

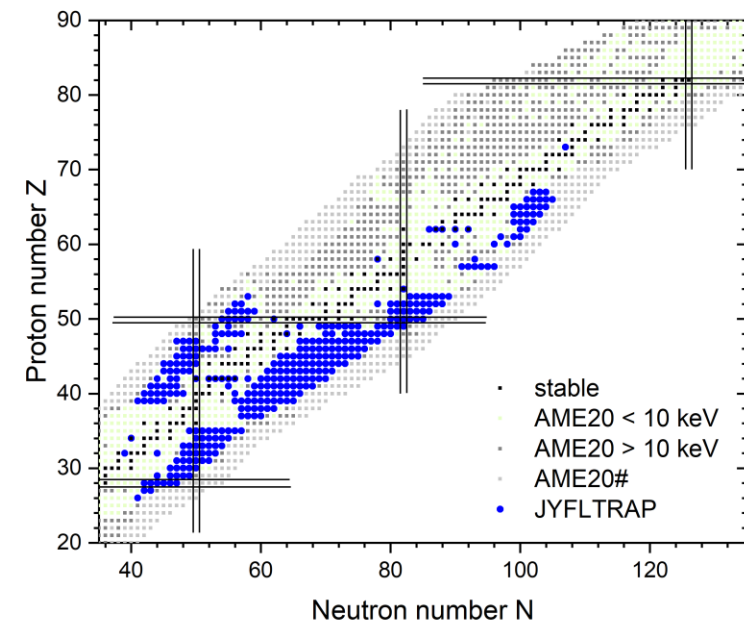
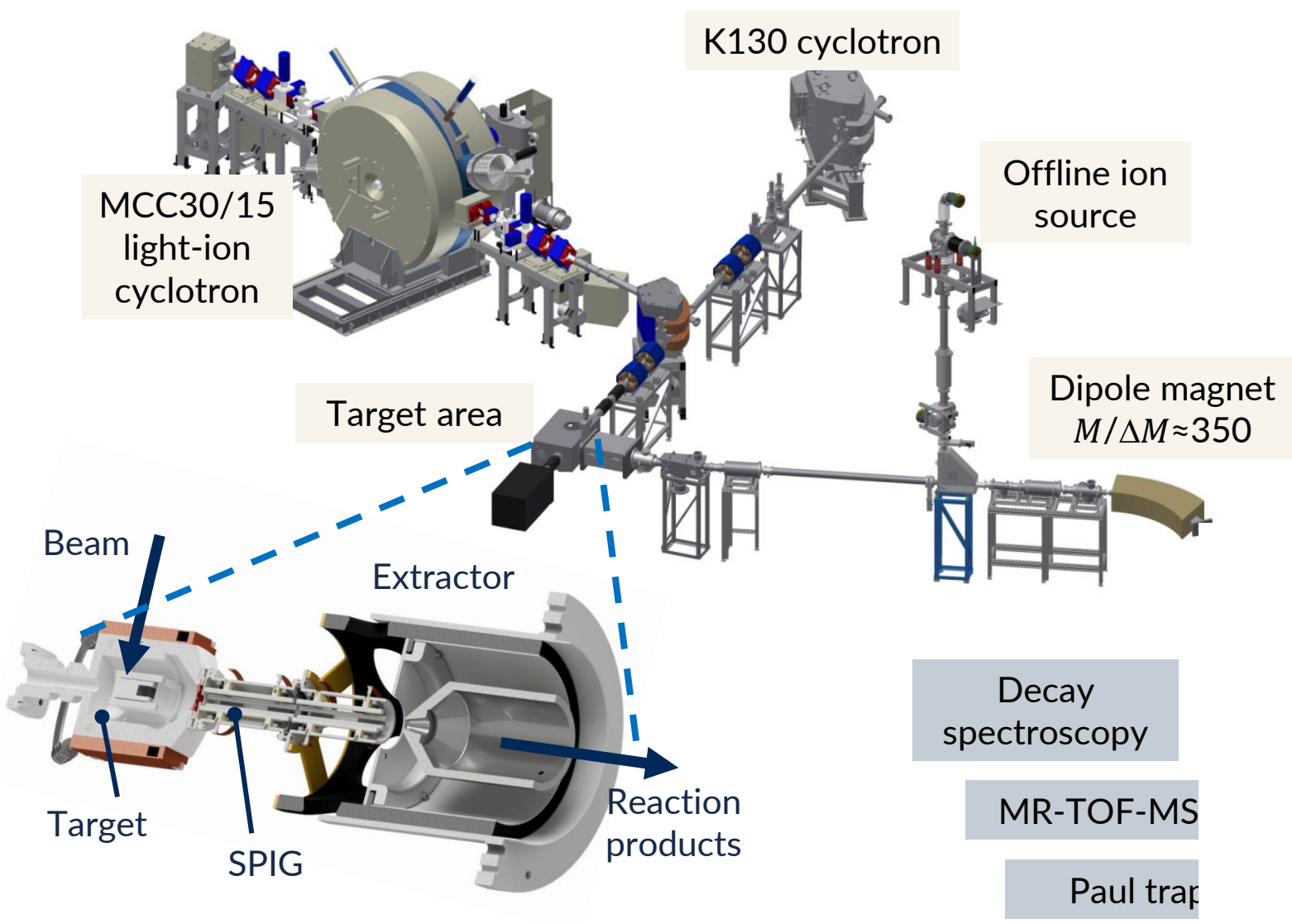


JYVÄSKYLÄN YLIOPISTO
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Recent Developments and Measurements at the JYFLTRAP Mass Spectrometer

Simon Rausch

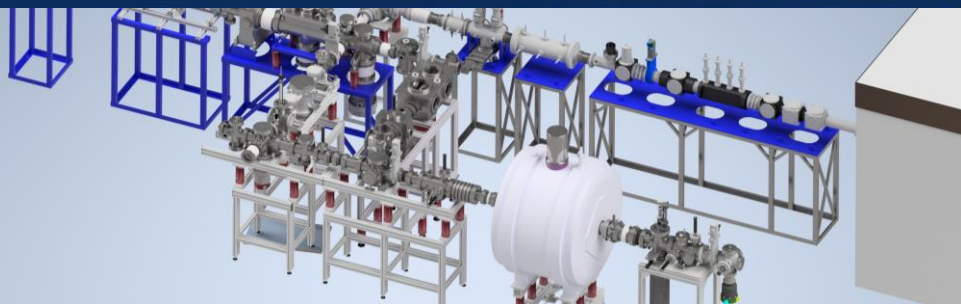
IGISOL



Motivation



IGISOL



Fast, chemistry-independent production of exotic nuclei



Access to short-lived isotopes far from stability



Enables nuclear structure and astrophysics studies

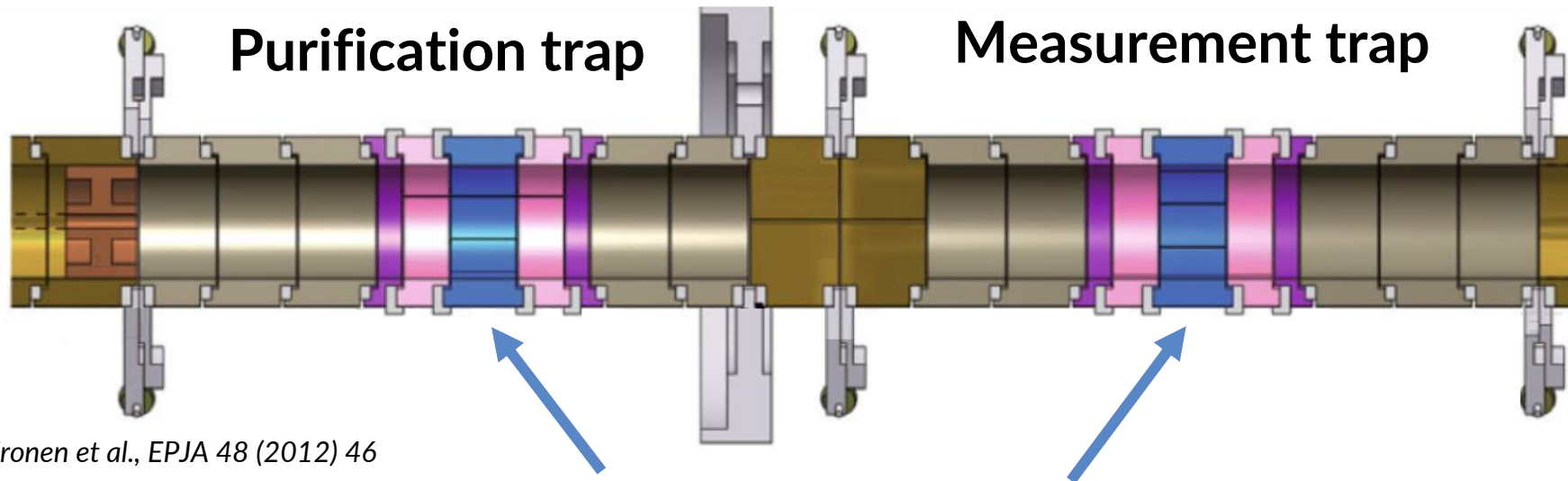
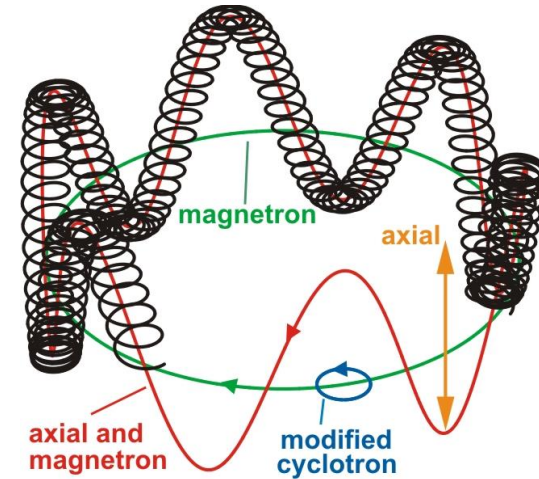


Platform for tests of fundamental symmetries

JYFLTRAP double Penning trap

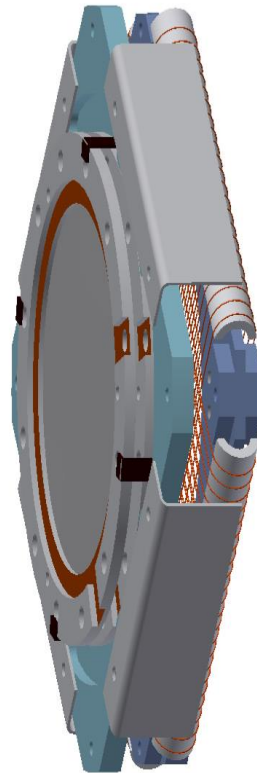


- Cylindrical Penning traps
- 7T homogeneous magnetic field
- Harmonic potential



Eronen et al., EPJA 48 (2012) 46

Segmented electrodes for
multipolar excitation

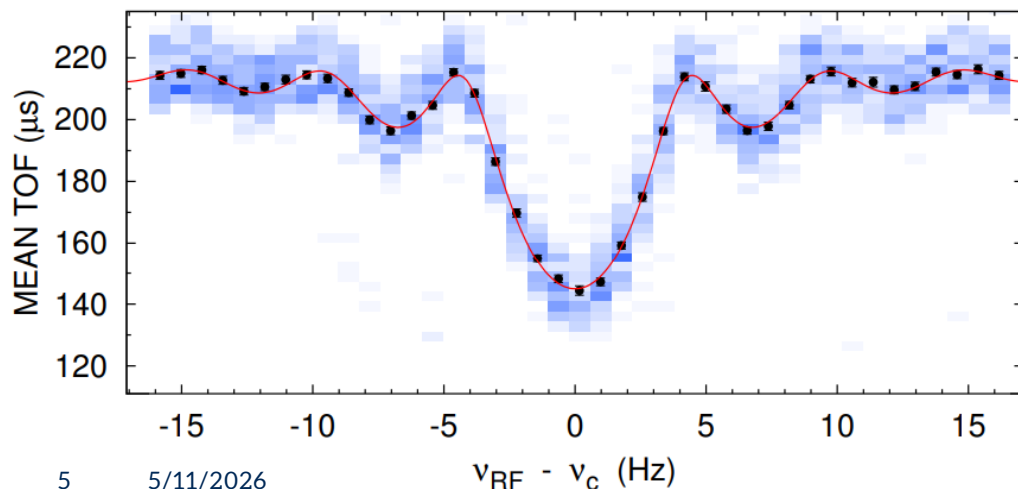


Ion cyclotron resonance (ICR) mass spectrometry



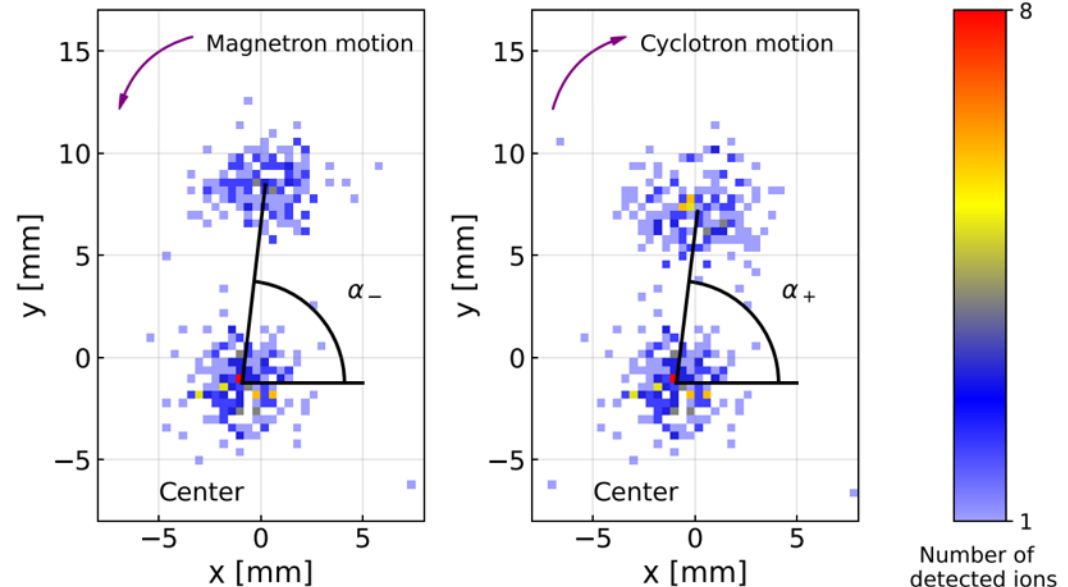
Time-of-flight ICR

- 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

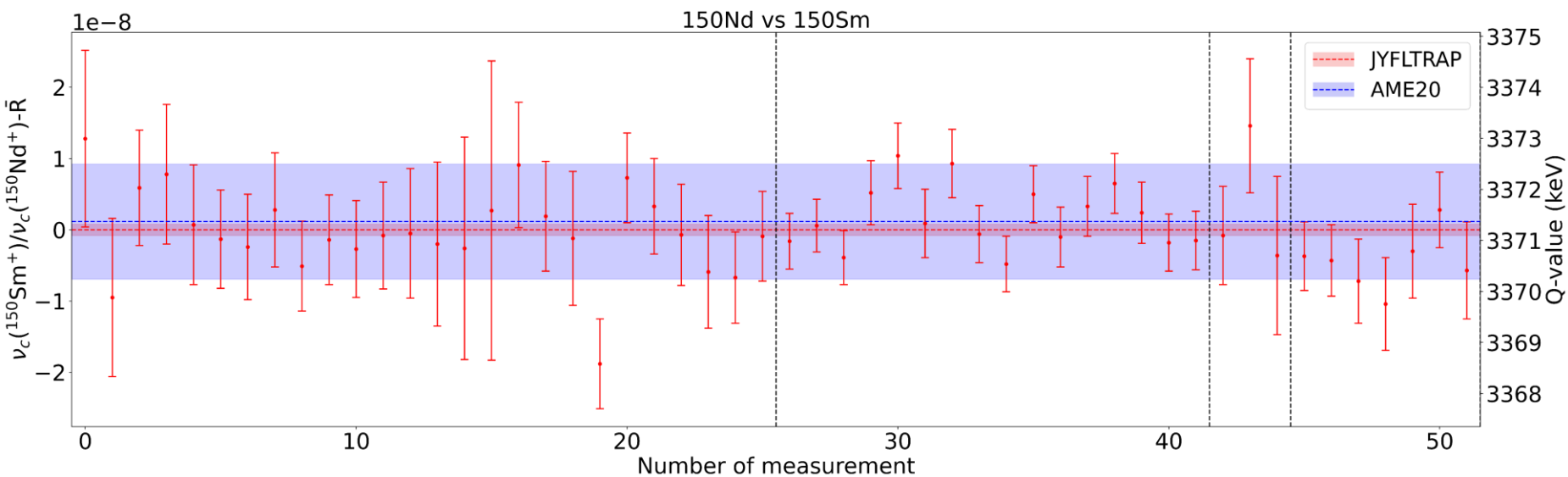
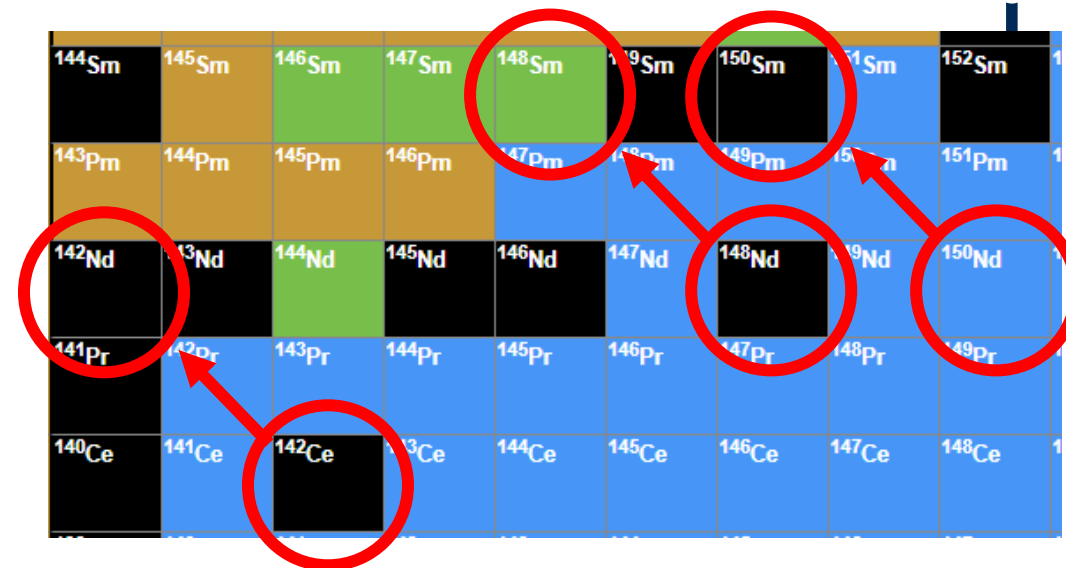
- Magnetron damping -> center spot
- Cyclotron excitation
- Conversion into magnetron motion
 - $\nu_c = \frac{(\alpha_+ - \alpha_-) + 2\pi(n_+ + n_-)}{2\pi t_{\text{acc}}}$



Double-beta decay Q-values

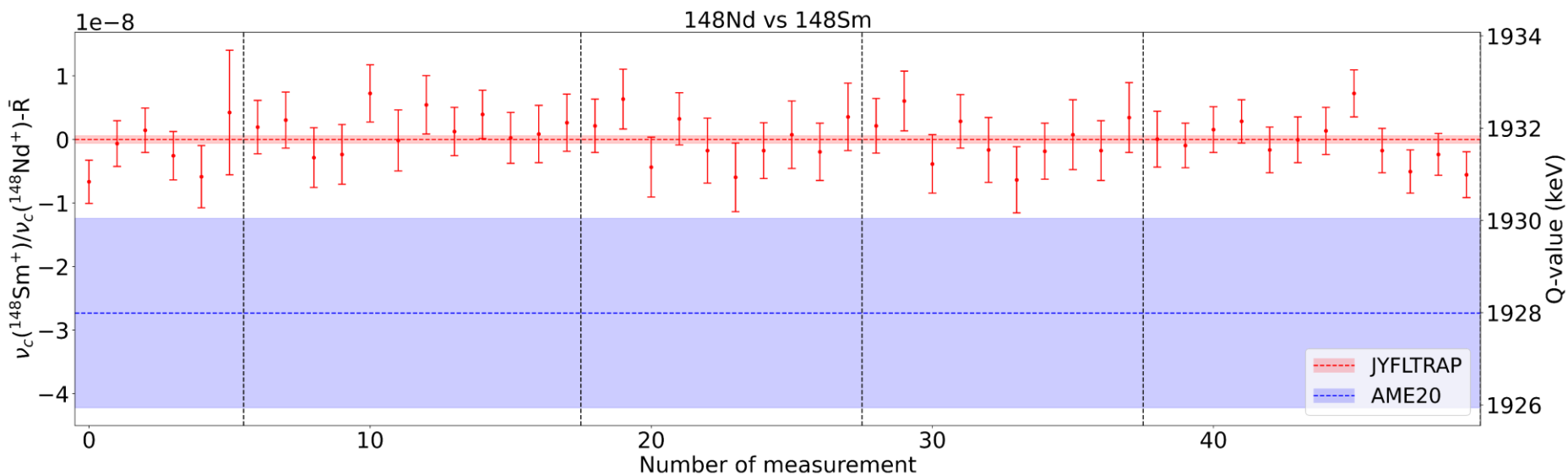


- Q-value measurements
 - $^{150}\text{Nd} \rightarrow ^{150}\text{Sm}$ (benchmark measurement)
 - $^{148}\text{Nd} \rightarrow ^{148}\text{Sm}$
 - $^{142}\text{Ce} \rightarrow ^{142}\text{Nd}$
- Input to calculate $0\nu\beta\beta$ decay and $2\nu\beta\beta$ decay half-life

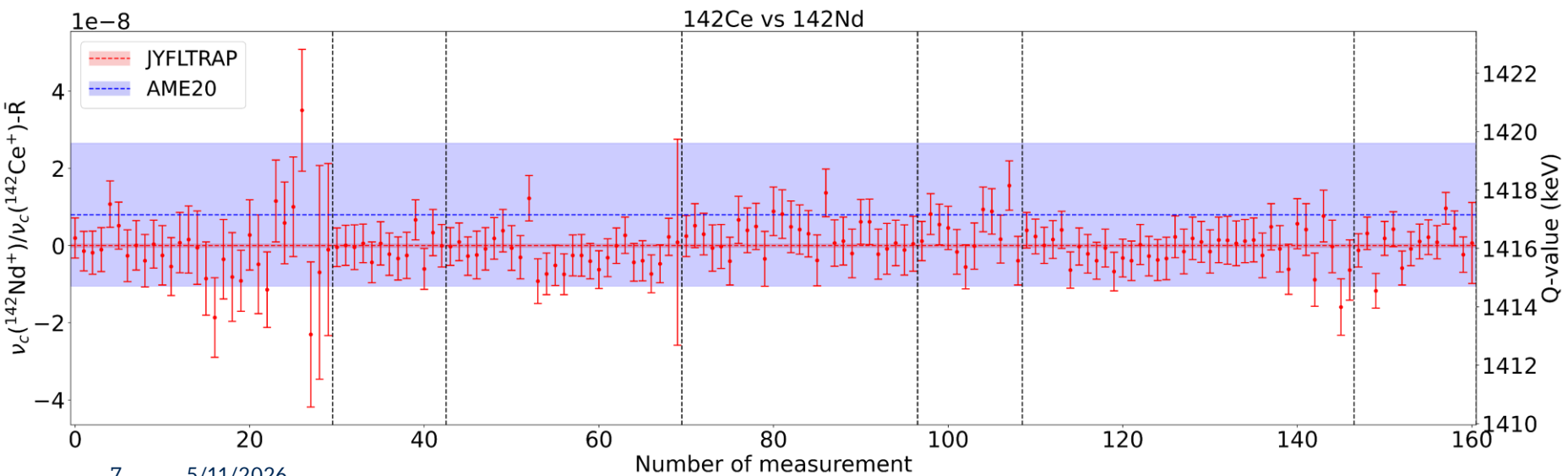


$$Q_{\beta-\beta} = 3371.208(110) \text{ keV}$$

Double-beta decay measurements



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

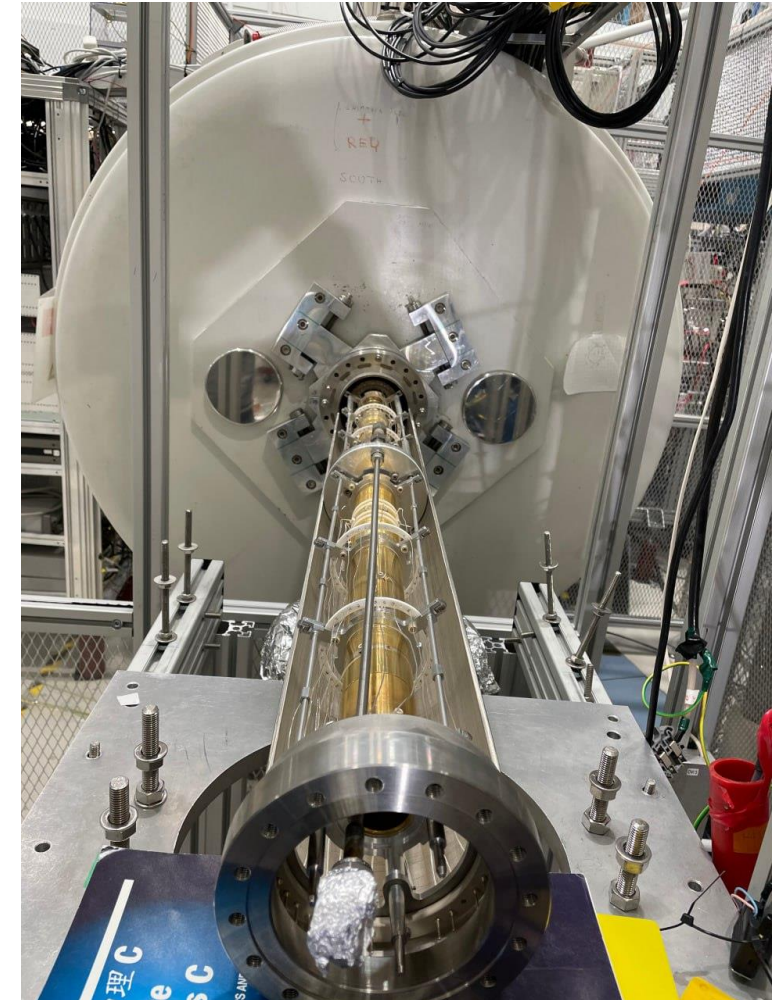
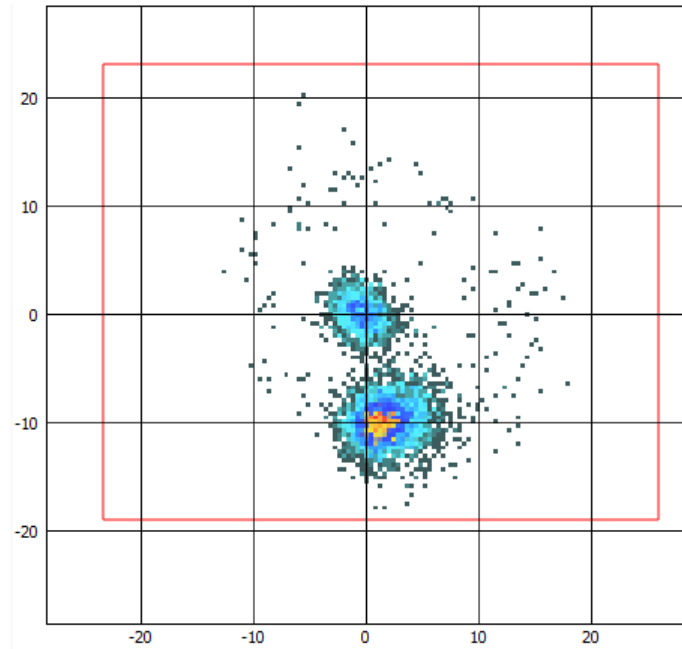
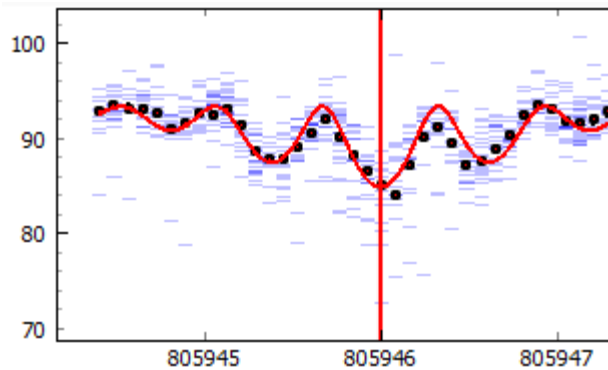


$$Q_{\beta-\beta^-} = 1416.047(60) \text{ keV}$$

Unexpected break and a fresh start



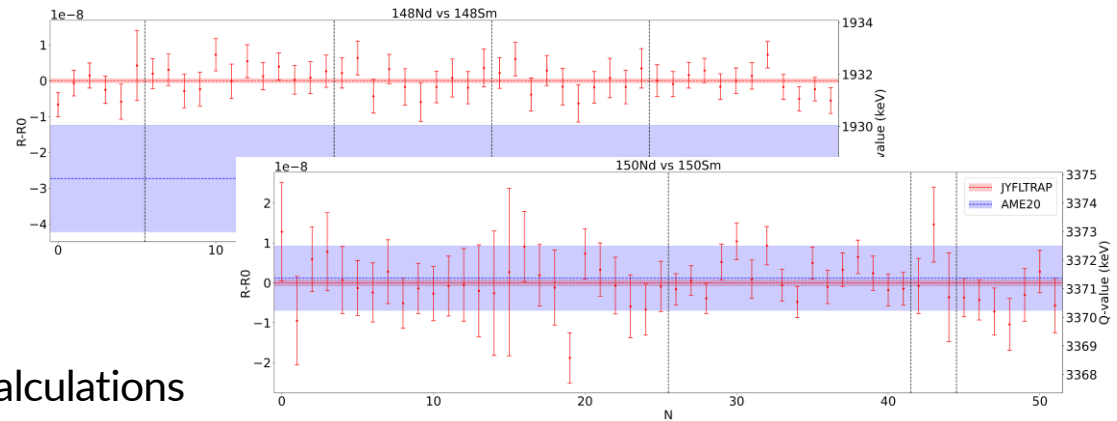
- Quench early 2024
- Recommissioning until fall 2025
- First TOF-ICR and PI-ICR on October 22nd
- First beamtime only two days later!
- Since then, 6 JYFLTRAP online beamtimes (26 days)



Summary

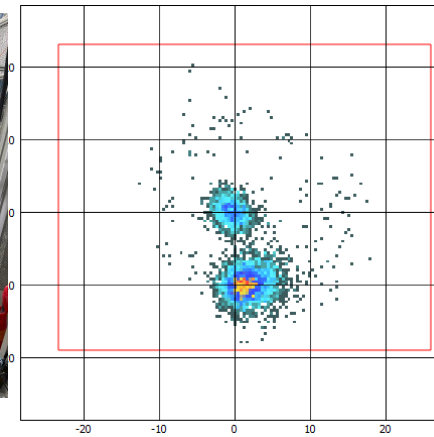
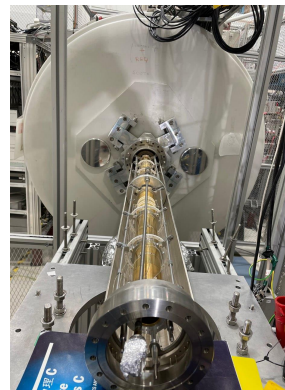


- Q-value measured for
 - $^{148}\text{Nd} \rightarrow ^{148}\text{Sm}$
 - $^{142}\text{Ce} \rightarrow ^{142}\text{Nd}$
 - Improved precision by factor 25 - 40
 - Input for $0\nu\beta\beta$ decay and $2\nu\beta\beta$ decay half-life calculations



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

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



24	08-Jun	09-Jun	10-Jun	11-Jun	12-Jun	13-Jun	14-Jun
	XIGSOL1 (7 days) p @ 30 MeV						
25	15-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun
	MAINT (4 days)						
26	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun
	138 (5 days) p @ 25 MeV (20pA)						
27	29-Jun	30-Jun	01-Jul	02-Jul	03-Jul	04-Jul	05-Jul
	MAINT (49 days)						
28	06-Jul	07-Jul	08-Jul	09-Jul	10-Jul	11-Jul	12-Jul
	MAINT (49 days)						
29	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul
	MAINT (49 days)						
30	20-Jul	21-Jul	22-Jul	23-Jul	24-Jul	25-Jul	26-Jul
	MAINT (49 days)						
31	27-Jul	28-Jul	29-Jul	30-Jul	31-Jul	01-Aug	02-Aug
	MAINT (49 days)						
32	03-Aug	04-Aug	05-Aug	06-Aug	07-Aug	08-Aug	09-Aug
	MAINT (49 days)						
33	10-Aug	11-Aug	12-Aug	13-Aug	14-Aug	15-Aug	16-Aug
	MAINT (49 days)						
34	17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug	23-Aug
	1342 (4 days) d @ 12 MeV (5 μA)						
	XIGSOL1 (11 days) p @ 30 MeV						
35	24-Aug	25-Aug	26-Aug	27-Aug	28-Aug	29-Aug	30-Aug
	RADEF (4 days) Cocktail 16.3 MeV						
	JMS7 (14 days) 80,82,84Kr @ 330 MeV						
36	31-Aug	01-Sep	02-Sep	03-Sep	04-Sep	05-Sep	06-Sep
	JMS7 (14 days) 80,82,84Kr @ 330 MeV (4ppA)						

Acknowledgements



ACADEMY OF FINLAND