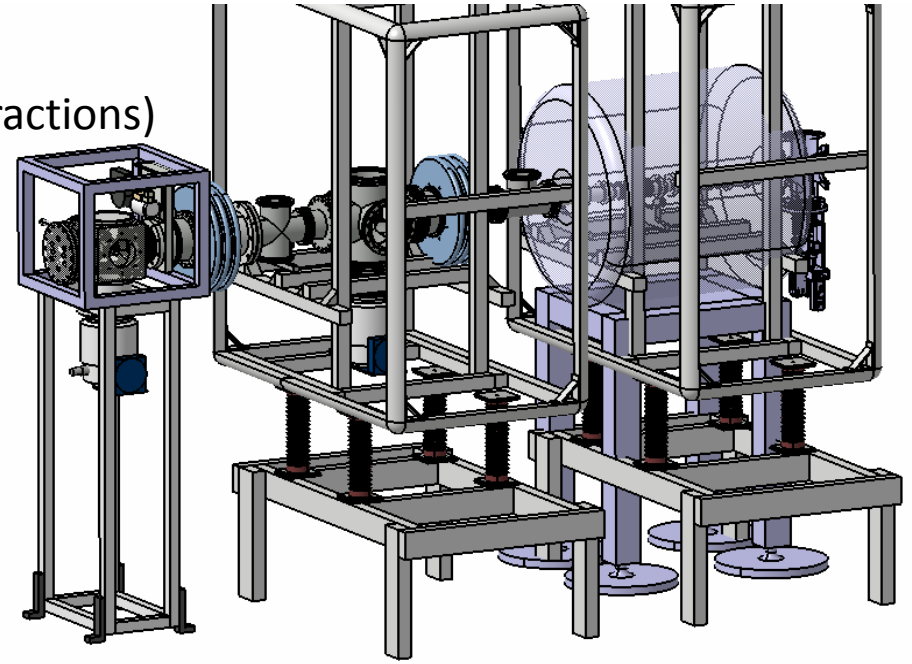
How ?

Double Penning trap system

- one to purify
- one to accumulate

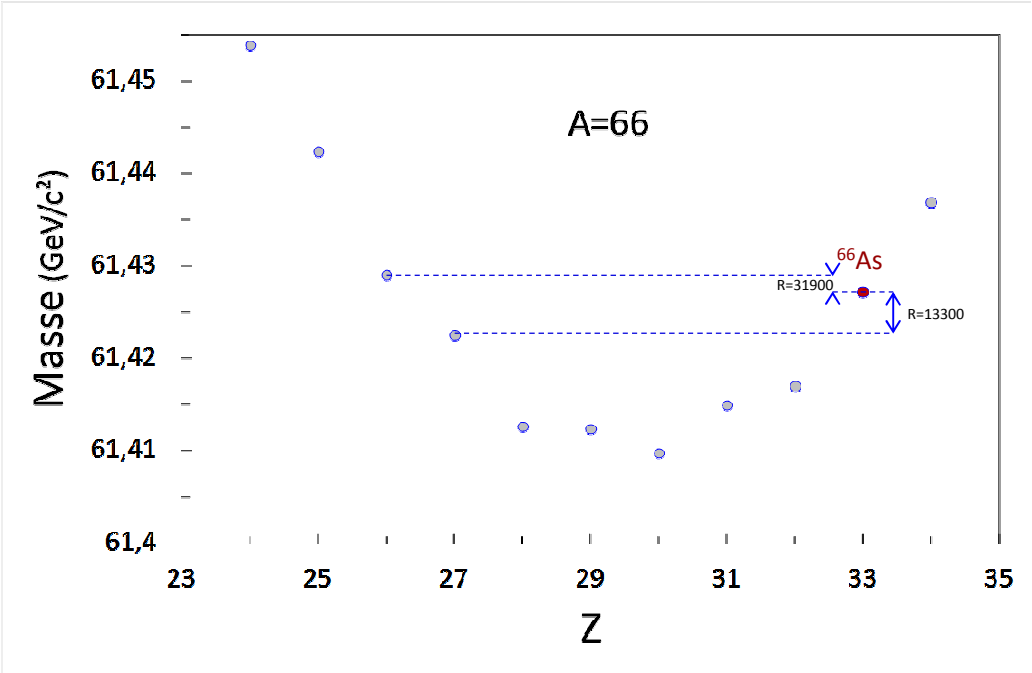
Which Physics ?

- Precision measurements (fundamental interactions)
- Decay spectroscopy
- Other applications (long $T_{1/2}$, waste…)
- …



Why PIPERADE ?

- Production of exotic nuclei extremely non-selective
- HRS not sufficient to « clean » samples when isobars have very similar masses



- Nuclei of interest decay over time
- Some experiments (i.e. test of weak interaction) need ultra-pure samples
- **Need a spectrometer with a resolving power $\Delta M/M \sim 10^5$**

Other experiments interested by high purification

- TAS measurements
  - Reconstruction of a nucleus level scheme via the total energy released for each decay.
  - Avoid « Pandemonium effect » but need to get rid of the contaminants.

- Measurement of the half-life of very long-lived nuclei
  - $T_{1/2}$ too long to be measured fitting the decay curve.
  - Need knowledge of both the absolute activity and the total number of nuclei.
  - Possibility to trap the parent of such nuclei to grow a well quantified sample the decay of which can be monitored offline.

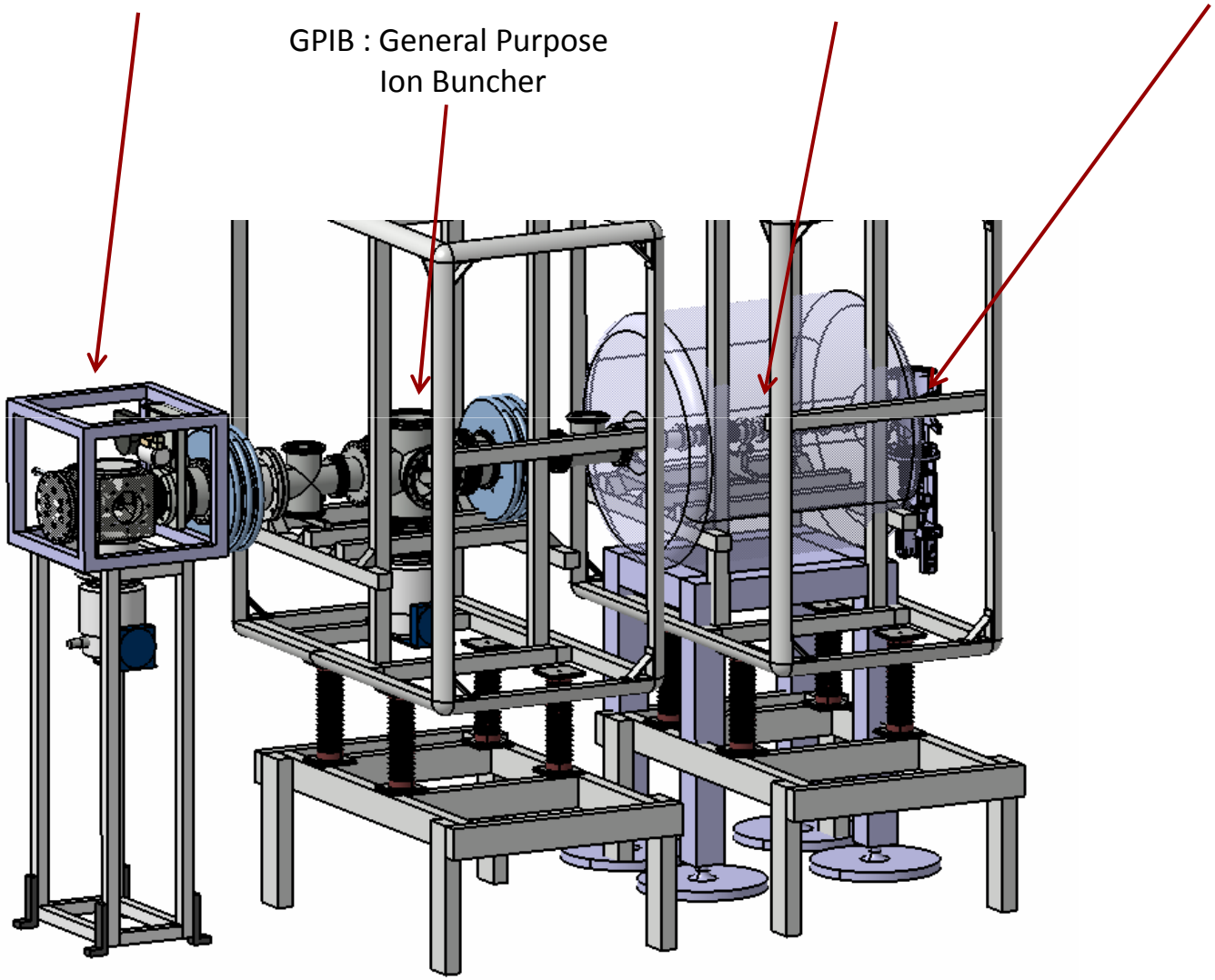
- Nuclear waste
  - Improve the knowledge of the β-decay properties of some key fission fragment.
  - Would help prediction regarding the heat generated by stored nuclear waste

- β-NMR
  - Same as NMR (probe of the local magnetic field) but detection of the nuclear spin precession via β decay asymmetry.
  - Sensitive to any contaminant β decay

- …

Technical description :

PIPERADE = Ion Source + RFQ cooler/buncher + Double Penning Trap + Detection System



Collaboration

CENBG	Franck Delalee	technical coordinator
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	Stéphane Grévy	scientific coordinator ANR
	Mathias Gerbaux	scientific coordinator CRA
	Bertram Blank	
	Hugo Guerin	PhD
CSNSM	Dave Lunney	
	Pierre Dupré	PostDoc
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IPC	Gilles Ban	
	Etienne Lienard	
	Jean Francois Cam	
Max-Planck-Institut für Kernphysik	Klaus Blaum	
	Pauline Ascher	PostDoc
	Sunil Kumar	PhD
	H. Golzke	Diploma

Financial support:

ANR :	860 000 €
Région Aquitaine:	220 000 €
Université Bx 1 :	50 000 €
IN2P3/CNRS	50 000 €
MPIK Heidelberg	50 000 €
IPF/Bx1	13 000 €
TOTAL	**1 200 000 €**

Ongoing work

start of the project : november 2011, 1st. → end of 2015

RFQ :

- simulations and test of the RFQ SHIRaC1
  PhD of Hugo Guerin@CENBG
- ISCOOL ? (→ collaboration with ISOLDE)

last RFQ meeting : today, january 24, 9:00 am, Atelier2

Penning Trap:

- test of the cleaning of large samples
  PhD of Sunil Kumar@KVI
  PostDoc Pauline Ascher@KVI
- simulation of double penning trap
  PostDoc Pierre Dupré@CSNSM
- prototype @ KVI

next PenningTrap meeting : Heidelberg, february 14-15.

next PIPERADE meeting : Heidelberg, april 24-25.

	Lumière	MLL	LPCTrap
> Transmission (for given masses) :	100% (70% at A=39)	: 95% without gas, without bunching / >50% in bunched mode	50%
> Bunch time spread :	FWHM<3 µs for 10^3 i/b →10 for 10^6 i/b	FWHM~2 µs	100ns
> Repetition rate :	5ms to 1s; user controllable via hardware	flexible…	200Hz
> Emittance :	<3pi mm mrad typical	~10 pi mm mrad	
> Energy spread :	<3eV	2.4eV after 10ms storage	1eV :
> Space charge capacity :	10^6 usefull for calibration scans	1-100 i/b	10^5
> Mass range :	all	40-240	6-40