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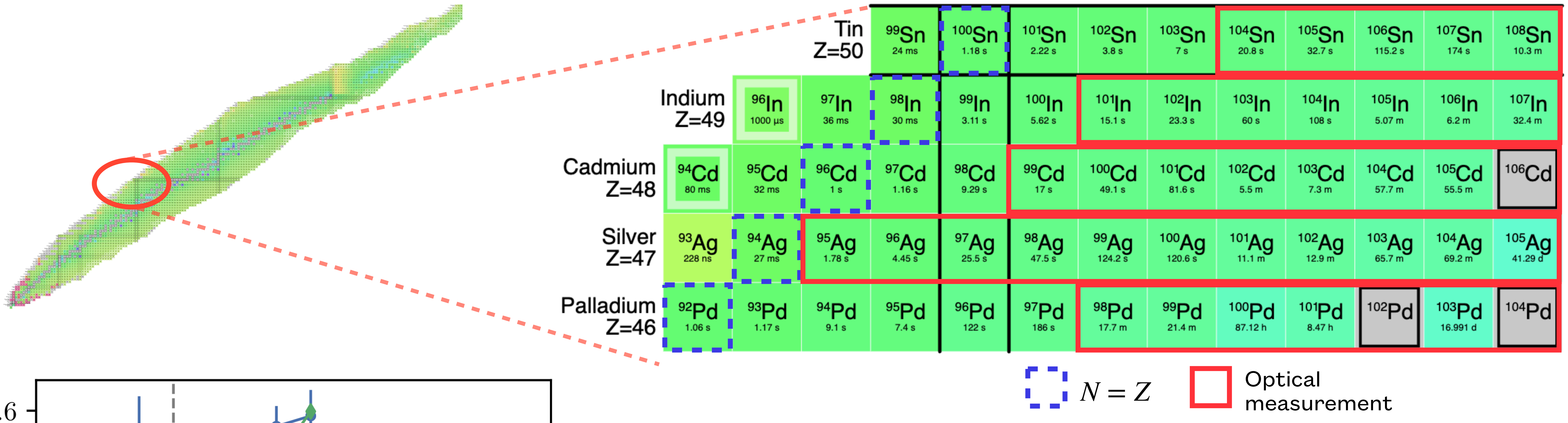
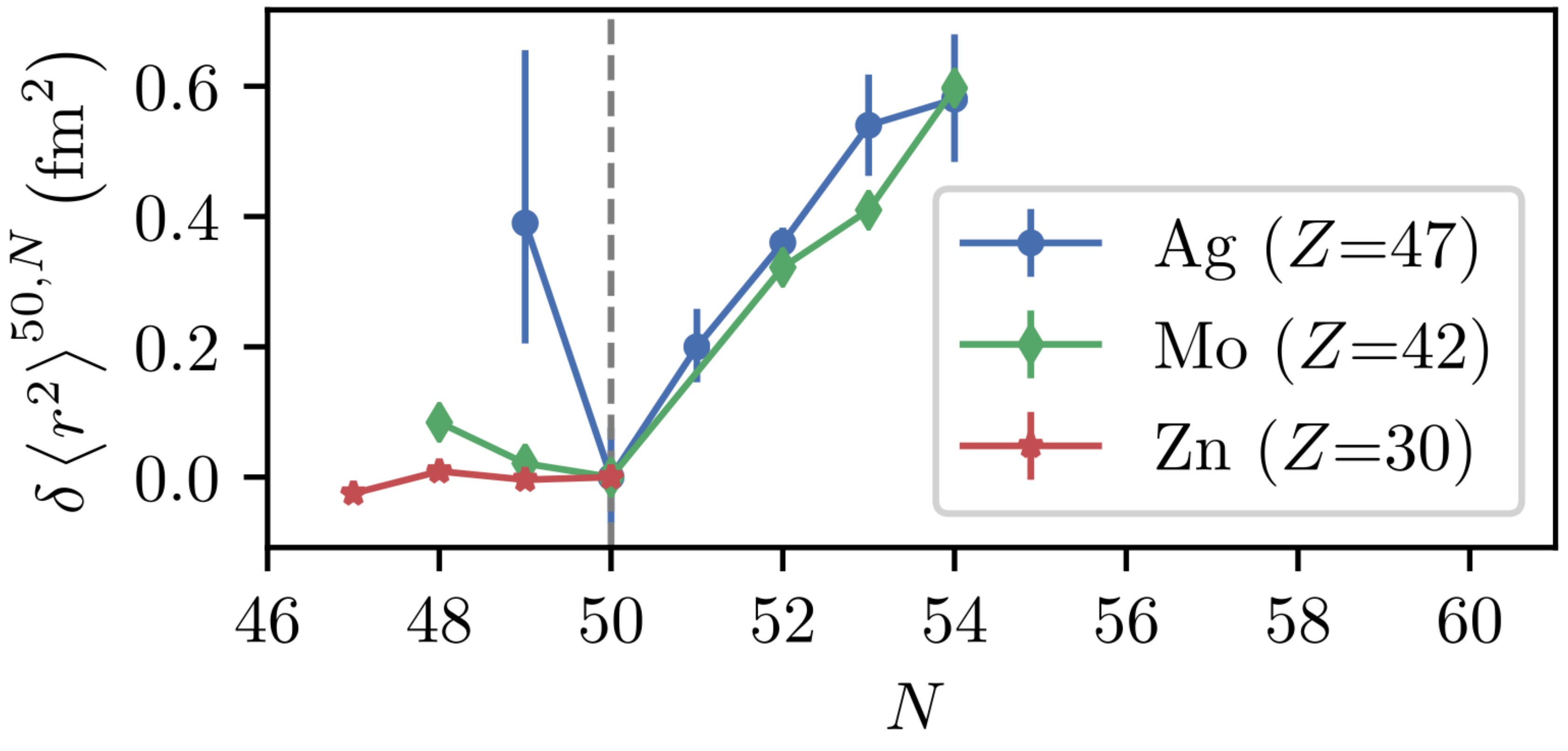
Ground-state properties of exotic silver isotopes in the immediate vicinity of ^{100}Sn

NATALIA AMBROSIO, 07.05.2026

15TH NORDIC MEETING ON NUCLEAR PHYSICS, VISBY, GOTLAND

Proton-rich Ag isotopes below ^{100}Sn



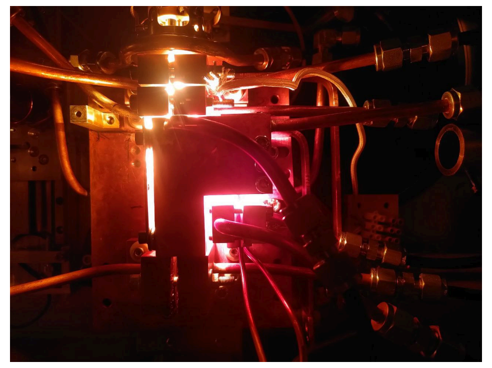


The change in the charge radii for Zn, Mo, and Ag near N= 50 illustrate an increasing trend in the magnitude of the kink as a function of proton number towards 100Sn. The error bars indicate the statistical error. (Extracted from Reponen et al., Nat. Commun. (2021) [1])

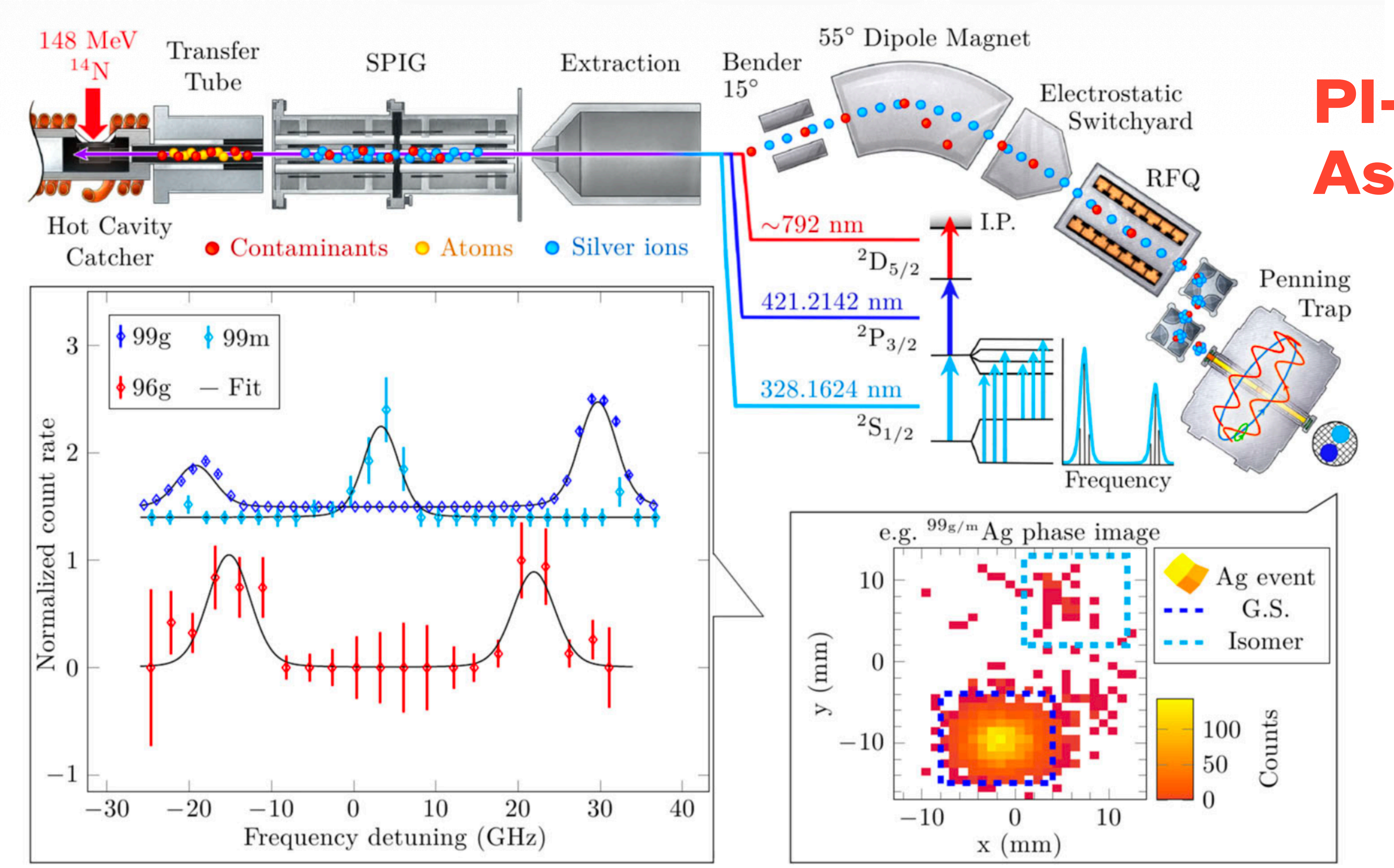
- Enhanced $p-n$ pairing correlations (Can we see a spin-aligned phase fingerprint in nuclear binding energies?).
- Crossing the N=50 line causes a pronounced discontinuity "kink" in nuclear charge radii.
- Current single-reference Density Functional Theory (DFT) models struggle to reproduce this sudden increase in size.

[1] M. Reponen et al. "Evidence of a sudden increase in the nuclear size of proton-rich silver-96". Nature Communications 12.1 (2021), p. 4596.

Experimental Methodology @ IGISOL



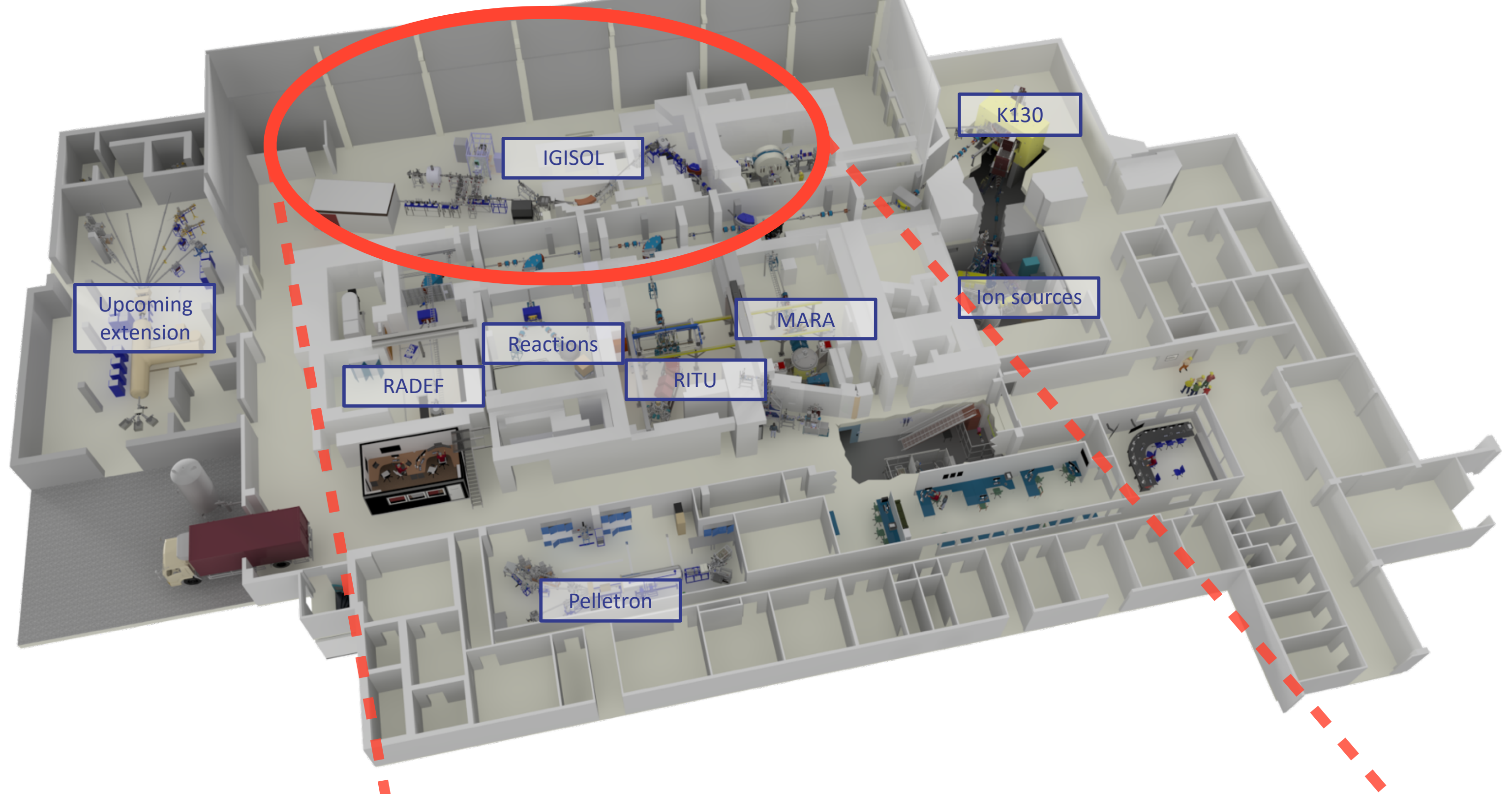
HCLIS

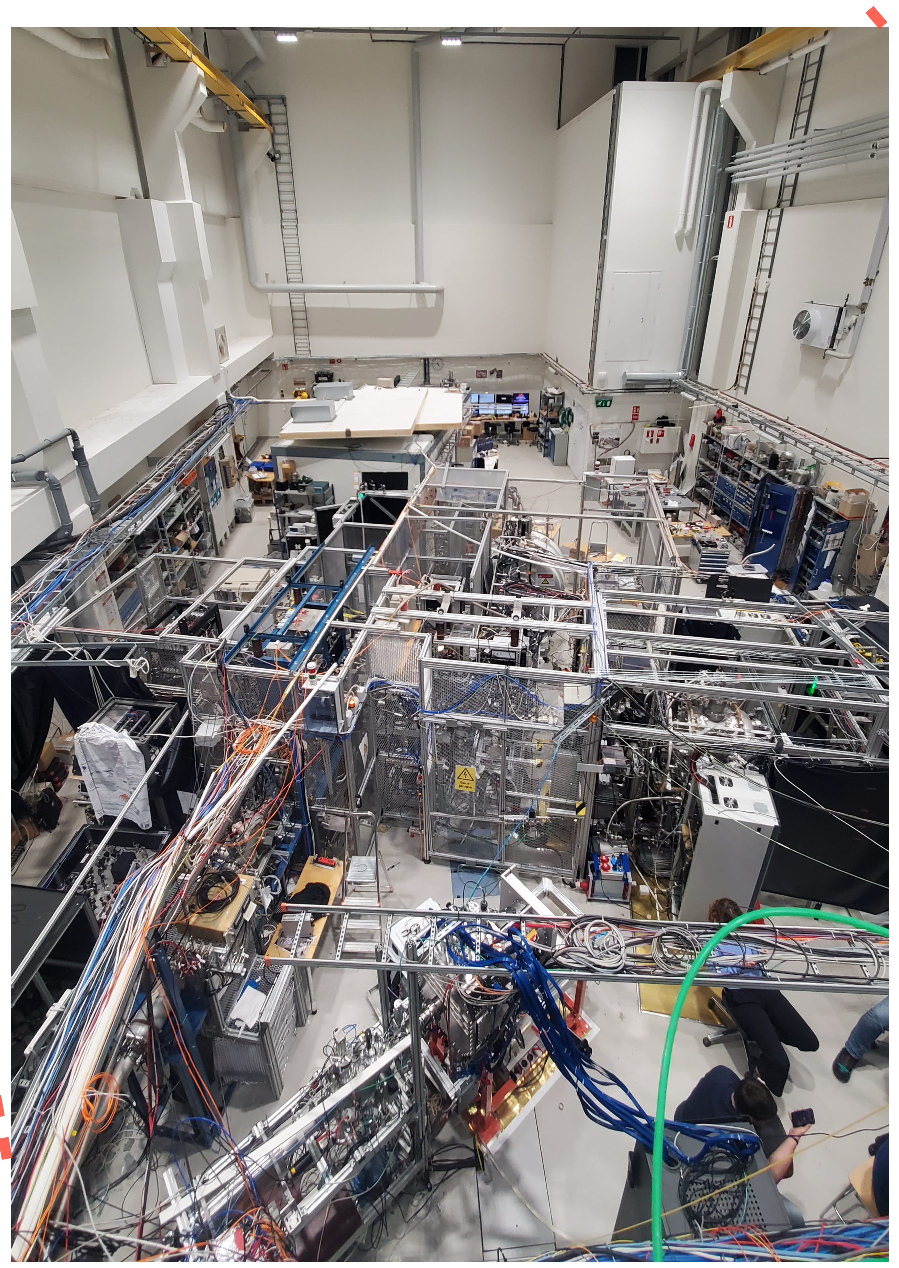


PI-ICR
Assisted RIS

Ionization & transport: Laser ionization → SPIG → acceleration, mass separation, RFQ bunching.
Detection: Penning trap (PI-ICR) → hyperfine spectra extraction.
(Extracted from Reponen et al., Nat. Commun. (2021) [1])

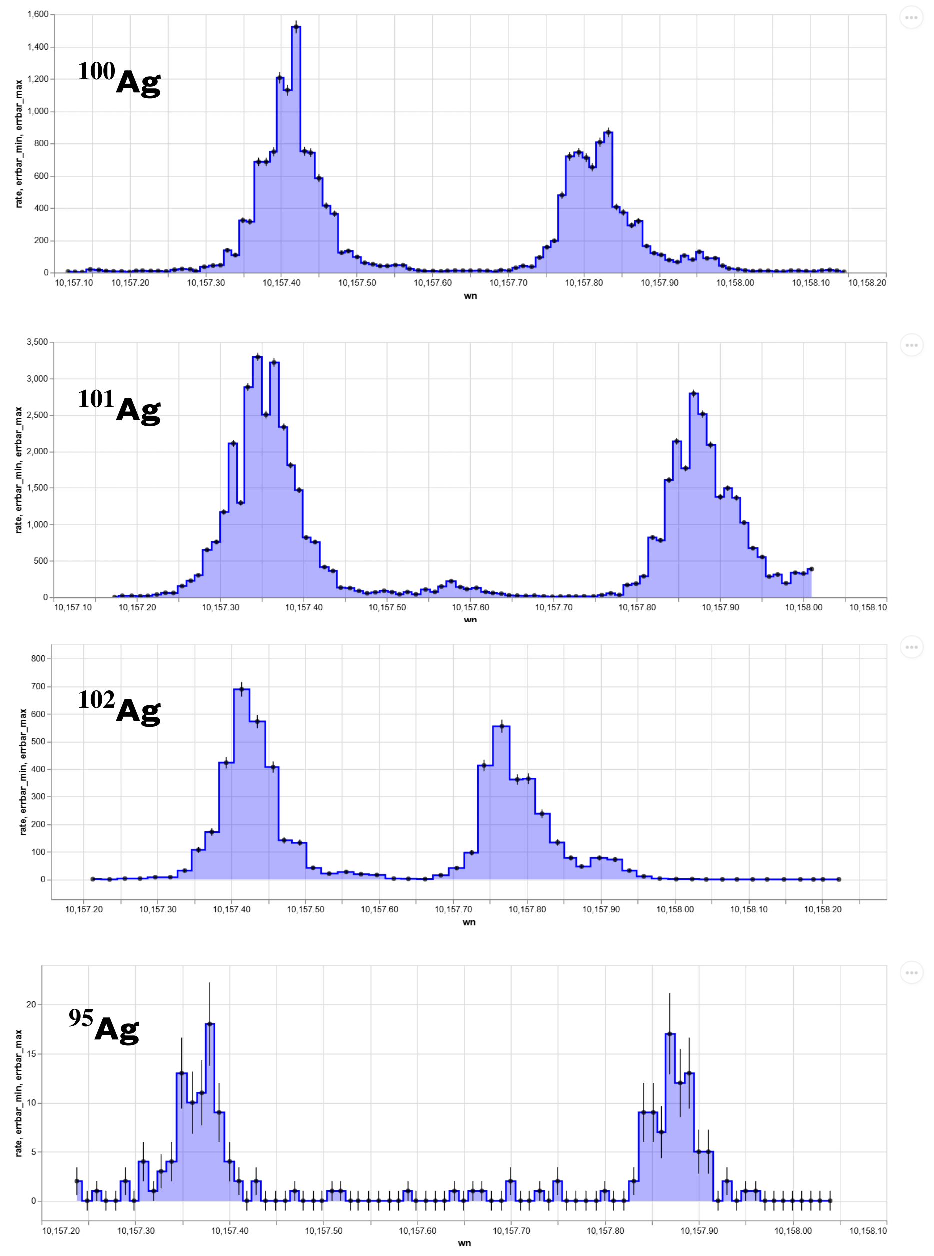
JYFL-ACCLAB

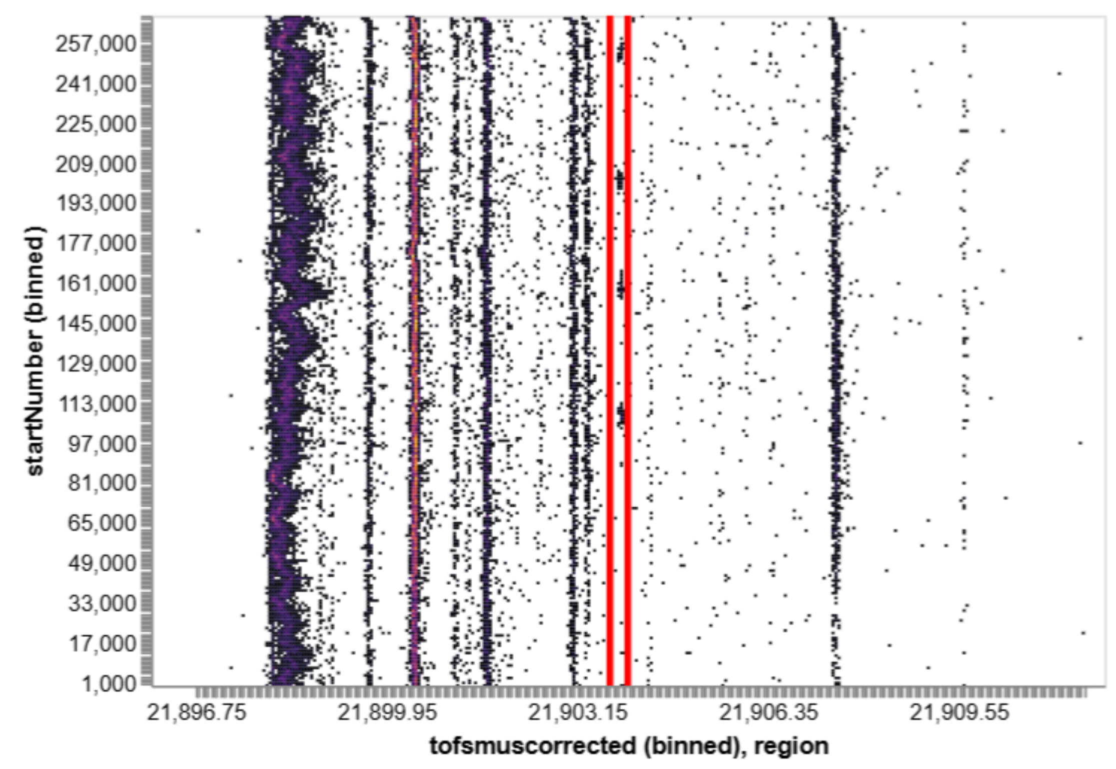




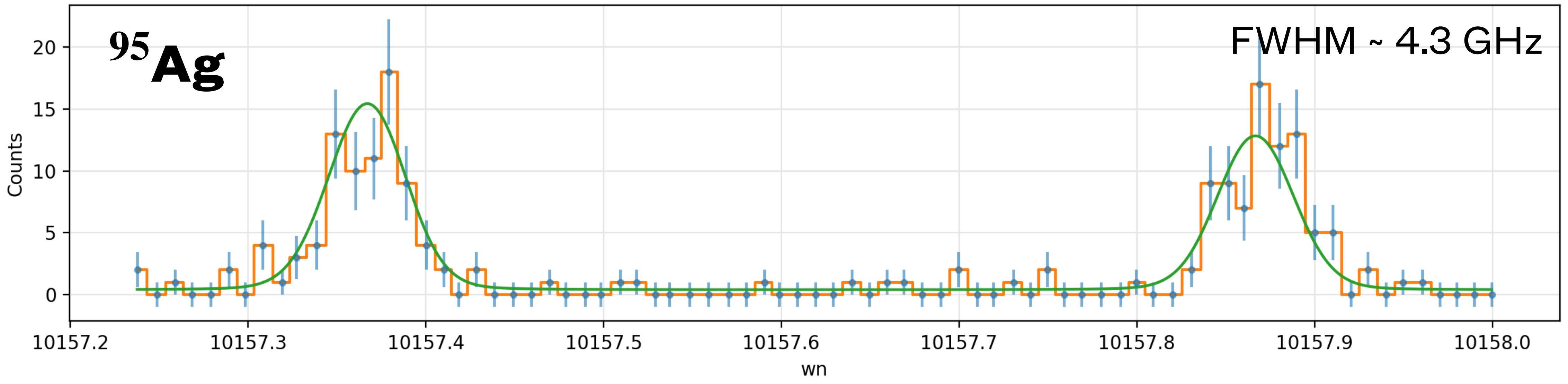
- Neutron-deficient silver produced via fusion-evaporation reactions.
- Atoms selectively produced using the Hot Cavity Catcher Laser Ion Source (HCLIS).
- Coupling of resonance ionization with Phase-Imaging Ion-Cyclotron Resonance (PI-ICR) in the JYFLTRAP Penning trap.

Results and Analysis

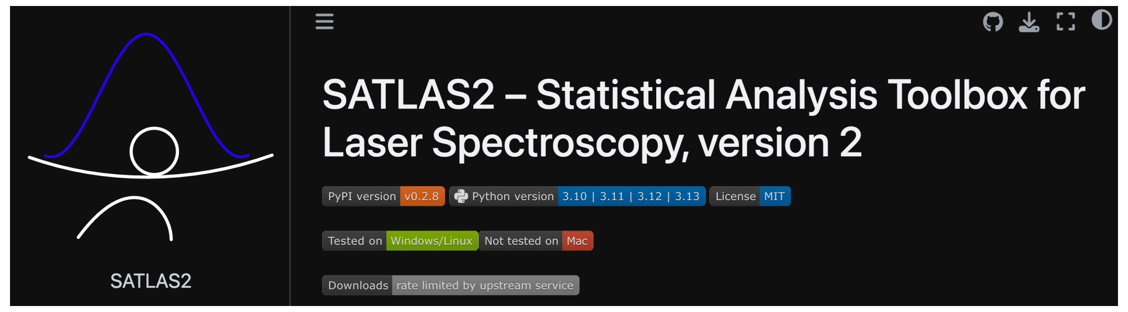




Experimental hyperfine spectra of $^{100-104}$Ag and ^{95}Ag.

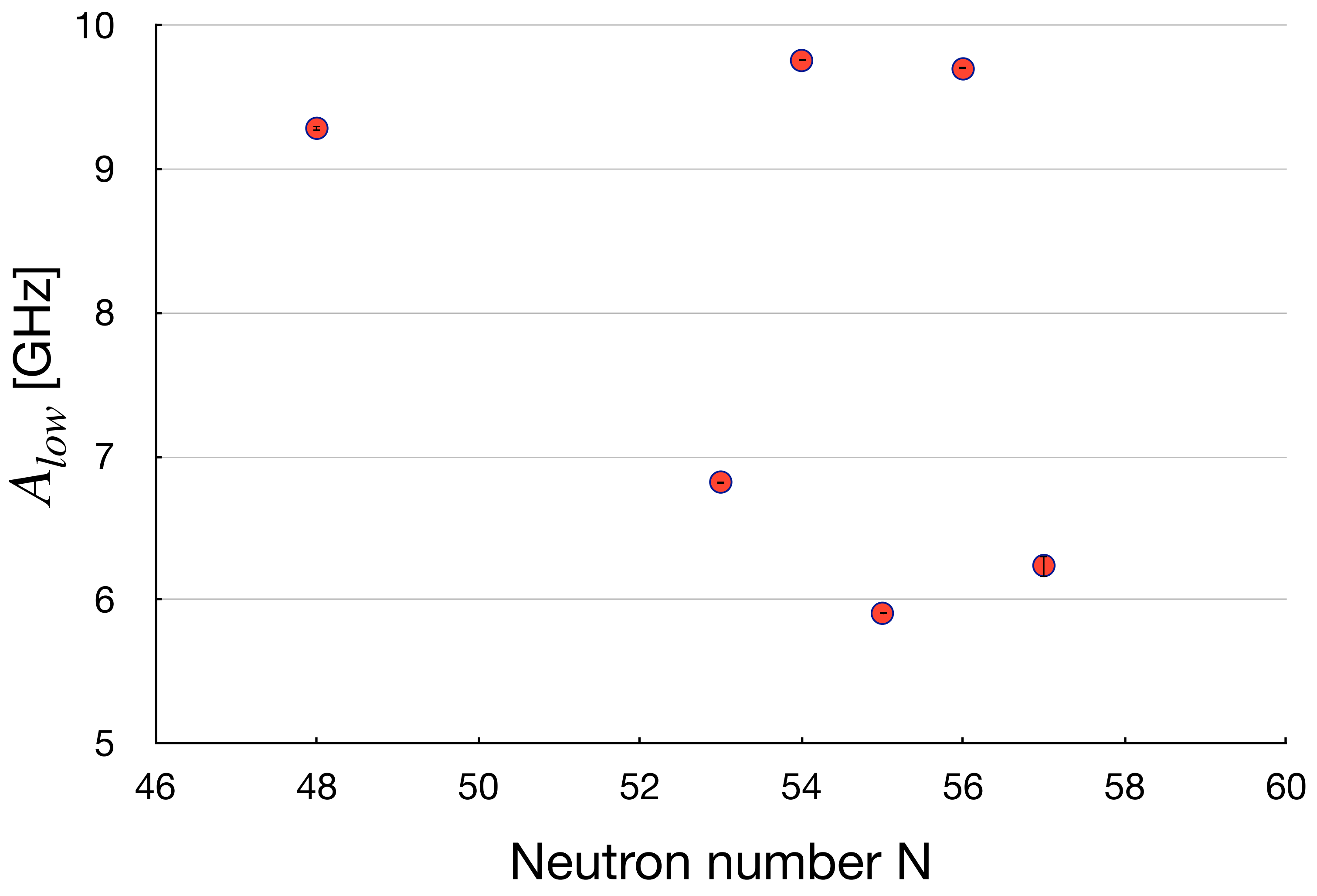


HFS fitting

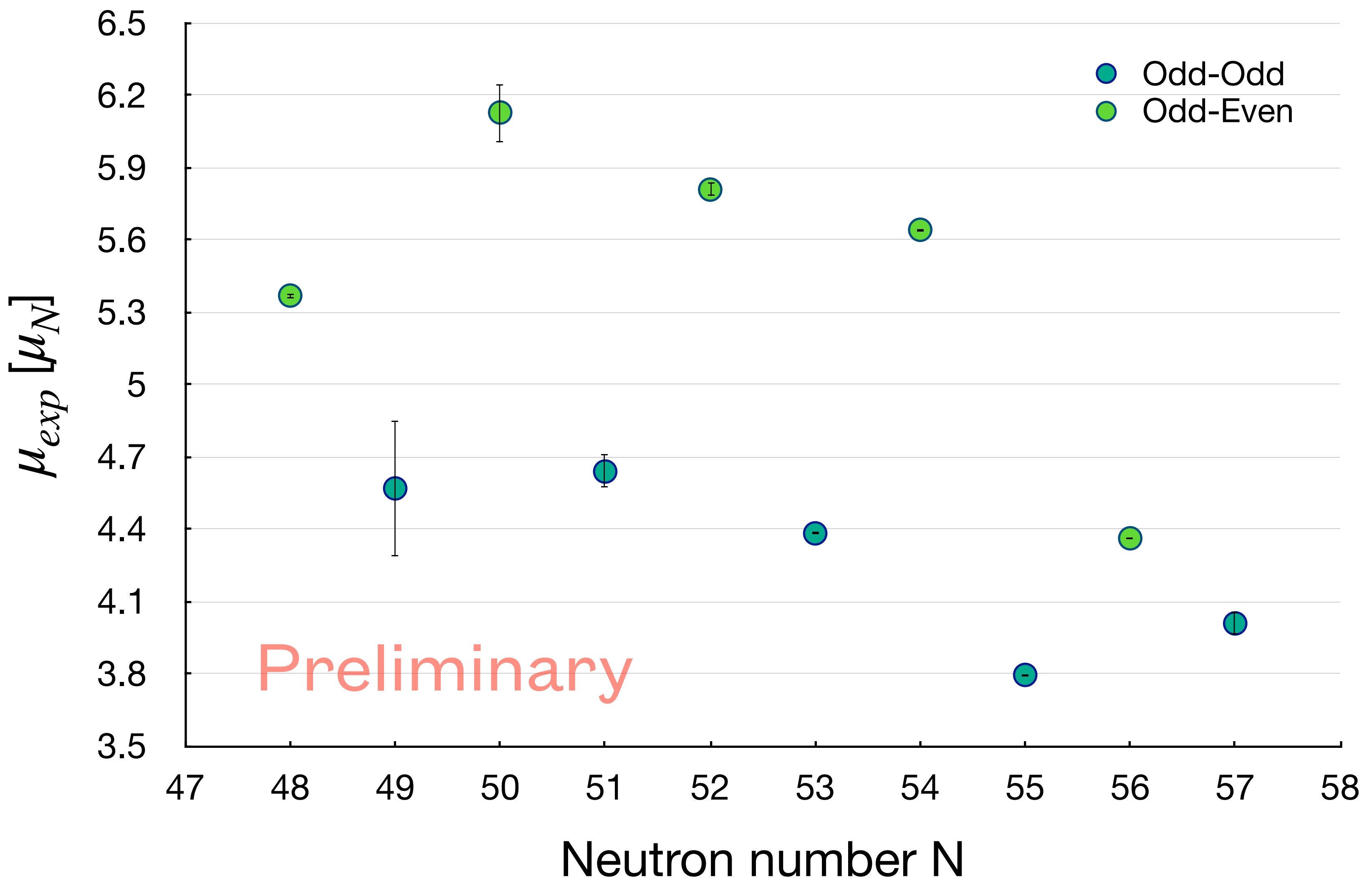


[3]

Ag isotopes: **hyperfine constant (A)**



Ag isotopes: **magnetic dipole moment (μ)**



328.1624 nm, [Kr]$4d^{10}5s^2S_{1/2} \rightarrow 5p^2P_{3/2}$ transition

^{96}Ag data from Reponen et al. [1], and $^{97-99}$Ag from Ferrer et al. [2].

[2] R. Ferrer et al., “In-gas-cell laser ionization spectroscopy in the vicinity of 100Sn: Magnetic moments and mean-square charge radii of N = 50–54 Ag”, Physics Letters B 728, 191–197 (2014).
[3] van den Borne, B., Gins, W., “SATLAS2 – Statistical Analysis Toolbox for Laser Spectroscopy, version 2”, Software documentation (2024). https://iks-nm.github.io/satlas2/index.html

Conclusion and Outlook

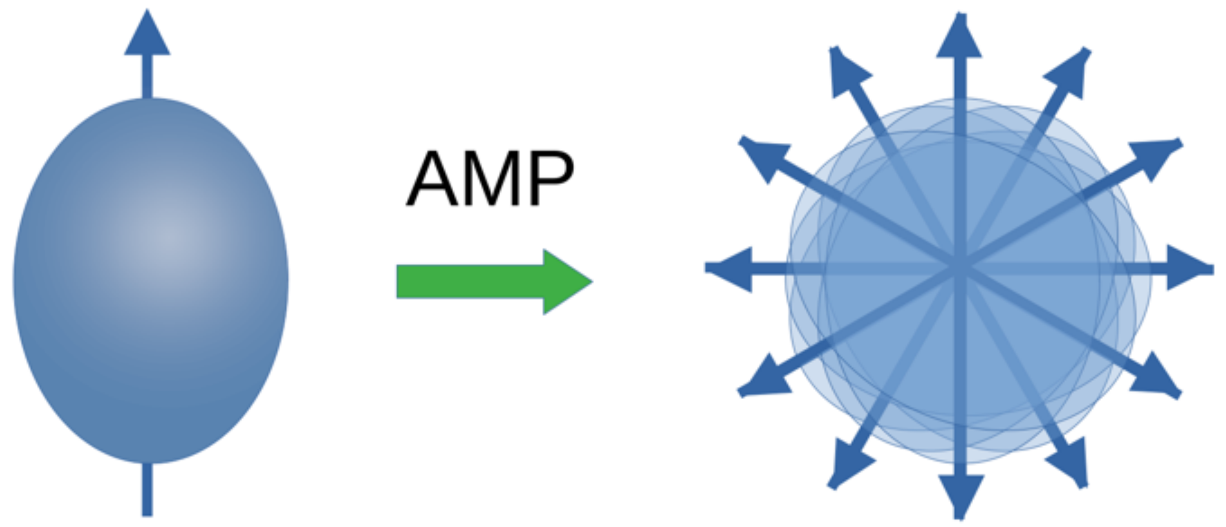
- These new measurements serve as a rigorous test for modern nuclear theories like DFT and ab initio models.

- The data will reveal if theory can finally replicate the sudden structural changes below N=50.
  - Theoretical part: Nuclear structure calculations are carried out in angular momentum projected (AMP) DFT picture.

- **Future Milestone:** The project is moving toward the first optical probing of a proton-emitting state (^{94}Ag, 21^{+}).

NUANZ Collaboration

(Nuclear properties at the N=Z line)



Thank you.

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Suomen Akatemia
Finlands Akademi
Research Council of Finland

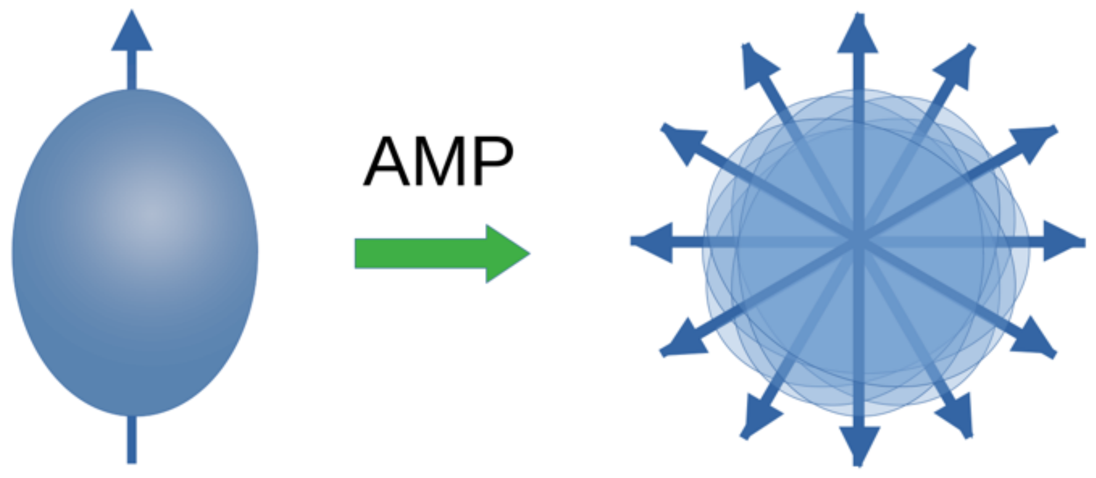
IGISOL

NUANZ Collaboration
(Nuclear properties at the N=Z line)

DFT calculations

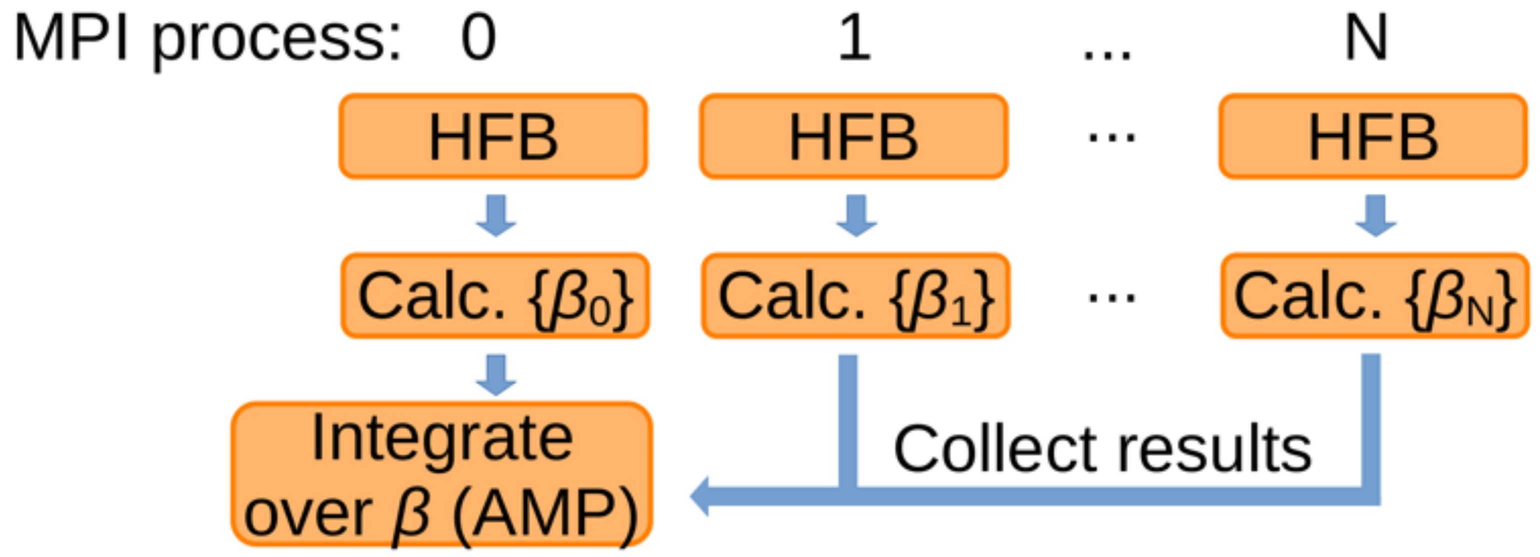
Slide courtesy of Markus Kortelainen.

- Nuclear structure calculations are carried out in angular momentum projected (AMP) DFT picture
- First, symmetry breaking HFB calculation is done for the nucleus, by allowing time-reversal breaking
- Presence of an odd particle polarizes the mean-field.
- Time-odd part of the EDF (e.g. spin-spin interaction) impacts on the magnitude of this polarization



- After HFB, the AMP is performed. In AMP, symmetry restored state is obtained as a linear combination from gauge angle rotated states
- AMP essential especially with magnetic moments (see discussion in Bonnard et al, PLB 843 138014 (2023))

MPI setup for AMP



- Calculations carried out with HFBTEMP computer code
- AMP parallelized in MPI framework. After loading HFB solution, each set of gauge angles β are distributed on separate MPI process

NUANZ Collaboration

(Nuclear properties at the N=Z line)