



# Status of the SPIRAL2 Project

**Marek Lewitowicz**

**GANIL, France**

*on behalf of the SPIRAL 2 Project Group*

*and*

*Physics Collaborations*



# GANIL/SPIRAL1/SPIRAL2 facility



GANIL/SPIRAL 1 today

DESIR Facility  
low energy RIB

S3 separator-  
spectrometer

Neutrons For  
Science

**Cost: 200M€**

**SP2 Beam time: 44 weeks/y**  
**GANIL Beam time: 35 weeks/y**  
**ISOL RIB Beams: 28-33 weeks/y**  
**GANIL+SP 2 Users: 700-800/y**

CIME cyclotron RIB at 1-20 AMeV  
(up to 9 AMeV for fiss. fragments)

HRS+RFQ Cooler

RIB Production Cave  
Up to  $10^{14}$  fiss./sec.

LINAC: 33MeV p, 40 MeV d, 14.5 A MeV HI

A/q=3 HI source  
Up to 1mA

A/q=6 Injector option

A/q=2 source  
p, d,  $^3\text{He}$ ,  $^4\text{He}$  5mA



# Status of the construction of SPIRAL2

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- Timeline
- Safety records
- Civil Construction Phase1 & LINAC
- Civil Construction Phase2 & RIB
- International Collaborations
- SPIRAL2 Phase 1 Day 1 experiments
- Towards a MoU for PARIS

# Timeline of SPIRAL 2

2006	2007	2008	2009	2010	2011	2012	2013
T1 T2 T3 T4	T1 T2 T3 T4	T1 T2 T3 T4	T1 T2 T3 T4	T1 T2 T3 T4	T1 T2 T3 T4	T1 T2 T3 T4	T1 T2 T3 T4

## Accelerator buildings & associated experimental Hall

Elaboration of programr								
Tenders buildings - Jury meetings	February 2008				★ ★	June 2008		
Conceptual study of buildings (APS +)								
Request for Permit of Construction					★	July 2009		
Public enquiry								
Permit of Construction granted								
Construction of buildings								
Hand-over of buildings								
Installation of equipement								
First beams								★ February 201
Operation								

## Production building & associated experimental Hall (DESIR)

Elaboration of programm								
Tenders buildings - Jury meetings								
Conceptual study of buildings (APS +)								
Request for Permit of Construction								
Permit of Construction granted								
Construction of buildings								
Hand-over of the buildings								
Installation équipements								
Tests								
Operation								★

Phase A - Feasibility

Phase B - Prel. Definition

Phase C/D - Detailed def.; Réalisation

Operation





# Safety records

September 15th 2008 : ASN/IRSN/GANIL/SPIRAL2 meeting

-> Strategy for the SPIRAL2 safety records and related procedures approved by the French Safety Authorities (ASN)

- Evaluation of the radiological impact of the facility : *Feb. 11<sup>th</sup>, 2009*
- Visit of the GANIL/SPIRAL2 by the ASN: *Feb. 13<sup>th</sup>, 2009*
- First meeting of Safety Information Commission (including local authorities and representatives of independent organisations) *Feb. 26<sup>th</sup>, 2009*
- Evaluation of the Preliminary Safety Record (R Pre S): *March 13<sup>th</sup>, 2009*

Safety records sent to the French  
Safety Authorities on April 30th, 2009

# Safety records

**Over 800 pages**

## DEMANDE D'AUTORISATION

de modification du périmètre  
de l'installation nucléaire  
de base n°113 pour implanter  
le projet **SPIRAL2**

**GANIL CAEN**

Boulevard Henri Becquerel  
BP 55027 / 14076 CAEN cedex 5  
[www.ganil-spiral2.eu](http://www.ganil-spiral2.eu)



AVRIL 2009

**GANIL**  
laboratoire commun CEA/DSM  
spiral2  
CHRS/IN2P3

### PARTIE 1

Identification du pétitionnaire

### PARTIE 2

Document descriptif

### PARTIE 3

Etude d'impact

### PARTIE 4

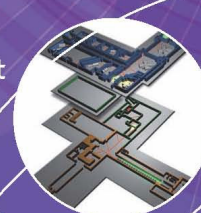
Etude de maîtrise des risques

### PARTIE 5

Plan de démantèlement

### PARTIE 6

Plans réglementaires







# Construction in 2 Phases

**Phase 1  
Accelerator & S3, NFS**

**Phase 2  
RIB production Building  
& DESIR**



**Civil construction: 2010 - 2012**



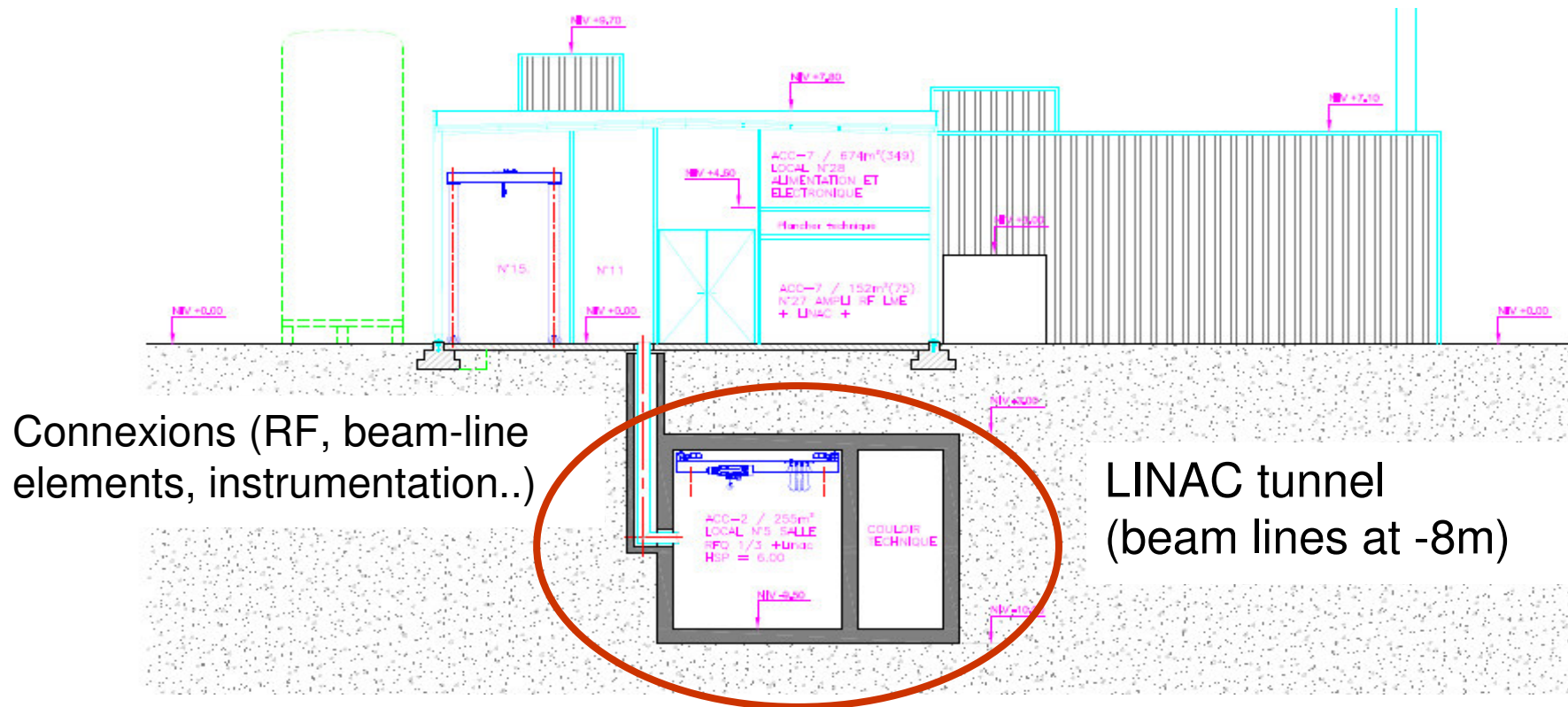
# Civil construction

Accelerator and associated experimental area = Phase1

INGEROP Company

Preliminary design study finished by of May 2009:

-> further cost reduction was necessary



Connexions (RF, beam-line elements, instrumentation..)

LINAC tunnel  
(beam lines at -8m)



# Infrastructures Phase 1

Accelerator and associated experimental area = Phase1

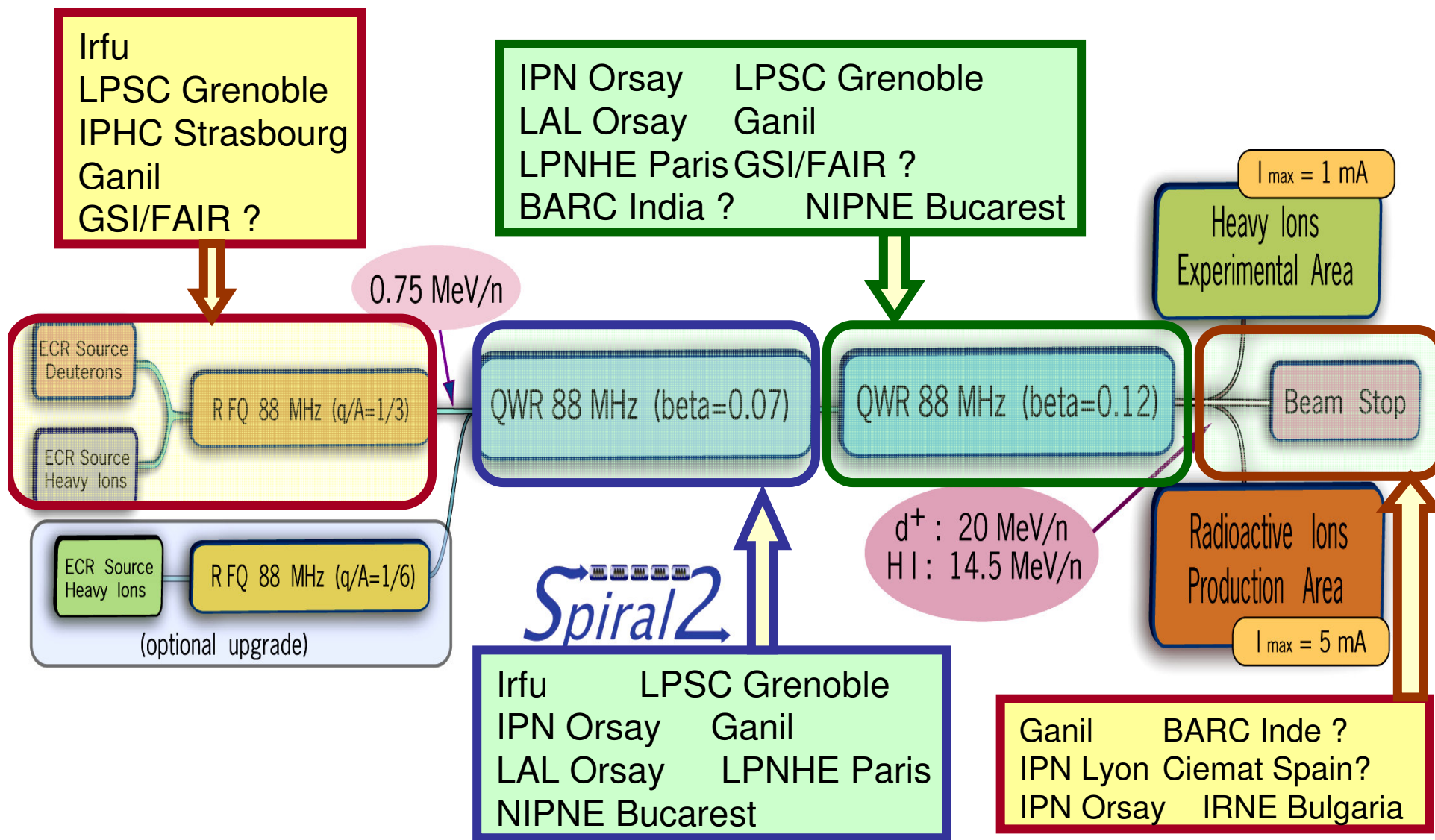
INGEROP Company

- Preliminary design validated on July 10th 2009 contains:
  - ❖ final configuration of all halls
  - ❖ technical solutions for safety requirements (earth quake and fire in particular)
  - ❖ cost estimate (better than +/-15%)
  - ❖ timeline
  - ❖ related documentation
- Construction Permit request submitted on July 31<sup>st</sup> 2009
- If everything goes well ground breaking by May-June 2010





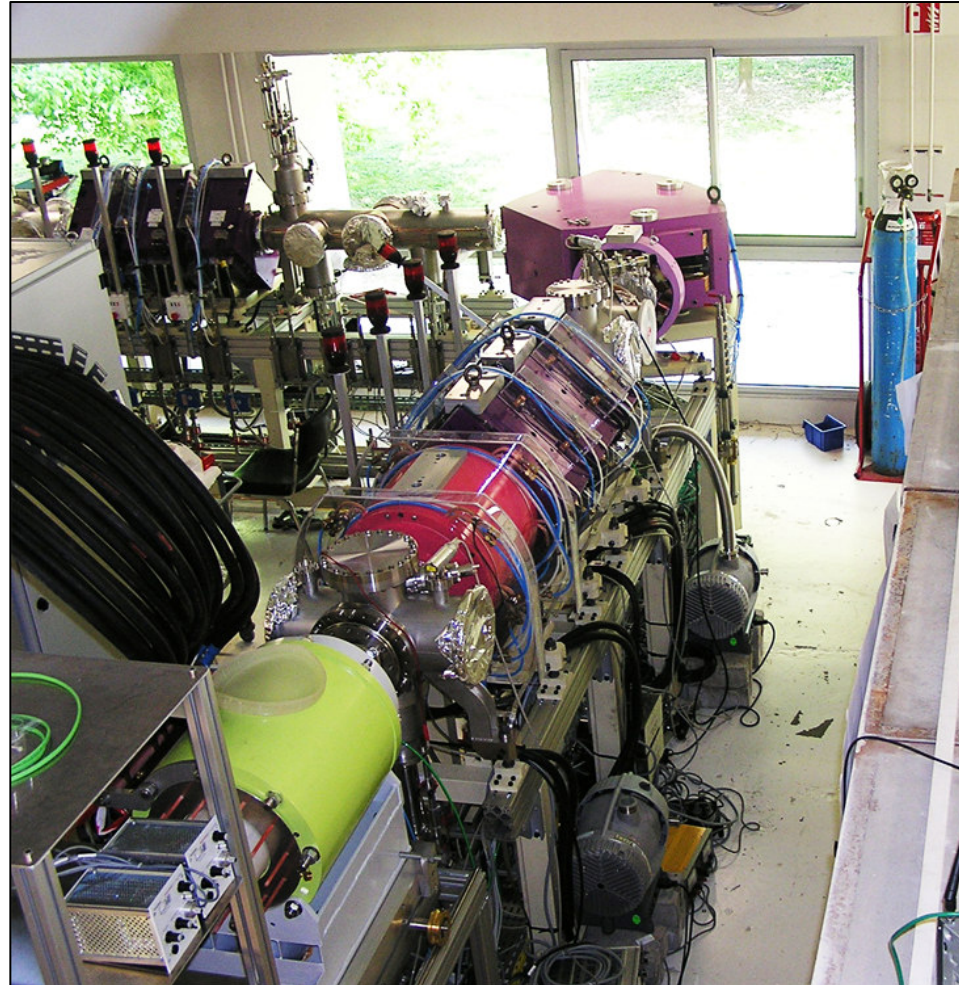
# SPIRAL2 Superconducting Linac





**LPSC, IRFU**  
**GANIL, IPNL**

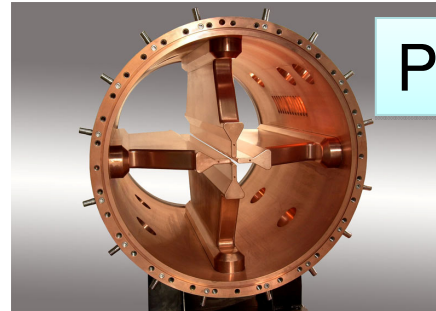
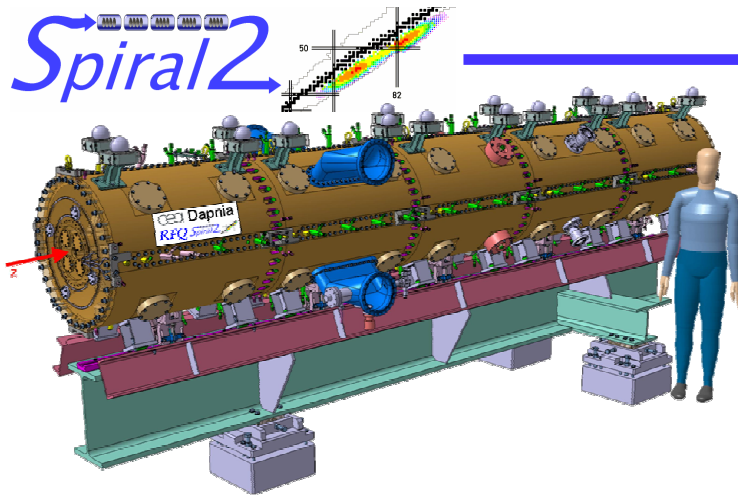
# Construction of SPIRAL 2



Heavy-Ion injector constructed at Grenoble, first  
mass separated beam May 20<sup>th</sup>, 2009



# LINAC

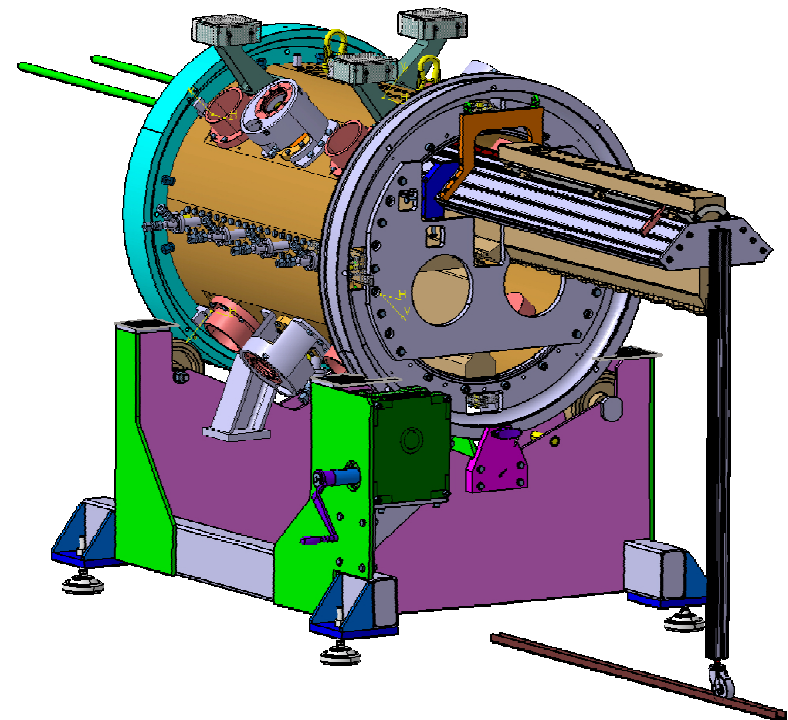
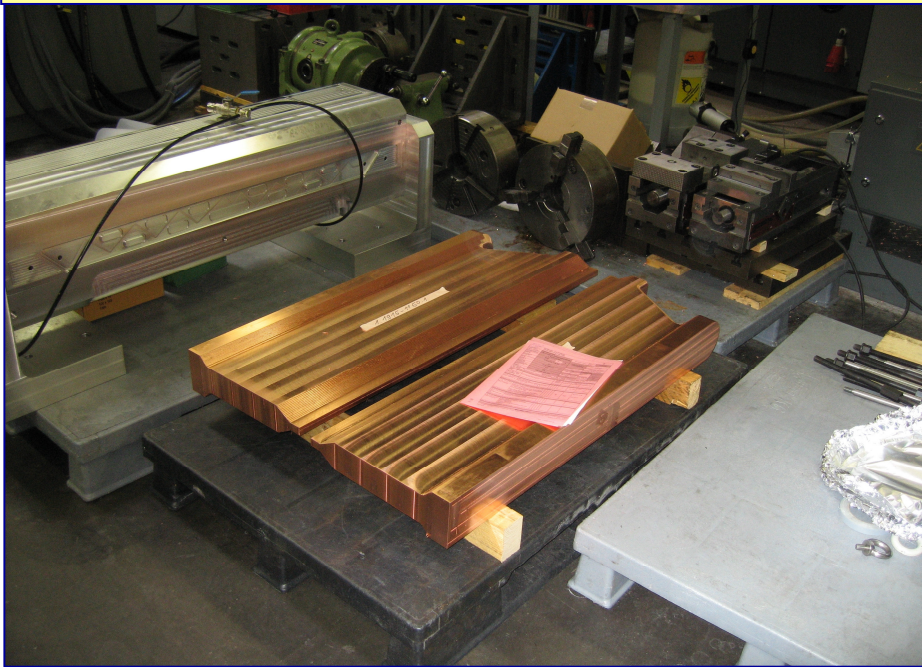


Prototype

Irfu  
RFQ

Dedicated tool development

Beginning of manufacturing  
- ACCEL **June 2009**







## IPN Orsay

SC Cavities type B delivery and tests



## LPSC

RF Couplers



## IPN Orsay Cryomodules B



11/08 : Prototype validation (IPNO)  
03/09 : Contract signature  
6 cryo-modules will be manufactured  
between 05/09 and 01/11

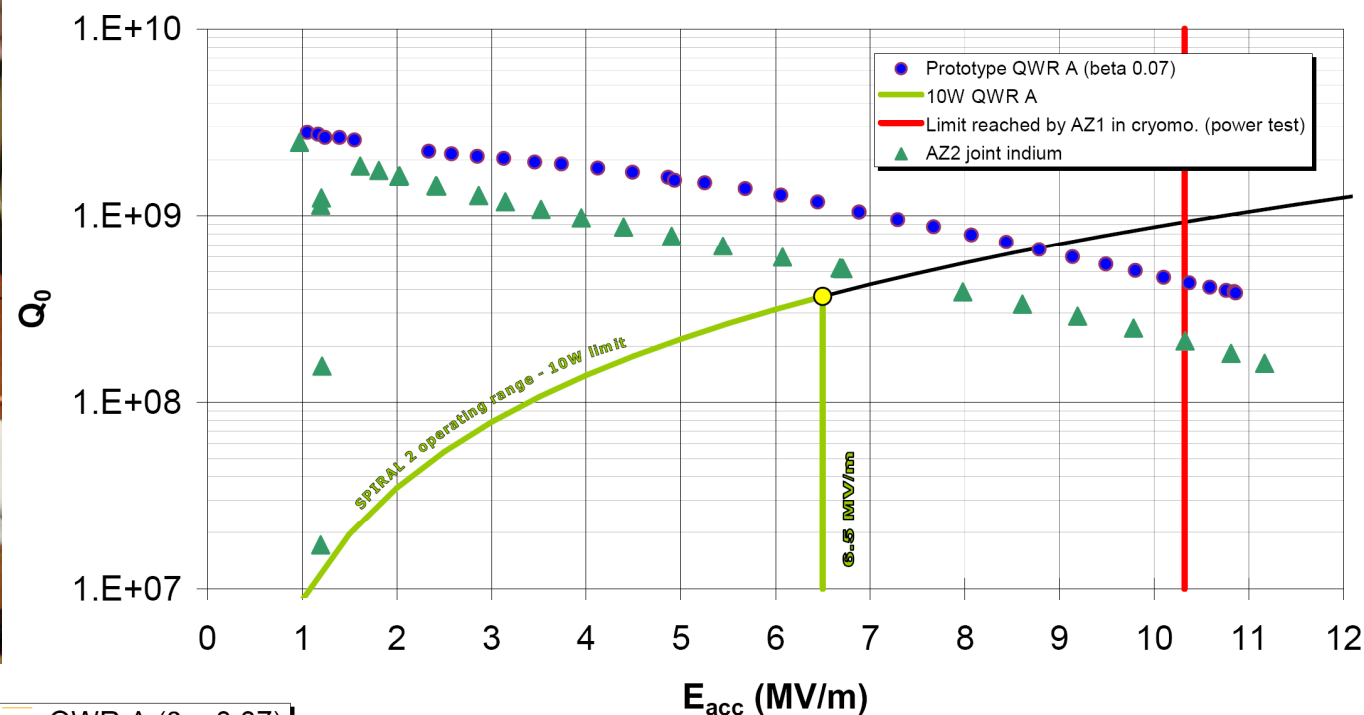


# LINAC

First prototype tests : **June 3<sup>rd</sup> 2009**  
 Second prototype tests : **July 8<sup>th</sup> 2009**

Irfu

SC Cavities type A



QWR A ( $\beta = 0.07$ )

$$L_{acc} = \beta \times \gamma = 0.24$$

Contract for manufacturing of SC Cavities type A signed





# Construction in 2 Phases

**Phase 2  
RIB production Building  
& DESIR**



**Civil construction: 2010 - 2012**



## Civil Construction Phase 2

# RIB production building and DESIR

1 – Preparation of detailed specifications for Phase 2

2 – Call for tender for Phase 2 November 18, 2008

3 - Revues

\* Internal Revues : Novembre 19 end December 10, 2008

\* External Revue : January 8, 2009

4 – Choice of the company

Jury meeting on October 2, 2009 : 4 companies will participate in the final round.

*Cost of Phase 2 proposed by different companies varies by more than factor of 2!*

☞ Further cost & design optimisation is necessary in the coming 6 months





# How the SPIRAL2 buildings might look like?

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Shown for the first time outside of France!



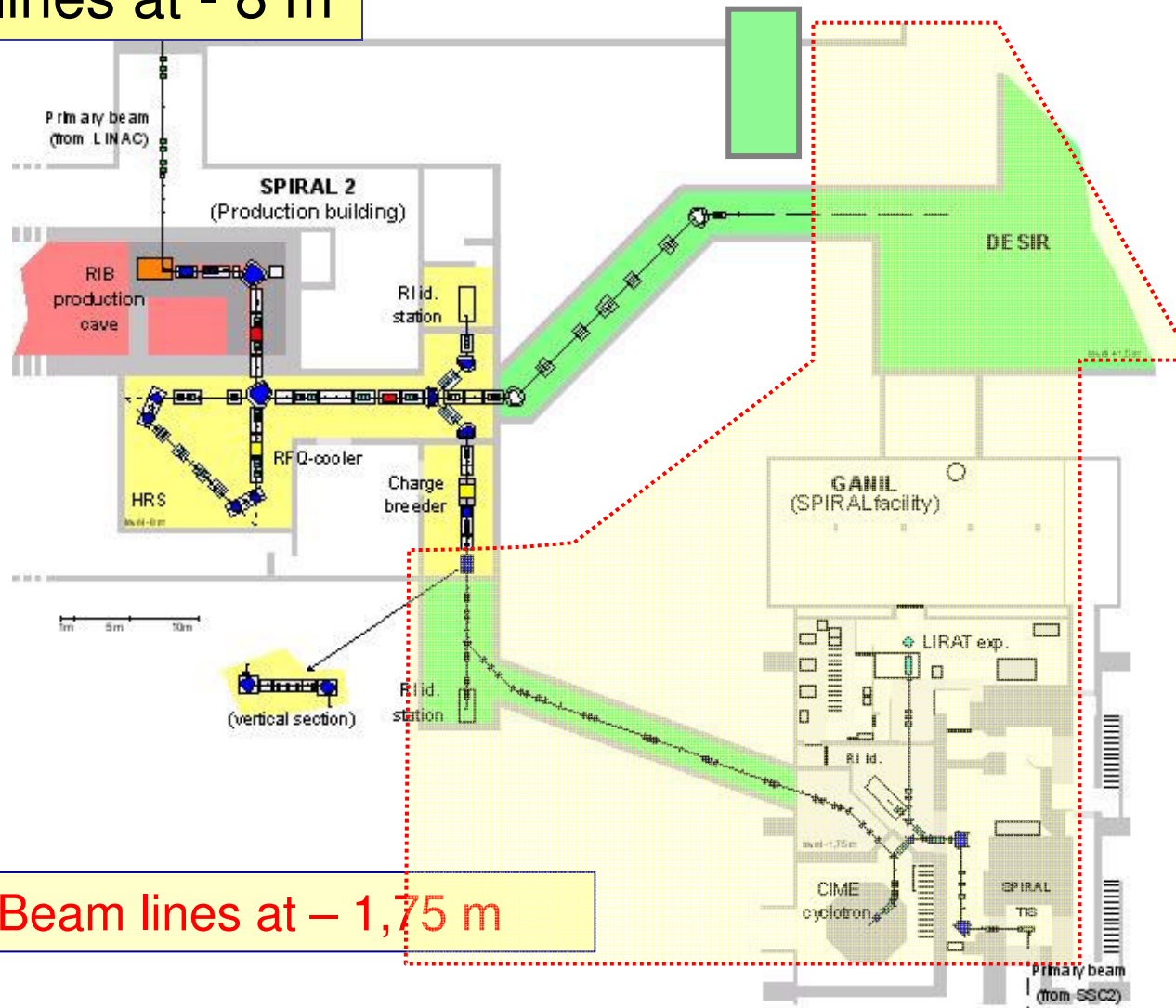




# RIB production building

## Definition of beam lines

Beam lines at - 8 m

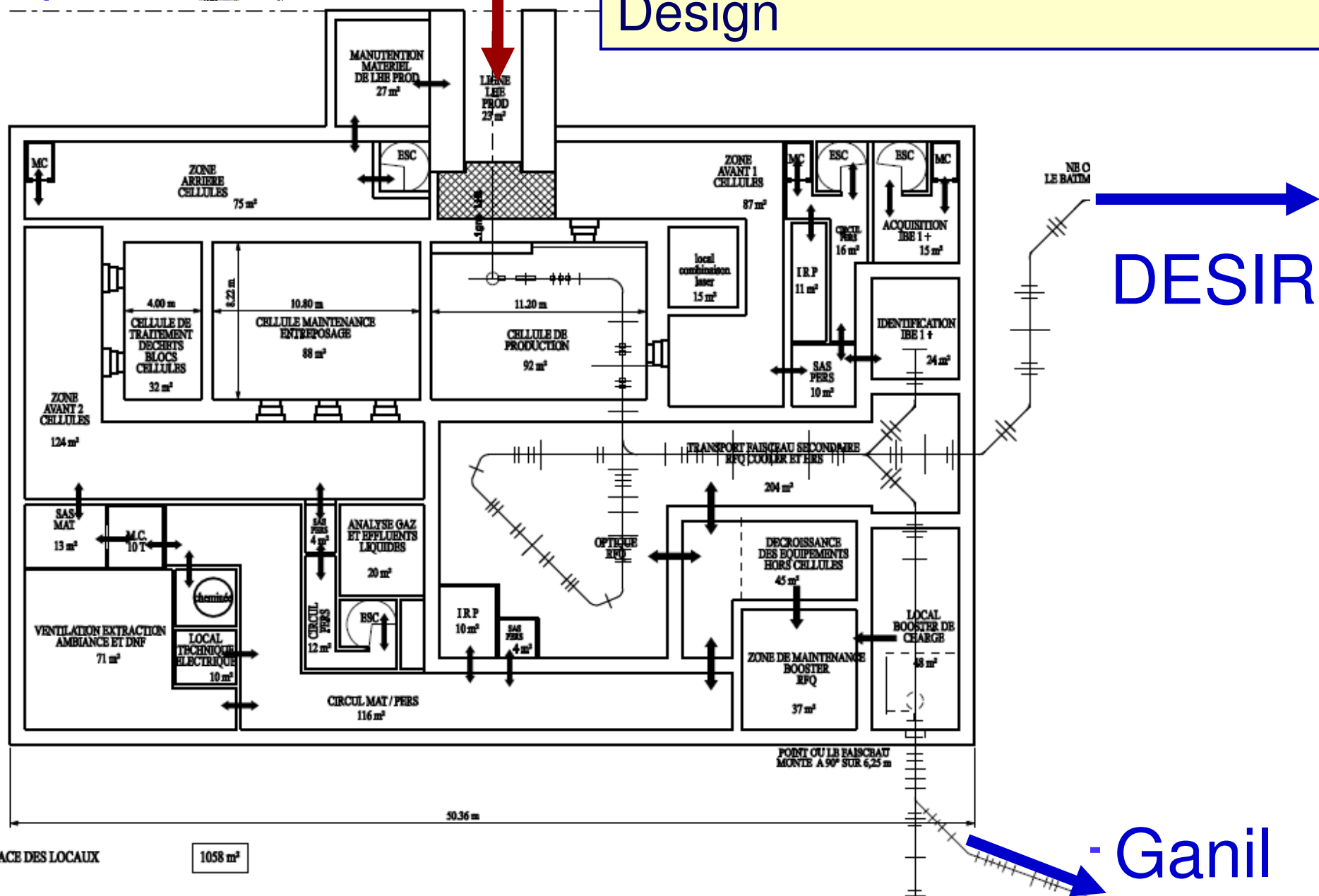


Beam lines at - 1,75 m

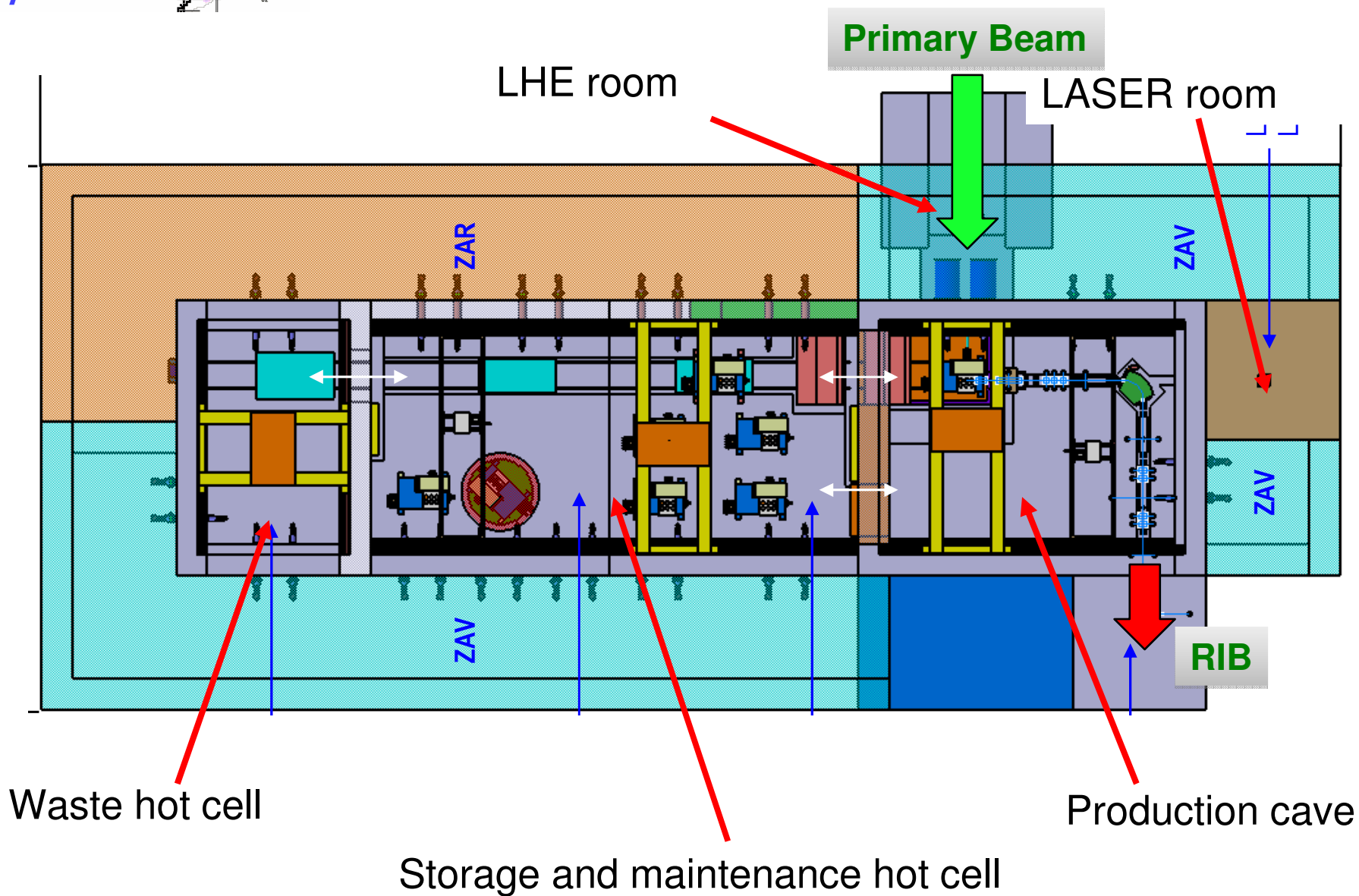
*Spiral2*

Beam from LINAC

# RIB production building Design



# Production cave architecture

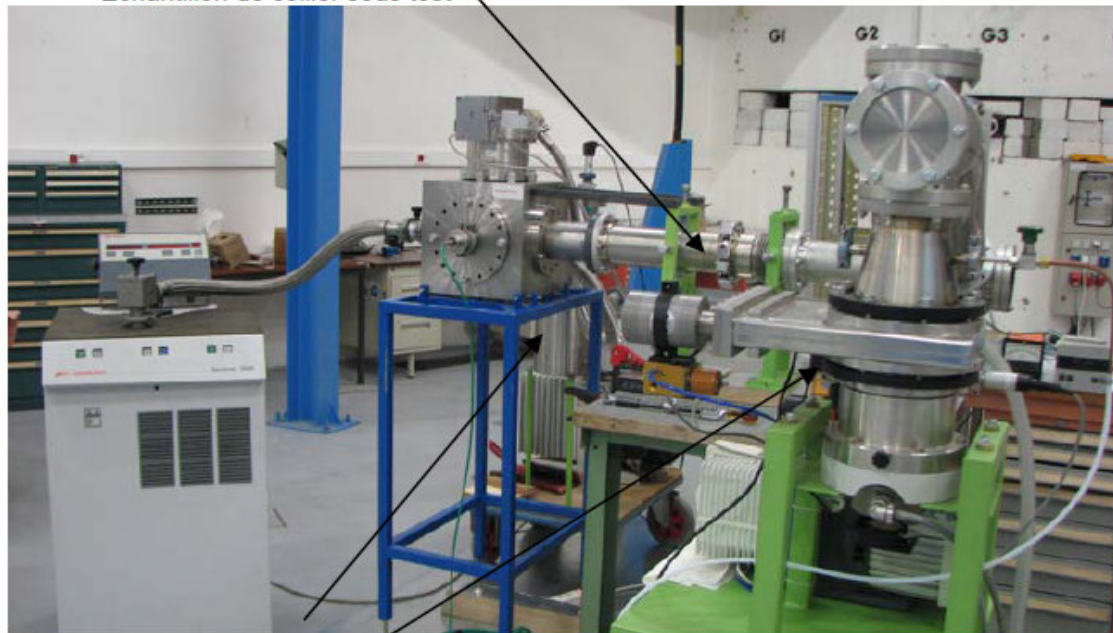




# RIB lines

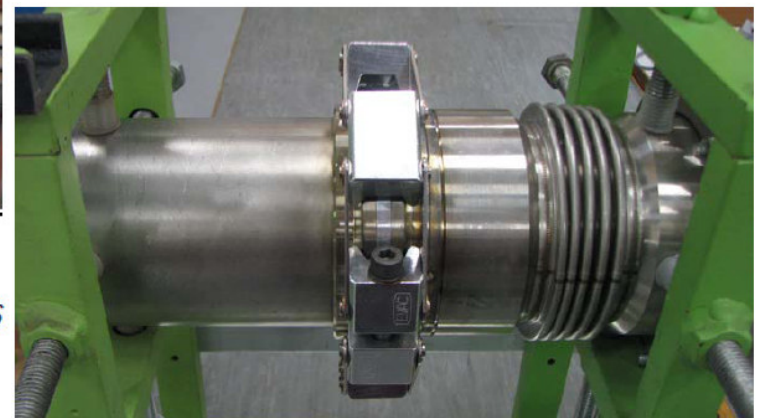
## Module of 1+ beam line

Echantillon de collier sous test



Groupes Turbo

*Vue de détail sur le banc de test du couplage mécanique entre modules  
(les modules sont remplacés par des sections de ligne)*



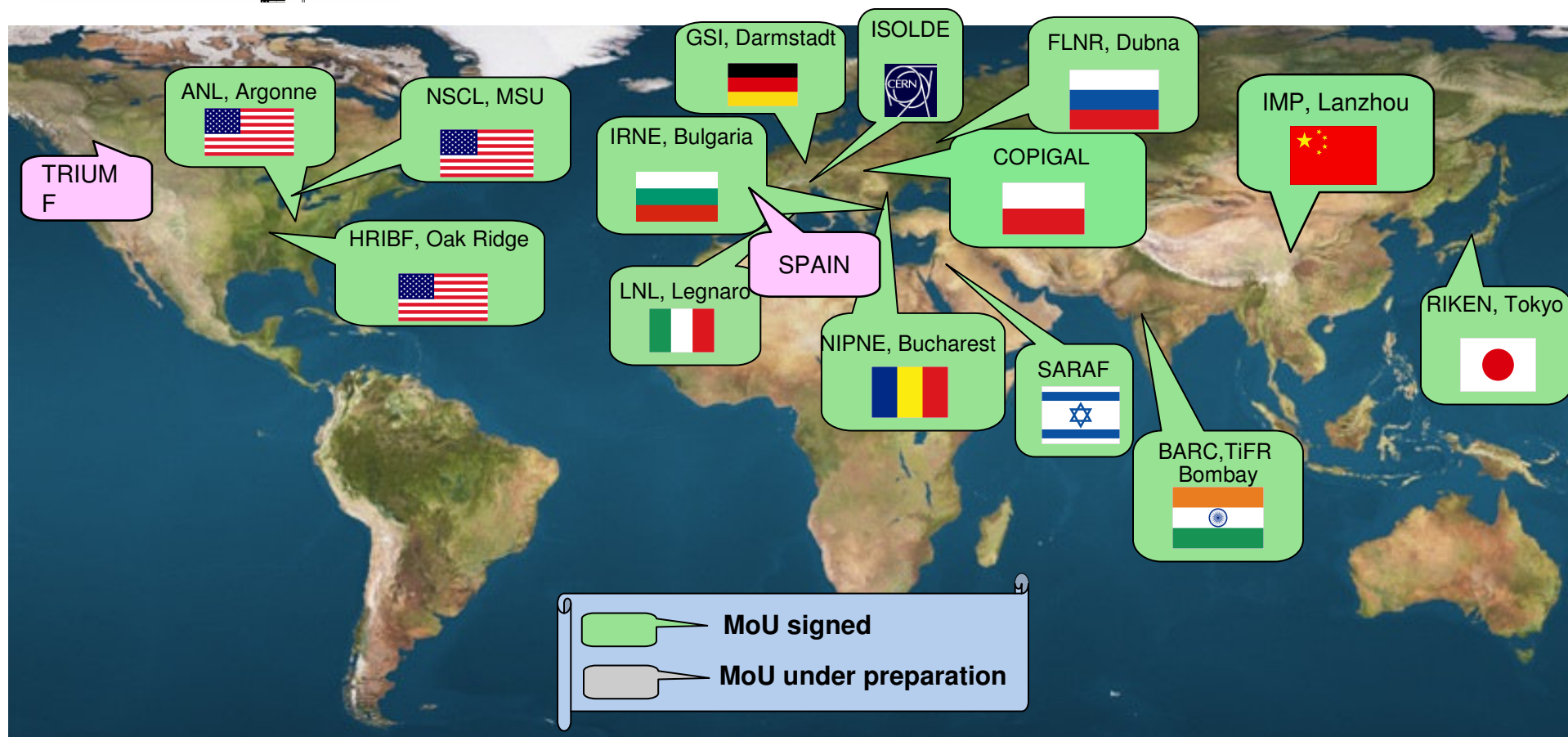
Collier de serrage EVAC monté sur brides

# IPHC

## Tests of 1+ beam-line module



# International Collaborations



EU FP7 3,9 M€ Preparatory Phase Contract

14 signed (LEA\*, LIA\*\*, MoU\*\*\*) agreements  
2 agreements under preparation

\**LEA = Laboratoire Européen Associé*  
 \*\**LIA = Laboratoire International Associé*  
 \*\*\**MoU = Memorandum of Understanding*



# FP7 SPIRAL2 Preparatory Phase



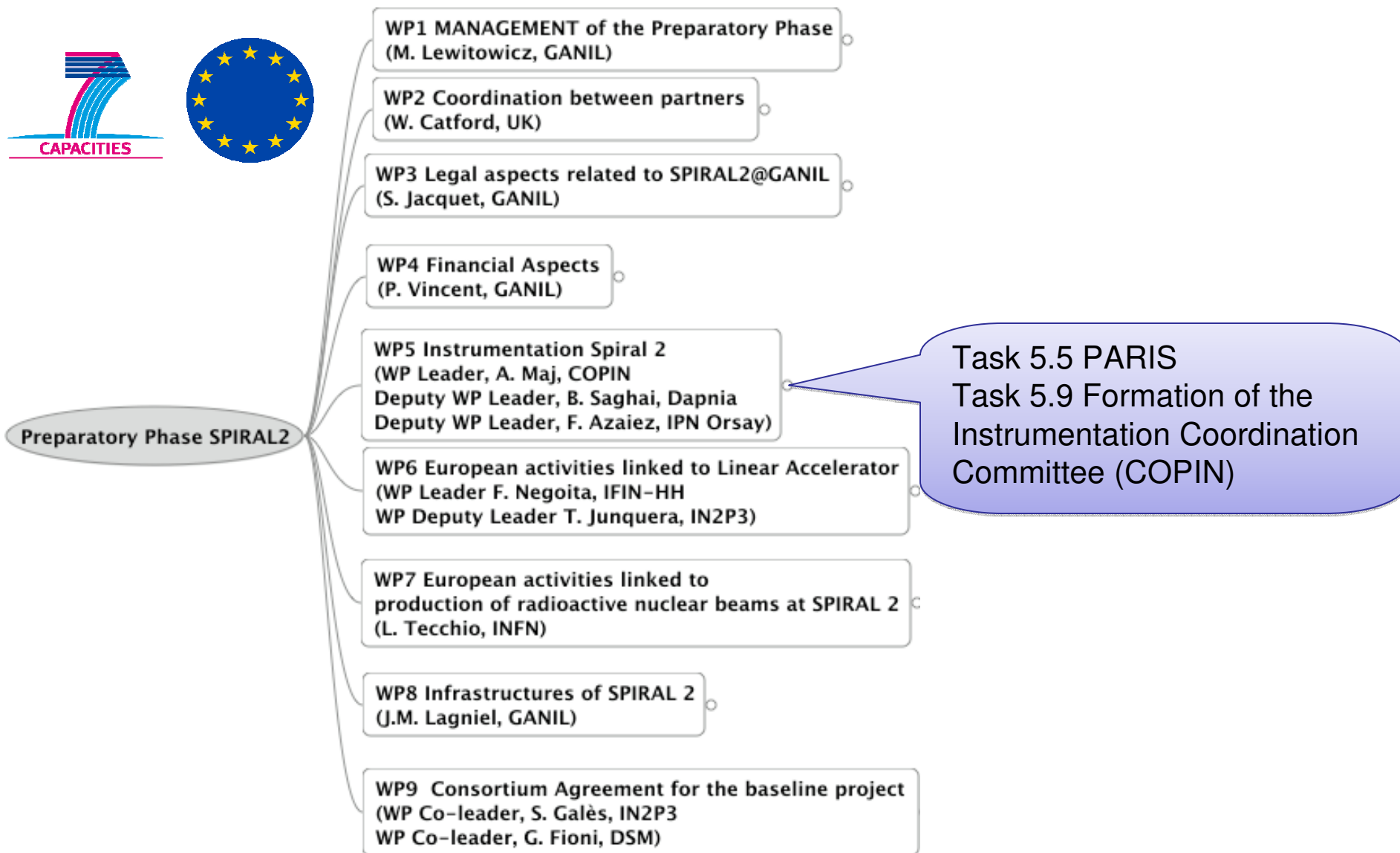
25 Partners - 13 Countries - 1 Coordinator =



ESFRI process and EU FP7 SPIRAL 2 Preparatory Phase contract (EC grant: 3,9 M€, 2008-2010, 25 partners) aims in the organisation and signature of the International Consortium for the construction of SPIRAL2 and the associated detectors -> **future intern. status of GANIL**



# Scheme of the FP7 SPIRAL 2 Preparatory Phase





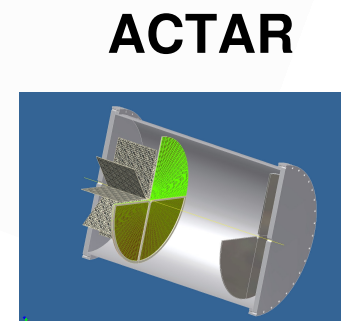
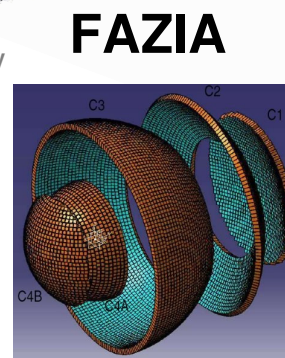
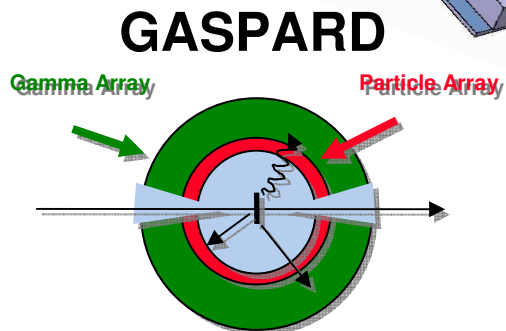
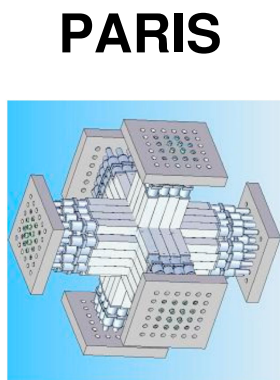
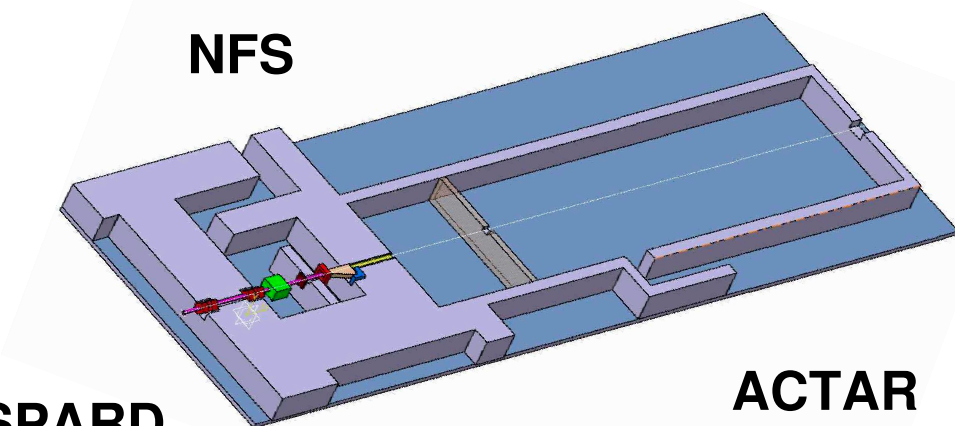
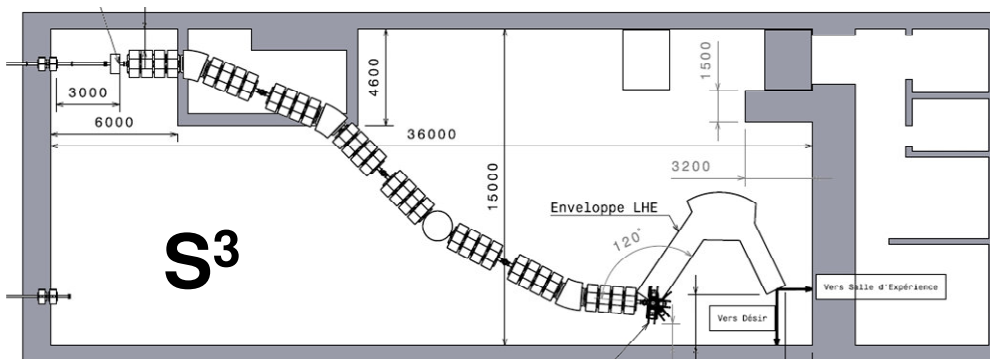
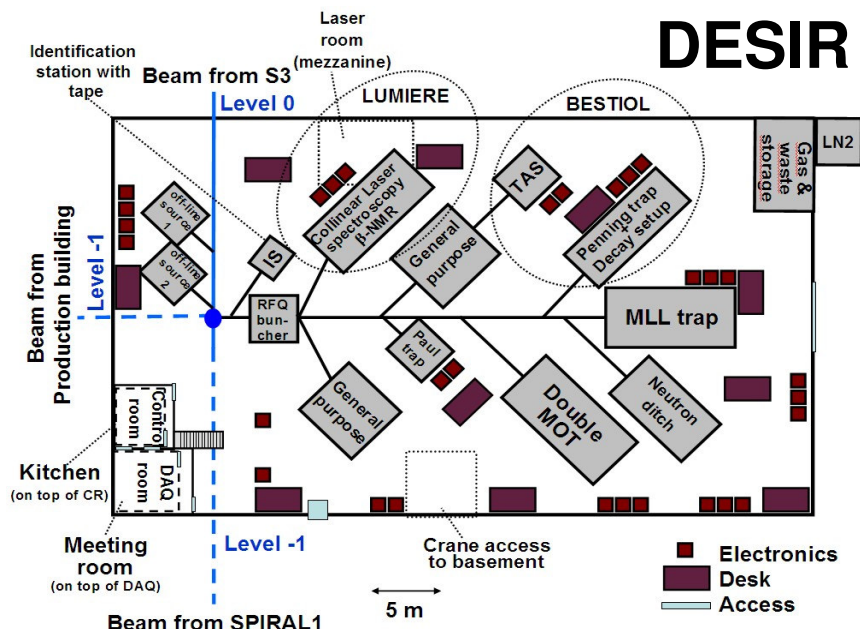


# PARIS SPIRAL2 Preparatory Phase Budget

		EC REQUEST					
		WP5					
		Personnel	Subcontracting	Travel	Other Direct Costs	Indirect costs	Total
1	GANIL				3 125	1 875	5 000
2	CNRS	-	-	-	8 125	4 875	13 000
	CENBG						
	CSNSM						
	IPNO				8 125	4 875	13 000
	IPHC						
3	CEA						-
4	INFN						-
5	STFC	22 927				24 073	47 000
6	COPIN	30 250		10 000	5 375	27 375	73 000
7	IFIN-HH						-
8	CIEMAT						-
9	KU Leuven						-
10	INRNE				2 500	1 500	4 000
11	UNIS				12 000	-	12 000
12	SOREQ						-
13	WEIZMANN Inst						-
14	UHU						-
15	Univ of SOFIA						-
16	ATOMKI				1 875	1 125	3 000
17	GSI-FAIR				7 500	4 500	12 000
18	FZK						-
19	RuG						-
20	NPI Prague						-
21	FAU Erlangen						-
22	Forster BAU GmbH						-
23	Univ of LIVERPOOL						-
24	Univ of YORK				8 125	4 875	13 000
25	CMEG						-
TOTAL		53 177	-	10 000	48 625	70 198	182 000



# New detectors to be used at SPIRAL 2





## SPIRAL2 PP Task 5.9

### **Instrumentation Coordination Committee**

A.Maj (chairman), F.Azaiez (deputy), B.Saghai (deputy),  
B.Blank (DESIR), G. de France (Exogam2), R. Bougault (FAZIA),  
D. Beaumel (GASPARD), X. Ledoux (NFS), A. Drouart (S3),  
G. de Angelis (Neutr. Det.), (PARIS is represented by A. Maj);  
N. Alahari (SPIRAL2), P. Roussel-Chomaz (ACTAR), H. Simon (NUSTAR),  
W. Korten/J. Simpson (AGATA), Y. Blumenfeld (HIE-ISOLDE)

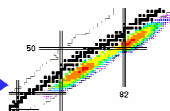
**3 meetings:** Giens, *June 2008*; Caen, *March 2009*, Paris, *August 2009*.



## Goals and actions of the ICC

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- Formation of the electronics and DAQ Working Group
- Formation of the HI-RIB Working group.
- Starting to coordinate synergies between SPIRAL2 detectors
- Request to all detector projects to nominate *technical liaisons* to SPIRAL2 project management
- Request to all detector projects to prepare the financial tables for detector construction phase
- Starting initiating discussions among collaborations for MoU preparations.
- Starting discussion on coordination of possible detector in-kind contributions from different partners



## Formation of Electronics and DAQ Working Groups

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The aim of these groups is :

--identify and encourage potential synergies in developments

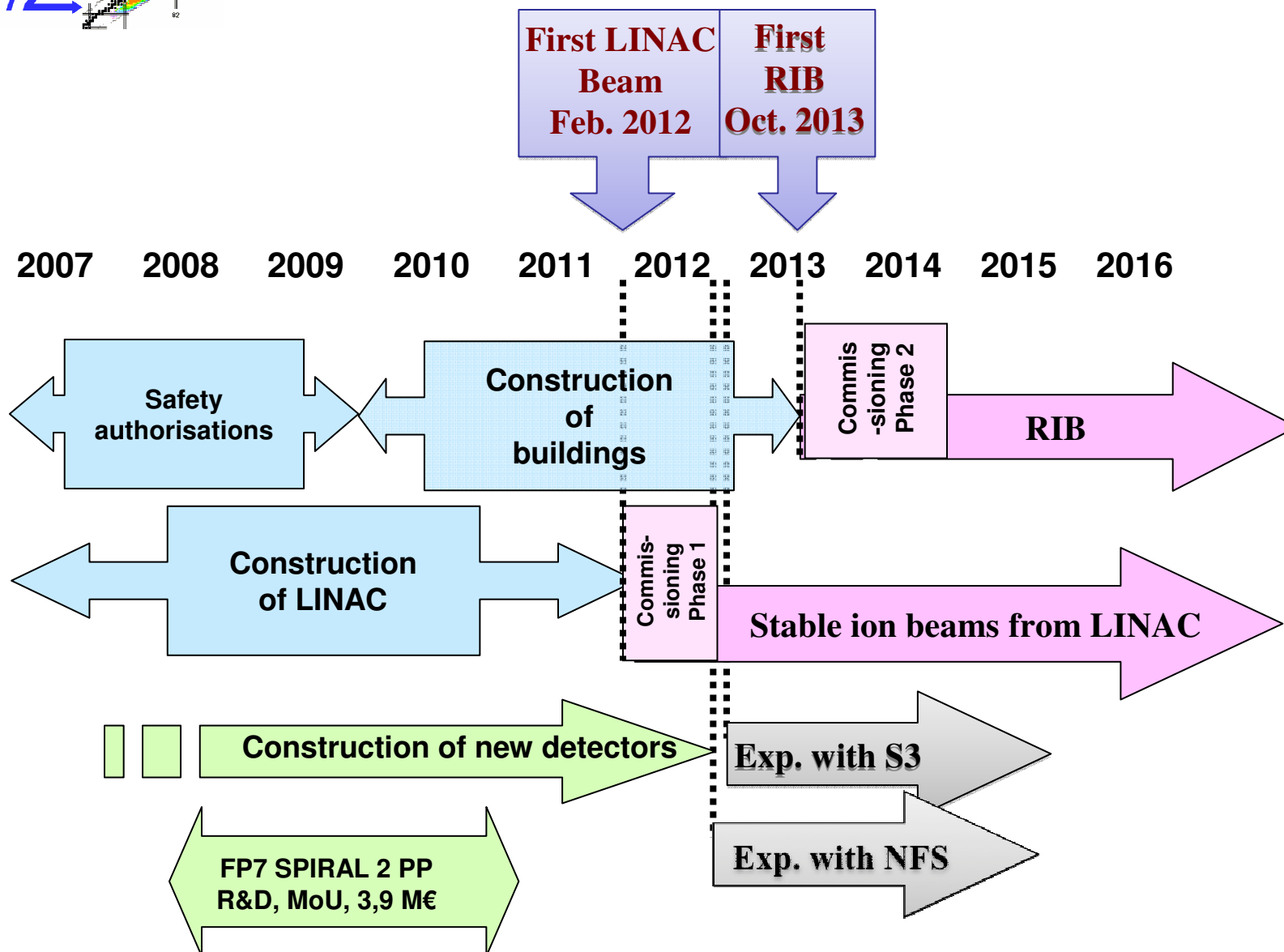
--Ensure compatibility of electronics and DAQ produced for new SPIRAL2 detectors for more efficient operation (especially when interconnecting different detectors).

Electronics working group: **Michel Tripon** (AGATA), Abderrhaman Boujrad (EXOGAM2), Adam Czermark (PARIS), Frédéric Druillole (ACTAR), Pierre Edelbruck (FAZIA), Nabil Karkour (S3), Emmanuel Pollacco(GASPARD), Haik Simon (NUSTAR)

DAQ working group : **Bruno Raine** , Shebli Anvar (GASPARD), Pierre Edelbruck (FAZIA), Xavier Grave (PARIS), Grégory Lebertre (EXOGAM2), Frédéric Saillant (ACTAR, S3), Haik Simon (NUSTAR)



# Planning SPIRAL 2





## Day 1 SPIRAL2 Phase 1 Experiments

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- Call for Letters of Intent for Day 1 SPIRAL2 Phase 1 Experiments (with S3 and NFS) in May 2009
  - NFS & S3 Workshops in May/June 2009
  - Dead-line July 20<sup>th</sup>, 2009
  - Evaluation of the Lol at the SAC meeting on September 11<sup>th</sup>, 2009 at Colloque GANIL in Giens
- Evaluation of status reports of all new SPIRAL2 detectors (ACTAR, DESIR, EXOGAM2, FAZIA, NFS, PARIS, S3) at the SAC meeting on September 11<sup>th</sup>, 2009



# LoI SPIRAL2 Phase 1 Day 1 experiments

Letter	Title	Spokesperson(s)	SAC referees
<b>LoI_Day1_1</b>	Fast ion-slow ion collisions –FISIC project	E. LAMOUR	M. Harakeh, W. Mittig
<b>LoI_Day1_2</b>	Production and spectroscopy of heavy and superheavy elements using S3 and LINAG	P. GREENLEES	B. Blank, W. Henning
<b>LoI_Day1_3</b>	In-source resonant laser ion spectroscopy of $^{94}\text{Ag}$	I. G. DARBY	D. Vernhet, B. Jonson, G. De Angelis
<b>LoI_Day1_4</b>	In-source resonant laser ion spectroscopy of the light Sn isotopes $A = 101-107$	I. G. DARBY	D. Vernhet, B. Jonson, G. De Angelis
<b>LoI_Day1_5</b>	In source resonant laser ion spectroscopy of $Z \geq 92$	I. G. DARBY	D. Vernhet, B. Jonson, G. De Angelis
<b>LoI_Day1_6</b>	Single proton states and proton-neutron interaction in $^{100}\text{Sn}$	L. CACERES, F. Azaiez	G. De Angelis, B. Blank
<b>LoI_Day1_7</b>	In-beam gamma spectroscopy of neutron-rich nuclei studied with PARIS at the intermediate focal plane of S3 Shell structure, isospin-symmetry and shape changes in $N=Z$ nuclei:	I. STEFAN, B. Fornal	F. Iachello, N. Alamanos, T. Motobayashi
<b>LoI_Day1_8</b>	Coulomb excitation of $^{104}\text{Sn}$ : probing large scale shell model calculation Coulomb excitations of the $T=1$ bands of the odd-odd $^{62}\text{Ga}$ , $^{66}\text{As}$ and $^{70}\text{Br}$ nuclei	G. DE ANGELIS, B. Wadsworth	N. Alamanos, F. Iachello
<b>LoI_Day1_9</b>	Quadrupole Moments of isomeric states using the Tilted-foils Technique at S3	G. GEORGIEV, M. Hass	D. Vernhet, W. Gelletly
<b>LoI_Day1_10</b>	Precision study of the superallowed beta decay of heavy odd-odd $N=Z$ nuclei	B. BLANK	W. Mittig, B. Jonson
<b>LoI_Day1_11</b>	$^{100}\text{Sn}$ factory – studies of the structure of nuclei in the $^{100}\text{Sn}$ region	D. SEWERYNIAK	W. Mittig, T. Motobayashi, F. Iachello
<b>LoI_Day1_12</b>	Fragment angular distributions in neutron-induced fission of actinides	L. TASSAN-GOT, L. Audouin	M. Harakeh, W. Henning
<b>LoI_Day1_13</b>	Study of the pre-equilibrium process in the $(n,xn)$ reaction	X. LEDOUX	D. Guillemeud-Mueller, W. Gelletly
<b>LoI_Day1_14</b>	Comparison between activation and prompt spectroscopy as means of $(n,xn)$ cross section measurements	M. KERVENO	D. Guillemeud-Mueller, W. Gelletly
<b>LoI_Day1_15</b>	Fission fragment distributions and neutron multiplicities	M. Aïche, D. DORE, F. Rejmund	M. Harakeh, W. Henning
<b>LoI_Day1_16</b>	Proton and deuteron induced activation reactions	P. BÉM, M. Avrigeanu, U. Fischer, S..P. Simakov	N. Alamanos, D. Guillemaud-Mueller



Choice of the parameters of LINAC and detectors for the first SPIRAL2 experiments:

- Accelerator:

- Choice of **first** light and HI beams

- ☑ **Deuteron beam at 40MeV, 2-10 $\mu$ A with fast chopper for NFS**

- ☑  **$^{22}\text{Ne}$ ,  $^{28-30}\text{Si}$ ,  $^{32-36}\text{S}$ ,  $^{40-48}\text{Ca}$ ,  $^{40}\text{Ar}$ ,  $^{58}\text{Ni}$  beams at 10p $\mu$ A -> A-Phoenix (or similar) high intensity ECR source is necessary**

- Detectors:

- First configuration for S3 (targets, detector systems)

- ☑ **Mainly decay experiments (SHE and  $^{100}\text{Sn}$ ) in the S3 final focus**

- First targets (converters) and detector system(s) for NFS

- ☑ **Rotating (C or Be) d->neutron converter**

- ☑ **New detection system for measurement of fission-fragment distributions**

# LINAC beams for the Day 1 SPIRAL2 Phase 1 experiments\*)

Based on the recommendations of SPIRAL2 SAC for the Lol

Ion(s)	Energy Range (MeV/nucleon)	Maximum Intensity (pμA)	Date of availability <sup>***)</sup>	Remarks
$^1\text{H}^{1+}$	20-33	2-10	December 2012	NFS beam line; Intensity with fast chopper 1/100
$^2\text{H}^{1+}$	10-20	2-10	December 2012	NFS beam line; Intensity with fast chopper 1/100
$^4\text{He}^{2+}$	10-20	2-10	December 2012	NFS beam line; Intensity with fast chopper 1/100
$^{12}\text{C}^{4+}$	5-7	$\geq 10^{**})$	February 2013	S3 beam line
$^{18}\text{O}^{6+}$	5-7	$\geq 10^{**})$	February 2013	S3 beam line
$^{22}\text{Ne}^{8+}$	5-7	$\geq 10^{**})$	February 2013	S3 beam line
$^{40}\text{Ar}^{14+}$	4-5	$\geq 10^{**})$	February 2013	S3 beam line
$^{28-30}\text{Si}^{10+}$ or $^{32-36}\text{S}^{12+}$	5-7	$\geq 10^{**})$	November 2013	S3 beam line
$^{40}\text{Ca}^{14+}$	5-7	$\geq 10^{**})$	November 2013	S3 beam line
$^{48}\text{Ca}^{16+}$	5-7	$\geq 10^{**})$	November 2013	S3 beam line
$^{58}\text{Ni}^{18+}$	4-14	$\geq 1^{**})$	November 2013	S3 beam line

\*) The parameters indicated in this table are the first and the best approximations that can be done today.

\*\*) Based on the order of magnitude of the expected best currents extracted from a high performance, fully operational, 28 GHz ECR Ion source.

\*\*\*) These dates assume that: installation of equipment in the NFS and S3 areas can start in July 2011.



## Recommendations for PARIS:

The SAC acknowledges the progress made by the PARIS collaboration in particular concerning the detector tests of the  $\text{LaBr}_3$  prototype cubic detectors which displayed excellent resolution in both configurations the 2'' -long and 4'' -long crystals. The test with the phoswich-type detector composed of  $\text{LaBr}_3$  and  $\text{CsI}(\text{Na})$  crystals is very encouraging indeed and should be quite useful in detecting high-energy  $\gamma$ -rays because of the high efficiency and very reasonable resolution. The GEANT4 simulations have been performed with the phoswich-type detector and it seems that the collaboration is now at the crossroad for making a choice between the cubic-like geometry and the radial-like geometry of PARIS, both consisting of rectangular phoswich crystals. The truly spherical geometry has been abandoned because of the choice of rectangular phoswich crystals. **The SAC is pleased to hear that the final decision of the geometry will be made in October 2009.**

The SAC in its last report asked the PARIS collaboration to present in the next status report the programme focussed at SPIRAL2 (and not the full PARIS programme). Though some physics cases have been discussed which are focussed on SPIRAL2, also the heavy-ion radiative capture case was presented which can be done at tandem facilities. **It would be strongly recommended that in the next status report both the GASPARD and PARIS collaborations should work out one or more experiments where the integrated GASPARD and PARIS detectors are used.**





## Towards the signature of the PARIS MoU

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- **Signature of the PARIS MoU is expected at the latest by end of 2010 (deliverable of the SPIRAL2 Preparatory Phase).**
- ***Preparation + negotiations of a MoU take typically 1 year!***
- **Template of the MoU for the SPIRAL2 detectors (based on the MoU of AGATA) is available.**
- **Template for the budget tables is available.**



# Preliminary budget tables (resources) for S3, NFS and EXOGAM2

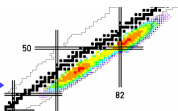
RESSOURCES in k€	Year 2009	Year 2010	Year 2011	Year 2012	Year 2013	Year 2014	Year 2015	Total Ressources				To be confirmed
	Total	Total	Total	Total	Total	Total	Total	S3	NFS	EXOGAM2	Total	
<b>France</b>												
CEA(DSM/IRFU)												
CEA (DAM+DEN)	40	70	70	-	-	-	-	-	180	-	180	50
CNRS/IN2P3	43	380	430	400	-	-	-	1 163	90	-	1 253	
GANIL	250	458	534	590	-	-	-	1 450	60	322	1 832	60
ILL	-	-	20	50	-	-	-	-	-	70	70	
Local authorities	-	-	-	-	-	-	-	-	-	-	-	
Other investment subsidies ( CPER,ANR)	150	330	220	-	-	-	-	400	200	100	700	200
EC FP7 SP2PP	80	35	63	-	-	-	-	55	51	72	178	
<b>Total France</b>	<b>563</b>	<b>1 273</b>	<b>1 337</b>	<b>1 040</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>3 068</b>	<b>581</b>	<b>564</b>	<b>4 213</b>	<b>310</b>
Germany	-	-	-	-	-	-	-	-	-	-	-	
Bulgaria	-	225	262	262	-	-	-	749	-	-	749	749
Hungary	-	-	100	-	-	-	-	-	-	100	100	100
India	-	-	155	275	-	-	-	400	-	30	430	430
Poland	-	72	114	84	-	-	-	240	-	30	270	270
Czech Republic	25	25	20	-	-	-	-	-	70	-	70	
Sweden	15	15	138	638	-	-	-	276	-	530	806	776
USA	-	115	801	926	-	-	-	1 842	-	-	1 842	1 842
<b>TOTAL RESSOURCES</b>	<b>603</b>	<b>1 725</b>	<b>2 927</b>	<b>3 225</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>6 575</b>	<b>651</b>	<b>1 254</b>	<b>8 480</b>	<b>4 477</b>
<b>TOTAL COST</b>	<b>664</b>	<b>1 897</b>	<b>3 357</b>	<b>3 170</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>7 808</b>	<b>751</b>	<b>529</b>	<b>9 088</b>	
<b>COST - RESSOURCES</b>	<b>-61</b>	<b>-172</b>	<b>-430</b>	<b>55</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>-1 233</b>	<b>-100</b>	<b>725</b>	<b>-608</b>	
<b>To be confirmed:</b>	<b>-</b>	<b>542</b>	<b>1 750</b>	<b>2 185</b>				<b>3 507</b>	<b>310</b>	<b>660</b>	<b>4 477</b>	



END



*Spiral2*



# GANIL/SPIRAL1/SPIRAL2 facility



GANIL/SPIRAL 1 today

DESIR Facility  
low energy RIB

S3 separator-  
spectrometer

Neutrons For  
Science

**Cost: 200M€**

**SP2 Beam time: 44 weeks/y**  
**GANIL Beam time: 35 weeks/y**  
**ISOL RIB Beams: 28-33 weeks/y**  
**GANIL+SP 2 Users: 700-800/y**

CIME cyclotron RIB at 1-20 AMeV  
(up to 9 AMeV for fiss. fragments)

HRS+RFQ Cooler

RIB Production Cave  
Up to  $10^{14}$  fiss./sec.

LINAC: 33MeV p, 40 MeV d, 14.5 A MeV HI

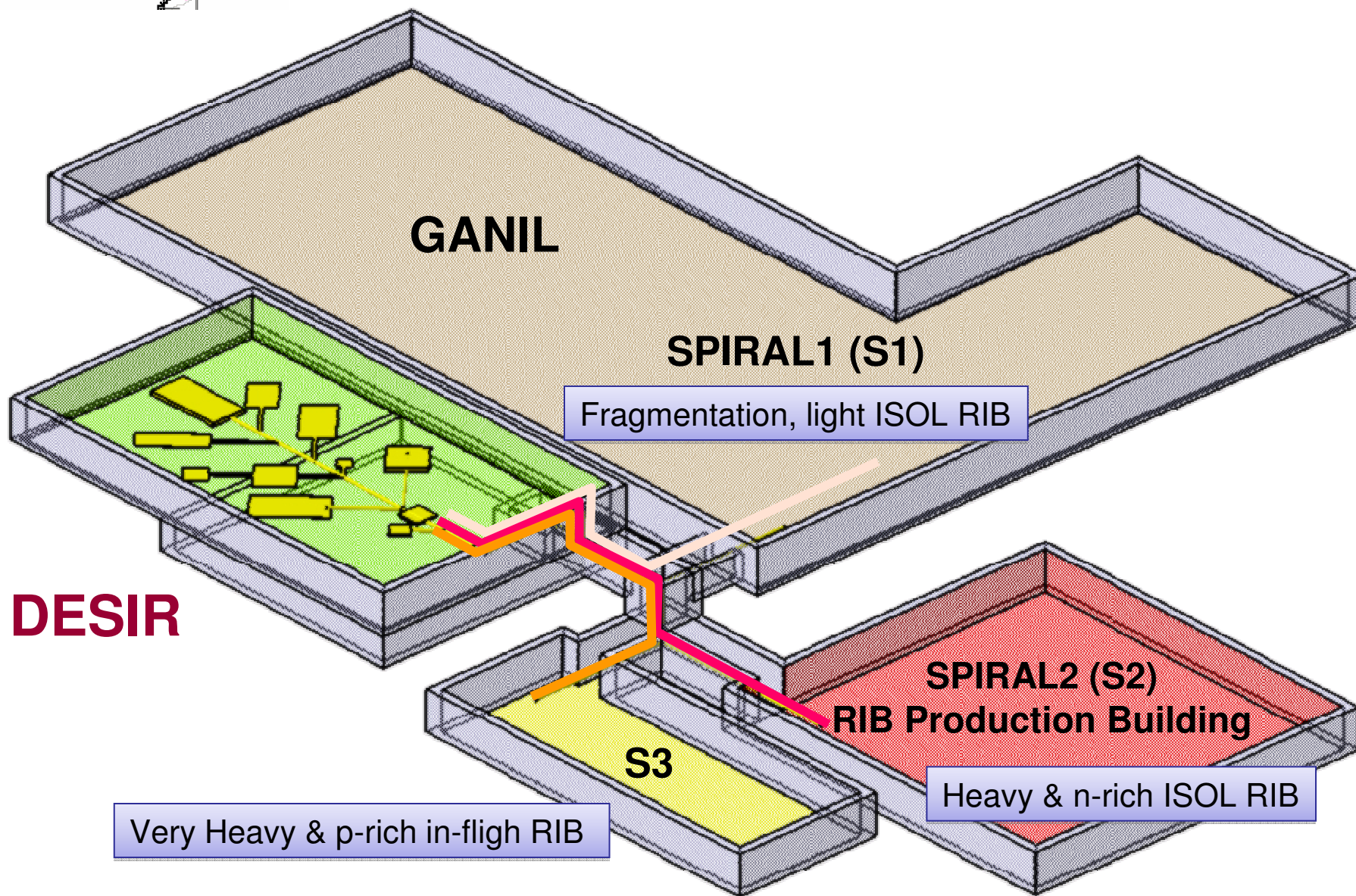
A/q=3 HI source  
Up to 1mA

A/q=6 Injector option

A/q=2 source  
p, d,  $^3\text{He}$ ,  $^4\text{He}$  5mA



# Various RIB beams in DESIR

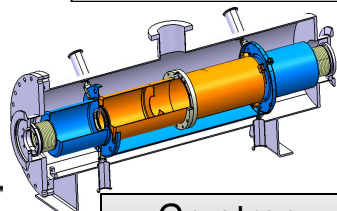


# Production of RIB

UC<sub>x</sub> target (up to 2.3 kg,  $\rho = 11\text{g/cm}^3$ )  
 Tests at Gatchina of up to 100g target  
 Construction and test of low density UC<sub>x</sub>  
 target at IPN Orsay/ALTO

Tests at Grenoble of  
 the  $1+ \rightarrow n+$  charge breeding

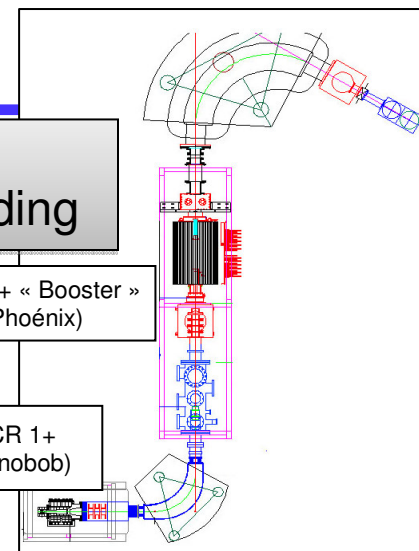
**p,d,H beam**



Cryotrap  
 GANIL/IPNO

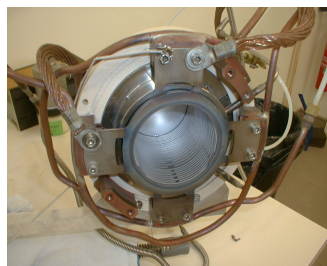
ECR N+ « Booster »  
 (Phoénix)

ECR 1+  
 (monobob)



$\phi$  80mm

Target oven  
 tests IPN Orsay

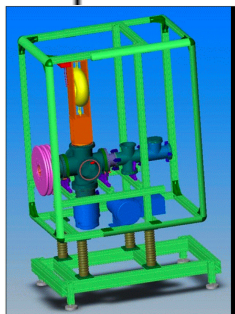
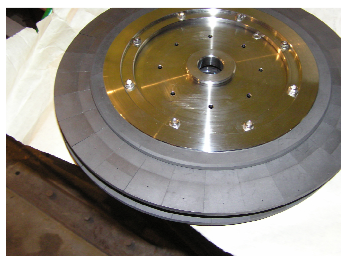


**Target Station**

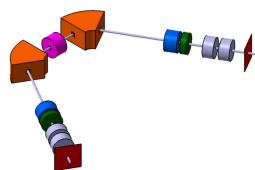
1+ ion-sources:  
 - Surface ionisation  
 - ECR  
 - Laser  
 - FEBIAD

**RFQ Cooler+HRS**

Graphite Converter  
 tests LNL Legnaro



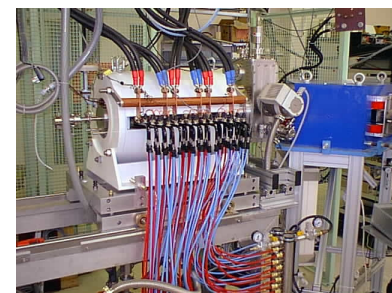
HRS  
 CENBG Bordeaux



**DESIR**

(low energy RIB)

Charge  
 Breeder ECR



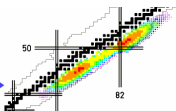
Charge breeder  
 (Phoenix ECR source)  
 LPSC Grenoble

**CIME**

(fast RIB)

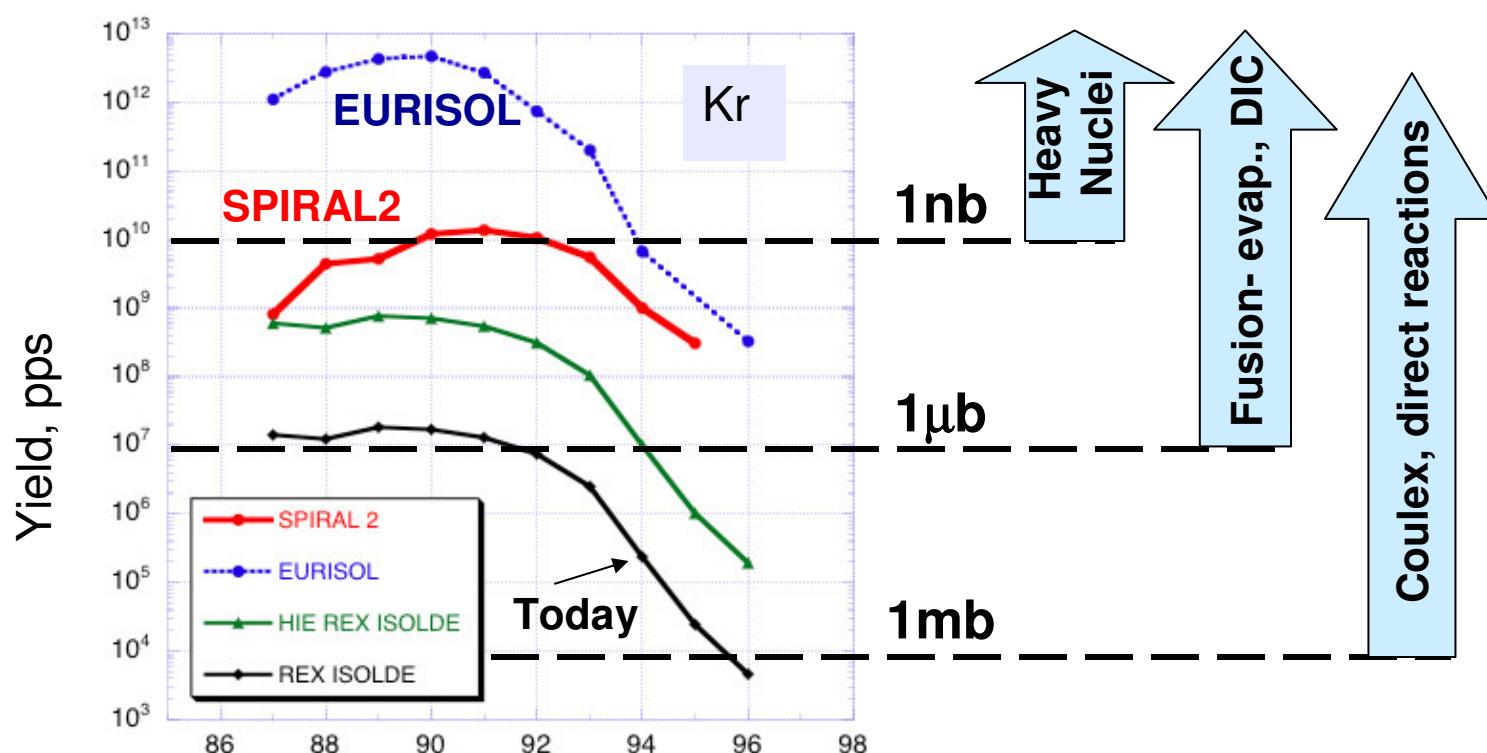
RFQ Cooler  
 LPC Caen





# SPIRAL 2: Advanced ISOL RIB facility

**SPIRAL 2: Experiments with RIB at low cross sections and very exotic nuclei at few MeV/nucleon**

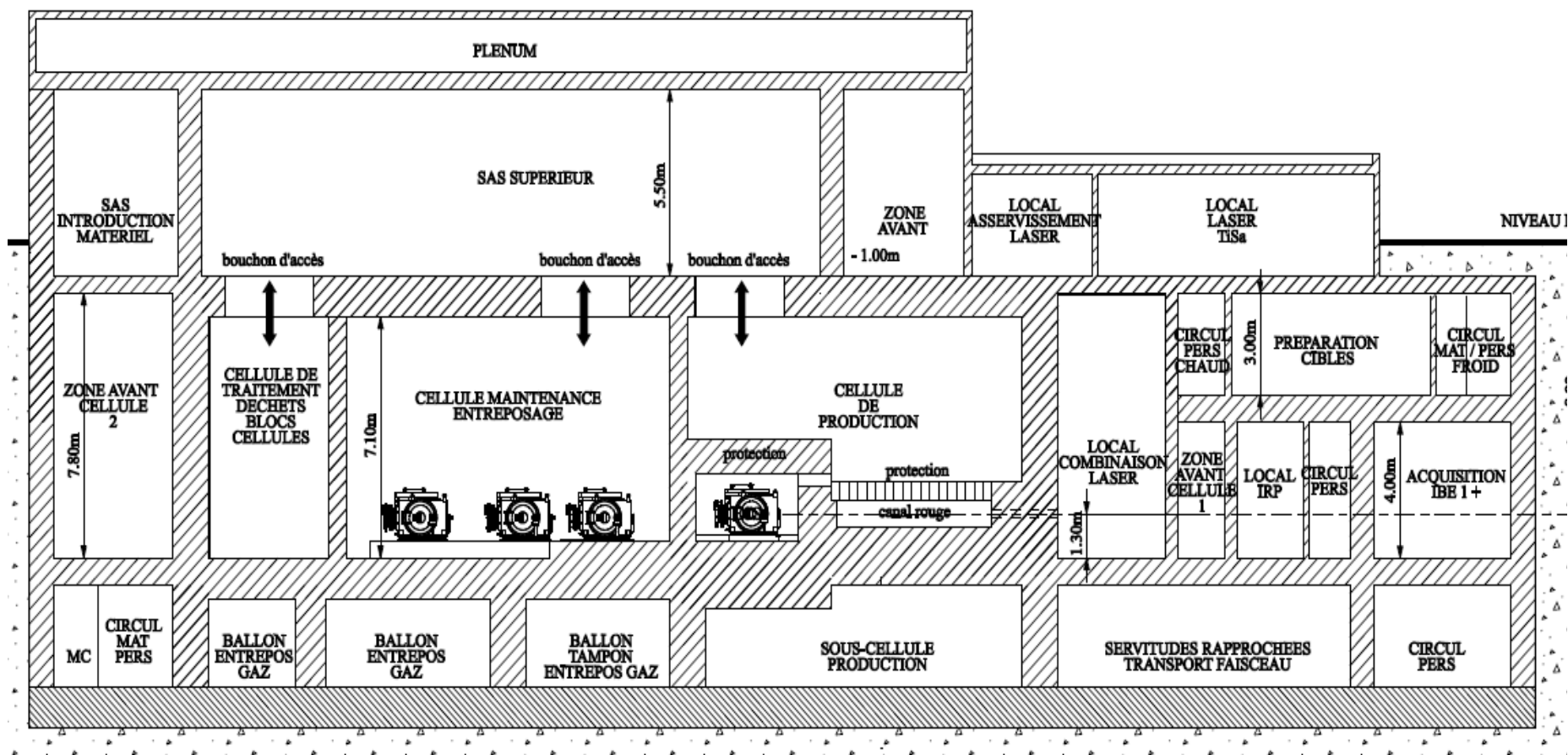


A

*Ex.: At 1nb 1 nucl./day via fusion-evaporation*



# RIB production building Design





## Goals of evaluation of Day 1 LoI for SPIRAL2

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### **Recommend few (2-3) top level experimental programs for the first year (2012/2013) of operation of S3 and NFS**

- Criteria to be taken into account:
  - Scientific excellence
  - Feasibility
  - Competitive character with respect to other facilities (by 2012)

The recommendations are essential to prepare all ingredients necessary to perform these first experiments :

- Accelerator:
  - Choice of first light and HI beams -> choice of the HI source, beam time structure for NFS,...
  - Refined planning for commissioning
- Detectors
  - First configuration for S3 (targets, detector systems)
  - First targets (converters) and detector system(s) for NFS