

The future of nuclear physics in Europe: new facilities and new funding

Brian Fulton
Chair of NuPECC
(University of York)

NuPECC – what it is and how it operates
European Funding – explaining the acronyms
International Aspects – IUPAP and OECD initiatives
Present work and Future plans in Europe

By the end of the talk I hope you will:

Understand what is driving the increasing collaboration between groups and the closer networking of facilities that is occurring in Europe – if you work with European groups, this may impact on you

Have learned about the new facilities and instruments emerging in Europe so you can judge how these relate to US plans

Have got a glimpse of where the growth areas of research are in Europe so you can explore synergies with US goals.

Have increased your acronym knowledge considerably!

CAUTION

Europe is a broad canvas and we can only get a
glimpse of the full picture

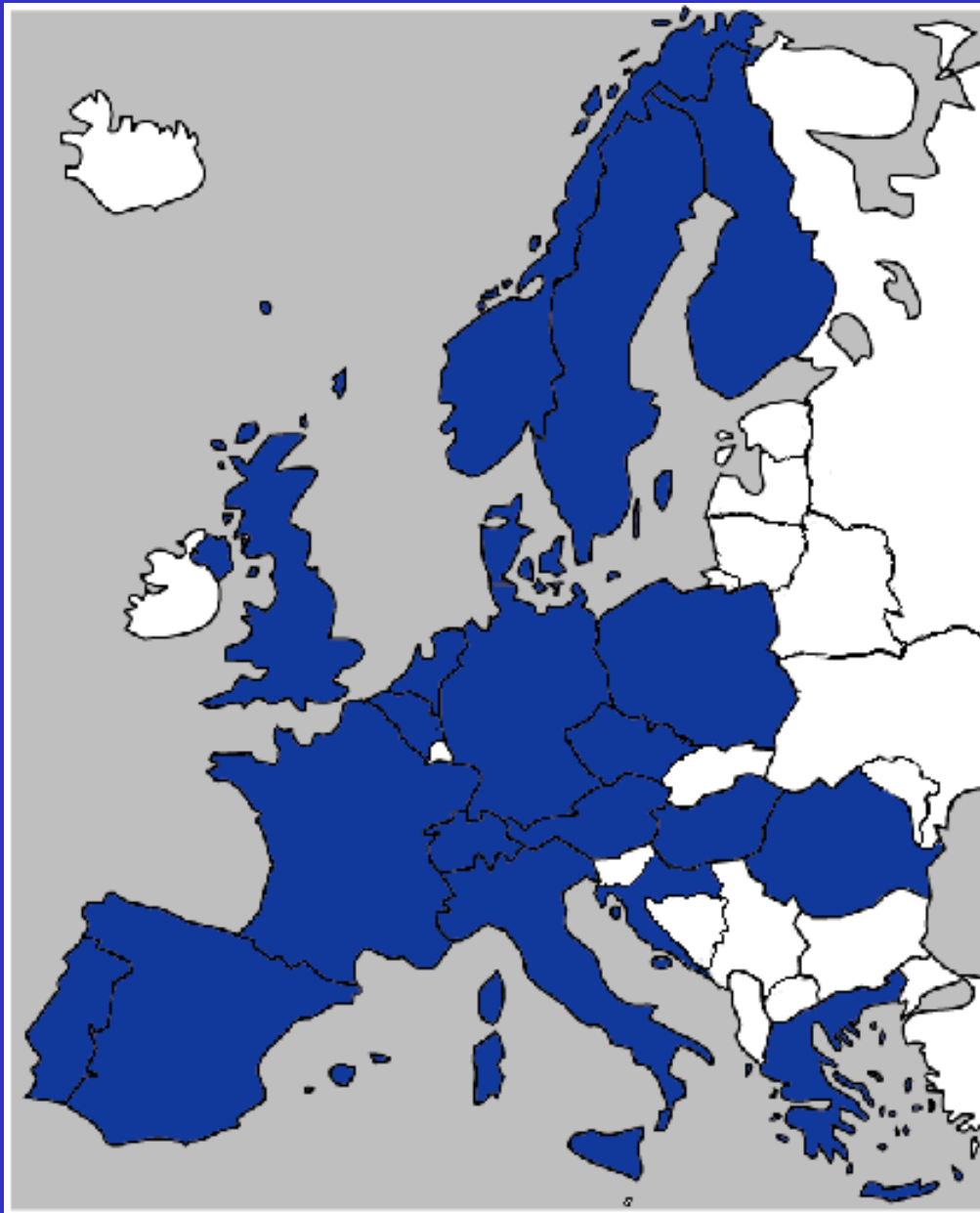
What NuPECC is (and is not)

NuPECC (Nuclear Physics European Collaboration Committee) is an Expert Committee of the European Science Foundation

It is funded by subscribing national funding agencies who nominate expert scientists as representatives (usual period is three years)

The objective of NuPECC is:

“To strengthen European collaboration in nuclear science through the promotion of nuclear physics and its trans-disciplinary use and application in collaborative ventures between research groups within Europe and particularly those from countries linked to the ESF”



Currently 28 members from 23 countries.
Croatia and Rumania in process of joining.

NuPECC is NOT

A body which dictates national policies – although national funding agencies take account of NuPECC recommendations

A body which dictates European policy – although it acts closely with the European Commission

A body which reacts to specific charges – NuPECC decides on its own agenda and actions

NuPECC strives to maintain its independence and to maintain the trust of the community it serves

How NuPECC operates

The committee (28 members) meets three times each year.

Meetings are hosted in turn by each country and start with a half day presentation on nuclear science activities in that country (this enables NuPECC members to keep up to date with developments)

A chair is elected to serve for three years

A scientific secretary (Sissy Koerner) looks after the administration and maintains the website (<http://www.nupecc.org>)

Working groups are established as required, e.g. for

Preparing reports (see later)

Meeting with other organisations

Community “Town Meetings” are organised when issues of particular importance are being considered (e.g. Forward Looks)

The chair, or nominated member, represents NuPECC on various related bodies (e.g. Governing Boards of ECT* and I3HP, NSAC, ESFRI, IUPAP, ECFA etc.)

NuPECC reports + publications

For full list see the website <http://www.nupecc.org>

Nuclear Physics News

Four issues per Year

Regular journal with a circulation of 6,000 throughout Europe, North America and Japan.

Long Range Plans

Approximately 5 year intervals

Come back to this later

Hand book for facility access

Every 3-4 years

A full listing of all accelerator facilities in Europe with details of beams, experimental facilities, PAC arrangements and contact details. Also the contact details for all nuclear physics groups in European labs, institutes and universities

Topical Reports

As opportunities arise

Radioactive Beam Facilities (2000)

Computational Nuclear Physics (2000)

ELFE Physics Motivations (2001)

Impact, Applications, Interactions of Nuclear Science (2002)

High Intensity Stable Beam Physics (in preparation)

Survey of Resources

5-6 year period

A survey of the resources (personnel and finance) by country and by sub-area. First report 1997 and a revision in progress.

Brochures

For the non-specialist

Radioactive Beams (2000)

Nature at the Femtoscale (joint with FINUPHY) (2003)

Outreach activities

PANS (Public Awareness of Nuclear Science)

<http://www.nupec.org/pans>

NUPEX (Nuclear Physics Experience)

<http://www.nupex.org>

Long Range Plan (2004)

Expert groups set up for six key subfields (December 2001)

Quantum chromodynamics

Phases of nuclear matter

Nuclear structure

Nuclei in the universe

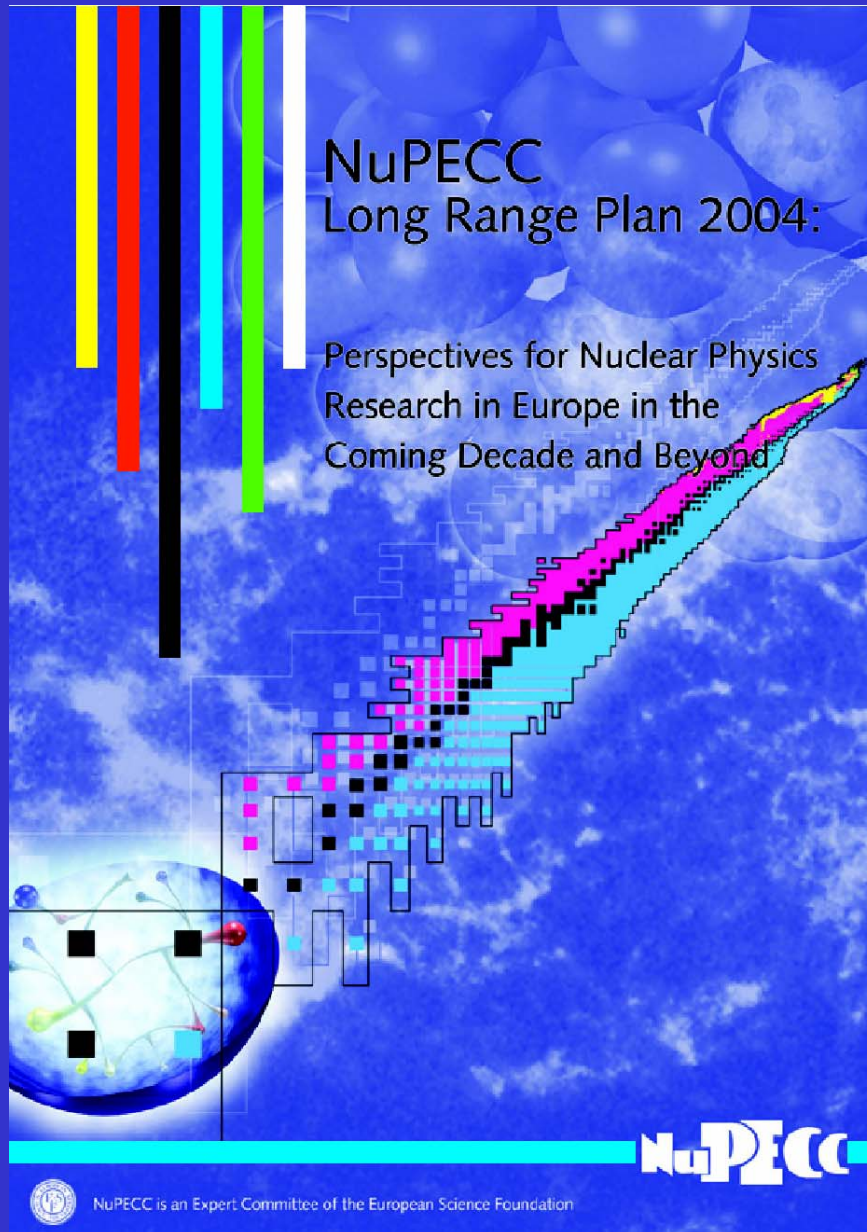
Fundamental interactions

Applications of nuclear science

WG's organised workshops to discuss their initial ideas (2002)

NuPECC formulated draft based on this input

Draft discussed at Town Meeting in Darmstadt (January 2003)



Copies available from
Sissy Koerner or download
(<http://www.nupecc.org>)

Recommendations from the LRP relevant to new facility construction

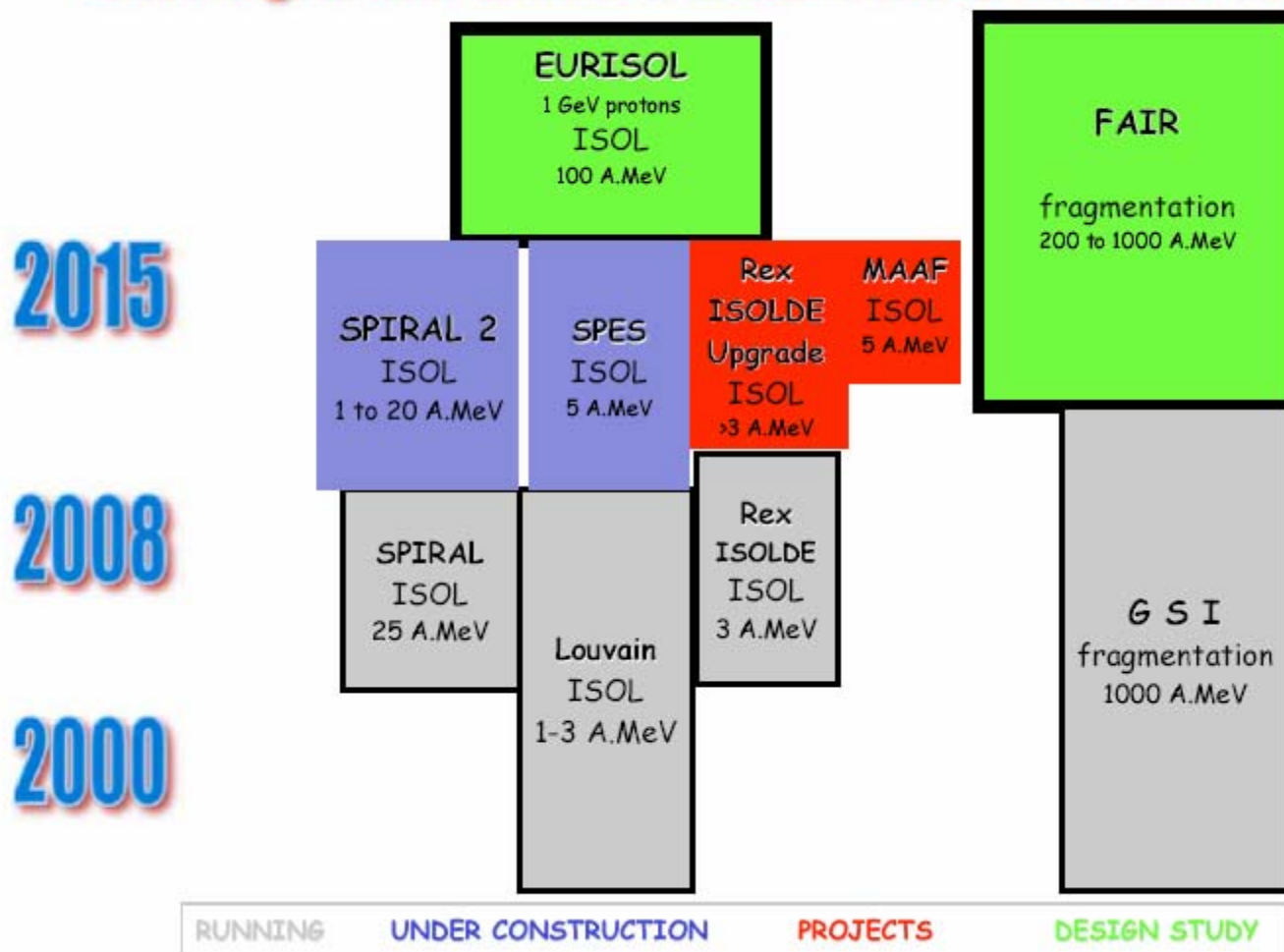
It is important to note that the LRP looks at all aspects of the support required for nuclear science in Europe.

New facilities are just a part of this.

The Long Range Plan identifies the top priority for Europe facility development as being in the rapidly growing area of radioactive beam research

NuPECC's vision, first articulated in the "Working Group on Radioactive Beam Facilities (2000)" is for two flagship RBF facilities in Europe, based on the complimentary approaches of ISOL and Fragmentation production. For the last six years, European physicists have been working to realise this goal

European RNB Facilities Road Map



NuPECC recommends as the highest priority for a new construction project the building of the international “Facility for Antiproton and Ion Research (FAIR)” at the GSI, Darmstadt.

After FAIR, NuPECC recommends the highest priority for the construction of EURISOL.

Because of the long time-line for EURISOL, NuPECC recommends the construction of intermediate-generation facilities that will benefit the EURISOL project in terms of R&D and will give the community opportunity to perform research and applications with RIBs of the ISOL scheme. NuPECC recommends to pursue the ongoing French project SPIRAL2 (Système de Production d’Ions Radioactifs Accélérés en Ligne 2) at GANIL, Caen, and the Italian project SPES (Study and Production of Exotic nuclear Species) at Legnaro, as well as the further upgrade of REX-ISOLDE (High Intensity and Energy ISOLDE “HIE-ISOLDE”) at CERN and the very specialised project MAFF (München Accelerator for Fission Fragments) at the new research reactor in Garching near München.

Since EURISOL will use a high-power (several MW) proton/deuteron accelerator which could benefit many other possible projects (e.g. neutrino factory), NuPECC recommends joining efforts with other interested communities to do the R&D and design work necessary to realise the high-power p/d driver in the near future

A personal view:

There is an immense amount of work to do in this area and in the associated aspects of target development. It seems to me that this should be coordinated on a World scale.

See later comments on International Issues

Targets and Ion Sources

A final note

Next year it is intended NuPECC will begin the process of developing the next Long Range Plan for European Nuclear Science

New projects are emerging which may have reached sufficient maturity and have developed strong enough science cases to feature in this:

DAPHNE-2

ECOS (High intensity stable beams)

Electron-hadron collider?

PART 2 Funding for Research in Europe

The important point to remember is that well over 90% of funding for research comes through national research funding bodies

However.....

1. The national funding bodies increasingly look to follow a European agenda in each research area
2. Large scale facilities are increasingly considered on a European basis
3. Although small, with effective direction the EU central funding can have a major impact in a field

European Union Funding

If you think the DoE/NSF funding rules are complex,
you can't begin to comprehend the European
Commission approach!

Framework programmes (FP)

Research funding is allocated in 3-4 year periods called Framework Programmes. We have just started FP7. *There has been little budgetary or time continuity between them*

Instruments

Within each FP, funds are divided amongst different Instrument each of which is designed to achieve some aspect of EU policy. *These change from FP to FP as political fashions change.*

Contracts

Unfortunately the EC doesn't award grants, but issues contracts. These are complex legal agreements with rigorous financial reporting controls. *A nightmare to administer*

Fortunately, the NP community has been fast to master these

NuPECC interaction with the European Commission

Although there is no formal link, NuPECC enjoys a good relationship with the European Commission DG XII (Directorate-General for Research)

FINA (Nuclear Physics collaboration in FP4)

FINUPHY (Nuclear Physics collaboration in FP5)

Developing bids for FP6 (EURONS, I3HP, EURISOL Design Study) worth ~€50M

Discussion on collaborations for FP7

Working with ESFRI (SPIRAL 2 and FAIR)

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Developing bids for FP6 (**EURONS, I3HP, EURISOL** Design Study) worth ~€50M

Discussion on collaborations for FP7 (**NuPNET**)

Working with ESFRI (**SPIRAL 2** and **FAIR**)

ESFRI (European Strategic Forum for Research Infrastructures)

New body established by the Commission to advise them on the need for large scale facilities in Europe

(NB Considers ALL research activities – not just science)



Roadmap for Construction of Nuclear Physics Research Infrastructures in Europe

In order to provide input to the European Commission and the European funding agencies for developing the roadmap for new research infrastructures in Europe for the next 10 to 20 years, NuPECC briefly presents in the following its Long-Range Plan 2004 (LRP2004). In this LRP2004, “Perspectives for Nuclear Physics Research in Europe in the Coming Decade and Beyond”, NuPECC makes recommendations and sets priorities for nuclear physics research in Europe.

NuPECC Roadmap for Construction of Nuclear Physics
Research Infrastructures in Europe (2005)

http://www.nupecc.org/pub/NuPECC_Roadmap.pdf

ESFRI produced its first “Roadmap” last year which listed 34 major facilities required in Europe – of those, two (SPIRAL2 and FAIR) were nuclear physics facilities.

<http://cordis.europa.eu/esfri/roadmap.htm>

Important politically, but also financially as FP7 has a new instrument for funding facility construction, but only open to facilities on the ESFRI Roadmap.

PART 3 International issues

Two developments in which NuPECC is involved:

The OECD Global Science Forum, at the instigation of the USA (Denis Kovar, DoE), have established a “Working group on Nuclear Physics”

Denis Kovar (Chair) and Bob Tribble

The IUPAP have established WG9 “Committee on International Collaboration in Nuclear Physics

Tony Thomas (Chair)

Actions: Personnel survey/Facility survey/Science survey

Outcomes: ??????

Targets and Ion Sources
Electron-Hadron collider

CAUTION

NuPECC considers that initiatives like the GSF play an important role in coordinating nuclear science on the world scene.

However.....

.....like any other area of scientific endeavour (astronomy, neutron science, synchrotron research, plasma research etc.) nuclear physics needs a coherent network ranging from equipment development facilities in universities, small-scale accelerators in universities or institutes, medium scale facilities in national laboratories as well as the few “flagship” facilities of international scale.

PART 4 Present work and Future plans

The present

EURONS and I3HP

The near future

NuPNET
FAIR and SPIRAL 2

The far future

EURISOL

THE PRESENT

EURONS (EUROpean Nuclear Structure)



This is an I3 (Integrated Infrastructure Initiative)

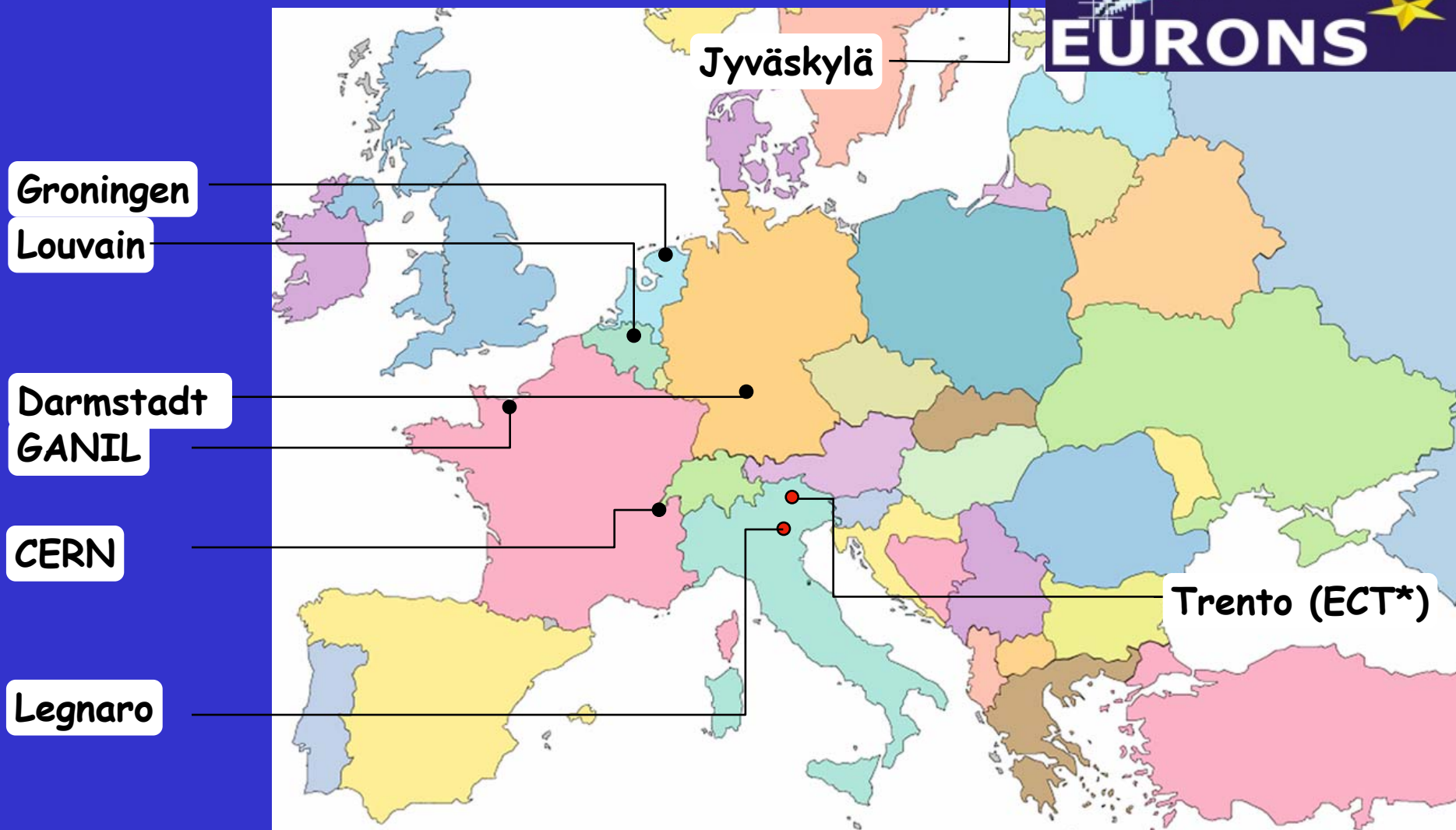
Funding: €14.056M

Involves 44 institutes in 21 countries

Facility access (8)
Joint Research Projects (11)
Networks (8)

<http://www.gsi.de/informationen/jofu/EURONS/>

Facility Access



2005 – 101 experiments supported for 590 users

Joint Research Projects



ACTAR	H.Savajols	GANIL		
ACtive TARget detectors for the study of extremely exotic nuclei using direct reactions				
AGATA	W.Korten	CEA Saclay		
Advanced GAMMA Tracking Array				
Charge Breeding	O.Kester	LMU Munic		
Advanced charge breeding of radioactive ions				
DLEP	O. Tengblad	CISC Madrid		
Detection of Low-Energy Particles from exotic β -decays				
EXL	N.Kalantar	KVI		
EXotic nuclei studied with Light hadronic probes				
INTAG	P.Butler	Univ. Liverpool		
INstrumentation for TAGing				
ISIBHI	G. Ciavola	LNS Catania		
Ion Sources for Intense Beams of Heavy Ions				
LASER	P.Van Duppen	Univ. Leuven		
LASer techniques for Exotic nuclei Research				
RHIB	T.Aumann	GSI		
Reactions with High-Intensity Beams of exotic nuclei				
SAFERIB	P.Thirolf	LMU Munic		
Radiation protection issues related to radioactive ion-beam facilities				
TRAPSPEC	N.Severijns	Univ. Leuven		
Improvements and developments of ion traps, spectrometers, and detectors for low-e. nucl. physics experiments				
EU contribution:	6.010 M€			

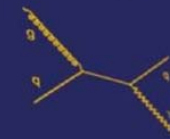
Networks



Network name	Goal	Coordinator	Institute
MANET	Management of EURONS	Alex C. Mueller	IPN Orsay (CNRS/IN2P3) and GSI Darmstadt
CARINA	Nuclear Astrophysics	Carmen Angulo	CRC, Louvain-la-Neuve
GAMMAPOOL	Gamma resources in Europe	Silvia Lenzi	INFN Padova
NEEN	North-East European Network	Rafal Broda	Univ. Warsaw / Krakow
Mapping	NuPECC mapping studies	Sissy Körner	NuPECC
PANSI3	Public Awareness of Nucl.Sci.	Helmut Leeb	TU Vienna
SEEN	South-East-European Network	Sotirios Harissopulo	NCSR Demokritos / Athens
SHE	Superheavy elements	Antonio Villari	GANIL
TNET	Theory Network	Ian Thomson	Univ. Surrey
		Sum	1.456 M€

I3HP (I3 Hadron Physics)

HadronPhysics I3



Study of Strongly Interacting Matter

This is an I3 (Integrated Infrastructure Initiative)

Funding: €17.400M

Involves 70 institutes and 2,000+ scientists

Facility access (9)

Joint Research Projects (12)

Networks (7)

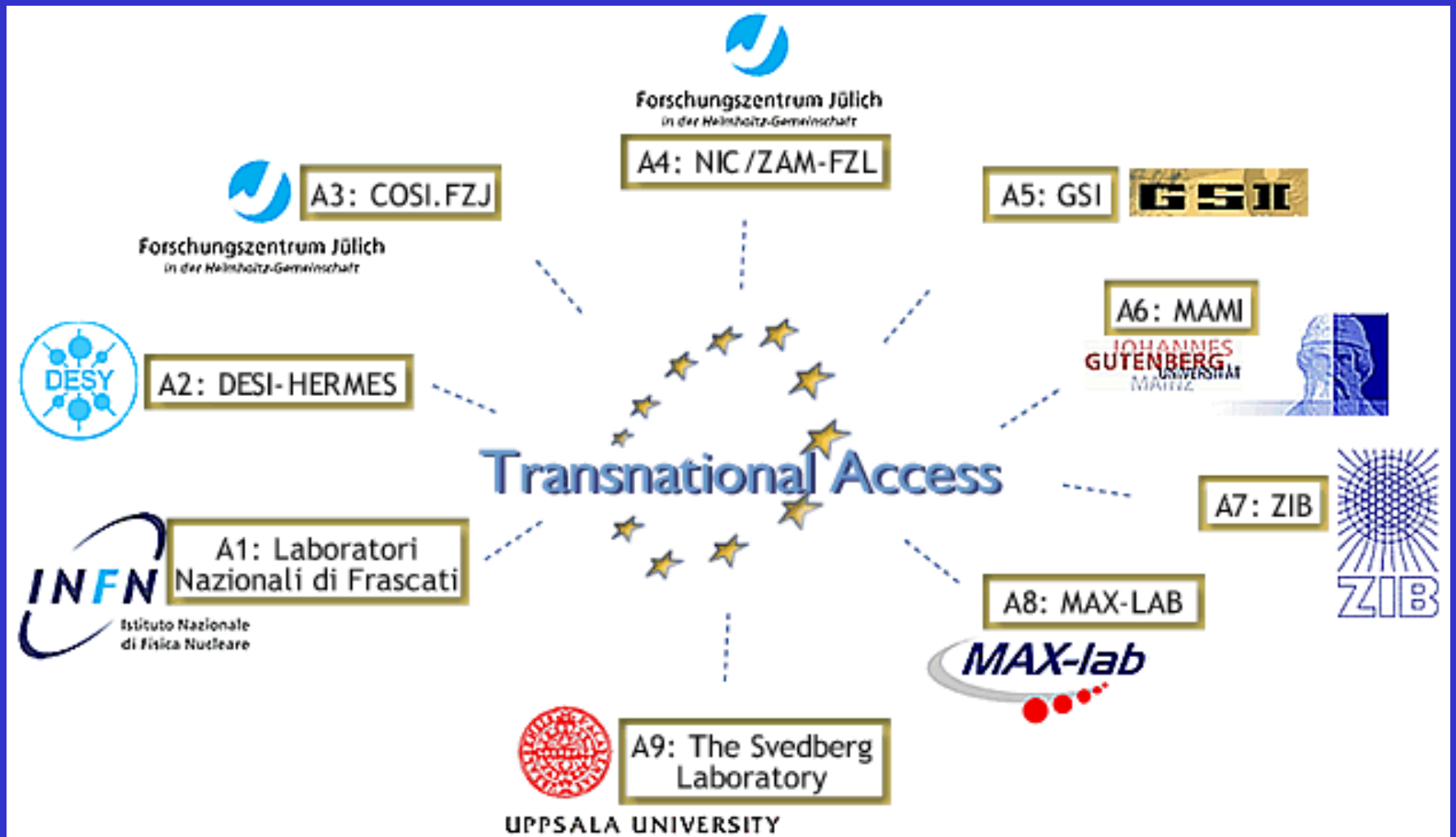
<http://hadronphysics.infn.it/>

Facility Access

HadronPhysics I3



Study of Strongly Interacting Matter



Joint Research Projects

HadronPhysics I3



Study of Strongly Interacting Matter



EuroTag

JRA3: European tagged photos facilities

FastEM Calorimeters

JRA2: Fast compact EM calorimeters and high power lasers

Gas Detectors



JRA4: High speed gas detectors with integrated electronics



GPD

JRA5: Generalized parton



HyperGamma

JRA6: High luminosity hypernuclear gamma-spectroscopy



FutureDAQ

JRA1: Future data acquisition system

Advanced TOF



JRA12: Advanced TOF detection system

Joint Research Activities



NoRHDia

JRA11: Novel Radiation Hard CVD-Diamond Detectors

Internal Target



JRA7: High luminosity internal targets for storage rings



SIDDHARTA

JRA10: Silicon drift detectors for X-ray spectroscopy



Polarized Targets

JRA8: Polarized nucleon targets for Europe

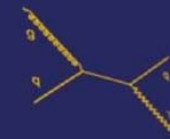


RICH Detectors

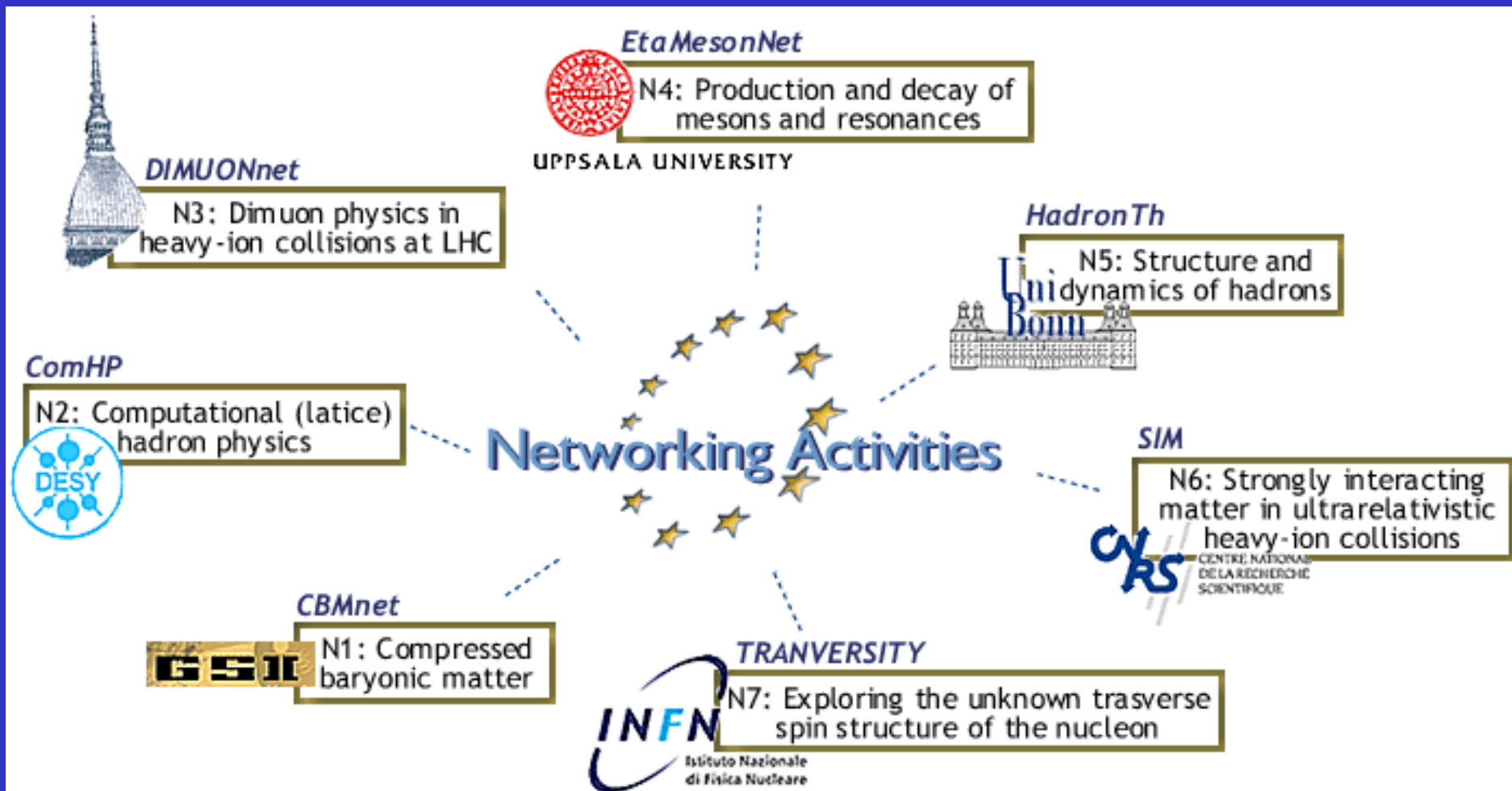
JRA9: Ring imaging Cherenkov counters for particle identification

Networks

HadronPhysics I3



Study of Strongly Interacting Matter



THE NEAR FUTURE

Ongoing operation of existing facilities

Follow-up's to EURONS and I3HP being prepared – include development of facilities (e.g. high intensity sources, targets for intense beams, faster digital readout etc.) plus new instruments (e.g. AGATA). (FP7 Bid for I3 Funds)

Construction of new facilities

SPIRAL2 and FAIR (FP7 Bid for Construction Funds)

Better coordination between Funding Agencies

NuPNET - Nuclear Physics Network (FP7 Bid for ERANET)

Take EURISOL to next stage

Complete Design Study and get into ESFRI Roadmap

Planning for the future

Next NuPECC LRP

NuPNET

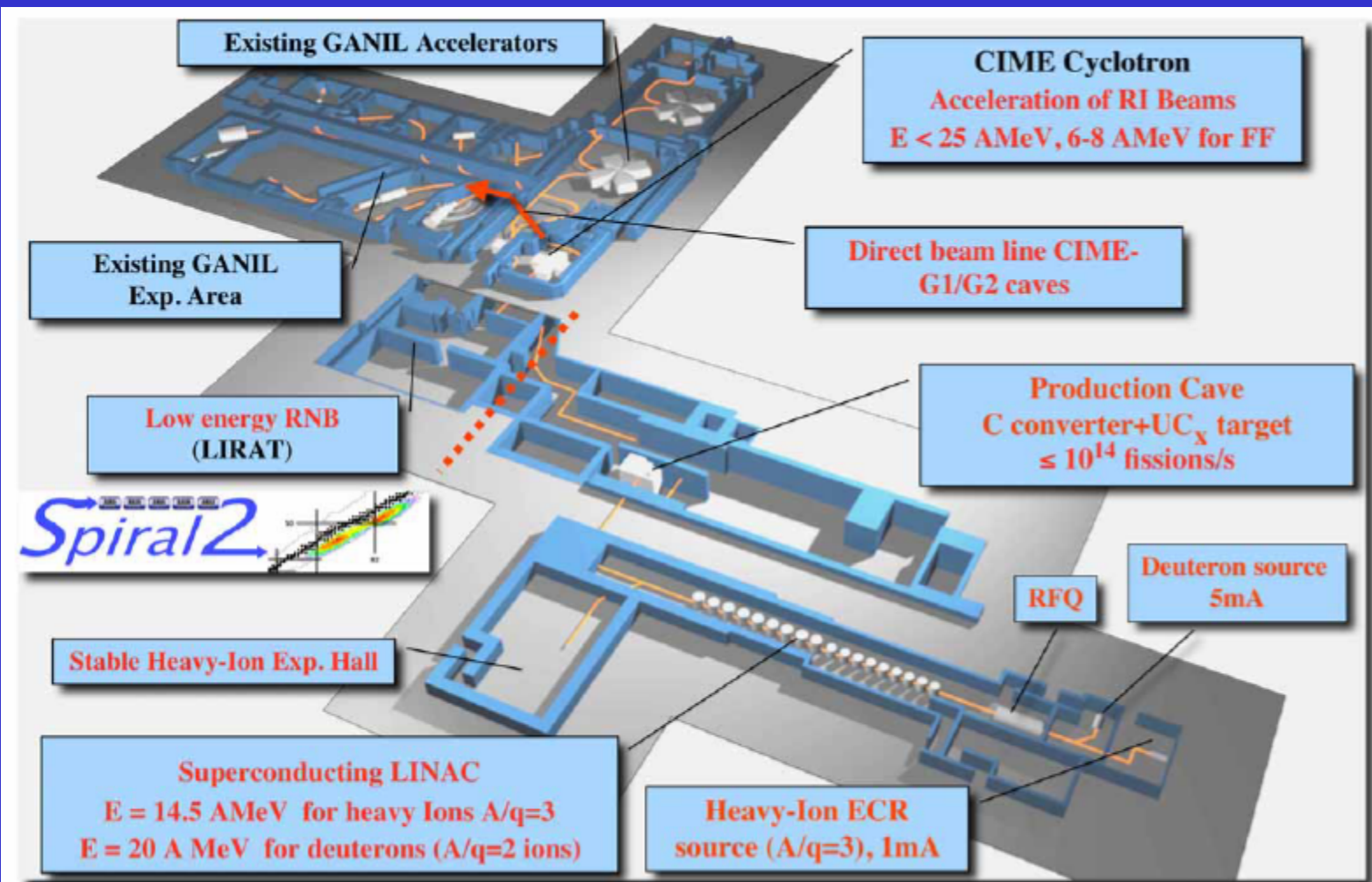
An application is being made for an ERANET in Nuclear Physics (NuPNET)

ERANET's are FP funded and bring together the different national funding agencies in a forum where they can discuss how to coordinate and fund particular areas of science.

A number were established in FP6 and have been judged to have been very successful – hence we will apply for one in FP7

Could solve the problem of coordinating the funding for projects like AGATA

SPIRAL-2






Regions of the Chart of Nuclei Accessible with SPIRAL 2 Beams

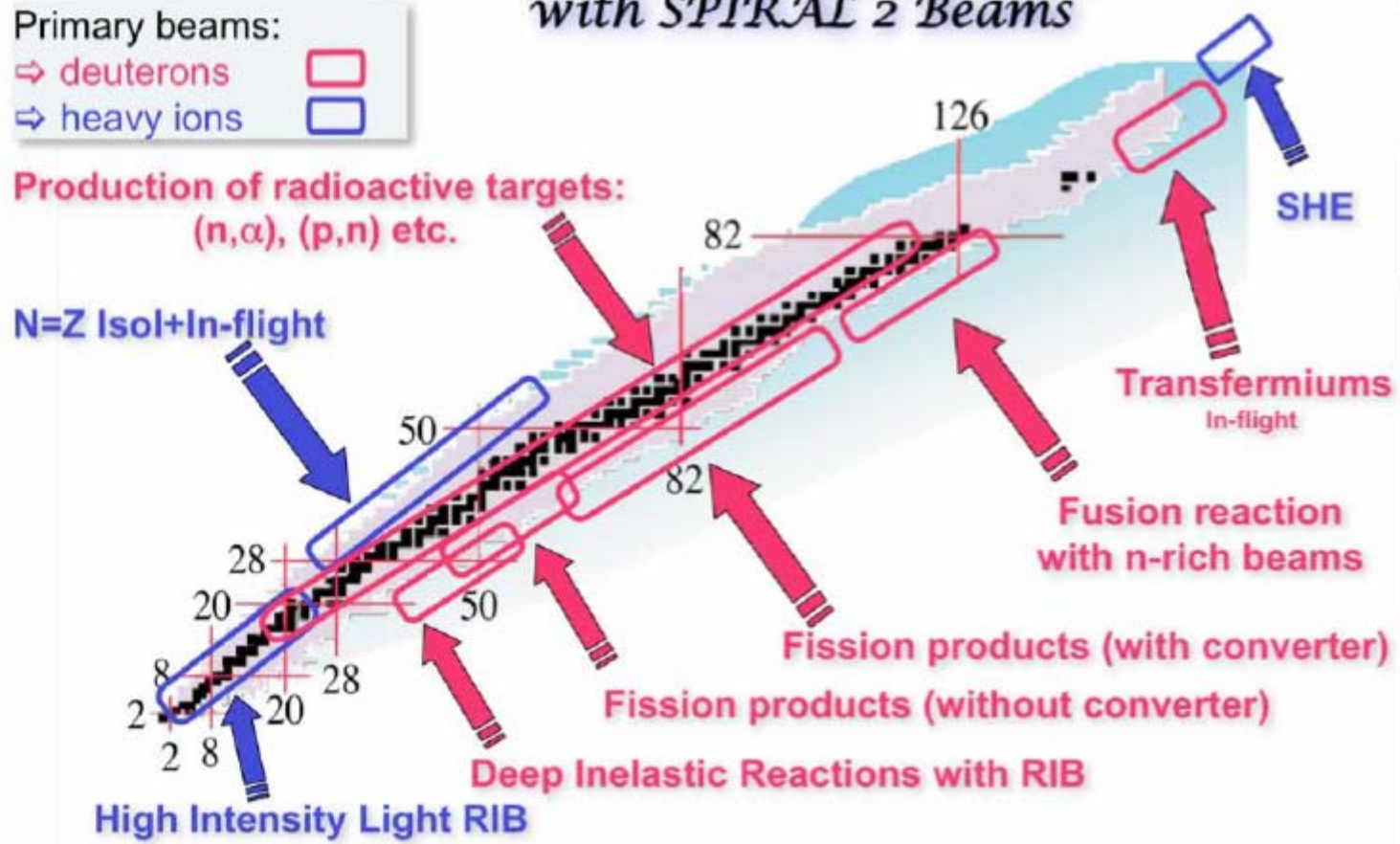
Primary beams:

⇒ deuterons 

⇒ heavy ions 

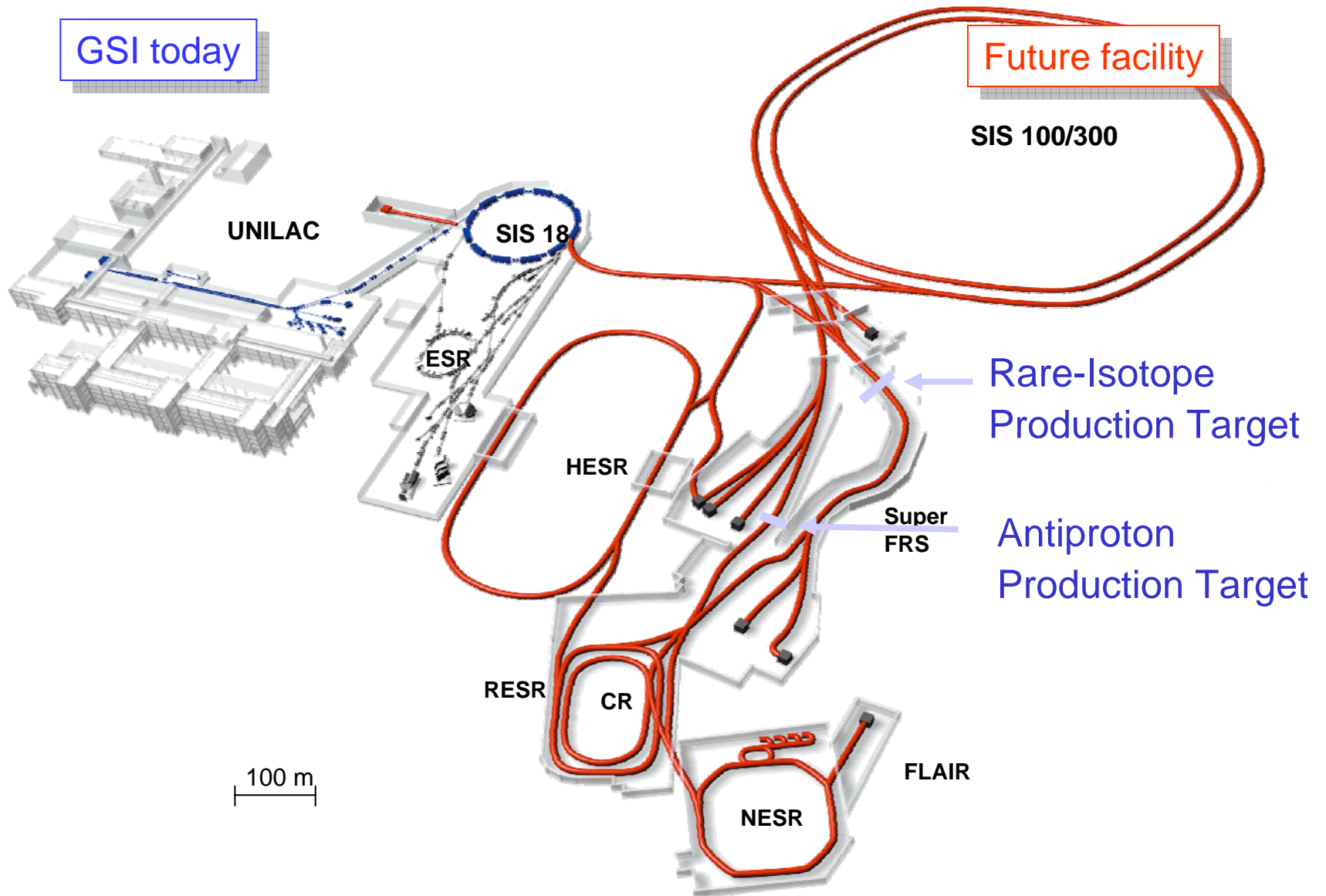
Production of radioactive targets:
(n,α), (p,n) etc.

N=Z Isol+In-flight

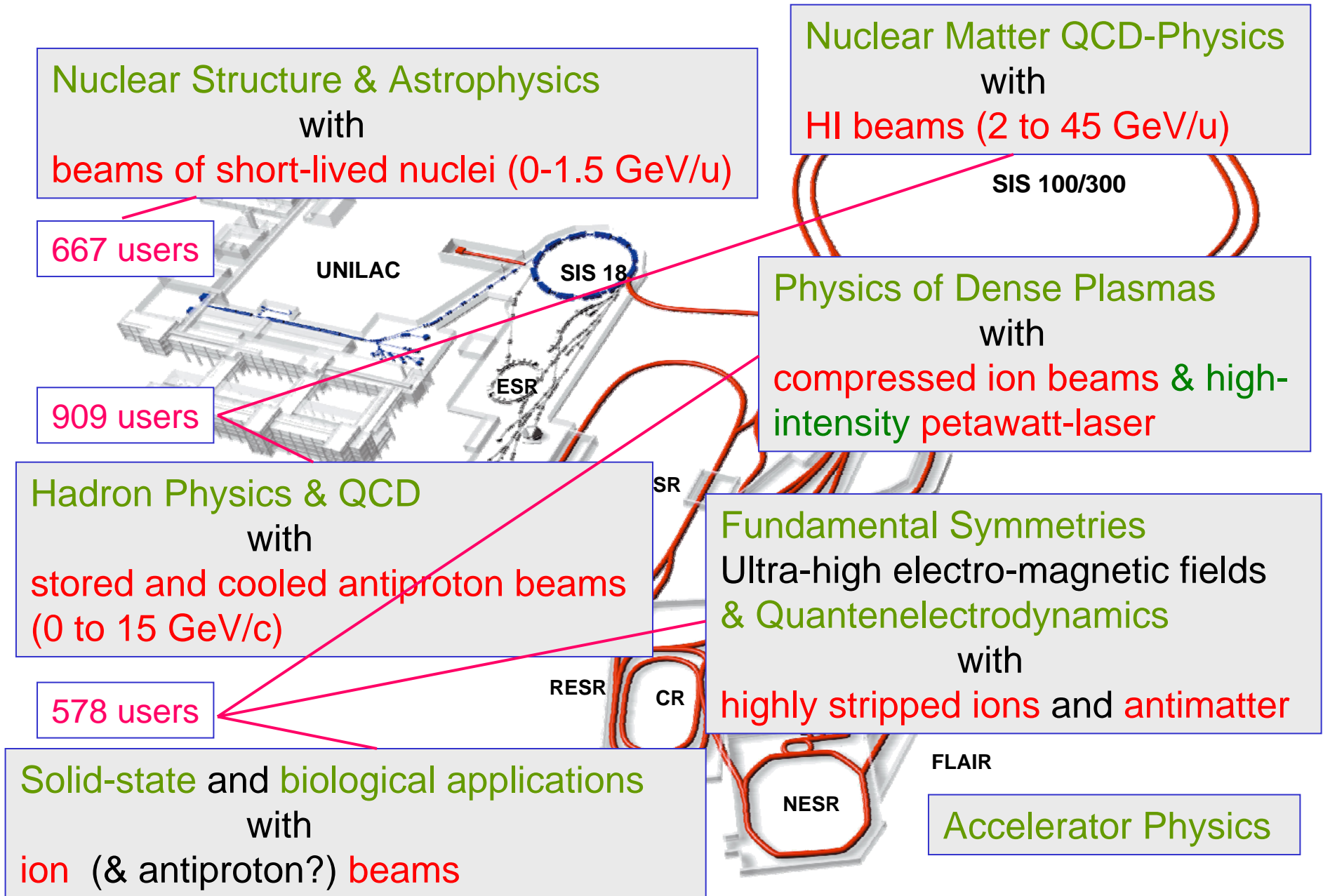


High Intensity Light RIB

FAIR - Facility for Antiproton and Ion Research



Fields of Research at FAIR



Nuclear Structure & Astrophysics
with
beams of short-lived nuclei (0-1.5 GeV/u)

667 users

909 users

Hadron Physics & QCD
with
stored and cooled antiproton beams
(0 to 15 GeV/c)

578 users

Solid-state and biological applications
with
ion (& antiproton?) beams

Nuclear Matter QCD-Physics
with
HI beams (2 to 45 GeV/u)

Physics of Dense Plasmas
with
compressed ion beams & high-
intensity petawatt-laser

Fundamental Symmetries
Ultra-high electro-magnetic fields
& Quantenelectrodynamics
with
highly stripped ions and antimatter

Accelerator Physics

UNILAC

SIS 18

ESR

SR

RESR

CR

NESR

FLAIR

SIS 100/300

THE FAR FUTURE

EURISOL

2000-2003

EURISOL Feasibility Study (FP5)

Final report published 2004

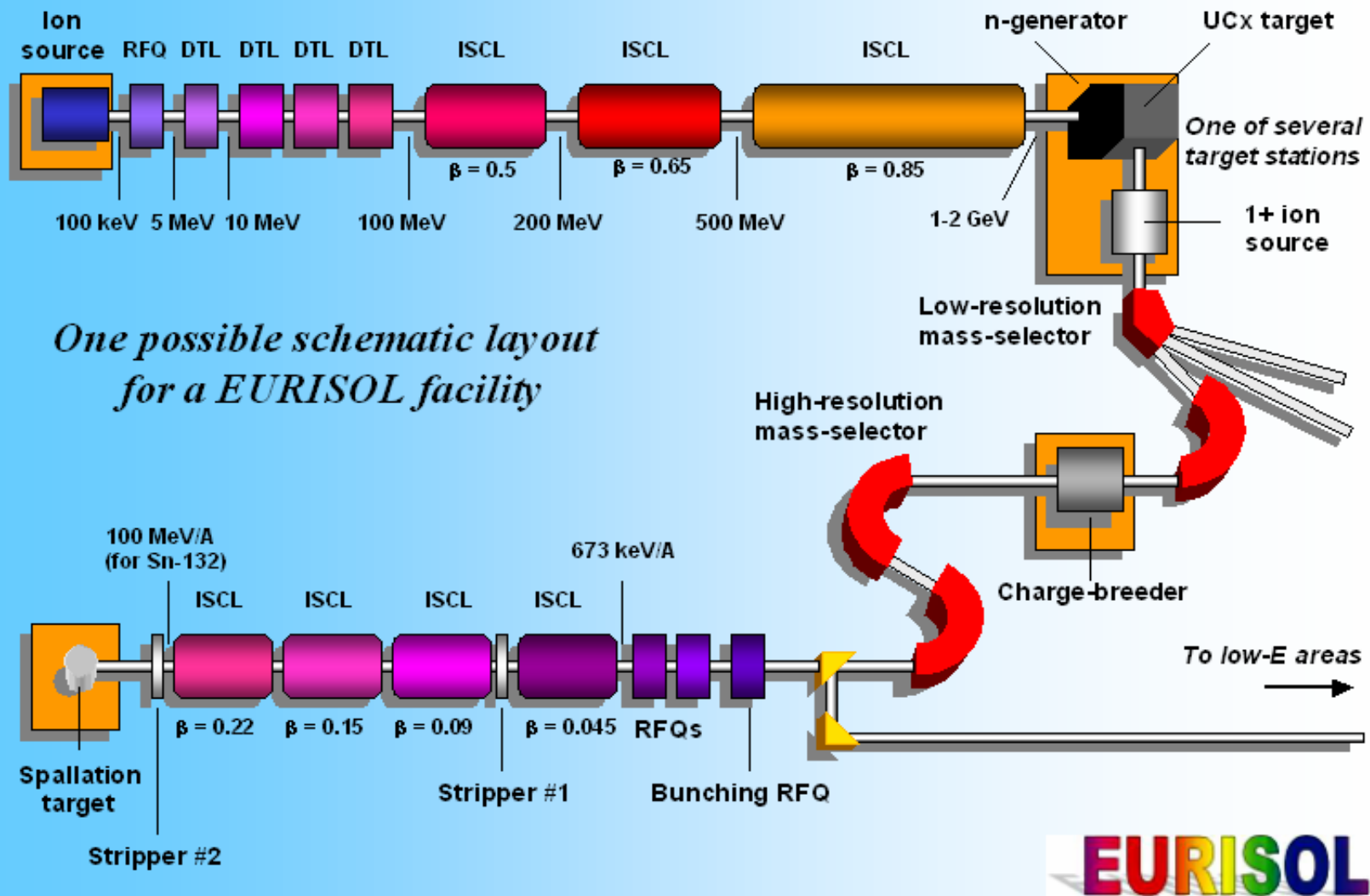
<http://www.ganil.fr/eurisol>

2005-2009

EURISOL Design Study (€9.2M)(FP7)

Engineering studies and technical prototyping

<http://www.eurisol.org>



4 TOPIC AREAS

EURISOL DS MANAGEMENT (GANIL/INFN-LNL/CNRS-IN2P3/CERN)

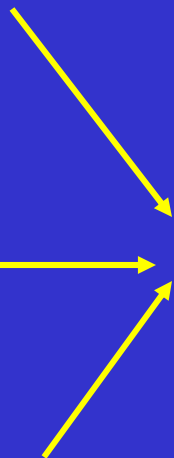
- 1 **Targets and ion sources** (*Synergies with neutron spallation sources and neutrino facilities*)
 - Multi-MW target station : liquid- mercury converter (CERN)
 - Direct target : Several target-ion source systems (CERN)
 - Fission target : UC_x target optimization (INFN-LNL)
- 2 **Accelerators** (*Synergies with HIPPI (CARE)*)
 - Proton accelerator design: the driver (INFN-LNL):
 - Heavy ion accelerator design: the post accelerator (GANIL)
 - SC cavity development: cavity prototypes and multipurpose cryomodule (CNRS-IN2P3/IPNO)
- 3 **Physics, beams and safety** (*Synergies with EURONS*)
 - Physics and instrumentation: conceptual design of novel instruments (U-LIVERPOOL)
 - Beam intensity calculations: yield optimization of RIB species (GSI)
 - Safety and radioprotection: radiation fields, activation, shielding, handling, storage, conformity to legislation (CEA)
- 4 **Beta-Beams Aspects** (*Synergies with BENE (CARE), EURONS*)
 - Beam preparation : breeders, 60 GHz ECR source (JYV)
 - Beta-beam aspects: conceptual design report of the Beta-Beam facility. It includes preliminary studies on modifications of CERN accelerators in case the facility is sited at CERN (CERN)

CONCLUSIONS

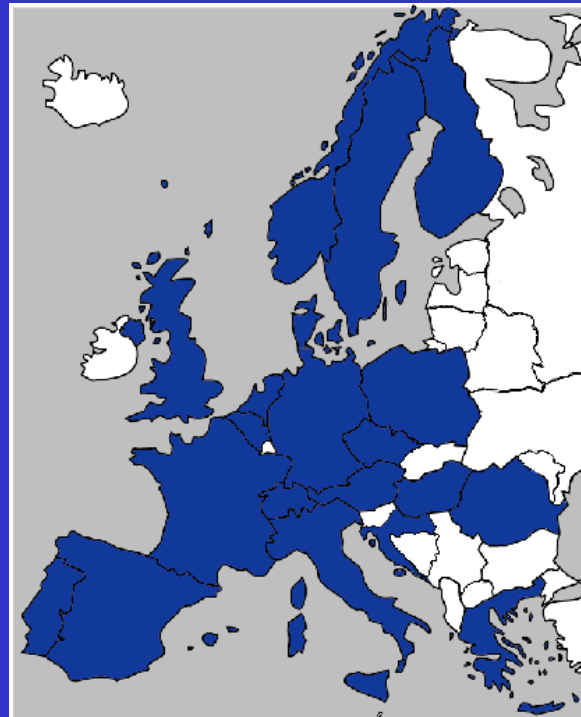
**National
Agencies**

EU

**User
Community**



NuPECC



**== Bright
== Future**