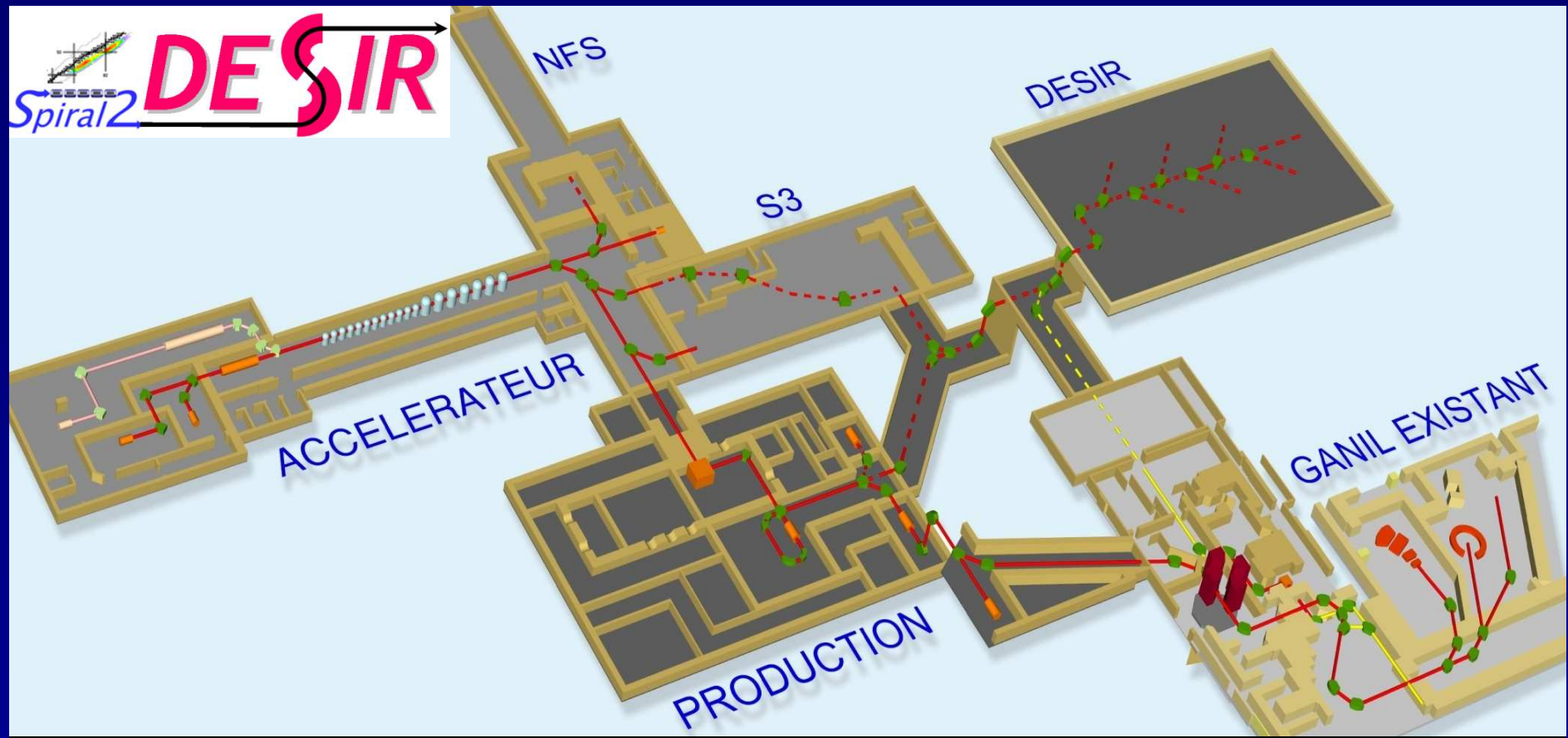


THE DESIR facility at SPIRAL2

<http://www.cenbg.in2p3.fr/desir>



Bertram Blank

CEN Bordeaux-Gradignan, France
Spokesperson of the DESIR collaboration

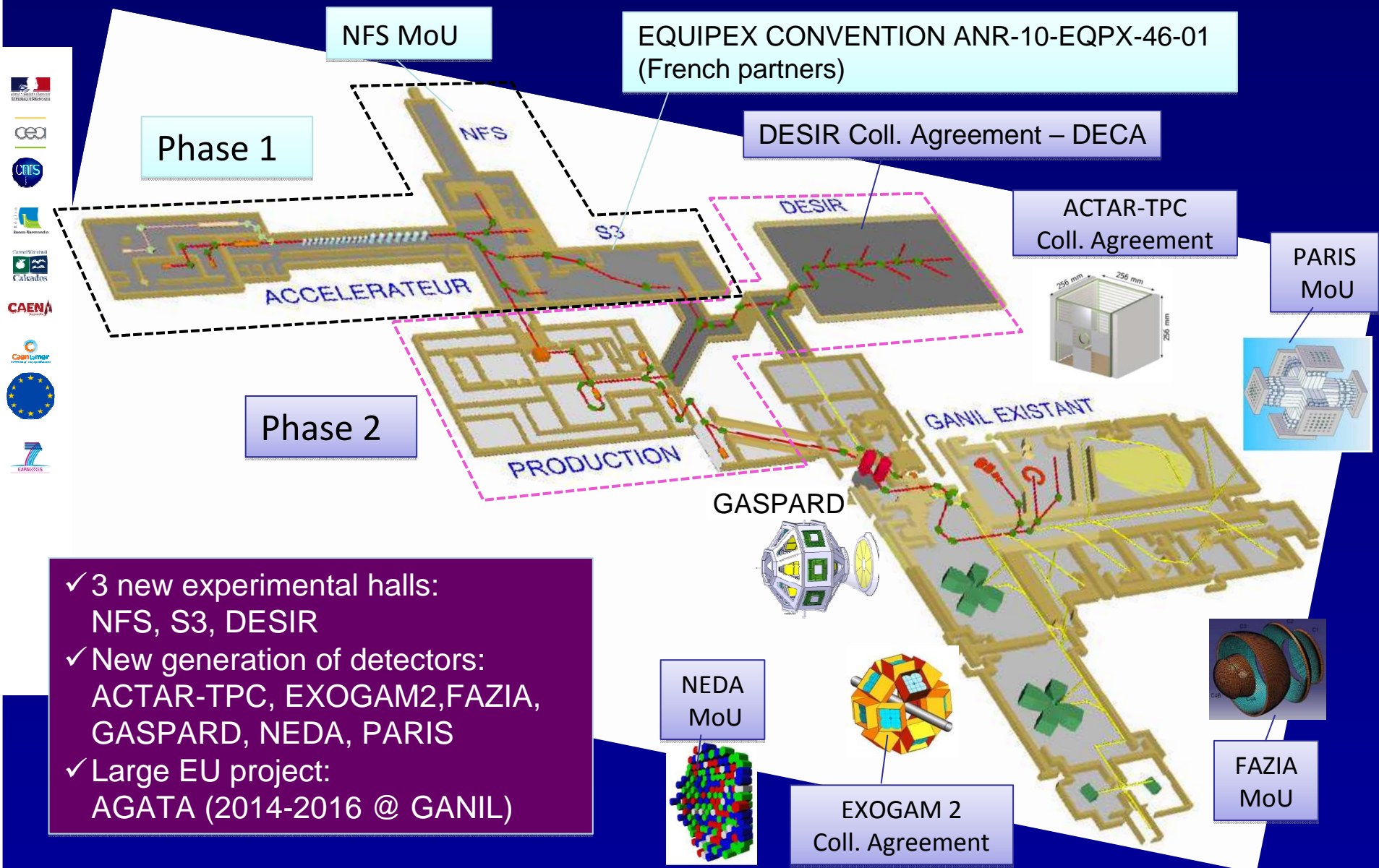
GANIL by 2017



S3 cave construction



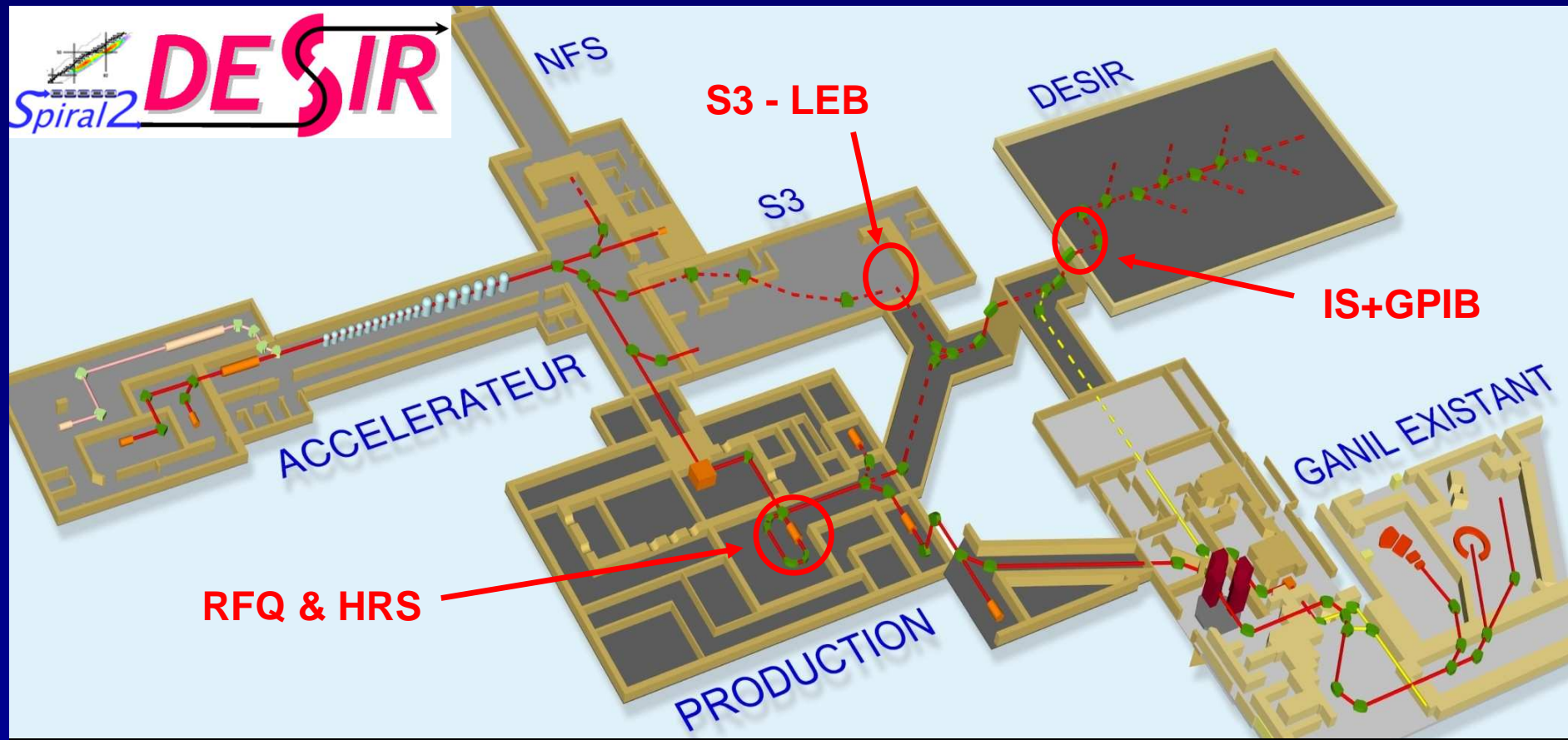
SPIRAL 2 New Exp. Halls & Detectors



- ✓ 3 new experimental halls: NFS, S3, DESIR
- ✓ New generation of detectors: ACTAR-TPC, EXOGAM2, FAZIA, GASPARD, NEDA, PARIS
- ✓ Large EU project: AGATA (2014-2016 @ GANIL)

THE DESIR facility at SPIRAL2

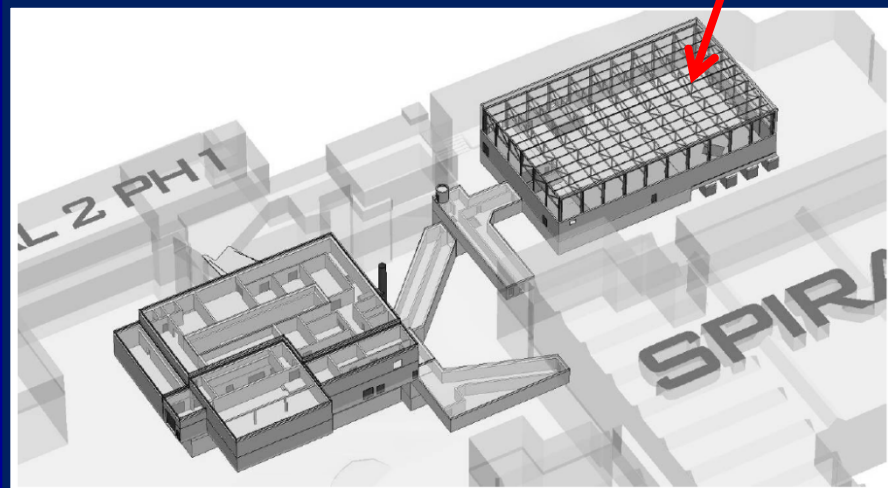
<http://www.cenbg.in2p3.fr/desir>



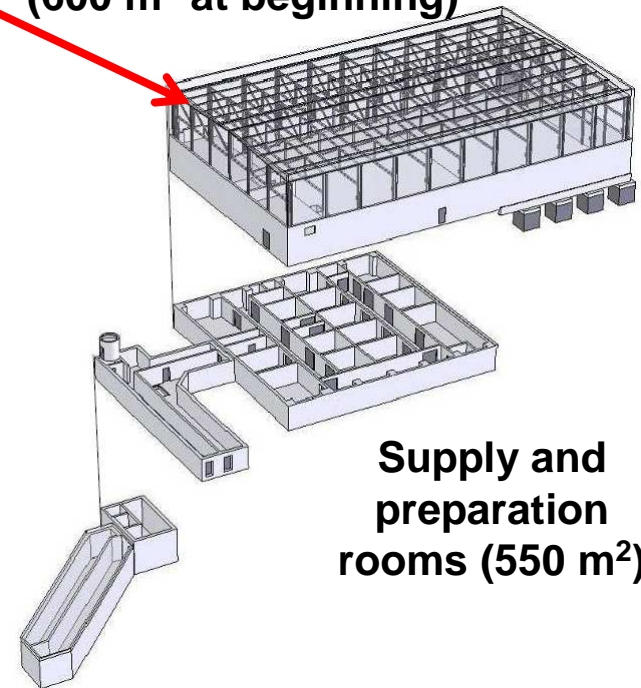
10 to 60 keV 1+ (radioactive) ion beams from

- SPIRAL1 (light nuclei from beam/target fragmentation)
- SPIRAL2 (n-rich fission fragments, transfer and fusion-evaporation products)
- S3 (fusion-evaporation, refractory elements)

DESIR buildings

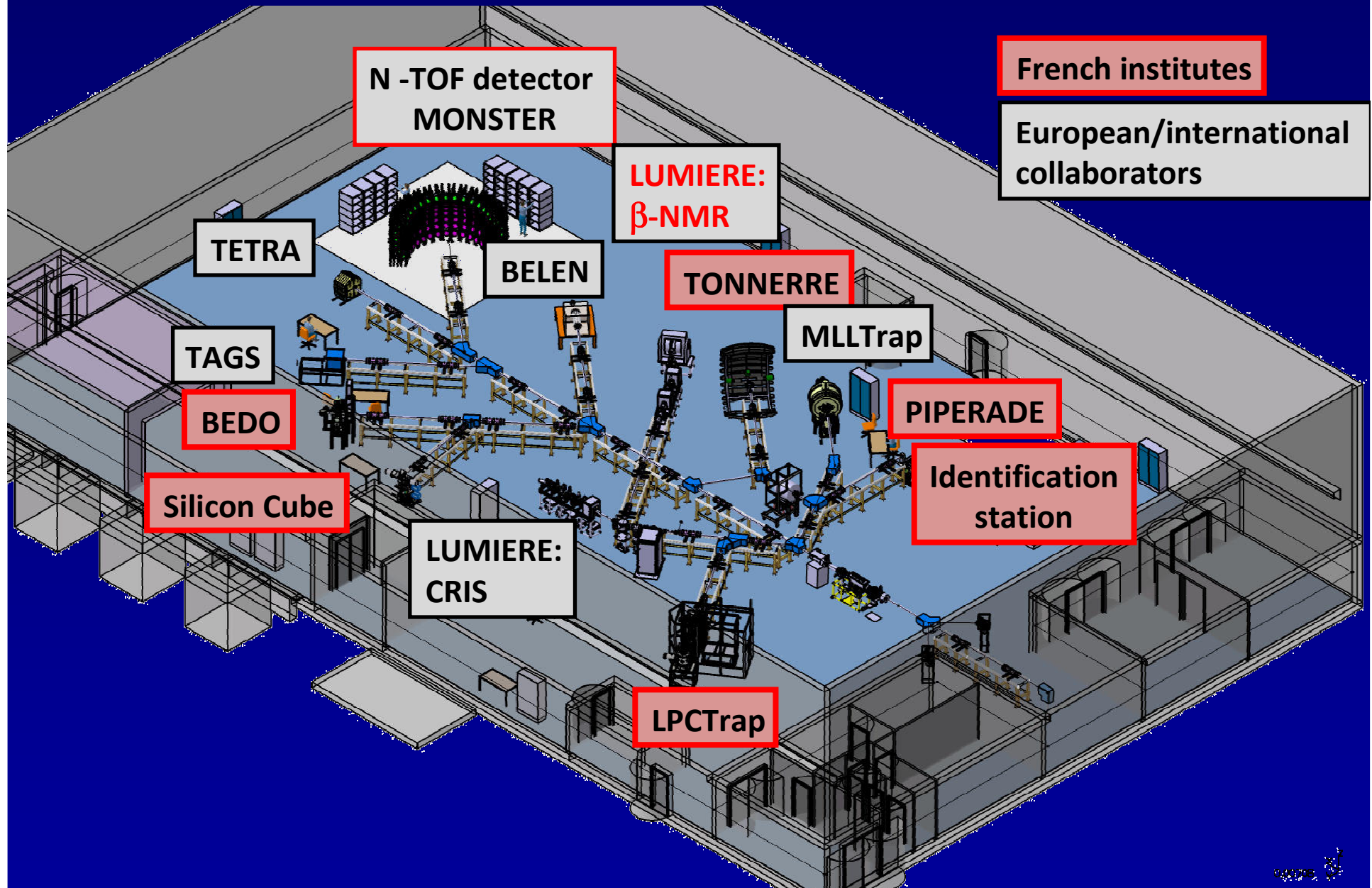


**Exp. Hall (1500 m²)
(600 m² at beginning)**



**Supply and
preparation
rooms (550 m²)**

DESIR experimental equipment within the DECA



DESIR planning

❖ HRS

2011	2012	2013	2014	2015
Preliminary optical & mechanical design		Command & control		Installation & test at CENBG
	Detailed optical & mechanical design	Manufacturing		

❖ DESIR infrastructure & Operation

- Red: EQUIPEX funding
- White: missing funding



The DESIR Physics program

(Based on the LoIs submitted in Dec. 2010)

- BESITOL
- LUMIERE
- DETRAP

The BESTIOL facility

BEta decay STudies at the SPIRAL2 IsOL facility

M.J.G. Borge, B. Blank et al., CSIC Madrid, CENBG

- high-precision measurements of super-allowed and mirror β decays

^{21}Na , ^{23}Mg , ^{31}S , ^{39}Ca , ^{66}As , ^{70}Br

- β -decay studies of neutron-rich and neutron-deficient nuclei

-> lifetime and decay spectroscopy: Nuclear structure and Astrophysics

^{81}Cu , $^{103-106}\text{Y}$, ^{81}Cu , ^{83}Zn , ^{86}Ga , ^{87}Ge , ^{88}As , ^{92}Se , ^{100}Kr , ^{130}Ag , ^{139}Sb , ^{142}Te

-> delayed charged-particle correlations (2p emission)

^{22}Al , ^{23}Si , ^{26}P , ^{27}S , ^{31}Ar , ^{35}Ca , ^{39}Ti

-> cluster emission: $^{112,114}\text{Ba}$

- Shape coexistence, deformation and Gamow-Teller strength (TAS)

$^{78-80}\text{Cu}$, $^{80-82}\text{Zn}$, $^{83-85}\text{Ga}$, $^{93-100}\text{Kr}$, $^{98,99,101}\text{In}$, ^{101}Sn , $^{97-99}\text{Cd}$, $^{130-132}\text{In}$, $^{129-132}\text{Cd}$, ^{130}Ag

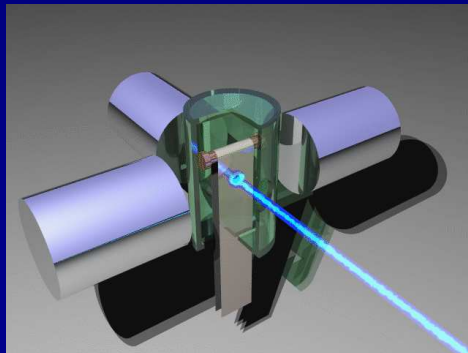
- $P_{n,2n}$, 2n correlations: ^{136}Sb

PIPERADE Double-Penning trap

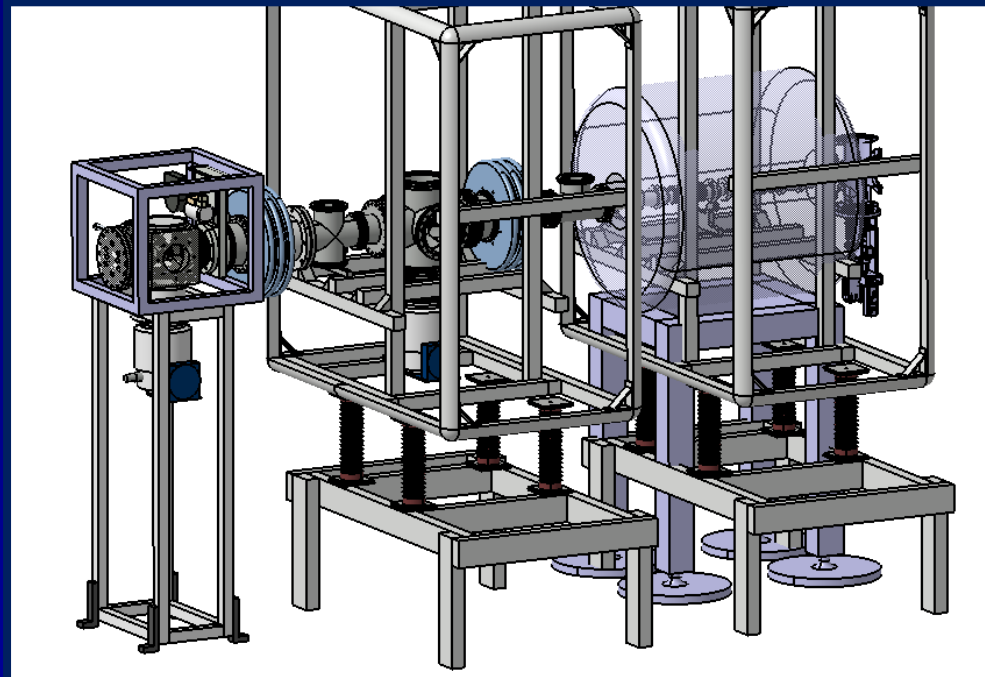
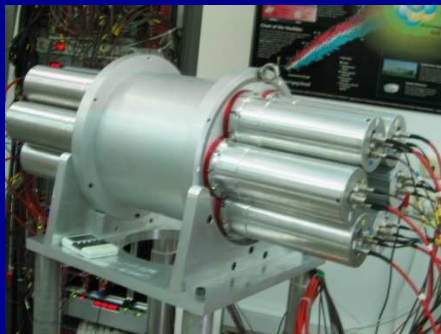
S. Grévy, M. Gerbaux, D. Lunney, K. Blaum et al., CENBG, CSNSM, MPIK

- beam purification for trap-assisted spectroscopy
 - high-precision measurements
 - ultra-pure large samples

β - γ spectroscopy



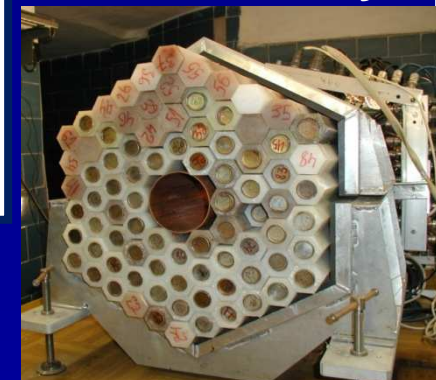
TAS



Si Cube



neutron arrays



LUMIERE

Laser Utilization for Measurement and Ionization of Exotic Radioactive Elements

F. Le Blanc, G. Neyens, P. Campbell et al., IPHC, IKS, Univ. Manchester

➤ **Collinear Laser spectroscopy**

- spins
- magnetic & quadrupole moments
- change of charge radii

N~Z = 28 (⁴⁸⁻⁵⁵Mn, ⁵²⁻⁵⁸Fe), **40** (^{A<89}Zr, ⁸⁸⁻¹⁰¹Sr, ⁸⁹⁻¹⁰³Y), **50** (⁹⁵⁻¹⁰²Ag, ¹⁰⁰⁻¹¹⁰Sn),
N=82 (⁷⁸⁻⁸⁴Ge, ⁸⁰⁻⁸⁵Ga), **N=104** (¹⁷⁹⁻¹⁸²Au)

➤ **β-NMR spectroscopy and β-delayed spectroscopy of polarized beams**

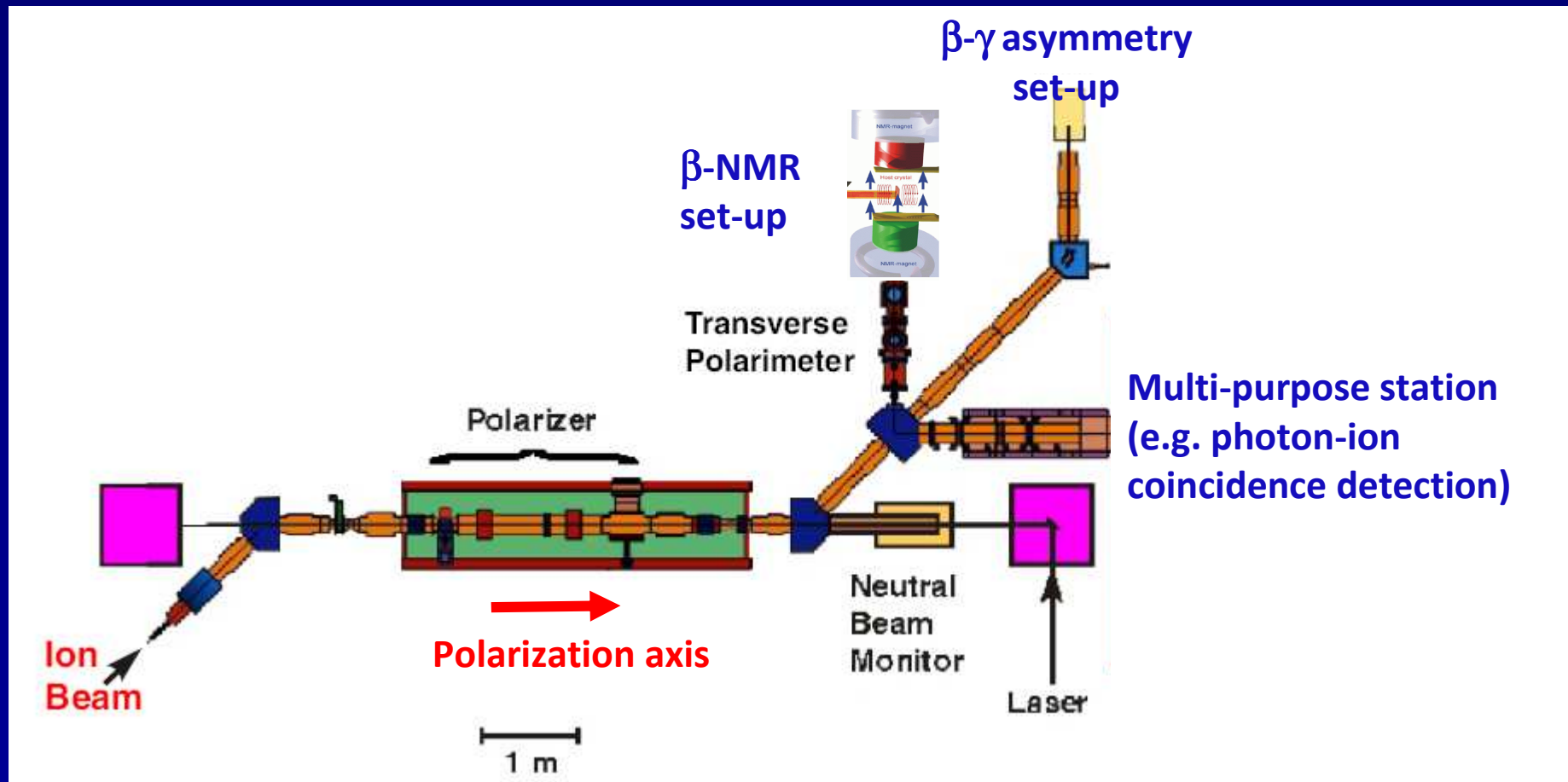
- spins
- magnetic & quadrupole moments

¹³²Sn region: ¹²⁷⁻¹³³In

Possible layout of LUMIERE

➤ Based on collinear laser beam line at TRIUMF

C.D.P. Levy et al. / Nuclear Physics A 746 (2004) 206c–209c



Mass measurements with the MLL trap

P. Thirolf et al., LMU Munich

- multi-reflection TOF spectrometer beam purification
- Penning trap for mass measurements

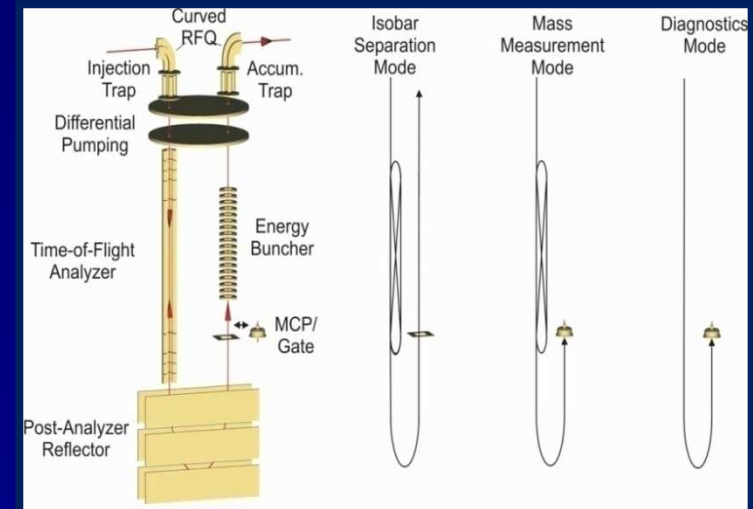
– Binding energy of N~Z nuclei: $^{94,95}\text{A}^{96}\text{Cd}$, ^{100}Sn from S^3

– Masses of A~100 nuclei: $^{97-100}\text{Kr}$, $^{99-102}\text{Rb}$, $^{101,102}\text{Sr}$, $^{102,103}\text{Y}$

– superallowed and mirror β -decay Q values: ^{66}As , ^{70}Br , ^{21}Na , ^{23}Mg , ^{25}Al , ^{27}Si , ^{29}P , ^{31}S , ^{35}Ar , ^{37}K , ^{39}Ca , ^{41}Sc

– Masses of transactinide isotopes: Z~104, from S^3

– Masses of r-process nuclei: $^{70,81}\text{Cu}$, ^{82}Zn , ^{100}Kr , ^{130}Ag , $^{130-132}\text{Cd}$, $^{131-133}\text{In}$



MLL trap commissioning at Garching



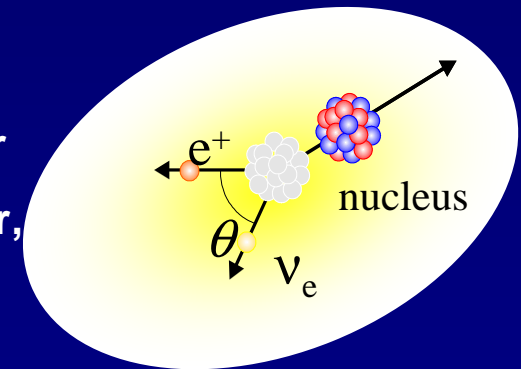
Fundamental interactions with the LPCTrap

E. Liénard, X. Fléhard et al., LPC Caen

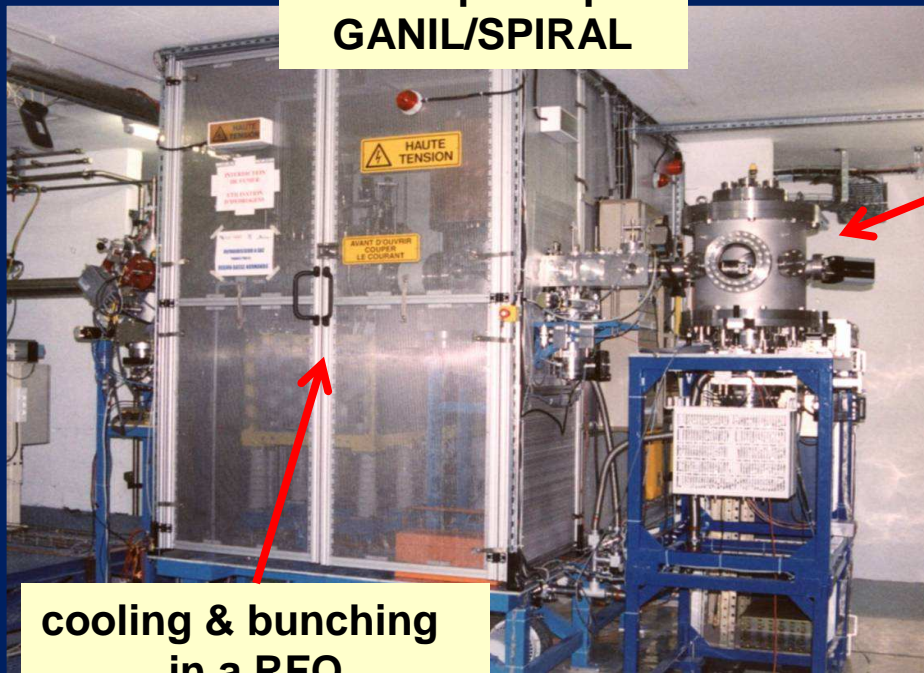
➤ β - ν angular correlation measurement in a Paul trap:

-> exotic currents in the weak interaction: ^8He , ^{19}Ne , ^{35}Ar

-> mirror β decay studies: ^{21}Na , ^{23}Mg , ^{25}Al , ^{27}Si , ^{29}P , ^{31}S , ^{35}Ar ,
 ^{37}K , ^{39}Ca , ^{41}Sc

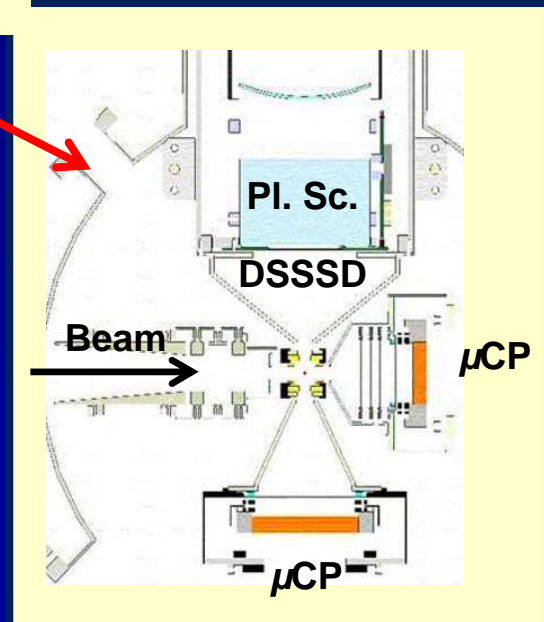


LPCTrap setup at
GANIL/SPIRAL



cooling & bunching
in a RFQ

trapping & decay
measurement



DESIR Physics (SPIRAL2 LoI - December 2010)

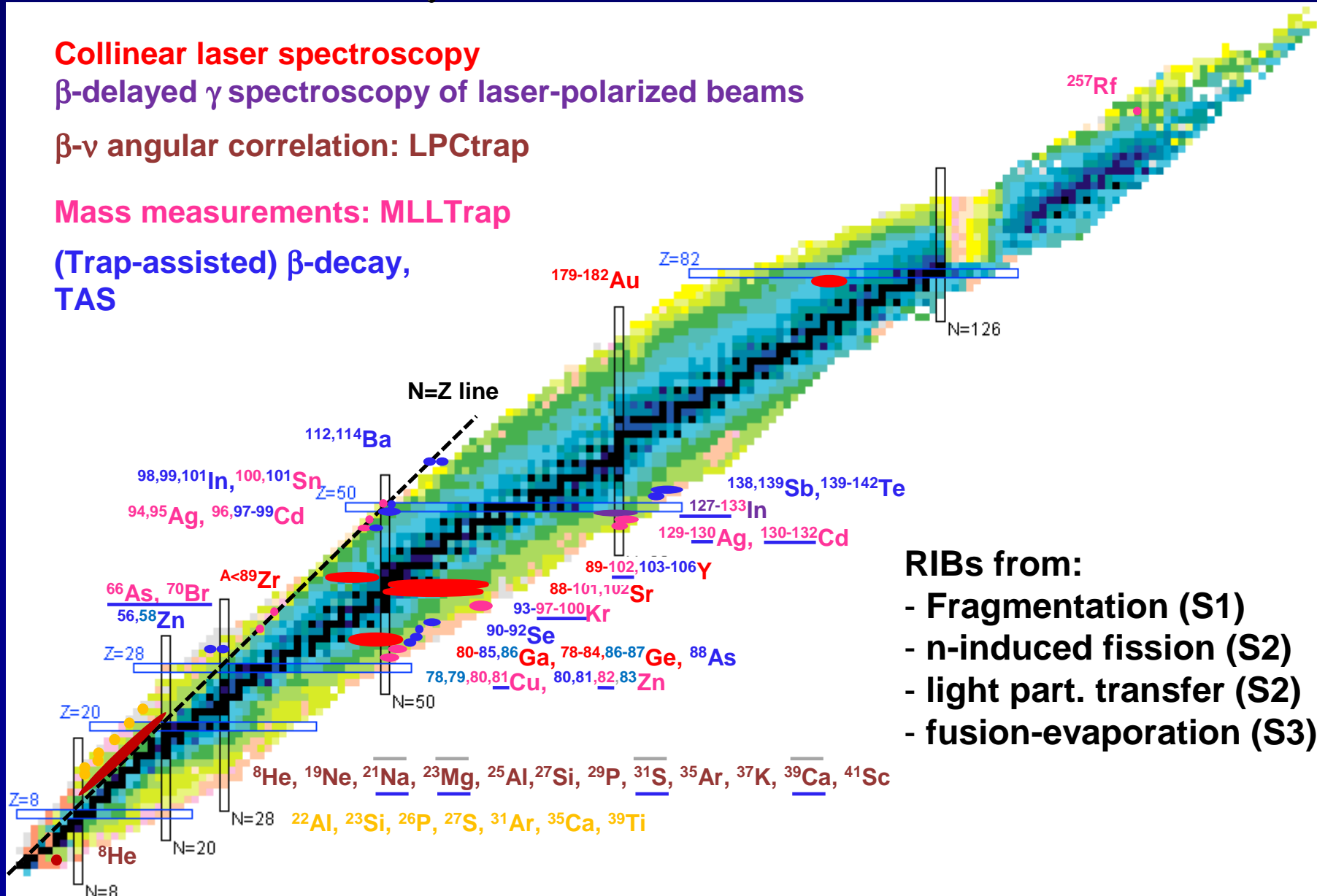
Collinear laser spectroscopy

β -delayed γ spectroscopy of laser-polarized beams

β -v angular correlation: LPCtrap

Mass measurements: MLLTrap

(Trap-assisted) β -decay,
TAS



RIBs from:

- Fragmentation (S1)
- n-induced fission (S2)
- light part. transfer (S2)
- fusion-evaporation (S3)

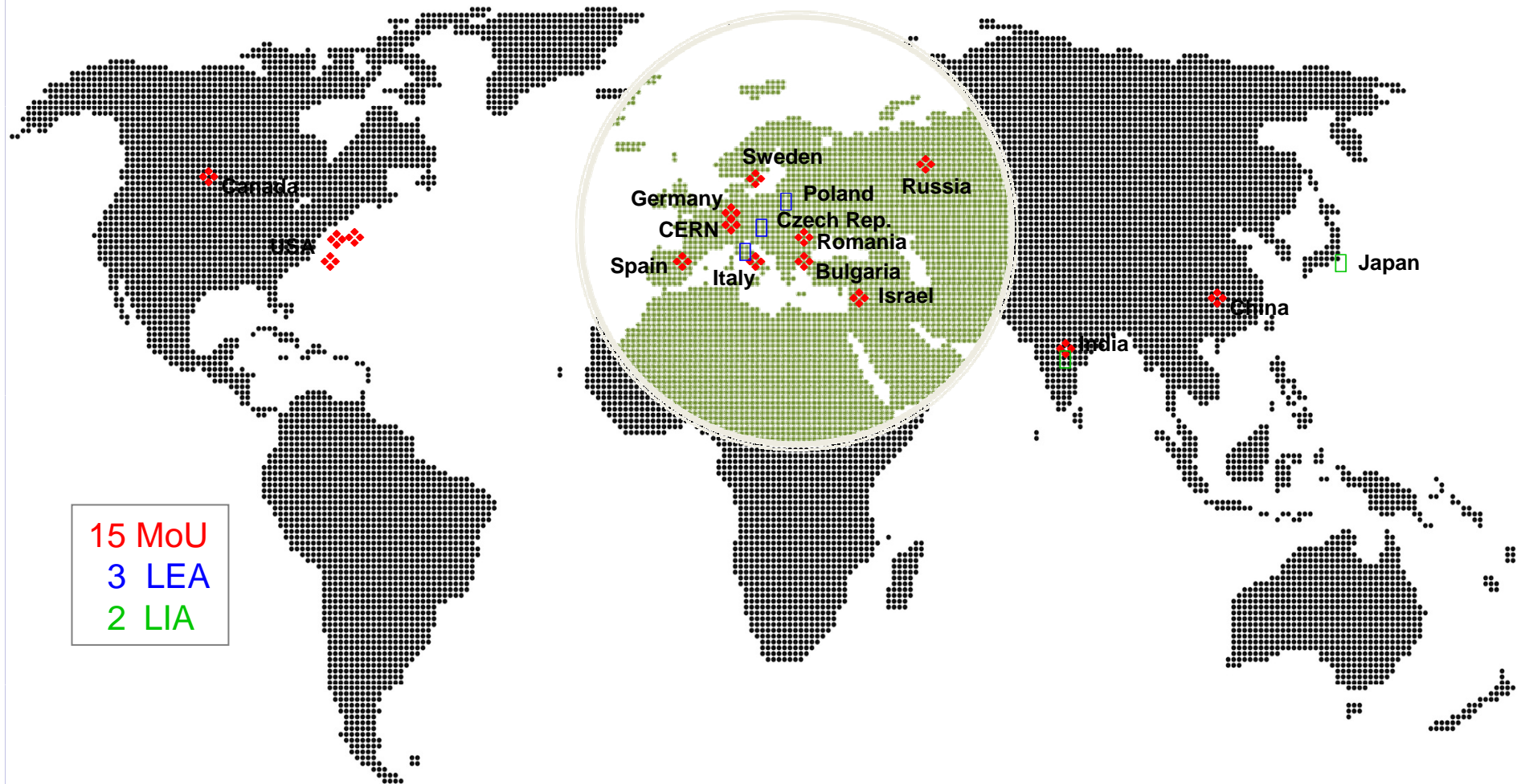
DESIR @ SPIRAL2

- **collaboration: about 120 scientists on LOI and TDR**
- **design: 2008 - 2014**
- **construction begin: 2015**
- **commissioning: 2017**
- **facility operation: 2018**

- **budget:**
 - **base line project: 8 M€ (buildings) + 5.5 M € (beam lines)**
 - **experiments: 5-6 M€**

- **available funds:**
 - **buildings and beam lines: 8 M€**
 - **running costs (-> 2019): 1 M€**
 - **mechanics of beam lines: ≤ 1 M€ (D.A.E.)**
 - **experiments funded within collaborations**

Bilateral Agreements for SPIRAL2



In progress: MoU SCK-CEN (Belgium), MoU KULeuven (Belgium), MoU LNS (Italy)
LEA with Bulgaria, MoU IBS (Korea)

DESIR Collaboration Agreement

Parties:

- GANIL/SPIRAL2, CEA-DSM/CNRS-IN2P3
- CEN Bordeaux-Gradignan, CNRS-IN2P3/Université de Bordeaux 1
- LPC Caen, CNRS-IN2P3/Université de Basse-Normandie, ENSICAEN
- CSNSM Orsay, CNRS-IN2P3/Université Paris 11
- IPN Orsay, CNRS-IN2P3/Université Paris 11
- IPHC Strasbourg, CNRS-IN2P3/Université Louis Pasteur
- LMU München
- K.U. Leuven
- University of Manchester
- FLNR JINR Dubna
- CSIC Valencia
- CSIC Madrid
- CIEMAT Madrid
- UPC Barcelona

Cost for general DESIR items:

• RFQ cooler SHIRaC:	400 k€
• High-resolution separator HRS	2000 k€
• DESIR beam lines	3960 k€
• Remote control of beam lines equipments	1500 k€
• DESIR hall	7342 k€
• Radioprotection Laboratory	87 k€
• Workshops equipment	57 k€
• Stable ion sources	59 k€
• General purpose ion buncher GPIB	390 k€
• DESIR identification station	209 k€

total: 16004 k€

Cost for DESIR experiments:

• Laser spectroscopy setup LUMIERE	1000 k€
• Total absorption gamma-ray spectrometer TAGS	400 k€
• DESIR double Penning-trap PIPERADE	844 k€
• Neutron ToF detector	580 k€
• Charged particle array Silicon cube	200 k€
• Beta-decay station BEDO	250 k€
• MLL Penning trap	700 k€
• LPC Paul trap	500 k€
• Neutron detector BELEN	150 k€
• Neutron multiplicity detector TETRA	300 k€

total: 4924 k€

Party	Planned capital investment (k€)	Funds committed (k€)	Personnel in person months
GANIL Caen	0	0	53.4
CENBG Bordeaux	0	657	200
IPHC Strasbourg	209	0	24.1
LPC Caen (LPCTrap)	200	300	10
LPC Caen (Neutron-TOF)	235	45	15
CSNSM Orsay	0	187	76
IPN Orsay (LASER)	137	177	0
IPN Orsay (BEDO)	250	0	40
LMU Munich	0	700	18
University of Manchester	150	70	12
KU Leuven	200	100	12
CSIC Valencia	0	400	10
CSIC Madrid	0	200	10
CIEMAT Madrid	0	300	10
UPC Barcelona	0	150	12
FLNR JINR Dubna	200	100	16
Total	1 381	3 486	518.5

Management structure

Steering Committee:
All parties
1 vote / member
Political body

Collaboration Council:
✓ Chaired by the DESIR
collaboration spokesperson
✓ DESIR facility coordinator
✓ 1 member for each party
Scientific body

Management board:
✓ DESIR facility coordinator
✓ DESIR collaboration spokesperson
✓ 1 LUMIERE representative
✓ 1 BESTIOL representative
✓ 1 DETRAP representative
Managing body

Purpose of this meeting

- **present GANIL/SPIRAL2/DESIR**
- **discuss possible involvement in R&D for DESIR**
- **think about future experimental activities at DESIR**
 - **near future: new call for LOIs**
- **possibility to join the DESIR Collaboration Agreement**
 - **installation of experimental equipment in DESIR**
 - **DESIR management structure and organization**
 - ➔ ➔ **put collaboration on a more formal basis**