



# ISOLDE in ERINS, EURISOL-DF and ESPP

March 19, 2019

Gerda Neyens



# ERINS

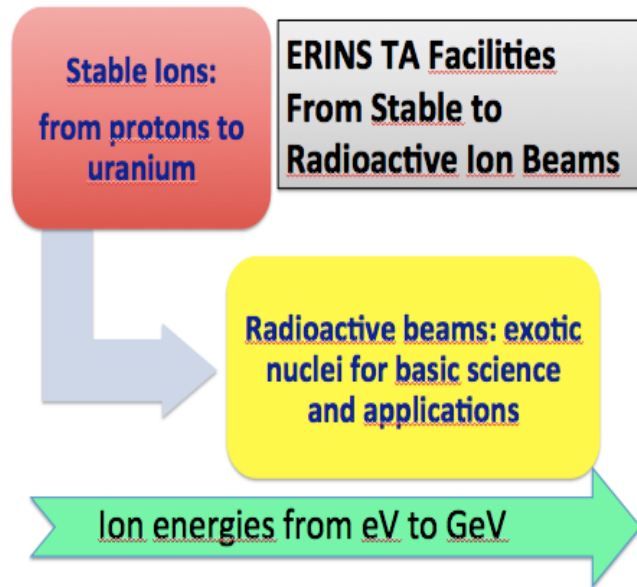
**The IA**



**European Research  
Infrastructures  
for Nuclear Science**

COORDINATOR: ANGELA BRACCO (INFN)  
Funding request: 10 MEuro

# ERINS: Transnational Access

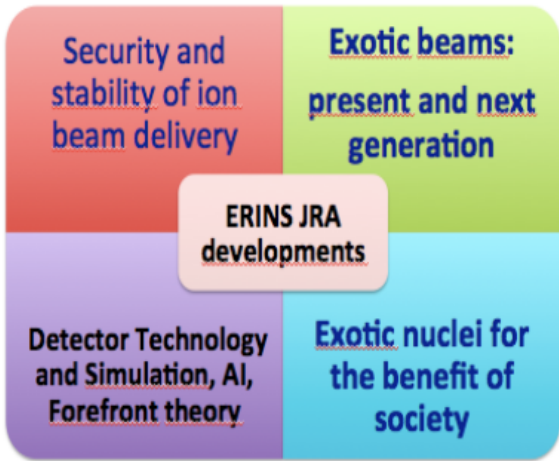


## 10 Facilities / Consortia

- Joint ALTO (F)/GANIL-SPIRAL2
  - CERN-ISOLDE (CH)
  - GSI (D)
  - JYFL (FI)
  - KVI-CART (NL)
  - joint LNL-LNS (I)
  - ECT\* (I)
  - joint NLC (PL)
  - joint IFIN-HH/ELI-NP(RO)
- and *new a joint multi-national facility* denoted as DSD (HU,ES,GR).

5 Meuro (750 kEuro for ISOLDE)

# ERINS: 9 Joint Research Activities



**IBIS** developments of ion sources and innovative cryogenic model-based controls

**ASTEX** o increase of the performance of gas cells for both the IFF and ISOL production methods

**App4RIB** will make developments for beam purification

**ASPHODEL** to lead cutting-edge R&D for EURISOL

**DETNA** : technological developments for several detector areas

**MANI** is focused on development of methods to perform test measurements of cross sections of nuclear reactions in laser-induced plasmas

**CEANN** : artificial neural networks and machine learning procedures in different experimental analysis

**FIS-NN** focuses on providing new insight into the microscopic nature of the nuclear force that underlies the structure of nuclei

**LIONESS** laser-based techniques and their application in medical and environmental-based science in the actinides and lanthanides.

**MAIA** production of radioisotopes for medical applications.

# ERINS: 6 Network Activities

ERINS  
NA

Strengthening links in nuclear structure, reactions and astrophysics

Preparation of scientific programs for future facilities

Exploiting cutting-edge research in applications

**EuPhyINN** reflects the growing need for specific nuclear structure studies connected to the field of neutrino, astro- and dark-matter physics.

**RADPROBE** intends to better exploit the available radioactive ions for condensed matter, materials science and biophysics research

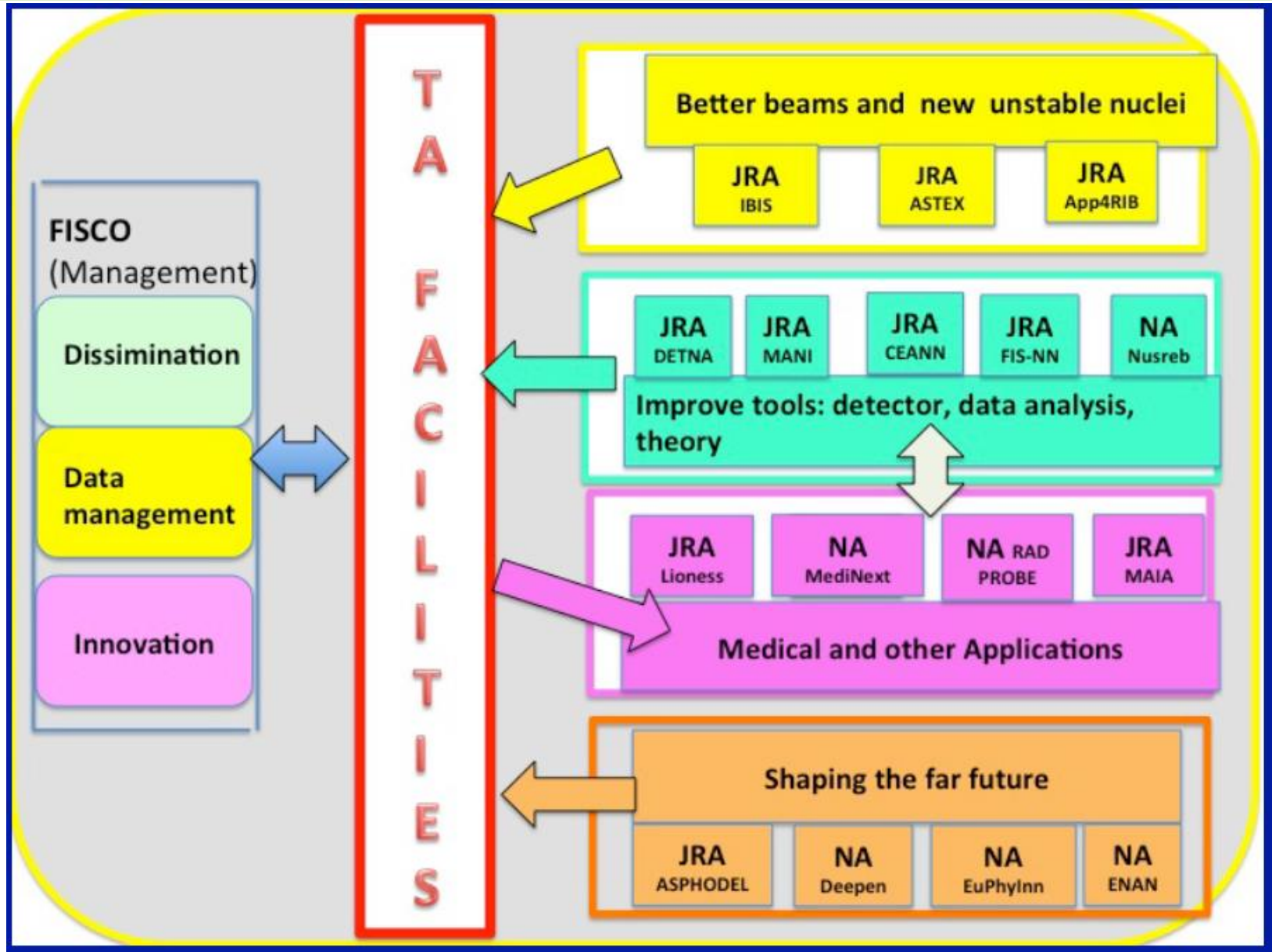
**MediNeXt** focuses on the implications of next-generation particle accelerators for biomedical applications and related technologies

**NUSREB** aims to improve integration of the researchers working in nuclear spectroscopy and reaction

**ENAN** focuses on integration and collaboration of European scientists working in nuclear physics for astrophysics

**DEEPEN** examination of the opportunities offered by electron scattering on exotic nuclei to investigate their electromagnetic properties.

# Relation between ERINS WP's





# 34 beneficiaries, 17 countries

Participant No *	Participant organisation name	Country
1/INFN	ISTITUTO NAZIONALE DI FISICA NUCLEARE	Italy
2/GANIL	GRAND ACCELERATEUR NATIONAL D'IONS LOURDS	France
3/CERN	EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH	Switzerland
4/CNRS	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	France
5/GSI	GSI HELMHOLTZZENTRUM FUER SCHWERIONENFORSCHUNG GMBH	Germany
6/RUG	RIJKSUNIVERSITEIT GRONINGEN	Netherlands
7/IFJ-PAN	THE HENRYK NIEWODNICZANSKI INSTITUTE OF NUCLEAR PHYSICS, POLISH ACADEMY OF SCIENCES	Poland
8/UNIWARSAW	UNIWERSYTET WARSZAWSKI	Poland
9/HH-IFIN	INSTITUTUL NATIONAL DE CERCETARE - DEZVOLTARE PENTRU FIZICA SI INGINERIE NUCLEARA "HORIA HULUBEI" (IFIN-HH)	Romania
10/FBK	FONDAZIONE BRUNO KESSLER	Italy
11/CEA	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	France
12/JLU MUENCHEN	JUSTUS-LIEBIG-UNIVERSITAET GIESSEN	Germany
13/LMU	LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN	Germany
14/NCSR	NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRITOS"	Greece
15/IST	INSTITUTO SUPERIOR TECNICO	Portugal
16/USC	UNIVERSIDAD DE SANTIAGO DE COMPOSTELA	Spain
17/USE	UNIVERSIDAD DE SEVILLA	Spain
18/ATOMKI-HAS	MAGYAR TUDOMANYOS AKADEMIA ATOMMAGKUTATO INTEZETE	Hungary
19/KU Leuven	KATHOLIEKE UNIVERSITEIT LEUVEN	Belgium
20/UG	UNIVERSITAET GREIFSWALD	Germany
21/JGU	JOHANNES GUTENBERG UNIVERSITAET MAINZ	Germany
22/UoC	UNIVERSITAET ZU KOELN	Germany
23/U.MANCHESTER	THE UNIVERSITY OF MANCHESTER	United Kingdom
24/CSIC	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS	Spain
25/CIEMAT	CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT	Spain
26/UPC	UNIVERSITAT POLITECNICA DE CATALUNYA	Spain
27/UGOT	GOETEBORGS UNIVERSITET	Sweden
28/ULIV	THE UNIVERSITY OF LIVERPOOL	United Kingdom
29/SNRC	SOREQ NUCLEAR RESEARCH CENTER	Israel
30/NPI-CAS	USTAV JADERNE FYZIKY AV CR	Czech Republic
31/SCK-CEN	STUDIECENTRUM VOOR KERNENERGIE/ CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE	Belgium
32/SURREY	UNIVERSITY OF SURREY	United Kingdom
33/JYU	JYVASKYLAN YLIOPISTO	Finland
34/ESS	EUROPEAN ESPALLATION SOURCE	Sweden

PI list for NA and JRA:

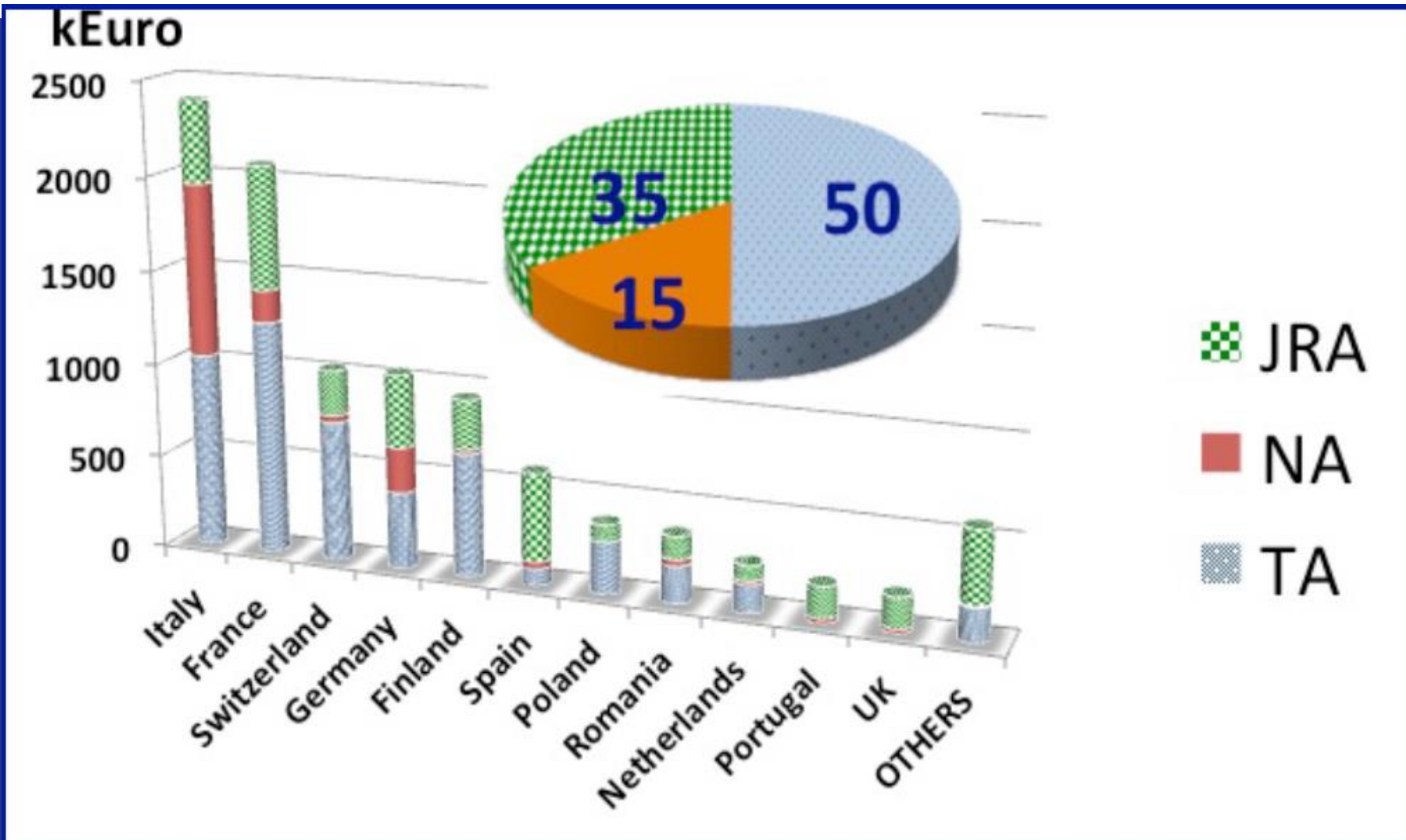
**NA**

Magdalena Gorska (DE)  
Clementina Agodi (IT)  
Faïrouz Hammache (FR)  
David VERNEY(FR)  
Peter G. Thirolf (DE)  
Ulrich Wahl (PT)

**JRA**

Hannu Koivisto (FI)/ Adnan Ghribi (FR)  
Wolfgang Plaß (DE)  
Stephan Malbrunot (CH)  
P. Delahaye (FR)  
Marco La Cognata (IT)  
Nasser Kalantar (NL) Héctor Alvarez Pol (ES)  
Teresa Peña (PT)  
Andres Gadea (ES)  
Iain D. Moore (FI)  
Stefano Corradetti (IT)

# ERINS: requested budget





# EURISOL-DF

- Several meetings (skype) of the EURISOL Steering Committee
  - November 9
  - December 20
  - February 4
- Meeting with E. Elsen to discuss ISOLDE in EURISOL-DF (January 18)
  - Strongly supports a unified coherent European nuclear physics community science programme. It will give more visibility to the nuclear physics facilities, including ISOLDE@CERN, and to the community as a whole.
  - No support for a 'common PAC' that decides on (some) beam time at ISOLDE
  - Suggests to start something in a less formal way (e.g. a common entry for proposals, as suggested to be prepared within ERINS).
- Summary of Minutes sent to the SC – discussed in its Feb. 4 meeting
- Reply on questions by ML (on behalf of SC) sent to EE on Feb. 19

# ISOLDE in ESPP: EPIC project

- Submitted December 17, 2018 (nr. 37)
- Total submitted documents = 160
- **Free access:** <https://indico.cern.ch/event/765096/contributions/>
- NEXT STEP: meeting in Granada (plenary and parallel sessions), May 13-17
  - ➔ Marek Lewitowicz will present the NUPECC Long Range Plan
  - ➔ G.N. present at the meeting / input ISOLDE unclear
- In parallel: meeting with E. Elsen to discuss future of ISOLDE (February 7)
  - ✓ Set-up a brain storming meeting with technical groups of CERN
  - ✓ Try to meet before Granada Meeting (end of April?)

# 3 objectives

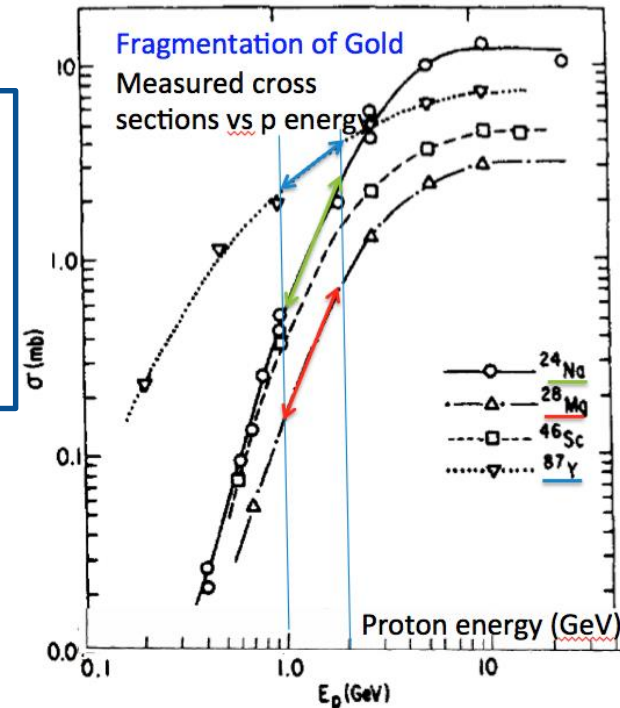
- Profit from increased driver beam energy and intensity (2 GeV, 4  $\mu$ A), thanks to the LIU at CERN and improve the exploitation of the existing infrastructure
- Have multiple simultaneous beams for users
- A new storage ring for short-lived, light and heavy ions

# Objective 1

## Profit from increased driver beam energy (2 GeV) and intensity (4 $\mu\text{A}$ )

- Take advantage of CERN's LHC Injector Upgrade (LIU): higher proton intensities from LINAC4 and Booster energy increase from 1.4 GeV to 2 GeV
- GAIN FOR ISOLDE: **Higher radioactive beam intensities** for fragmentation and spallation products (gain between factor of 2 and more than 10 in intensity)

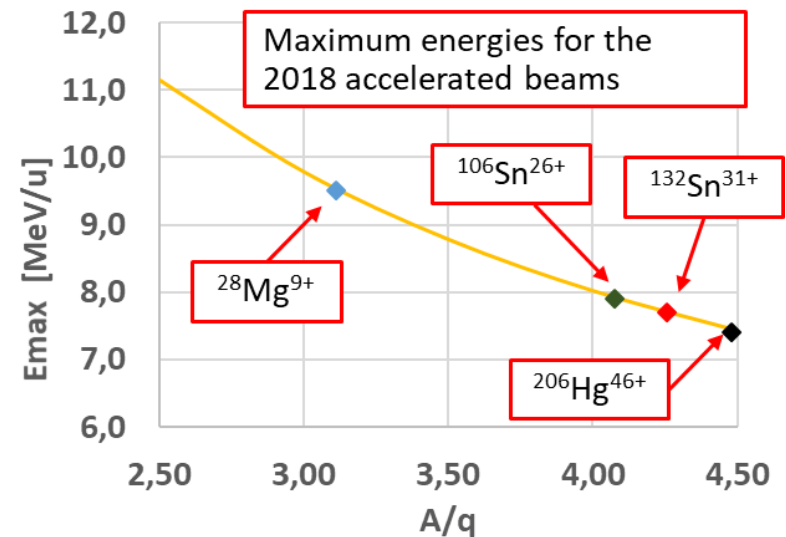
- **NEEDED CERN INVESTMENTS, in order for ISOLDE TO RECEIVE THESE BEAMS:**
  - ✓ New beam dumps to cope with higher power
  - ✓ New transfer line from booster to ISOLDE



# Objective 1

## And improve the exploitation of the existing infrastructure

- HIE-ISOLDE post-accelerator design goal:  
beams up to 10 MeV/u, for light and heavy beams  
NOW: max 9.4 MeV/u for light beams  
max 7.4 MeV/u for heavy beams



### SOLUTIONS TO REACH FULL ENERGY POTENTIAL:

- ✓ Have all cavities working (will reach 8.2 MeV/u for heavy beams after LS2)!
- ✓ FINALIZE the HIE-ISOLDE energy upgrade:  
post-accelerated beams in the full (low) energy range from 0.3 and 2.8 MeV/u  
(most important for astrophysics experiments) and up to 10 MeV/u  
**METHOD: upgrade of the (20 years old!) REX-part of the HIE-ISOLDE LINAC**

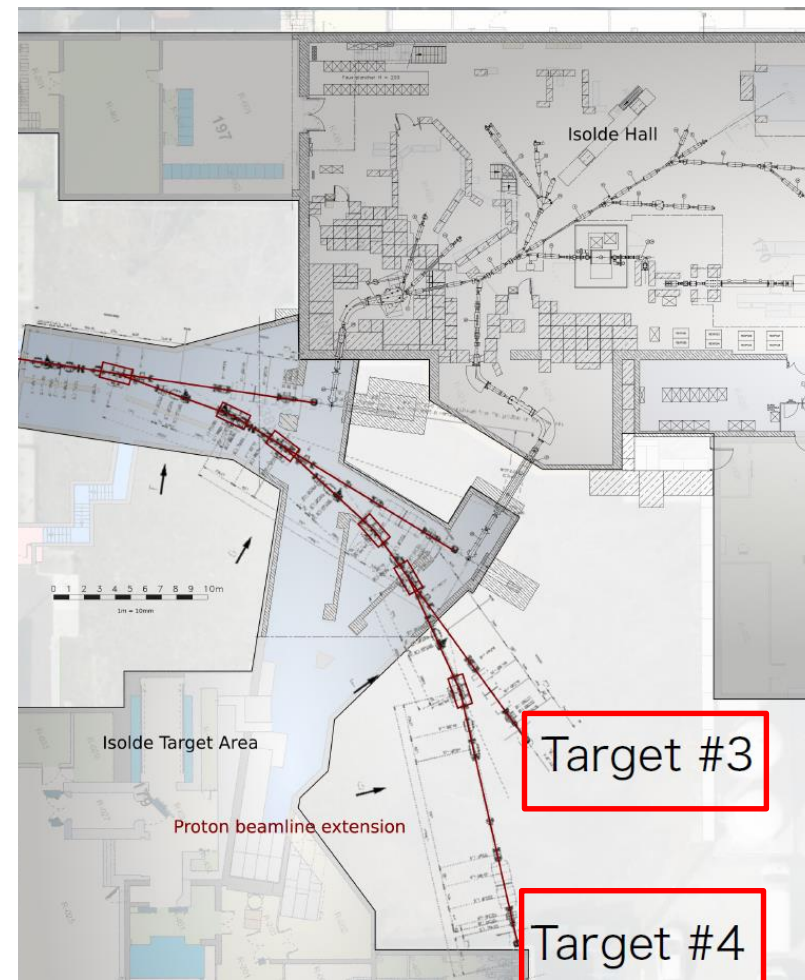
# Objective 2

## Have multiple simultaneous and better quality beams

- GOAL: serve the ever growing ISOLDE users community, who pursues very diverse research program
  - in nuclear physics,
  - fundamental interaction studies,
  - atomic physics
  - nuclear astrophysics
  - material sciences
  - biochemical/ medical research

- **METHOD:**

- 1. Two new additional target stations**



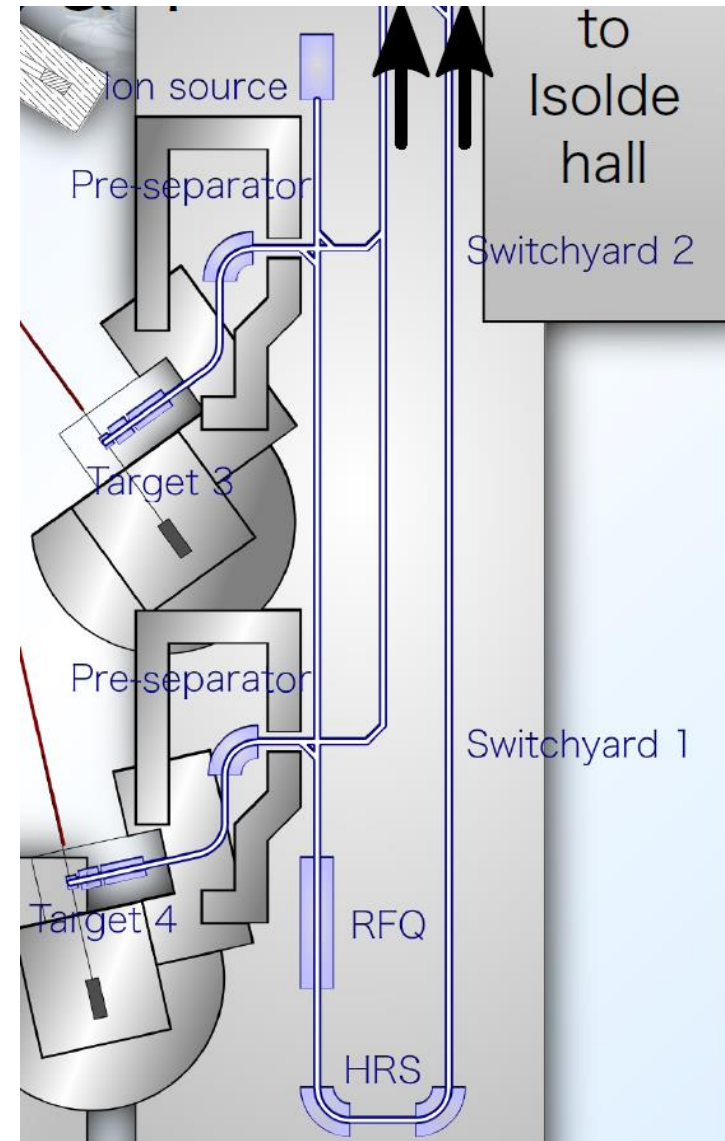


# Objective 2

Have multiple simultaneous better quality beams

➤ **METHOD:**

1. Two new additional target stations
2. **A new high-resolution mass separator** (state-of-the-art) to deliver purer beams (very important for HIE-ISOLDE operations)
  - ➔ currently, some RIB's beams cannot be efficiently accelerated due to contamination that is too high
  - ➔ *A detailed design study is needed*
  - ➔ *Input from other laboratory upgrades could be used (e.g. HRS for DESIR (SPIRAL2-GANIL), HRS for Triumf)*



# Objective 3

## A new compact storage ring for light and heavy ions

- Stored radioactive beams have many advantageous:
  - Can be used multiple times in an in-ring detector (luminosity increase)
  - Can be cooled to deliver excellent quality beams to external experiments for high-precision studies

- **Research areas:**  
nuclear ground-state properties,  
reaction studies of astrophysical relevance,  
investigations with highly-charged ions  
studies with pure isomeric beams  
(e.g. fundamental constants)

Eur. Phys. J. Special Topics 207, 1-117 (2012)

K. Blaum, Y. Blumenfeld, P.A. Butler, M. Grieser, Yu.A. Litvinov,  
R. Raabe, F. Wenander and Ph.J. Woods (Eds.)

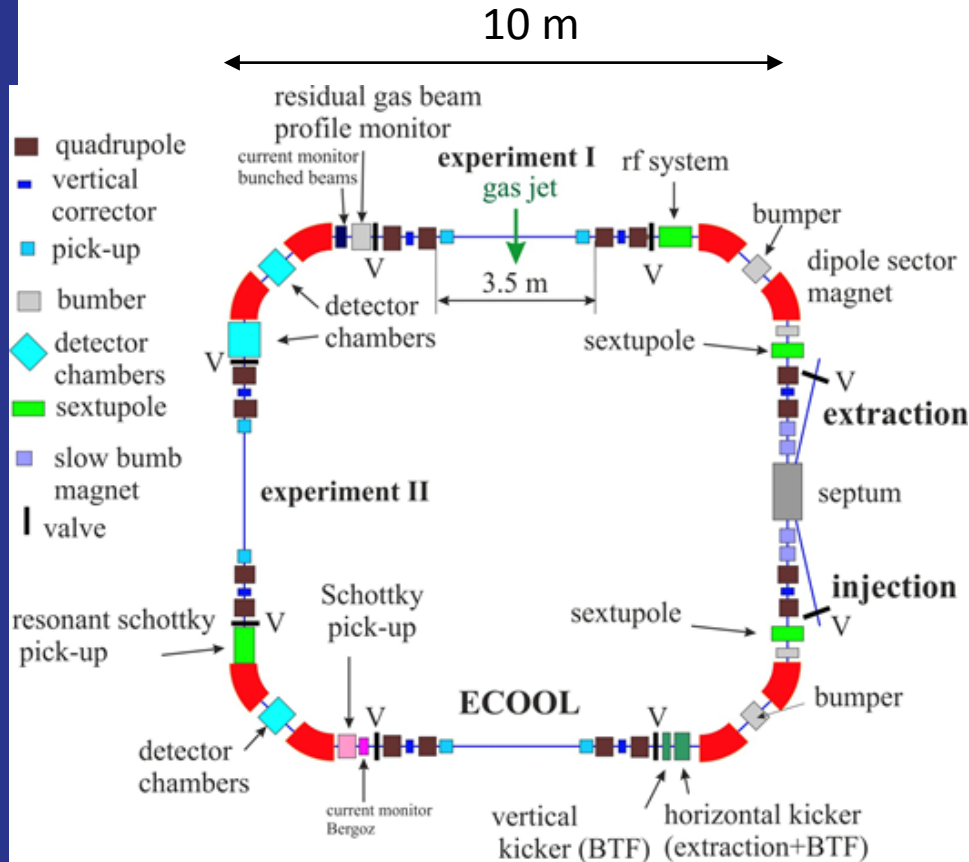
Storage Ring Facility at HIE-ISOLDE



A photograph of the ion storage ring TSR at the Max-Planck Institute for Nuclear Physics in Heidelberg. It is proposed to install this ring at the HIE-ISOLDE facility in CERN, thus enabling a variety of unique experiments in nuclear, astro- and atomic physics.

# Objective 3

## A new compact storage ring for light and heavy ions



**Preliminary design:**

Manfred Grieser, MPI-K Heidelberg

**Preliminary integration in ISOLDE:**

Erwin Siesling