High-precision mass measurements of exotic nuclides: The 2006 harvest of ISOLTRAP

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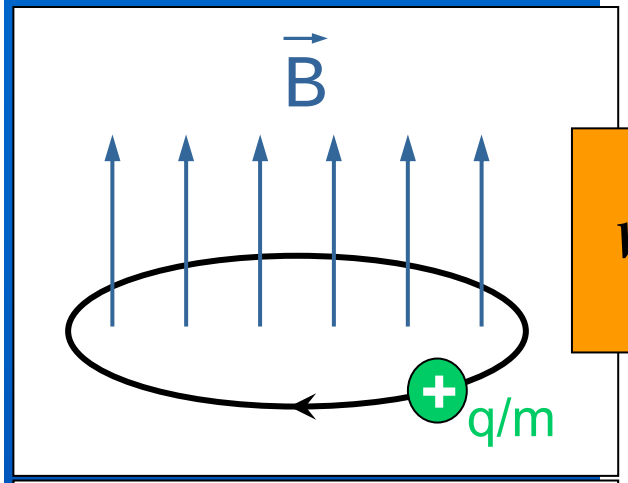
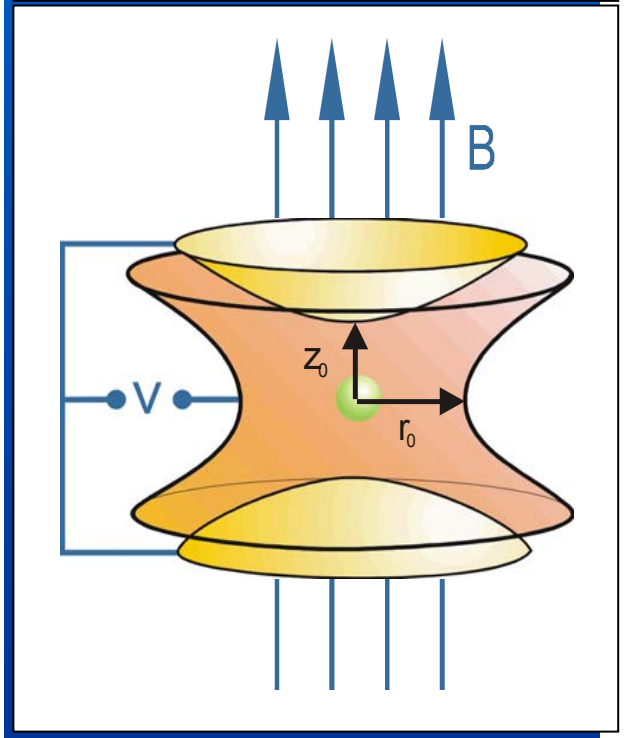
for the ISOLTRAP Collaboration

CERN, PH-IS, Geneva

ISOLTRAP: Experimental setup



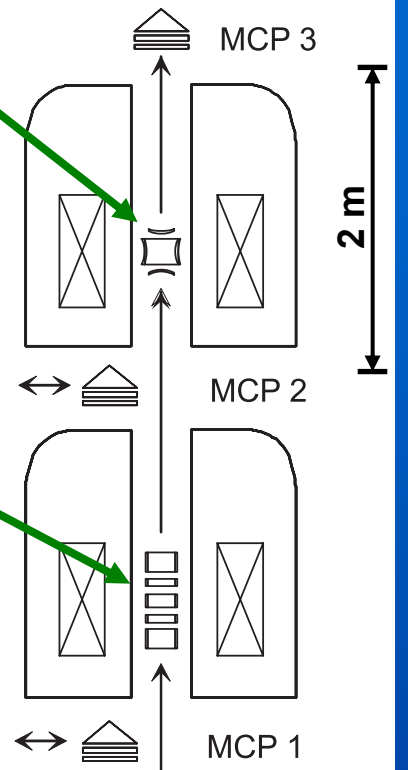
$$\nu_c = \frac{1}{2\pi}\frac{q}{m}B$$

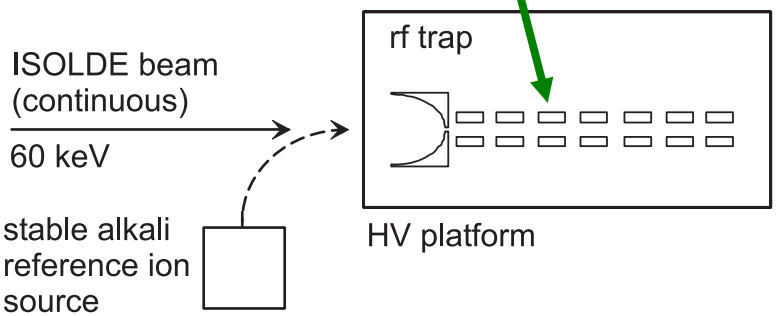


determination of cyclotron frequency ($R = 10^7$)

removal of contaminant ions ($R = 10^5$)

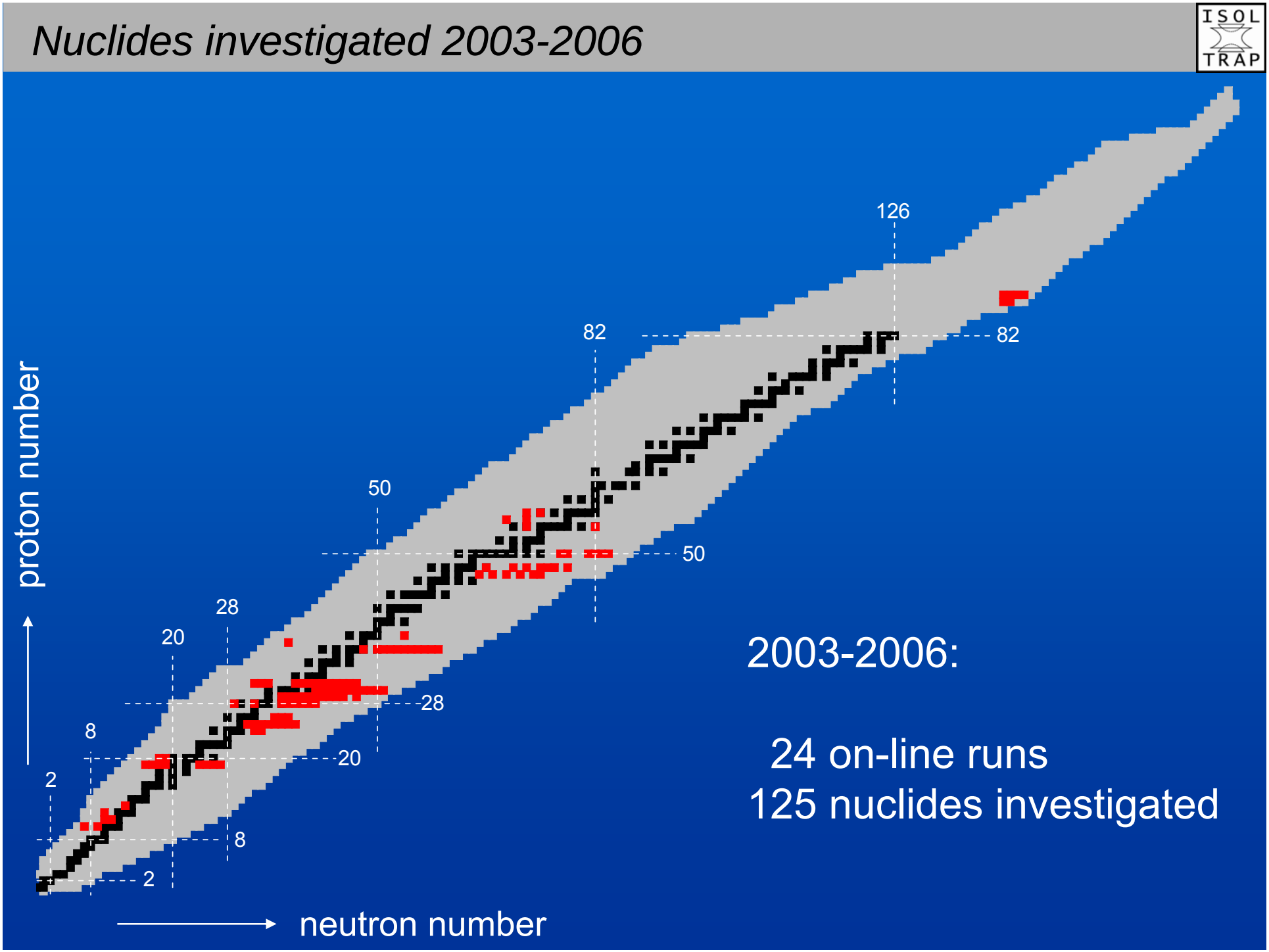
Bunching of the continuous beam





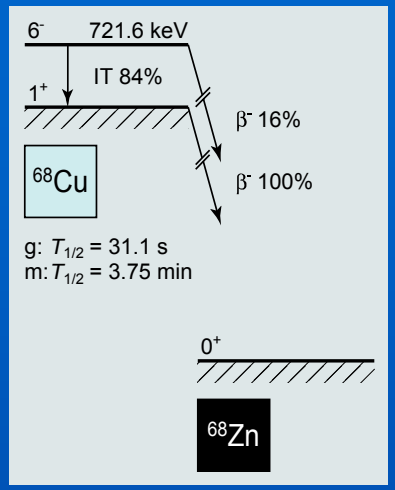
G. Bollen, et al., NIM A 368, 675 (1996)
F. Herfurth, et al., NIM A 469, 264 (2001)

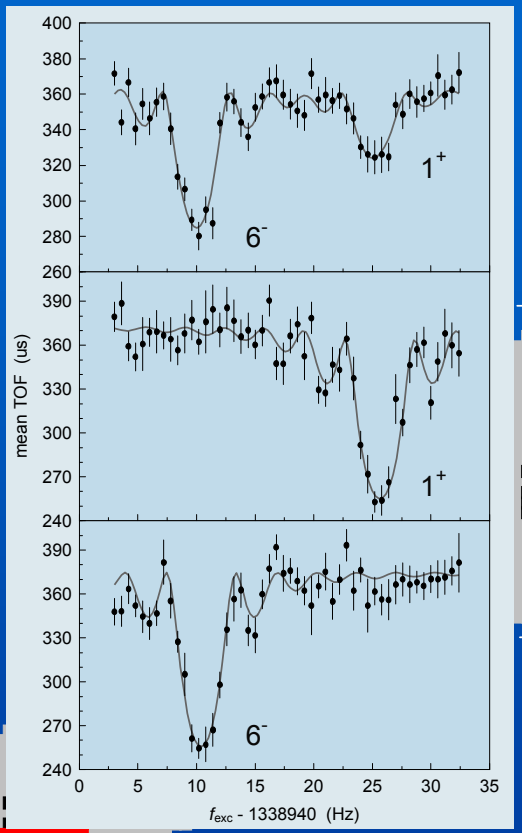
Nuclides investigated 2003-2006



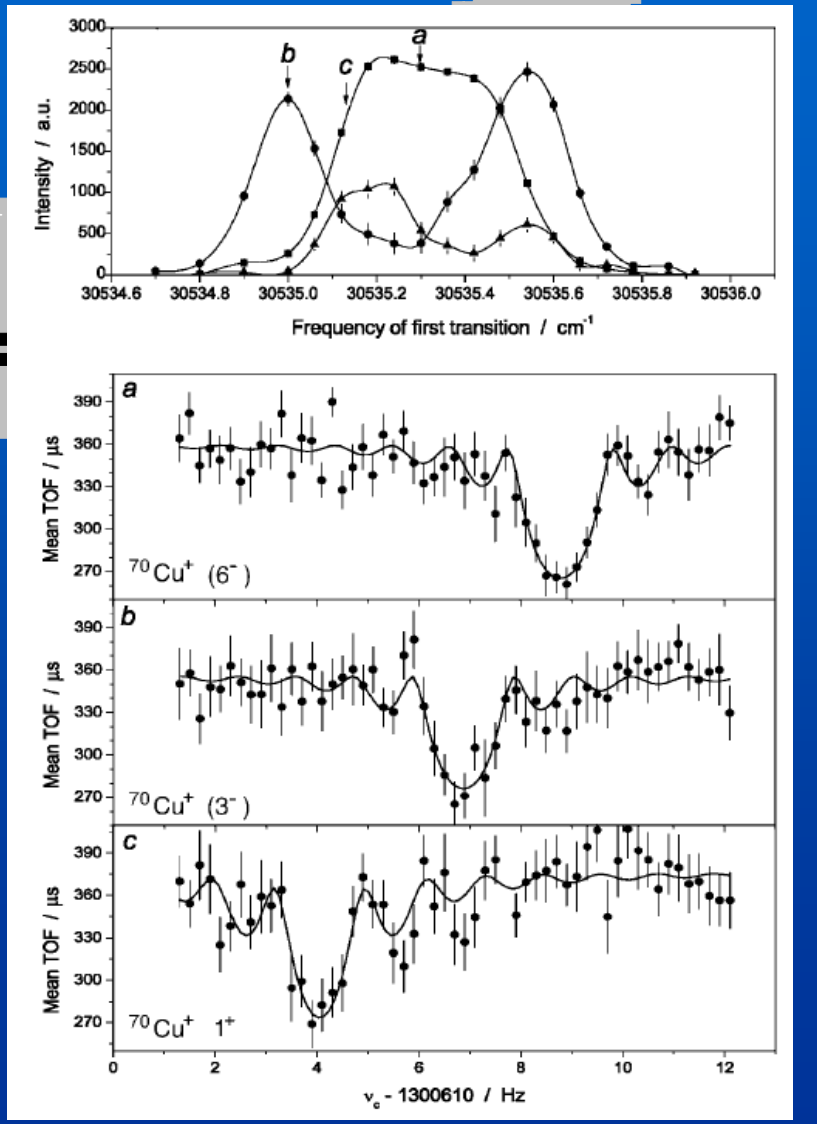
Isomer selection and spin assignment

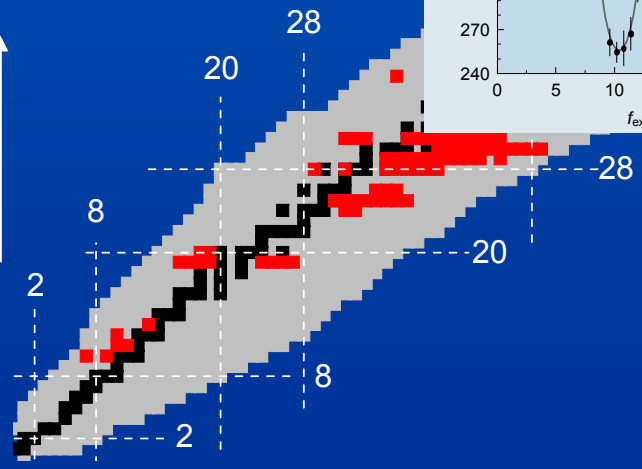
K. Blaum *et al.*, Europhys. Lett. 67, 586 (2004)



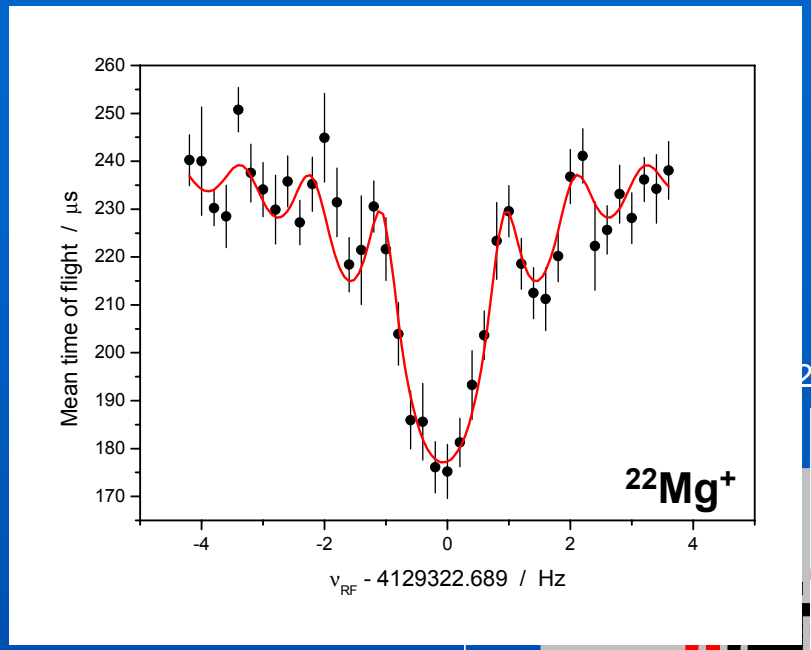


J. Van Roosbroeck *et al.*,
Phys. Rev. Lett. 92, 112501 (2004)





Test of CKM unitarity

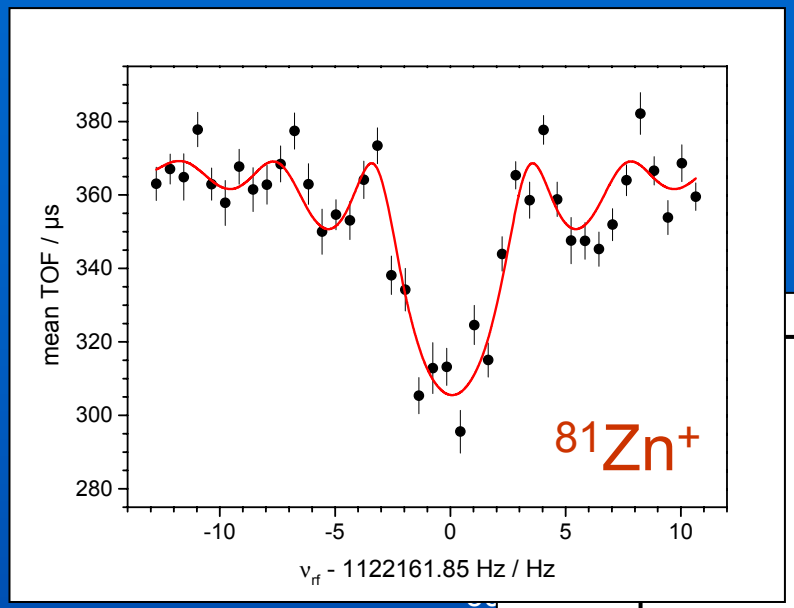


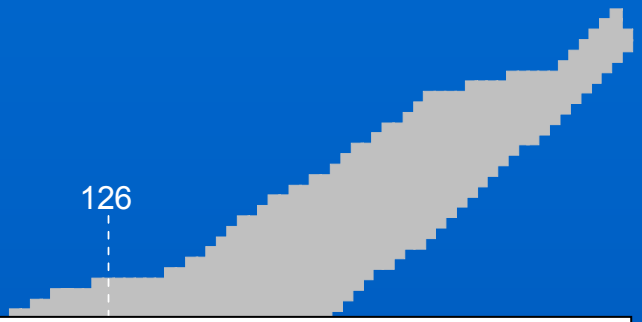
F. Herfurth *et al.*, EPJA 15, 17 (2002)
A. Kellerbauer et al., PRL 93, 072502 (2004)
M. Mukherjee *et al.*, PRL 93, 150801 (2004)

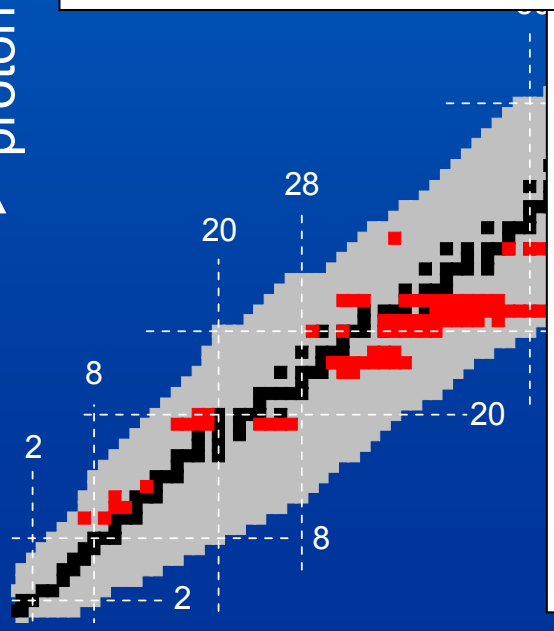
$$Ft \equiv ft(1+\delta_R)(1-\delta_C) = \frac{K}{2G_V^2(1+\Delta_R^V)}$$

J.C. Hardy and I.S. Towner, Phys. Rev. C 71, 055501 (2005)

Nucleosynthesis and r-process

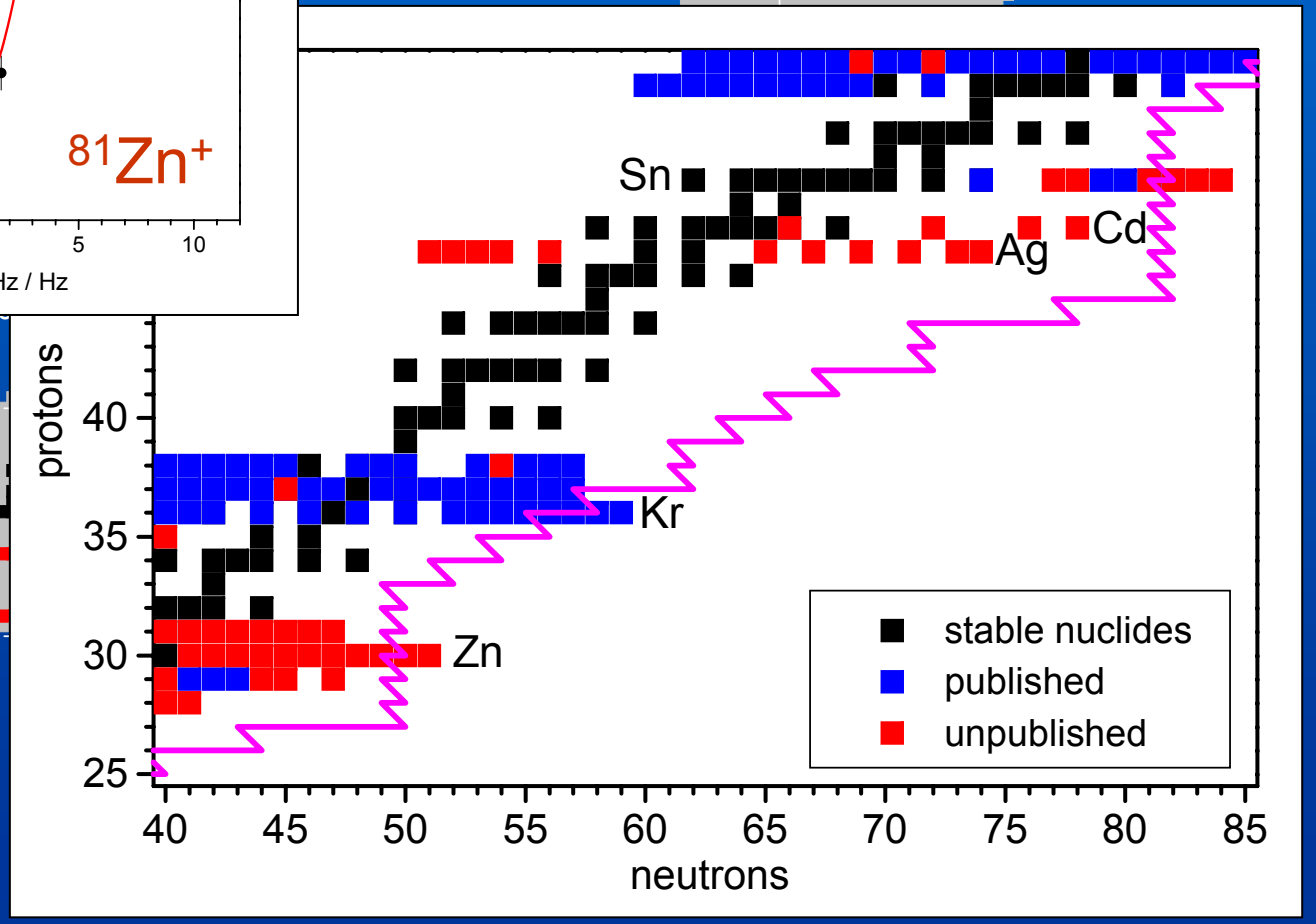




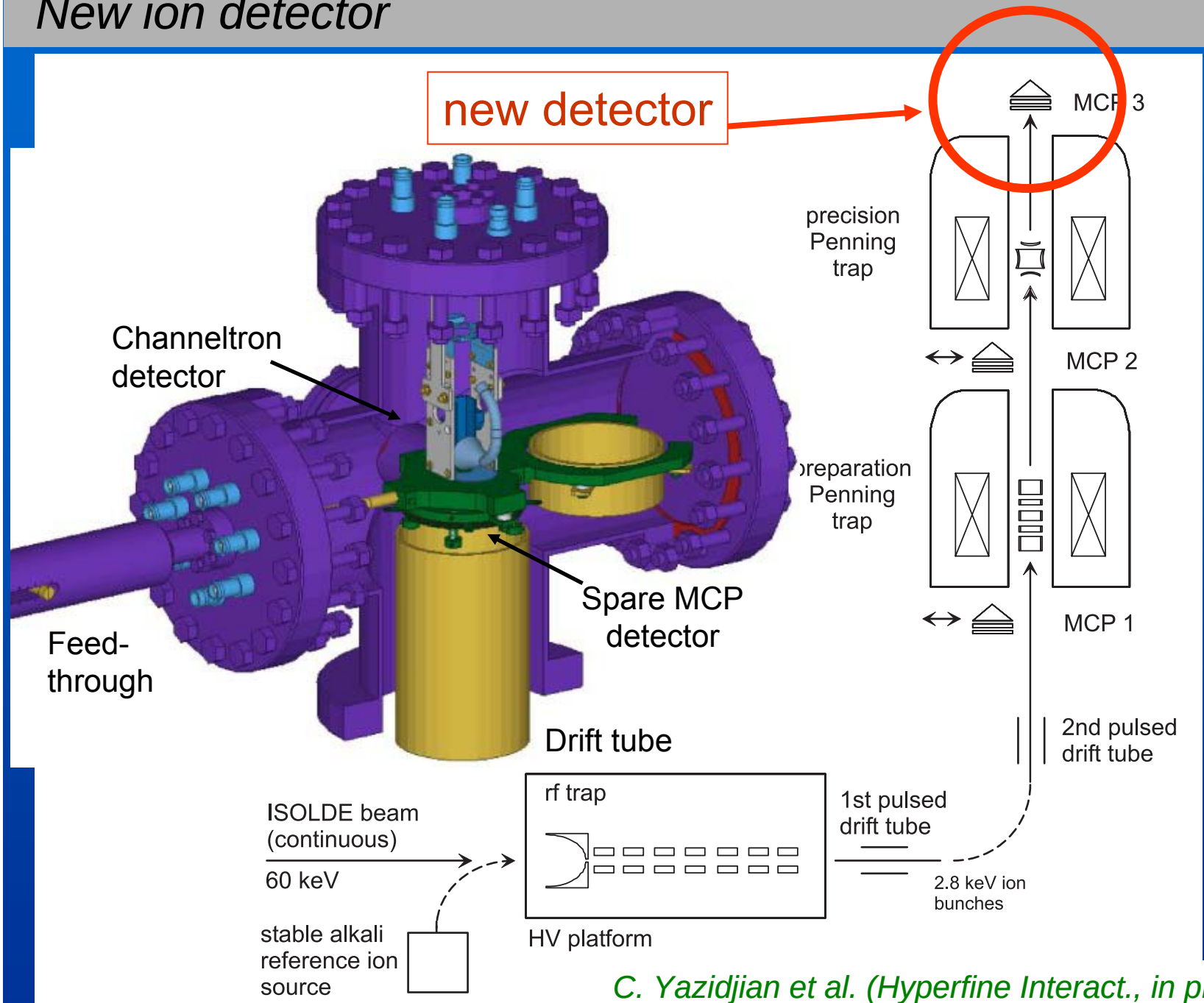


proton number

neutron number

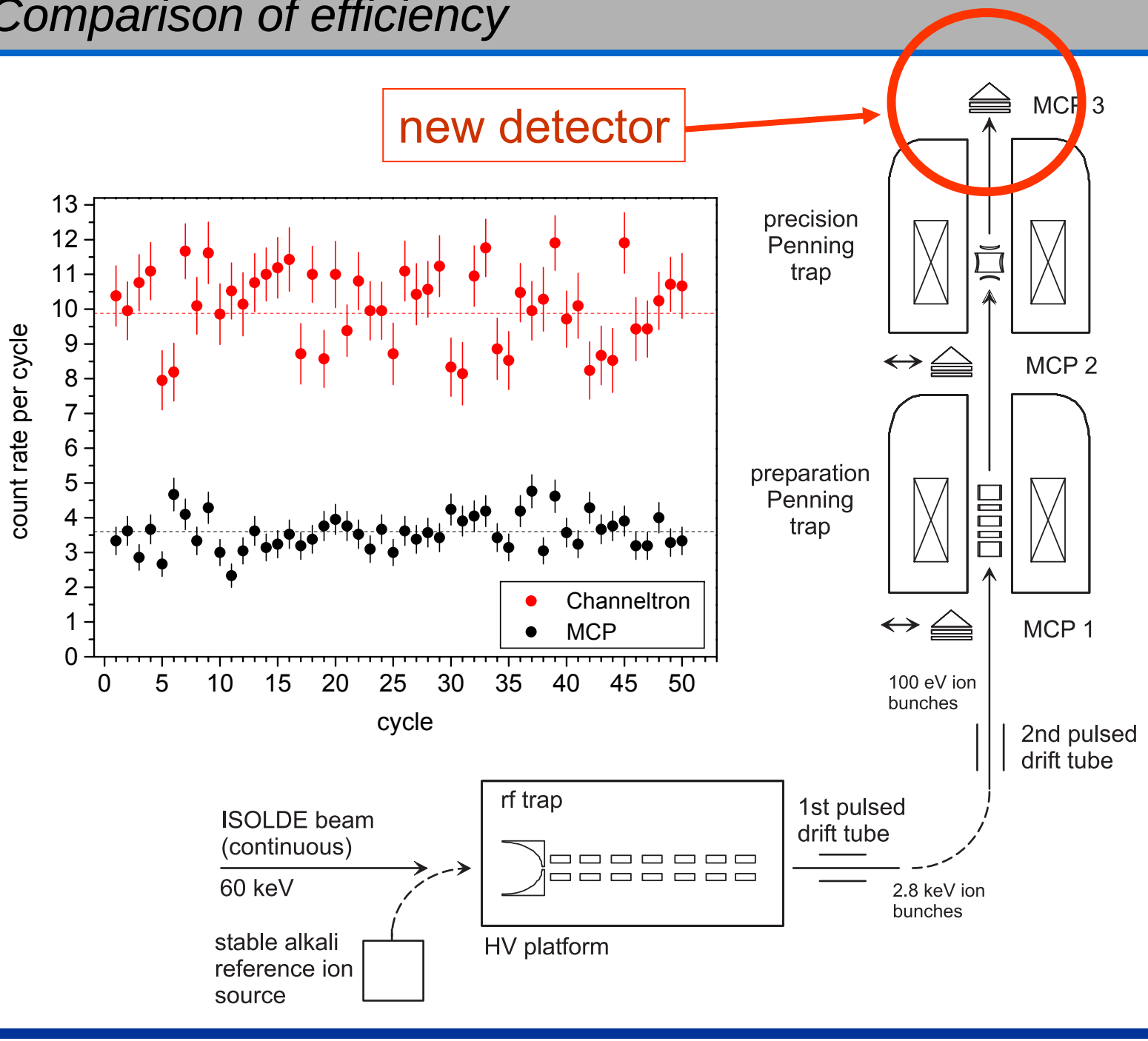


New ion detector



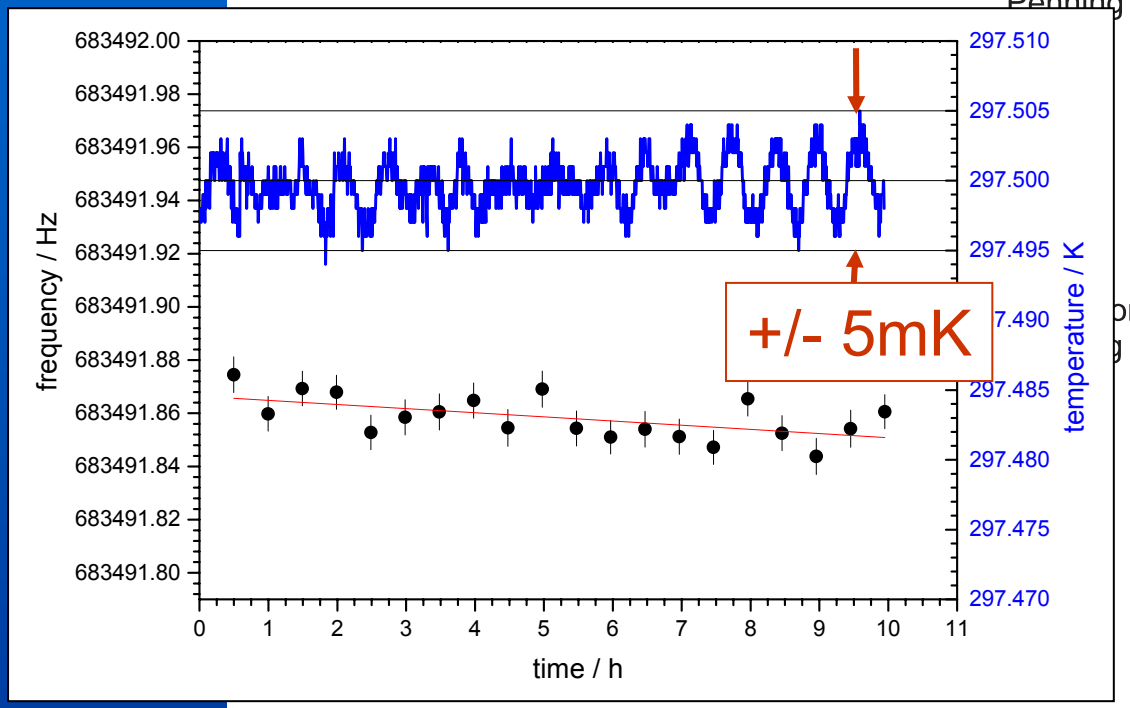
C. Yazidjian et al. (Hyperfine Interact., in print)

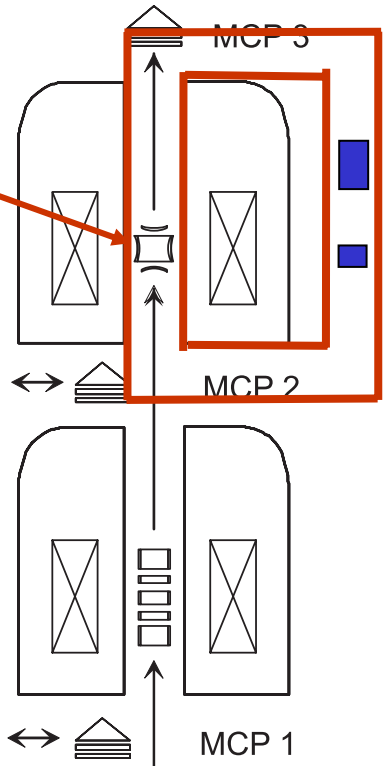
Comparison of efficiency



New temperature-stabilization system

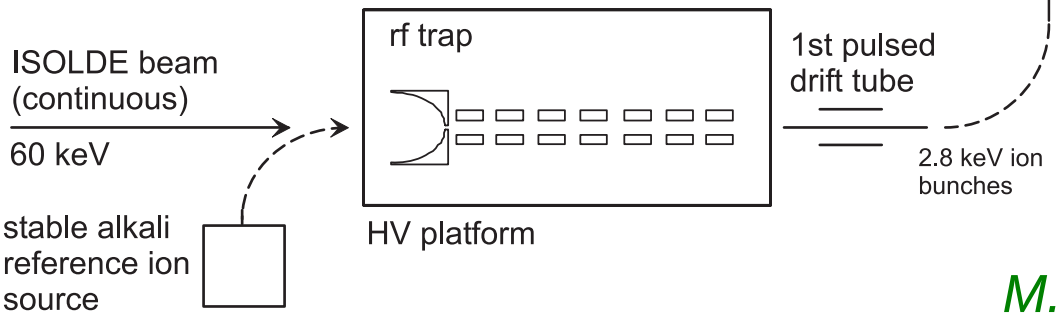
temperature sensor





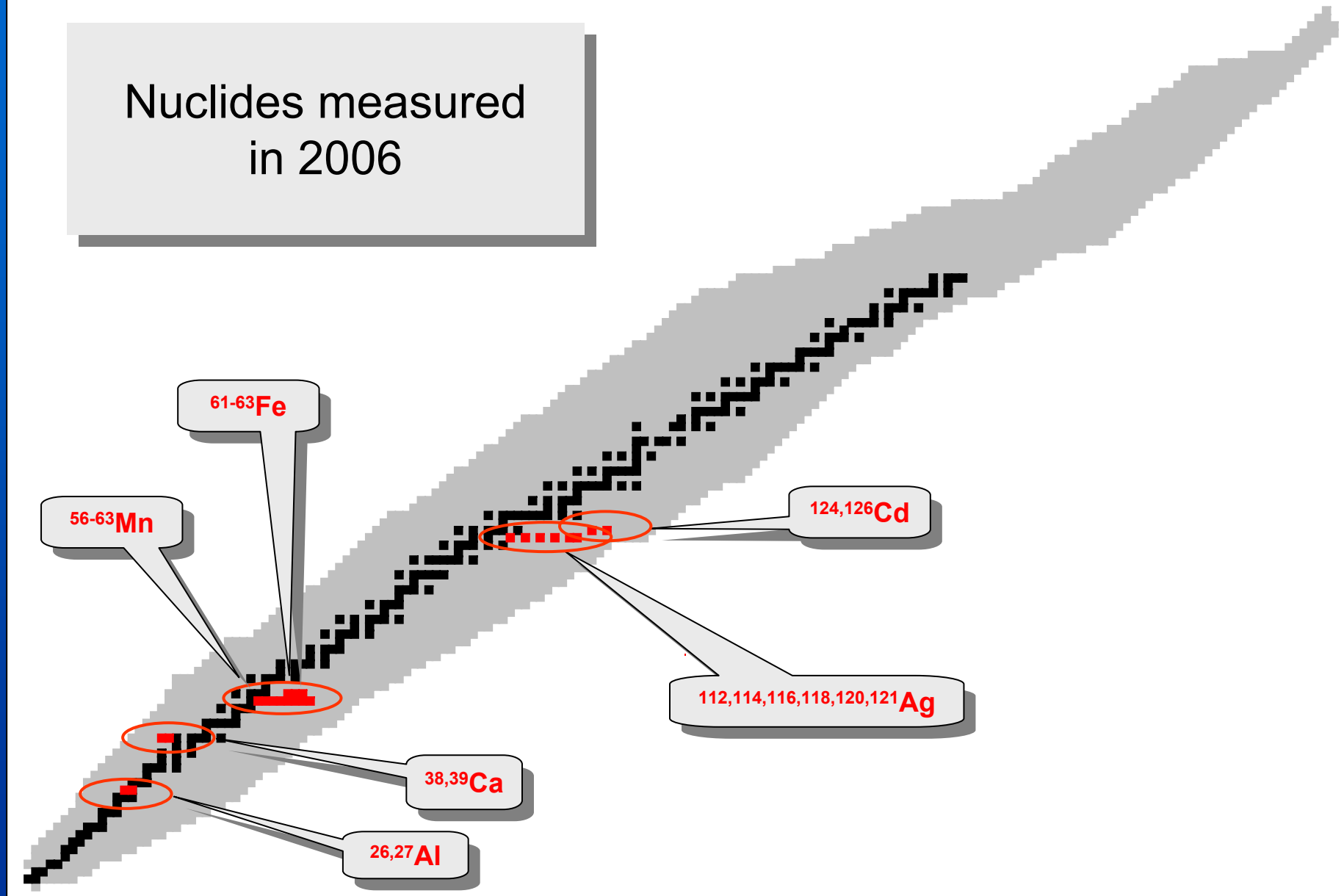
Heater
Fan

2nd pulsed drift tube

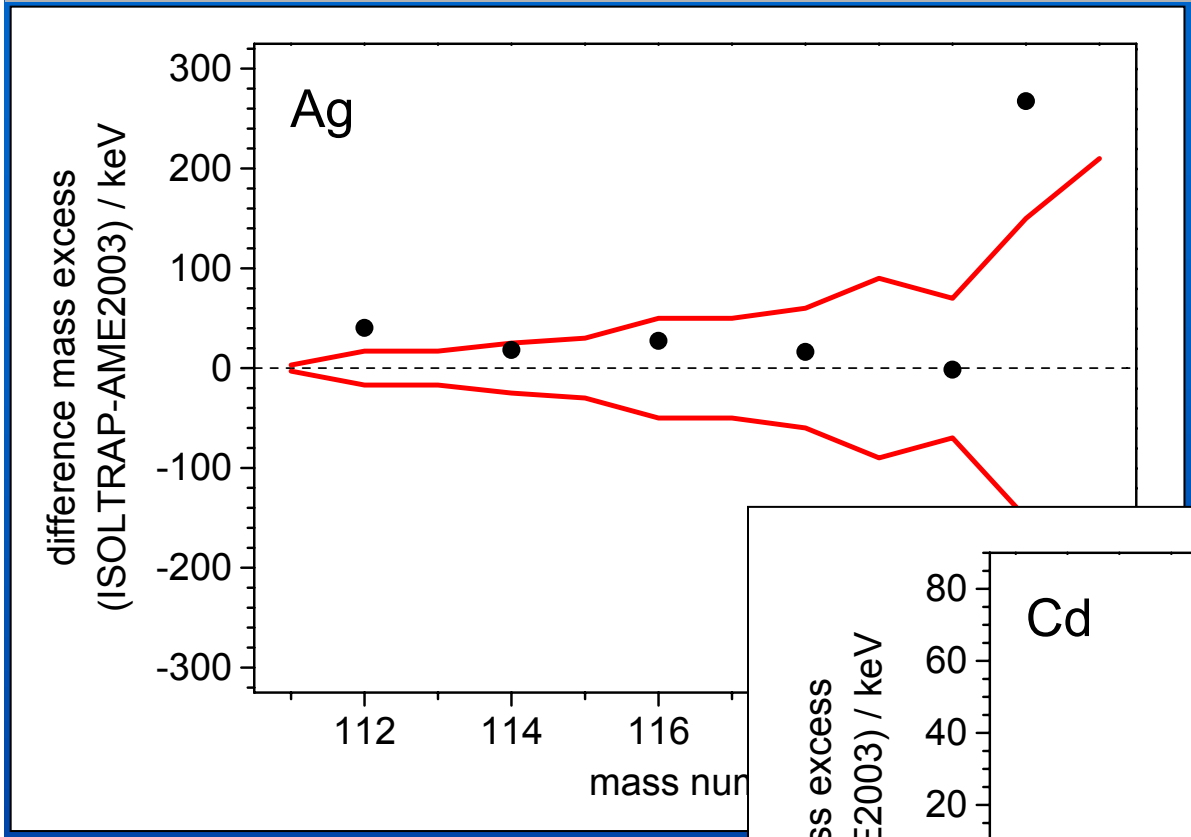


M. Marie-Jeanne et al.

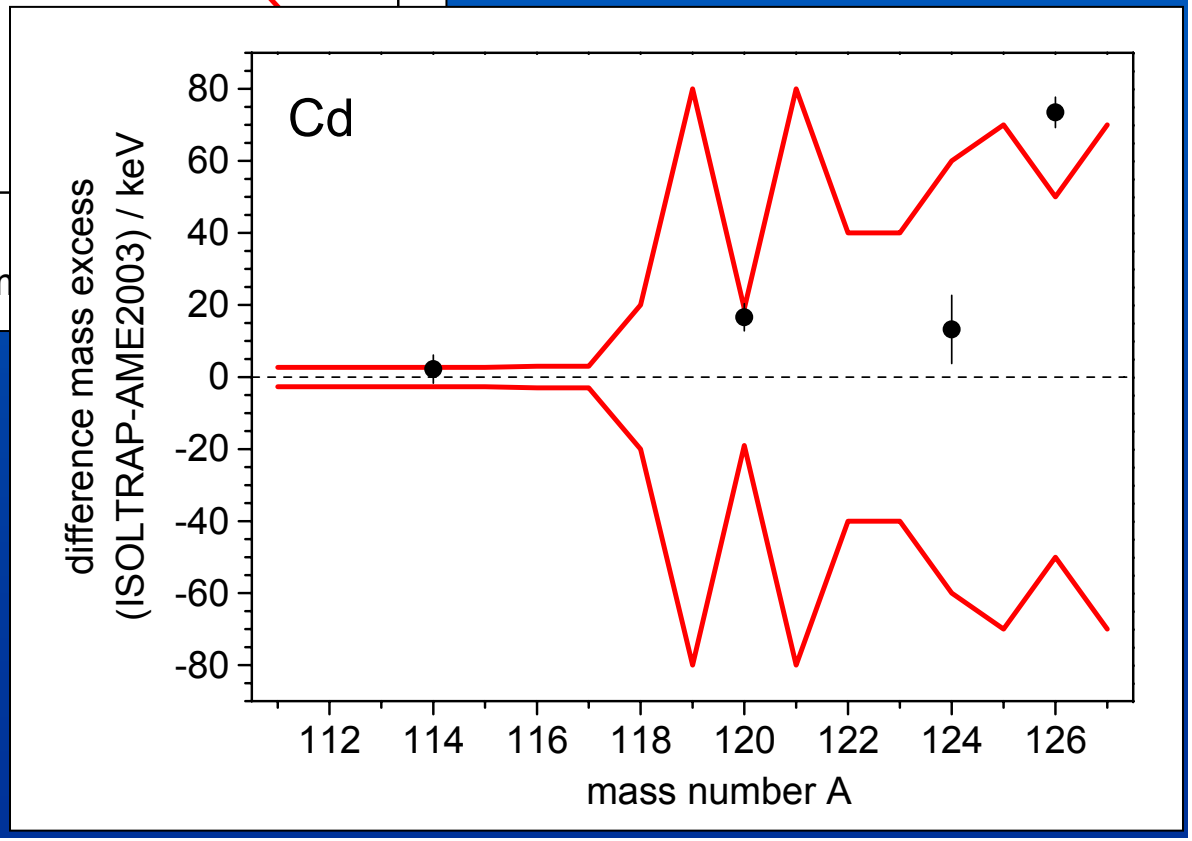
ISOLTRAP mass measurements in 2006



Mass excess comparison for Ag and Cd data



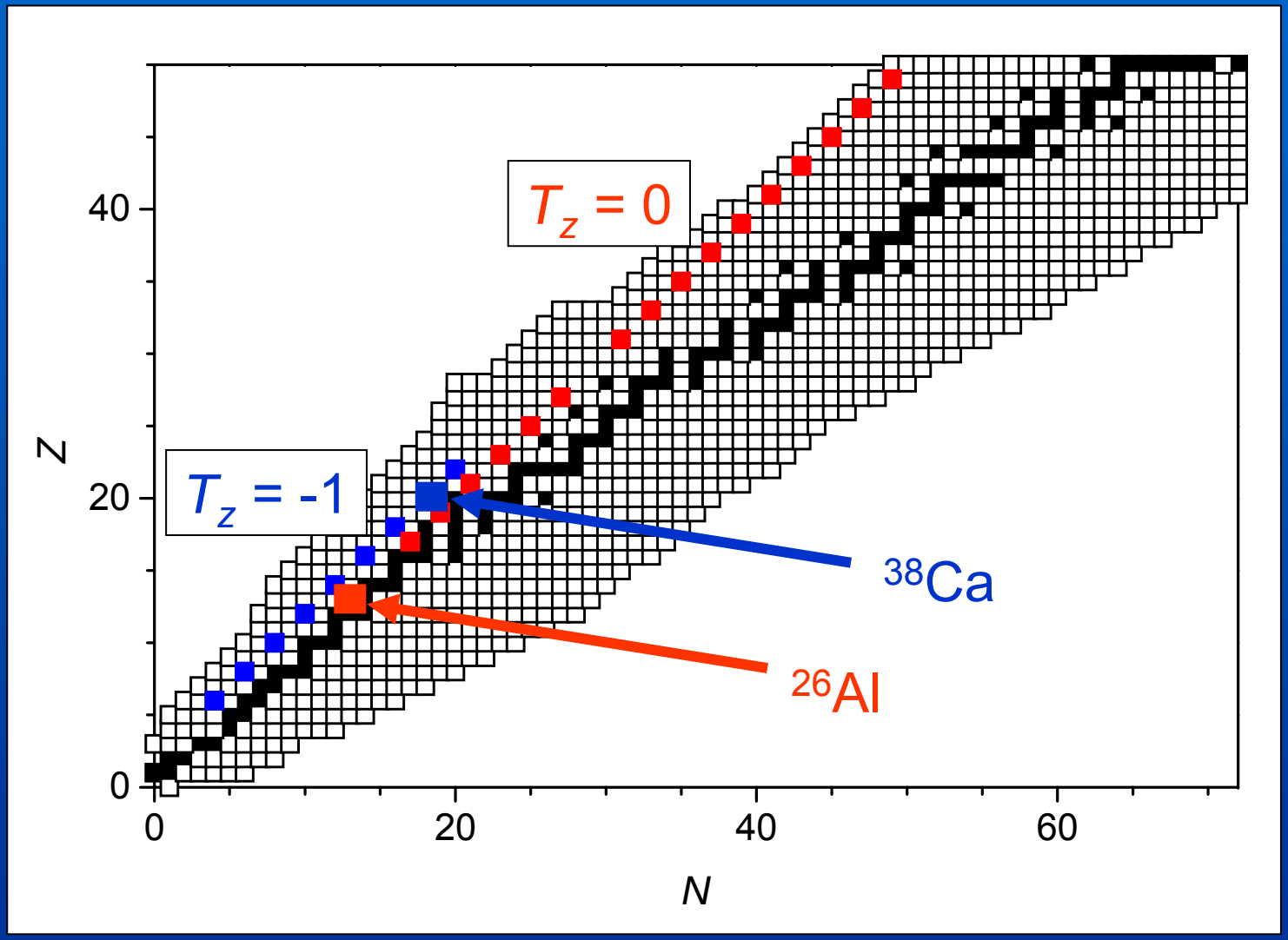
both runs stopped
by power cuts



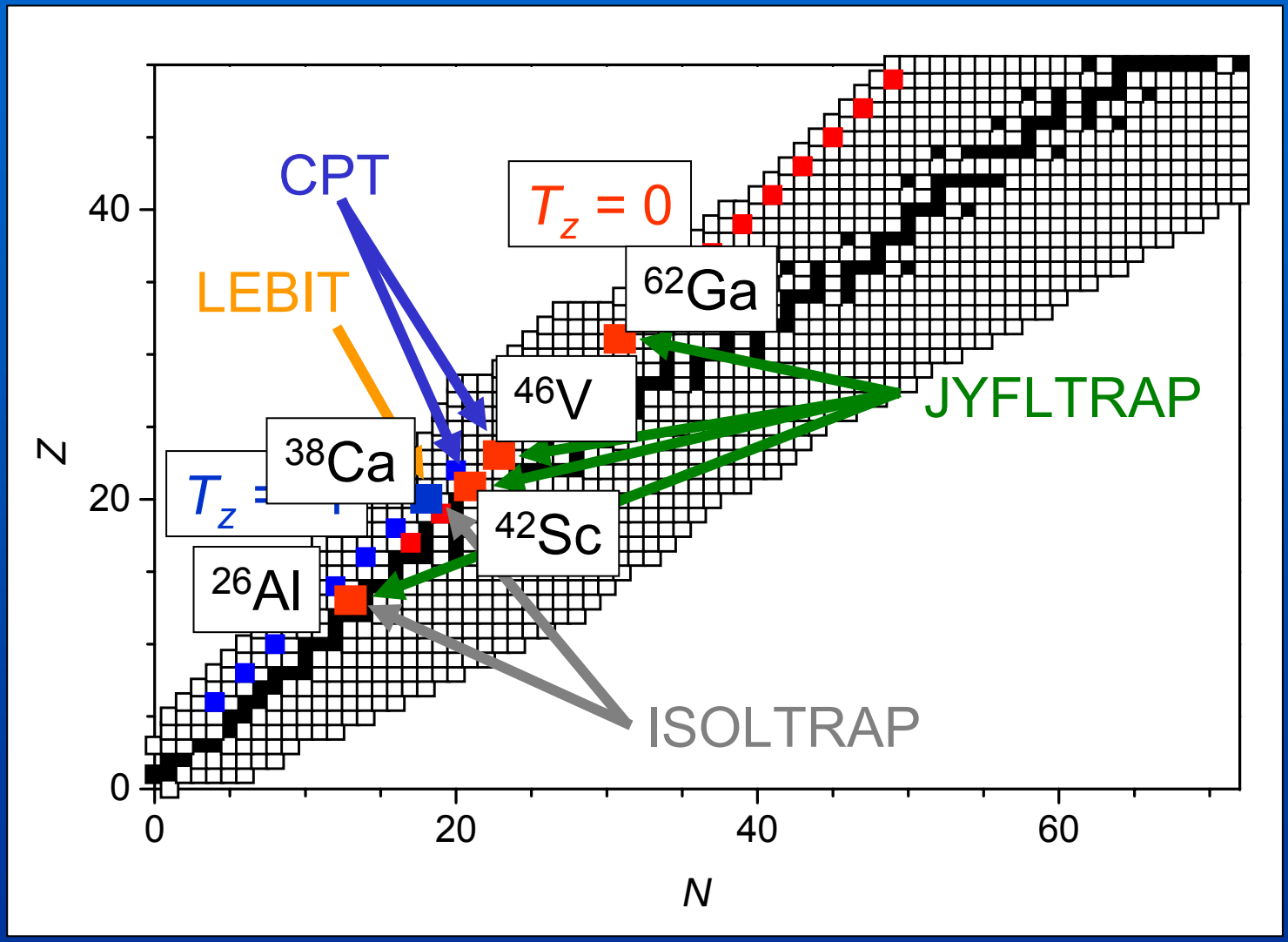
new on-line
measurements
planned in 2007

ISOL TRAP

masses for CKM-unitarity test (superallowed β decay)



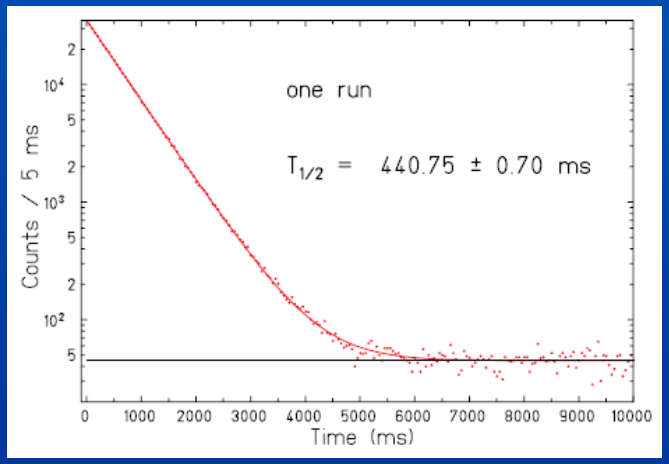
... and other investigations from Penning trap spectrometers



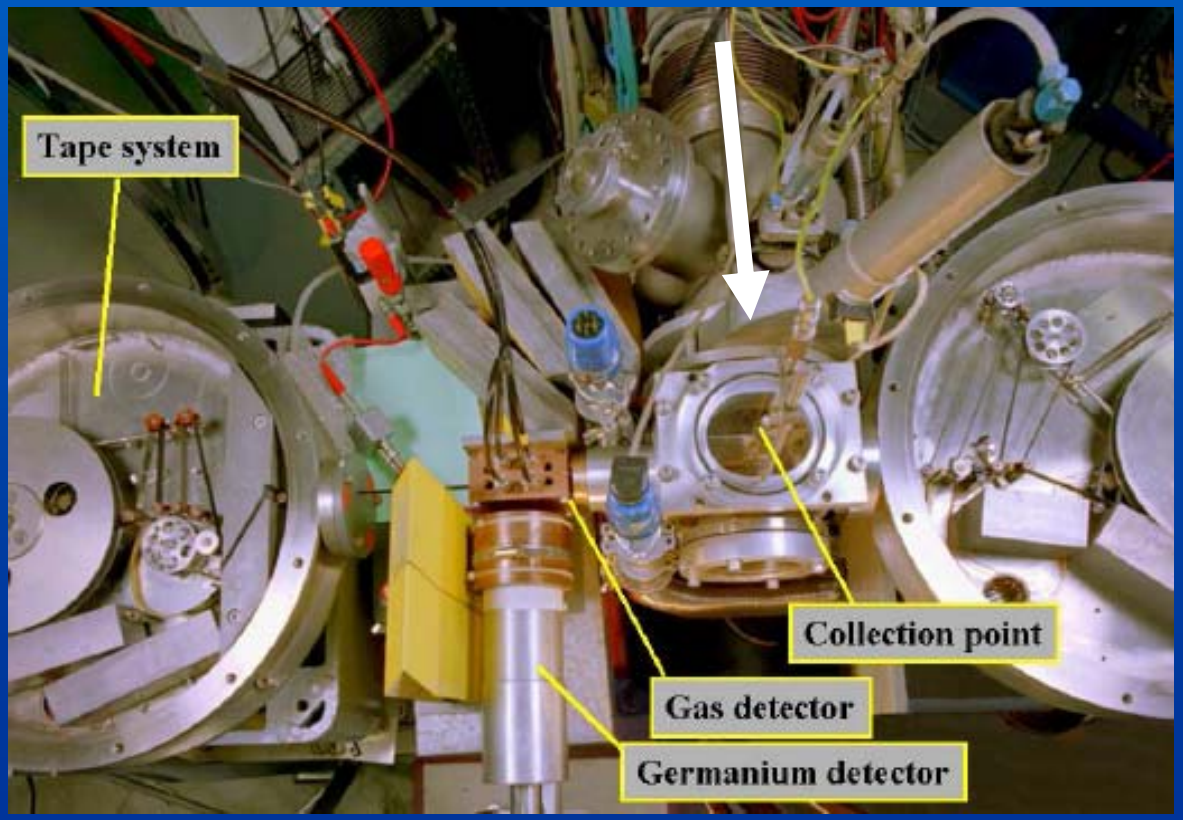
Mass and half-life of ^{38}Ca

Experiment IS437: Precision measurement of the half-life and the β-decay Q value of the superallowed $0^+ \rightarrow 0^+$ β decay of ^{38}Ca

- fluorination of ^{38}Ca at target and removal of daughter ^{38m}K with REXTRAP
- half-life measurement with tape-station system mounted behind REXTRAP
- mass measurement (in parallel) with ISOLTRAP



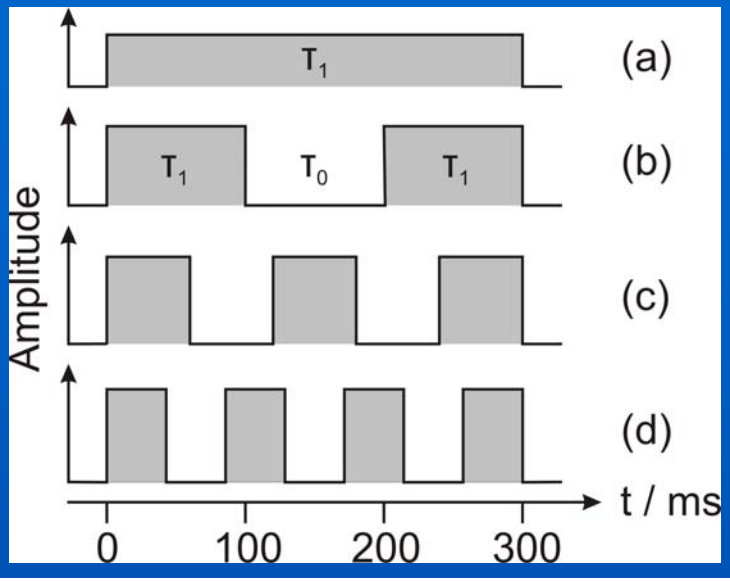
simulation for ^{38}Ca

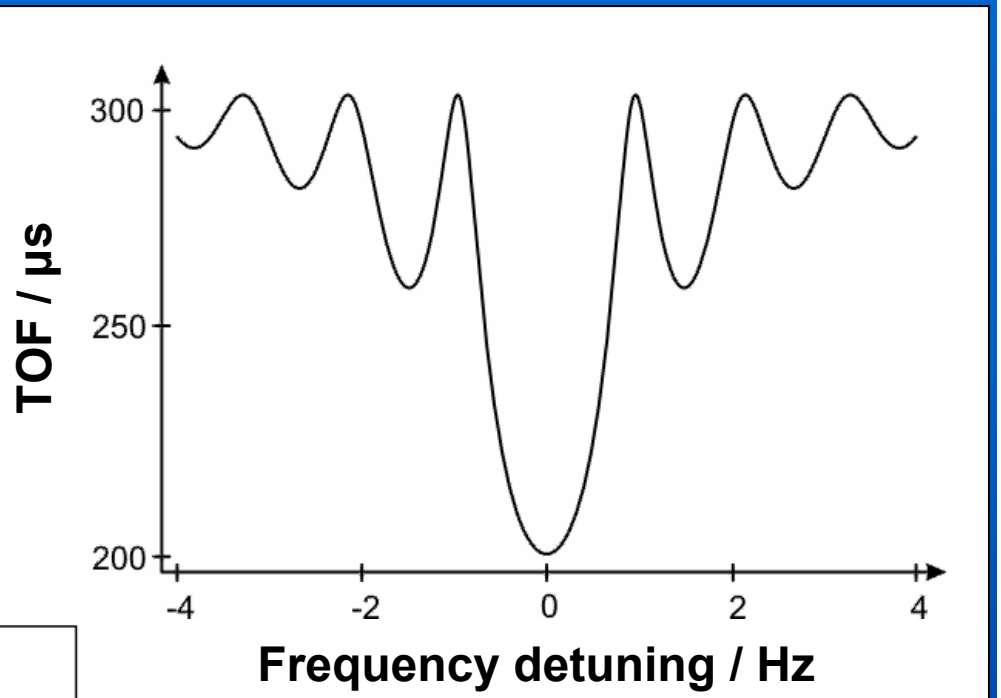


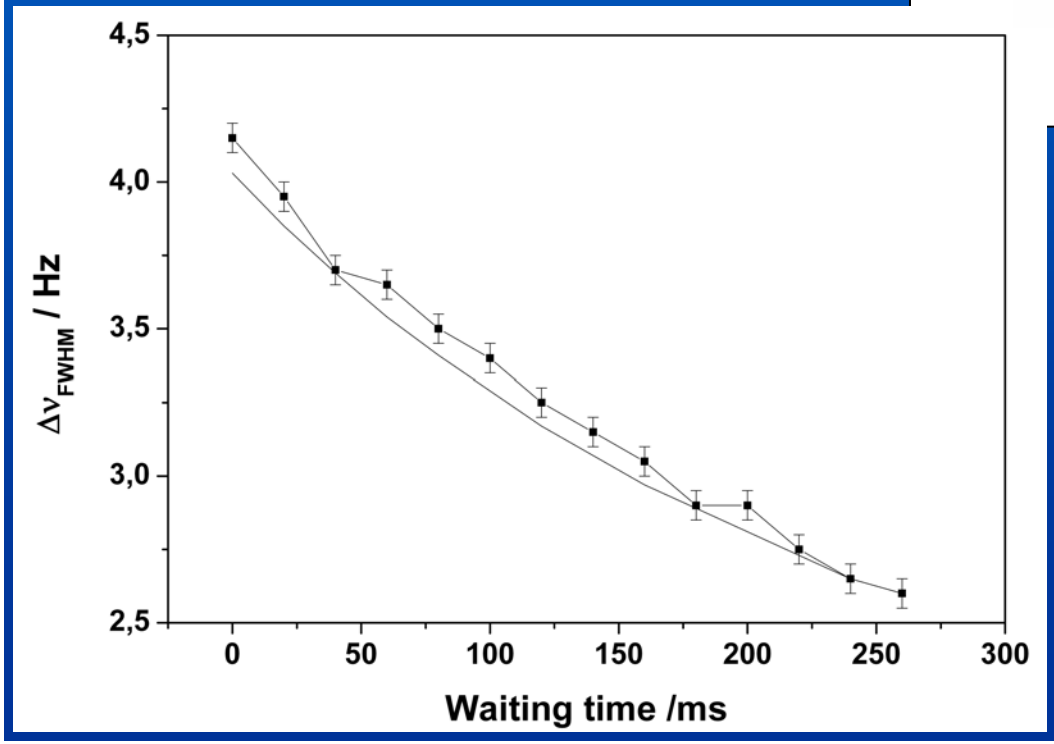
→ talk by Bertram Blank on Wednesday

B. Blank et al.

Time-separated rf excitations (Ramsey scheme)



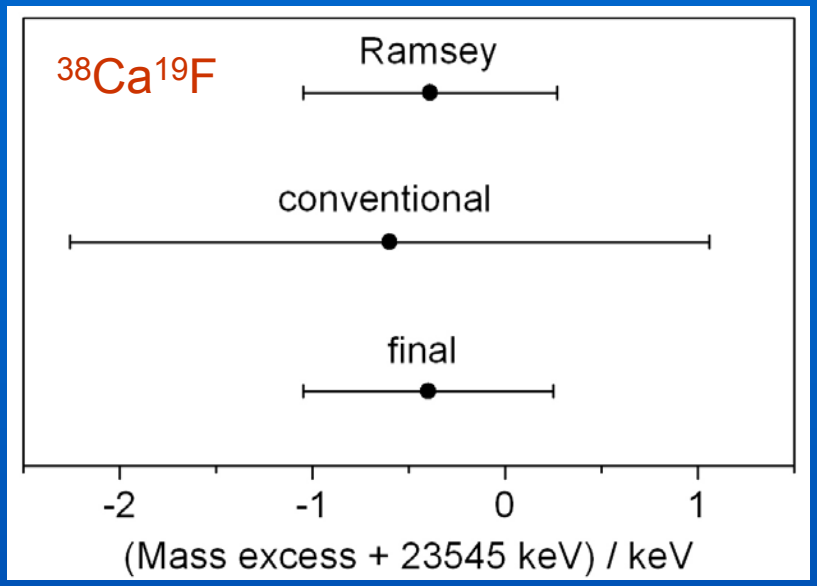


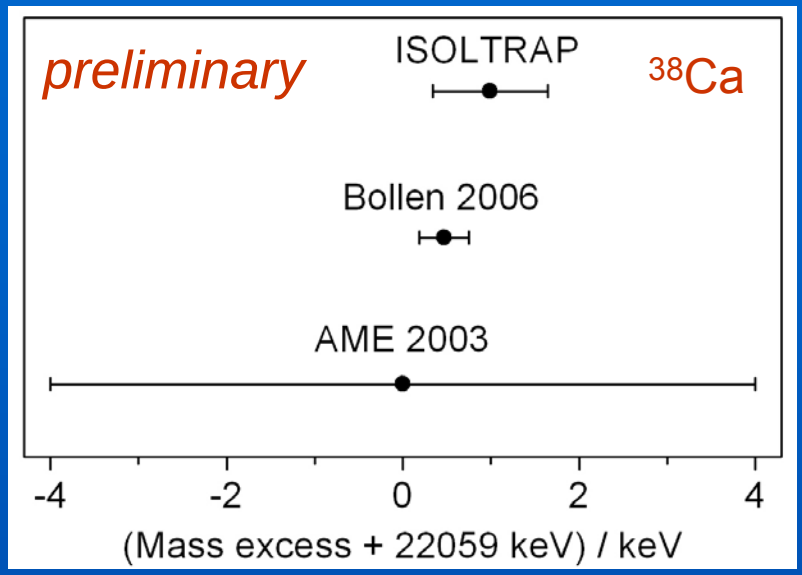


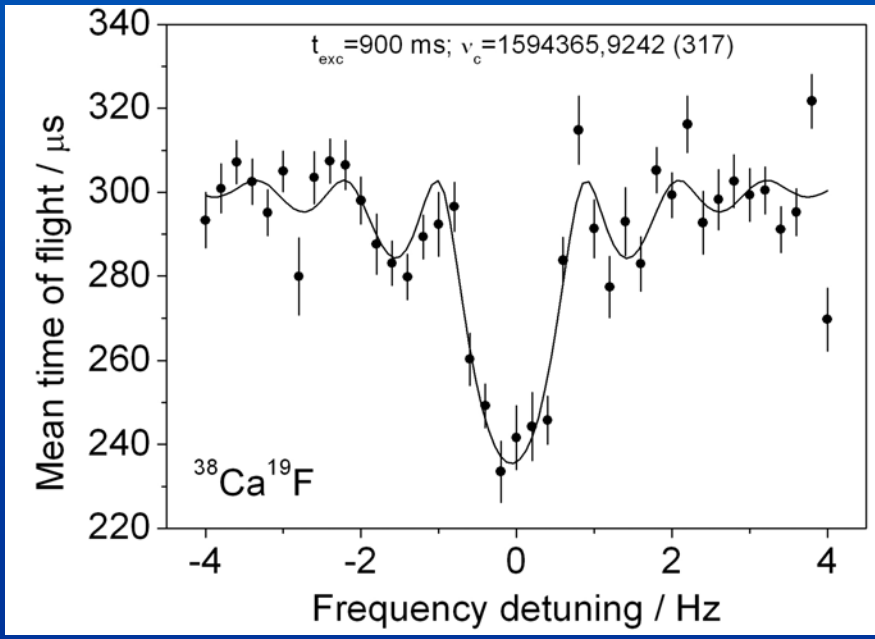
two excitation periods

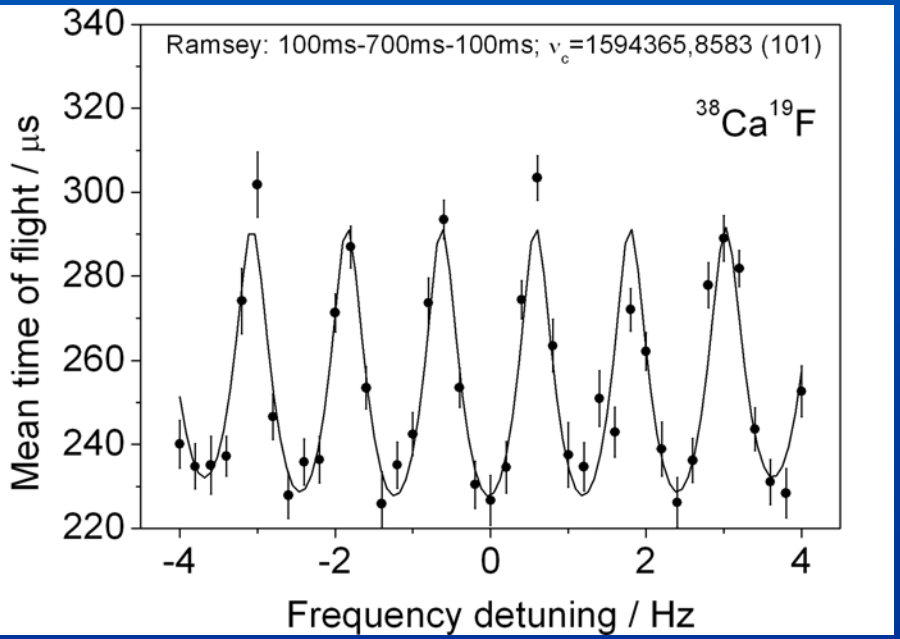
S. George et al.
(to be published)

Preliminary result ^{38}Ca



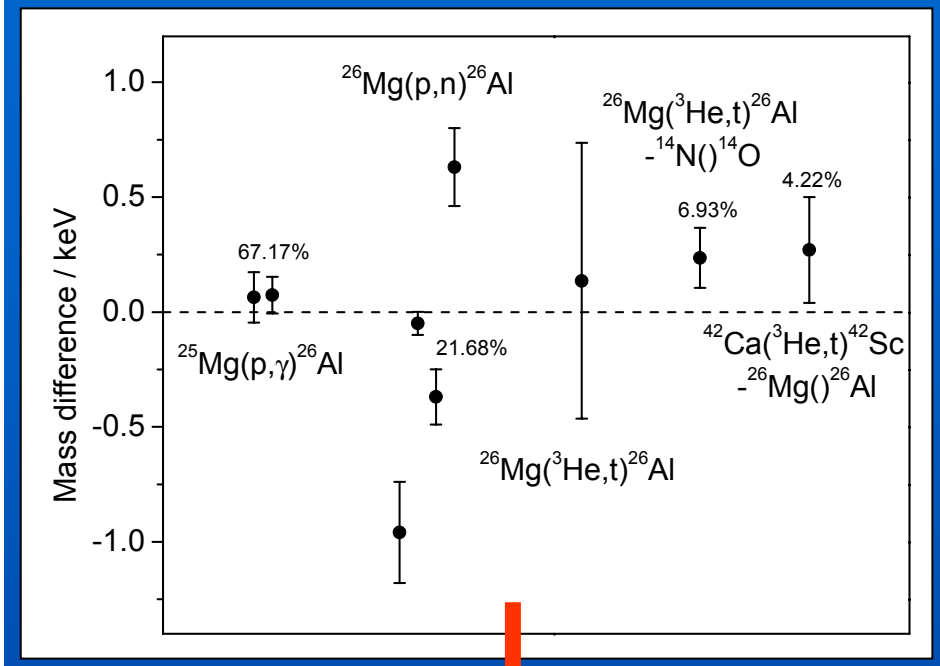






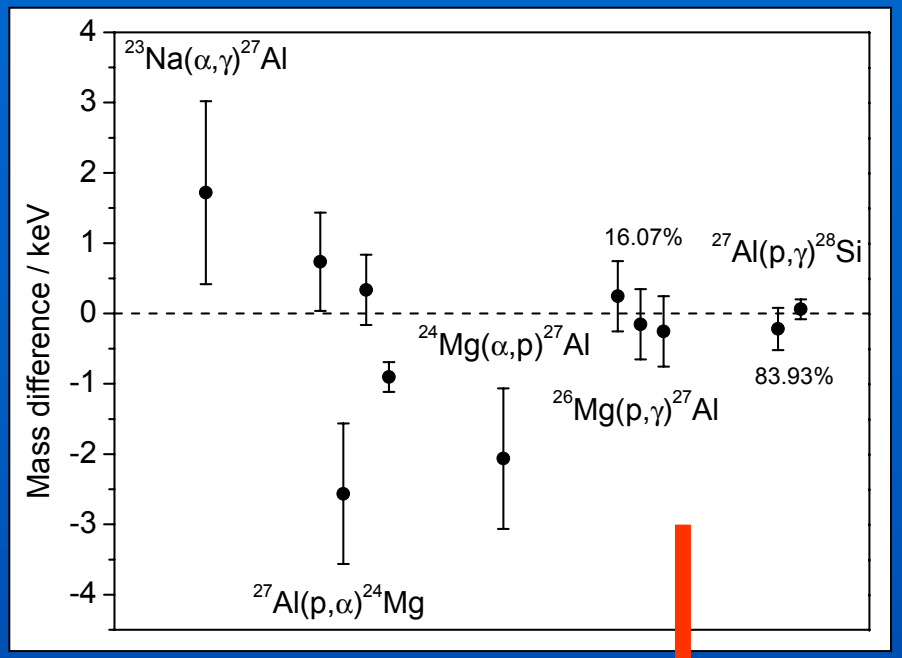
S. George et al. (to be published)

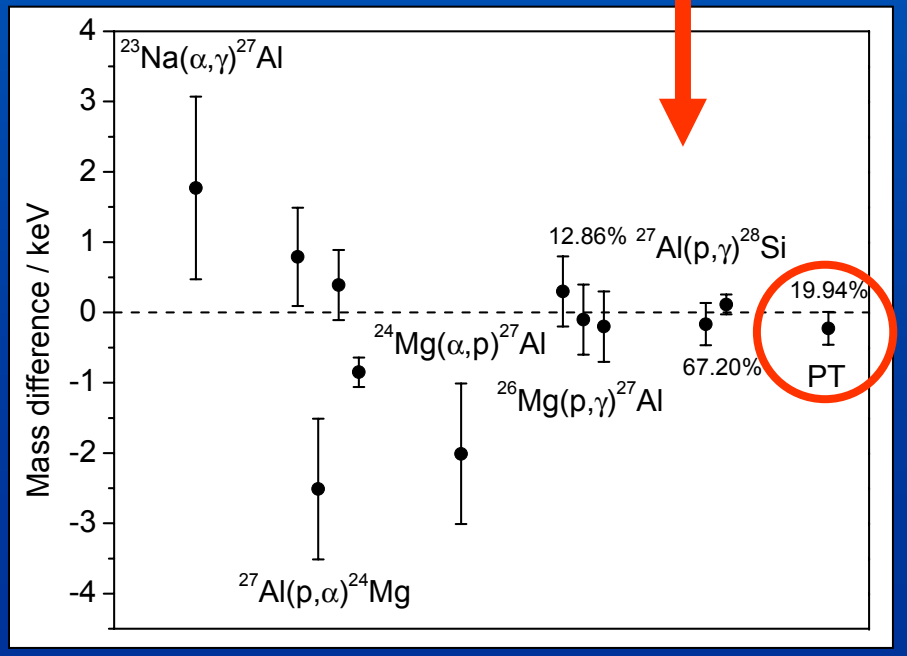
The case of $^{26,27}Al$



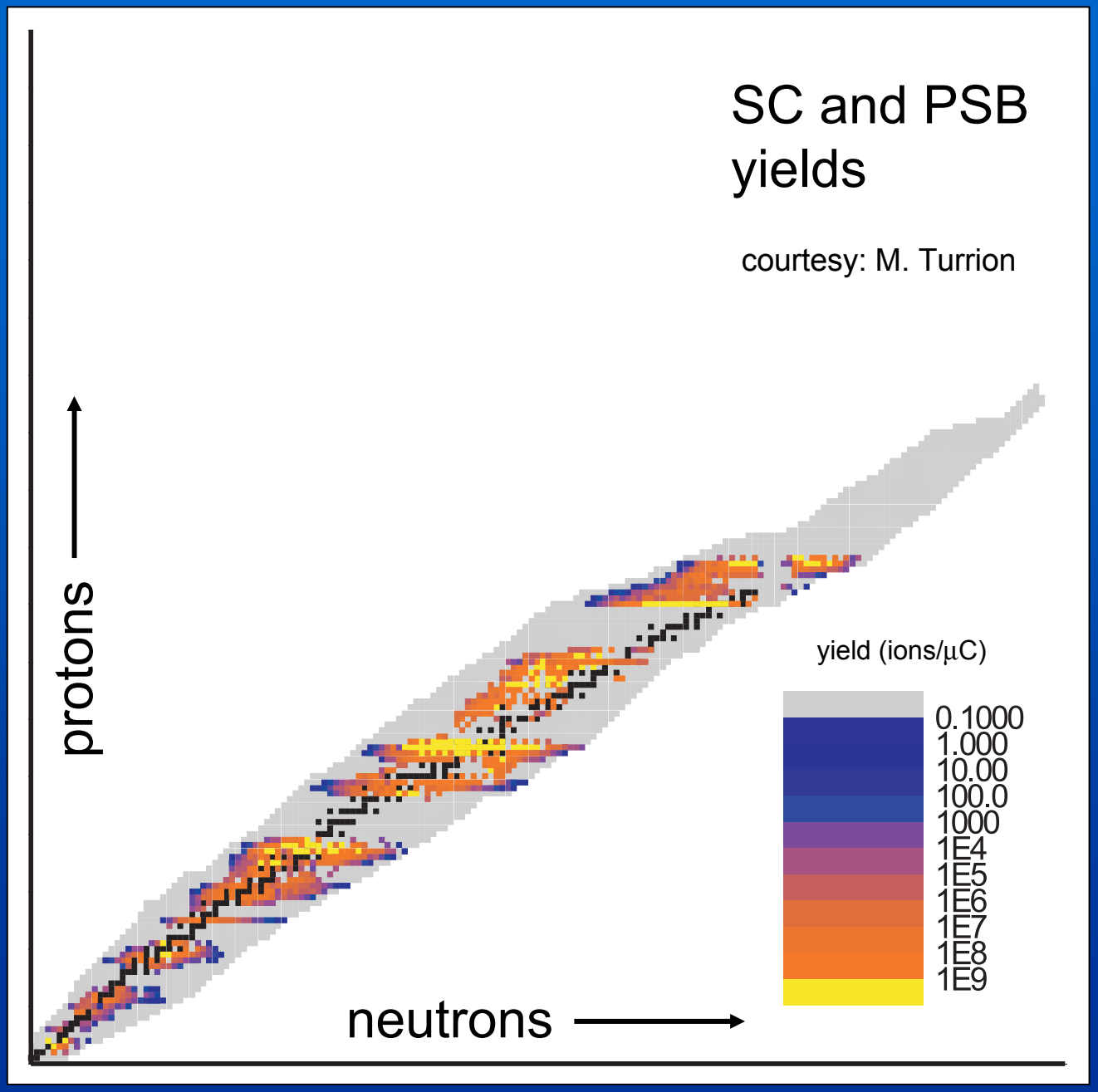
?

(evaluation in progress ...)



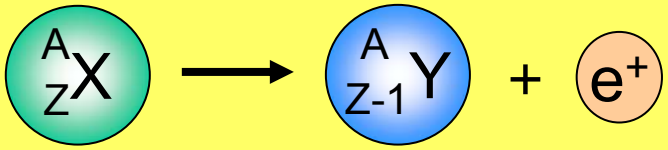


Ion yields at ISOLDE



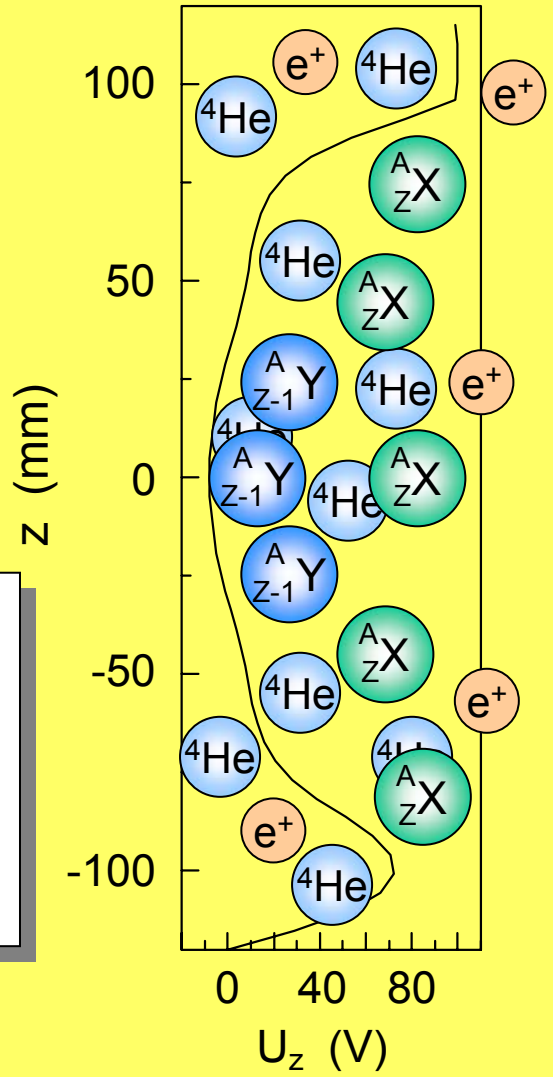
Decay in the buffer-gas-filled preparation trap

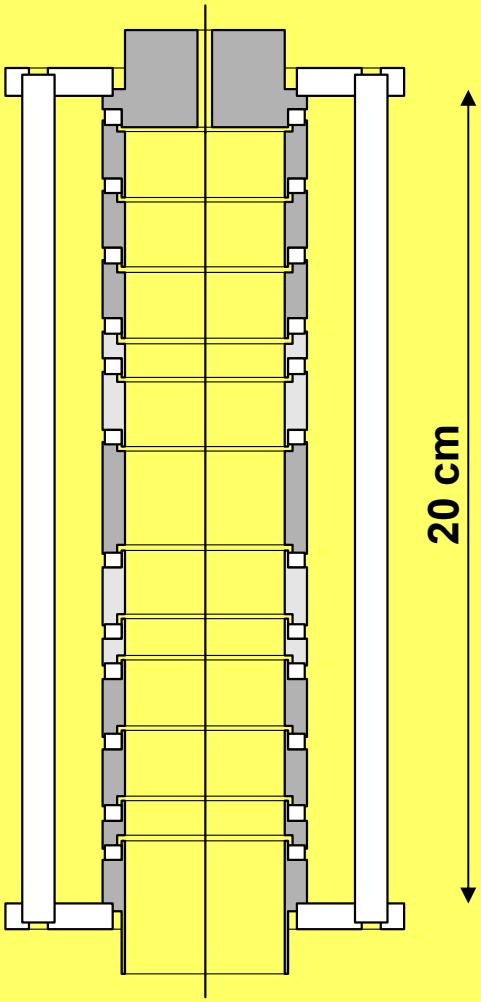
produced at ISOLDE



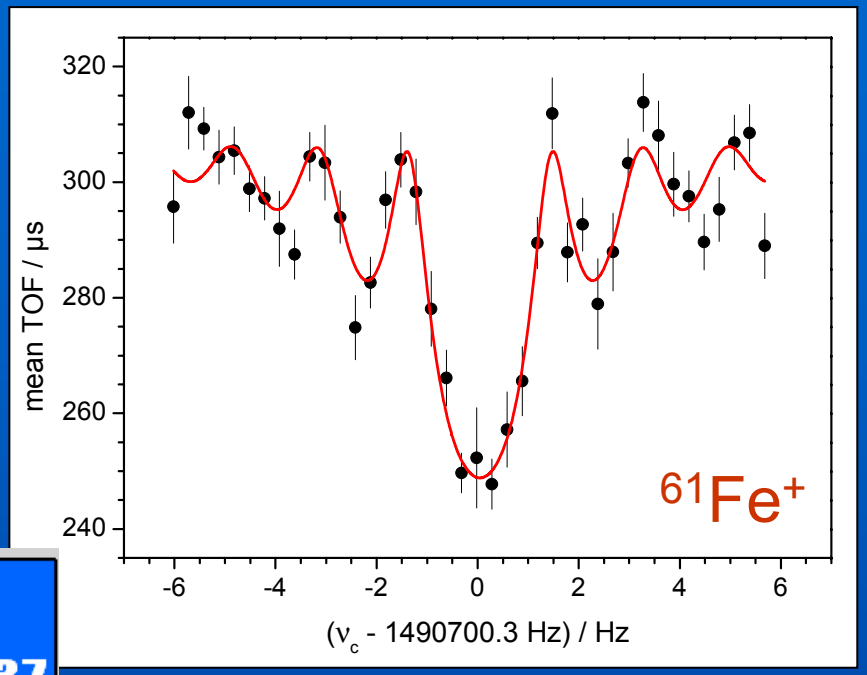
not produced at ISOLDE

- **Make more radioactive species available**
- **Nearly simultaneous ω_c measurement of mother and daughter nuclei**



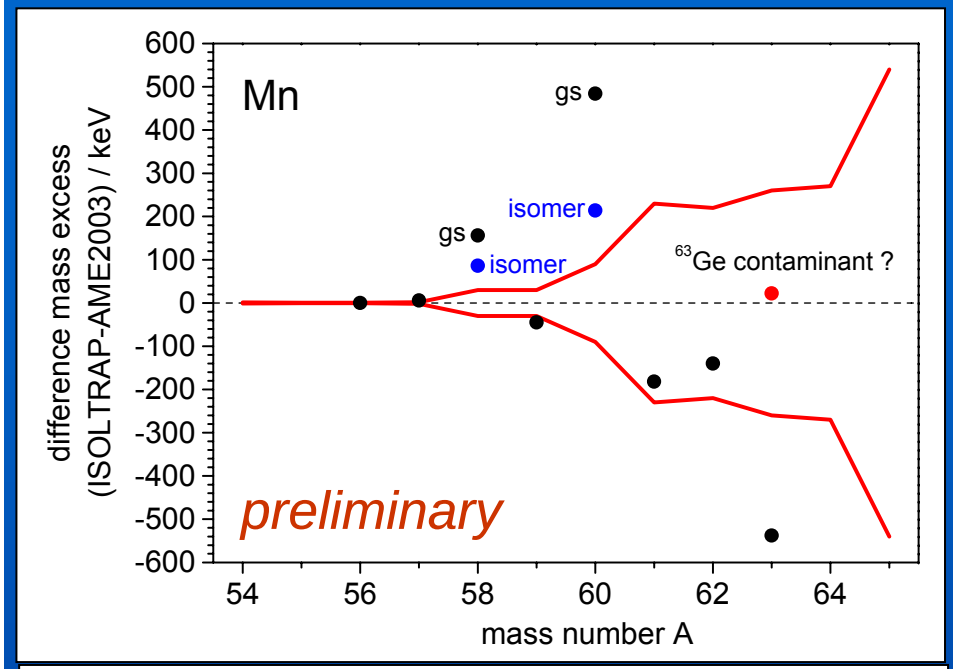


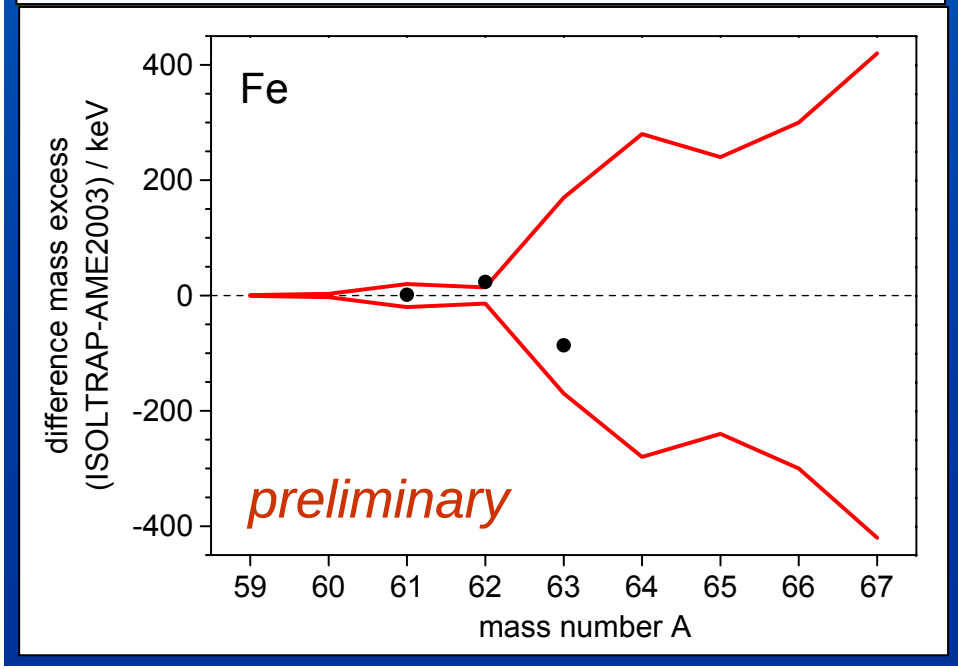
First application of in-trap decay mass spectrometry



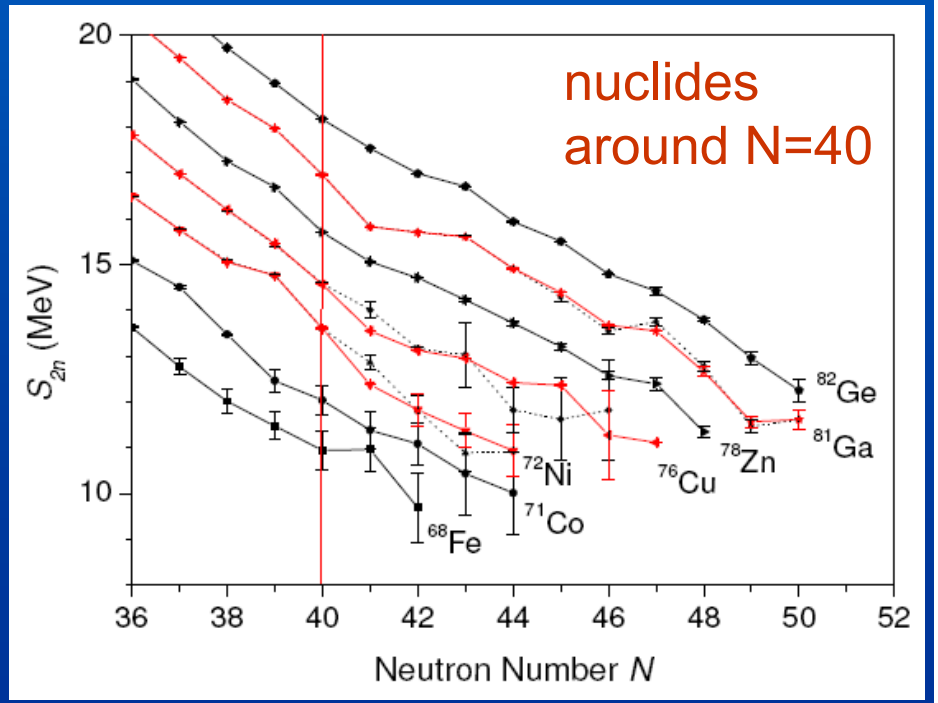
$^{61}_{26}Fe_{35}$ 250 ns 9/2⁺# Eex 861 (3) IT=100% 5.98 m 3/2⁻,5/2⁻ M⁻58921 (20) β⁻=100%	$^{62}_{26}Fe_{36}$ 68 s 0⁺ M⁻58901 (14) β⁻=100%	$^{63}_{26}Fe_{37}$ 6.1 s (5/2)⁻ M⁻55550 (170) β⁻=100%
$^{61}_{25}Mn_{36}$ 670 ms (5/2)⁻ M⁻51560 (230) β⁻=100% β⁻n=?	$^{62}_{25}Mn_{37}$ 92 ms (1⁺) Eex 0# (150#) β⁻=100% β⁻n≈0% 671 ms (3⁺) M⁻48040 (220) β⁻=100% β⁻n=?	$^{63}_{25}Mn_{38}$ 275 ms 5/2⁻# M⁻46350 (260) β⁻=100% β⁻n=?

Mass excess of neutron-rich Mn and Fe isotopes



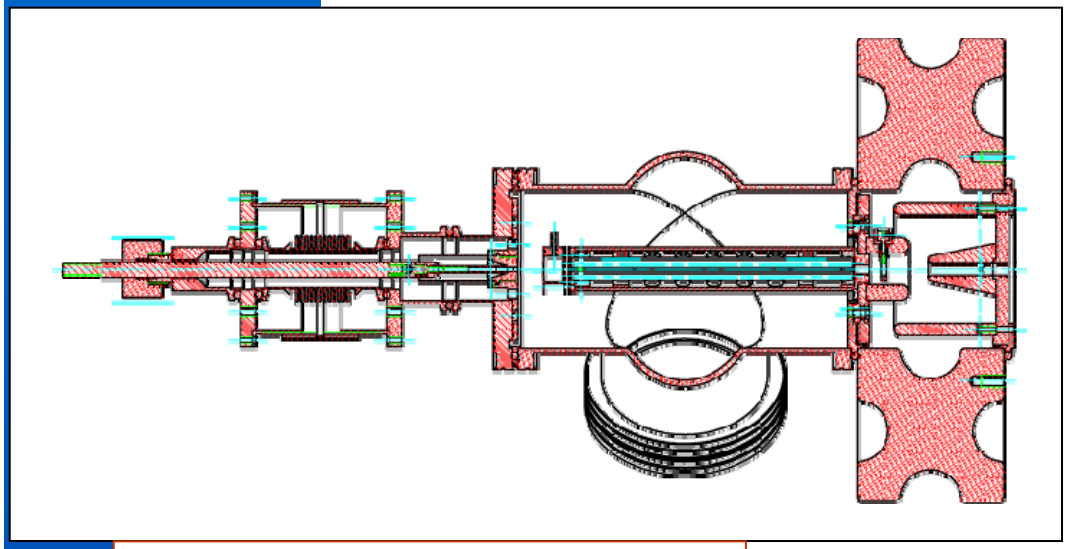


further measurements required ...

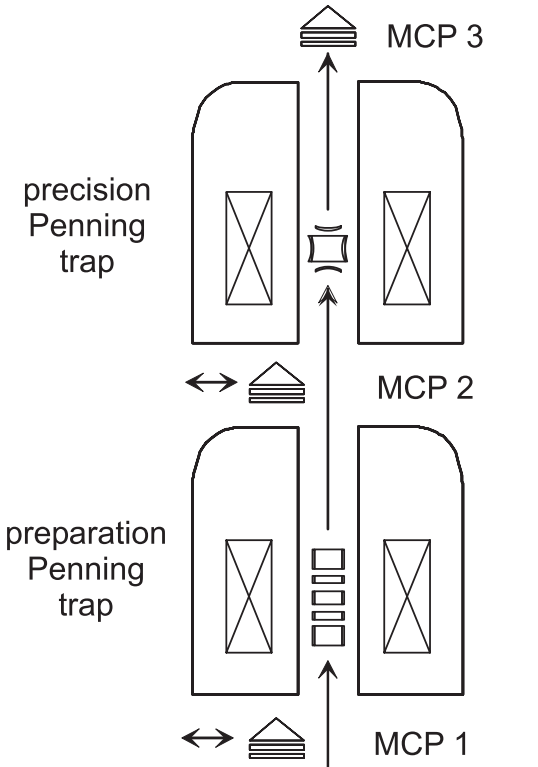


PhD thesis C. Guénaut

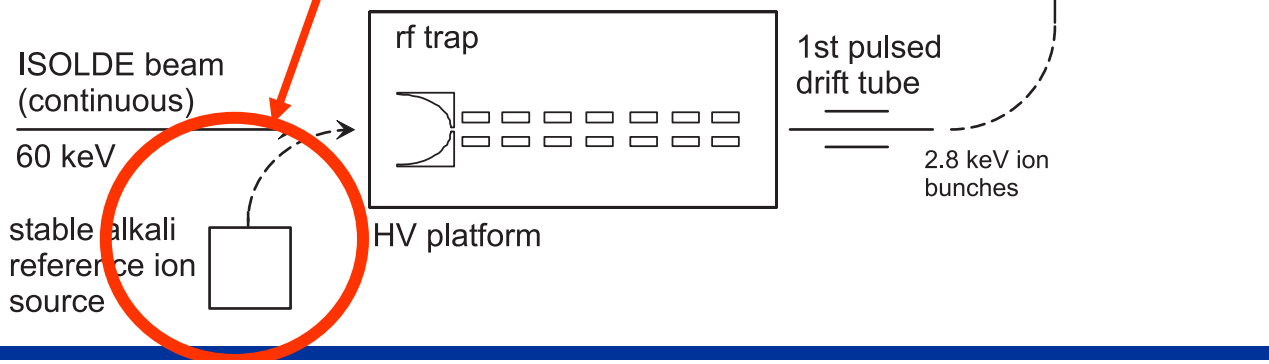
Outlook - New ion source (graphite oven and gas inlet)



installed end of 2006

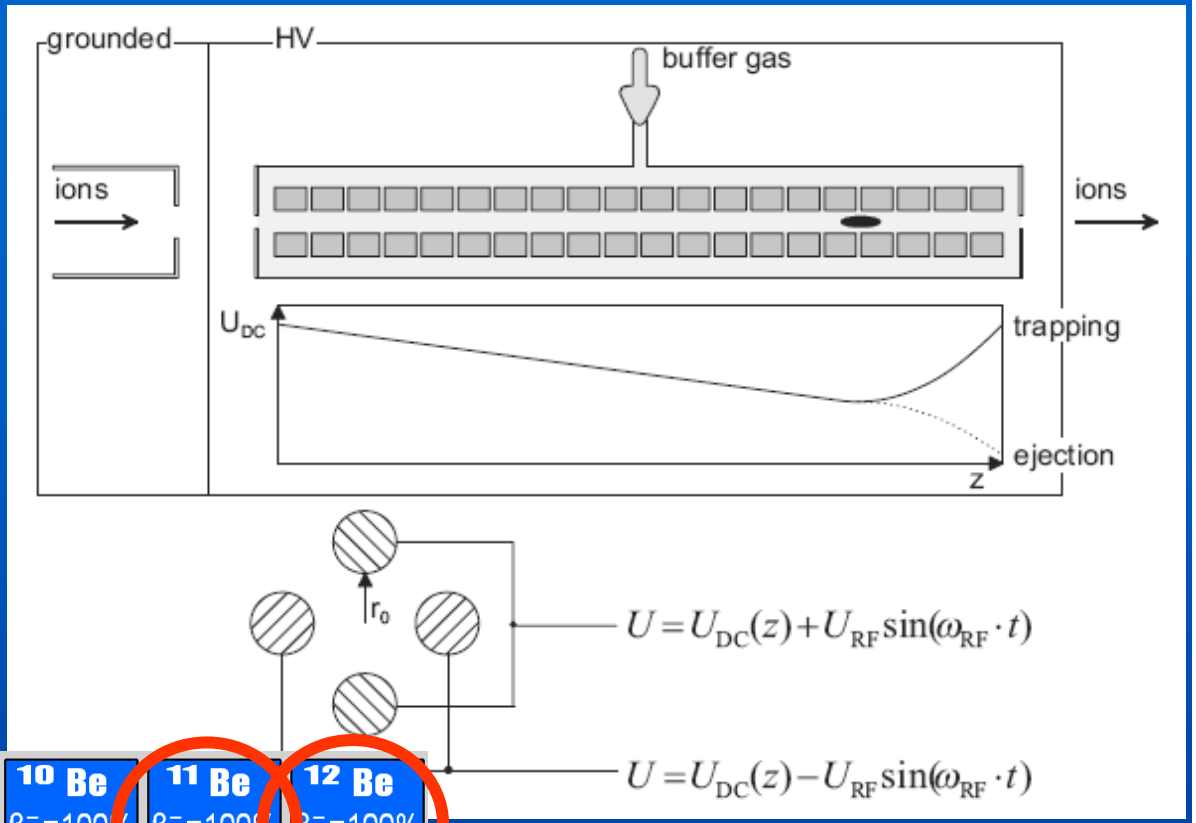


new ion source



Outlook - Hydrogen cooling for light nuclides

masses as input values for charge radii measurements ...



^{5}Be p?	^{6}Be 2p=100%	^{7}Be EC=100%	^{8}Be α=100%	^{9}Be Abundance=100%	^{10}Be β⁻=100%	^{11}Be β⁻=100%	^{12}Be β⁻=100%
^{4}Li p=100%	^{5}Li p=100%	^{6}Li Abundance=7.59%	^{7}Li Abundance=92.41%	^{8}Li β⁻=100%	^{9}Li β⁻=100%	^{10}Li n=100%	^{11}Li β⁻=100%
^{3}He Abundance=0.000137%	^{4}He Abundance=99.999863%	^{5}He n=100%	^{6}He β⁻=100%	^{7}He n=100%	^{8}He β⁻=100%	^{9}He n=100%	^{10}He 2n=100%
^{2}H Abundance=0.0115%	^{3}H β⁻=100%	^{4}H n=100%	^{5}H 2n=100%	^{6}H n?	^{7}H 2n?		

F. Herfurth, 2001

Not to forget …

Thanks to my co-workers:

G. Audi, S. Baruah, D. Beck, K. Blaum, G. Bollen, M. Breitenfeldt, P. Delahaye, M. Dworschak, S. George, C. Guénaut, U. Hager, F. Herfurth, A. Kellerbauer, H.-J. Kluge, D. Lunney, M. Marie-Jeanne, M. Mukherjee, S. Schwarz, R. Savreux, L. Schweikhard, C. Weber, C. Yazidjian, ..., and the ISOLTRAP and ISOLDE collaboration

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Thanks a lot for your attention!