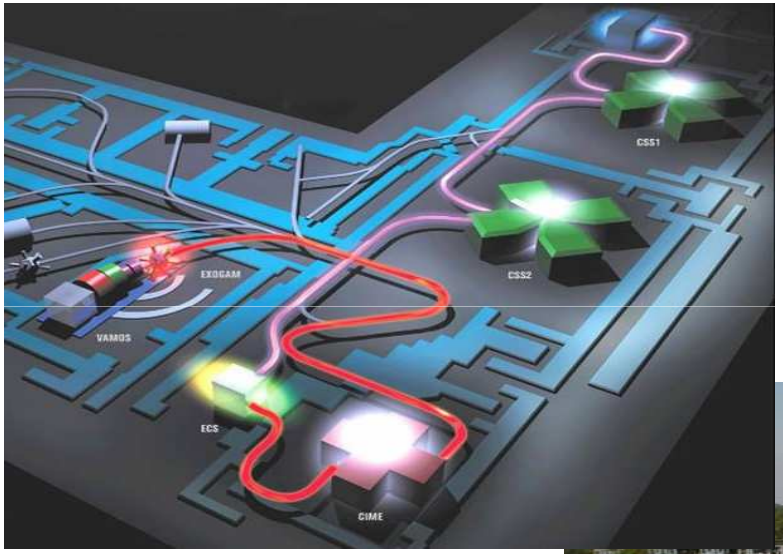
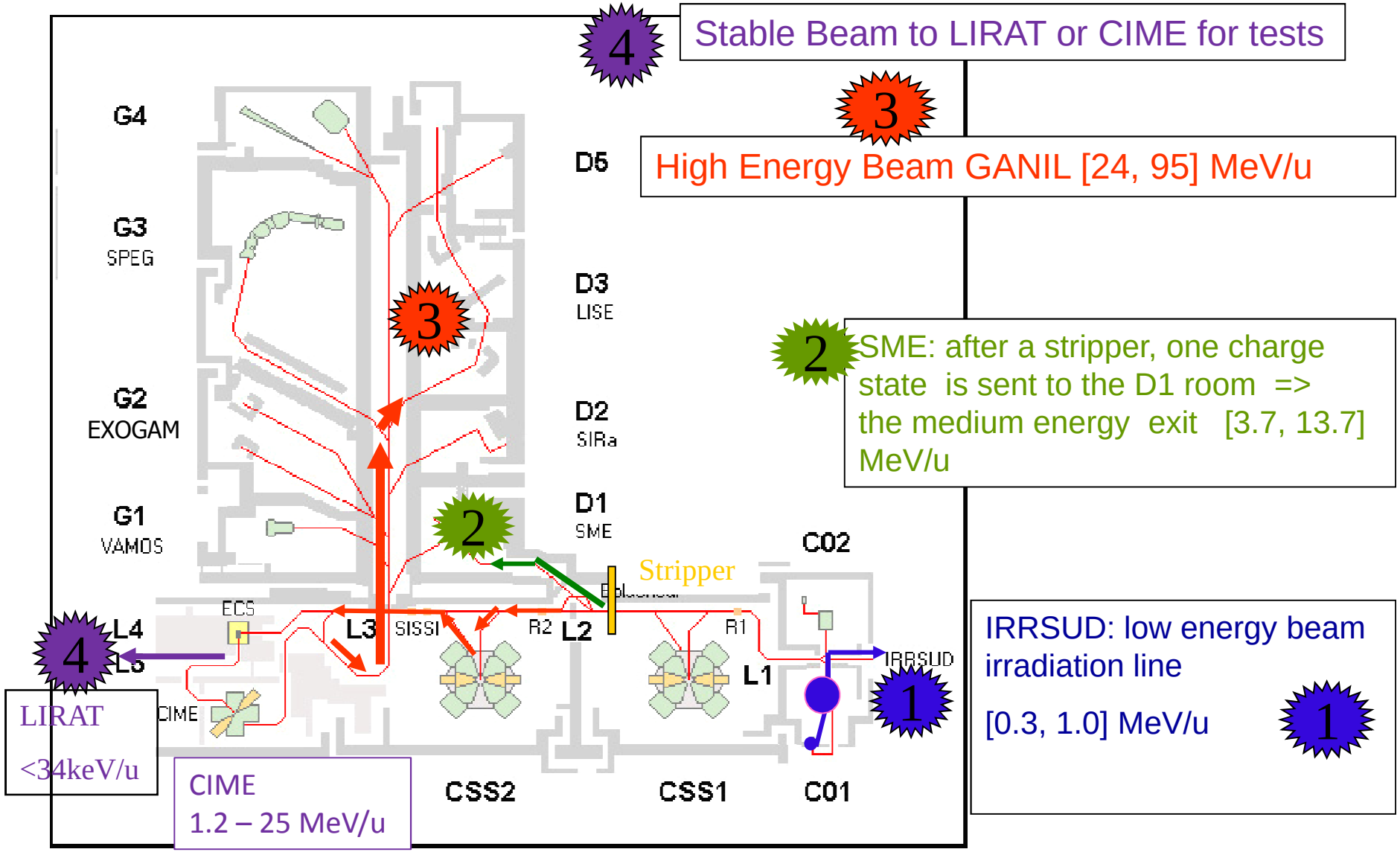
GANIL STATUS REPORT

A. Savalle
(on behalf of the GANIL/SPIRAL2 staff)

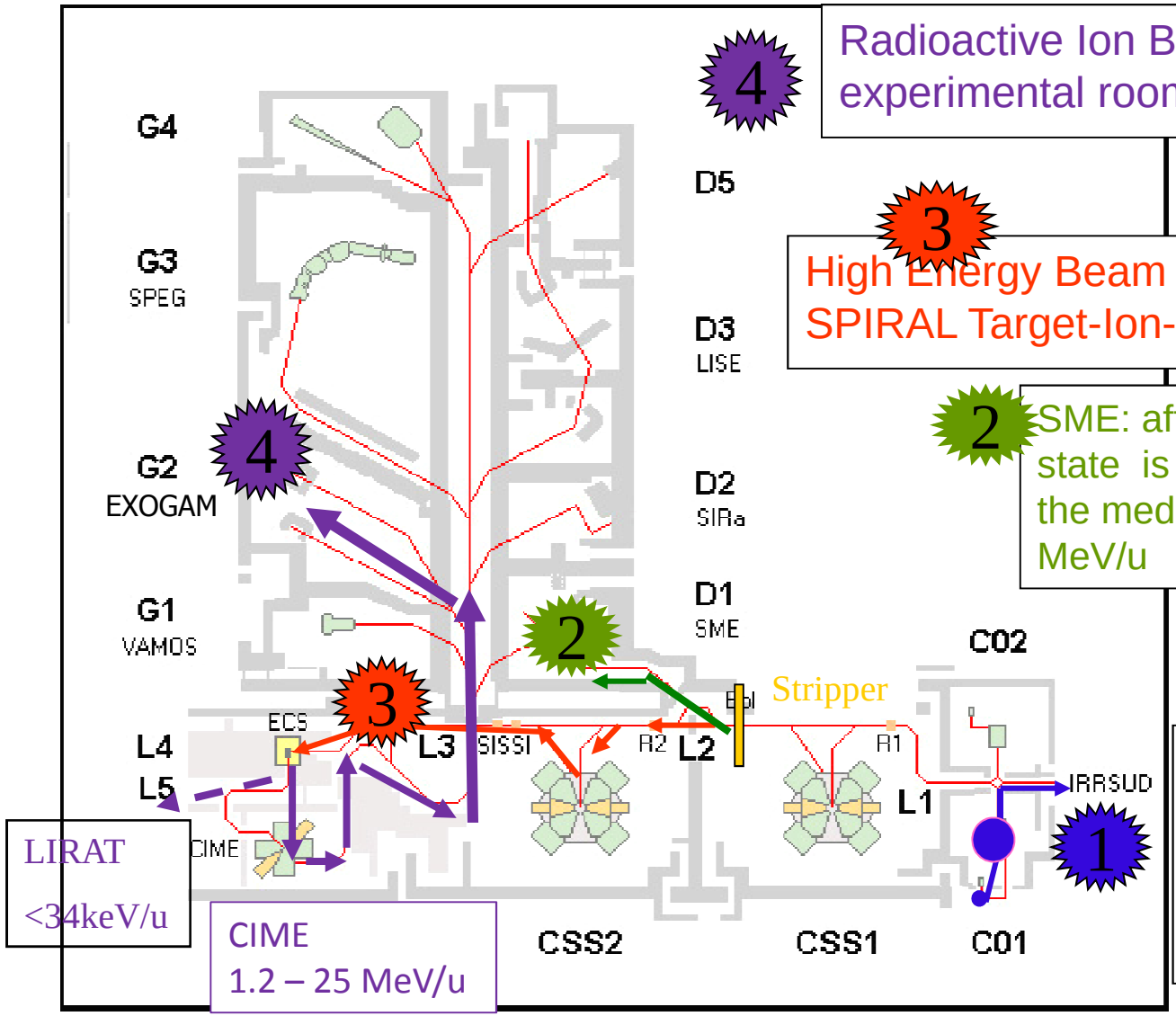


- GANIL OPERATION STATUS
- SPIRAL1 / UPGRADE
- SPIRAL2 STATUS
- DESIR PROJECT

Operating Mode – stable beams



Operating Mode with SPIRAL



Radioactive Ion Beam to LIRAT or experimental rooms via CIME

High Energy Beam GANIL [< 95] MeV/u to SPIRAL Target-Ion-Source-System

SME: after a stripper, one charge state is sent to the D1 room => the medium energy exit [3.7, 13.7] MeV/u

IRRSUD: low energy beam irradiation line

[0.3, 1.0] MeV/u

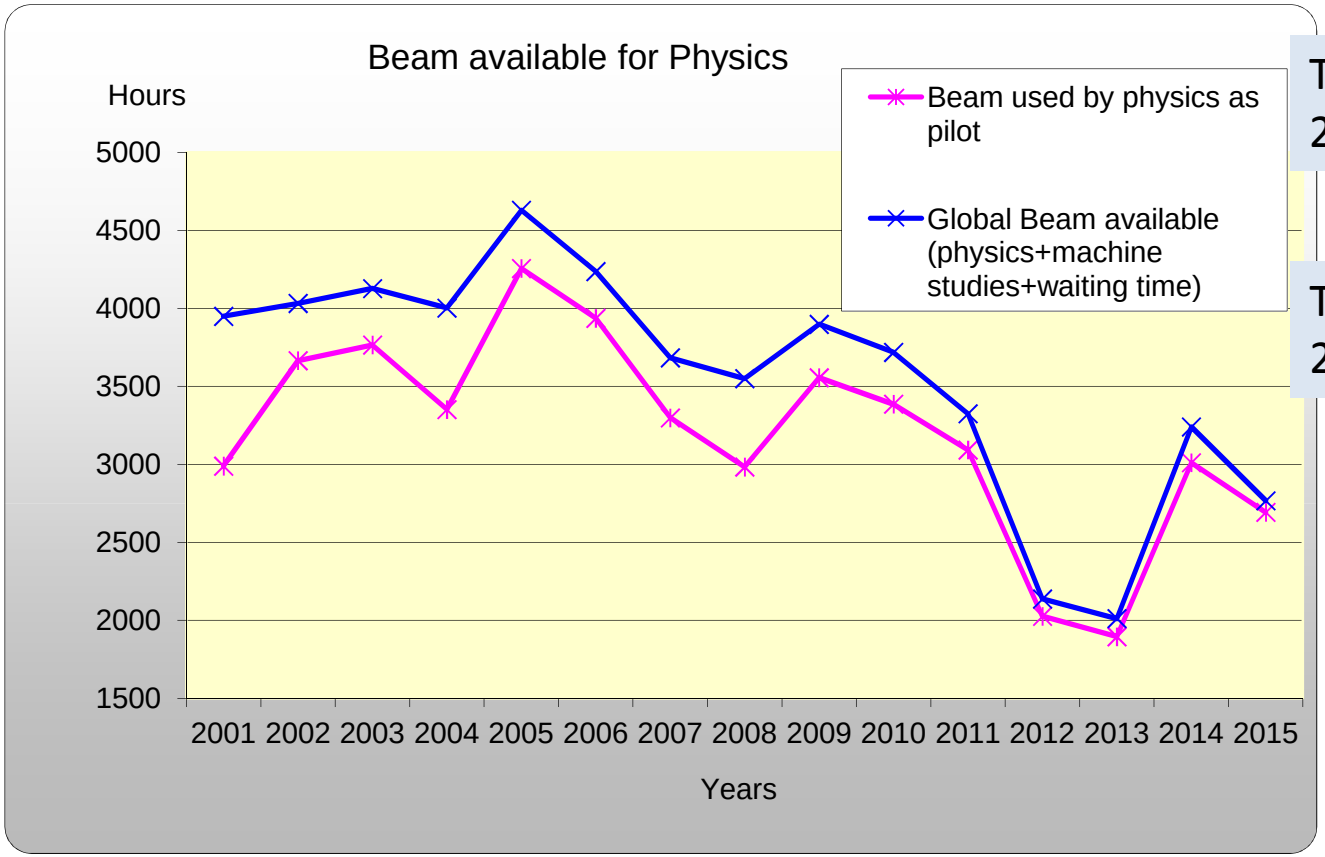
LIRAT

<34keV/u

CIME

1.2 – 25 MeV/u

Operation 2001-2015



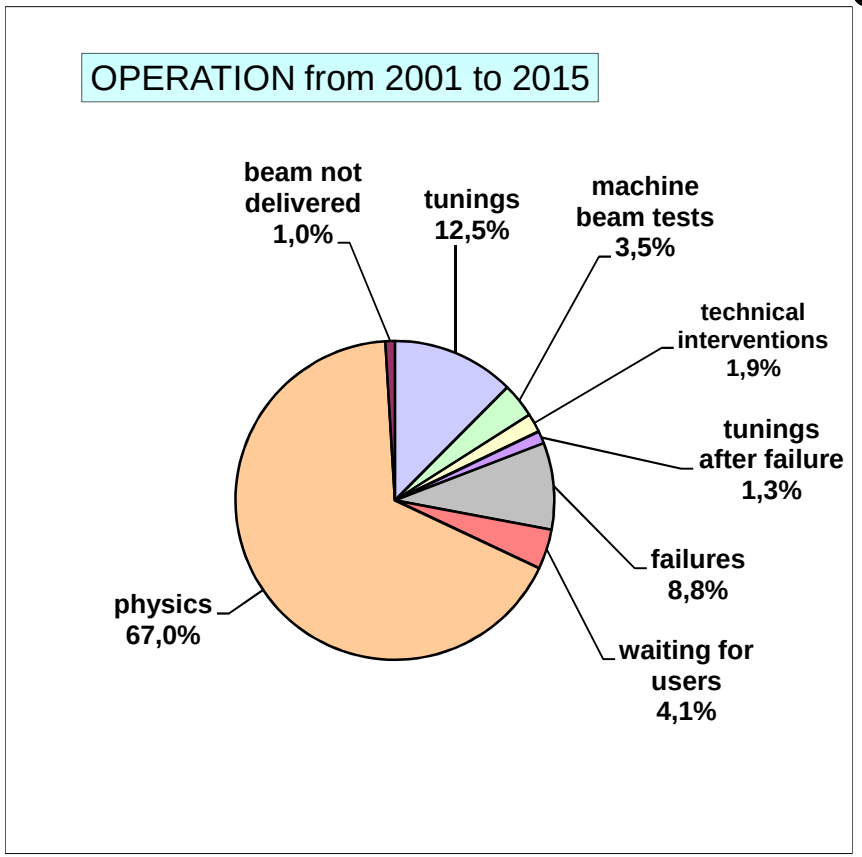
Total running time (2001-2015) : 71000 hours

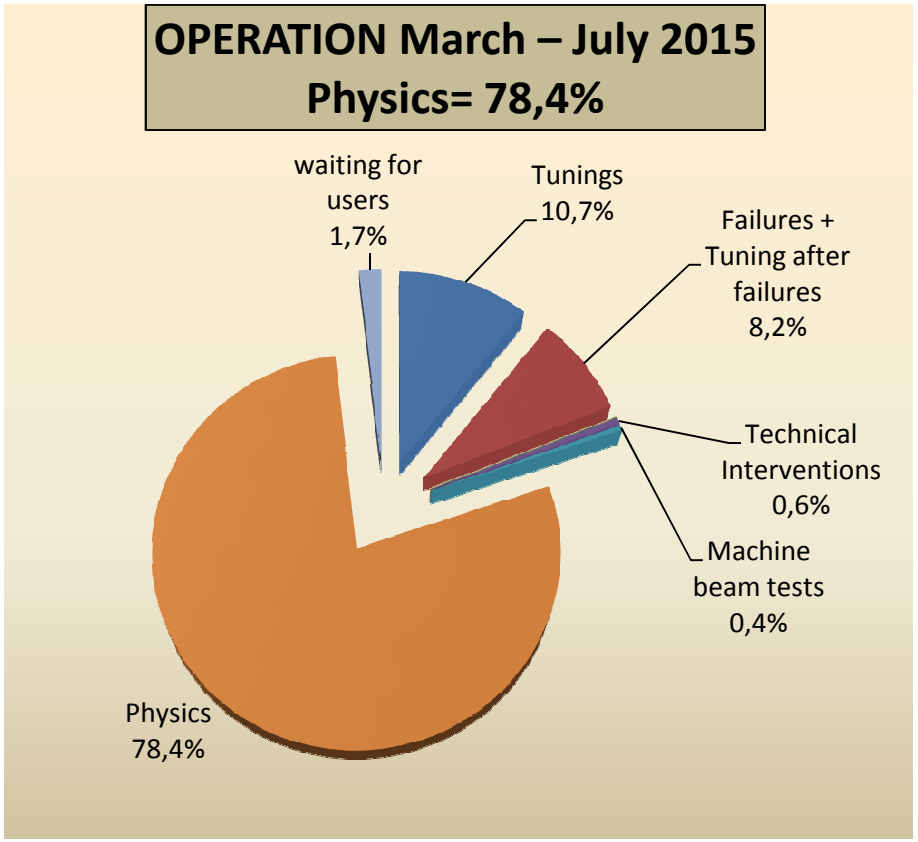
Total pilot time (2001-2015) : 48000 hours

Pilot + SME + IRRSUD : 6000 hours/year

+ atomic physics at low energy using dedicated sources (1700 hours in 2014)

Running statistics





Failures; impact of age

The failure rate, as seen by the pilot, is quite low in 2015

Water leaks in 2015 :
Beam stop in « SME » (repaired)
Slits in SME (unsolved, limited power)
Vacuum chamber in SME (unsolved, limited power)
Slits in high energy line (unsolved, the slits have been forced outside the beam trajectory)

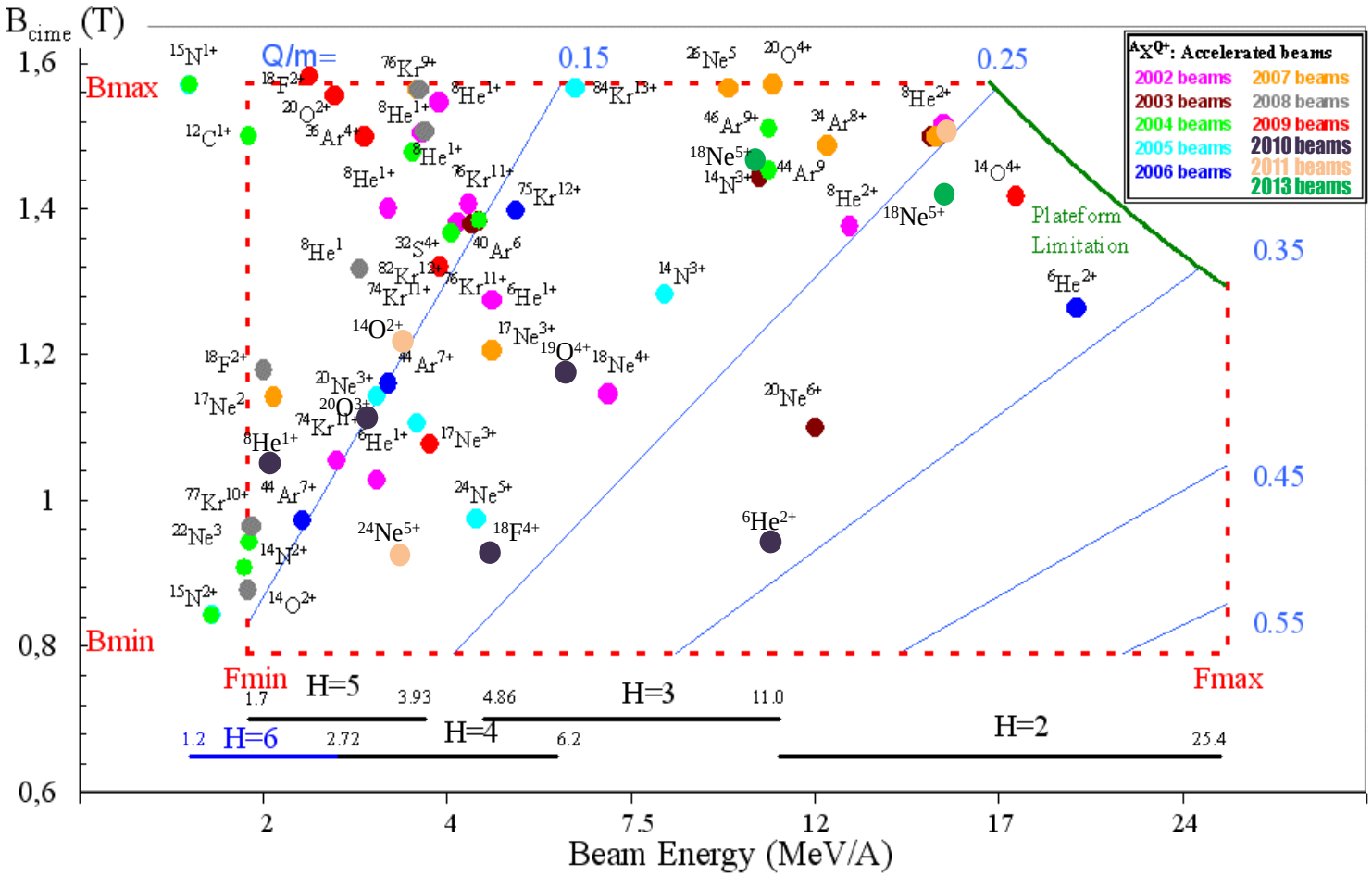
RF Cavity of injector cyclotron C01 (4 times, the last one unsolved : use of C02)

We managed to distribute beam to pilot (not so well to medium energy and IRRSUD), but we have work before the next run !

SPIRAL1

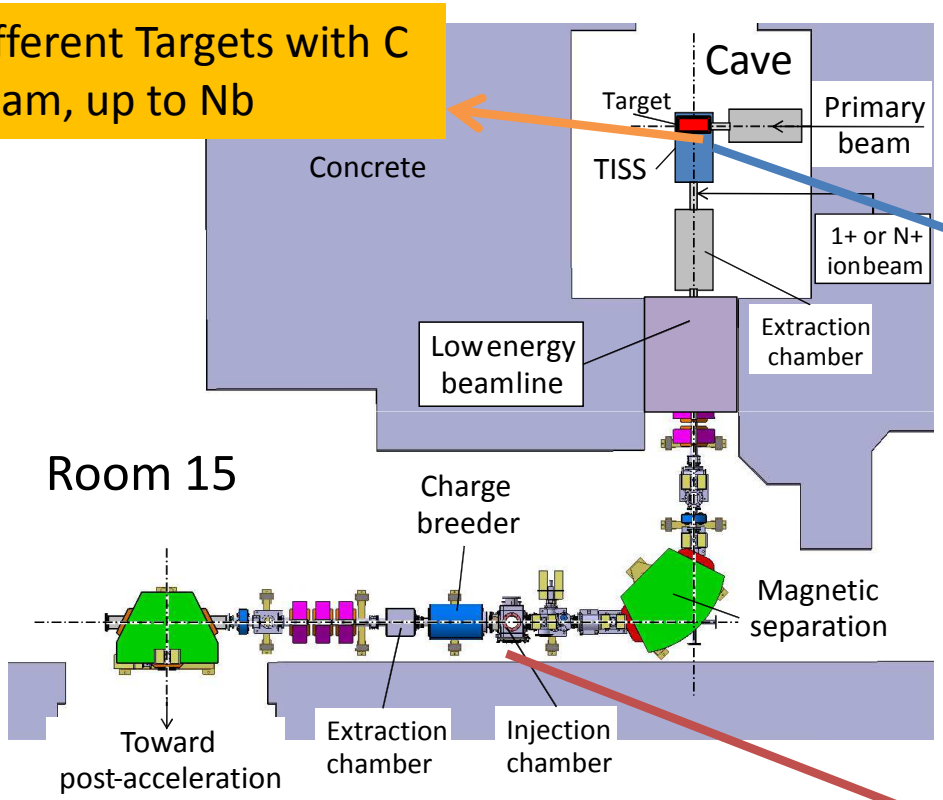
Table of elements

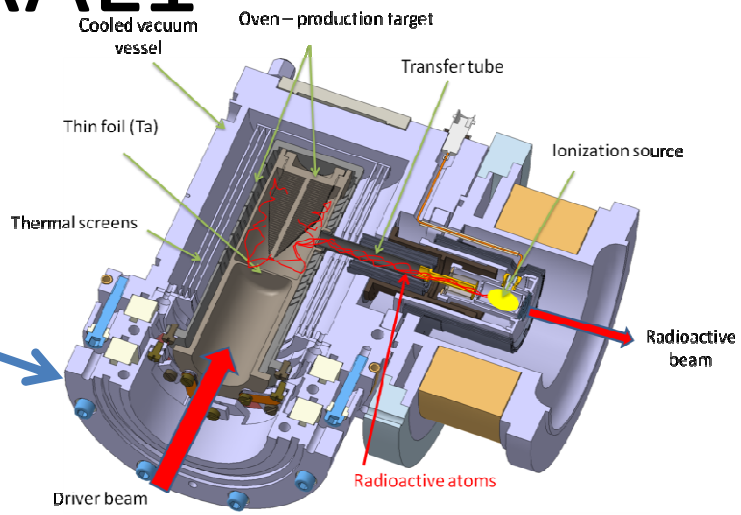
Graphite Target
Selective ECR source



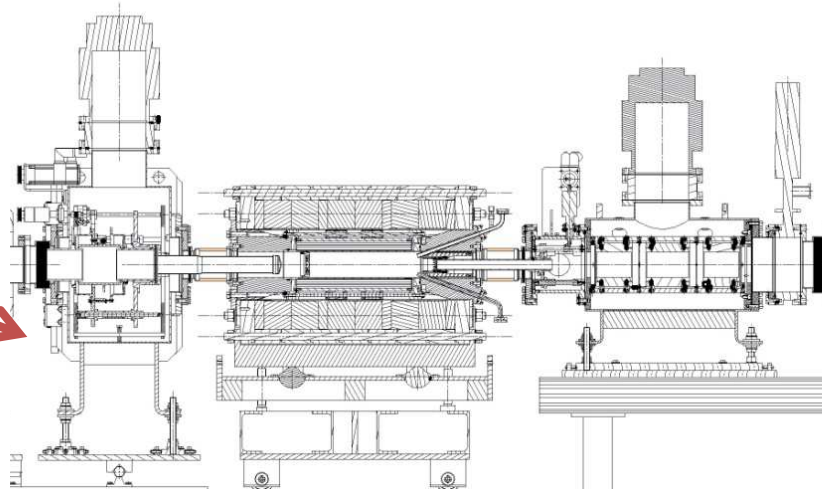
Upgrade SPIRAL1

Different Targets with C Beam, up to Nb





FEBIAD 1+ Source



Charge breeder

Beam tests

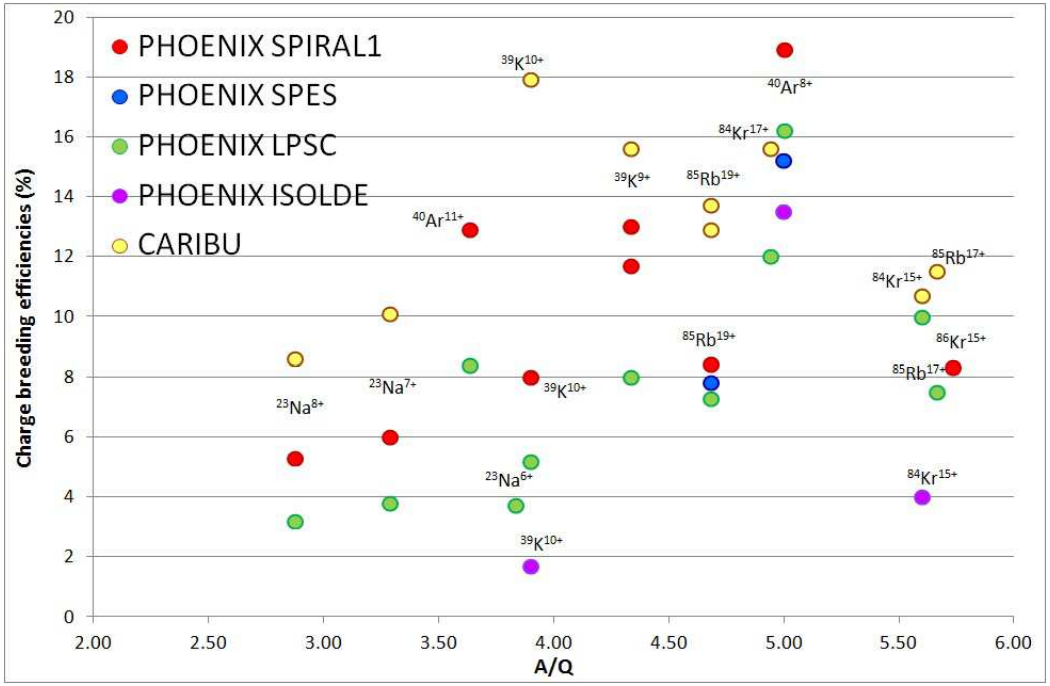
Ar 36 + Carbon target + FEDIAD (2013)

Isotope	Power (W)	Rate (pps)
21Na	984	3.00E+07
25Na	964	2.20E+07
23Mg	1299	1.33E+07
25Al	964	2.30E+04
28Al	981	1.55E+06
29Al	1301	1.40E+07
30Al	1287	4.40E+04
29P	1226	9.70E+03
30P	1287	4.20E+05
31Cl	1337	3.27E+03
32Cl	1024	6.50E+04
33Cl	1235	9.50E+06
37K	821	3.30E+07
38K	1214	6.40E+07
39Cl	1013	1.14E+04

Production yields are satisfactory

FEBIAD reliability to improve

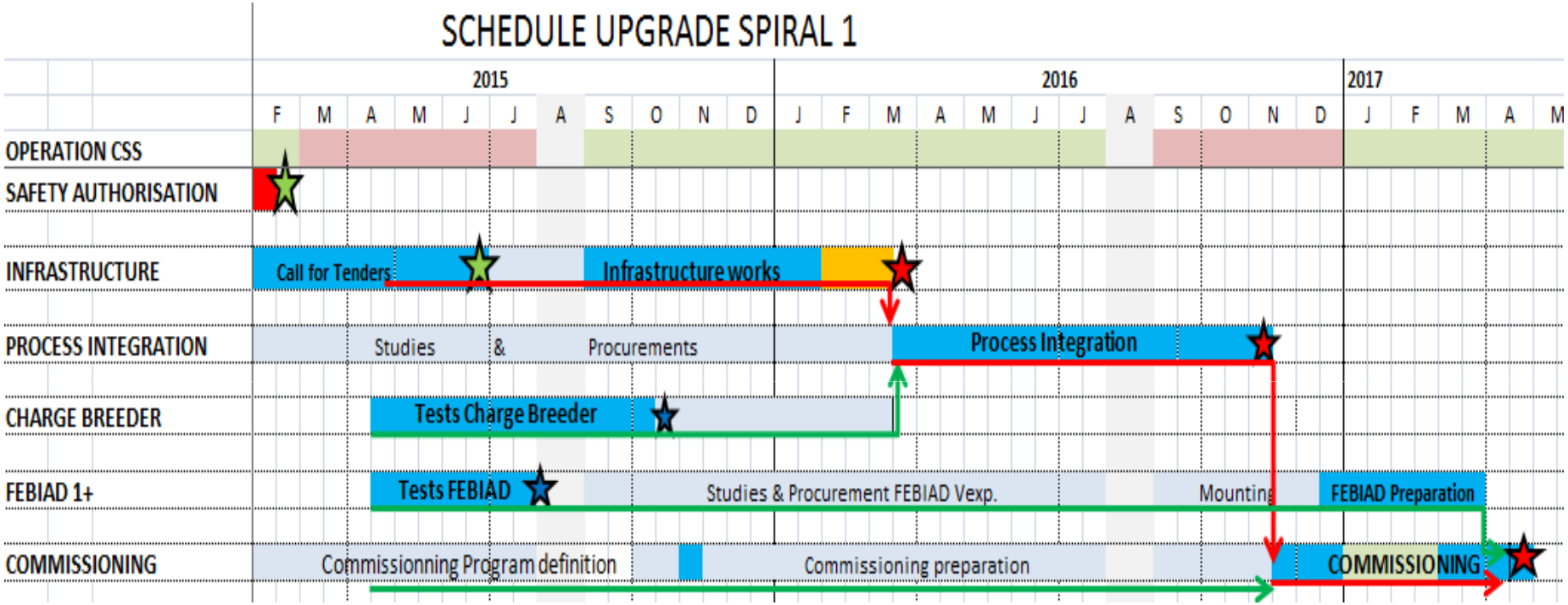
Booster tests at LPSC Grenoble



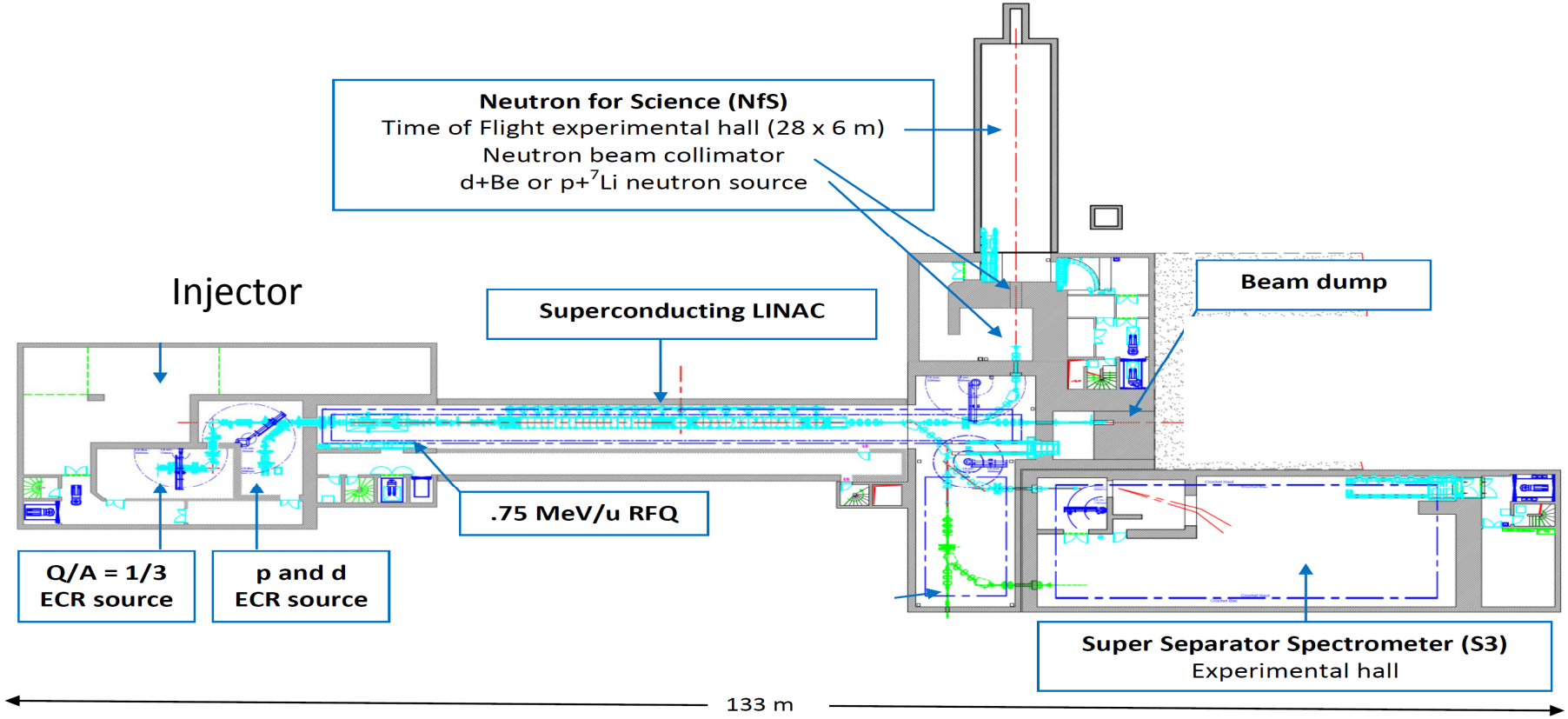
The charge state distributions are satisfactory, they may be improved

L. Maunoury et al, submitted to Rev. sci. Instr. for publication in the proceedings of the 16th International Conference on Ion Sources, New-York, August 23-28, 2015.

Upgrade SPIRAL1 SCHEDULE



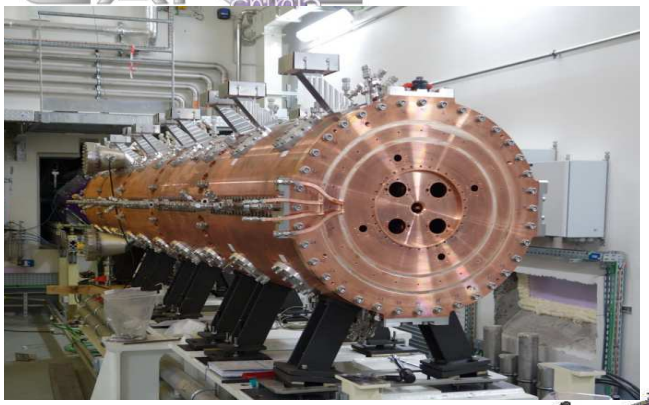
SPIRAL2

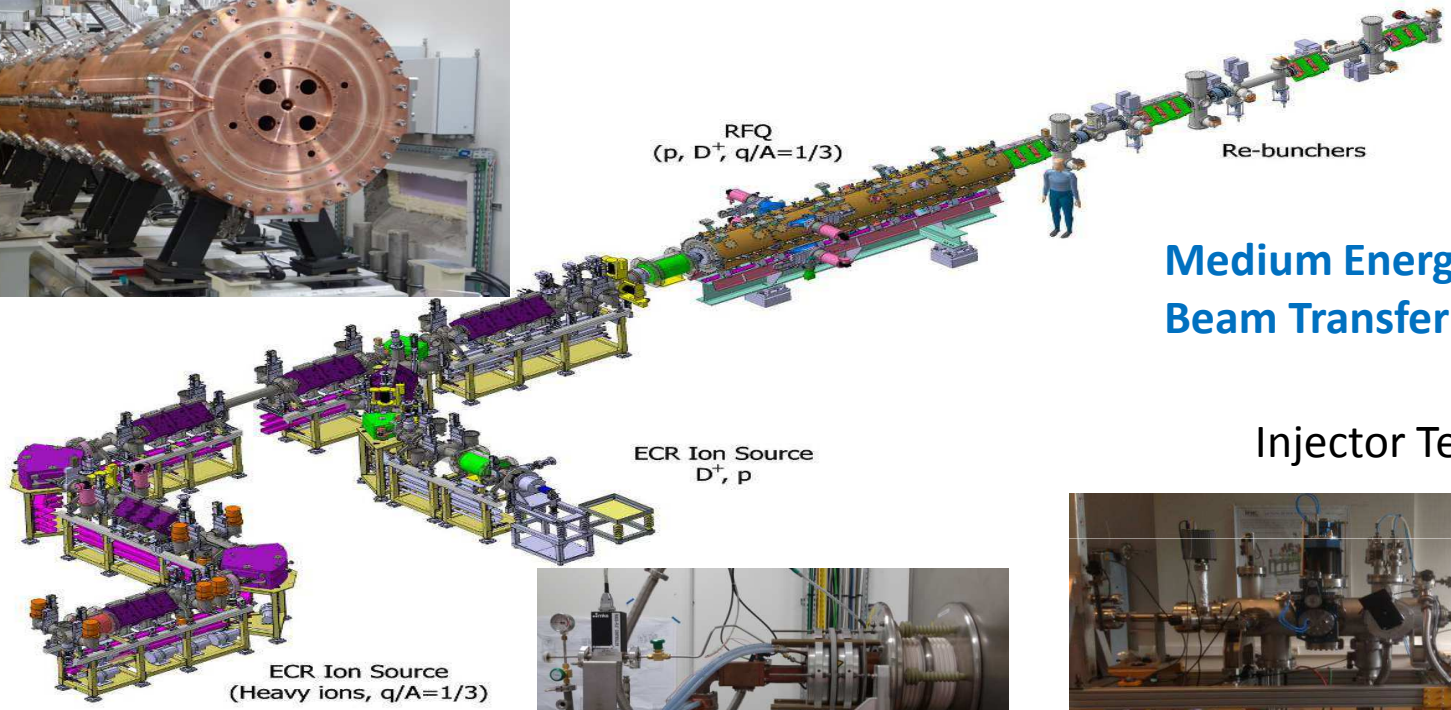


	Q/A	I max (mA)	Energy (MeV/n)	CW max beam power (kW)
P	1/1	5	2 - 33	165
He	*2/3*	*1*	*2-2 4*	*36*
D	1/2	5	2 - 20	200
Ions	1/3	1	2 - 14.5	45

JM Lagniel et al, proceedings of the 13th Heavy Ion Accelerator Technology Conference, Yokohama, September 7-11, 2015

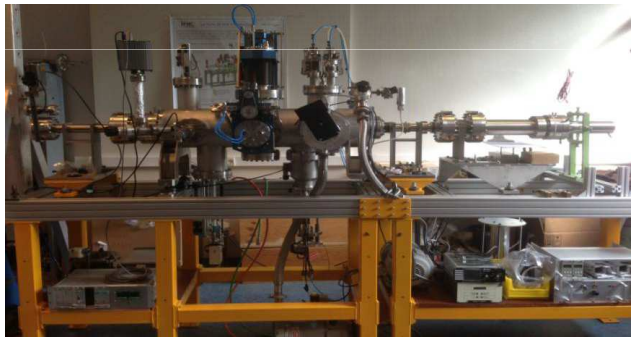
Injector

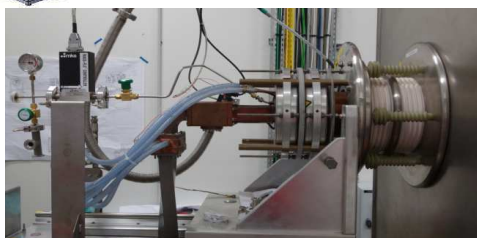




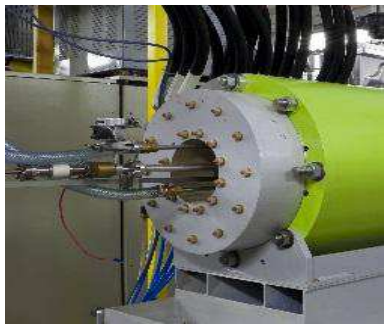
Medium Energy Beam Transfer Line

Injector Test Bench





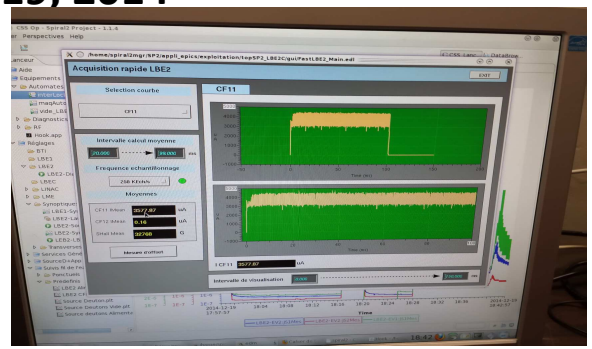
2.45 GHz 40 kV IRFU Saclay

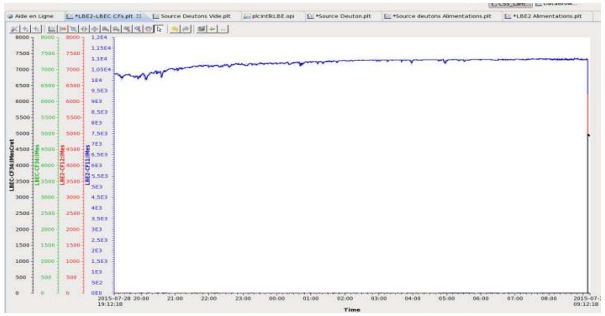


18 GHz 60 kV LPSC Grenoble

Proton and ion sources status

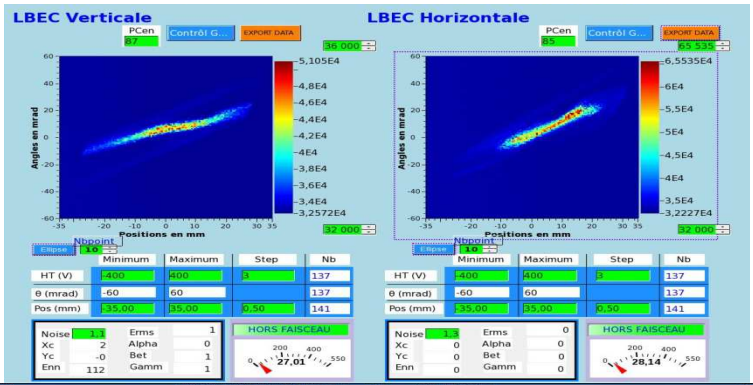
First beam (proton) December 19, 2014



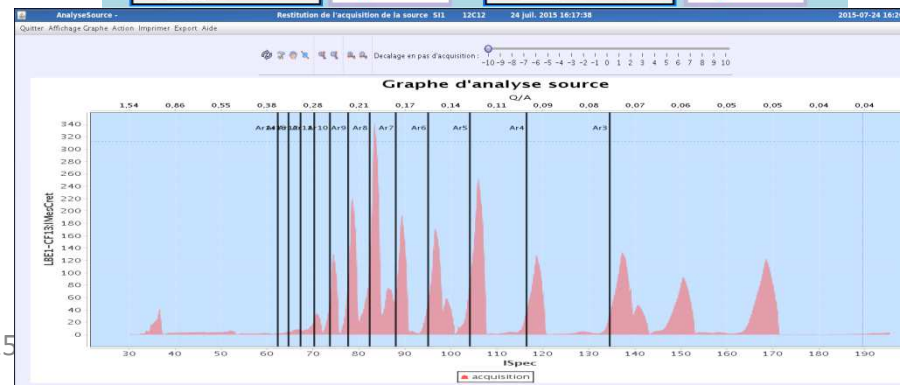


Long period stability (6 mA CW proton)

0.2 π mm mrd rms norm.

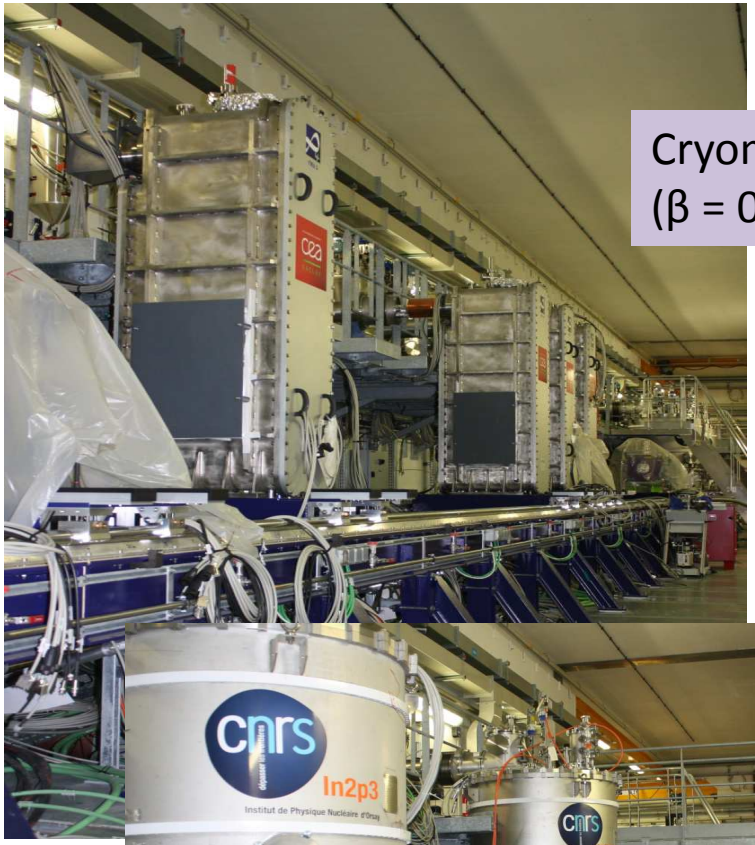


First beam (230 µA Argon 9+) July 10, 2015



RFQ and LINAC installation

RFQ commissionning
should start in october



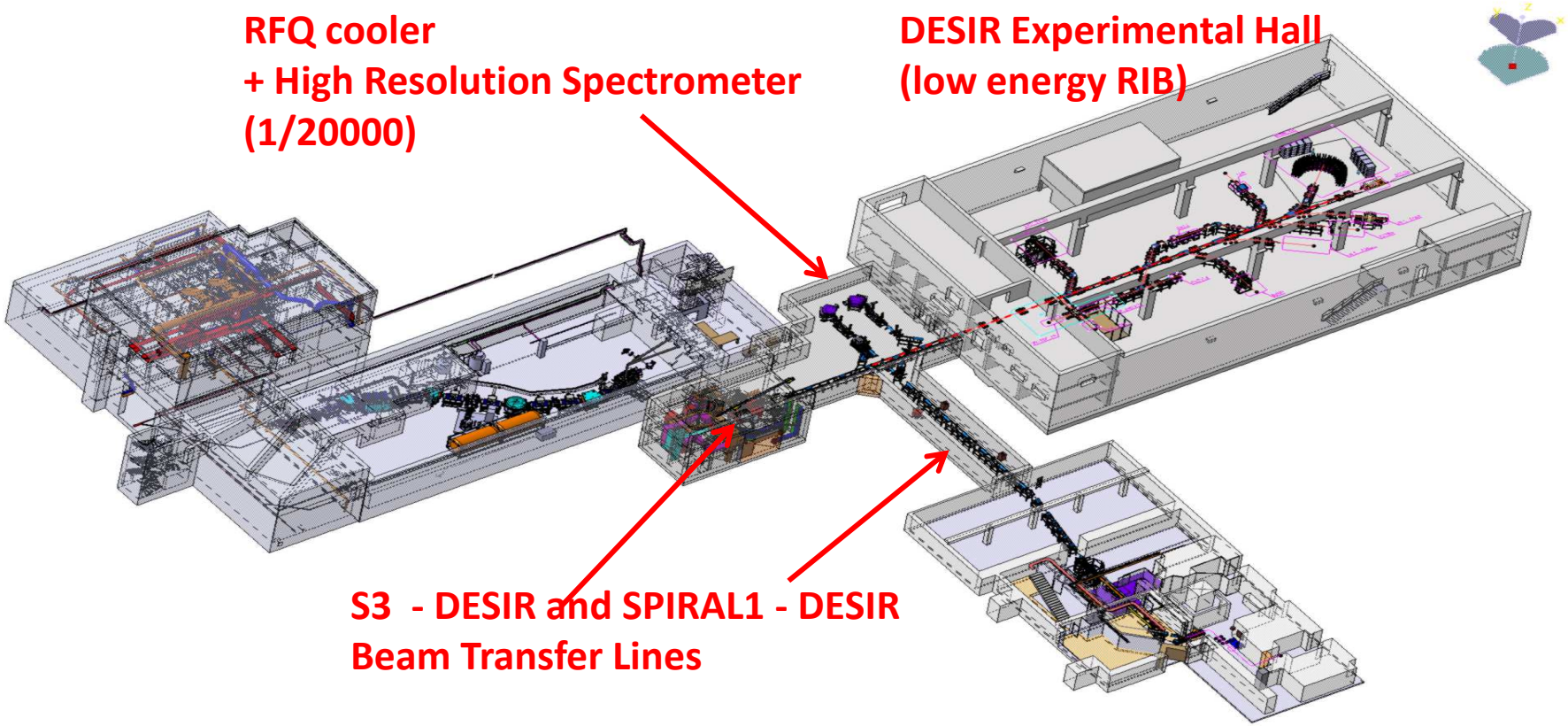
Cryomodules « A »
(β = 0.07)

Cryomodules « B »
(β = 0.12)

LiNAC Commissionning
: 2nd semester 2016

DESIR Project

(Desintegration, Excitation, Storage of Radioactive Ions)



Budget Consolidated

Commissionning expected end of 2019

Conclusions

Despite age effects, the cyclotrons are still providing 6000 hours/year (low, medium and high energy)

SPIRAL1 facility is being upgraded to produce new beams

The commissionning of SPIRAL2 injector has begun, the installation of the LINAC continues (commissionning in 2016)

The DESIR project begins (process studies well advanced, building studies are launched)

Thank you for your attention

IN MEMORY OF ERIC BARON

HEAD OF THE ACCELERATOR DIVISION 1998-2001

Exotic beams production before upgrade

ions	W [MeV/u]	[pps]	ion	W [MeV/u]	[pps]
6He	3.8	$2.8\ 10^{7}$	20F	3	$1.5\ 10^{4}$
6He	2.5	$3.7\ 10^{7}$	17Ne	4	4.10^{4}
6He	5	3.10^{7}	24Ne	4.7	2.10^{5}
6He	LIRAT (<34 keV/u)	2.10^{8}	24Ne	7.9	$1.4\ 10^{5}$
6He	20	5.10^{6}	24Ne	10	$2\ 10^{5}$
8He	3.5	1.10^{5}	26Ne	10	3.10^{3}
8He	15.5	1.10^{4}	31Ar	1.45	1.5
8He	15.4	$2.5\ 10^{4}$	33Ar	6.5	3.10^{3}
8He	3.5	6.10^{5}	35Ar	0.43	4.10^{7}
8He	3.9	8.10^{4}	44Ar	10.8	2.10^{5}
14O	18	4.10^{4}	44Ar	3.8	3.10^{5}
15O	1.2	$1.7\ 10^{7}$	46Ar	10.3	2.10^{4}
19O	3	2.10^{5}	74Kr	4.6	$1.5\ 10^{4}$
20O	3	4.10^{4}	74Kr	2.6	$1.5.10^{4}$
20O	4	4.10^{4}	75Kr	5.5	2.10^{5}
18Ne	7	1.10^{6}	76Kr	4.4	4.10^{6}
18F	2.4	$2\ 10^{4}$			

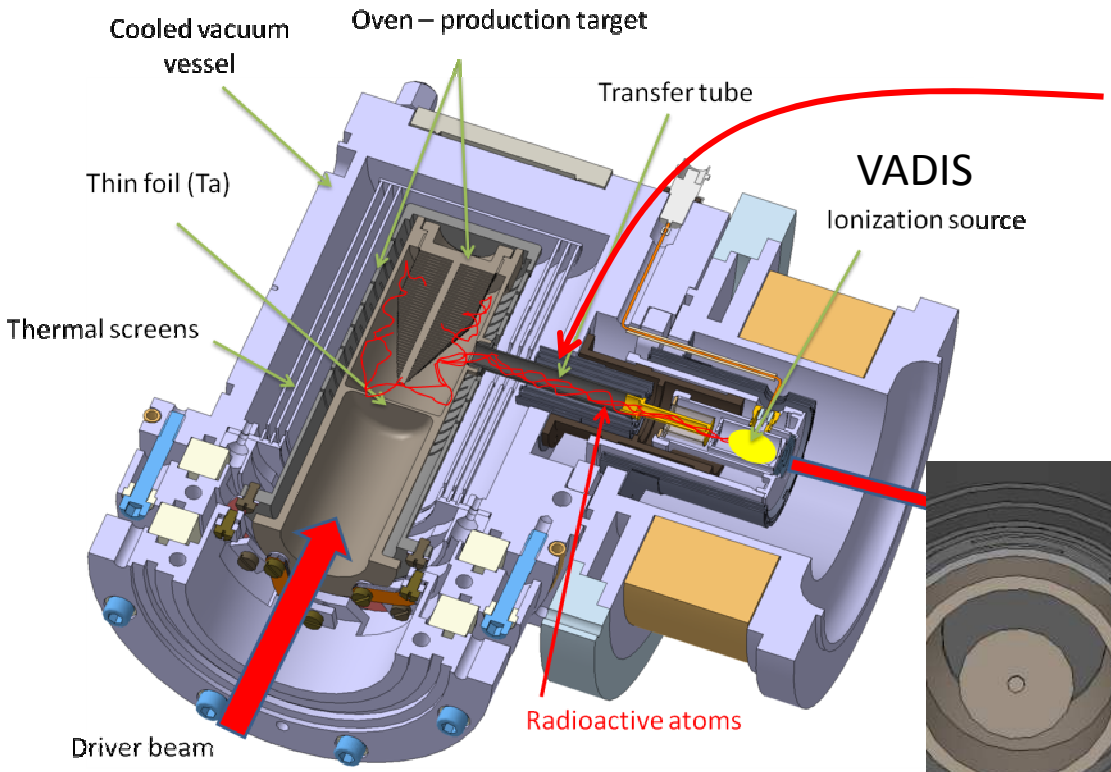
1+ FEBIAD source (type VADIS ISOLDE)

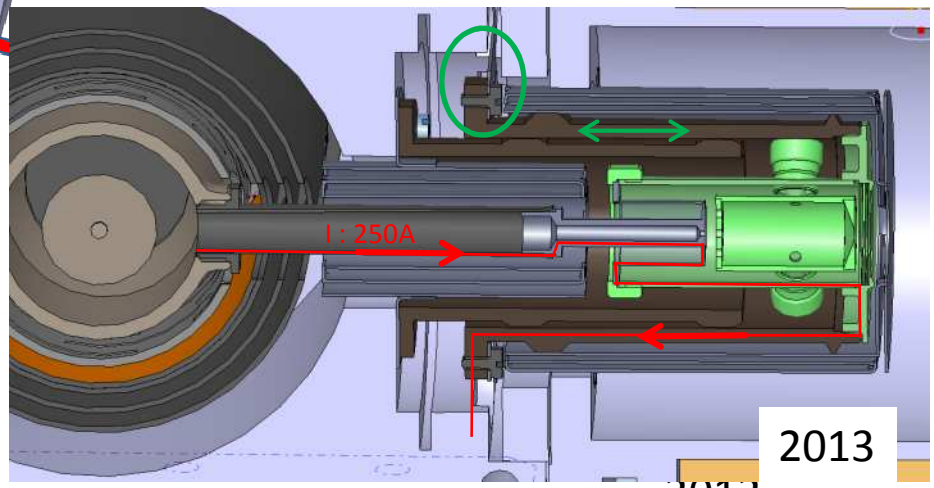
FEBIAD ion source development since 2011

Main difficulty to overcome :
Thermal expansion of the transfer tube

Transfer tube length :
- 20° : 62.5mm
- 2000° : 62,5 + ***1.5mm***

Need to develop a system having a translation movement while conserving a good electrical contact (~250A)





2013

2012

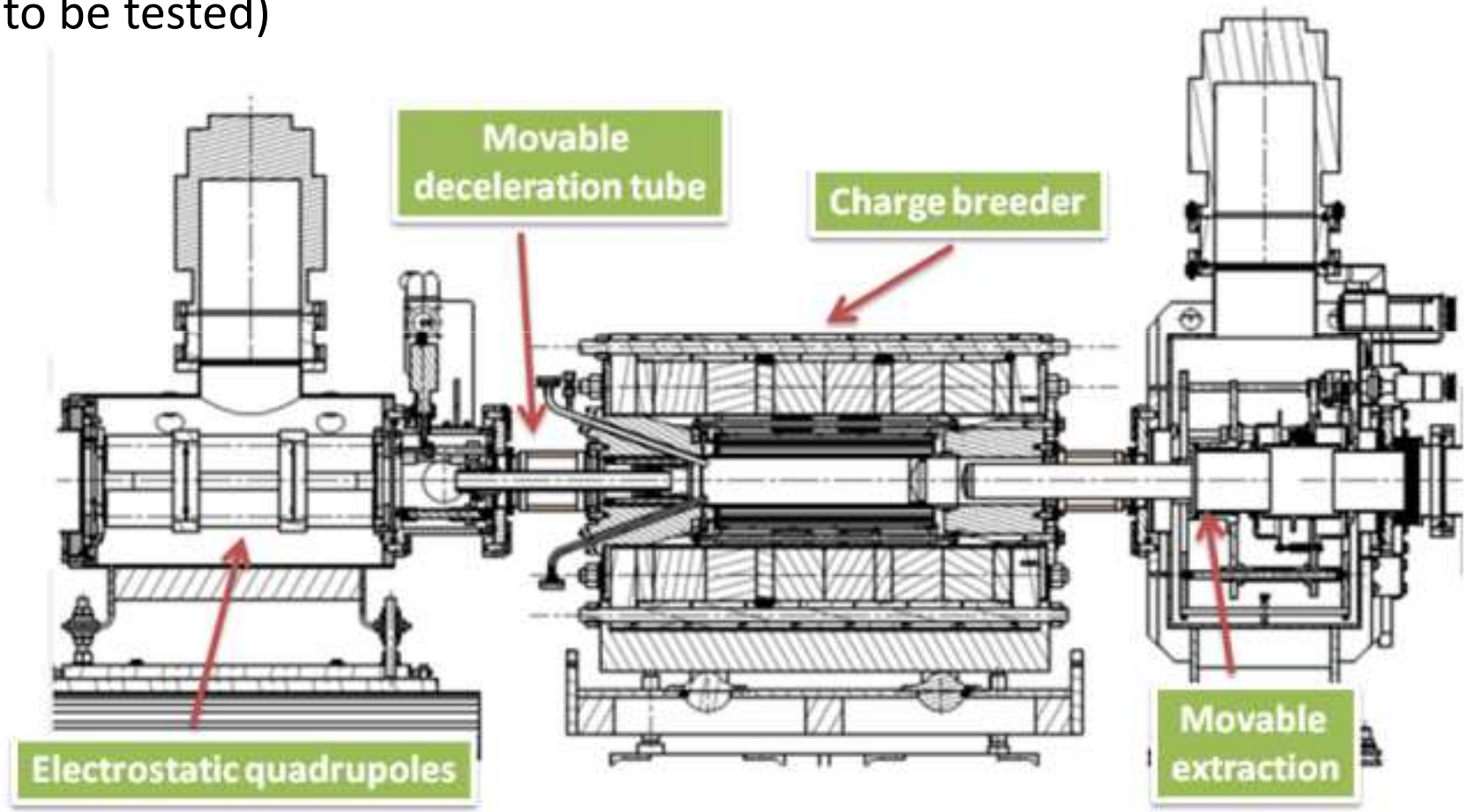
- Non selective source : Mg, Ca, Sc, Cr, Mn, Co, Ni, Cu, Zn, Ga, Ce, As, Se, Al
- But no acceleration by CIME (Q/A too low)

FEBIAD: Forced Electron Beam Induced Arc Discharge

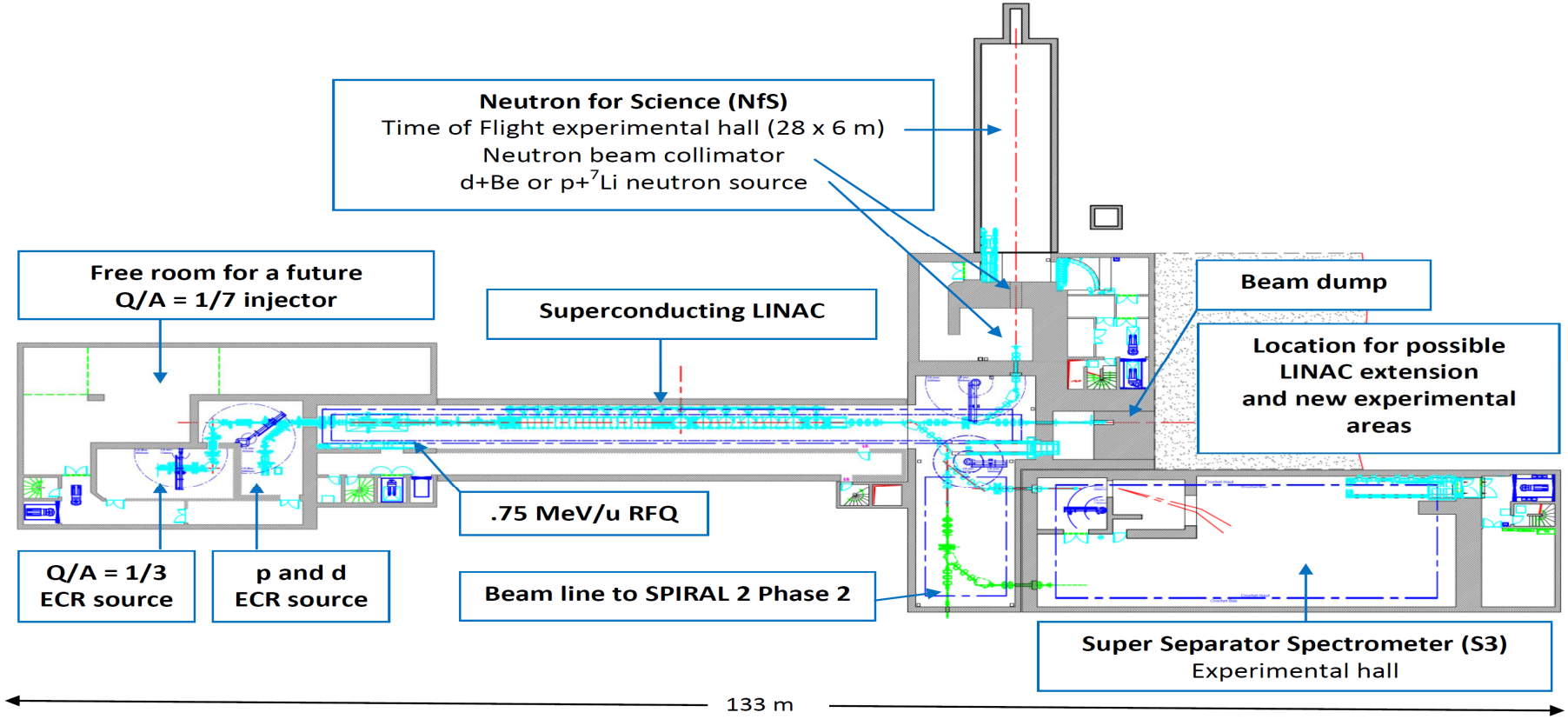
2 RF guides :
14 GHz
18 GHz
(to be tested)

Materials optimized
for vacuum

4 Turbo-pumps



SPIRAL2



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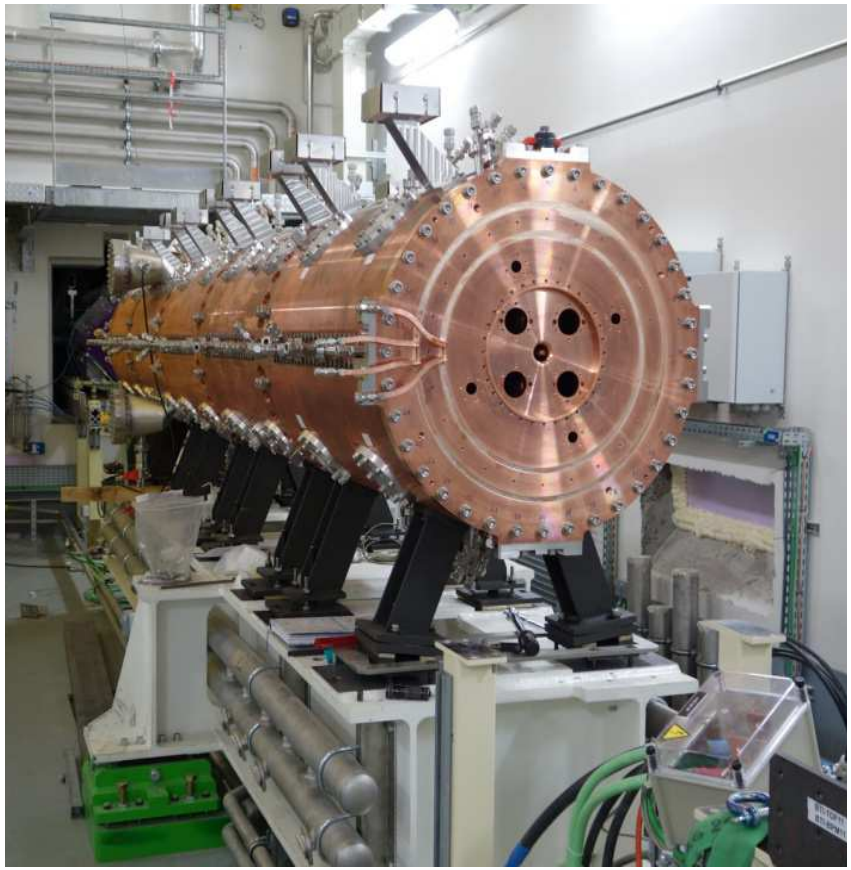
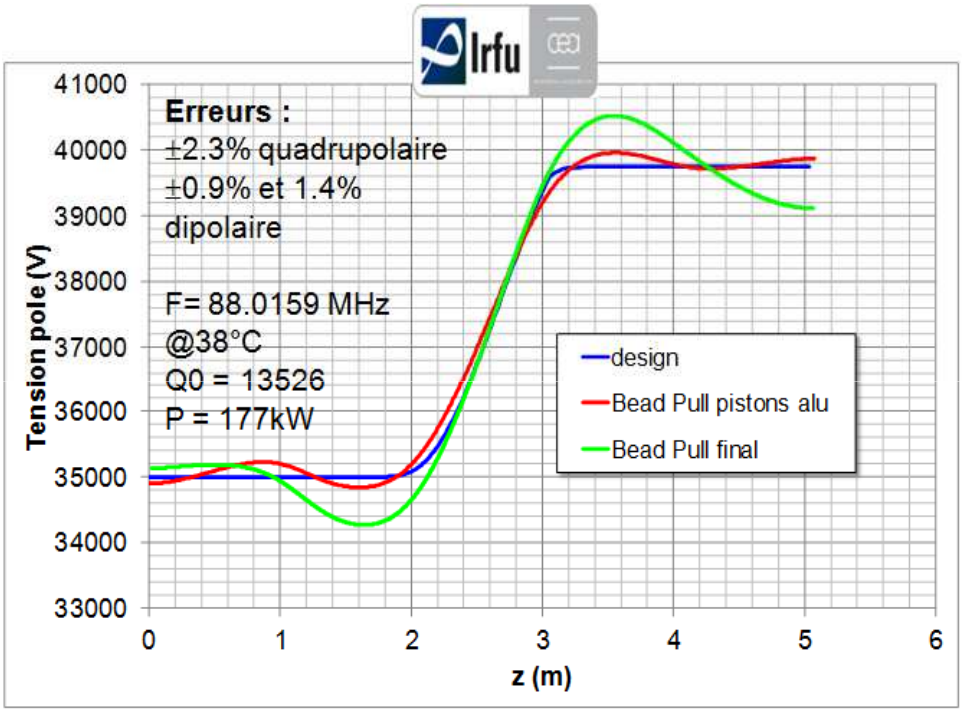
D	1/2	5	2 - 20	200
Ions	1/3	1	2 - 14.5	45

-1- SPIRAL 2 RFQ Status



Installation Nov. 2014 to Feb. 2015



Voltage law (bead-pull) measurements + adjustments (40 plungers) OK March 2015

Max error = 2.3 % on the quadrupolar mode (+3 % longitudinal emittance increase)

Expected transmission = 99.7 %