

Experimental Proposals

E040, E048, E055, E063, E077, E078

• Experiments related to mass measurements:

E040: "Nuclear Astrophysics Studies at the FRS-ESR: Ground State and Decay Properties of Neutron-Rich Nuclei in the ^{132}Sn Region"

Spokesperson: H. Schatz, MSU, U.S.A.

GSI Contact Person: Yu.A. Litvinov, GSI

Year of Approval: 1998

Shifts: approved 63(21)
left 20(0)

E048: "Exploring Long-Living K-Isomers via Schottky-Mass-Spectrometry at the ESR"

Spokesperson: P.M. Walker, Uni. Surrey, U.K.

GSI Contact Person: Yu.A. Litvinov, GSI

Year of Approval: 1999

Shifts: approved 27(0)
left 10(0)

E055: "Experimental program for direct mass measurements at FRS-ESR using isochronous and time-resolved Schottky mass spectrometry"

Spokesperson: C. Scheidenberger, GSI

GSI Contact Person: Yu.A. Litvinov, GSI

Year of Approval: 2002

Shifts: approved ~90(0)
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Physics Motivation

Masses of more than **1100**
Nuclides were measured

Mass accuracy:

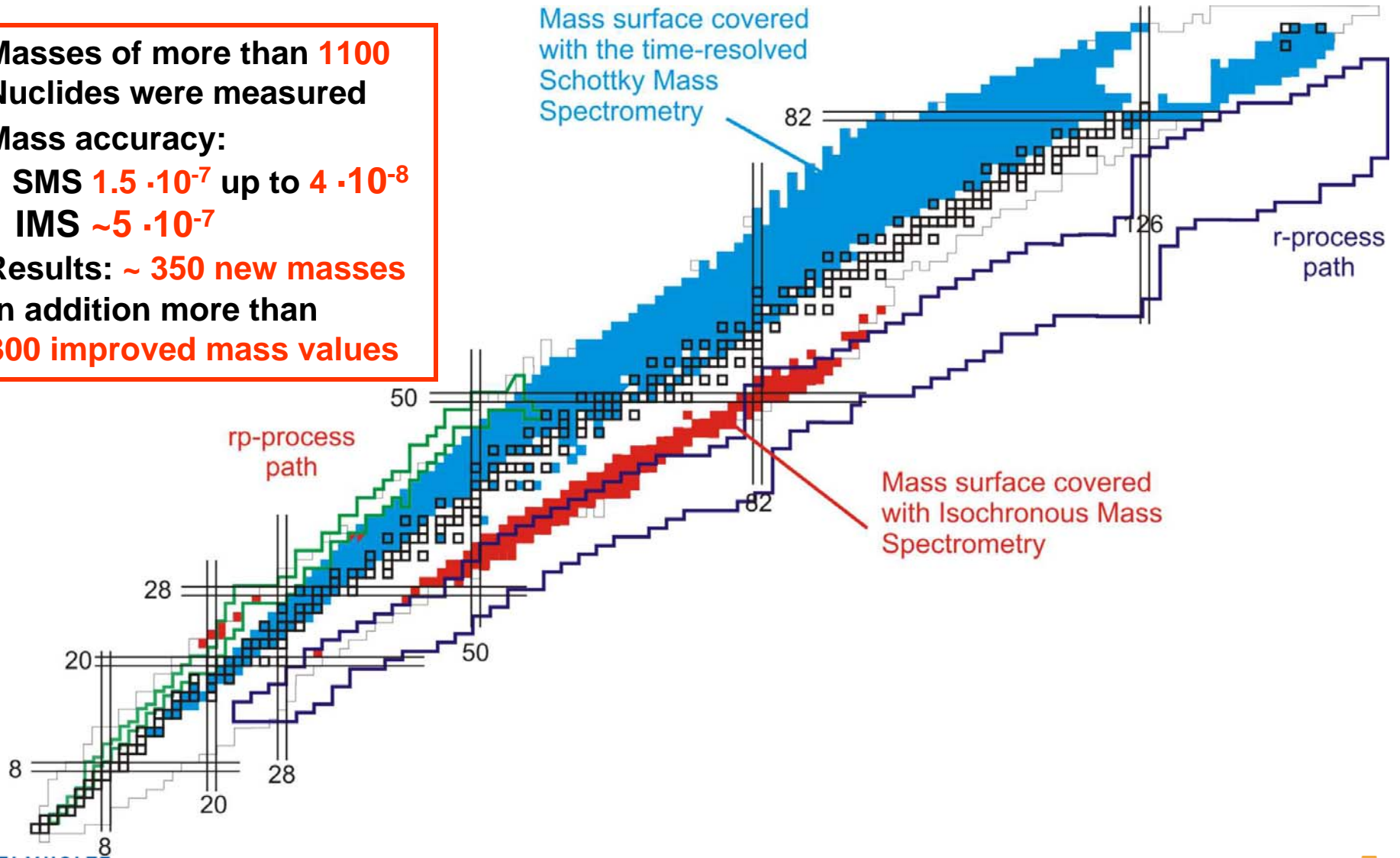
SMS $1.5 \cdot 10^{-7}$ up to $4 \cdot 10^{-8}$

IMS $\sim 5 \cdot 10^{-7}$

Results: **~ 350 new masses**

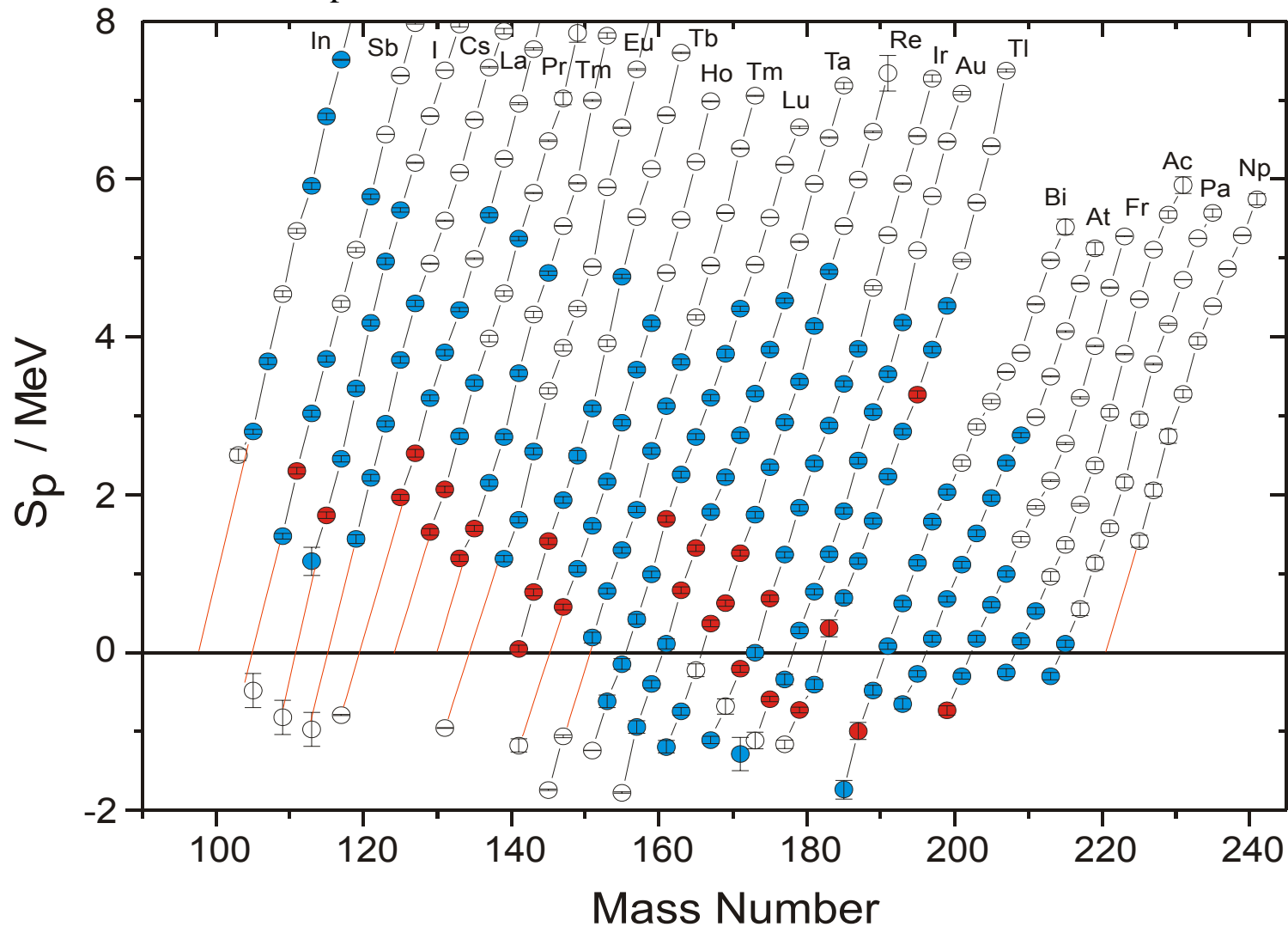
In addition more than
300 improved mass values

Mass surface covered
with the time-resolved
Schottky Mass
Spectrometry

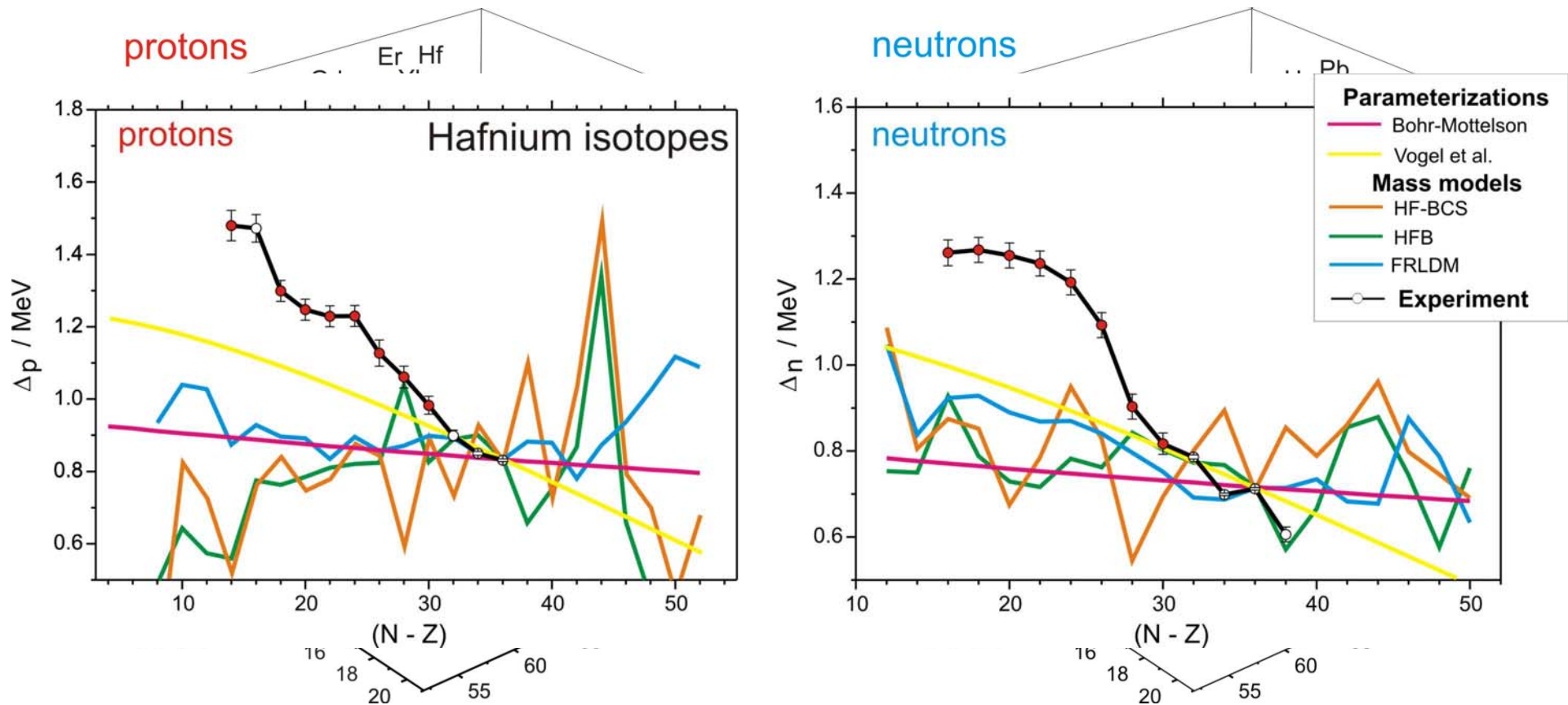


Limits of Nuclear Existence

$$S_p = (m(N, Z-1) + m_p - m(N, Z)) \cdot c^2$$

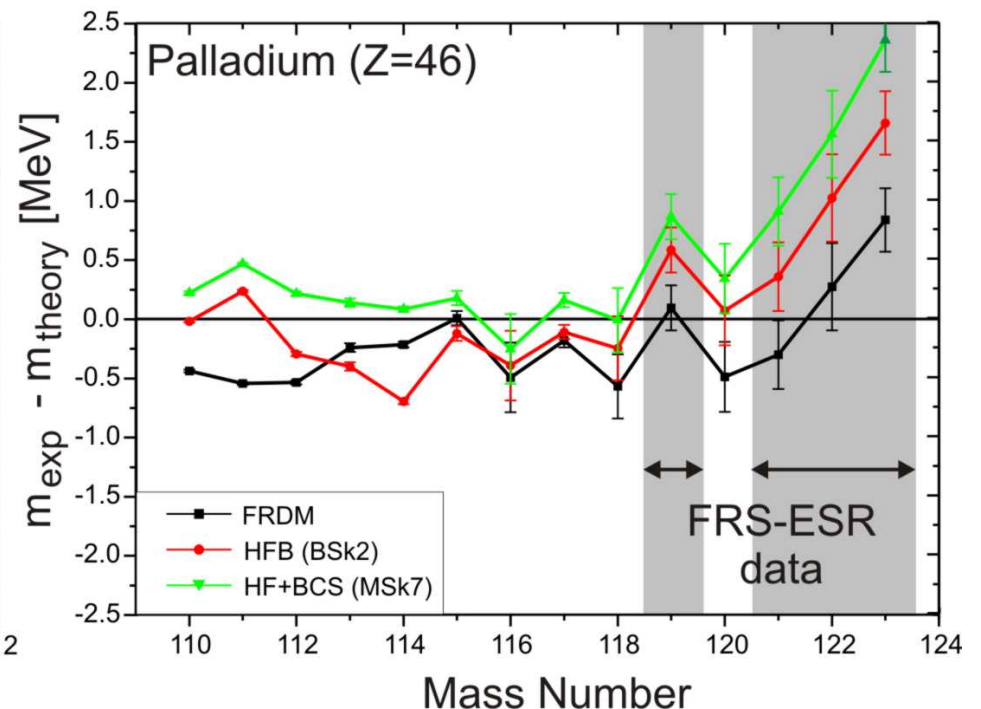
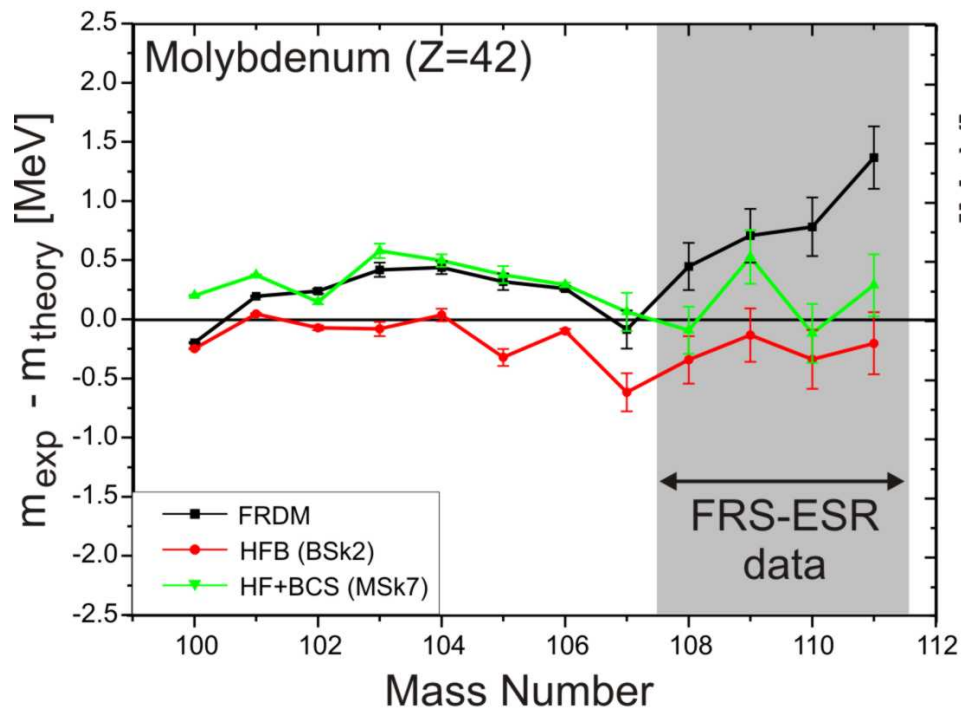


Odd-Even Staggering of Nuclear Binding Energies



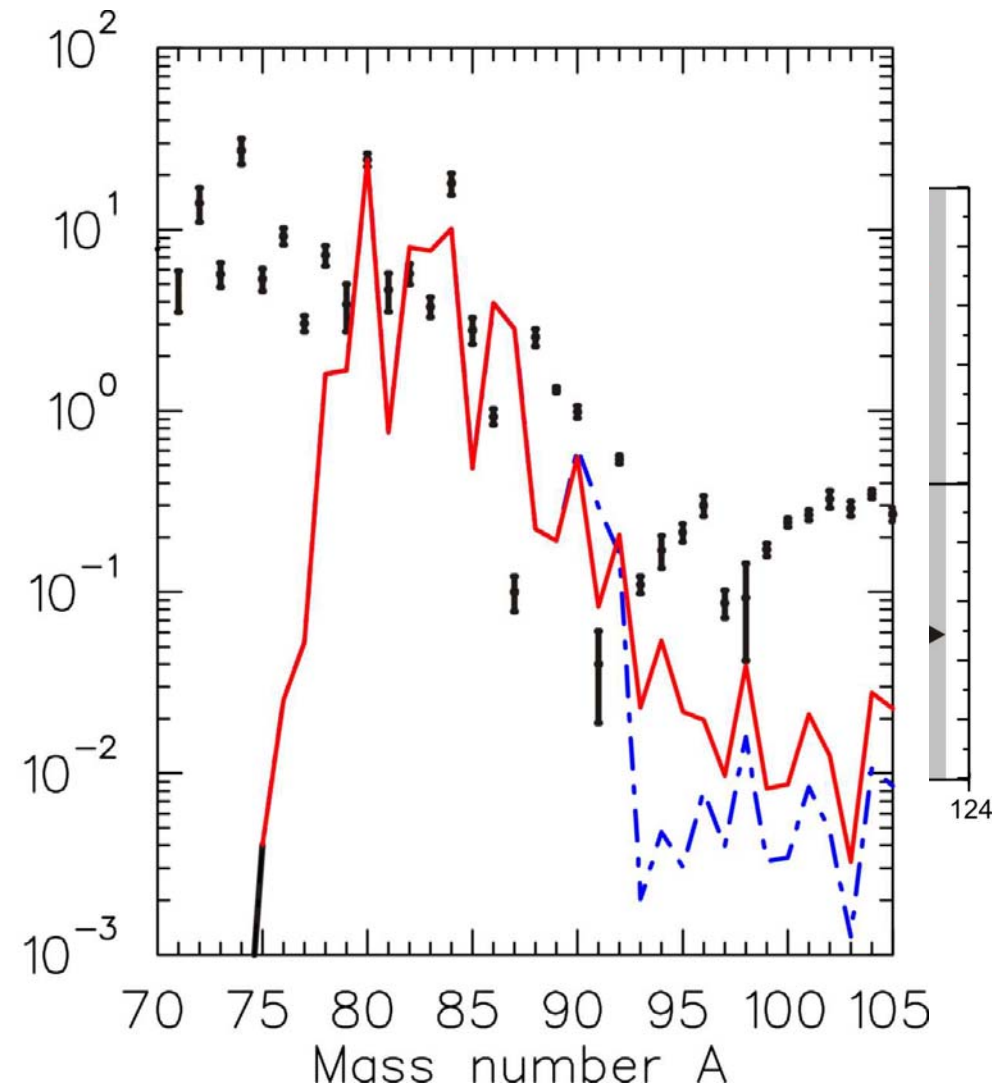
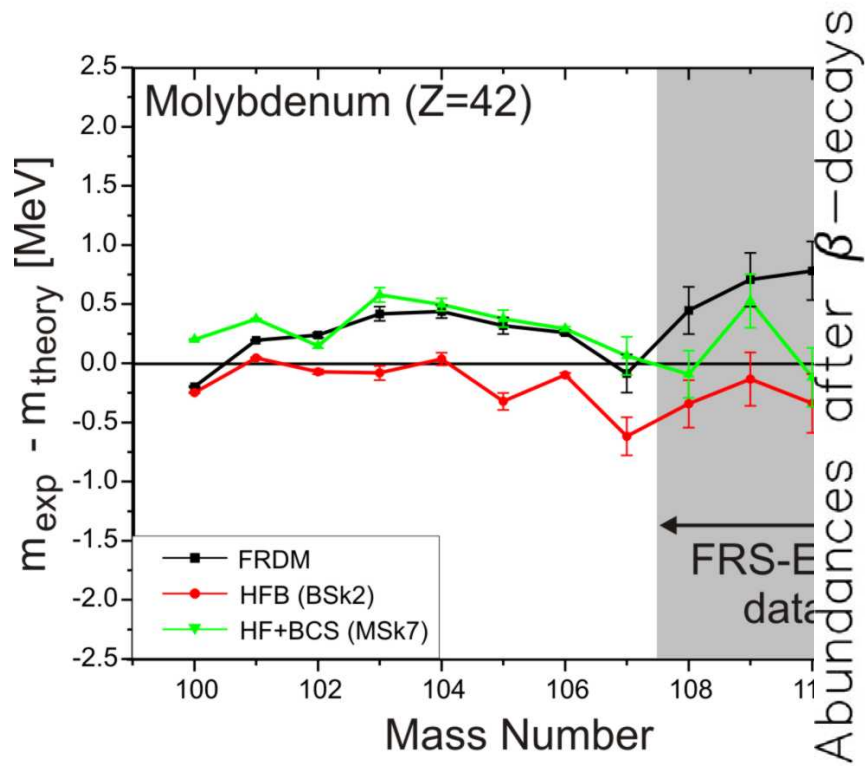
Yu.A.Litvinov, Th. Bürvenich et al., Phys. Rev. Lett. 95 (2005) 042501

Predictive Powers of Mass Models



H. Geissel et al., NP A746 (2004) 150c

Predictive Powers of Mass Models



Setup

- FRS focal planes equipment
Vacuum, should be ready
- Is there any new or non-standard equipment required?
Slits moving over the middle
- Is there a modification or a new DAQ required?
No
- What is the requested primary beam and intensity?
 ^{181}Ta , $5 \cdot 10^9$ particles/spill
 ^{238}U , $2 \cdot 10^9$ particles/spill
 ^{107}Ag , $2 \cdot 10^9$ particles/spill
- How many shifts are requested for 2008?

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- **Experiments related to half-life measurements:**

E077: "Single-Ion Spectroscopy of Two-Body Beta-Decays"

Spokesperson: Yu.A. Litvinov, GSI, F. Bosch, GSI

GSI Contact Person: ----

Year of Approval: 2006

Shifts: approved 75(0)

left 10(0)

E078: "Influence of hyperfine interaction on the nuclear electron capture decay"

Spokesperson: Yu.A. Litvinov, GSI

GSI Contact Person: ----

Year of Approval: 2007

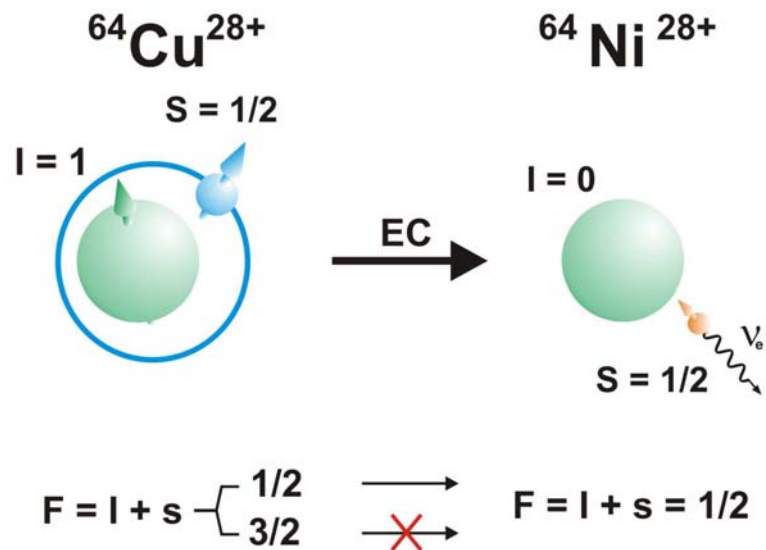
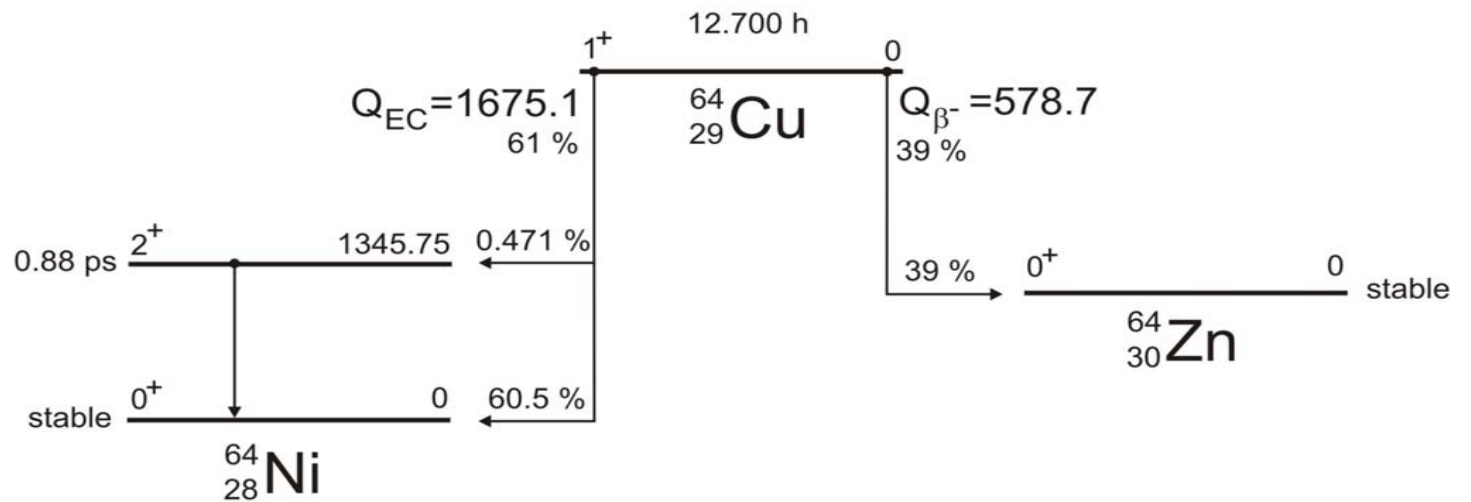
Shifts: approved 21(0)

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Next Step

B.M. Dodsworth et al., Phys. Rev. 142 (1966) 638.

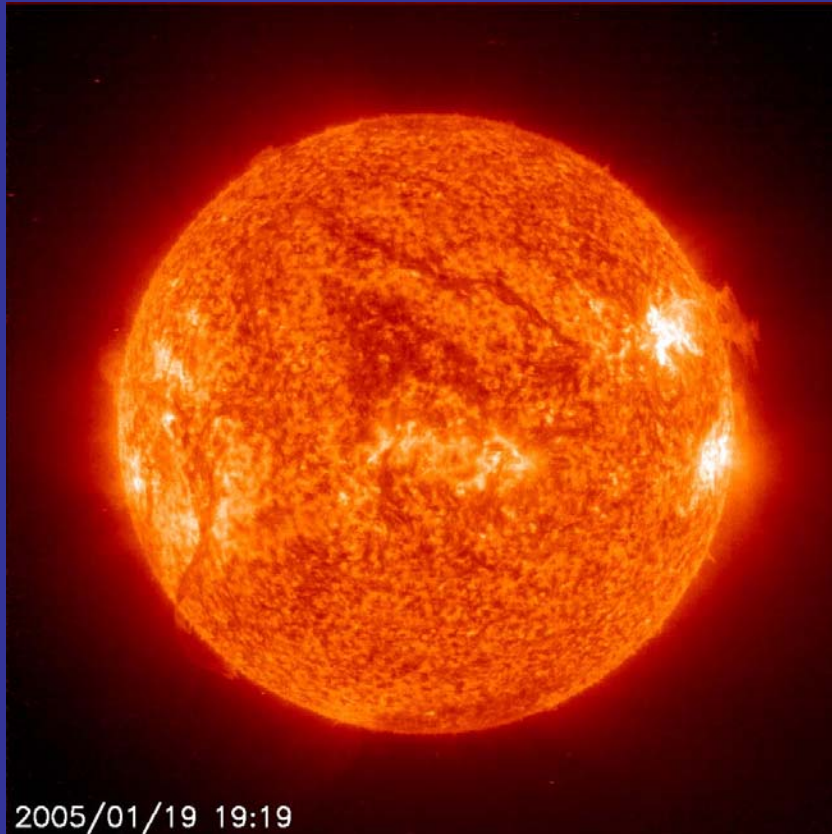
$$\mu(^{64}\text{Cu}) = -0.217(2) \mu_N$$



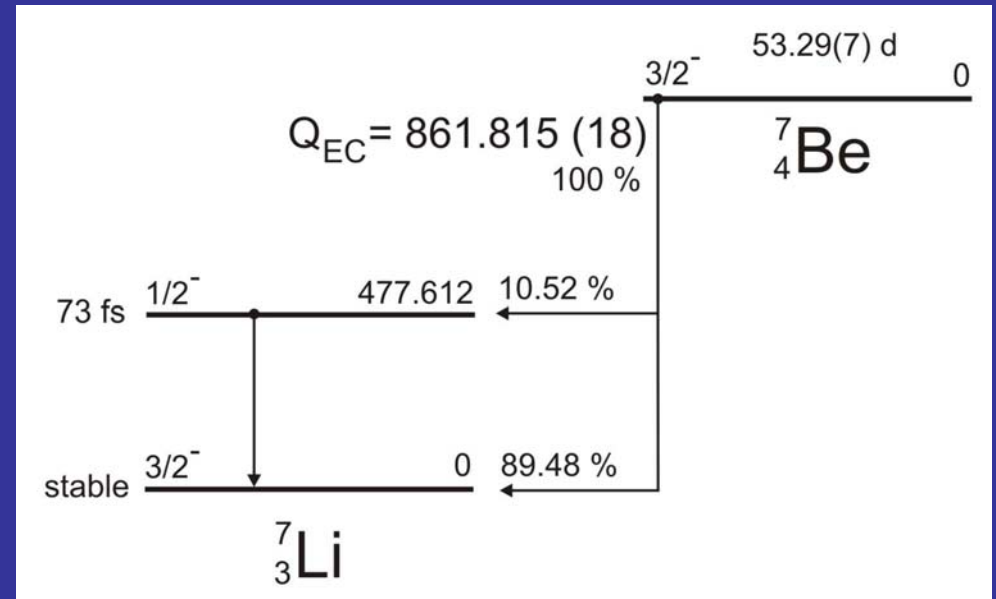
Some speculations on the EC-decay of ${}^7\text{Be}$

A.V. Gruzinov, J.N. Bahcall, *Astroph. J.* 490 (1997) 437

Ionization of ${}^7\text{Be}$ in the Sun can be $\sim 20\text{-}30\%$



2005/01/19 19:19



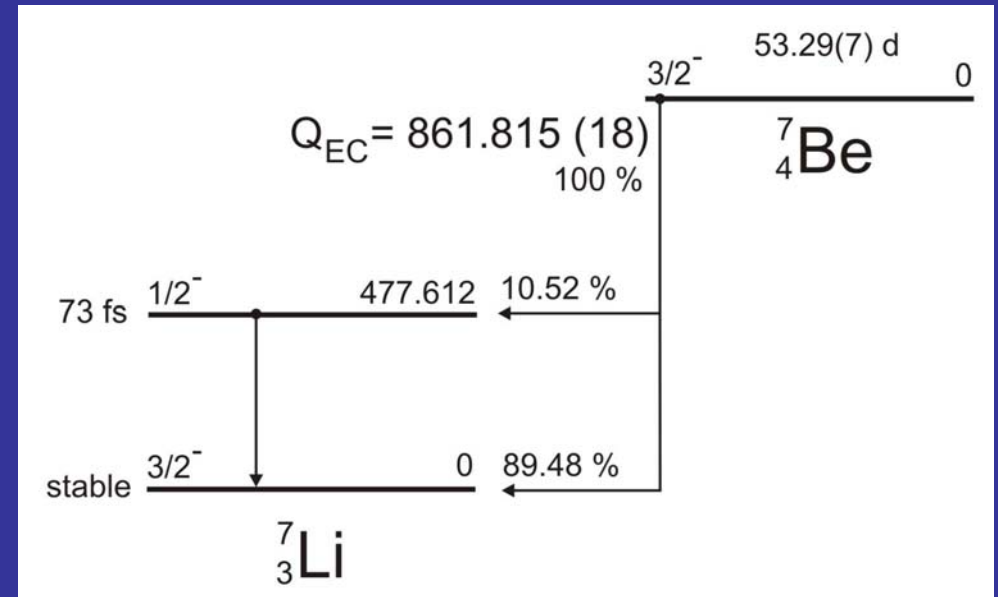
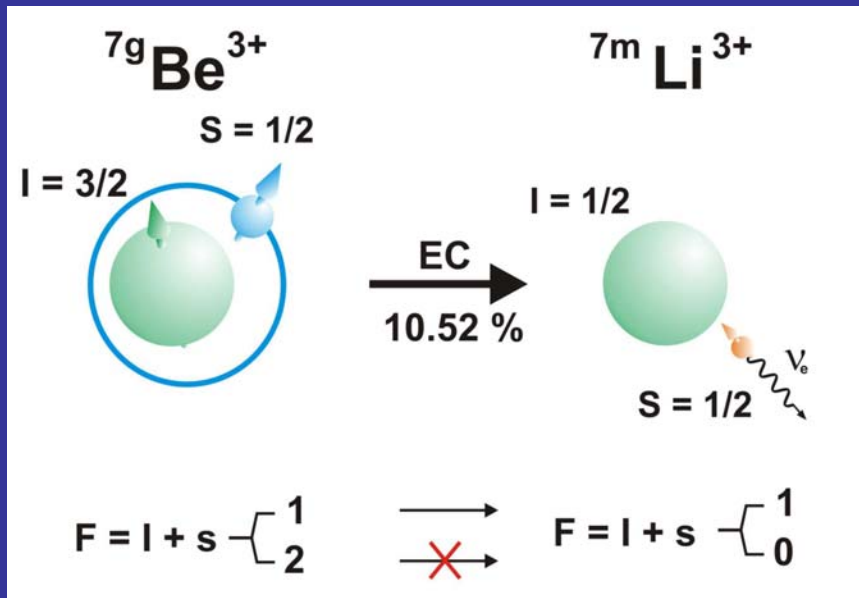
Transition ($F=1 \rightarrow F=1$) is accelerated by $(2I+1)/(2F_1+1)$ i.e. by $8/3$

However, there are only $(2F_1+1)/((2F_1+1)+(2F_2+1)) = 3/8$ of ${}^7\text{Be}$ in this state

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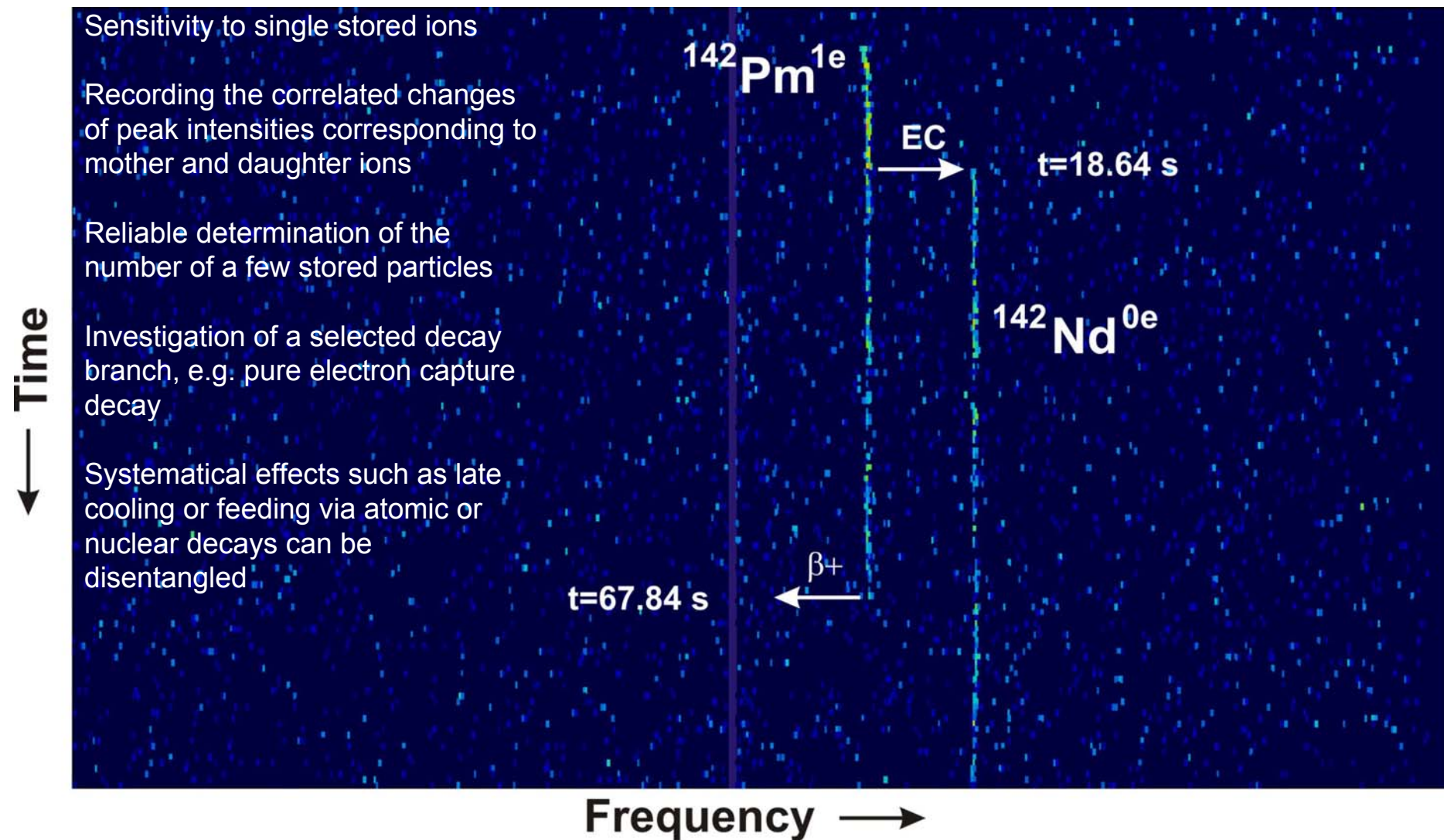
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Setup

- FRS focal planes equipment
Vacuum, S2-wedge (731 mg/cm² Al disk)
- Is there any new or non-standard equipment required?
No
- Is there a modification or a new DAQ required?
No
- What is the requested primary beam and intensity?
⁶⁵Cu, $1 \cdot 10^{10}$ particles/spill
???
- How many shifts are requested for 2008?

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- **Experiments related to in-ring reactions:**

E063: "ESR measurements of proton-induced reaction rates in the Gamow window of the astrophysical p process"

Spokesperson: M. Heil, GSI

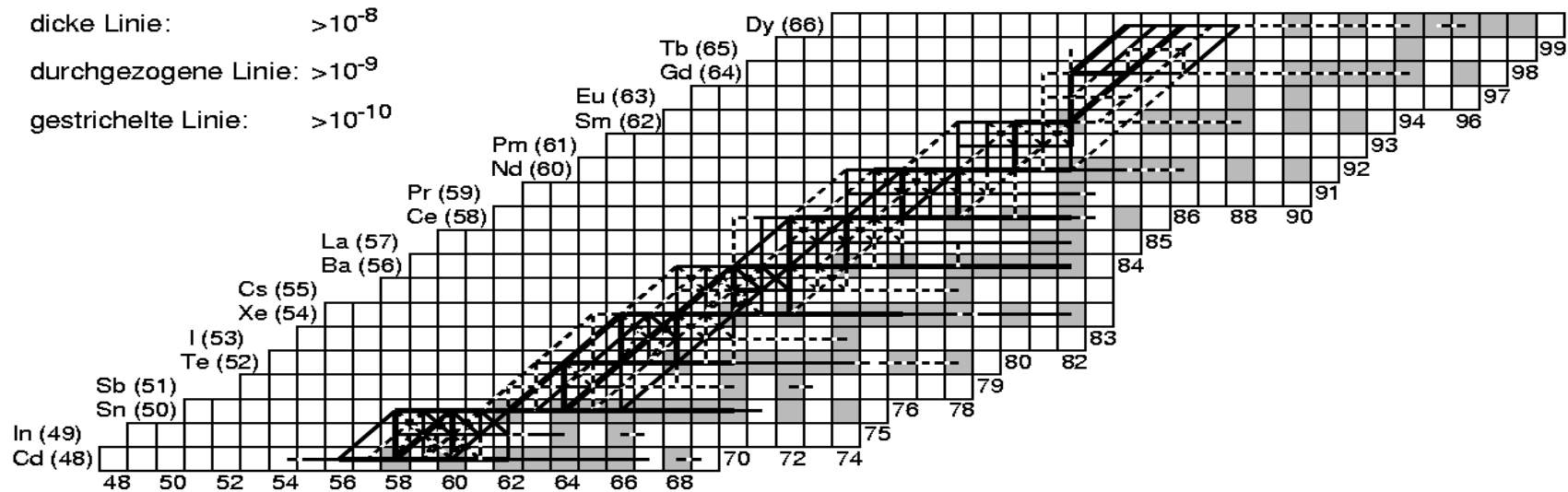
GSI Contact Person: Yu.A. Litvinov, GSI

Year of Approval: 2004

Shifts: approved 21(0)

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p-process calculations



About 1500 nuclei involved
More than 10000 reactions

Lack of experimental information on (p,γ) and (a,γ)
Reaction rates from theory are very uncertain even for stable nuclides
 $^{92,94}\text{Mo}$ and $^{96,98}\text{Ru}$ anomaly

Setup

- FRS focal planes equipment
no FRS
ESR: Deceleration in the ESR, Gas-Jet Target
- Is there any new or non-standard equipment required?
No
- Is there a modification or a new DAQ required?
No
- What is the requested primary beam and intensity?
 $^{112}, ^{114}\text{Sn}$, $5 \cdot 10^8$ particles/spill
- How many shifts are requested for 2008?

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$E040 + E048 + E055 + E078 = 3$ weeks of beam-time

$E063 = 21$ shifts (SIS-ESR) if $^{112,114}\text{Sn}$ are available

$E077 = ???$