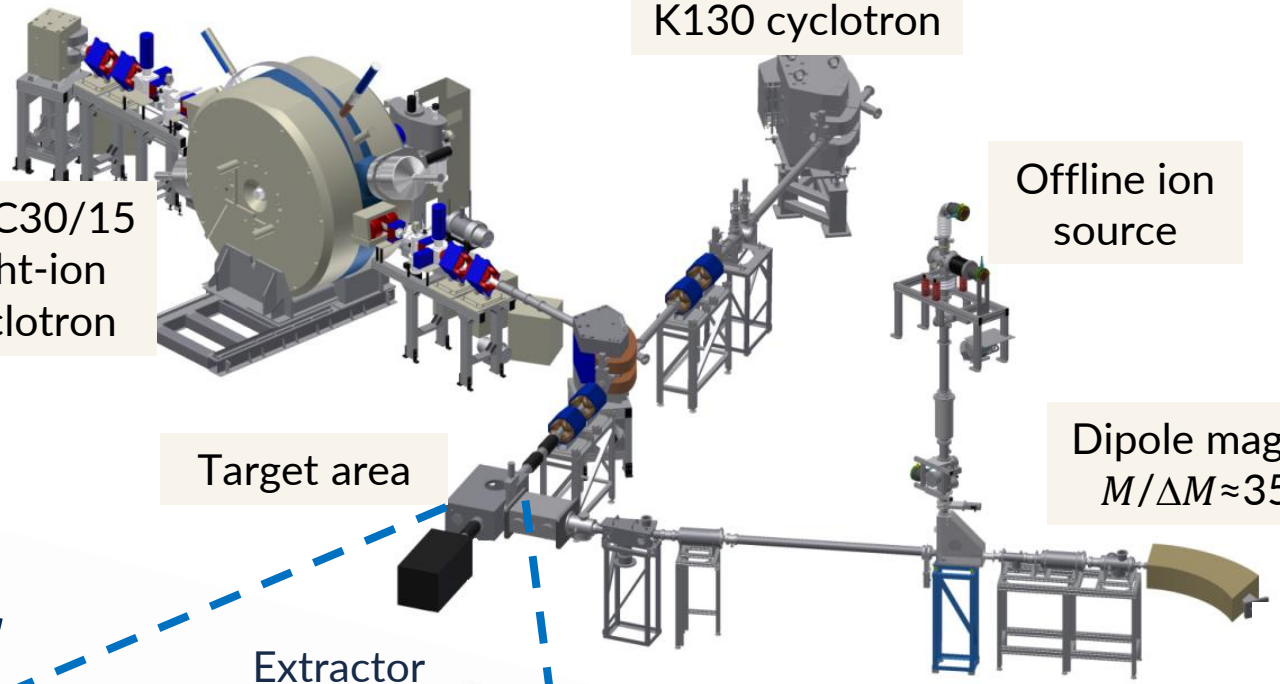
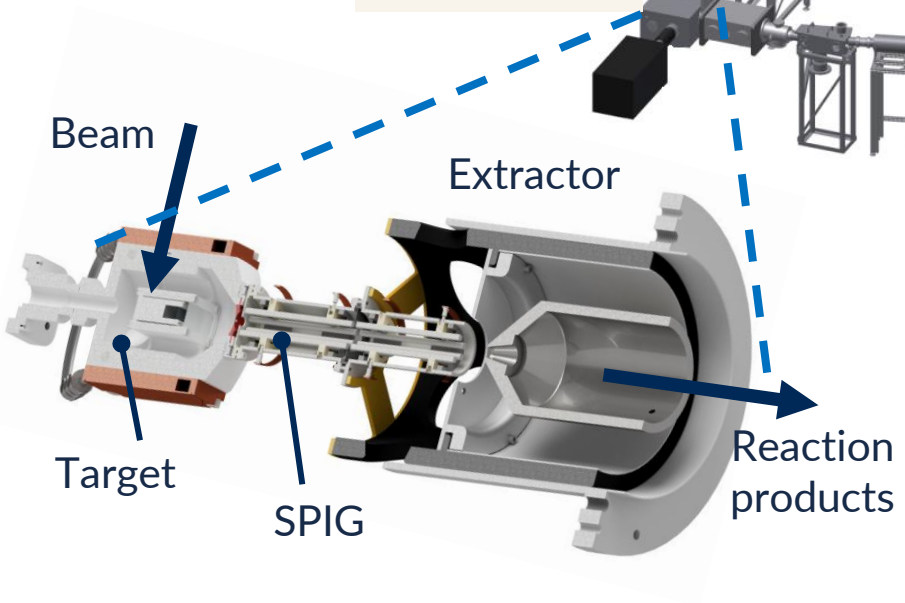
JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

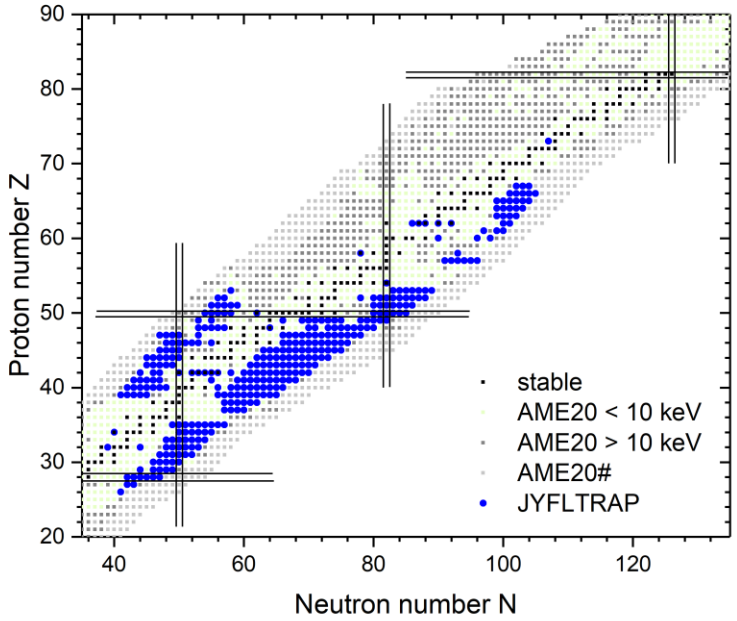
Recent Developments and Measurements at the JYFLTRAP Mass Spectrometer

Simon Rausch

IGISOL







Decay spectroscopy

MR-TOF-MS

Paul trap

JYFLT spec

py

Motivation

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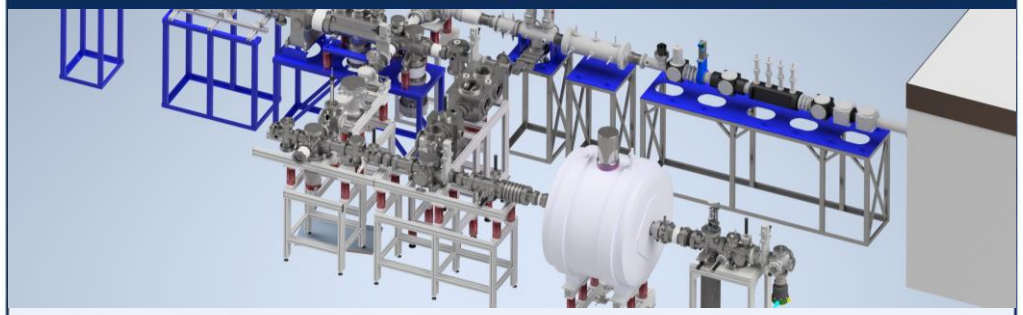


Fast, chemistry-independent production of exotic nuclei

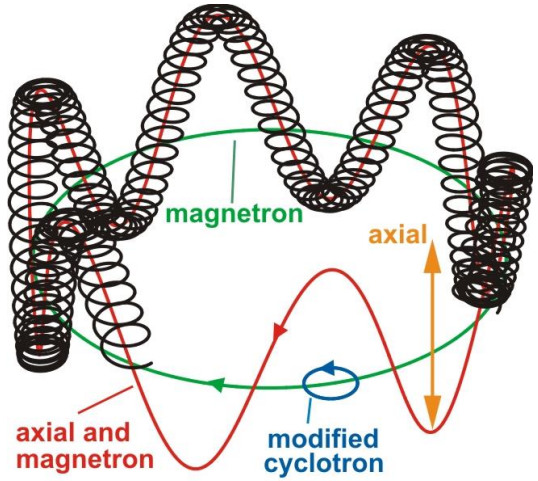
Access to short-lived isotopes far from stability

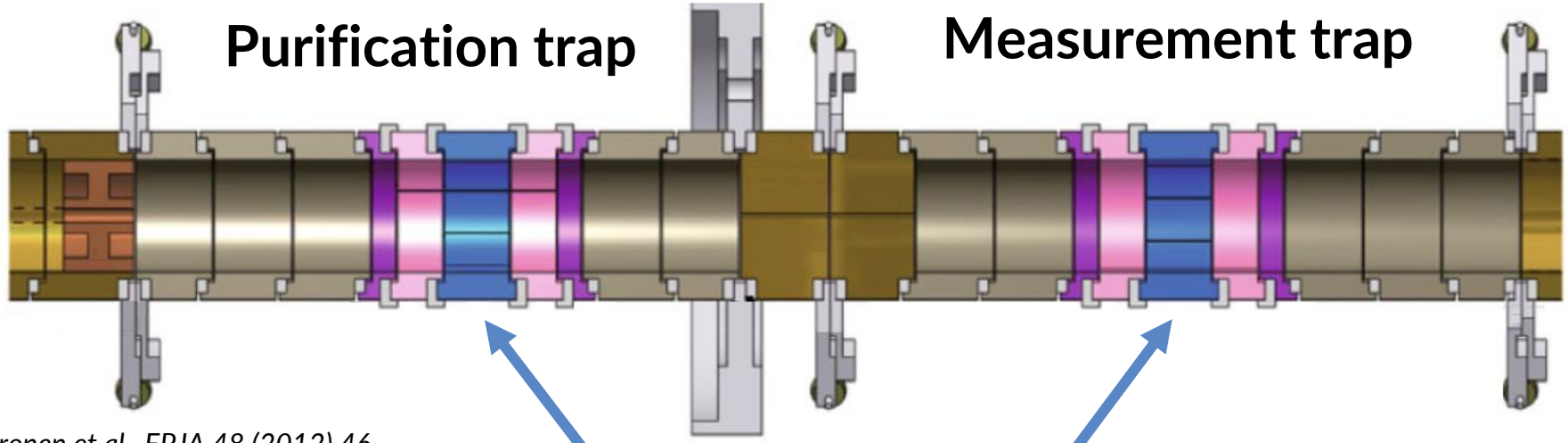
Enables nuclear structure and astrophysics studies

Platform for tests of fundamental symmetries

JYFLTRAP double Penning trap

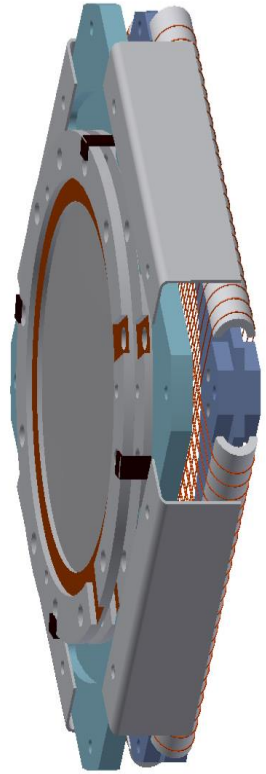
- Cylindrical Penning traps
- 7T homogeneous magnetic field
- Harmonic potential





Eronen et al., EPJA 48 (2012) 46

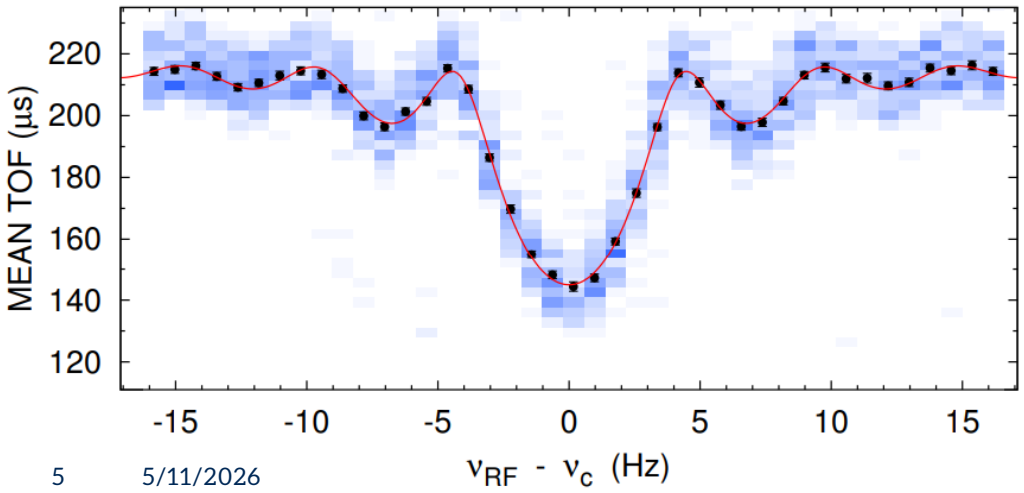
Segmented electrodes for multipolar excitation



Ion cyclotron resonance (ICR) mass spectrometry

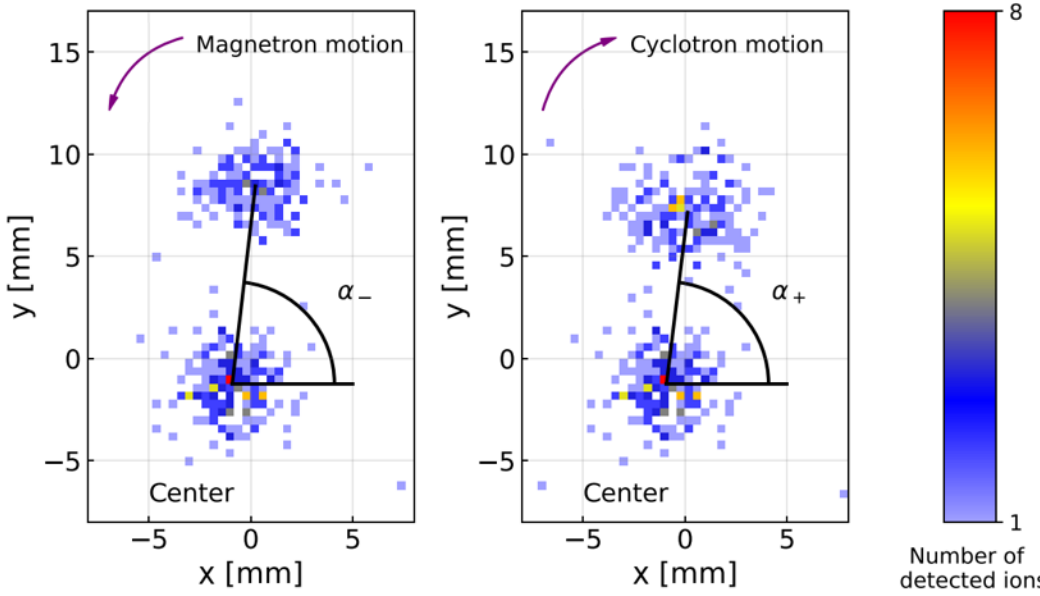
Time-of-flight ICR

- Magnetron excitation
- Conversion into modified cyclotron motion
  - $\nu_c = \nu_+ + \nu_- = \frac{qB}{2\pi m}$
  - More energy in radial motion
  - Shorter TOF during extraction



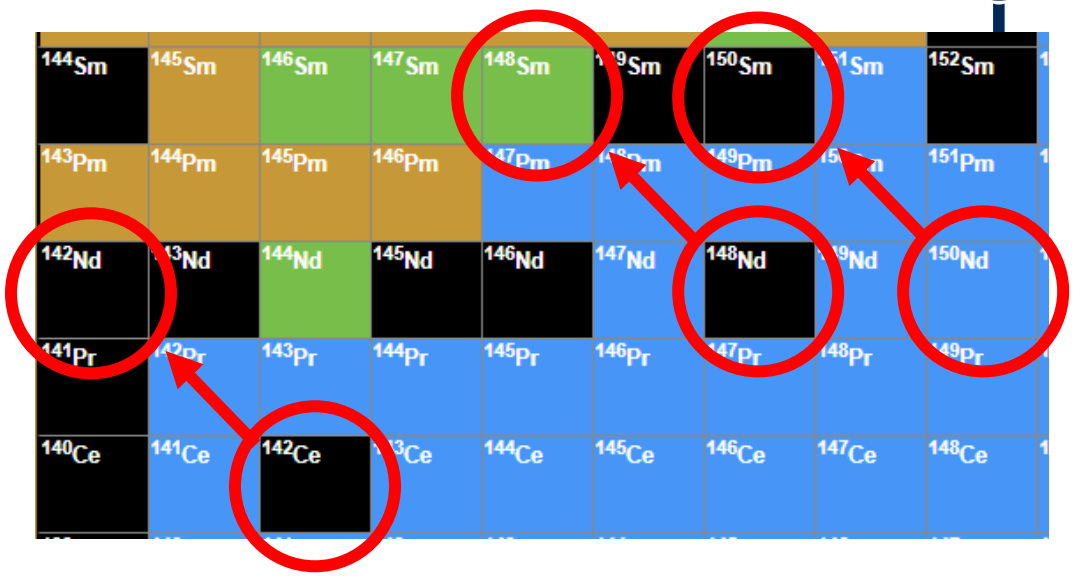
Phase-imaging ICR

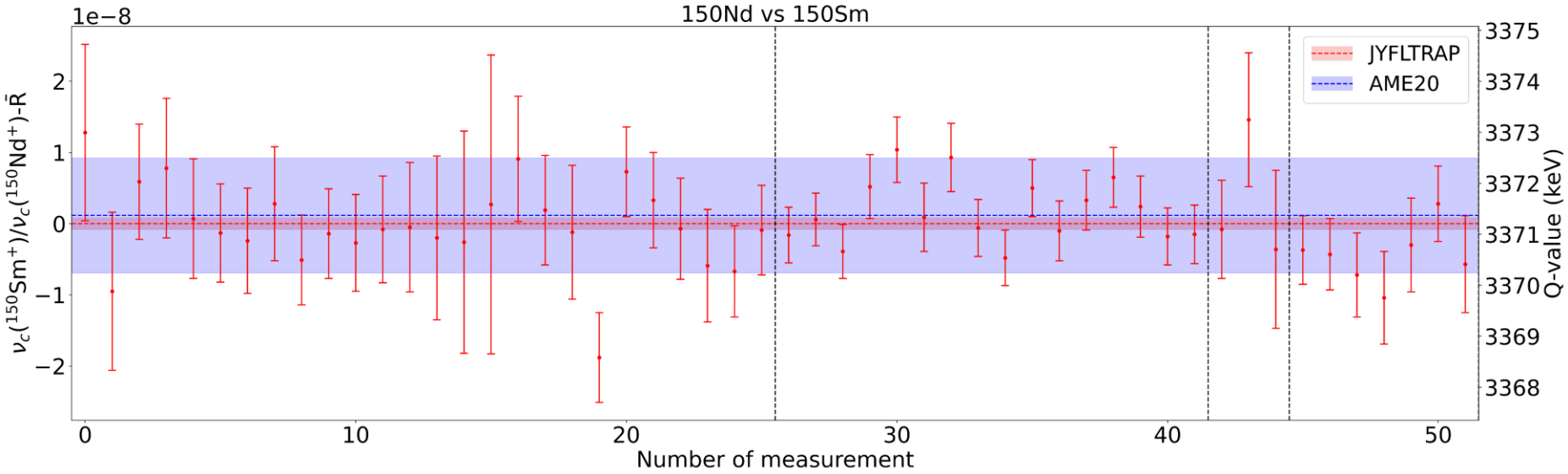
- Magnetron damping -> center spot
- Cyclotron excitation
- Conversion into magnetron motion
  - $\nu_c = \frac{(\alpha_+ - \alpha_-) + 2\pi(n_+ + n_-)}{2\pi t_{acc}}$



Double-beta decay Q-values

- Q-value measurements
  - ^{150}Nd -> ^{150}Sm (benchmark measurement)
  - ^{148}Nd -> ^{148}Sm
  - ^{142}Ce -> ^{142}Nd
- Input to calculate 0νββ decay and 2νββ decay half-life

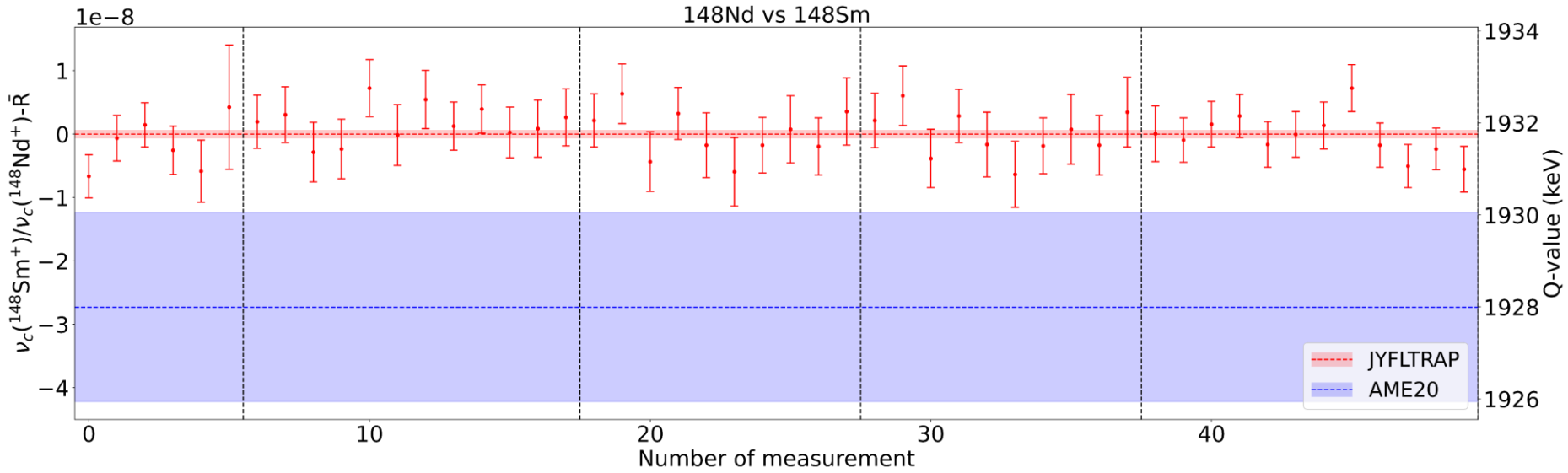




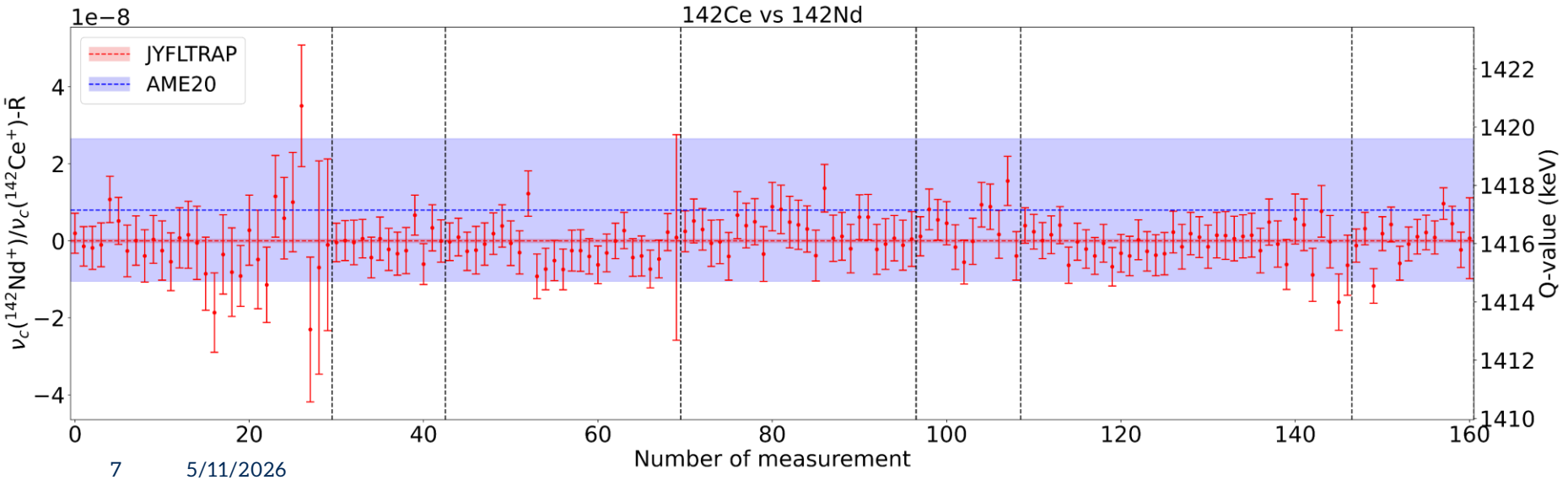
$Q_{\beta\text{-}\beta\text{-}}$ = 3371.208(110) keV

[1] M. Wang et. al, Chinese Phys. C 45 030003 (2021)

Double-beta decay measurements



$Q_{\beta\text{-}\beta\text{-}}$ = 1931.756(82) keV

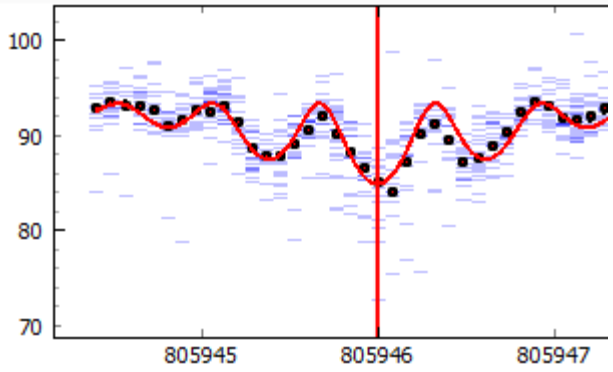


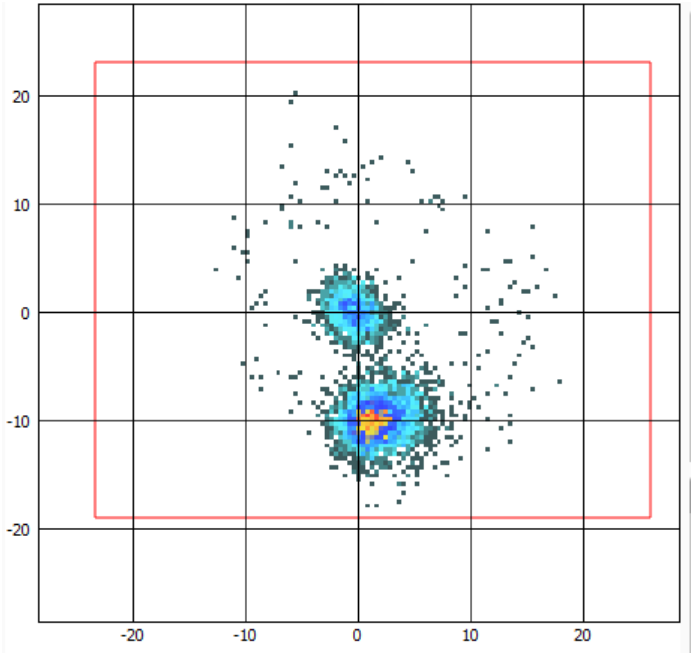
$Q_{\beta\text{-}\beta\text{-}}$ = 1416.047(60) keV

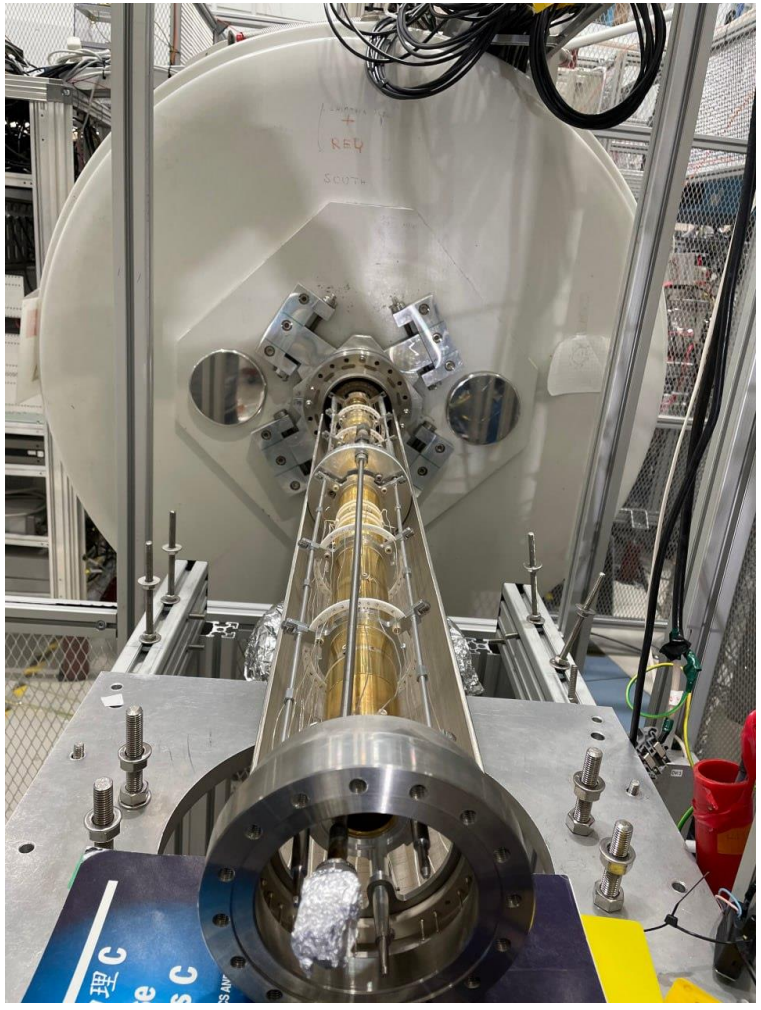
[1] M. Wang et. al, Chinese Phys. C 45 030003 (2021)

Unexpected break and a fresh start

- Quench early 2024
- Recommissioning until fall 2025
- First TOF-ICR and PI-ICR on October 22nd
- First beamtime only two days later!
- Since then, 6 JYFLTRAP online beamtimes (26 days)

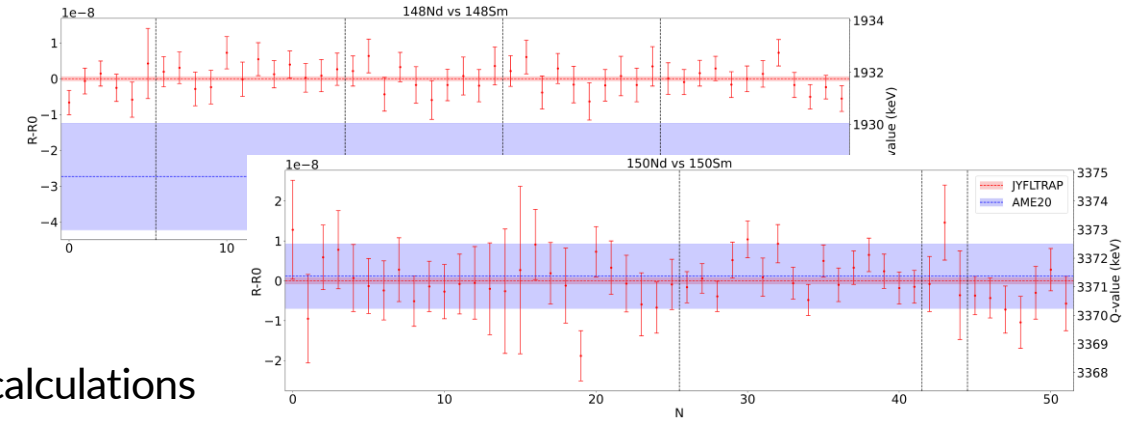




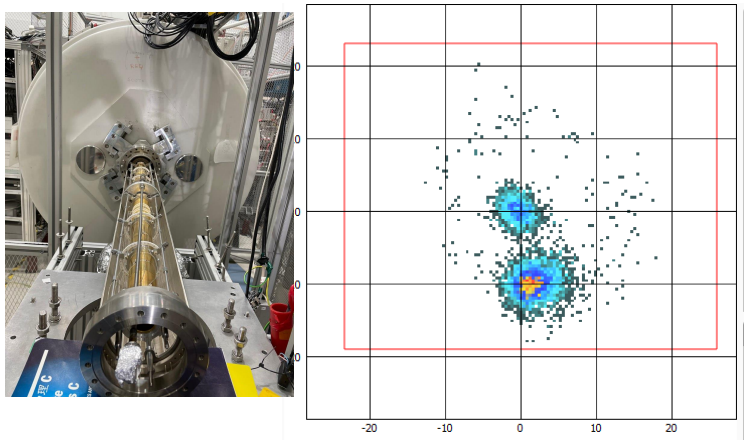


Summary

- Q-value measured for
  - ^{148}Nd -> ^{148}Sm
  - ^{142}Ce -> ^{142}Nd
  - Improved precision by factor 25 - 40
  - Input for 0νββ decay and 2νββ decay half-life calculations



- Trap recommissioned after quench
- First data is already in
- Analysis ongoing



- Already 13 pending proposals (80 days) for trap measurement

Acknowledgements

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