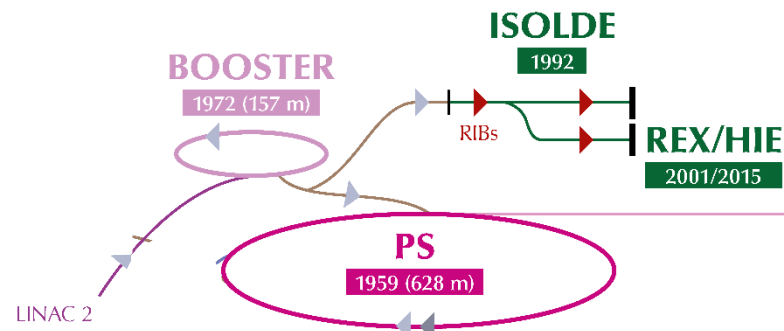


a Radioactive Ion Beam (RIB) facility at

G. Neyens,
ISOLDE Collaboration Spokesperson



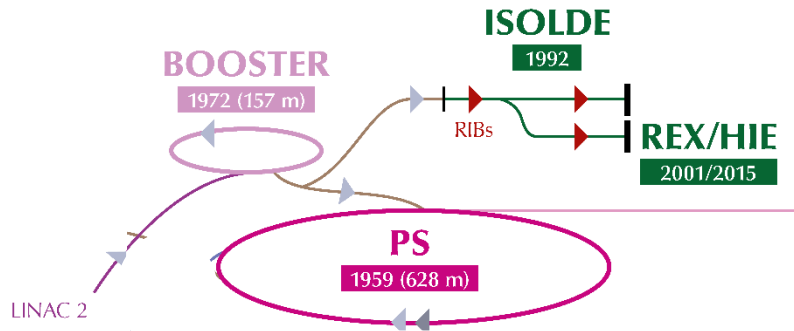
UNIQUE worldwide thanks to 1.4 GeV protons on thick targets (20 cm)
More than 50 years of experience in production of pure radioactive isotopes and beams

- **> 1000 isotopes available already (of 3000 known)**
- > 70 different elements
- > 10 different permanent experimental set-ups (and new ones coming!)

Since 2001: re-acceleration of RIB's with REX and HIE-ISOLDE (NC and SC Linac)

- Beams up to 9.5 MeV/nucleon
- Doubled the users community (reactions with RIB's)
- **More than 45 experiments for more than 500 users/year (from 43 countries)**
 (> 900 registered ISOLDE users)

a Radioactive Ion Beam (RIB) facility at CERN



~ 50% of Booster protons are used by ISOLDE

Complementary to new big RIB-facilities around the world:

FRIB (MSU), RIBF (Tokyo), FAIR (Darmstadt)

→ all of these start from FRAGMENTATION of an energetic HEAVY beam

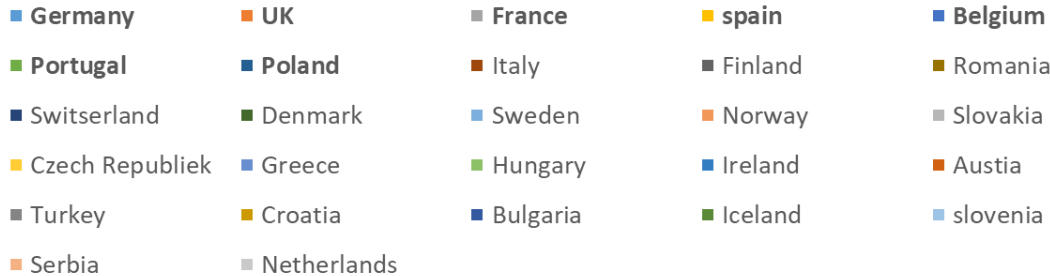
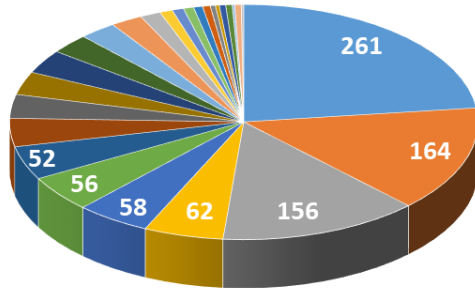
(→ very energetic low-quality RIB)

→ then: stop + re-ionize + reaccelerate to produce high-quality energetic RIB's

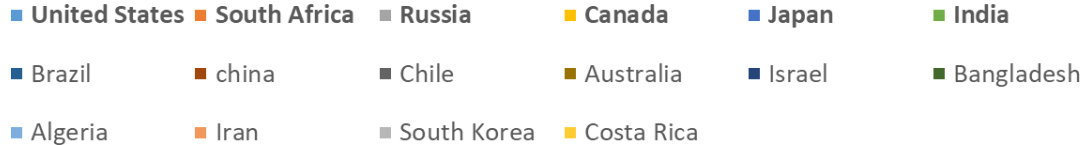
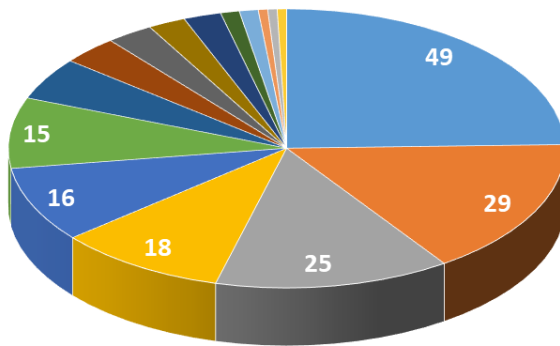
→ disadvantage: at most 1-2 isotopes available/experiment

→ different types of experiments !!!

The ISOLDE users community



Since post-accelerated beams became available: continuously expanding users community !



ISOLDE USERS:

- In pre-HIE-ISOLDE era: 400-500
- Today: more than 900 !
 - ✓ From 43 countries
 - ✓ From > 200 institutions
 - ✓ From all around the world

A very diverse research program using exotic isotopes and molecules...

Nuclear and Atomic Physics,

Nuclear Astrophysics

Materials sciences,

Life sciences and biochemistry

AND Fundamental Interactions and Symmetry studies

**Radioisotopes as complementary laboratories to explore
high energy physics – the precision frontier**

Our physics cases were covered at Granada (ESPP) in following presentations:

- Stephan Paul (The **EDM** hunt)
- Gunar Schnell (**Strong interaction physics** with CERN's pre-accelerators)
- Suzanne Mertens (Measurements of the **neutrino mass**)
- Marek Lewitowics (NuPECC)
- Jorgen d'Hondt (Concluding remarks on QCD Physics)

EPIC

Exploiting the Potential of ISOLDE at CERN

The ISOLDE Collaboration input to ESPP



Gerda Neyens, ISOLDE Collaboration Spokesperson
Richard Catherall, ISOLDE Technical Coordinator
Bertram Blank, Chair of the ISOLDE Collaboration
Karsten Riisager, Chair of the ISOLDE and n-TOF (INTC) program committee

With thanks to Klaus Blaum, Yuri Litvinov, Ronald Garcia Ruiz, Kieran Flanagan, Manfred Grieser, Erwin Siesling, Tim Giles and many others...

EPIC

Exploiting the Potential of ISOLDE at CERN

The ISOLDE Collaboration input to ESPP

1. **Take advantage of LIU: the BOOSTER energy increase and LINAC4 intensity increase**
 - Gain a factor of 2 - 20 in radioactive beam intensity (isotope dependent)
2. **Install additional target station(s): allow parallel beams for low/high energy experiments**
 - double beam time for increasing amount of users
(more than 60 accepted experiments on the books + ~40 new per year)
3. **Install a 'Storage Ring' for *short-lived* isotopes – unique worldwide**
 - new opportunities in atomic and nuclear physics, fundamental constants
4. **A new experimental hall**
 - 5 new experimental set-ups in preparation, no space in current hall

EPIC Workshop December 3-4

Tuesday 3/12

1.30 pm Opening by F. Bordry

Session 1: LHC Intensity Upgrade and it's potential for ISOLDE

3.45 pm Coffee

Session 2: Needs and benefits of 2 GeV protons at ISOLDE

5.50 pm: POSTER Session

New experiments to come – space !

Proposals for upgrades of existing experiments

EPIC Workshop December 3-4

Wednesday 4/12

9 am

Session 1: ISOLDE Storage Ring

10.25 am photo + coffee

Session 2: Upgrades of the HIE-ISOLDE accelerator

12.00 Lunch

1.45 pm

Session 3: New Physics with an upgraded ISOLDE facility

3.45 pm Coffee

followed by working groups (parallel) meetings

5.30 pm

Reports from the working groups

6.15 pm end of the meeting

1. Take advantage of LIU upgrades

Increased BOOSTER p-energy (2 GeV) and intensity (4 μA)

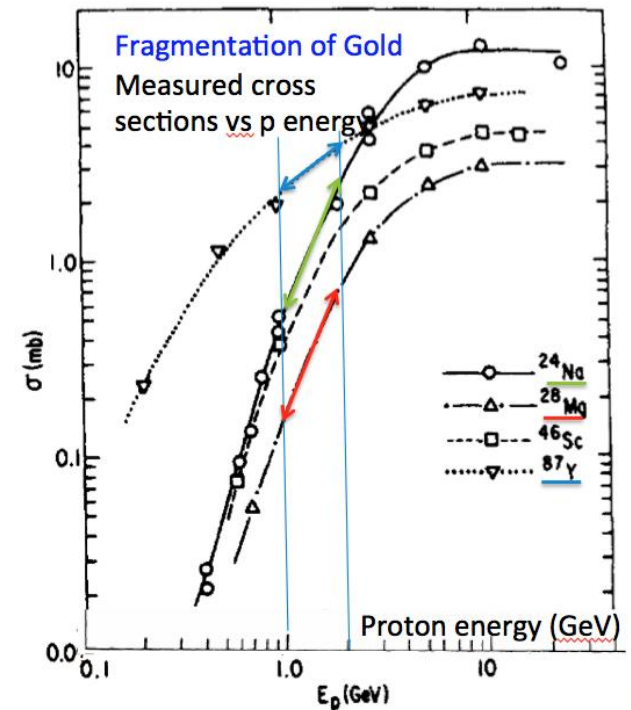
GAIN FOR ISOLDE: **Higher radioactive beam intensities** for fragmentation and spallation products (gain between factor of 1 and 10 in intensity)

NEEDS:

- New beam dumps to cope with higher power
- New transfer line from booster to ISOLDE

Estimated cost: 9 MCHF

Ideal timing: installation works during LS3



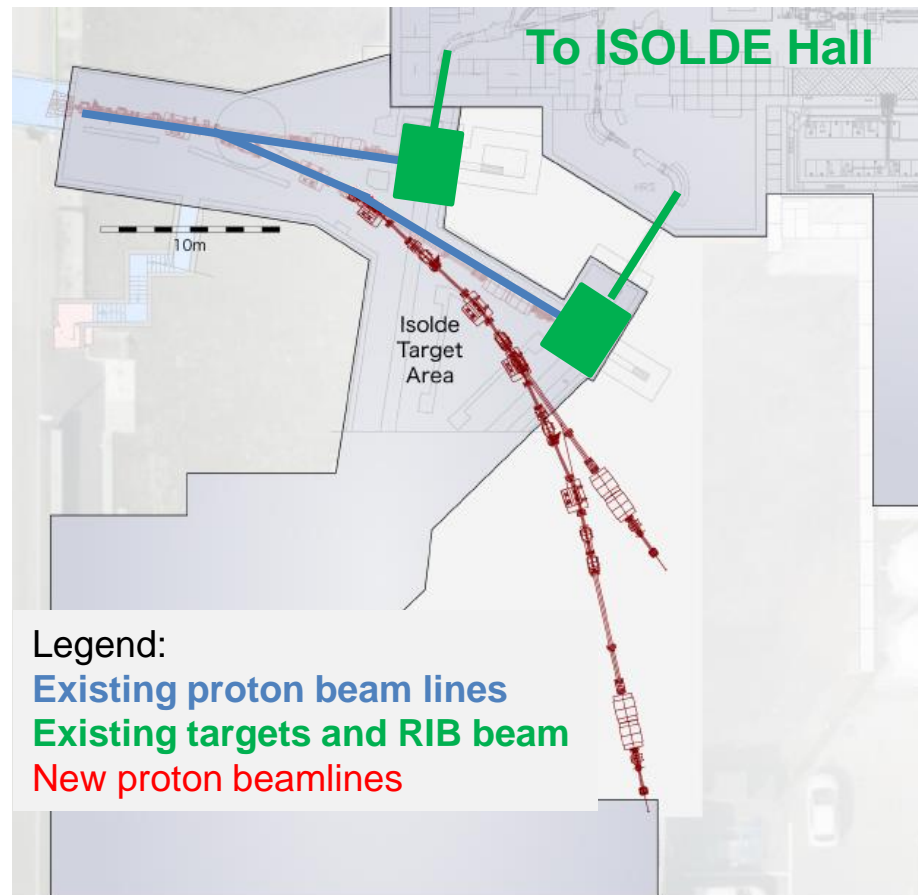
2. Install additional target station(s): allow parallel beams

Have multiple simultaneous and better quality beams

NEEDS:

- Two new proton beam lines
- Two new Target stations

➤ **GOAL:** serve the diverse research program of the continuously growing ISOLDE users community (from ~400 in 2000 to >900 now)

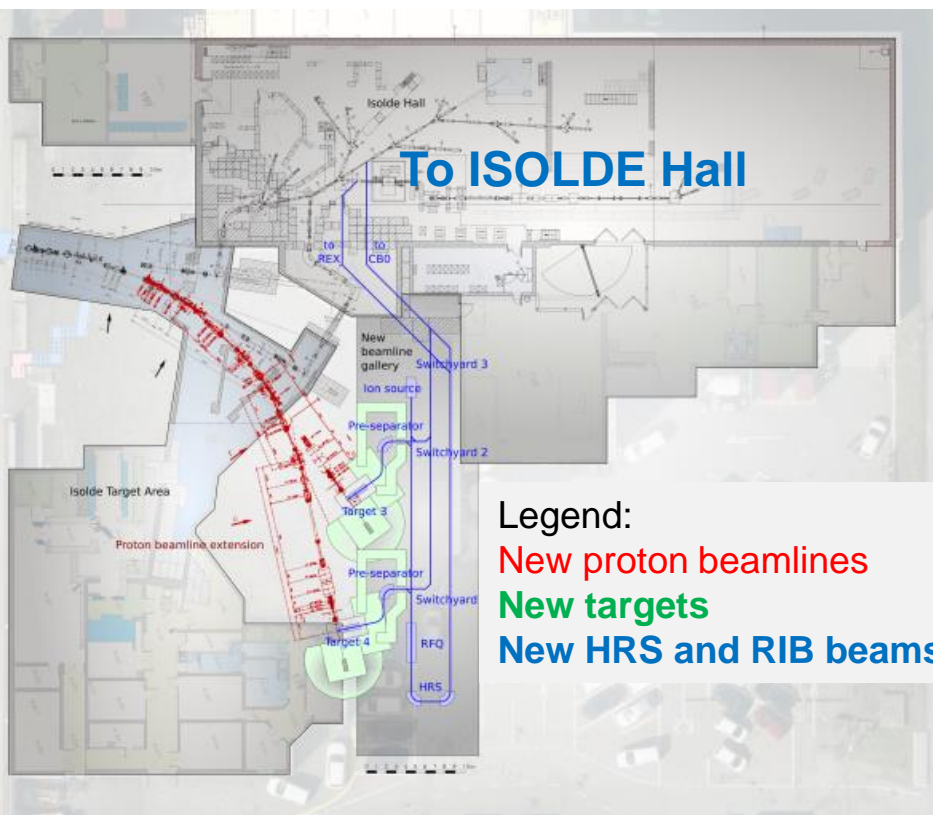


2. Install additional target station(s): allow parallel beams

Have multiple simultaneous and better quality beams

NEEDS:

- Two new proton beam lines
- Two new Target stations
- A new High Resolution Mass Separator with parallel beams to low-energy ISOLDE and HIE-ISOLDE
- Improved beam quality (RFQ cooler, laser lab, etc...)

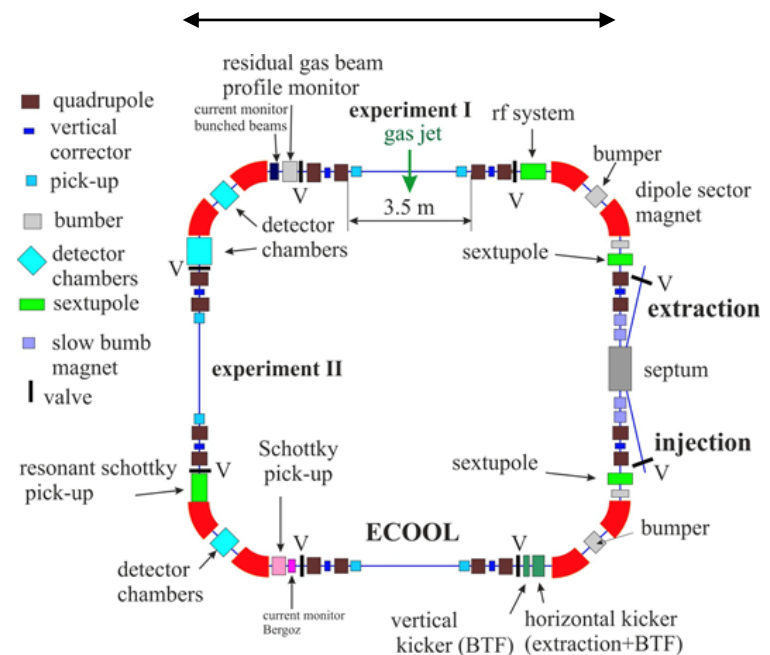


3. A new Compact Storage Ring for short-lived isotopes

- 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

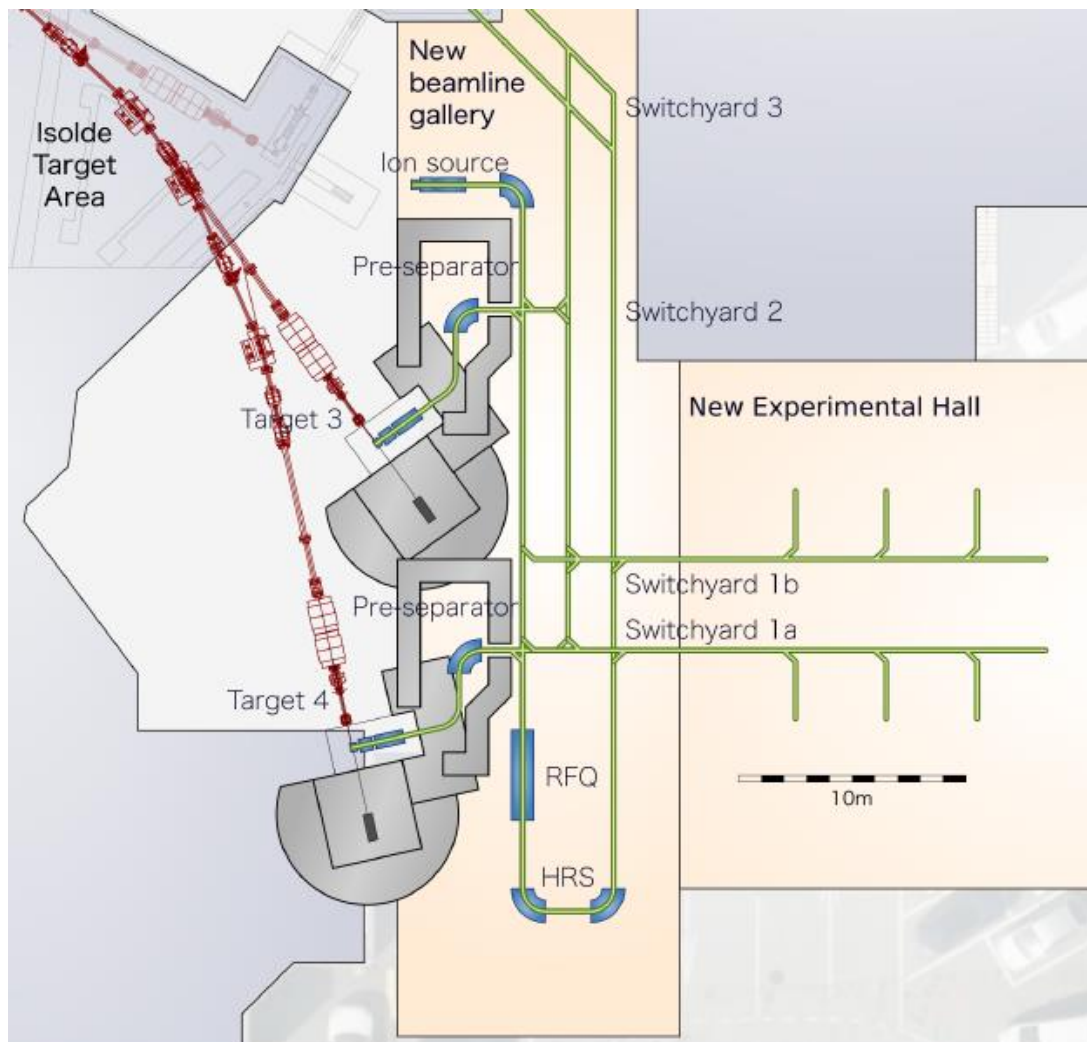
- **Research areas:**
 - nuclear ground-state properties,
 - reaction studies of astrophysical relevance,
 - investigations with highly-charged ions
 - studies with pure isomeric beams
(e.g. fundamental constants)

Preliminary design:
 Manfred Grieser, MPI-K Heidelberg
 10 m



ESTIMATED Cost: 17 MCHF

4. A new experimental hall



- **More than 5 new low-energy experimental set-ups look for a place (not available in current hall)**
 - **GANDALF** (atomic spectroscopy of radioactive elements)
 - **MIRACLS** (ultrapure beams + laser spectroscopy)
 - **PUMA** (interactions between exotic matter and antiprotons)
 - **Set-up/Trap for RaF molecules** (eEDM and other symmetry violations)
 - **Large superconducting magnet** (PAC for materials studies)
- **Two new HIE-ISOLDE set-ups:**
 - A HIE-ISOLDE Recoil Separator
 - A Compact Storage Ring

Impact on Physics

- Many HIE-ISOLDE and ISOLDE proposals suffer from low intensity → **shorten beam time per experiment.**
- **New and more exotic species will be available** with the increase of intensities: **from x2-x5** for fragmentation, x1 – x2 for fission, **x6-x10** for spallation.
- New target stations and higher available proton intensities will allow **parallel operation of low-energy and high-energy experiments**, thus doubling the available beam time.
- Several HIE-ISOLDE experiments cannot reach full intensity due to contamination in the ISOLDE beam → **need better beam purification (new HRS mass separator, MR-TOF, ...)**
- **A Recoil Separator and the Storage Ring** will allow for new types of experiments in different fields (astrophysics, fundamental symmetries, nuclear structure, atomic physics) and for precision experiments.

Discussion

- Aims of the workshop
- Workshop program
- How to mobilize the community
- Next steps
 - Establishing physics and technical working groups
 - Preparation of Conceptual Design Report
- How to approach funding bodies