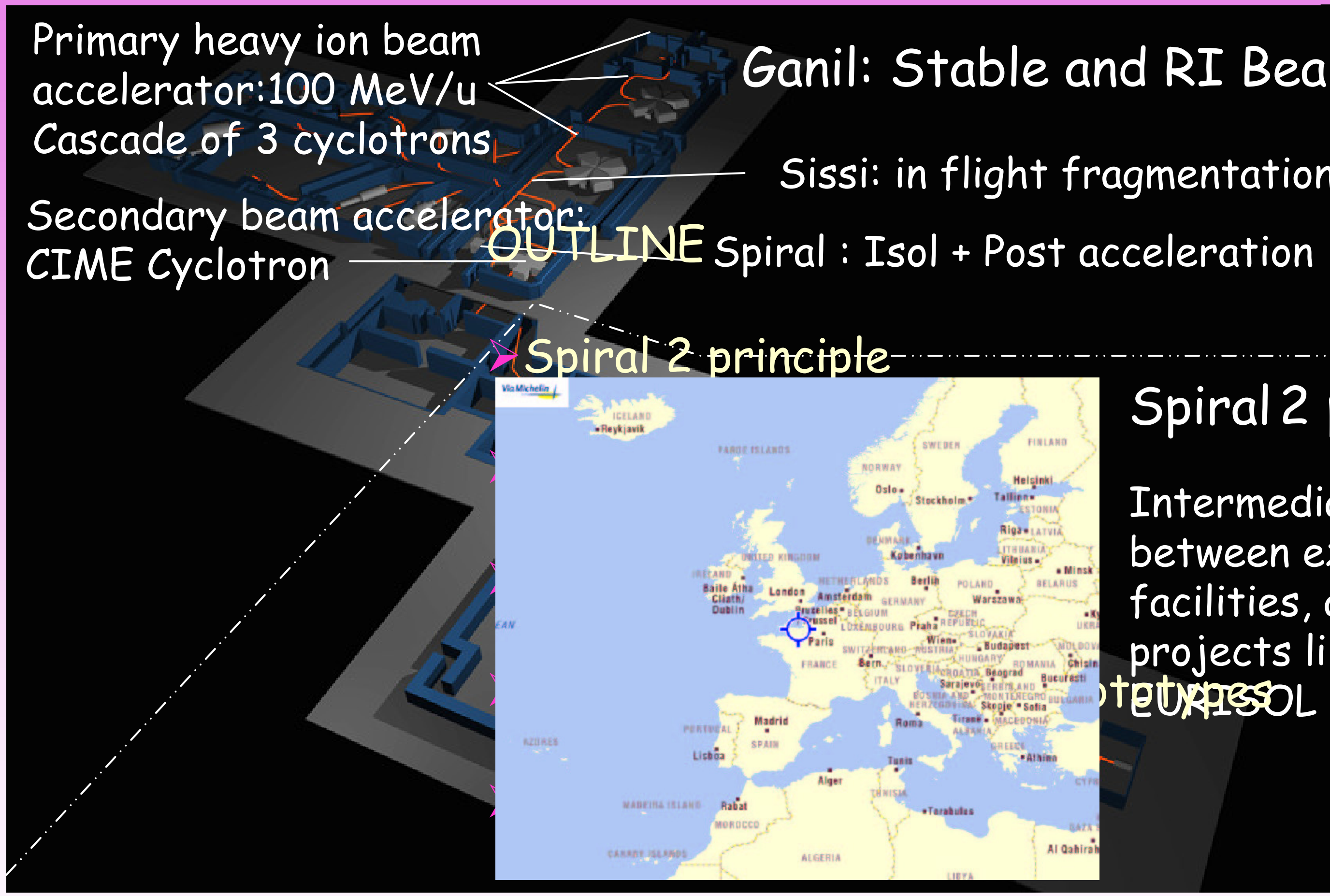
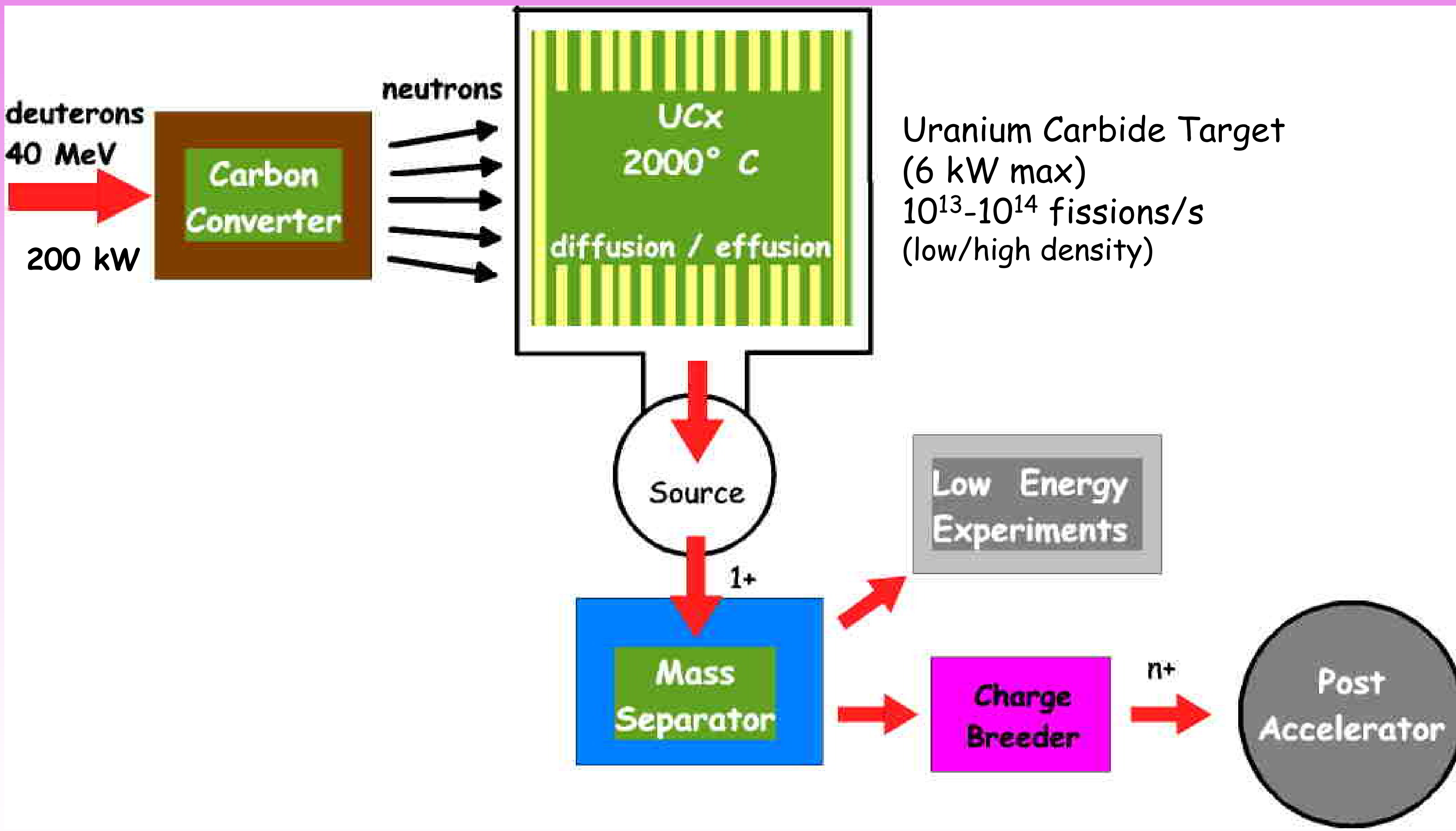


Spiral 2 project

Intermediate step between existing RIB facilities, and future projects like EURISOL or RIA.

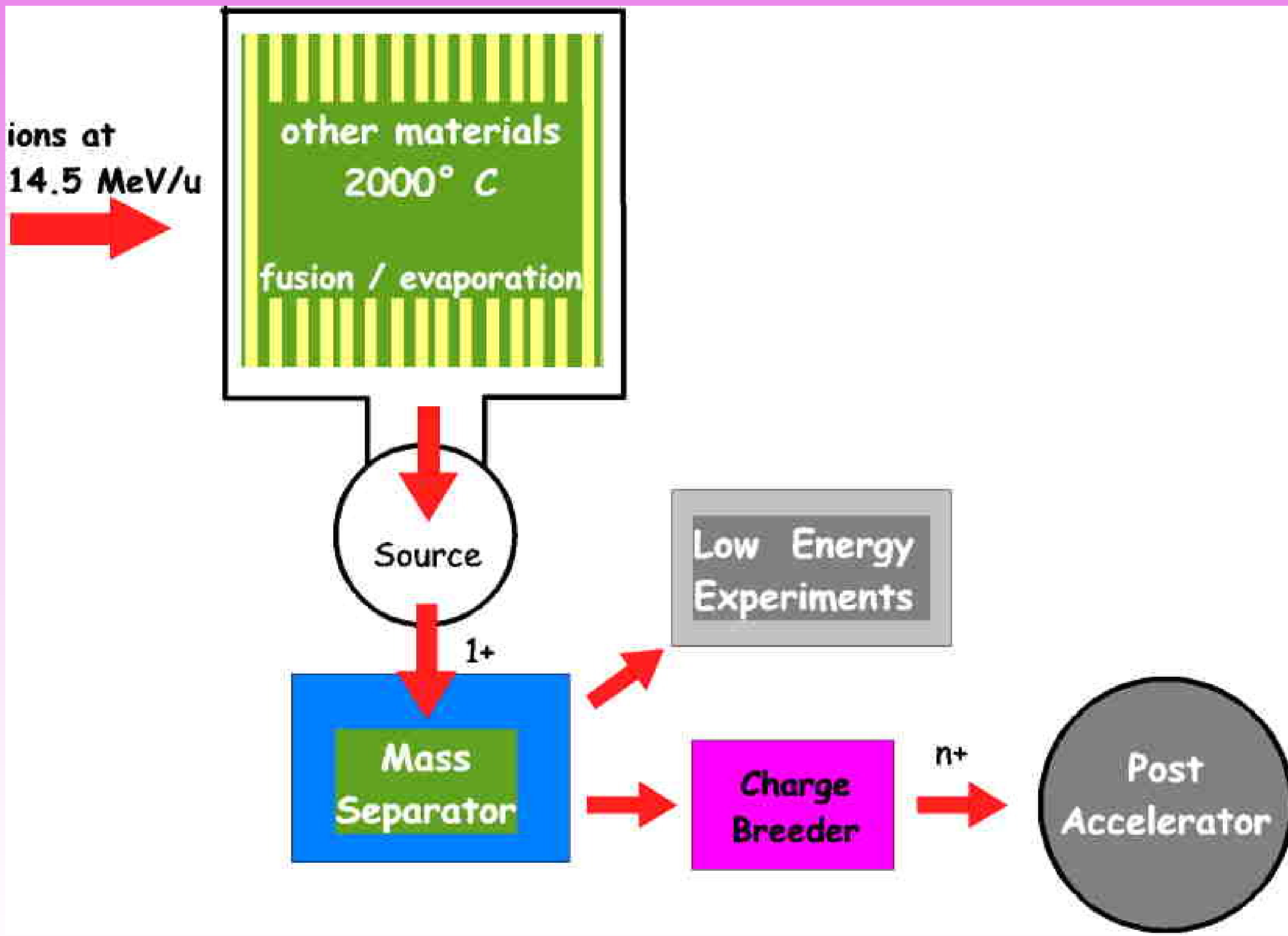
The SPIRAL 2 Project at GANIL

Spiral2 principle

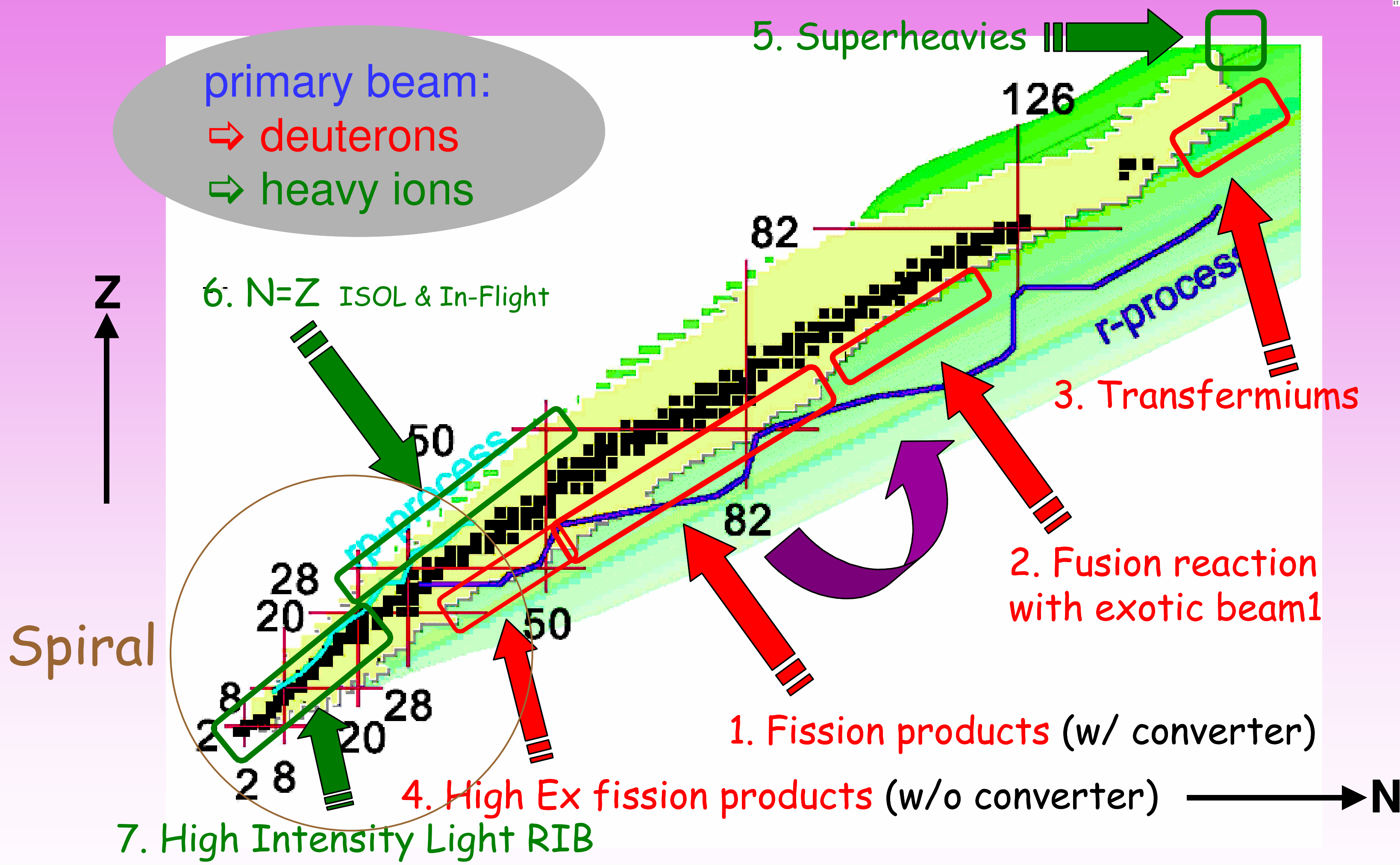


Uranium Carbide Target
(6 kW max)
10^{13}-10^{14} fissions/s
(low/high density)

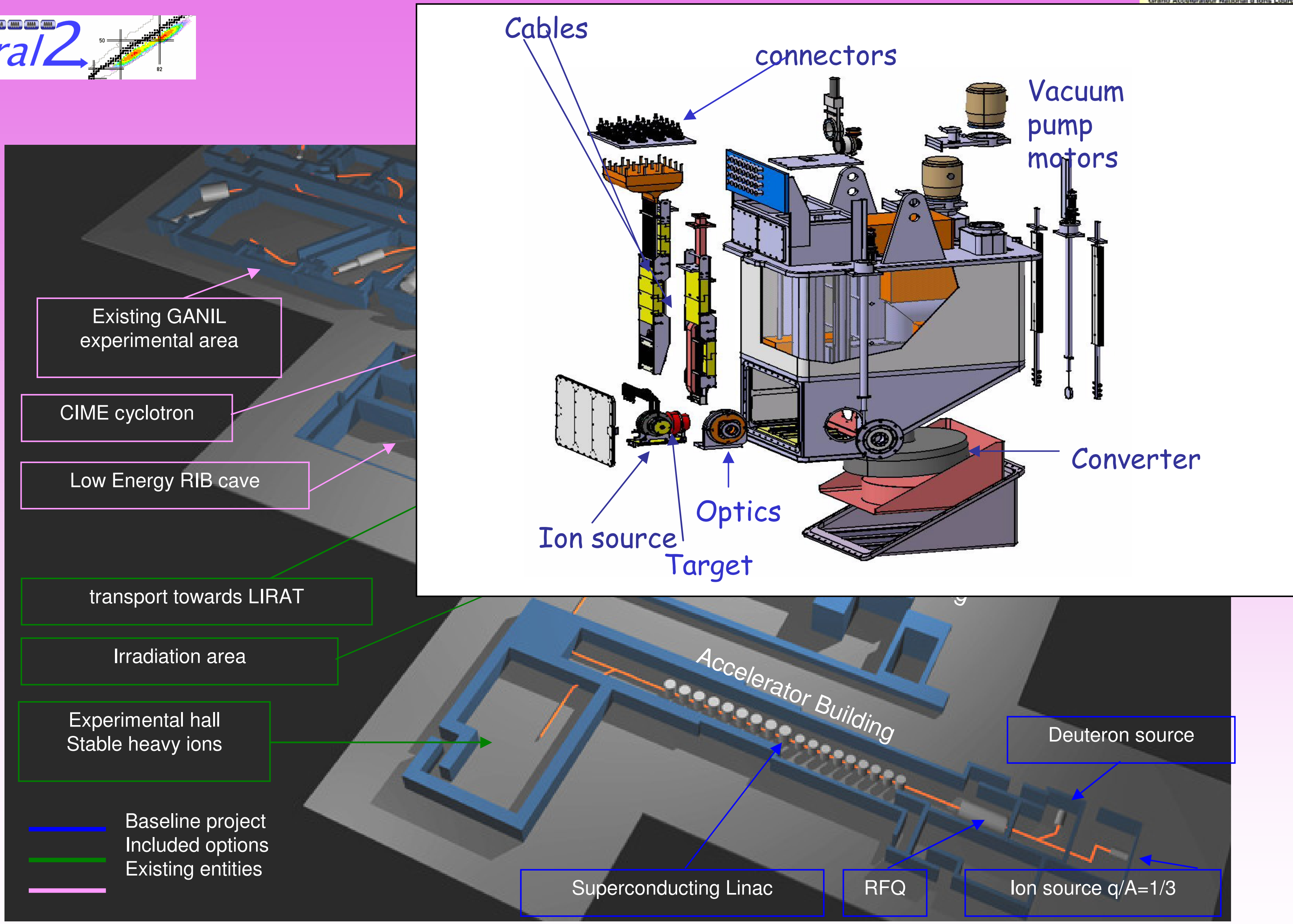
Spiral2 principle



Spiral2 principle



Spiral2


Existing GANIL experimental area
CIME cyclotron
Low Energy RIB cave
transport towards LIRAT
Irradiation area
Experimental hall
Stable heavy ions
Baseline project
Included options
Existing entities
Accelerator Building
Deuteron source
Superconducting Linac
RFQ
Ion source q/A=1/3
Cables
connectors
Vacuum
pump
motors
Converter
Optics
Ion source
Target

Project Milestones

- 1999 – 2001 : Conceptual design at GANIL of a future facility for high intensity rare beams using a sc linac to accelerate medium mass ions at 100 MeV/n: LINAG

- 2001 – 2002 : LINAG Phase 1: low energy, high intensity deuteron beam to obtain neutron-induced fission considered as an option for the SPIRAL 2 project, and chosen in alternative to photofission.

- 2003 – 2005 : SPIRAL 2 DD : Participation of most of French Labs to the detailed study coordinated by A. Mosnier (Spiral2 collaboration)

- 2005 – 2010 : Construction approved in May 2005, Project leader named in July: M. Jacquemet First beam expected in 5 years.

Linear Accelerator Specifications

- **CW machine**

- **Two ion sources,**
  - one for deuterons,
  - the other one for ions q/A=1/3

- **Beam currents**
  - Ions: up to 1 mA (Argon)
  - Deuterons: up to 5 mA

- **Beam energy:**
  - Ions : 14.5 MeV/u
  - Deuterons: 20 MeV/u

- **Maximum energy gain for each kind of ion**
(implies independently phased cavities)

- **Optimisation of the accelerator for q/A=1/3,**
in order to have the possibility to increase the ion energy in the future

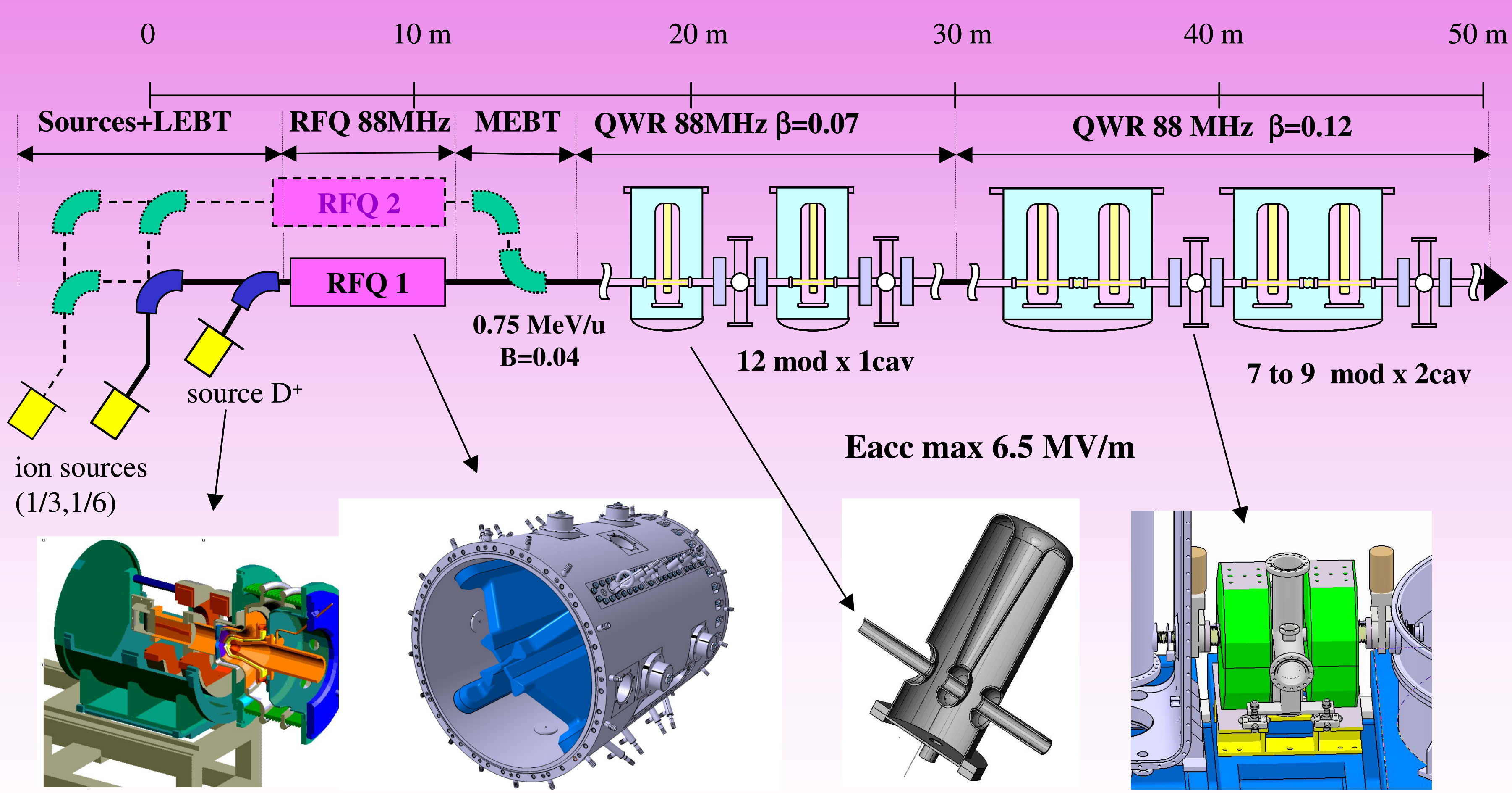
KEPT POSSIBILITIES for future upgrade:

- **To increase the ion energy to 100 MeV/u**

- **To accelerate ion beams of q/A=1/6**
(up to 1 mA) in a second step

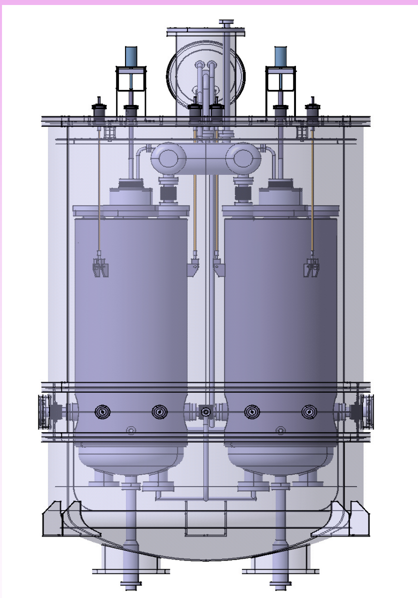
- **To add a fast chopper** placed in the MEBT, with the ability of selecting from 1/50 to $1/10^5$ bunch **(bunch isolator)**

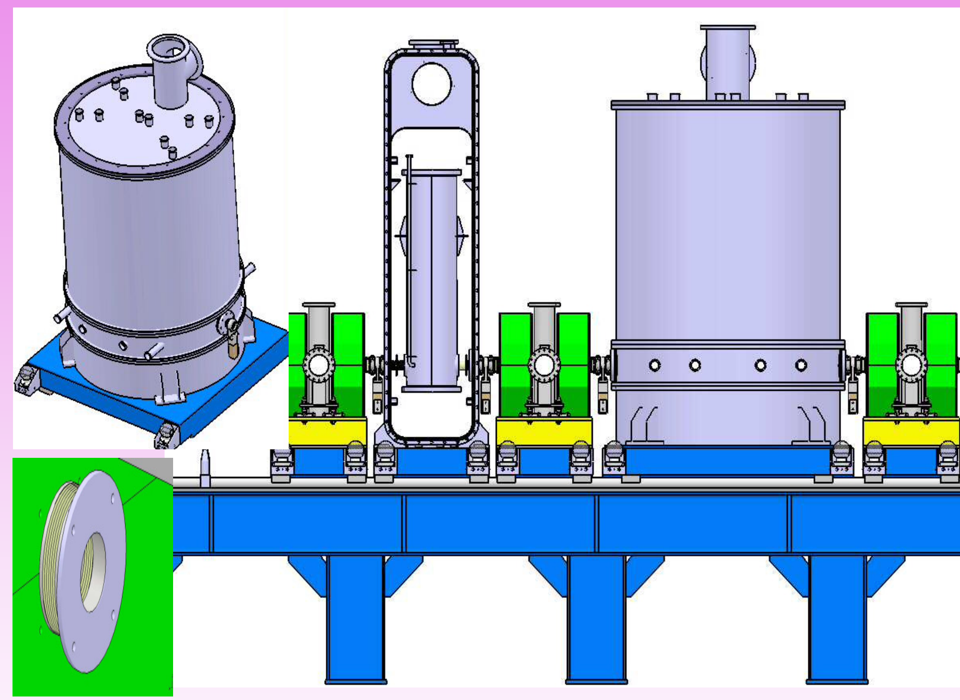
Linear Accelerator

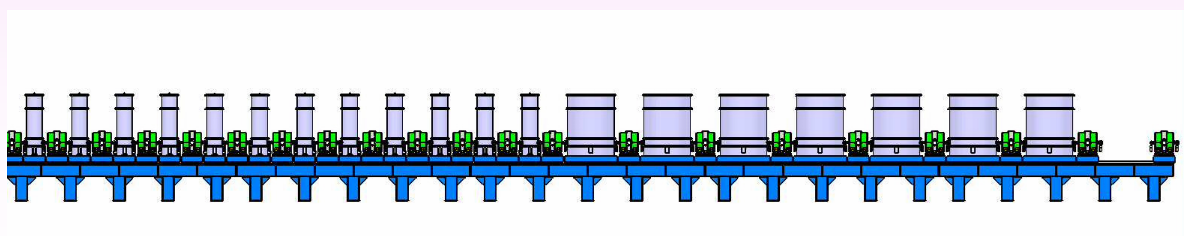


Linear Accelerator: SC Linac

- 88.05 MHz
- QWR with no steering effect compensation
- Short cryostats (1 or 2 cavities)
- Normal conducting Qpoles
- 20 kW Solid state amplifiers
- Digital LLRF





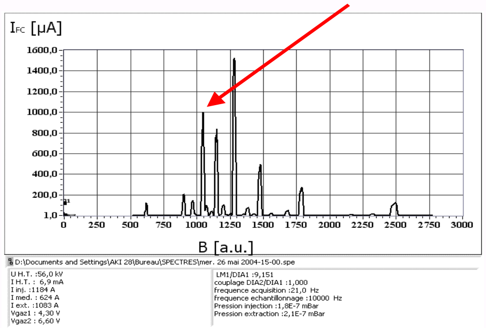


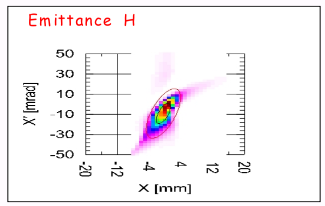
Linear Accelerator: Prototypes

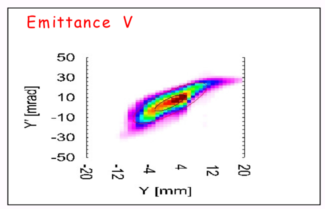
Phoenix ion source

design emittance:0.4 π.mm.mrad

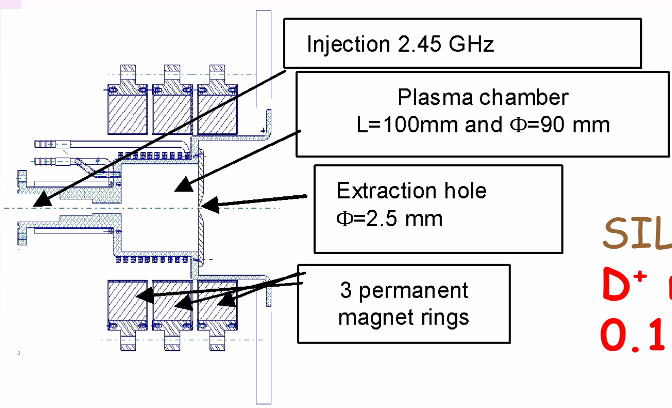
PHOENIX 28 GHz : high current extraction (Ox)
SPIRAL II nominal beam for $^{16}O^{6+}$ 1 mAe 60 KV $\varepsilon_{H\&V}$ < 0.4 π.mm.mrad



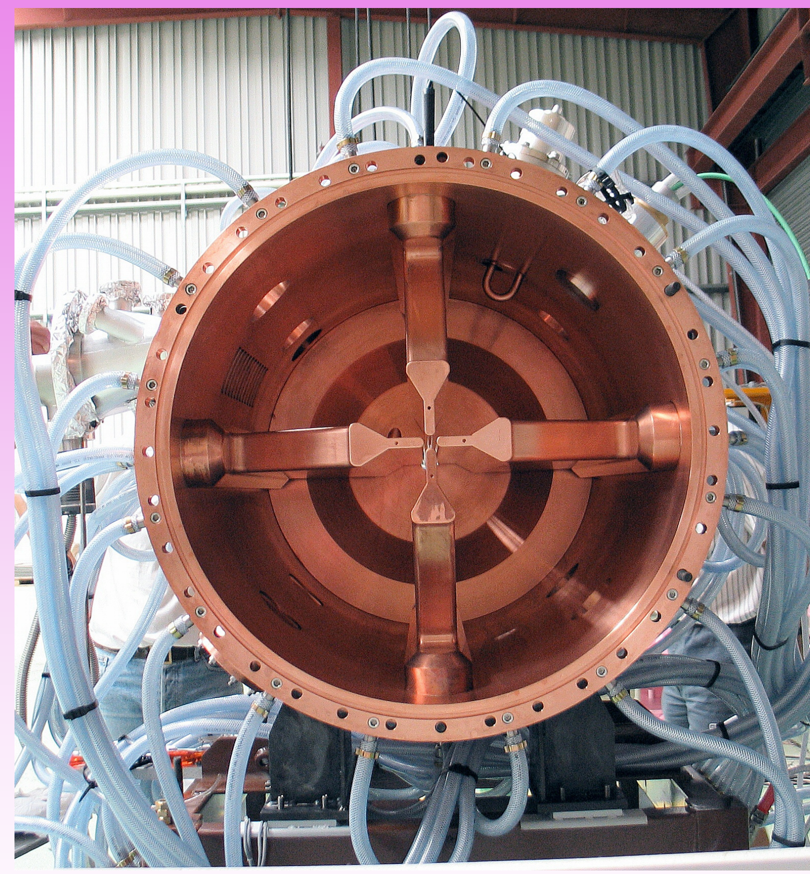




$E_{y\ norm}$ =0.26 π.mm.mrad
$E_{x\ norm}$ =0.18 π.mm.mrad



SILHI like source:
D⁺ measured emittance:
0.1 π.mm.mrad



88.05 MHz
113 kV - 40 kW

Linear Accelerator: Prototypes

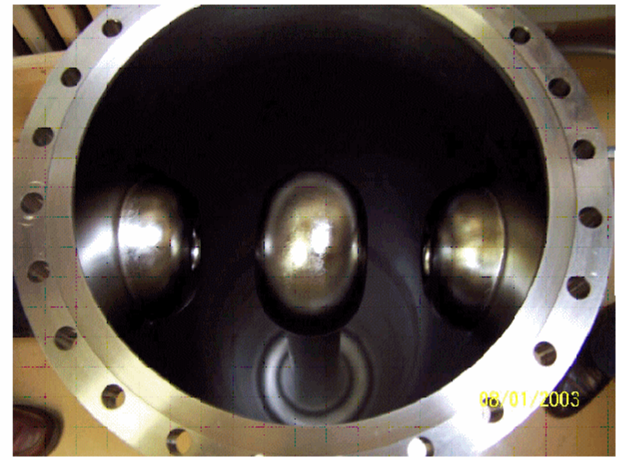
QWRs

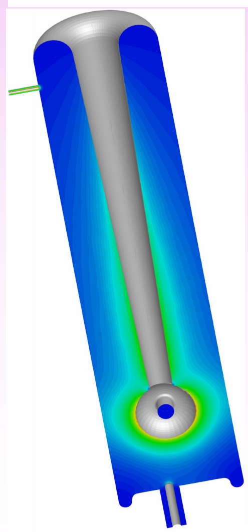
Manufacturing of 1 prototype of each beta family

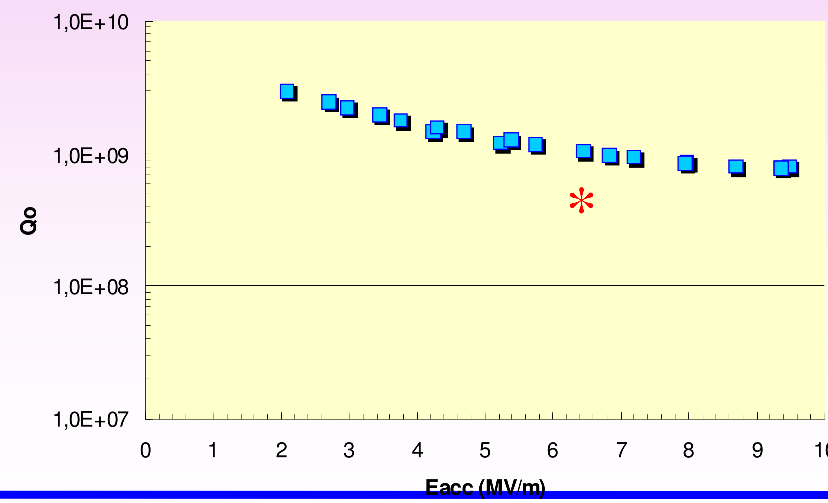
tested in Nov.2004-June.2005

MoPO2 by G. Devanz

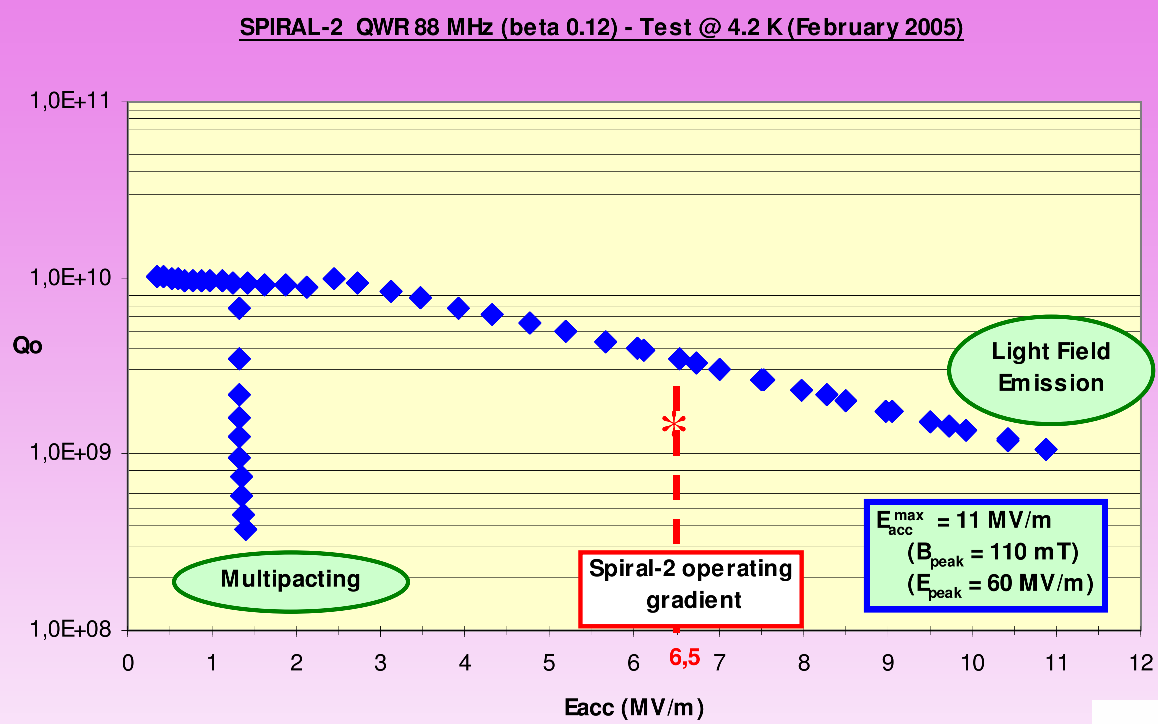
β 0.07 cavity prototype

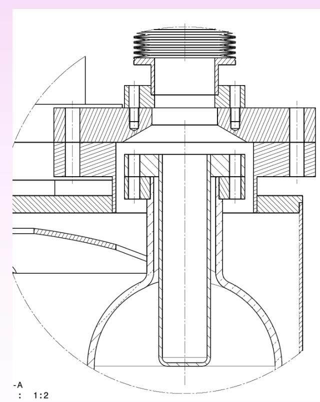


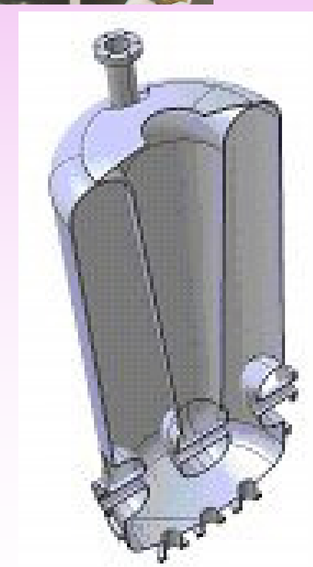




Linear Accelerator: Prototypes







High beta cavity prototype
Using for the first time in SC QWR
A SC magnetic plunger as tuner

TuP37

*G. Olry, J-L. Biarrotte, S. Blivet, S. Bousson, C. Commeaux, C. Joly, T. Junquera, J. Lesrel, E. Roy, H. Saugnac, P.Szott, B. Legoff * CNRS/IN2P3/IPNO, Orsay, France*

Linear Accelerator: Prototypes

15 kW fix coupler prototypes

Cylindrical window

Disk window

40 kW test bench being assembled at LPSC Grenoble

ThA04
by T. Garvey

Linear Accelerator: Prototypes

1 kW solid state amplifier prototype

500 W reflected power accepted

Limited by 1.1 KW heat radiation capability,

20 kW, variable VSWR test bench being assembled at Ganil

Status/Conclusions

ACCELERATOR:

- Single device design study well advanced
- Design, manufacture and tests of the cryostats in the next 2 years

PRODUCTION BUILDING AND MAINTENANCE EQUIPEMENT:

- Conceptual design finished
- Contract with a nuclear engineering company
  detailed studies of the whole maintenance equipement
  (hot cell, storage, ventilation…) and building (cost,…)
- Contract started on March; results expected in 10 months

RADIOACTIVE ION BEAM TRANSPORT LINES:

- continuation of the optical design of the lines and separators

Acknowledgements

G.Auger, W. Mittig, A.C. Villari and M.H. Moscatello:
project "fathers and mother"

Many colleagues from all the following laboratories (Spiral 2 collaboration) participate to the work I've presented:

CEA/DAPNIA/SACM,SIS CEA/DPTA

CNRS/IN2P3/IPNO, IRES, LPC Caen, LPSC, CENBG, CSNSM

GANIL- CEA/CNRS,

INFN/LNL, Gatchina, Bucarest

Special thanks to Argonne and Triumf labs for all fruitful discussions

Spiral2 project is opened to international collaboration

Status/Conclusions

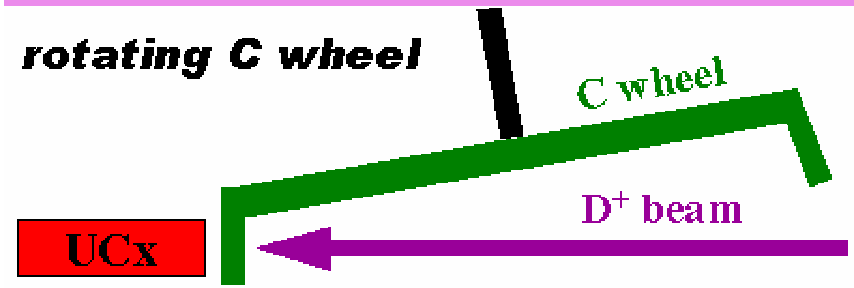
Courtesy of G. Devanz

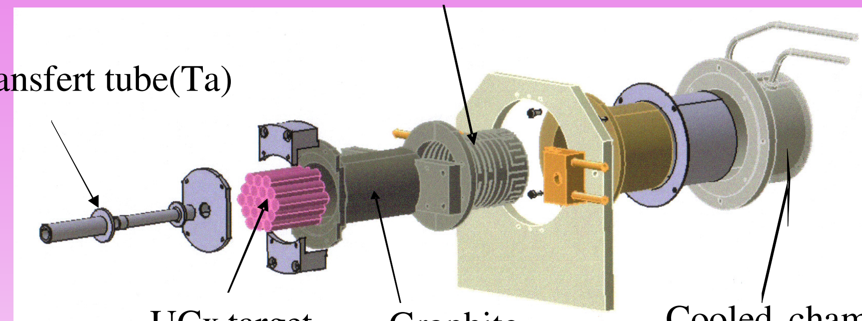
Cornell University proposed collaboration: the linac tunnel

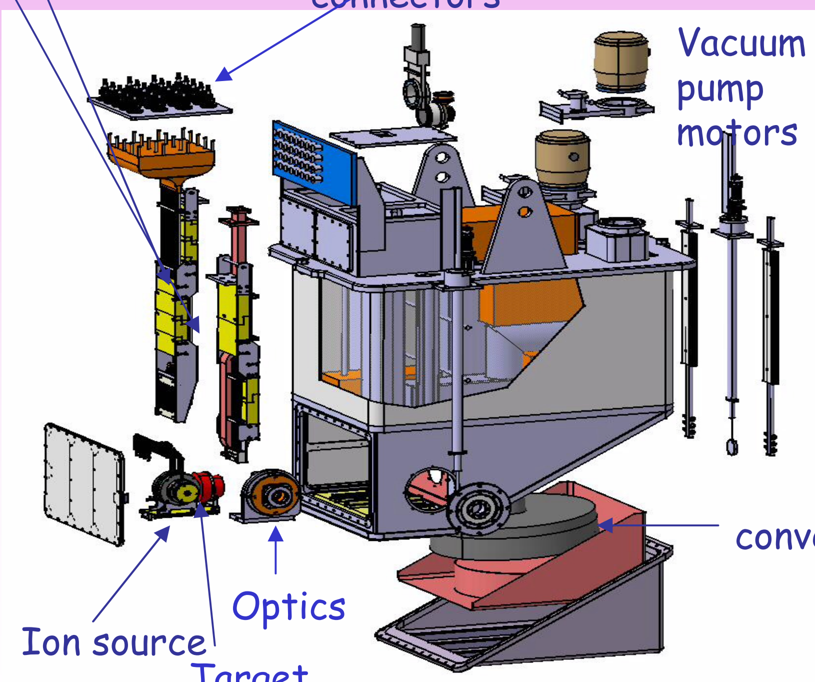
……………..Thank you for your attention

Annexes

Target/Ion source production system







Uranium pellets

Safety aspects

Rather straight forward for the driver (losses <1W/m in the SC linac)

6.10^{14} Becquerel in the high density Ucx target

Extraction Line + Separator + Charge-breeder

in hard radiation environment ⇒ in the production hall

Studies subcontracted to Nuclear engineering companies

to find appropriate solutions allowing maintenance

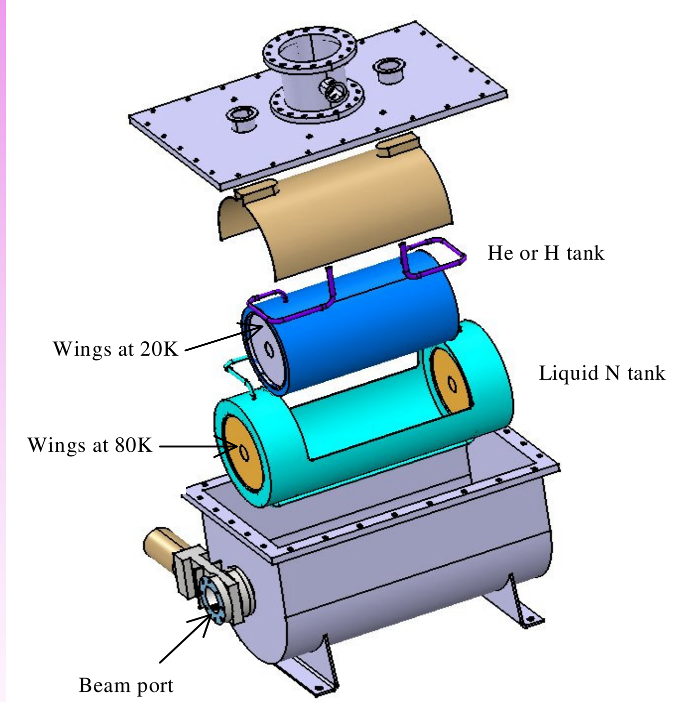
w/o personnel exposure to radiation, w/o dissemination of nuclear matter

⇒ presently, extra-cost not precisely known

Studies to purify the beams upstream in progress

in order to transport only the elements of interest

- increase the selectivity of the ion sources
- use of cryotraps to stop radioactive gases in the beam lines
- resolution enhancement of the cyclotron CIME (a few 10^{-4}) use of RF deflectors (selection of ±10° at CIME exit) ?



Schematic diagram of the Cryotrap principle