Photo: CERN 2004

Physics report
INTC 75

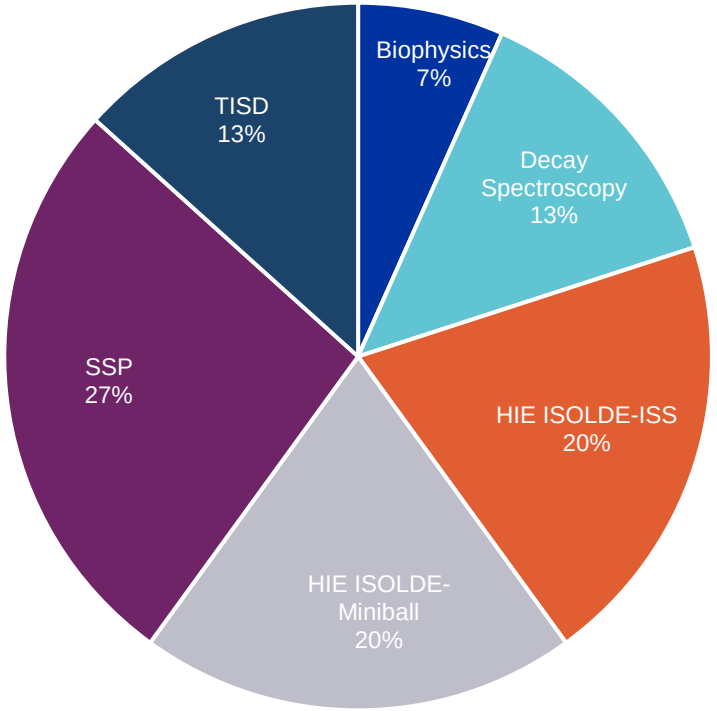
Feb 2024 - Hanne Heylen

INTC 75 summary

	# of documents	Requested shifts	Requested protons
ISOLDE	**15**	**240**	**0**
Addendum	1	14	0
Letter of Clarification	1	18	0
Letter of intent	2	12	0
Proposal	11	196	0
nTOF	**6**	**0**	**1.9E+19**
Addendum	1	0	4.7E+18
Letter of intent	2	0	3.4E+18
Proposal	3	0	1.1E+19
Grand Total	**21**	**240**	**1.9E+19**

ISOLDE

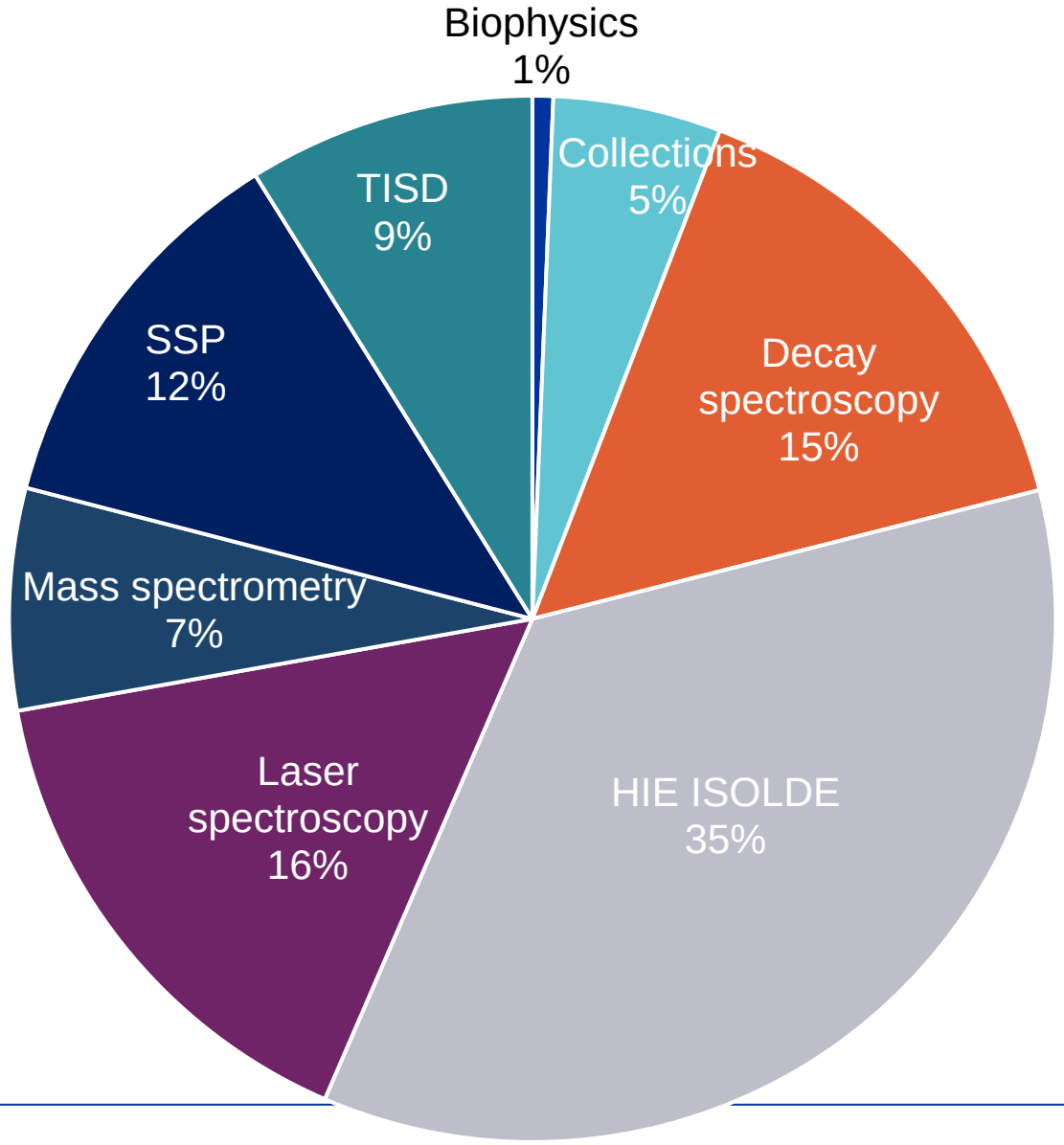
Distribution of documents per topic



1 shifts = 8 hours; 1 day~ 1 x 10^{17} protons

ISOLDE backlog before INTC 75

- ~1300 open shifts
- ~150 active experiments

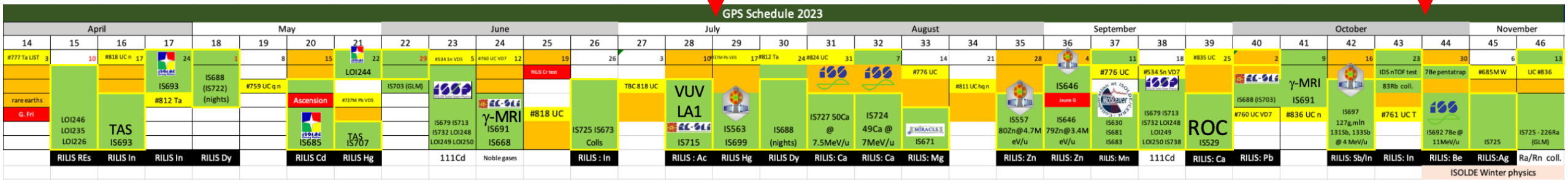


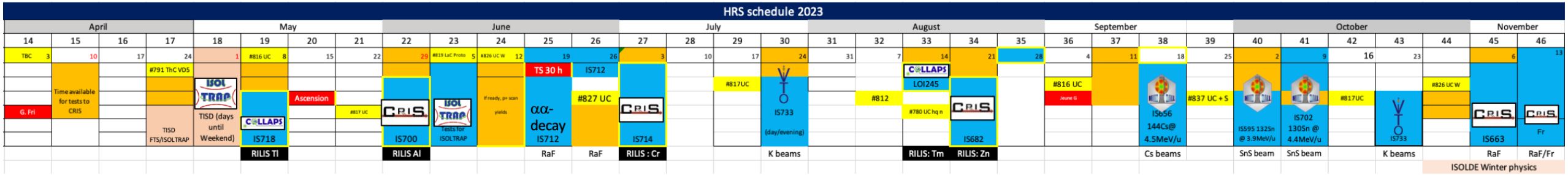
ISOLDE schedule 2023

Protons for physics to ISOLDE from **10 April – 30 October**
→ 20% less than 2022 due to energy considerations

HIE-ISOLDE: 21 July

Winter Physics: 30 Oct.

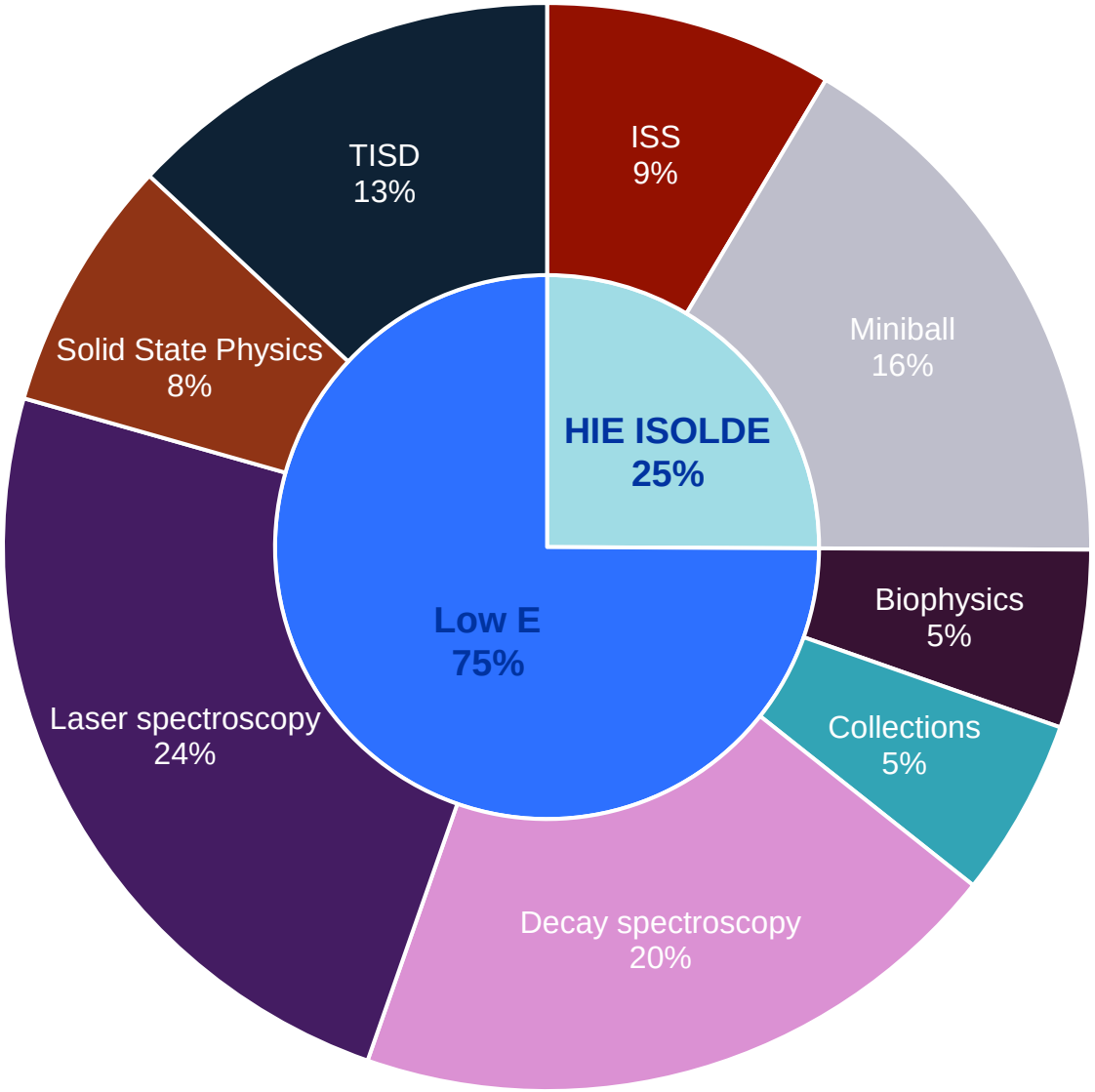




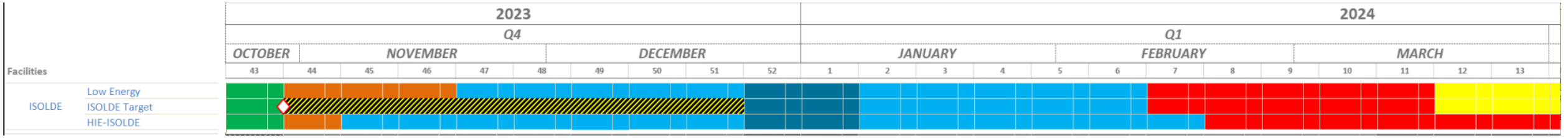
In total there were **64 runs**, giving beam to **46 INTC** approved experiments (some ran more than once), including10 HIE-ISOLDE experiment.

ISOLDE schedule 2023

- 493 shifts were delivered, reducing the backlog by 426 shifts.
- 67 shifts (=13.5%) available for ad-hoc opportunities (extension of beam times, alternative measurements in case of failures, etc.)



Yearly Technical Stop (YETS) and 2024 Restart



Key dates

- 30th October 2023 – End of proton physics and start of winter physics
- 6th November 2023 – End of HIE winter physics (1 wk)
- 20th November 2023 – End of Low Energy winter physics (3 wks)
- 19th February 2024 – Start of Target, Low E and HIE ISOLDE HW Commissioning
- 18th March 2024 – Start of Target and Low E Beam commissioning (first protons to ISOLDE 28th March. SEMGRID tests 28th March – 8th April)
- **8th April 2024 – End of the Low E and Target Beam Commissioning / Start of Low E Physics**
- 13th May 2024 – Start of HIE-ISOLDE Beam Commissioning
- 21st June 2024 – HIE ISOLDE stable beam to exp. Stations
- **11th July 2024 – Start of HIE ISOLDE Physics**
- 28th October 2024 – End of protons

Material provided by Zixuan Yue

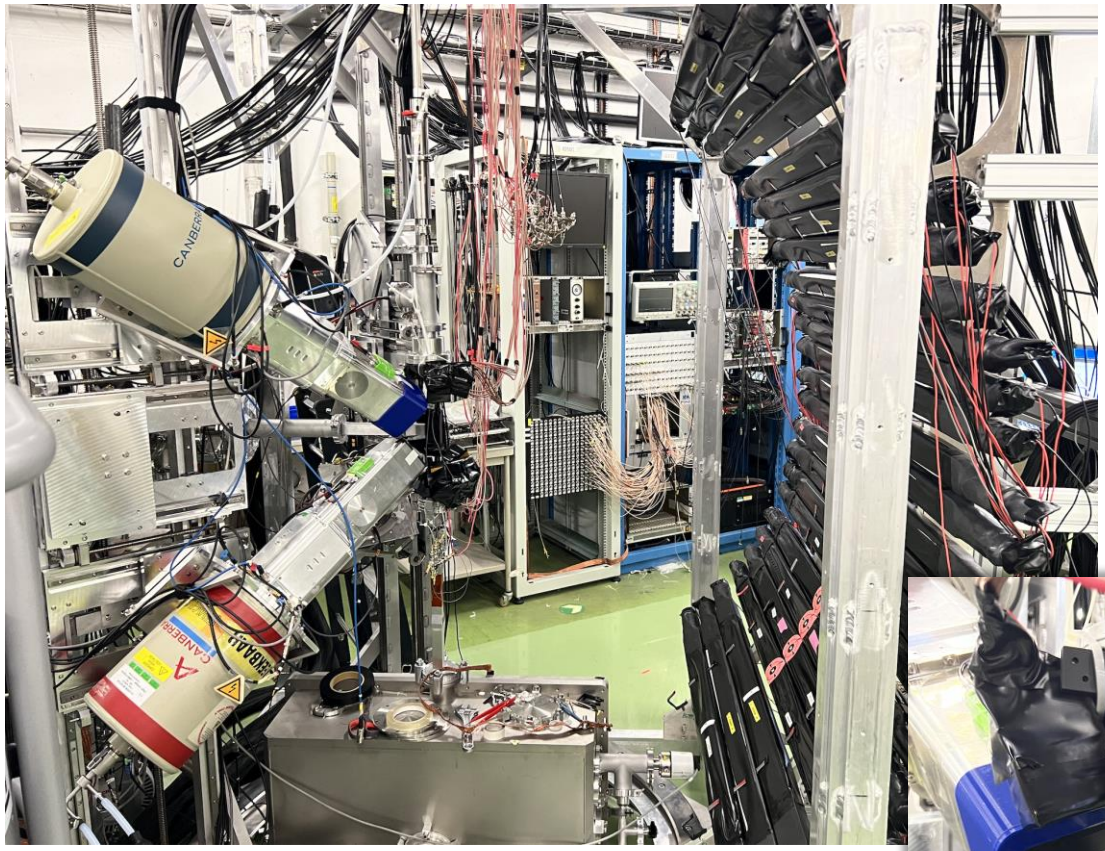
Feedback from runs

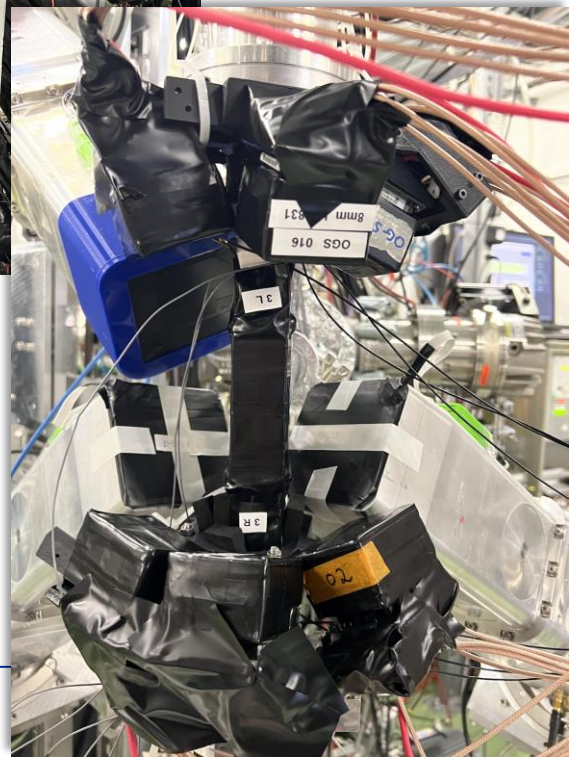
IDS

Test run for IS702

- 132-135In neutron decay measurements
- Setup
  - Installation of 6 new OGS detectors
    - Low-energy neutrons + higher efficiency
  - INDiE bars
  - 4 clovers for gammas and 3 beta detectors

Ad-hoc 29-31Na experiment as VITO replacement





Ready for neutron spectroscopy campaign this year!

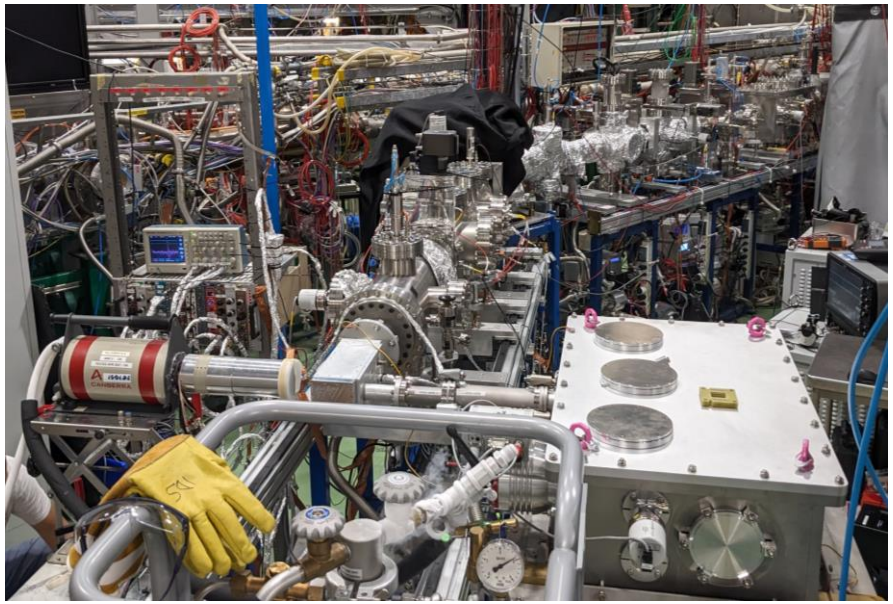
Material provided by Louis Lalanne

Feedback from runs

CRIS

Setup

- Upgrade of the end of the beam line: beam transport efficiency toward the ion and particle detectors improved by a factor 4.
- Installation and commissioning of the CRIS decay spectroscopy station: tape system synchronised with lasers and ion release. Allows to perform decay assisted laser spectroscopy and decay spectroscopy with isometrically purified beams. System commissioned successfully with 75Zn during the Zn beam time.



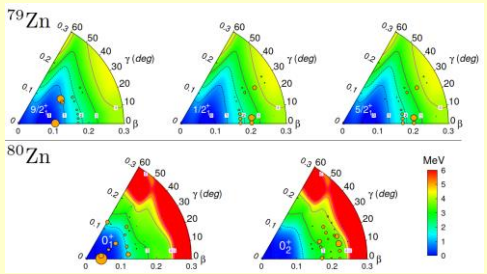
Physics

- High res. 29-34Al, charge radii across N=20 in the island of inversion
- High res. 80,81,82Zn, Charge radii across N=50 and moments of N=51 in the vicinity of 78Ni
- High res. 50-62Cr. Charge radii and moments from N=28 to N=40 entering the N=40 island of inversion
- Low res. of 221Fr. New states discovered. Successful preparation of the 2024 run.
- Low and high res. of 226,225RaF. New state discovered. Pin down the rotational constants of 225RaF

Feedback from runs

Ch. Schweiger and
L. Nies (CERN) and
D. Lange (MPIK)

Further evidence for shape coexistence near doubly-magic ^{78}Ni

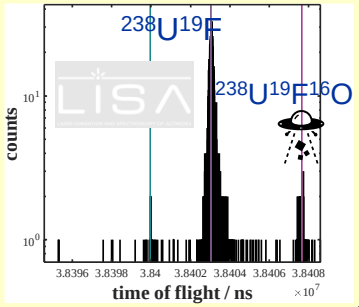


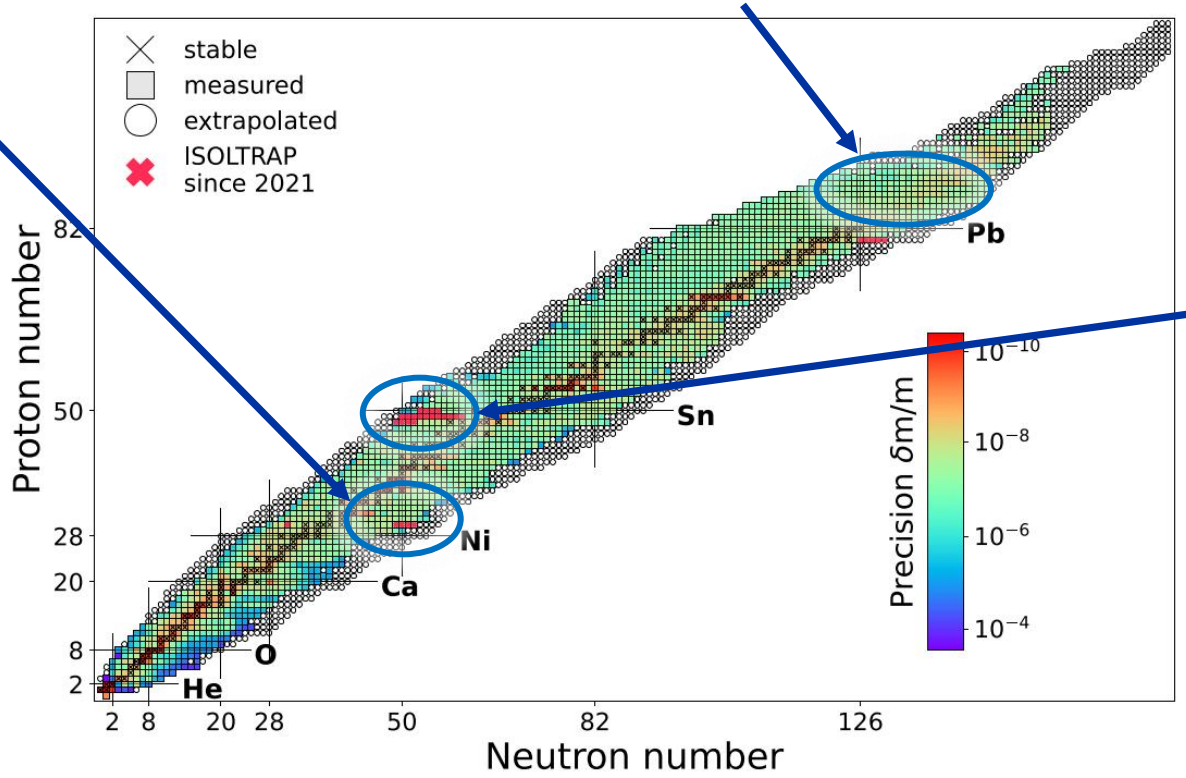
Nies et al., Phys. Rev. Lett. **131**, 222503 (2023)

Actinide Studies with LISA

Target and ion source development with the „Laser Ionization and Spectroscopy of Actinides“ ITN consortium

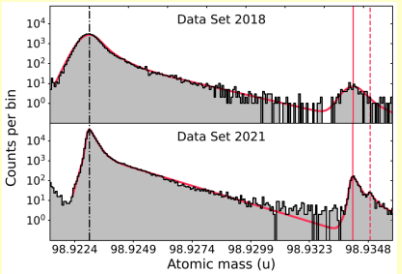
M. Au et al., Phys. Rev. C **107**, 064604 (2023)
M. Au et al., NIM B **541** (2023), p. 375-379





Closing in on ^{100}Sn: Investigation of shell evolution near doubly-magic

First-ever measurement of ^{99m}In at N=50



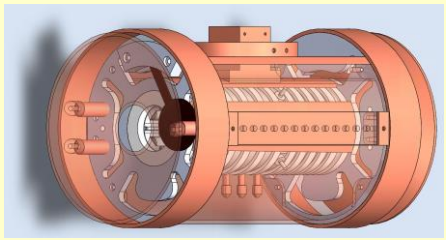
Nies et al., Phys. Rev. Lett. **131**, 022502 (2023)

First-ever measurement of ^{97gs,m}Cd past N=50

D. Lange et al., in preparation

Outlook: Going Beyond

New State-of-the-art Multi-Reflection Time-of-Flight Mass Spectrometer And Cryogenic Paul Trap for ultra-low yield rare isotopes



Feedback from runs

Three very successful experiments in 2023!

Sensitivity limit pushed down to less than 40 ions/s and 25MHz resolution

IS 529 **Laser spectroscopy of very exotic Ca isotopes**

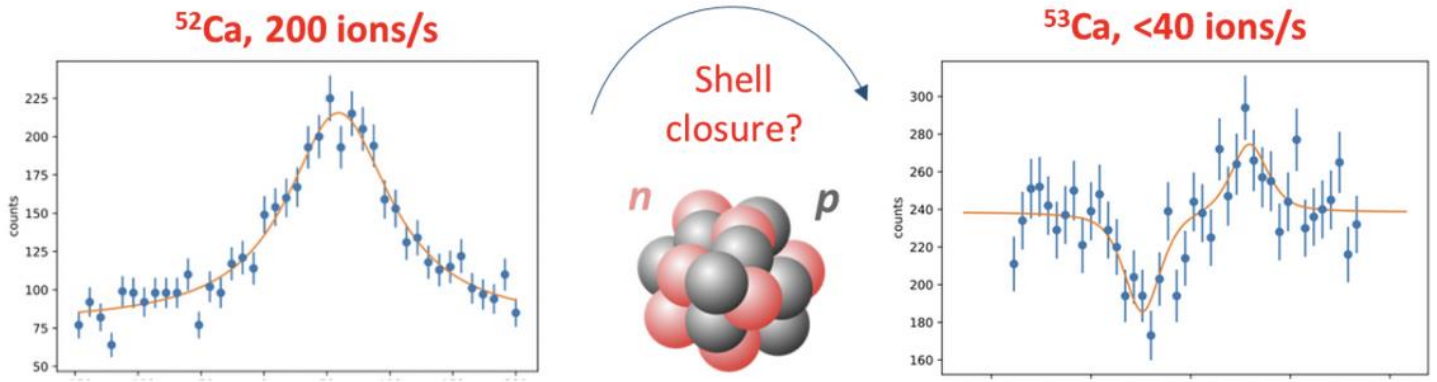
- ✔ Spectroscopy on Ca isotopes with less than 40 ions/s using the recently developed ROC setup.
- ✔ Hyperfine structure and isotope shift of ^{53}Ca measured for the very first time.

LoI 245 **Towards the proton emitter nuclei ^{147}Tm**

- ✔ Hyperfine structures and isotope shifts of more than 20 isotopes and 10 isomers measured.
- ✔ Two new isomeric states discovered.
- ✔ Very high-precision data with less than 25MHz resolution.

IS 718 **Laser spectroscopy of neutron rich Tl isotopes**

- ✔ Hyperfine structures and isotope shifts of more than 25 isotopes and 15 isomers measured.
- ✔ Nuclear properties of more than 15 isotopes measured for the very first time.



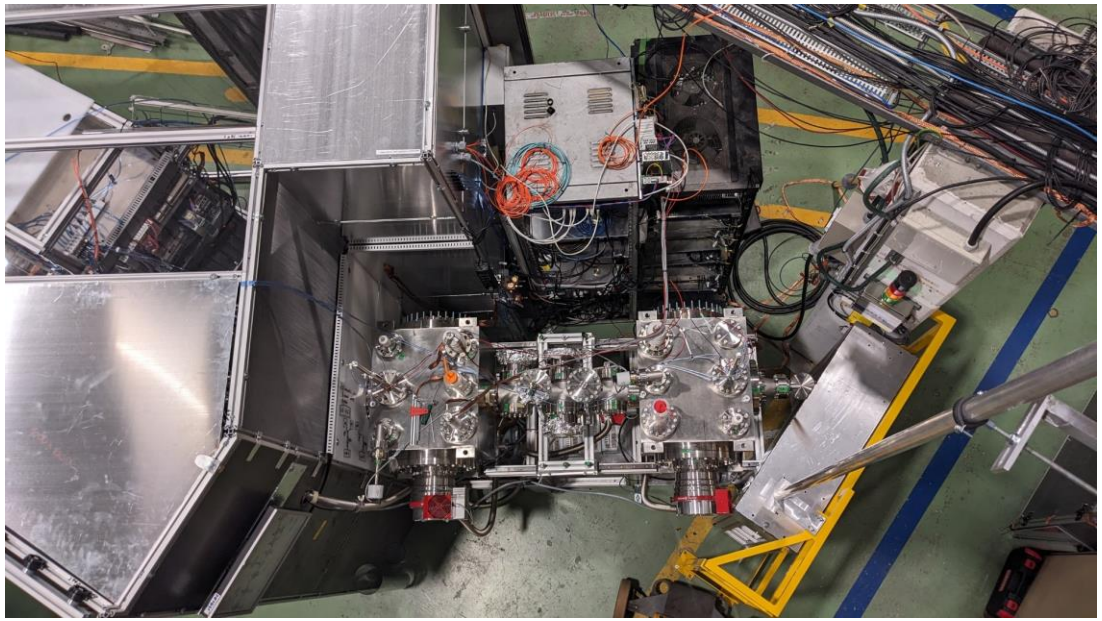
Material provided by Liss Vazquez-Rodriguez

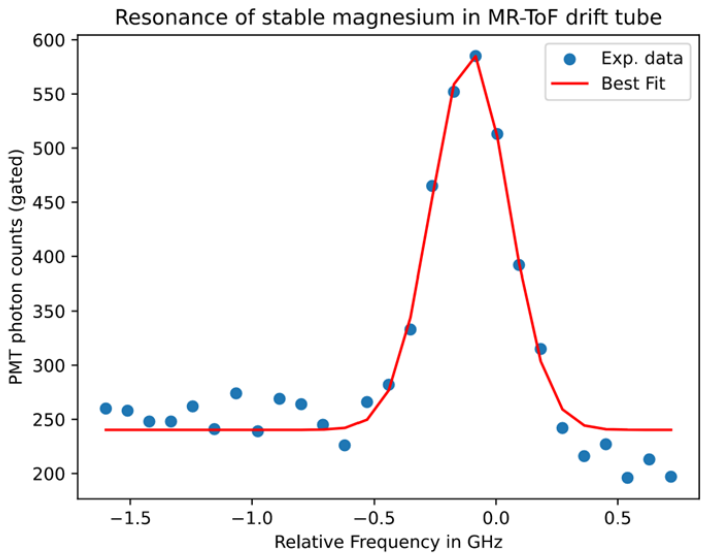
Material provided by Simon Lechner

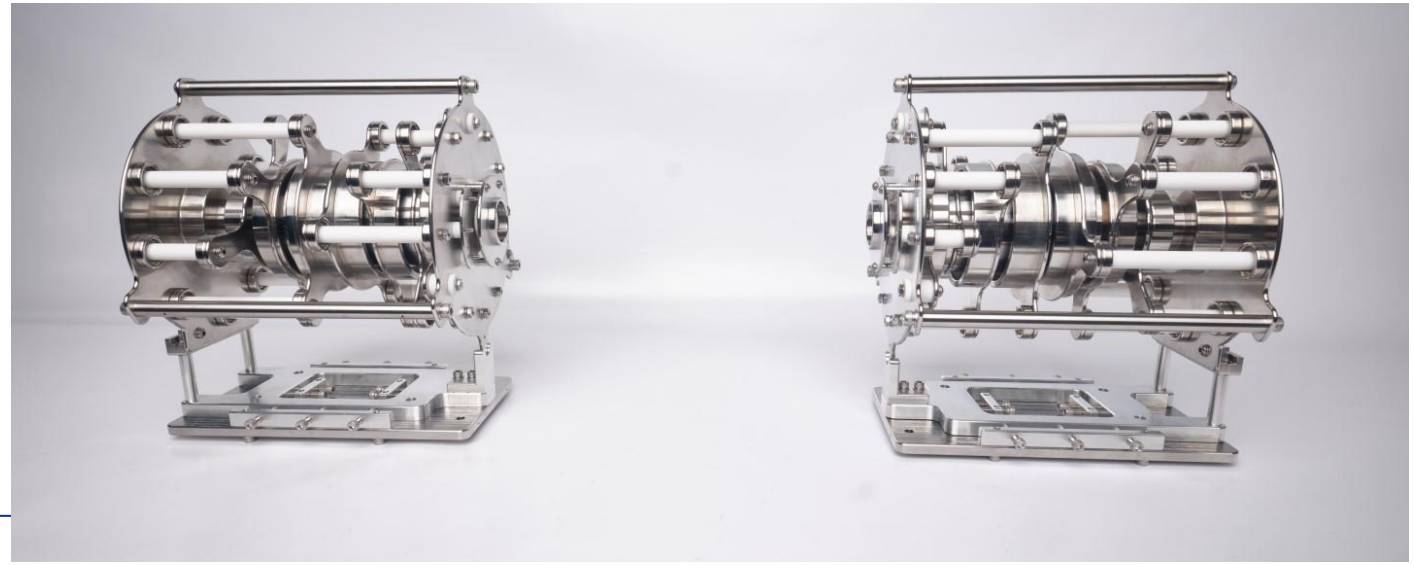
Feedback from runs

MIRACLS

- New MIRACLS setup fully operational for the first time
- Trap ions in MR-ToF for 16 revolutions
- First CLS spectra of 26Mg from ISOLDE





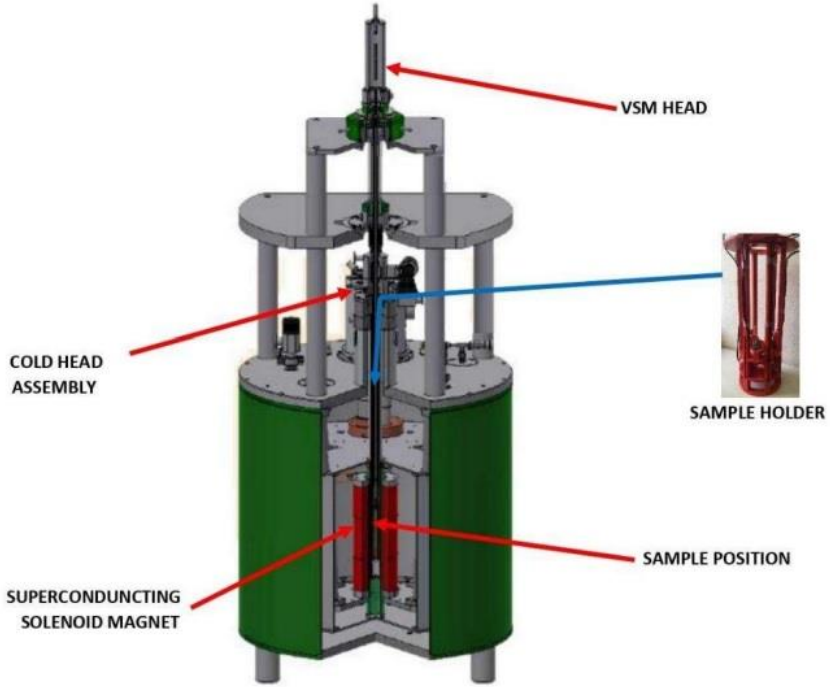


Material provided by Juliana Schell

Feedback from runs

SSP

- Successful commissioning of **MULTIPAC setup** (currently installed in b. 275):
  - Hardware is fully operational, including detectors
  - Good energy resolution (2.8% for 60Co)
  - At the moment, poor time resolution (10 ns), working on improvements to reach 220 ps
    - Limited to simple magnetic elements so far
- Tested new emission Mossbauer setup



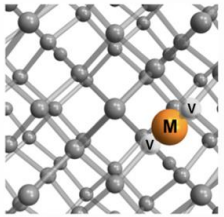
Material provided by Uli Wahl

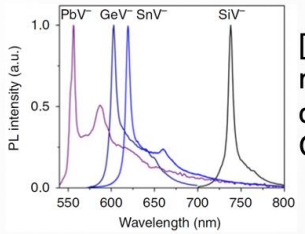
Feedback from runs

^{209}Pb emission channeling identification of Pb*V* colour centers in diamond

SSP

- Pb*V*$^{-}$ is one of the group IV-*vacancy* complexes in diamond which are promising for applications in quantum information processing [1]



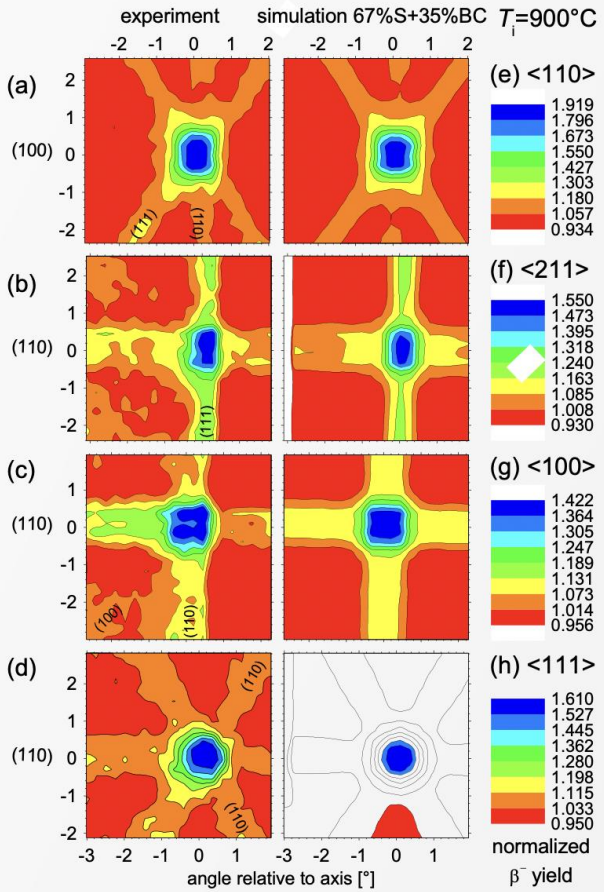


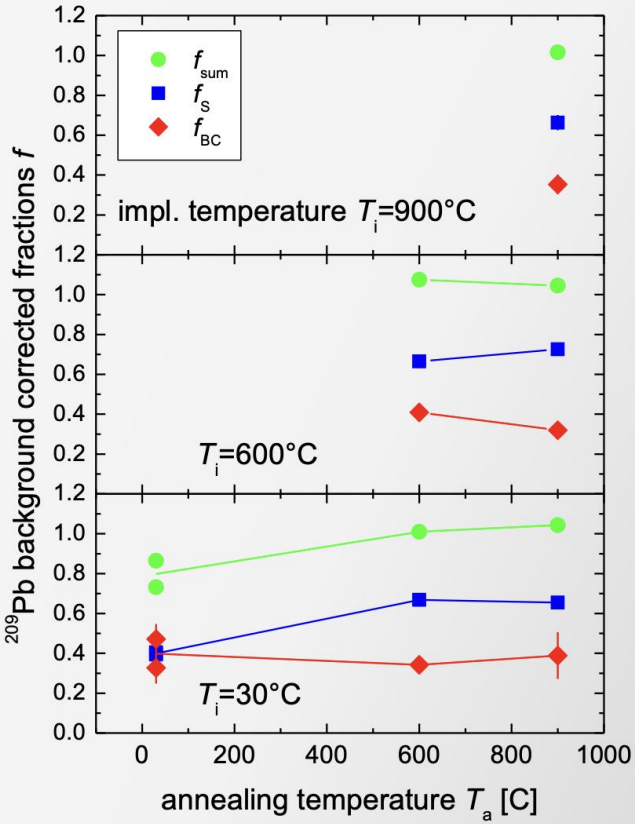
[1] C. Bradac *et al*, "Quantum nanophotonics with group IV defects in diamond", Nature Comm. 10 (2019) 5625

- First emission channeling lattice location experiments using ^{209}Pb ($t_{1/2}$=3.25h) in diamond
- Implantations and annealings up to 900°C identified 35-40% of ^{209}Pb on bond-center (BC) sites in split-vacancy complexes.

⇒ **High *structural* formation yield and high thermal stability of Pb*V* against thermal annealing**

- However, reported *optically active* formation yield [1] is only ~2%. Why? Pb*V* not in correct charge state?

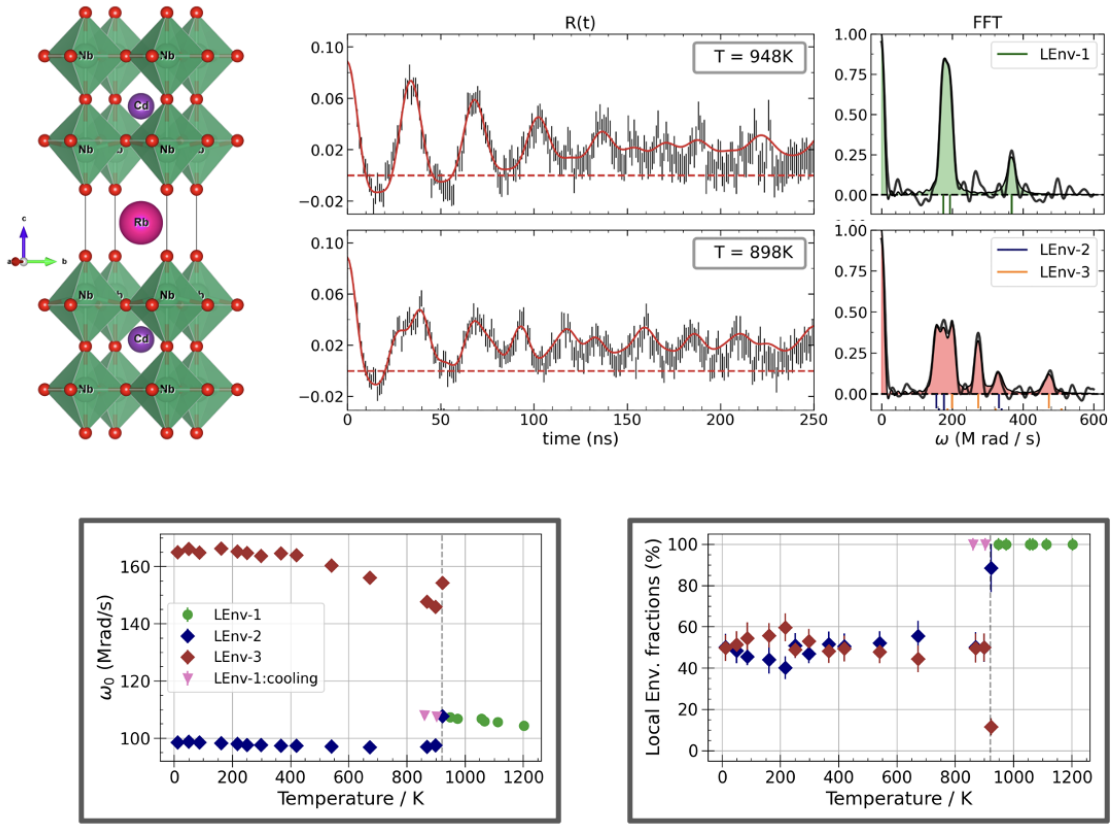




Feedback from runs

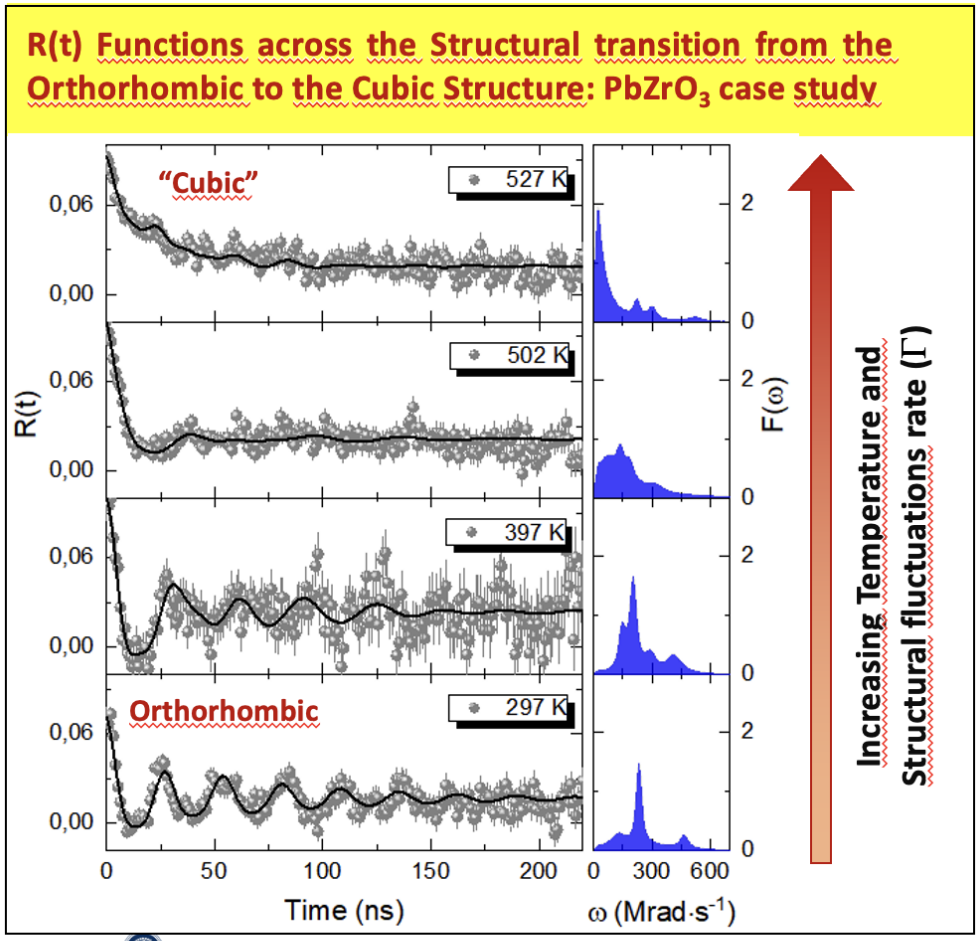
Material provided by Pedro Rodrigues

IS738 ^{111m}Cd Microscopic insight by nuclear hyperfine methods on ferroic Perovskites



new 1st order phase transition at 920K

IS730 - ^{111m}Cd Perturbed Angular Correlation (PAC) Study of Dynamic Order-Disorder Structural transitions in Halide and Oxide Perovskite Systems

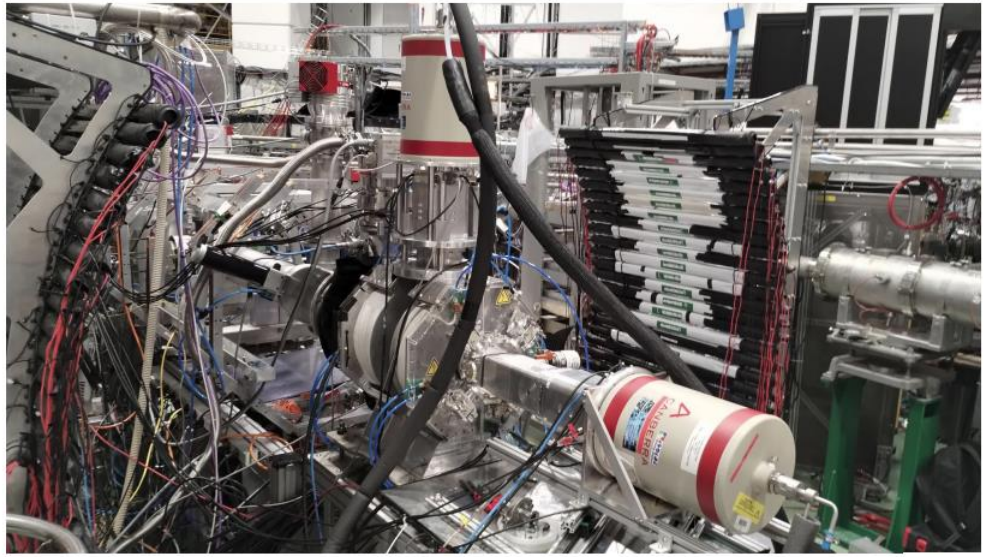


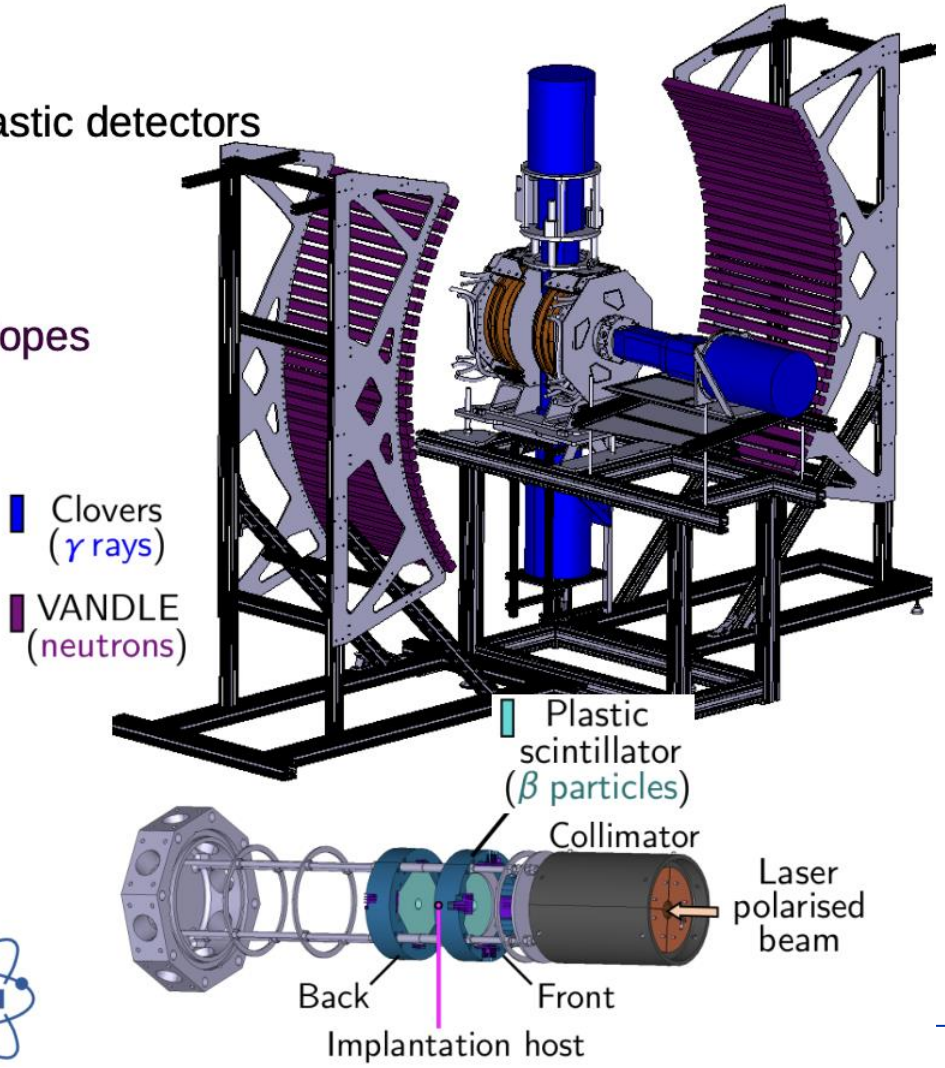
Feedback from runs

Material provided by Monika Piersa-Silkowska

New end station at VITO – DeVITO

- β-decay spectroscopy with laser-polarised beams
- Detection setup: 3x Clovers, 2x VANDLE *tof* arrays, 2x plastic detectors
- DAQ: XIA PIXIE-16 (160 channels used)
- New compact magnet and implantation system
- Successfully commissioned in July 2023 with n-rich K isotopes





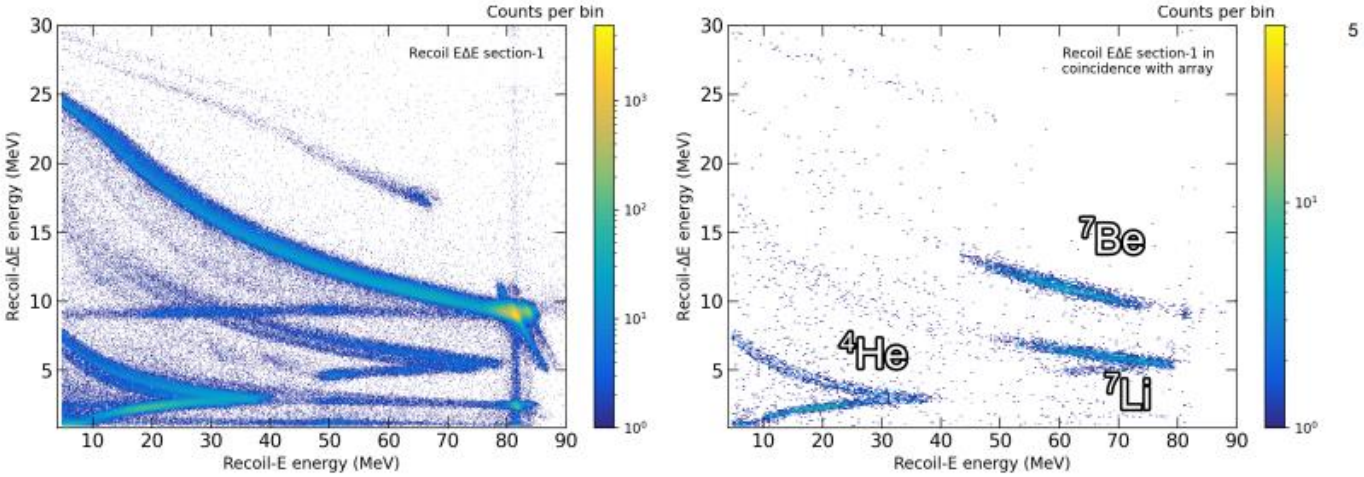
Material provided by Patrick Macgregor

Feedback from runs

ISOLDE Solenoidal Spectrometer

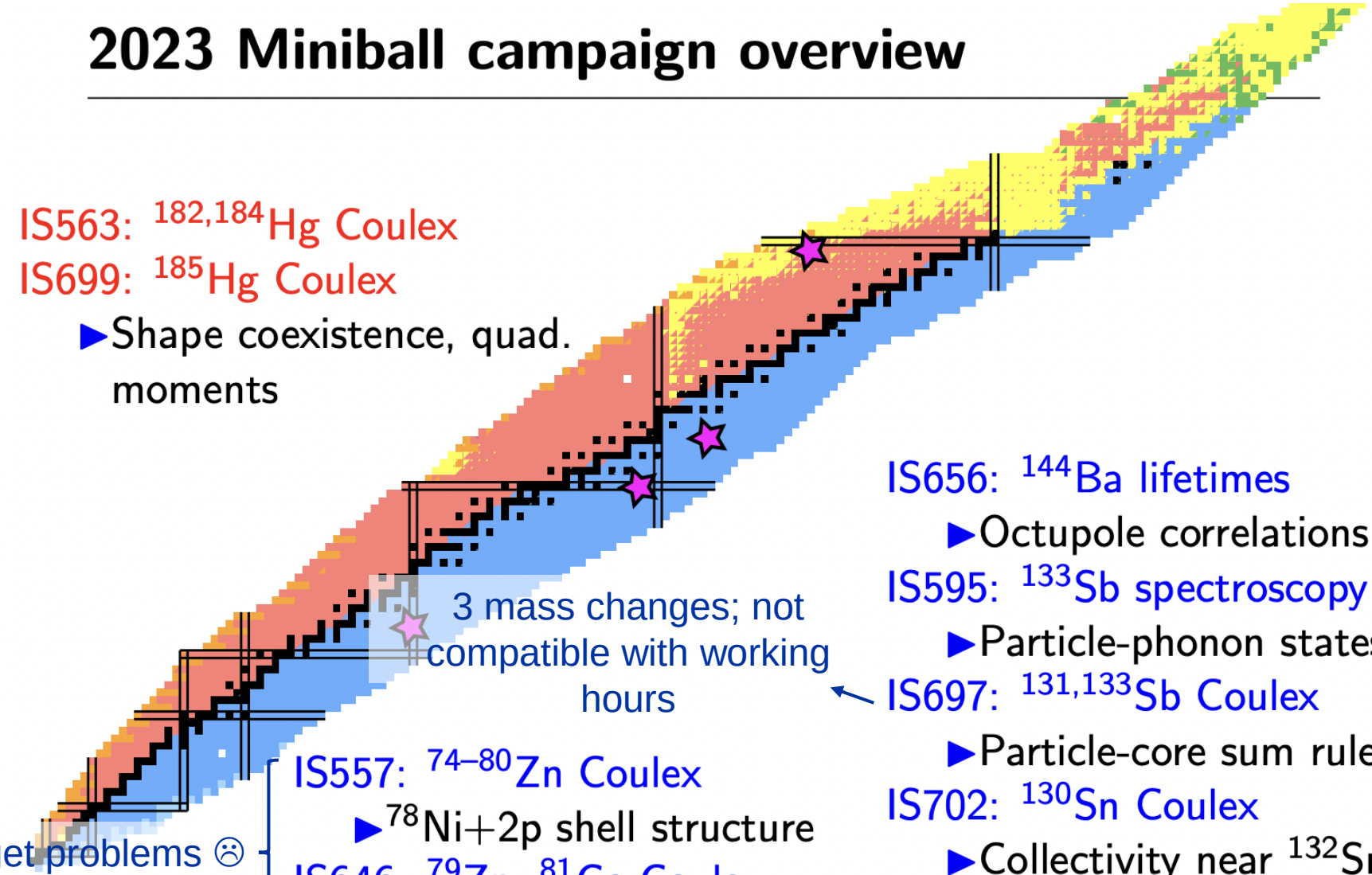
3 successful runs in 2023

- Commissioning of the SPECMAT detector at ISS
- 49,50Ca(d,p)
- 7Be(d,p) @ 11 MeV/A to populate high-lying rotational bands in 8Be
  - "*ISOLDE is the only facility that can provide the necessary yield and energy*" → Happy users
  - Winter Phvsics (less influence of 7Li contamination)



Feedback from runs

Material provided by Frank Browne



Winter physics

Material provided by T.E. Cocolios/M. Deseyn

- **IS672**
  - Preparation for absolute charge radii measurement of 108mAg via muonic x-ray spectroscopy at PSI
  - Sample irradiated at PSI inserted in ISOLDE target
  - Determine best conditions to separate 110mAg from the contaminants

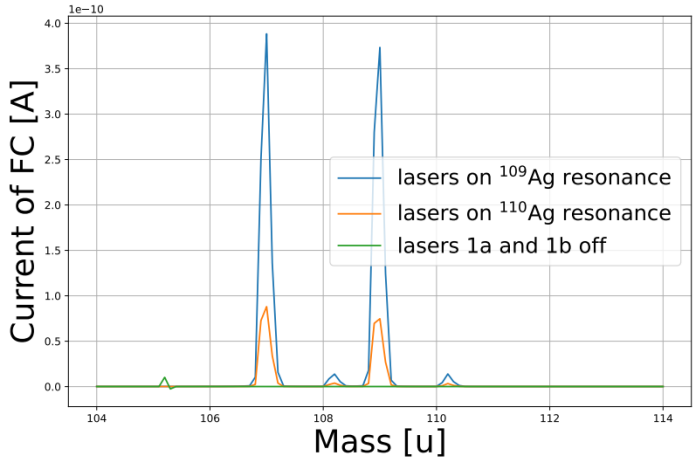
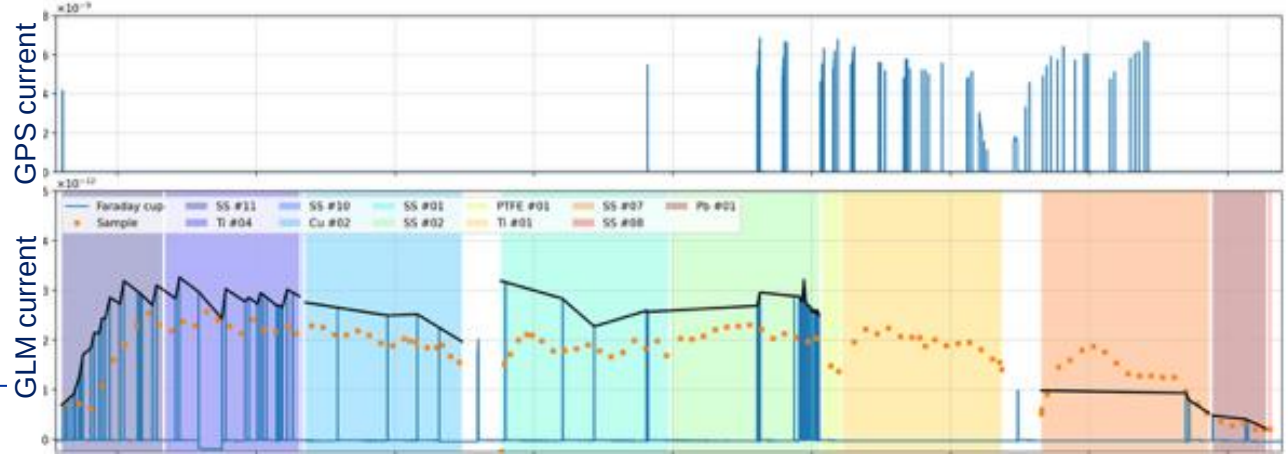
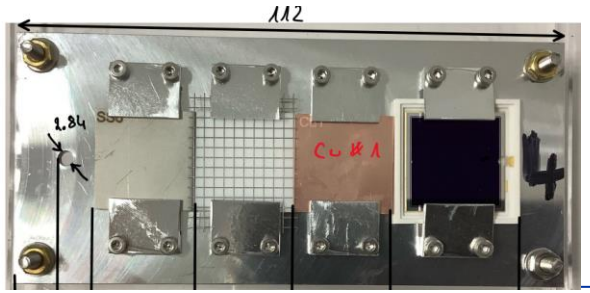


Figure 4: Mass scans for the lasers on the ^{109}Ag and ^{110m}Ag resonances as well as without lasers. The target and line temperature equals 0A and 260A, respectively.

- **IS725**
  - 226Ra in several materials → transport to MPIK for detector characterization in the context of the XENON and DARWIN/XLZD direct dark matter search experiments.
  - Didn't collect required activity, but nevertheless positive experience. Will come back.





Material provided by F. Joerg, G. Volta

Safety

- Safety files!
- Procedures – contect EP safety
- Cleaning
  - ISOLDE hall
  - B. 275 – Thanks Liss Vazquez-Rodriguez!!