



**EURISOL**



# The EURISOL Design Study

*Peter Butler (CERN & Liverpool)*

*JOINT UK Nuclear and Particle Physics meeting on the beta-beam 17-18 Jan 2005*

# In Flight

# ISOL

heavy ions

driver accelerator  
or  
reactor

light ions,  
neutrons

thin target

high-temperature thick target

fragment separator

ion source

gas cell  
(ms)

mass separator

storage ring

post accelerator

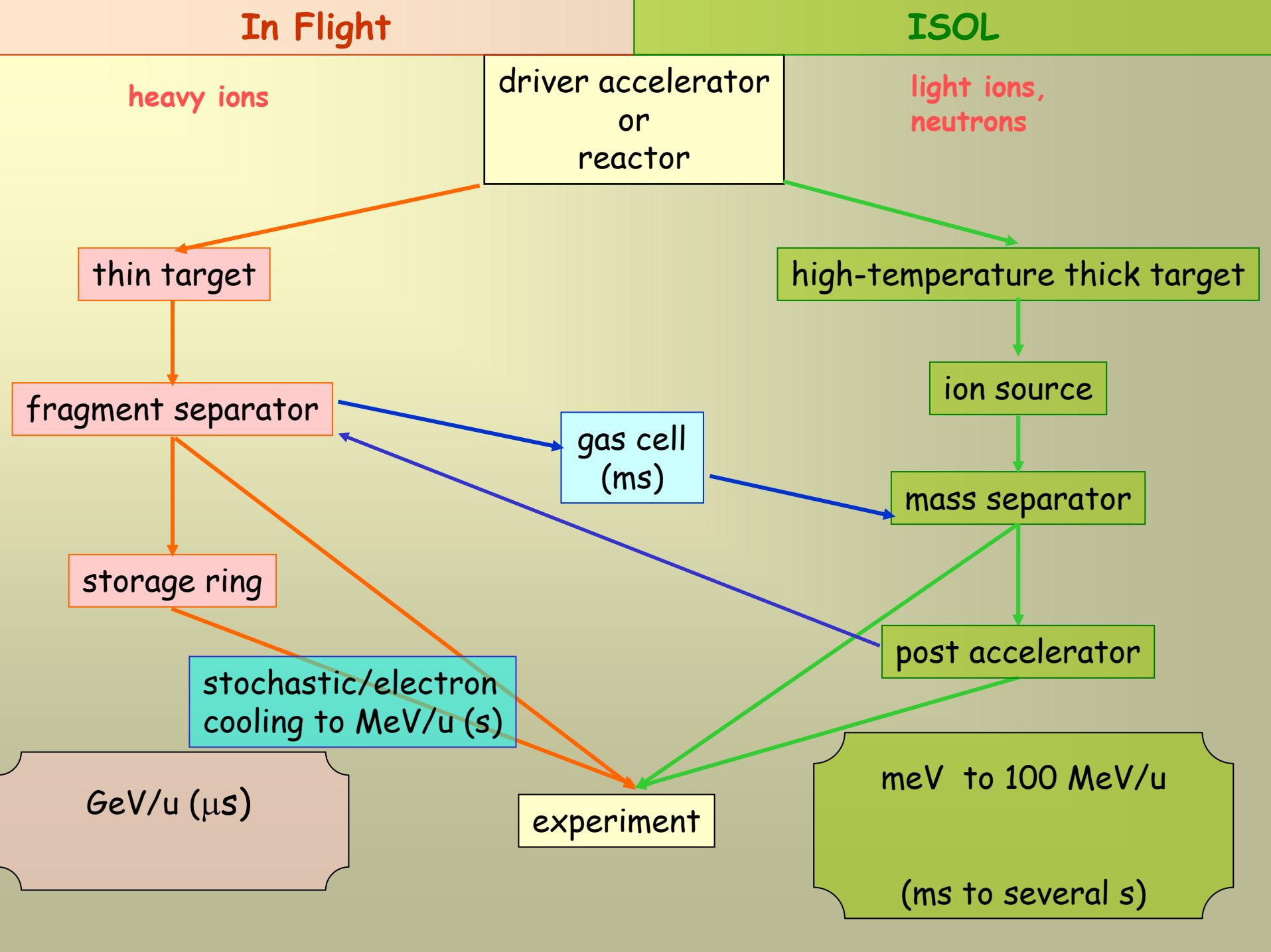
stochastic/electron  
cooling to MeV/u (s)

meV to 100 MeV/u

GeV/u ( $\mu$ s)

experiment

(ms to several s)



# Energetic Radioactive Beam Facilities in Europe

CRC, Louvain-la-Neuve, Belgium  
delivering **ISOL** beams since 1989

FAIR  
**IF** beams

GANIL, Caen, France  
delivering **IF** beams since 1984  
(SPIRAL) **ISOL** beams since 2001

GSI, Darmstadt, Germany  
delivering **IF** beams since 1990

Dubna **ISOL** beams

SPIRAL II  
**ISOL** beams

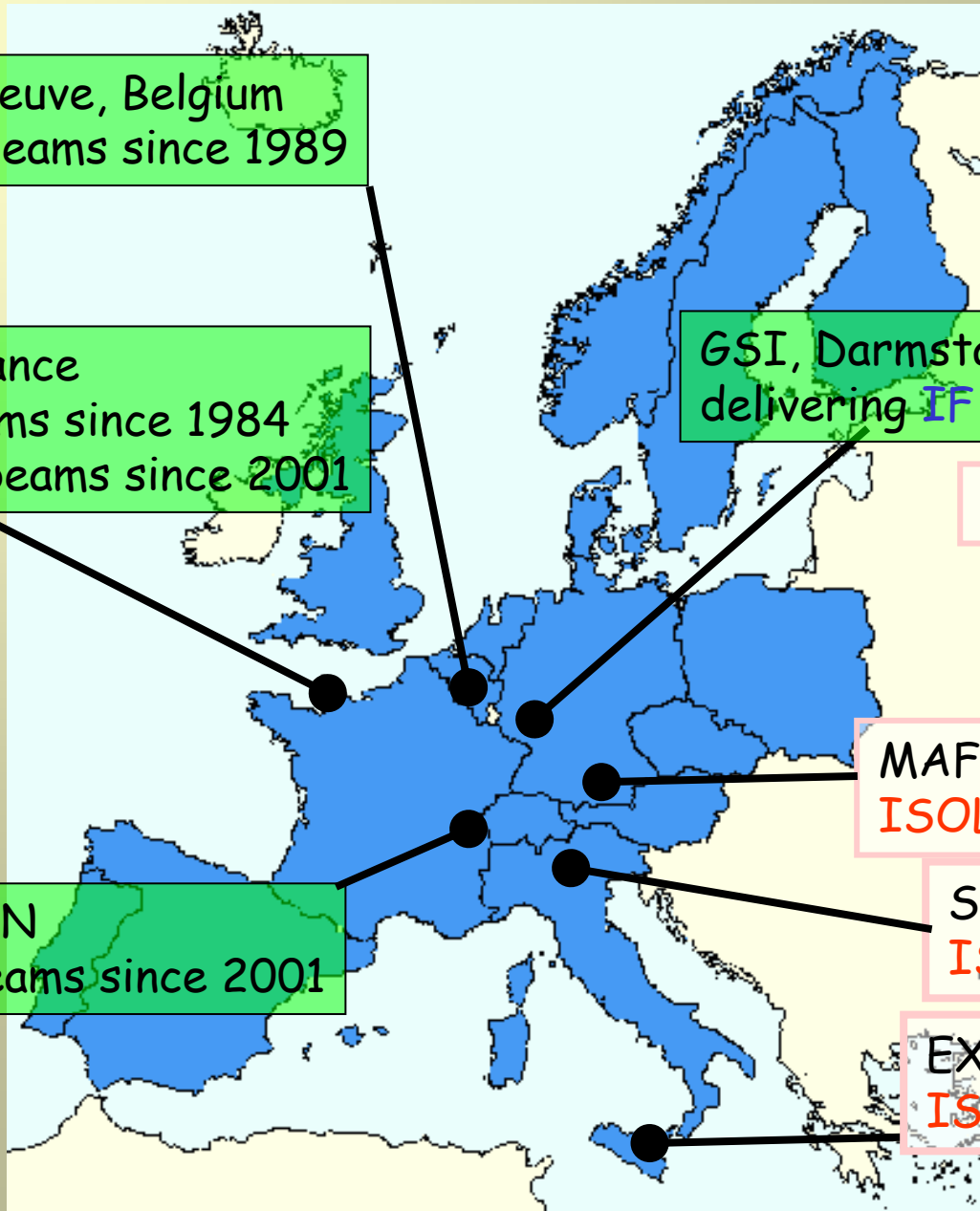
MAFF, Munich, Germany  
**ISOL** beams

REX-ISOLDE, CERN  
delivering **ISOL** beams since 2001

SPES, Legnaro, Italy  
**ISOL** beams

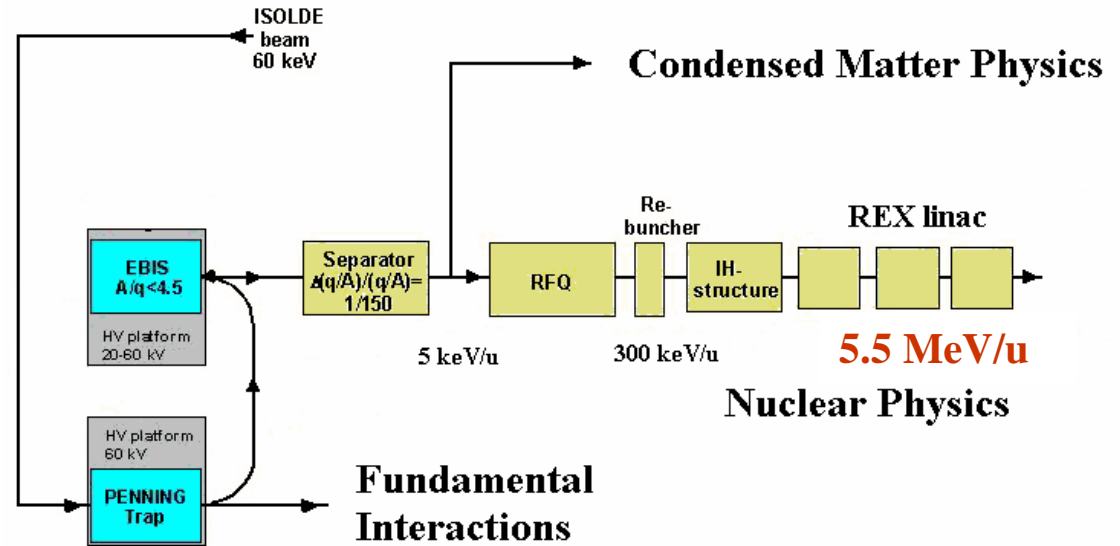
HIE-ISOLDE  
**ISOL** beams

EXCYT, Catania, Italy  
**ISOL** beams

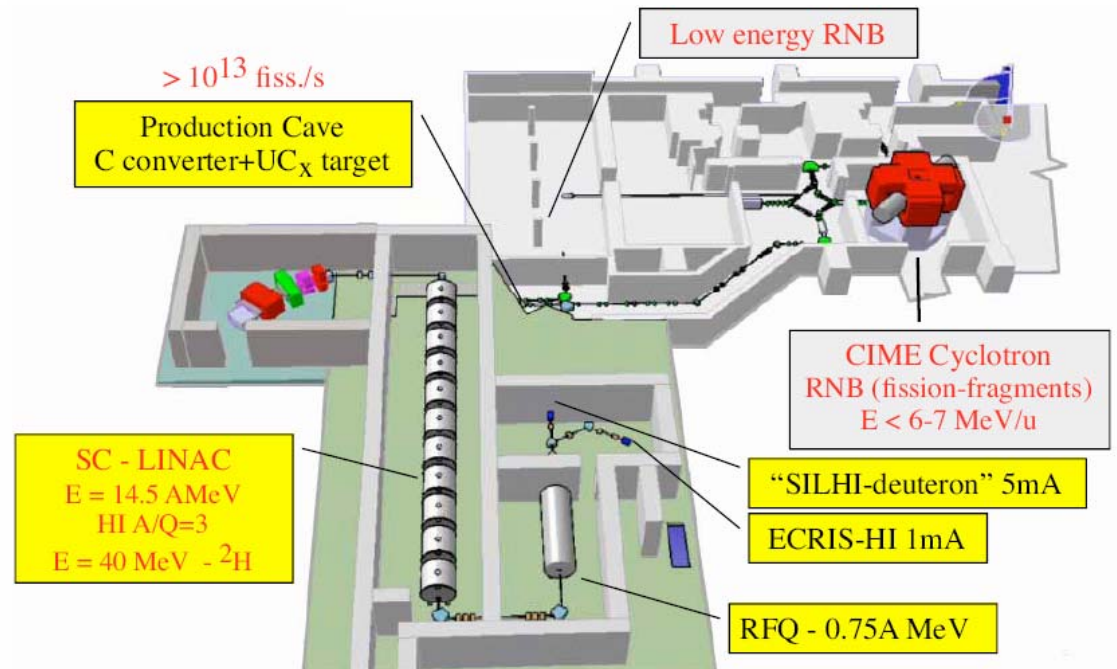


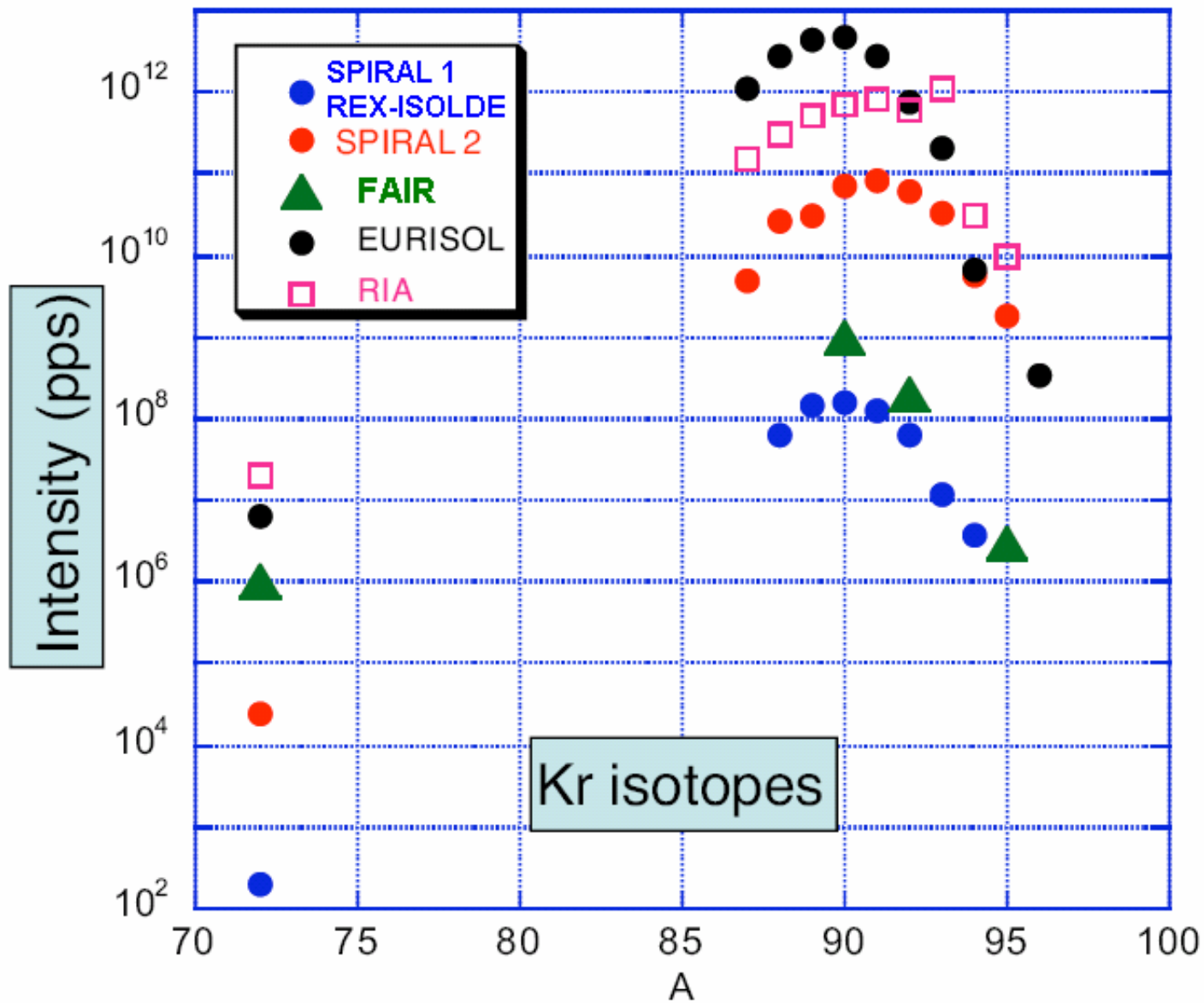
# ISOL in Europe: the next 5 years

## HIE-ISOLDE



## SPIRAL II





Peter Butler (CERN & Liverpool)

JOINT UK Nuclear and Particle Physics meeting on the beta-beam 17-18 Jan 2005



**100kW direct production**  
**5 MW spallation n target**  
**→ 100 MeV/u RIB**

**For  $^{90}\text{Kr}$  :**

**x  $10^5$  increase in yield for ISOL products**  
**from existing RIB (e.g. REX-ISOLDE)**

**X 100 increase from 2nd generation ISOL**

# EURISOL yields

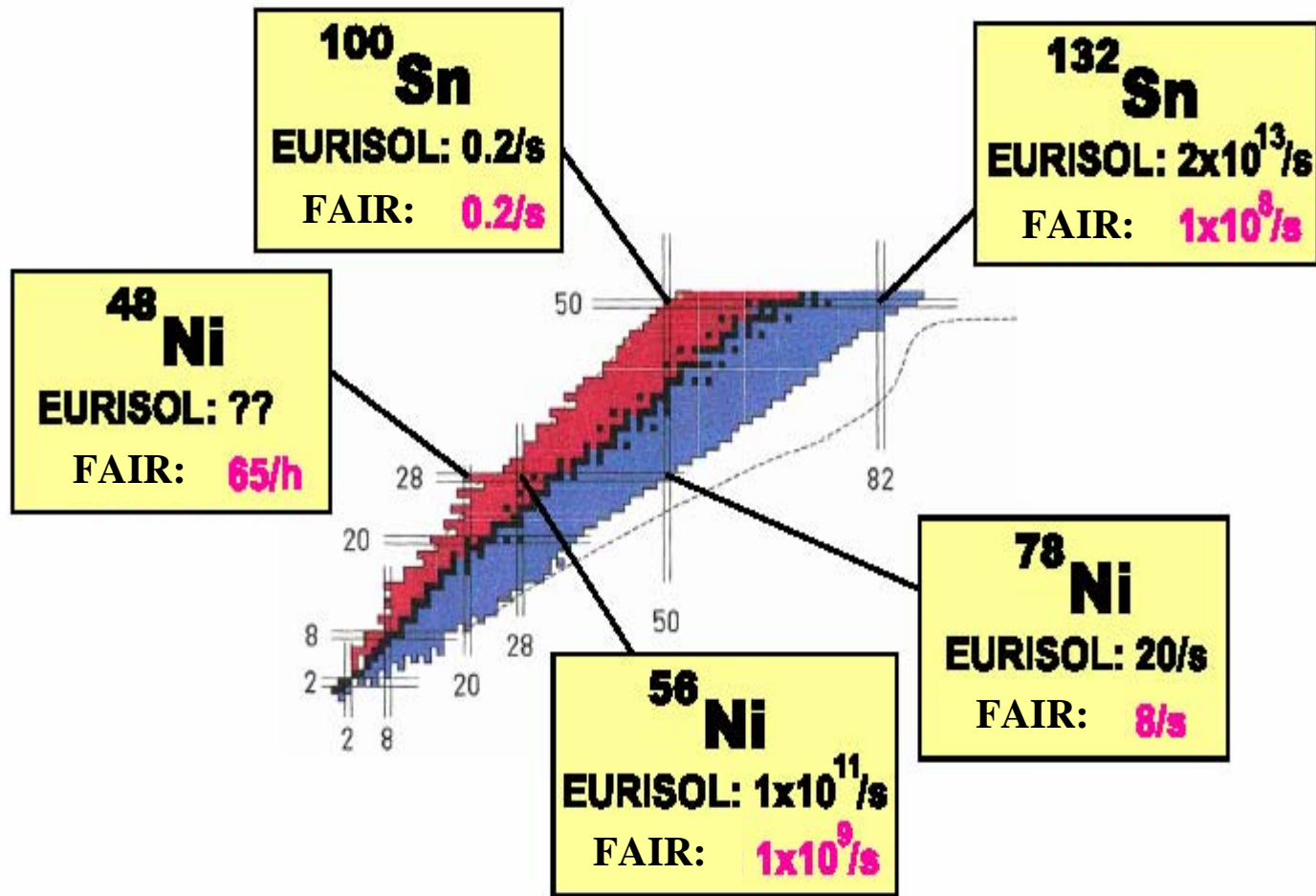
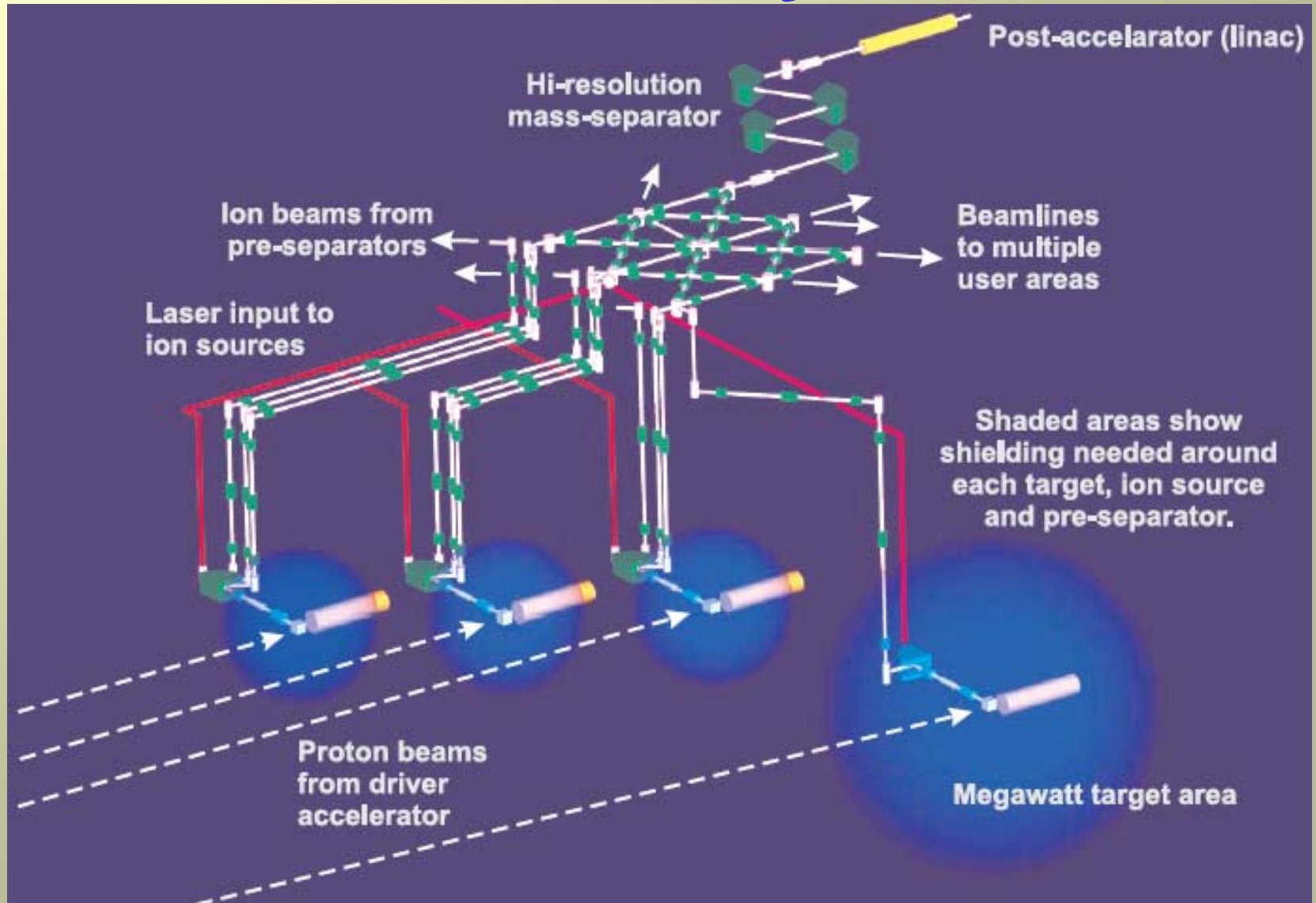


Fig. 5.2: The region of the chart of nuclides that illustrates the interesting doubly-magic nuclei far from stability and a comparison of their projected rates (as in figure 5.1) at EURISOL and the future GSI facility ('SIS 200').



# Eurisol layout



Peter Butler (CERN & Liverpool)

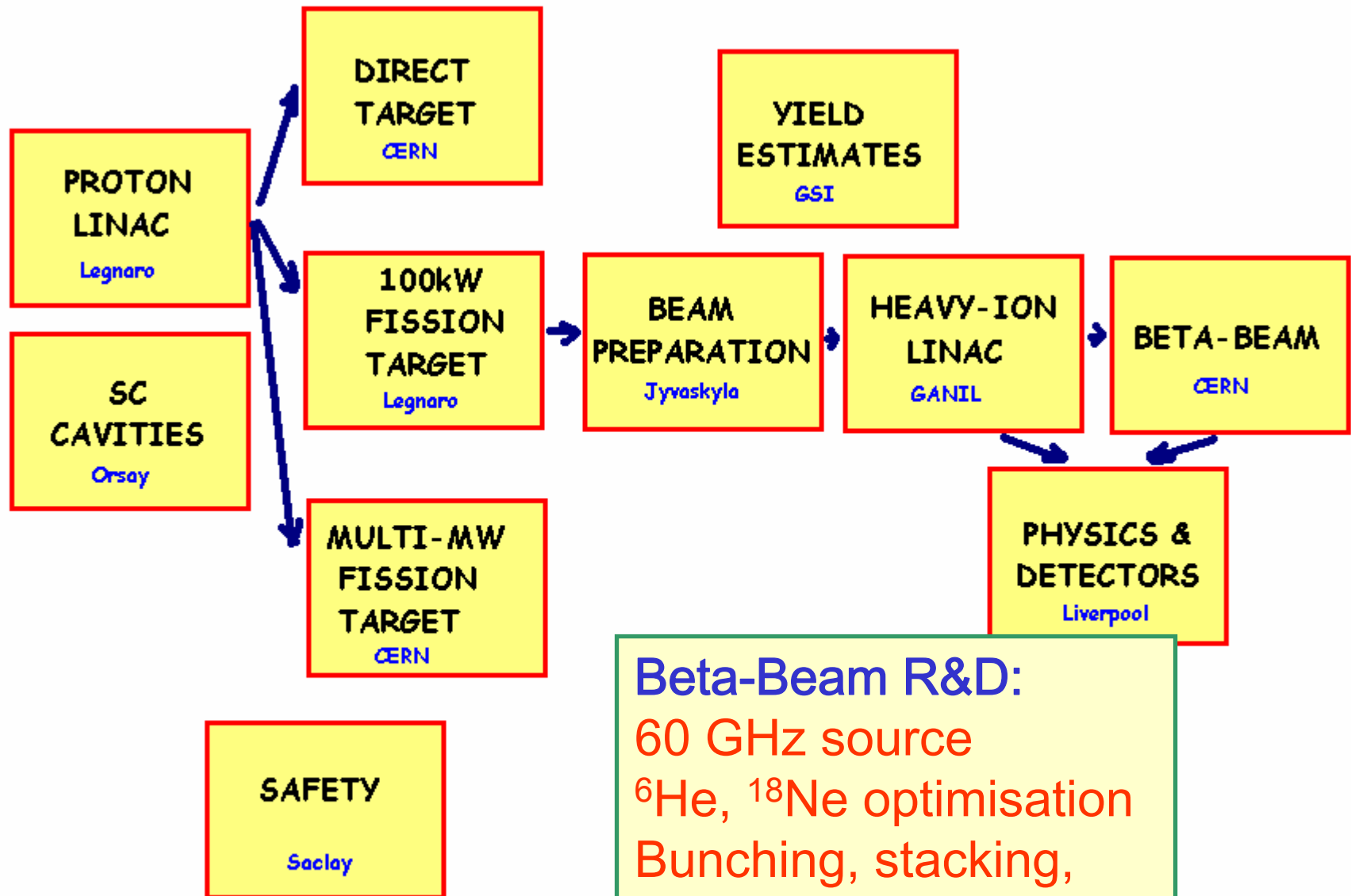
JOINT UK Nuclear and Particle Physics meeting on the beta-beam 17-18 Jan 2005



# Approved Design Study 2005-2009

- Detailed engineering oriented studies and technical studies
  - 20 participants
  - 21 contributors from Europe, Asia and North America
  - Total Cost : 33 M€
  - Contribution from EU : 9 M€
- R&D will benefit 2<sup>nd</sup> generation ISOL projects*

Project starts Feb 1 2005  
Kick-Off Orsay 3-4 Feb



**Beta-Beam R&D:**  
 60 GHz source  
 ${}^6\text{He}$ ,  ${}^{18}\text{Ne}$  optimisation  
 Bunching, stacking,  
 acceleration of RIB  
 Low energy  $\nu$  physics

Peter Butler

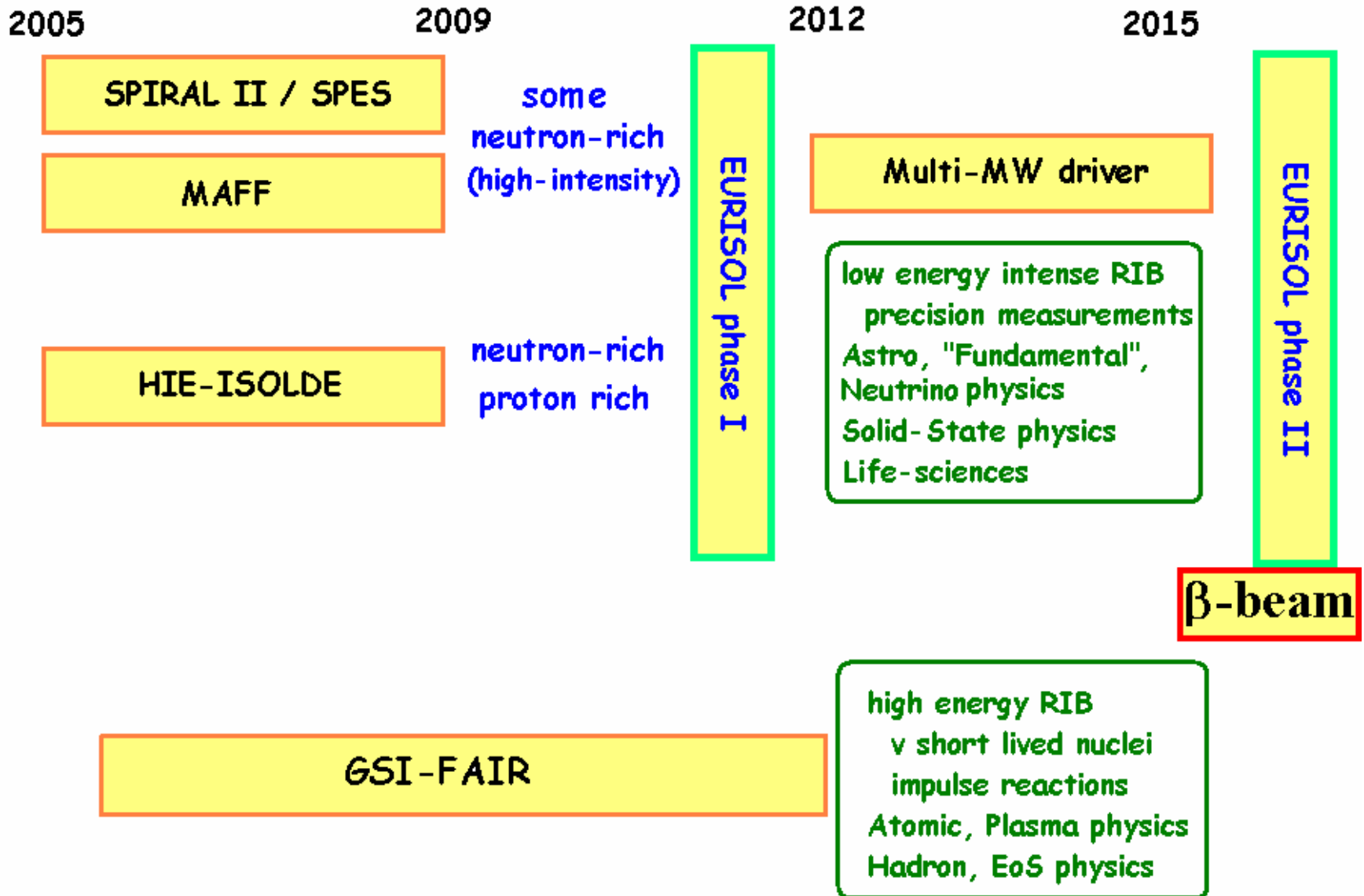
# EURISOL: possible sites

- **European Joint Laboratory** - INFN-Legnaro and GANIL, funded mostly by host state(s)
- **CERN**, funded by subscription
- **Green-field site** in less-favoured region near nuclear physics institute, funded by European Structured Funds

*Review of funding mechanism during DS*



# European NP Roadmap



Peter Butler (CERN & Liverpool)

JOINT UK Nuclear and Particle Physics meeting on the beta-beam 17-18 Jan 2005

*Peter Butler (CERN & Liverpool)*

***JOINT UK Nuclear and Particle Physics meeting on the beta-beam 17-18 Jan 2005***

# Future RNB facilities

Location	Driver	Post-accelerator	Fragment separator	Type of facility
GSI –FAIR	synchrotron, heavy ions: 1.5 A GeV	-	‘Super-FRS’	In-Flight
EURISOL	protons, 1 GeV, 1-5 MW	CW Linac, up to 100 A MeV	-	ISOL
USA: RIA Rare Isotope Accelerator	900 MeV protons heavy ions: 400 A MeV, 100 kW	Linac up to 8–15 A MeV	4-dipole Separator	ISOL, In-Flight
JAPAN: RIKEN RIB Factory	Ring-cyclotrons up to 400 A MeV (light ions); up to 150 A MeV (heavy ions)	-	3 fragment Separators storage & cooler rings	In-Flight

*Peter Butler (CERN & Liverpool)*

*JOINT UK Nuclear and Particle Physics meeting on the beta-beam 17-18 Jan 2005*



# 60 GHz « ECR Duoplasmatron » for gaseous RIB

Plasma density  $\sim$  (frequency)<sup>2</sup>

1 - To bunch the gas in short time

*$\sim > 20 \mu\text{s}$*

2 - To ionize (>1+) with a time smaller than the effusion time

*$n_e \approx 10^{14} \text{ e/cm}^{-3} \quad \approx 60 \text{ GHz ECR discharge}$*

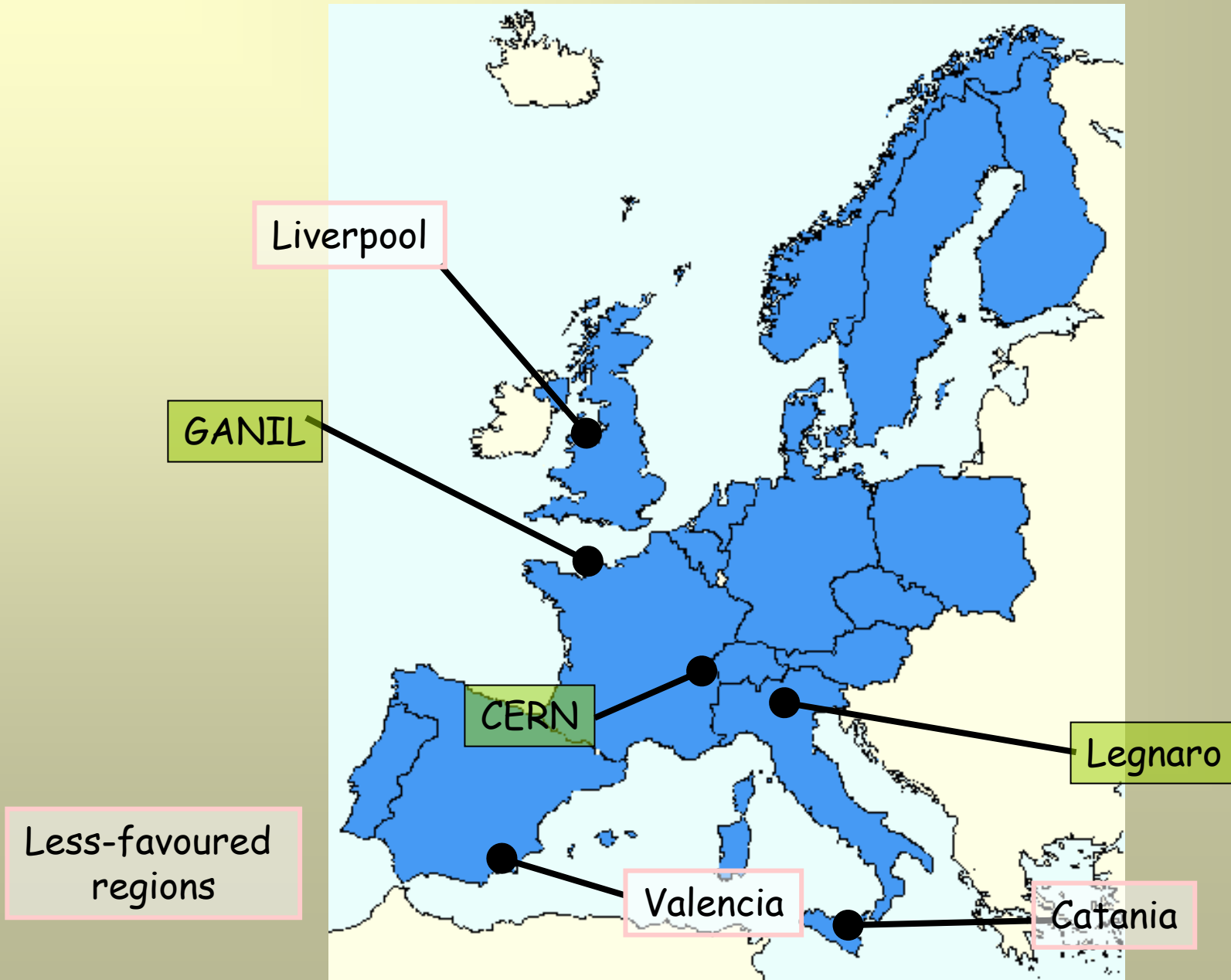
*+ strong axial magnetic field during the discharge ( $\approx 2 \text{ T}$ )*

3 - To deliver a beam with a repetition rate compatible

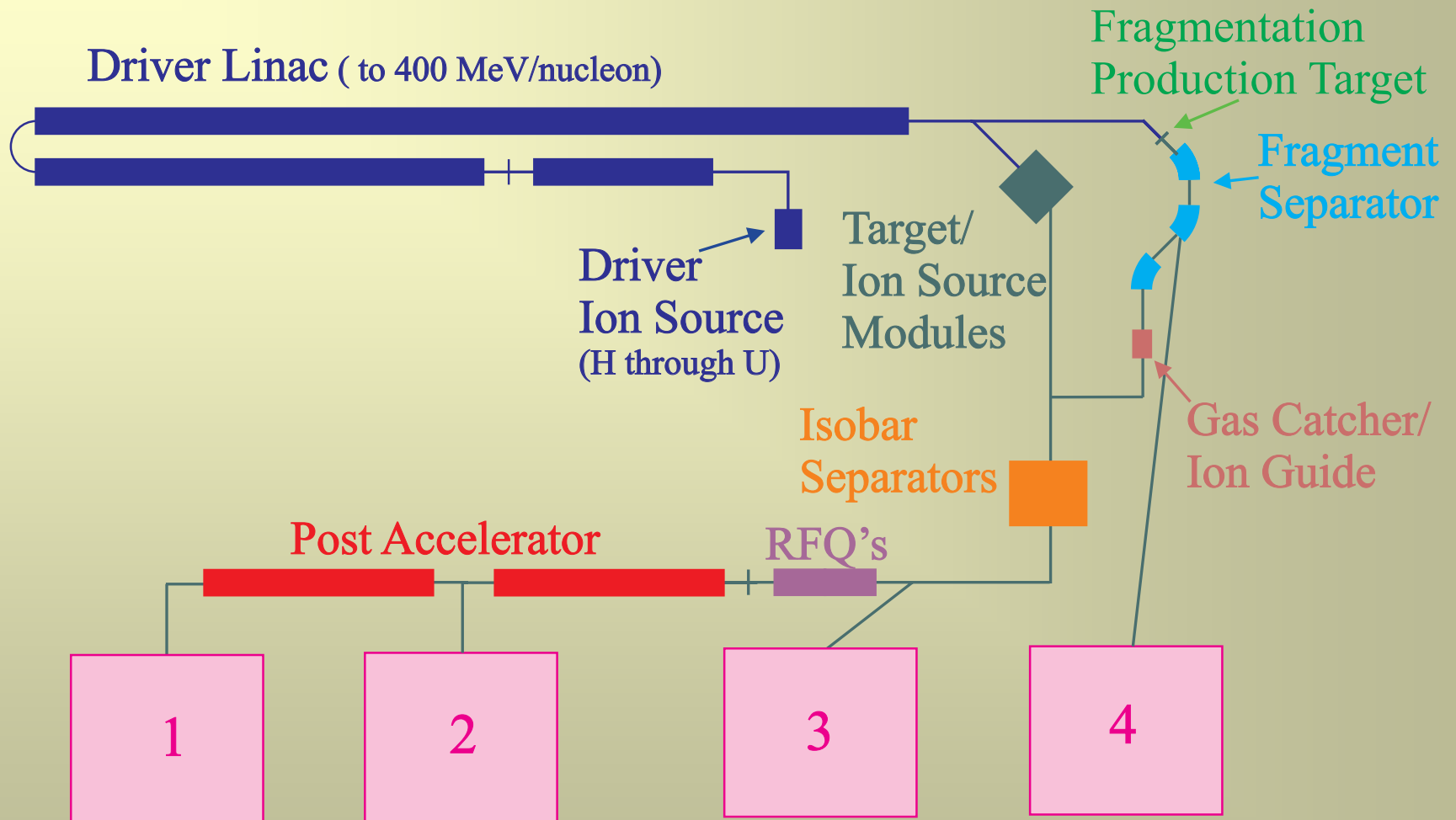
with the lifetime of the ions

Pascal Sortais

# Possible sites for EURISOL



# RIA Layout



Experimental Areas:

1:  $< 12$  MeV/u    2:  $< 1.5$  MeV/u    3: Nonaccelerated    4: In-flight fragments

*Peter Butler (CERN & Liverpool)*

**JOINT UK Nuclear and Particle Physics meeting on the beta-beam 17-18 Jan 2005**