EUROPEAN SPALLATION SOURCE

# Experience of In-Kind at CERN and ESS

## The collaborative model

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www.europeanspallationsource.se
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# Outline

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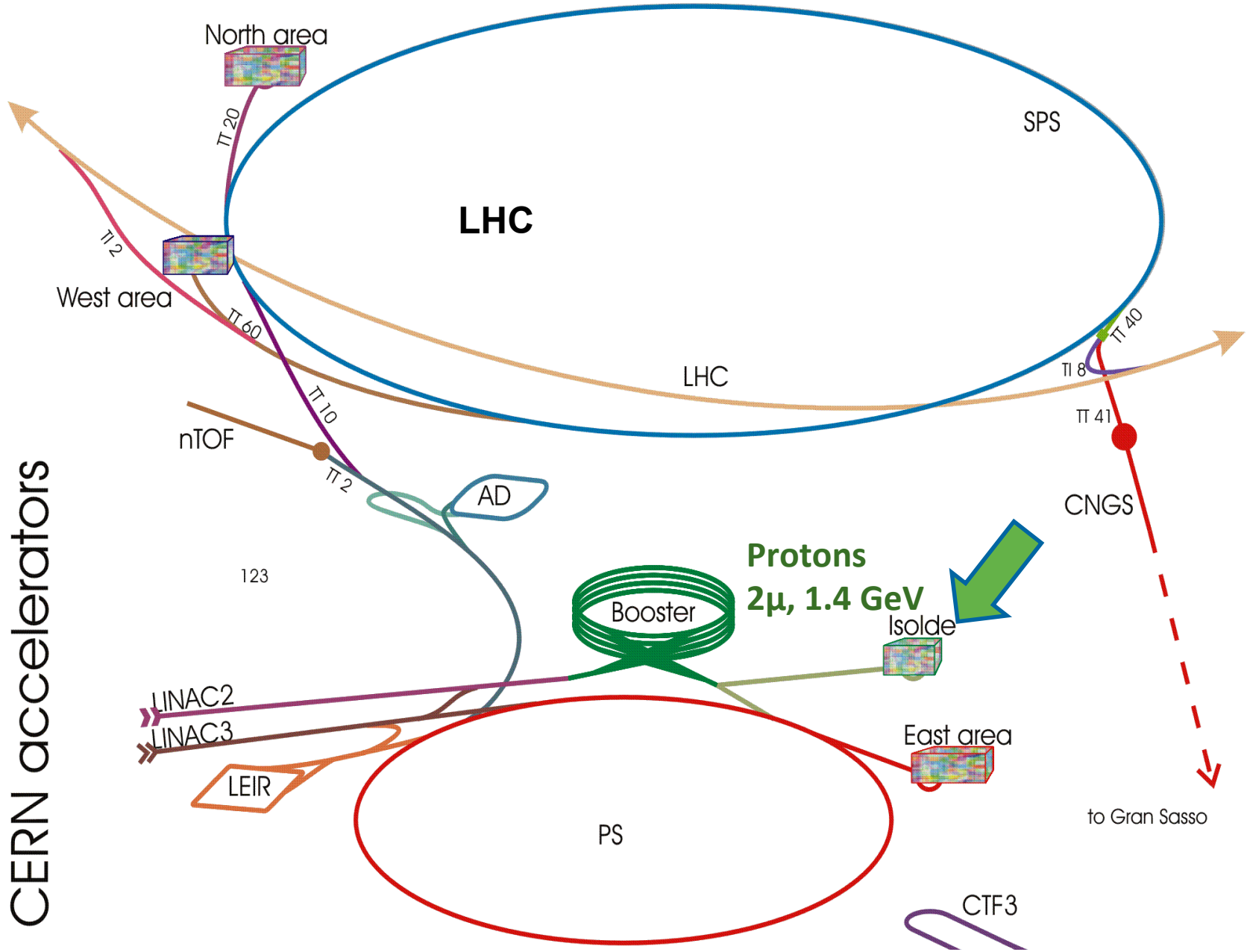
- I will speak about In-kind at one of CERN facilities (ISOLDE) run by a CERN collaboration
  - ✓ Collaboration manages in-kind (and advices on science program) with strong host laboratory support
- I will also speak about In-Kind contributions for the ESS Accelerator design update project and the preparations for the in-kind contributions for the ESS accelerator construction
  - ✓ Laboratory manages in-kind with advice from e.g. the collaboration.

# ISOLDE: A Few Facts

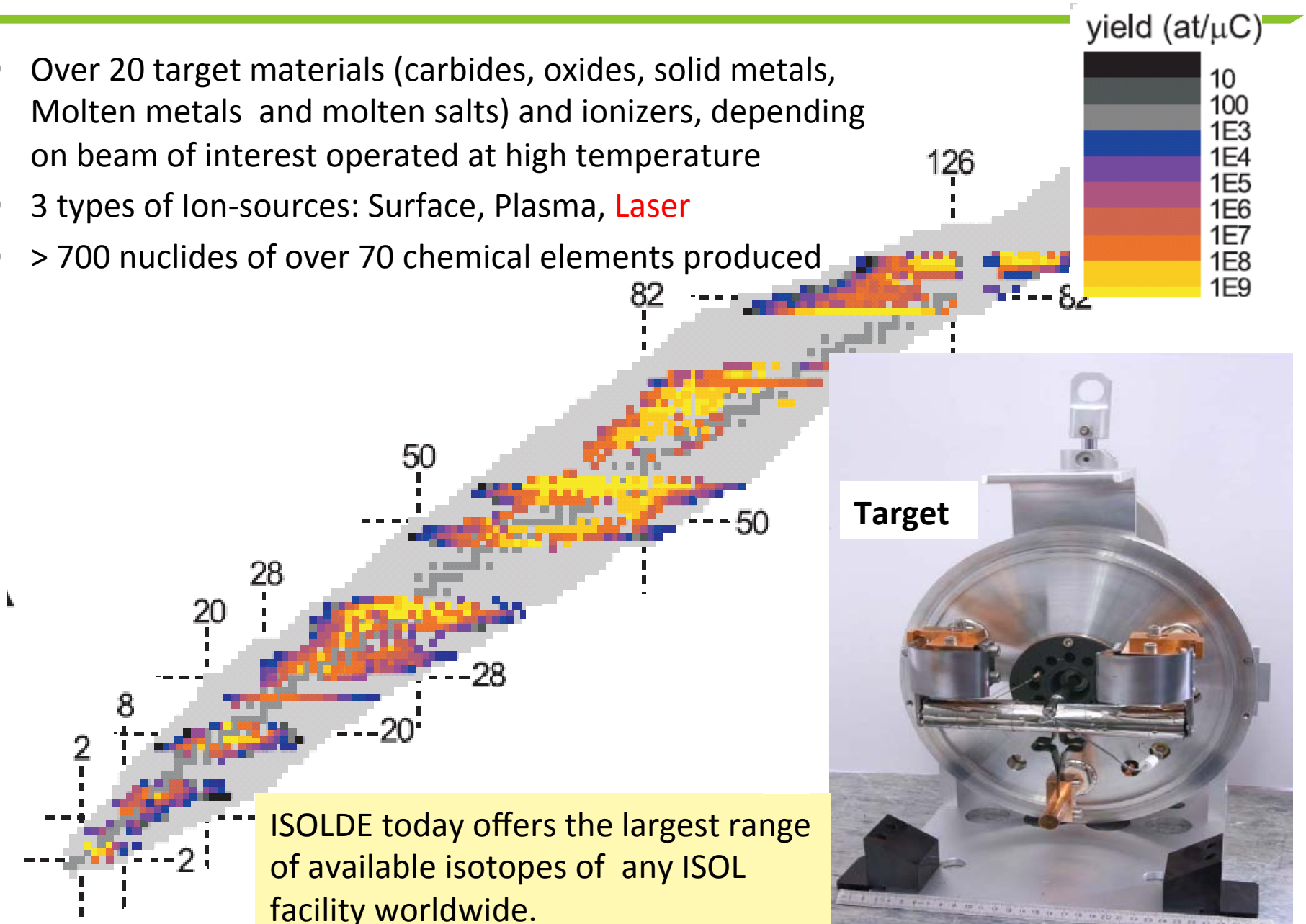
- ISOLDE is the CERN radioactive beam facility
- In operation since 45 years
- The largest selection of isotopes of any ISOL facility worldwide
- Provides low energy or post-accelerated beams
- Run by an international collaboration: 13 members (B, CERN, Dk, E, F, Ge, Gr, I, *India*, N, R, S, UK)
- Open to users from around the world
- HIE-ISOLDE Project approved in 2009

# ISOLDE at CERN



# Produced Nuclei: ISOLDE 45 y Experience

- Over 20 target materials (carbides, oxides, solid metals, Molten metals and molten salts) and ionizers, depending on beam of interest operated at high temperature
- 3 types of Ion-sources: Surface, Plasma, Laser
- > 700 nuclides of over 70 chemical elements produced



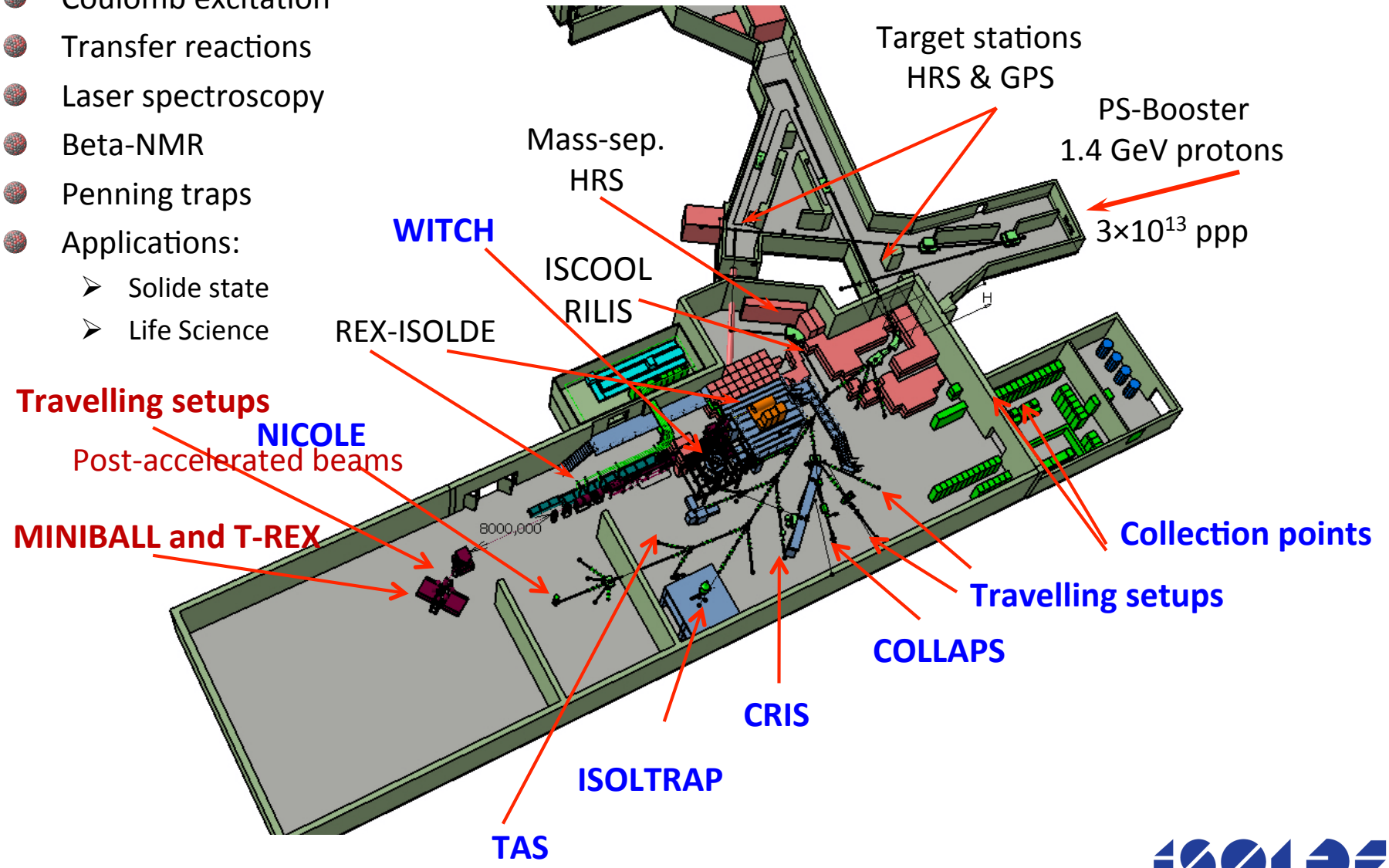




ISOLDE today offers the largest range of available isotopes of any ISOL facility worldwide.

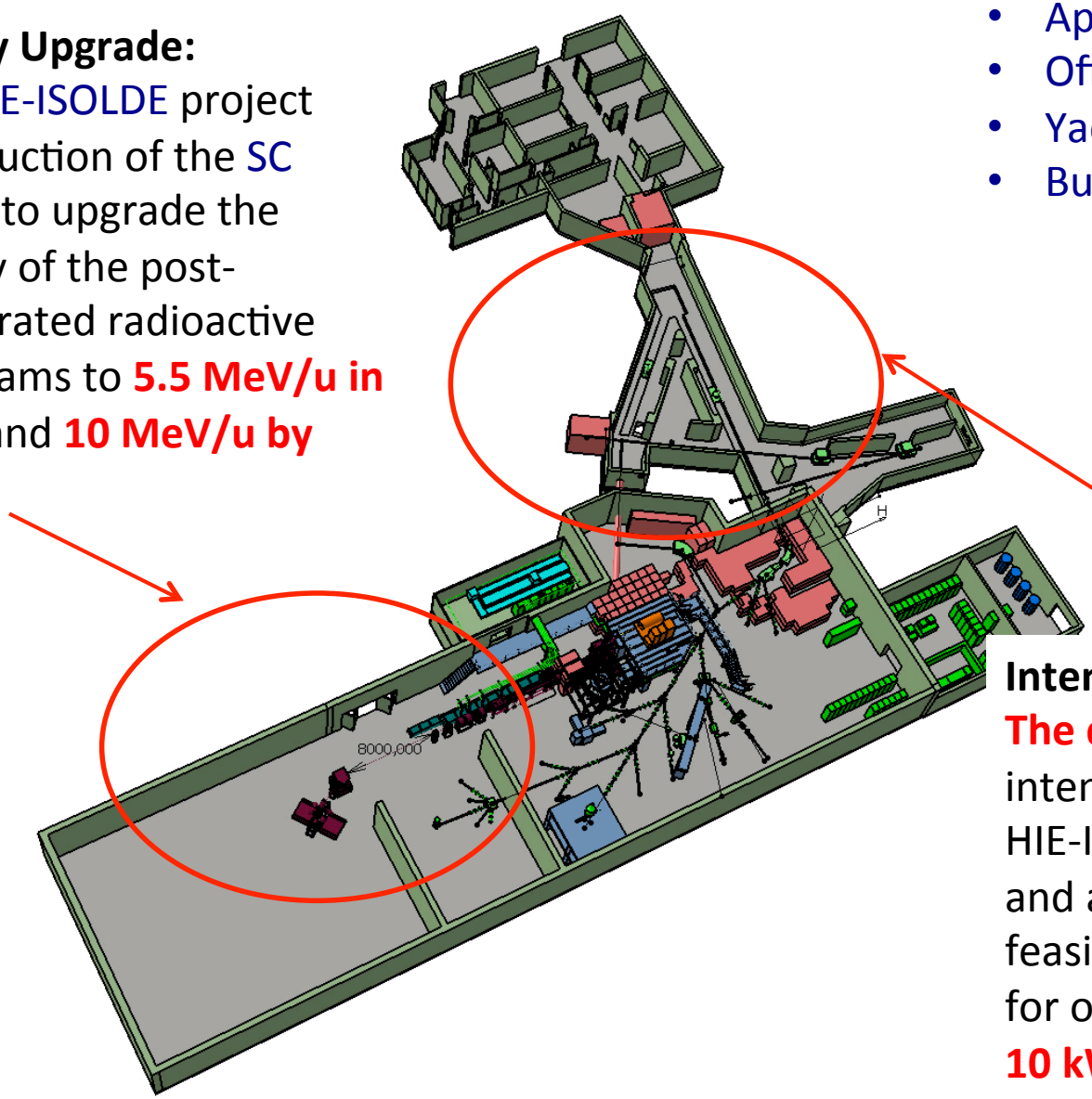
# Experimental hall

- Decay spectroscopy
- Coulomb excitation
- Transfer reactions
- Laser spectroscopy
- Beta-NMR
- Penning traps
- Applications:
  - Solide state
  - Life Science



# Near Future: HIE-ISOLDE project

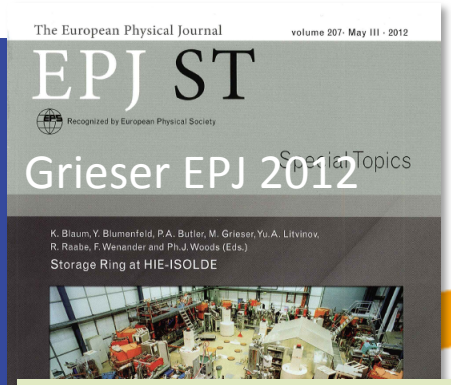
**Energy Upgrade:**
The HIE-ISOLDE project construction of the SC LINAC to upgrade the energy of the post-accelerated radioactive ion beams to **5.5 MeV/u in 2015** and **10 MeV/u by 2017**

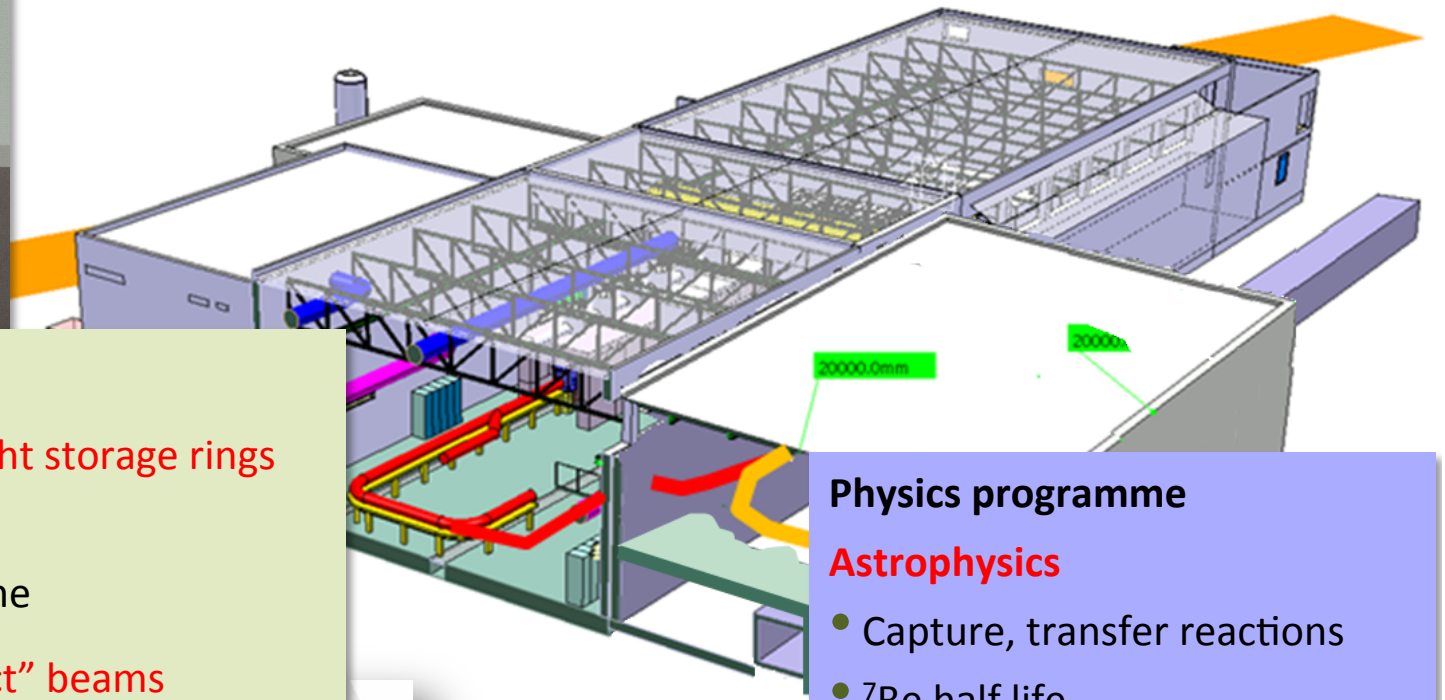



- Approved Dec 2009
- Offically started Jan 2010
- Yacine Kadi project Leader
- Budget 40 M$

**Intensity Upgrade:**
**The design study** for the intensity upgrade, also part of HIE-ISOLDE, **started in 2011**, and addresses the technical feasibility and cost estimate for operating the facility at **10 kW** once LINAC4 and PS Booster are online.

# The TSR in a nutshell



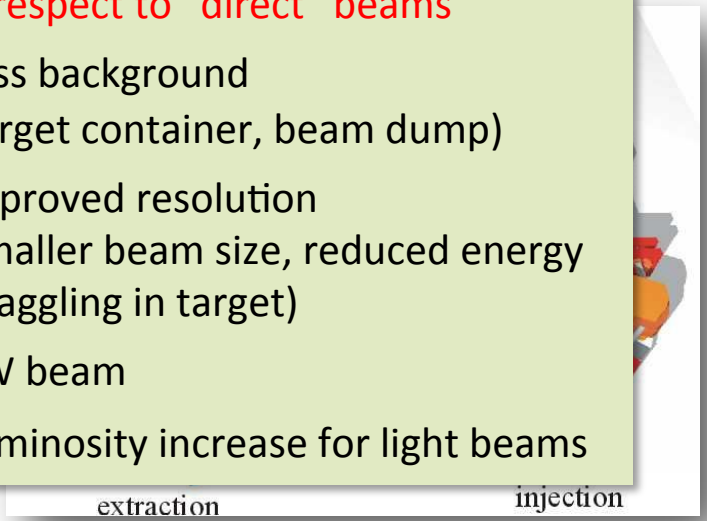

**Advantages**

With respect to in-flight storage rings

- Higher intensity
- Shorter cooling time

With respect to "direct" beams

- Less background (target container, beam dump)
- Improved resolution (smaller beam size, reduced energy straggling in target)
- CW beam
- Luminosity increase for light beams




**Physics programme**

**Astrophysics**

- Capture, transfer reactions
- $^{7}$Be half life

**Atomic physics**

- Effects on half lives
- Di-electronic recombination

**Nuclear physics**

- Nuclear reactions
- Isomeric states
- Laser spectroscopy

# HIE-ISOLDE & TSR

- TOTAL COST OF THE Project = 43.180 KCHF
- External contribution 21.980 KCHF
- TSR Storage Ring for ISOLDE = 17950 KCHF
- The  two projects  together 61130 KCHF

# ISOLDE collaboration and CERN

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- The international collaboration representing a major part of the users are at the core of ISOLDE
  - ✓ Collaboration proposes ISOLDE team leader to CERN and elects spokesperson
  - ✓ MoU formalizes relationship to CERN (e.g. sharing of costs)
  - ✓ Annual contributions from collaboration members is used for facility improvements and experiments
  - ✓ Collaboration coordinates grant application for new projects and new experiments
  - ✓ University groups in collaboration  member states owns and operates open fixed experiments at ISOLDE

- CERN role
  - ✓ Operates the facility according to MoU and pays for infrastructure for CERN approved upgrades and projects
  - ✓ Approves all experiments through a peer review process in a the appropriate CERN scientific committee (INTC)

# ESS accelerator

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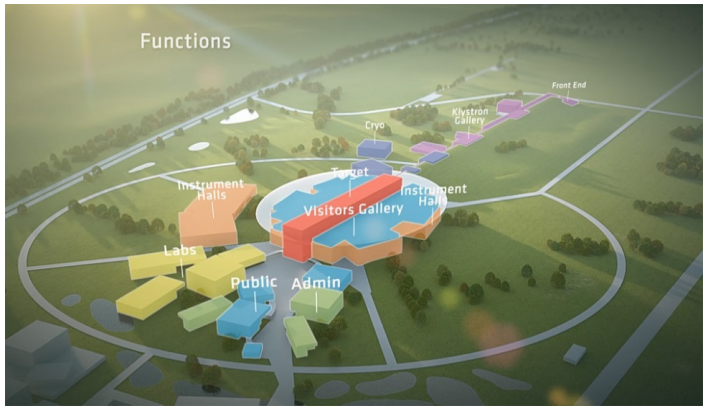
Design Drivers:

- High Average Beam Power
  - 5 MW
- High Peak Beam Power
  - 125 MW
- High Availability
  - > 95%




Key parameters:

- -2.86 ms pulses
- -2 GeV
- -62.5 mA
- -14 Hz
- -Protons (H+)
- -Low losses
- -Attention is paid to cryoplant turn down capabilities to minimize use of electrical heaters at low temperatures and proper cryogenic design techniques to minimize static heat leaks
- -Flexible design for future upgrades

# ESS Linac

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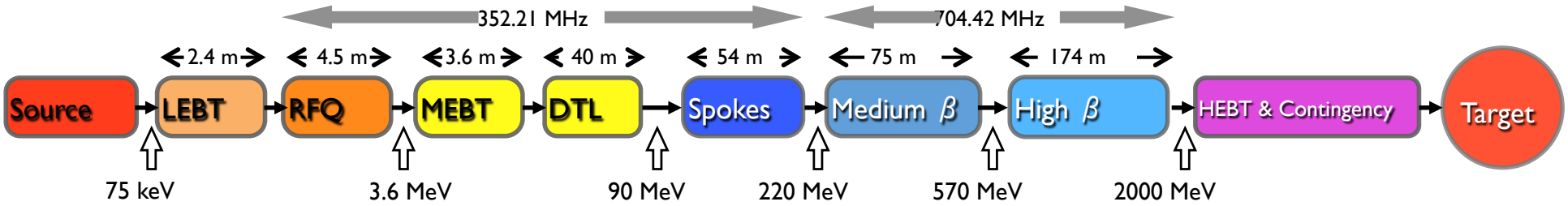


| | Energy (MeV) | No. of Modules | No. of Cavities | $\beta$ g | Temp (K) | Cryo Length (m) |
|---|---|---|---|---|---|---|
| **Source** | 0.075 | 1 | 0 | – | ~300 | – |
| **LEBT** | 0.075 | – | 0 | – | ~300 | – |
| **RFQ** | 3.6 | 1 | 1 | – | ~300 | – |
| **MEBT** | 3.6 | – | 3 | – | ~300 | – |
| **DTL** | 90 | 5 | 5 | – | ~300 | – |
| **Spoke** | 220 | 13 | 2 (3C) × 13 | 0.5 $\beta_{opt}$ | ~2 | 4.14 |
| **Medium $\beta$** | 570 | 9 | 4 (6C) × 9 | 0.67 | ~2 | 8.28 |
| **High $\beta$** | 2000 | 21 | 4 (5C) × 21 | 0.86 | ~2 | 8.28 |
| **HEBT** | 2000 | – | 0 | – | ~300 | – |

# Prototyping the ESS accelerator

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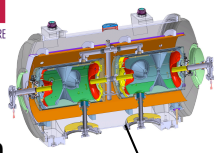
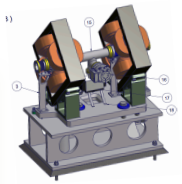
IPN INSTITUT DE PHYSIQUE NUCLÉAIRE ORSAY



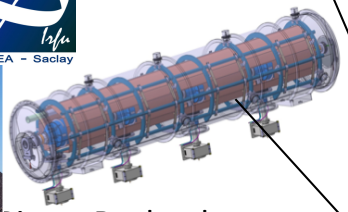
Sebastien Bousson



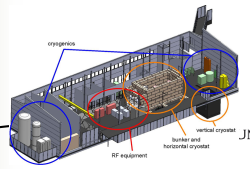
ISA

Søren Pape Møller

cea CEA - Saclay

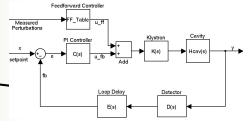


Pierre Bosland



UPPSALA UNIVERSITET

Roger Ruber



LUNDS UNIVERSITET

Anders J Johansson

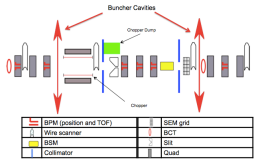
CERN

CERN

University of HUDDERSFIELD Inspiring tomorrow's professionals

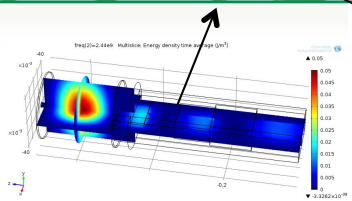
Roger Barlow

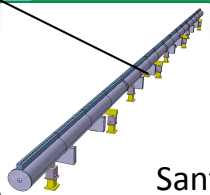
The National Center for Nuclear Research, Swierk




Ibon Bustinduy

ESS bilbao

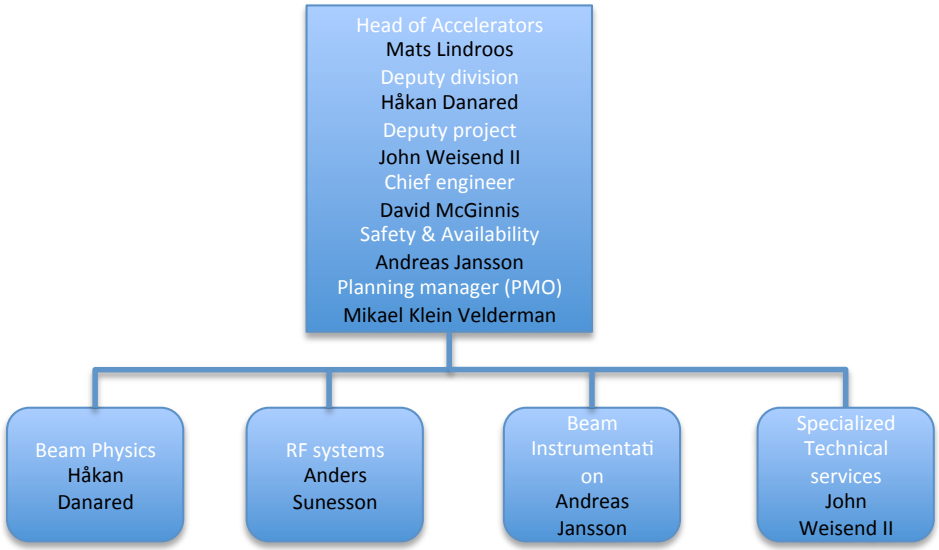




INFN Istituto Nazionale di Fisica Nucleare

Santo Gammino

# Organization and Work package leaders

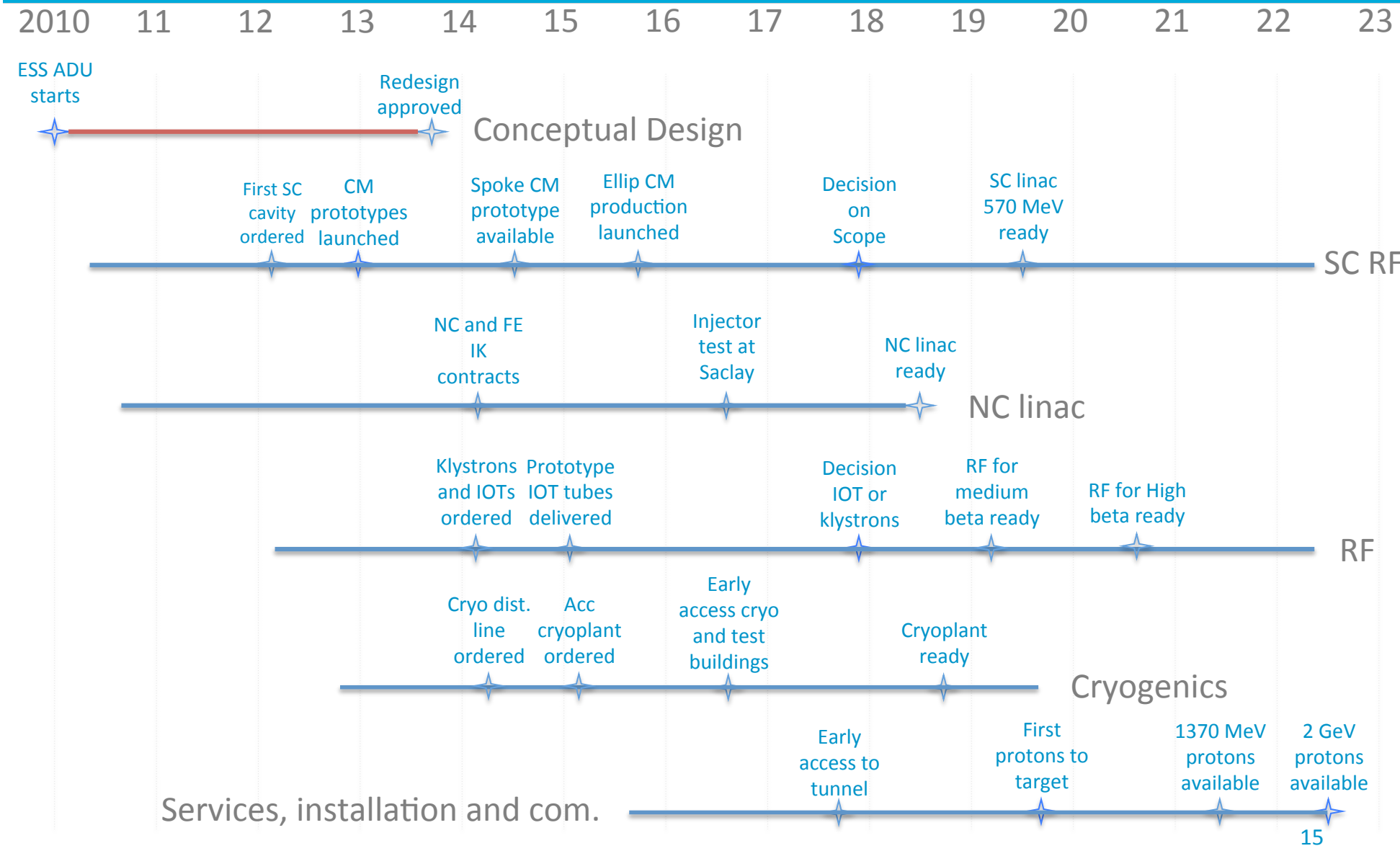



**Lead engineers:** Aurelien Ponton, Benjamin Cheymol, Stephen Molloy, Christine Darve, Peter Ladd, Tom Shea

| WP# | WP TITLE | WP LEADER | EXTERNAL WP? | LIASON FOR EXTERNAL WP |
|---|---|---|---|---|
| 1 | MANAGEMENT | J.G. WEISEND II | NO | |
| 2 | ACCELERATOR PHYSICS | M. ESHRAQI | NO | |
| 3 | NORMAL CONDUCTING FRONT END | S. GAMMINO | YES | A. PONTON |
| 4 | SPOKE CRYOMODULES | S. BOUSSON | YES | S. MOLLOY |
| 5 | ELLIPTICAL CRYOMODULES | P. BOSLAND | YES | C. DARVE |
| 6 | HEBT & MAGNETS | S. MØLLER | YES | P. LADD |
| 7 | BEAM DIAGNOSTICS | A. JANSSON | NO | |
| 8 | RF SYSTEMS | A. SUNESSON | NO | |
| 9 | ACCEL INFRASTRUCTURE & INSTALLATION | G. LANFRANCO | NO | |
| 10 | TEST STANDS | W. HEES | MIXED | W. HEES |
| 11 | CRYOGENICS | P. ARNOLD | NO | |
| 12 | VACUUM | P. LADD | NO | |
| 13 | SAFETY & RELIABILITY | A. JANSSON | NO | |
| 14 | REDESIGN EFFORT | D. McGINNIS | NO | |
| 15 | COOLING & ELECTRICAL SUPPORT | F. JENSEN | NO | |

- Division and project aligned at high level
  - ✓ "WP as a group" would make for too big fragmentation
  - ✓ Four WPs have external leaders
- Weekly or bi-weekly meetings at ESS Accelerator Division
  - ✓ Management board of project and division
  - ✓ WP leaders
  - ✓ Lead engineers
  - ✓ Safety
- Regular meetings for ACCSYS project
  - ✓ Technical board (all WP leaders and reps of labs/ uni. with contract) as governance and CCB on project level (6 meetings per year)
  - ✓ Collaboration board with reps of director of of labs/uni. with contracts as oversight committee
  - ✓ Audits yearly of every WP
  - ✓ Reviews (Conceptual, design, ready to build) as required mostly co-organized with audits

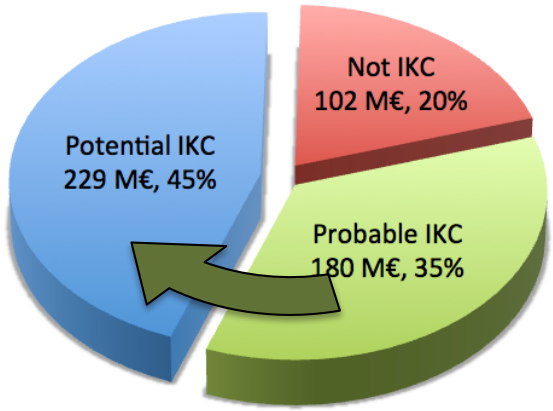
# Very high level Schedule



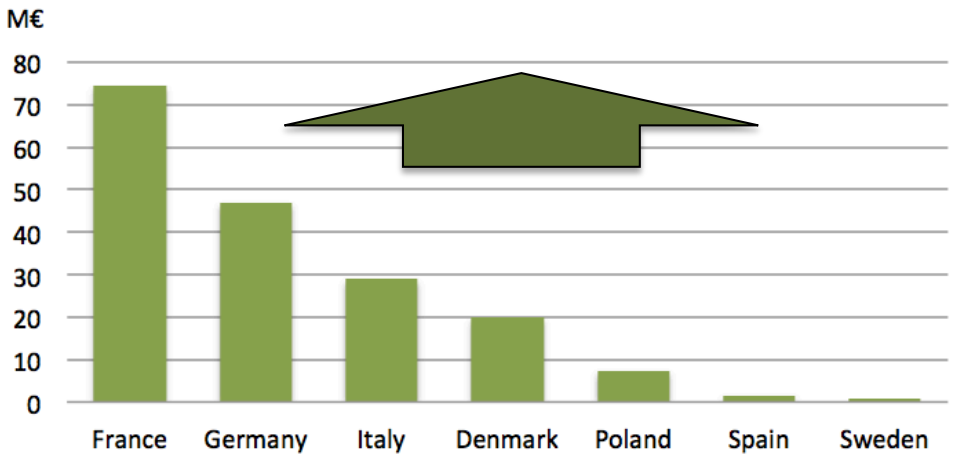
# In-Kind Potential and Partners

Probable in-kind contributions where contacts are established with partners amount to 35% of ACCSYS budget.

Another 45% are mainly commercial items which are potential in-kind contributions, but where no partners that could provide funding have been identified.

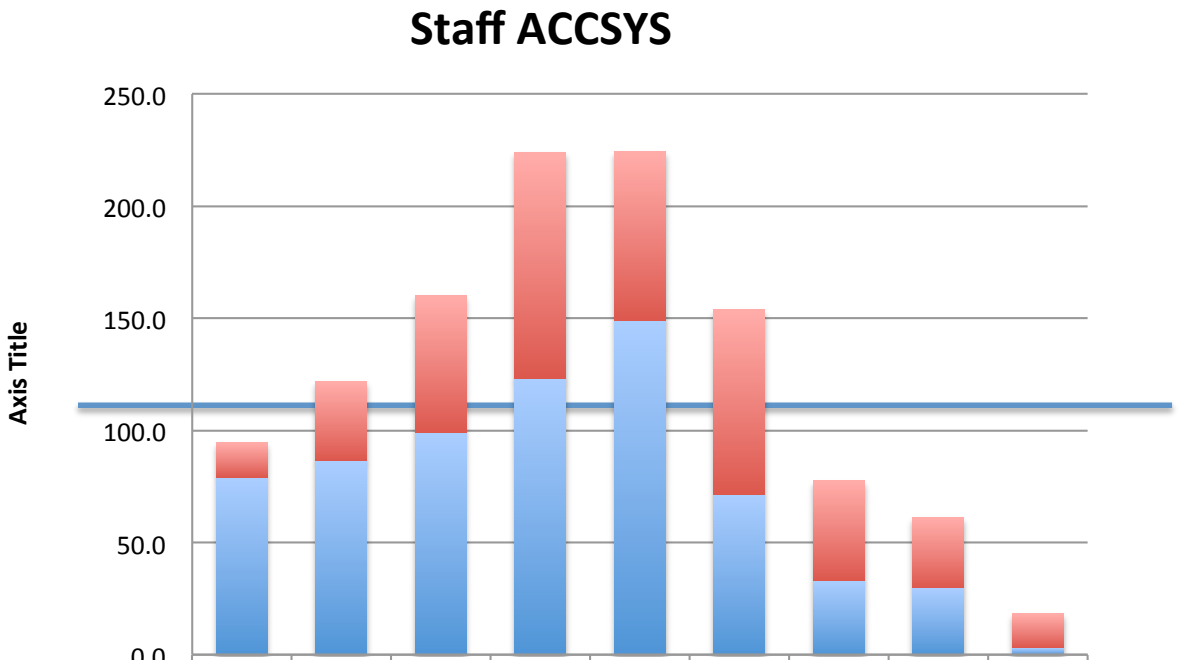



Seven countries are giving contributions to the ACCSYS pre-construction phase, and all are expected to participate also as in-kind partners for construction.



# Staff plan and in-kind

- Leveling required: i) move non critical activities, ii) temporary staff movements within division and iii) look for in-kind partners who can contribute with staff on site




| | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|
| In-kind | 15.4 | 35.3 | 60.9 | 100.8 | 75.5 | 82.1 | 44.4 | 31.5 | 15.1 |
| ESS | 79.2 | 86.7 | 99.1 | 123.2 | 148.9 | 71.6 | 33.2 | 29.8 | 3.2 |

Probable in-kind ->

# Experiences from ESS ACCELERATOR collaboration

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- The collaboration of laboratories and universities working with the design and construction of the ESS accelerator was formed in parallel to ESS contracting and grant proposals for in-kind contributions.
- A collaboration agreement to which ESS is a partners sets out the framework for the collaboration.
- The collaboration has served as a direct link for the ESS management to the management of all contracted collaboration partners
- The collaboration has helped along in-kind discussions in ESS member states for the ESS accelerator and discussed division of work
- The collaboration has recently invited potential in-kind partners (not yet contracted) to facilitate discussions for ESS on future in-kind contributions to the accelerator
- Some high level technical issues involving the partner labs are discussed in the collaboration committee
  - ✓ The Technical Board of the accelerator project and the weekly project management board handles the project management within the ESS management structure

# Strategy, disputes and competition for IK proposals

- ISOLDE collaboration:
  - ✓ The collaboration takes decisions on the the future plans for the ISOLDE facility based on the user communities needs and agrees on a strategy for grant proposal to finance new activities and projects.
  - ✓ Fully financed improvements of the facility and the experiments can be realized after final approval from INTC and the CERN Research board
  - ✓ The framework for the collaborations work and responsibilities is set out in an MoU with CERN

- ESS accelerator collaboration:
  - ✓ The collaboration discuss and advice the ESS CEO on in-kind issues for the ESS accelerator project
  - ✓ The ESS STC has the final say in all in-kind matters after advice from the appropriate ESS committees. In particular, the IK Review Committee play a key role for the approval of in-kind
  - ✓ Contracts between ESS and the partners regulates the details and sets out process for e.g. resolving disputes, delays etc.

# Conclusions

- The model with a collaboration of partners which advices and facilitates the management of in-kind contributions is a powerful tool:
  - ✓ Identify and help with grant proposals to finance in-kind
  - ✓ To create consensus on the division of work between in-kind partners
  - ✓ Resolving conflicts and technical issues at laboratory level whenever possible
- Partners with a solid link to the future users have a long term commitment and a stronger motivation to look for grants to finance in-kind
- "Open books" within collaboration (where the host laboratory is one partner) creates trust and helps assure good value for invested money