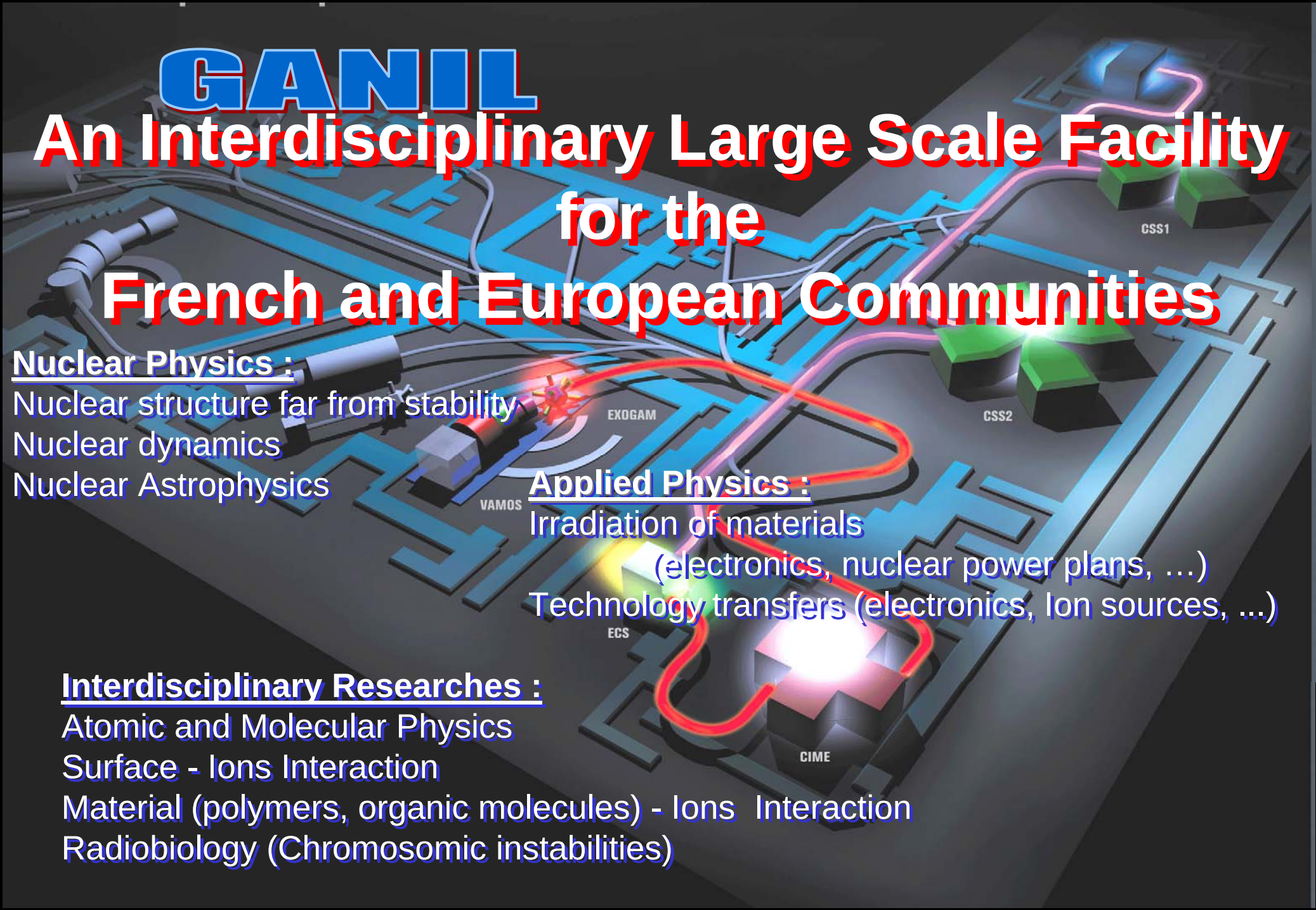
Bruno PIQUET

RADECS Workshop:
The GANIL Facility

GANIL

An Interdisciplinary Large Scale Facility for the French and European Communities



Nuclear Physics :

Nuclear structure far from stability
Nuclear dynamics
Nuclear Astrophysics

Applied Physics :

Irradiation of materials
(electronics, nuclear power plans, …)
Technology transfers (electronics, Ion sources, ...)

Interdisciplinary Researches :

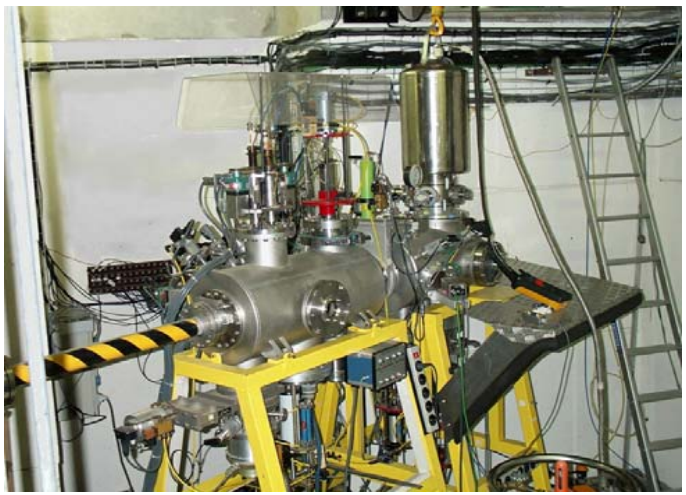
Atomic and Molecular Physics
Surface - Ions Interaction
Material (polymers, organic molecules) - Ions Interaction
Radiobiology (Chromosomic instabilities)

Bruno PIQUET

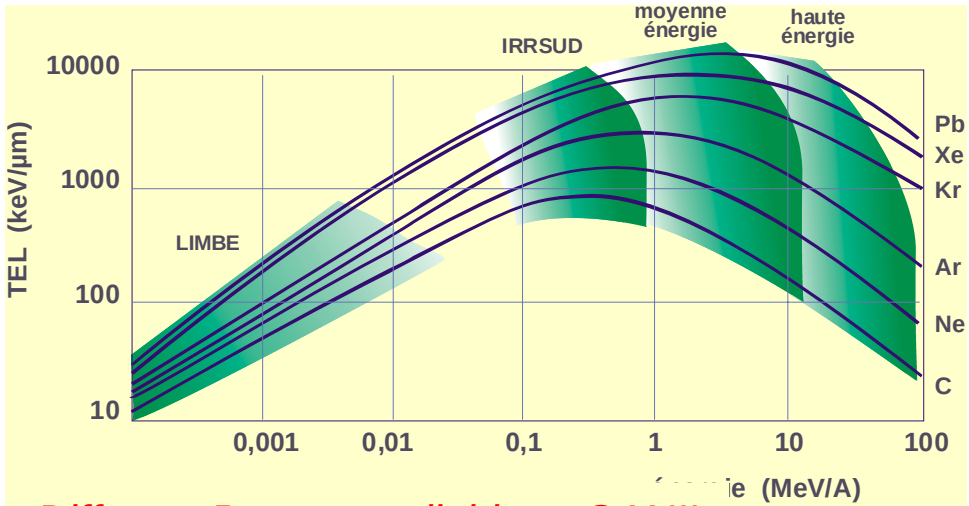
Interdisciplinary Researches at GANIL with Ciril

GANIL offers a wide range of energies from keV to GeV.

- *Atomic Physics,*
- *Condensed Matter Physics,*
- *Material Sciences,*
- *Chemistry under irradiation,*
- *Radiobiology,*
- *Applications*



Irradiation device IRABAT



Different Beams available at GANIL

GANIL
GRAND ACCELERATEUR NATIONAL D'IONS LOU

... applied physics

Simulation of radiation-damage

Reactors

Steel: containment vessel, structure	EDF, DRT, DSM
Sheaths for fuel	DEN
Radiolysis of coolant water	DSM, ITER

Reactor fuel

Ageing	DSM, DEN, CNRS
Matrices for burning and storage	DEN, CNRS

Polymers, organic materials

Ageing of cable sheaths	EDF, DRT, COGEMA

Cosmic rays

Electronic components in space	MATRA, DAM

Modification of materials

Chemical attack

Microporous membranes	

Surgical implants

Haemocompatible polymers	DSM

Interaction faults - microstructure

Trapping of Bloch faults (magnetic materials)	CNRS
Trapping of vortexes (superconductivity)	DSM, CNRS

Mesoscopic Physics

Magnetic field plots (measurement probes)	CNRS

Radioactive-ion implantation

Wear measurements	DRT

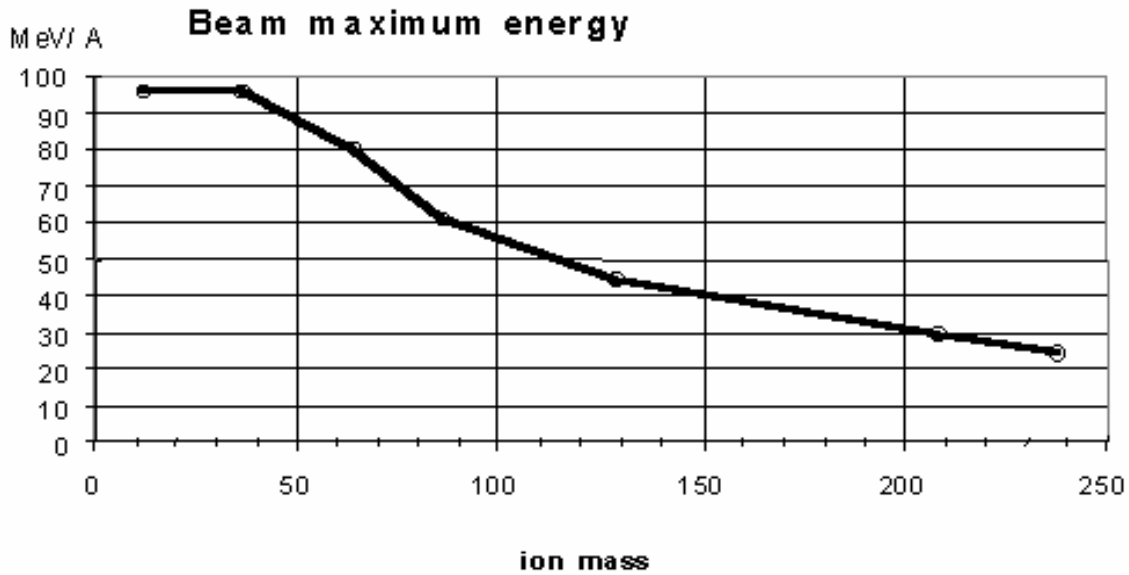
Supernanogan: ECR ion source with permanent magnets produced et commercialised by the Pantechnik company

Technology Transfer

BIOPORE (1986-90)	microporous membranes
GANELEC (1989-93)	electronic modules
MATRA (1989-97)	irradiation of components
PANTECHNIK (1991- ...)	ion sources
X-ION (1998- ...)	microelectronics
Normandie Incubation (2000- ...)	support for innovation
EADS ASTRIUM (2004-...)	irradiation of components
CNES (2004-...)	irradiation of components
XXXX (2005 - ...)	microporous membranes

The GANIL beams

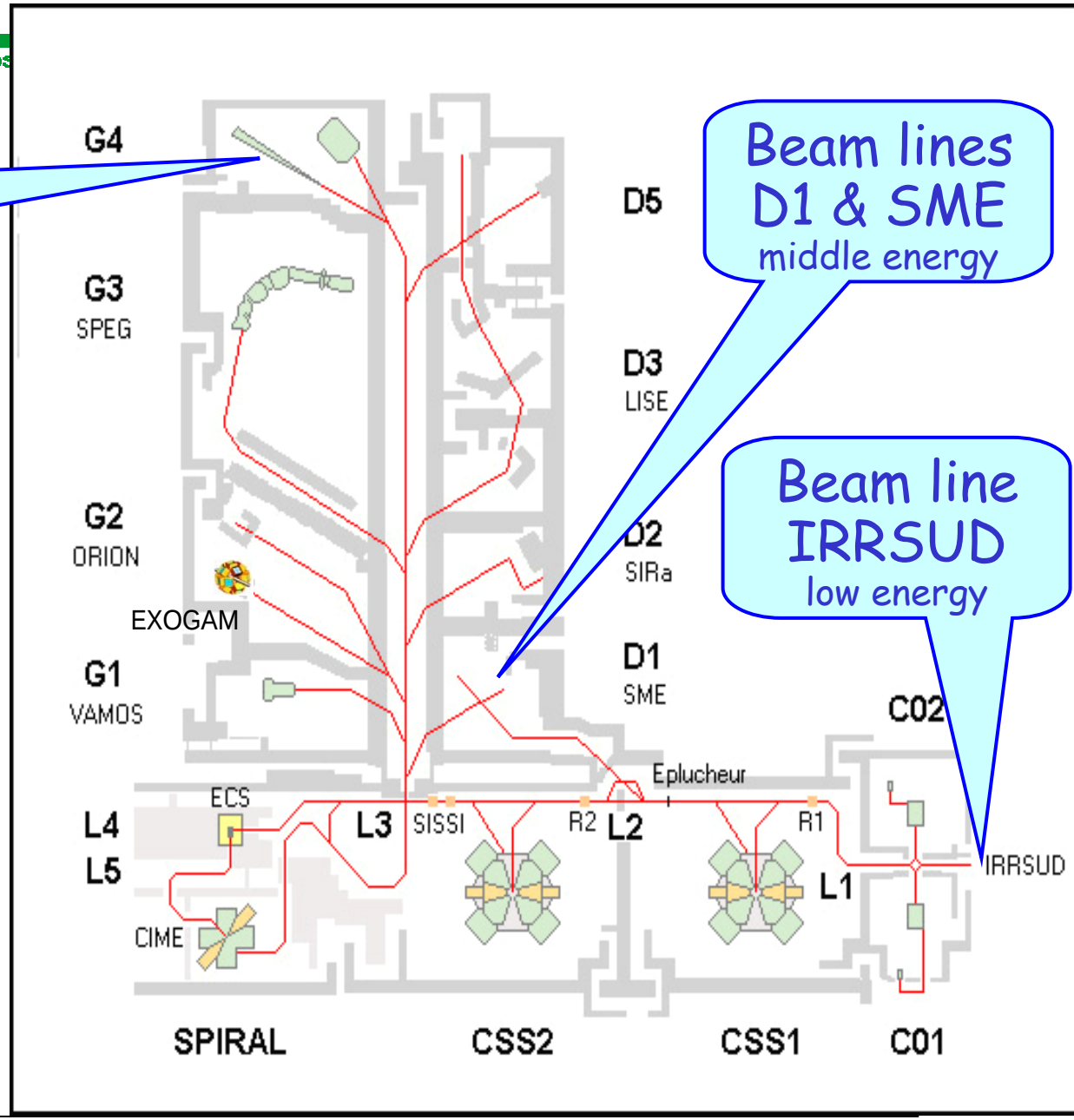
- Light to heavy ions for nuclear research
  - Carbon Ions up to 95 MeV/a
  - Uranium Ions up to 24 MeV/a
  - Up to 2 x 10^{13} pps



GANIL
GRAND ACCELERATEUR NATIONAL D'IONS LOURDS

Layout of the GANIL facility

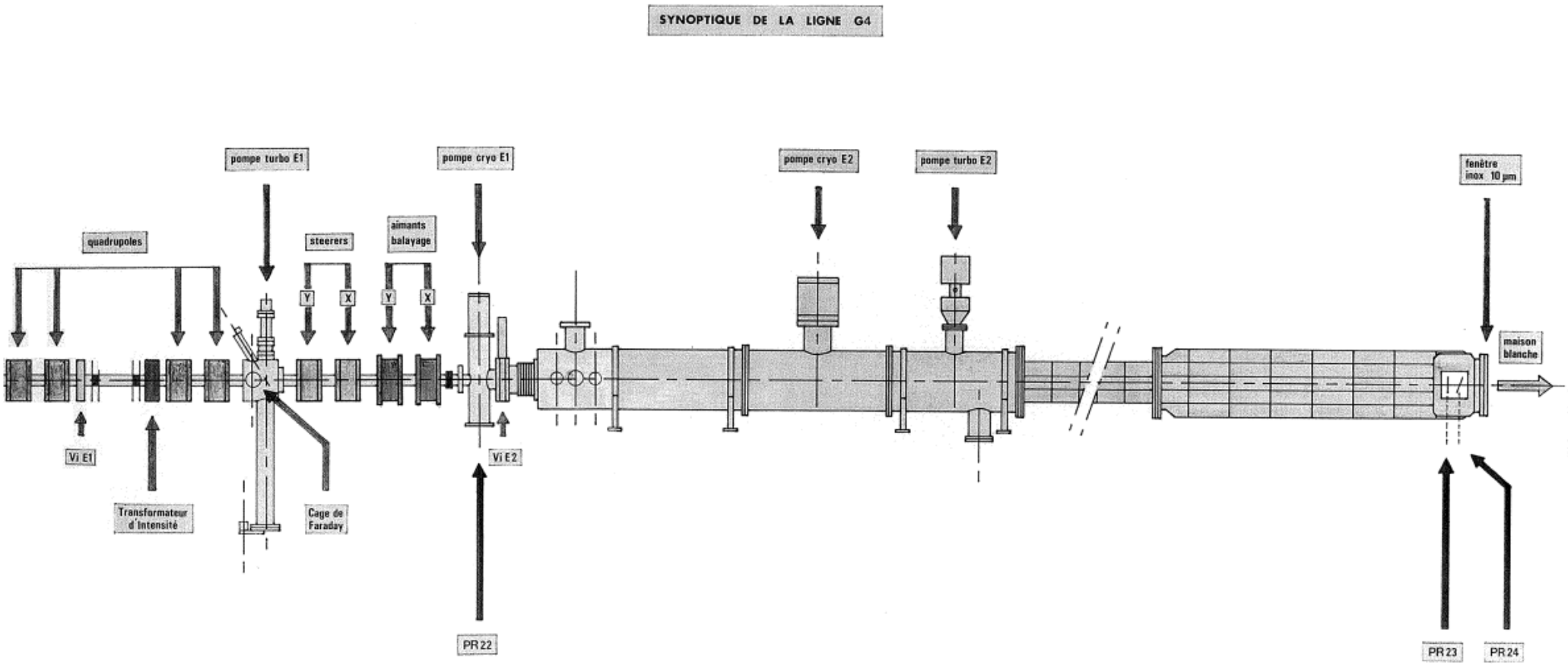
most of irradiations for components are in G41



Irradiation for industry

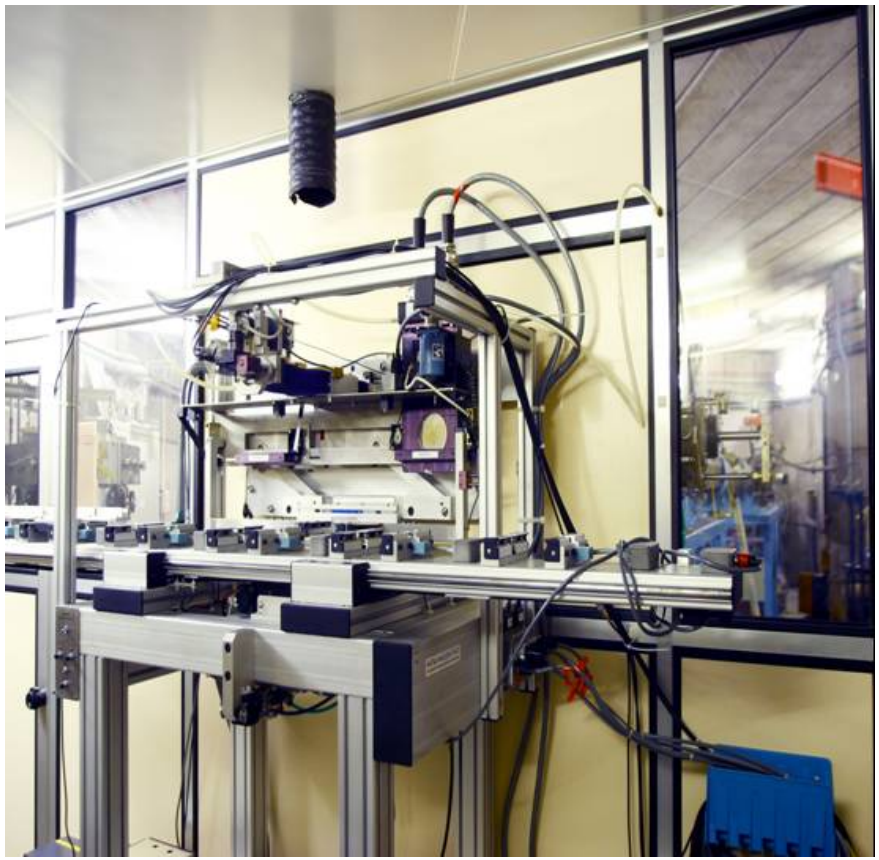
- Irradiation beam line G41
  - Scanning magnets
    - Horizontal: 200 Hz; max 50 cm
    - Vertical: 2 Hz ou 8 kHz; max 4 cm
  - Beam control
    - Secondary emission or gas detectors
  - Irradiation in the air
    - Stainless steel window: 10 μm

Irradiation beam line G41



CAVE G4

- The « white room »
- The samples irradiation device
  - 6 places for 30x20cm boards
  - Irradiation area 4x30 cm
  - Tilt possibility (0..60°)
  - Longitudinal movement (air thickness adjustment 53 … 189 mm)



The GANIL beams for G41

- Beam from
  - CSS1 (up to 13 MeV/a)
  - CSS1 + CSS2 (up to 95 MeV/a)
  - CIME (up to 13 meV/a)
- LET and range adjustment
  - *Do not forget the steel window (10 μm)*
  - Air (53 .. 189 mm)
  - Aluminium foils (25 .. 2000 μm)

The GANIL beams for G41

- Xenon beam (129 Xe), 35 MeV/a
  - EADS ATRIUM *(March & November 2004)*
  - LET exploration: 34 .. 54 MeV.cm²/mg
  - Range over 100 μm
- Lead beam (208 Pb), 29 MeV/a
  - CNES *(December 2004)*
  - LET exploration: 72 .. 98 MeV.cm²/mg
  - Range over 63 μm

The GANIL beams for G41

Ions	Initial energy (accelerator) (MeV/u)	de/dx min. (MeV.cm²/mg) (Air=53mm. Al=0µm)	de/dx max. (MeV.cm²/mg)	range for de/dx min (µm)	range for de/dx max. (µm)	Air (mm) for de/dx max.	Al (µm) for de/dx max.
36 Ar	95	2,0	2,3	4 220	3 019	189	1000
36 Ar	27	5,4	9,9	445	113	53	300
40 Ca	95	2,5	2,9	3 812	2 611	189	1000
58 Ni	52	7,6	11,2	1 013	427	100	500
84 Kr	35	16,4	37,8	484	49	179	325
86 Kr	60	11,0	42,1	1 223	27	189	1000
93 Nb	31	22,7	34,0	349	128	53	200
112 Sn	47	24,2	48,7	601	100	53	450
132 Xe	35	33,5	62,1	393	54	160	250

Access to the GANIL facility

- Annual schedule
  - Available in October for the next year
  - Four running periods (8..10 weeks)
  - Maintenance (Winter 10 weeks, Summer 4 weeks)
- Priority is given to physics
  - Program Advisory Committee (twice a year)
  - PACs concerns 90% of available beam time
  - 4 to 6 times more requested time as beam time
  - about 5 to 10 % beam time available for industrial applications (not subject to the PAC)

Access to the GANIL facility

- Unit of Time of eight hours (UT)
- Beam production and tuning
  - 2 or 3 UT (one or two cyclotrons)
    - the same time is needed for a modification of energy
    - an alternative way is to use a degrader
- for industrial users
  - 1 UT (beam in the cave)
  - 2 UT for any energy modification during the run
  - as many UT as necessary
    - (this time includes beam setup in the cave and irradiation)

Access to the GANIL facility

- (very) long response time to a request
  - Beam (ion, energy) is planned ? 2-4 months
  - If not 4-6 months
- Announce the planned beams
  - Shorter response time, but…
  - Very few heavy ions beams (and unpredictable)
- Pre-schedule of "right beam" window
  - 3 or 4 times a year
  - Requires confirmation !

Pre-schedule for RADECS community

- What should be the right beam(s) ?
  - Ion, Energy, Beam intensity …
- Could there be a unique partner ?
  - (for RADECS community)
- What should be the deadline to confirm ?…
  - 8 weeks before beam ?
- Could we have a commitment on a minimum annual beam time utilization ?

Thank you for your attention!