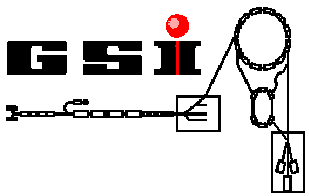
ISOLTRAP Status Report

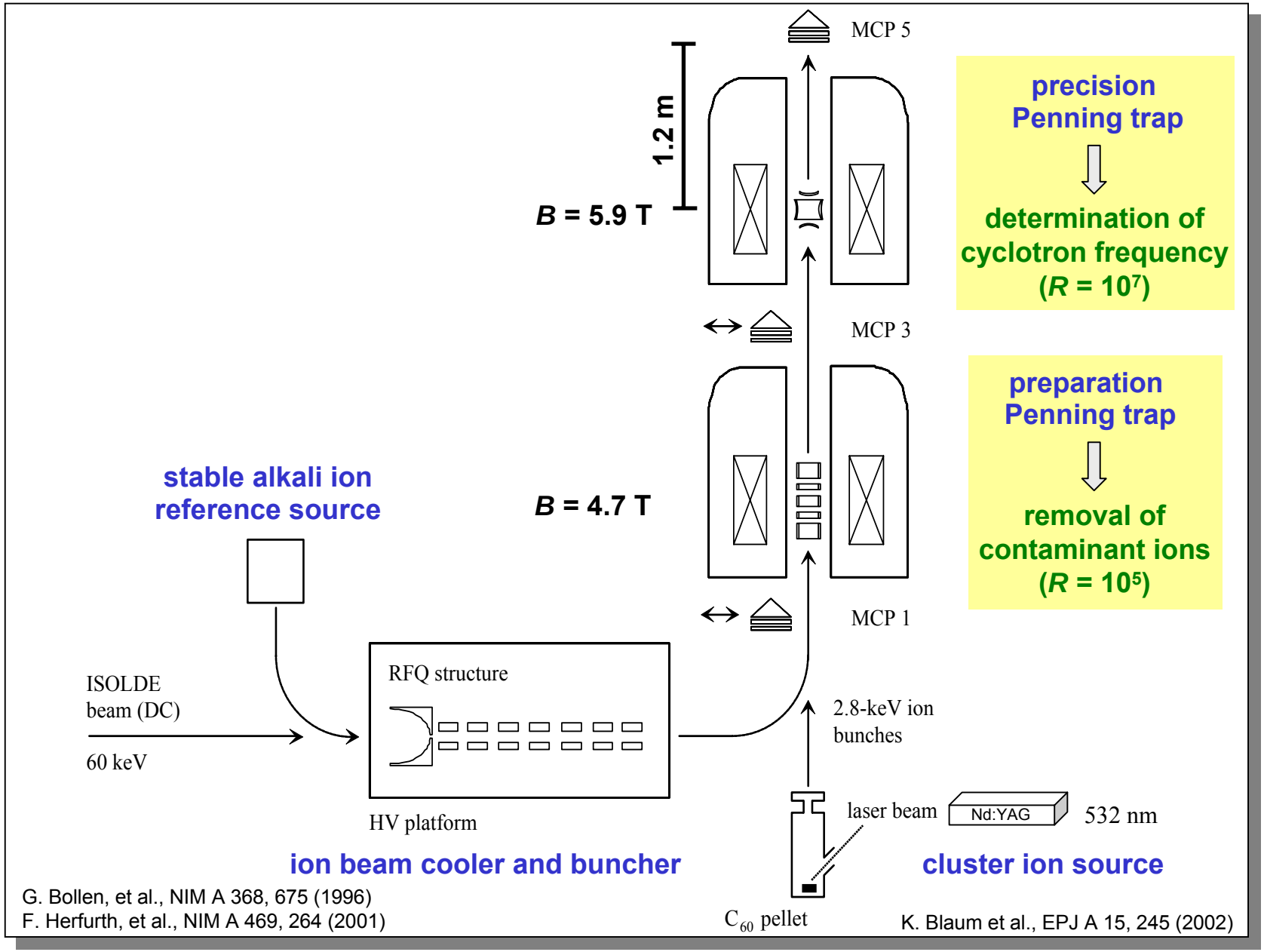
Klaus Blaum for the ISOLTRAP Collaboration
University of Mainz and GSI Darmstadt

Outline

- Experimental setup
- Recent experimental highlights
- Future measurement program



Triple-Trap Mass Spectrometer ISOLTRAP

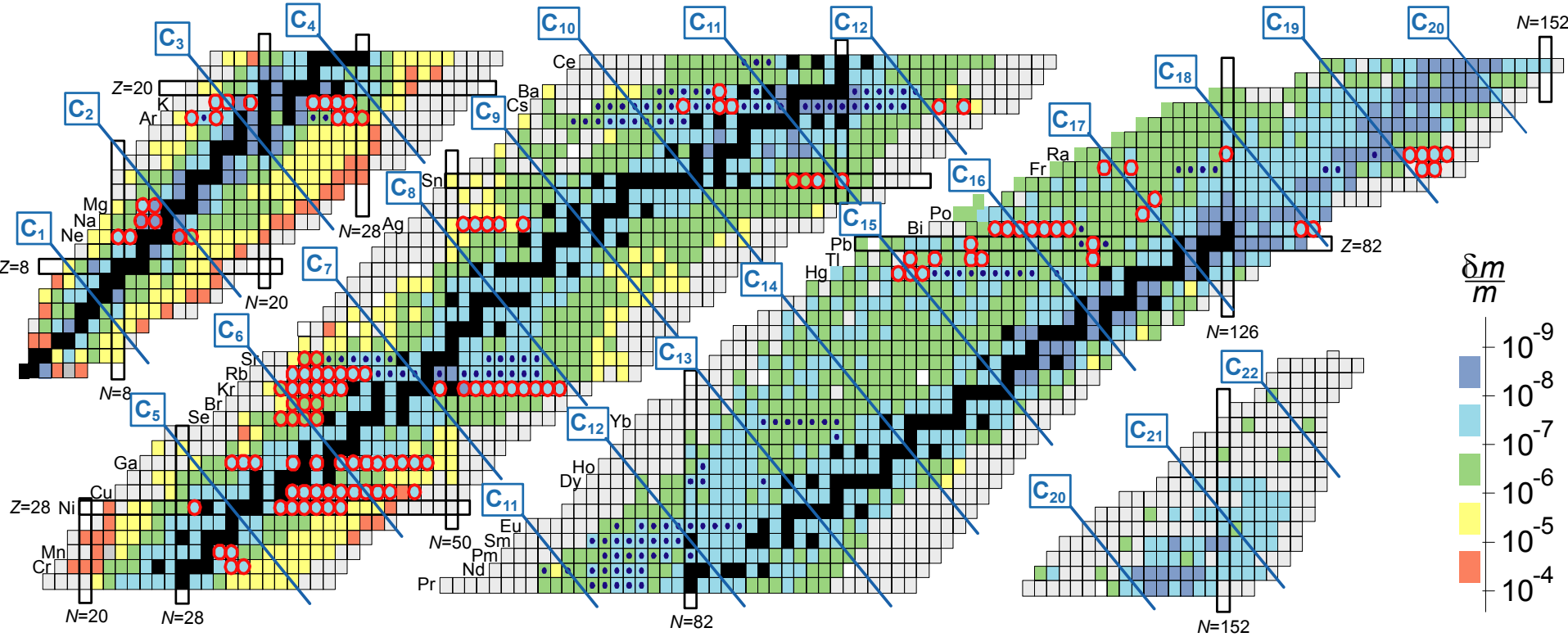


G. Bollen, et al., NIM A 368, 675 (1996)
F. Herfurth, et al., NIM A 469, 264 (2001)

K. Blaum et al., EPJ A 15, 245 (2002)

ISOLTRAP Setup

Measured ISOLTRAP masses

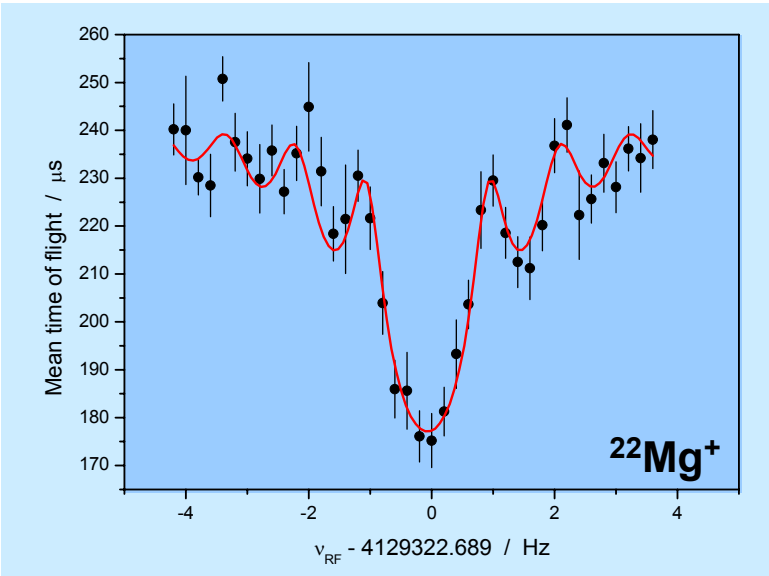


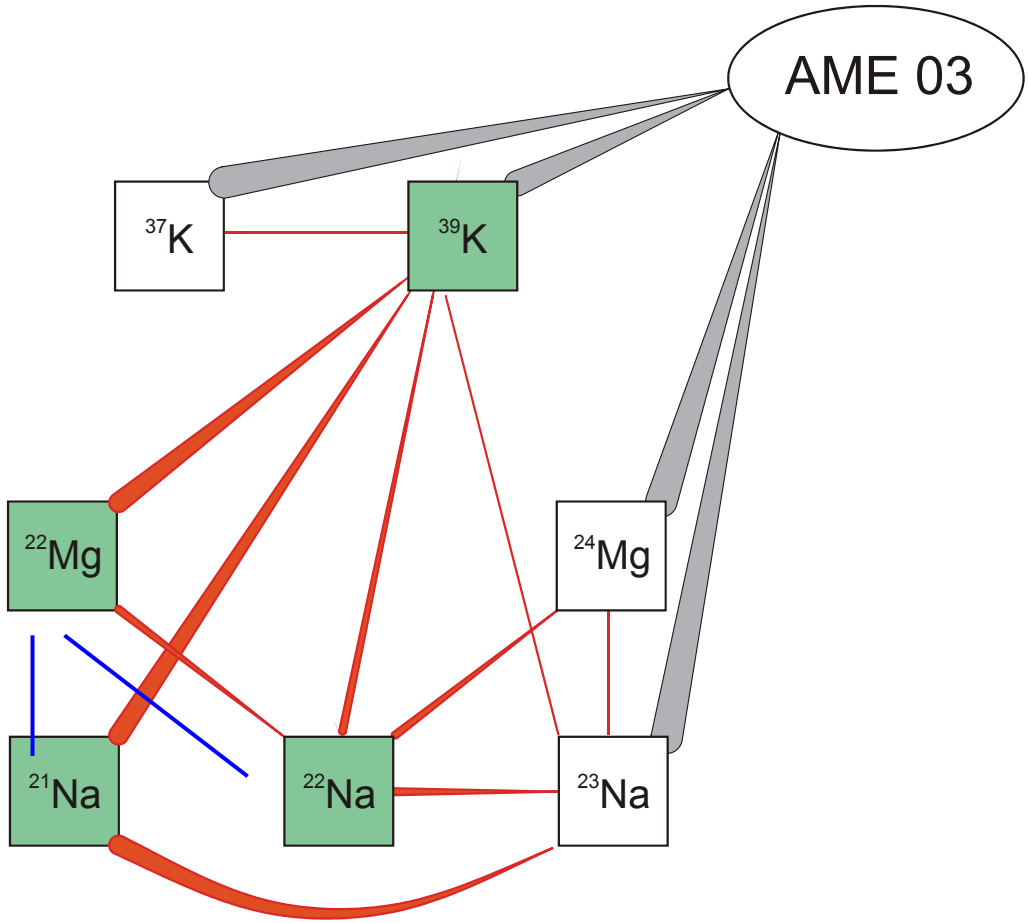
Masses measured with ISOLTRAP

- before 2002 (142 masses)
- since 2002 (131 masses)

The mass of ^{22}Mg

- 10 frequency ratios meas.
- 16 relations included in χ^2 adjustment



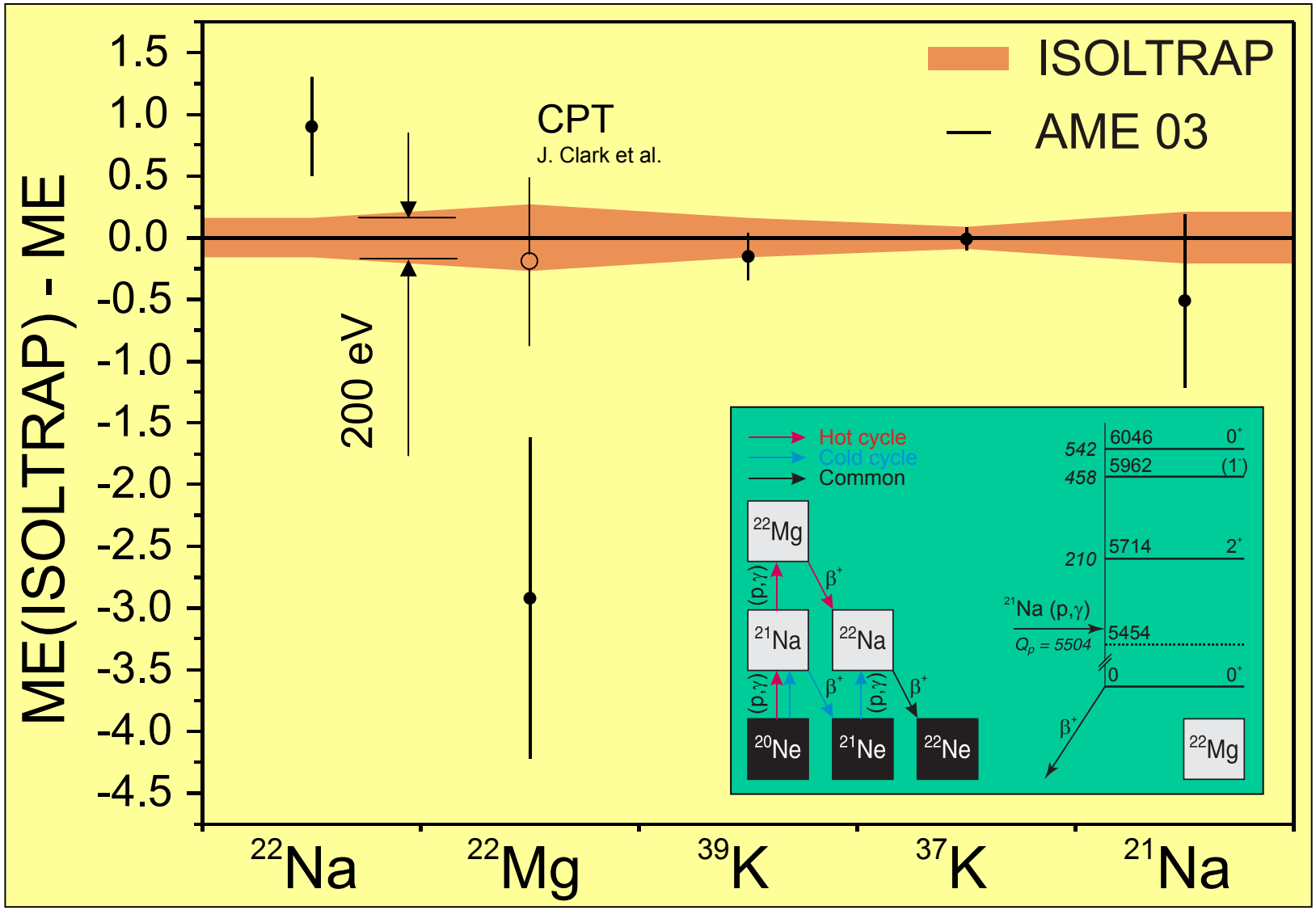


Mass uncertainty reduced by ISOLTRAP

measured frequency ratios and data flow

M. Mukherjee *et al.*, Phys. Rev. Lett. 93, 150801 (2004).

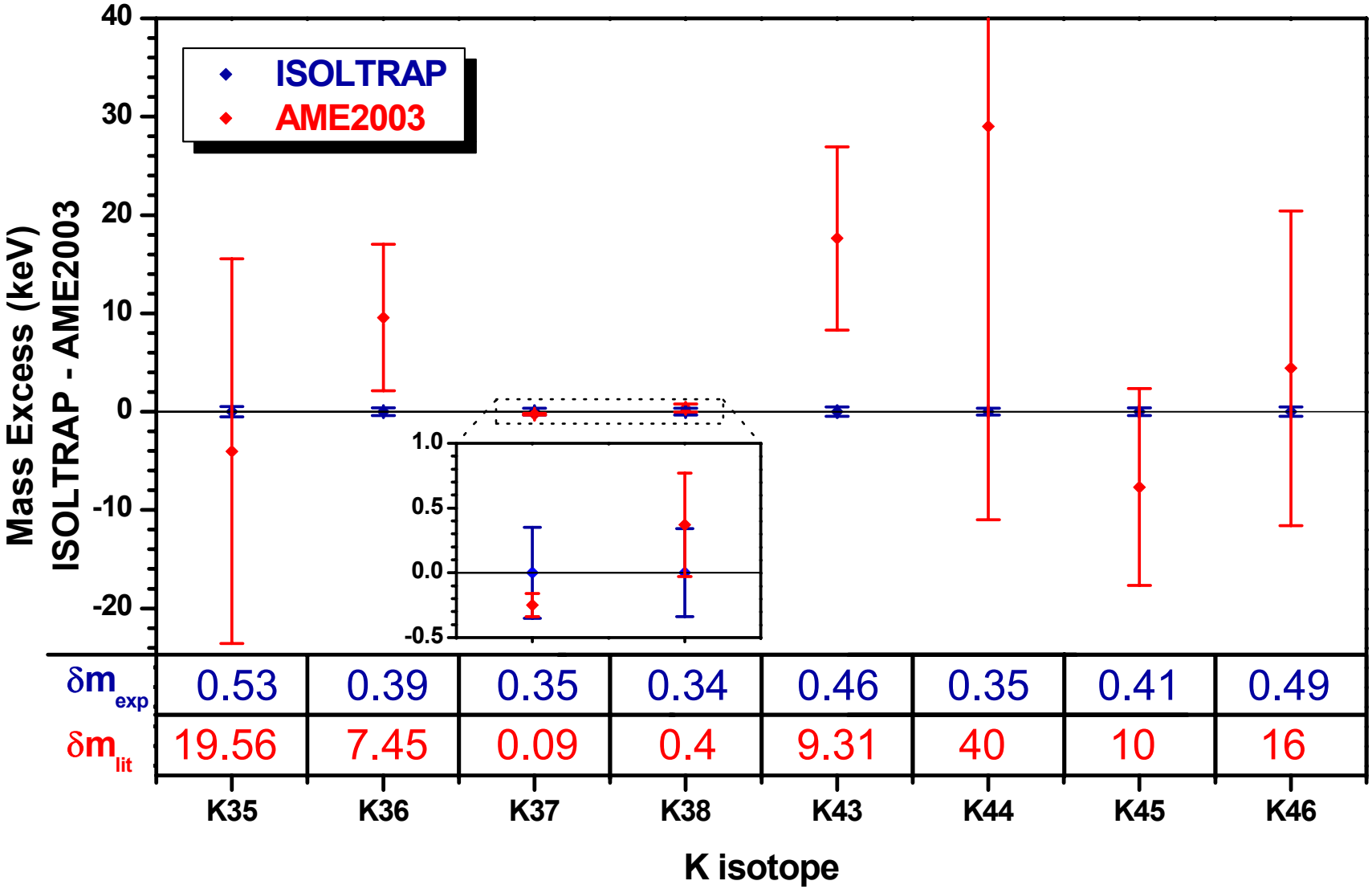
Solving the mass discrepancy of ^{22}Mg



M. Mukherjee *et al.*, Phys. Rev. Lett. 93, 150801 (2004).

Test of the IMME in the T=3/2, A=35 system

Final data evaluation not yet finished!

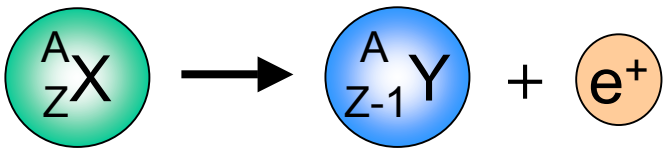


	K35	K36	K37	K38	K43	K44	K45	K46
δm_{exp}	0.53	0.39	0.35	0.34	0.46	0.35	0.41	0.49
δm_{lit}	19.56	7.45	0.09	0.4	9.31	40	10	16

A Novel Idea: In-Trap Decay Mass Spectrometry

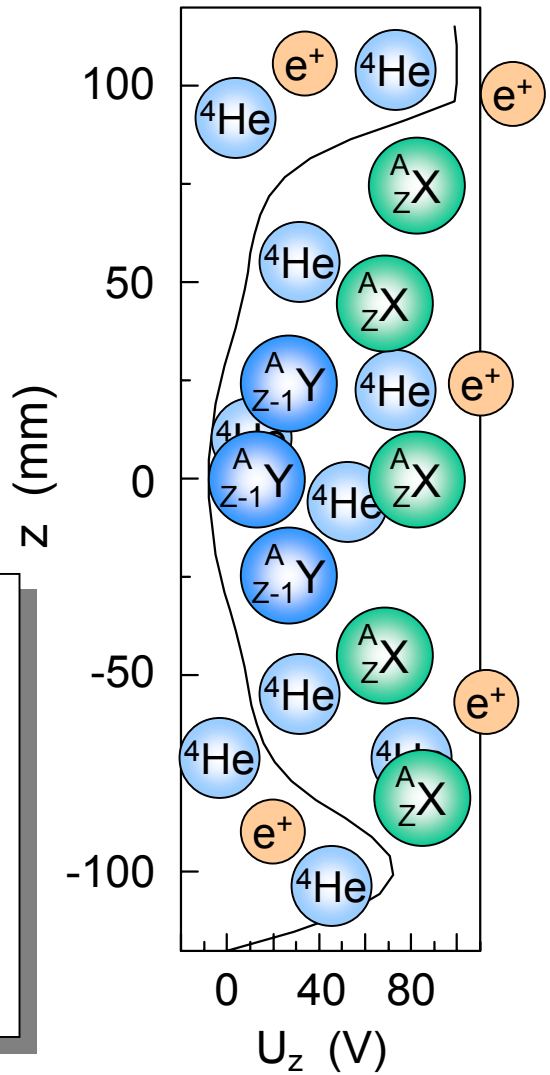
Decay in the buffer-gas-filled preparation trap

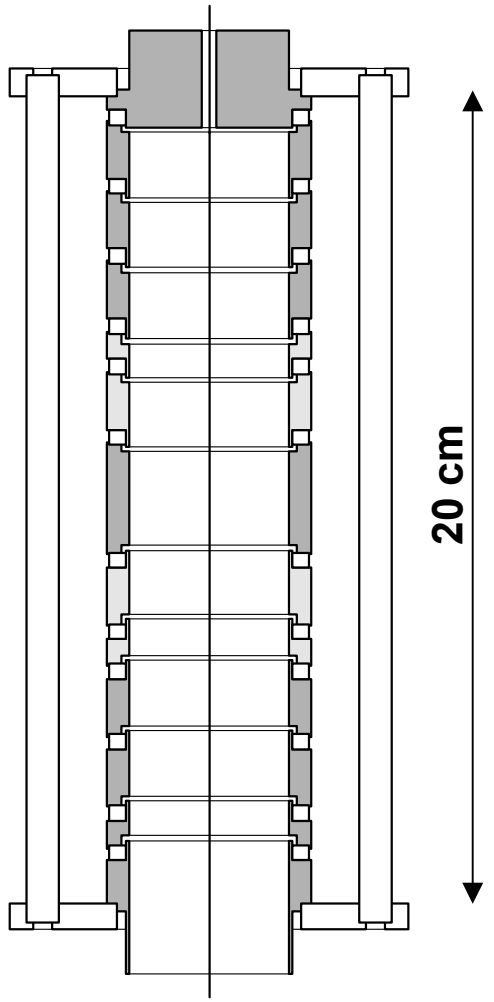
produced at ISOLDE



not produced at ISOLDE

- **Make more radioactive species available**
- **Nearly simultaneous ω_c measurement of mother and daughter nuclei**
- **Test candidate: $^{37}K \rightarrow {}^{37}Ar$**

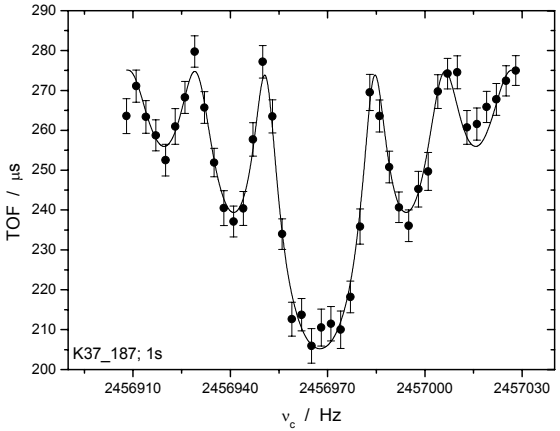




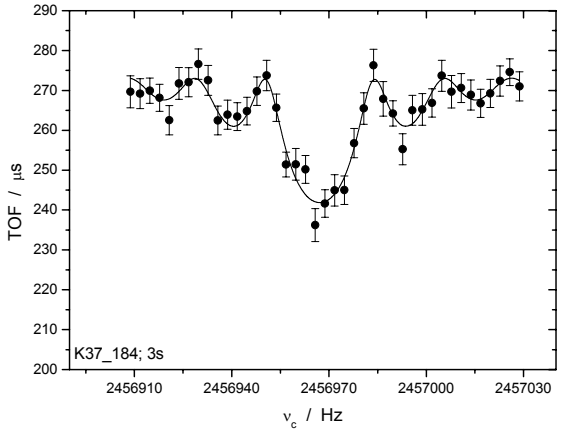
In-Trap Decay Results

$^{37}K^{+}$

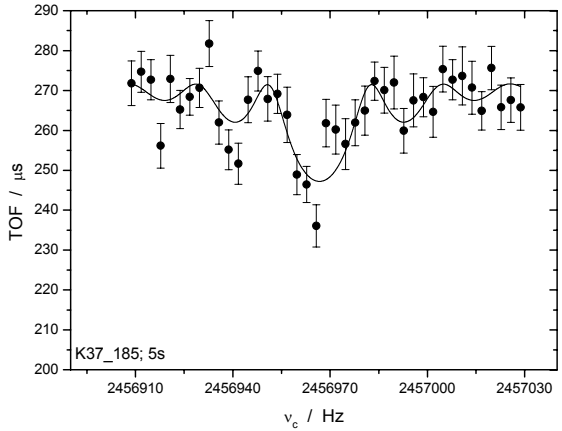
1 s waiting time



3 s waiting time

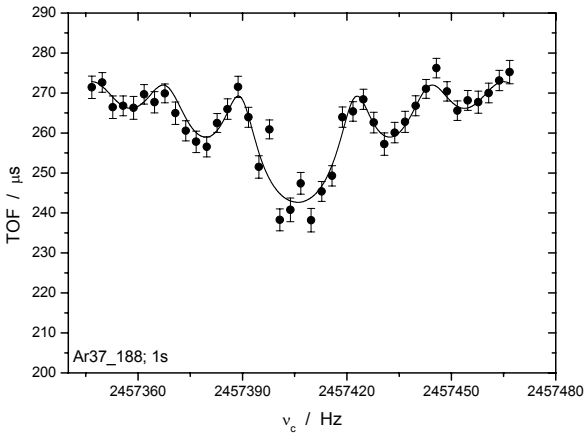


5 s waiting time

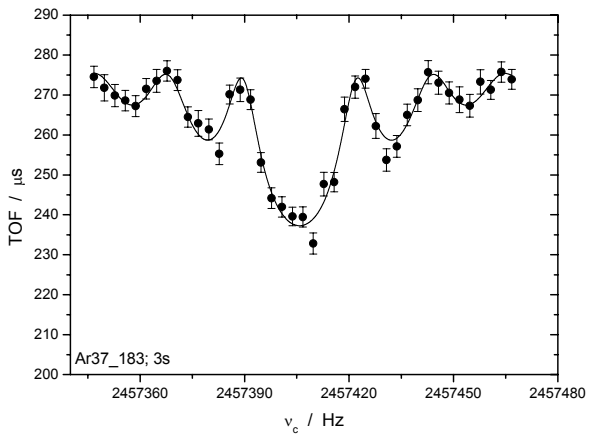


$^{37}Ar^{+}$

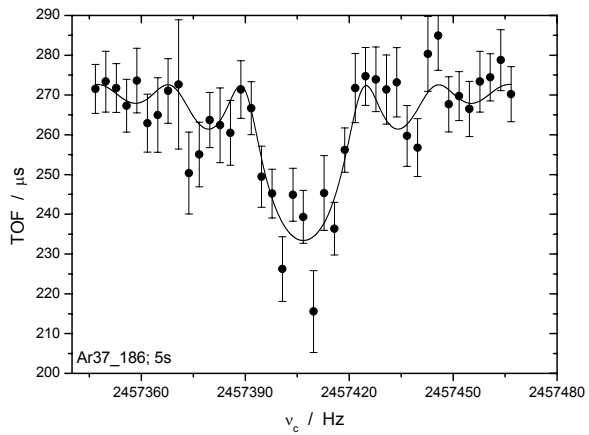
1 s waiting time



3 s waiting time



5 s waiting time

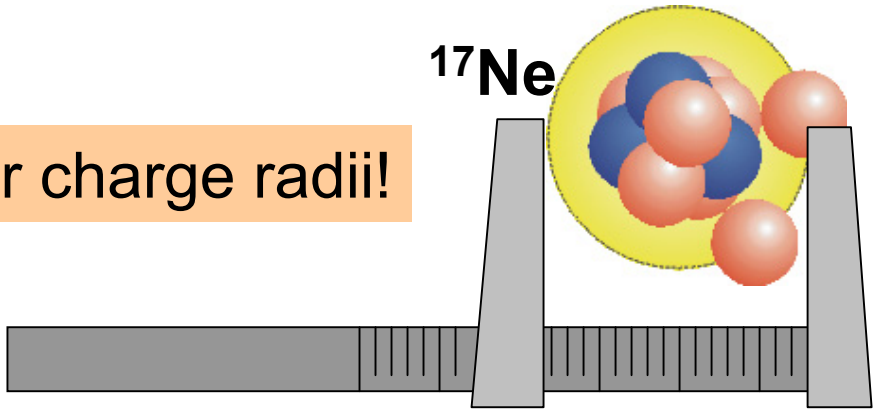


Elements/isotopes which are in principle not produced are accessible!

The mass of ^{17}Ne

How to probe if ^{17}Ne is a proton halo?

Via the nuclear charge radii!



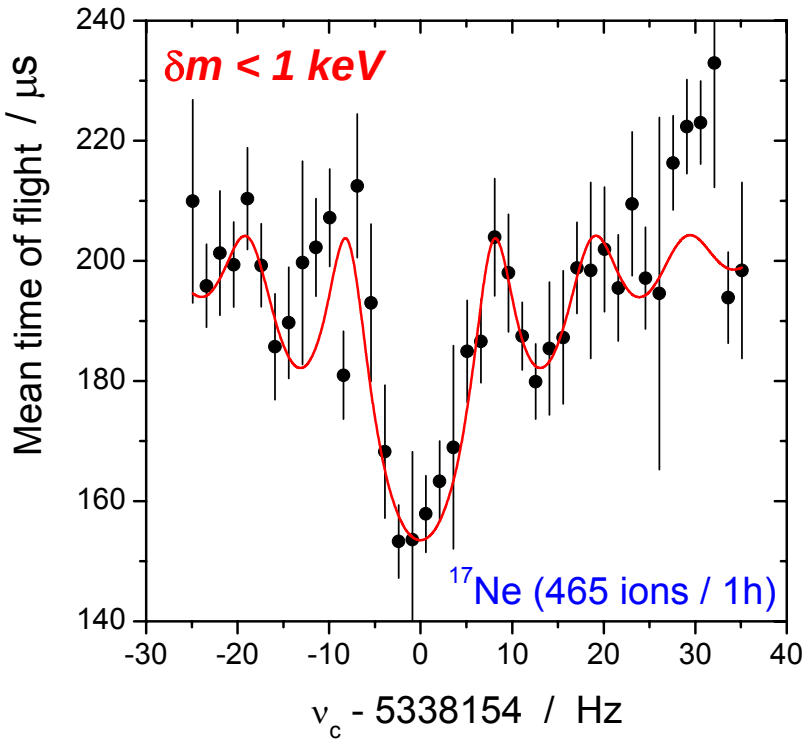
$T_{1/2}$ = 109 ms
Yield = 1000/s

Isotope-shift measurements:

$$\delta\nu_{IS}^{A,A'} = (K_{NMS} + K_{SMS}) * \frac{M_{A'} - M_A}{M_{A'} M_A} + F_{el.} * \delta\langle r^2 \rangle^{A'A}$$

$$\delta\langle r^2 \rangle^{A'A} \Rightarrow \textbf{nuclear charge radii}$$

Mass uncertainty of $\delta m / m \approx 1 \cdot 10^{-7}$ (~ 2 keV) required!



Conclusion and Outlook

- new high-precision measurements on a large number of nuclei
- smallest mass uncertainty: 160 eV (^{22}Na)
- impact on many aspects of physics by mass measurements of ^{22}Mg, ^{35}K, ^{70}

Not to Forget …

Thanks to my co-workers:

G. Audi, G. Bollen, D. Beck, P. Delahaye, C. Guénaut, A. Herlert, F. Herfurth, A. Kellerbauer, H.-J. Kluge, D. Lunney, D. Rodríguez, C. Scheidenberger, S. Schwarz, L. Schweikhard, C. Weber, C. Yazidjian ..., and the ISOLTRAP and ISOLDE collaboration

Thanks for the funding and support:

GSI, BMBF, CERN, ISOLDE,
EU networks EUROTRAPS, EXOTRAPS, and NIPNET

Thanks a lot for your attention.