The first isochronous mass spectrometry at CSRe

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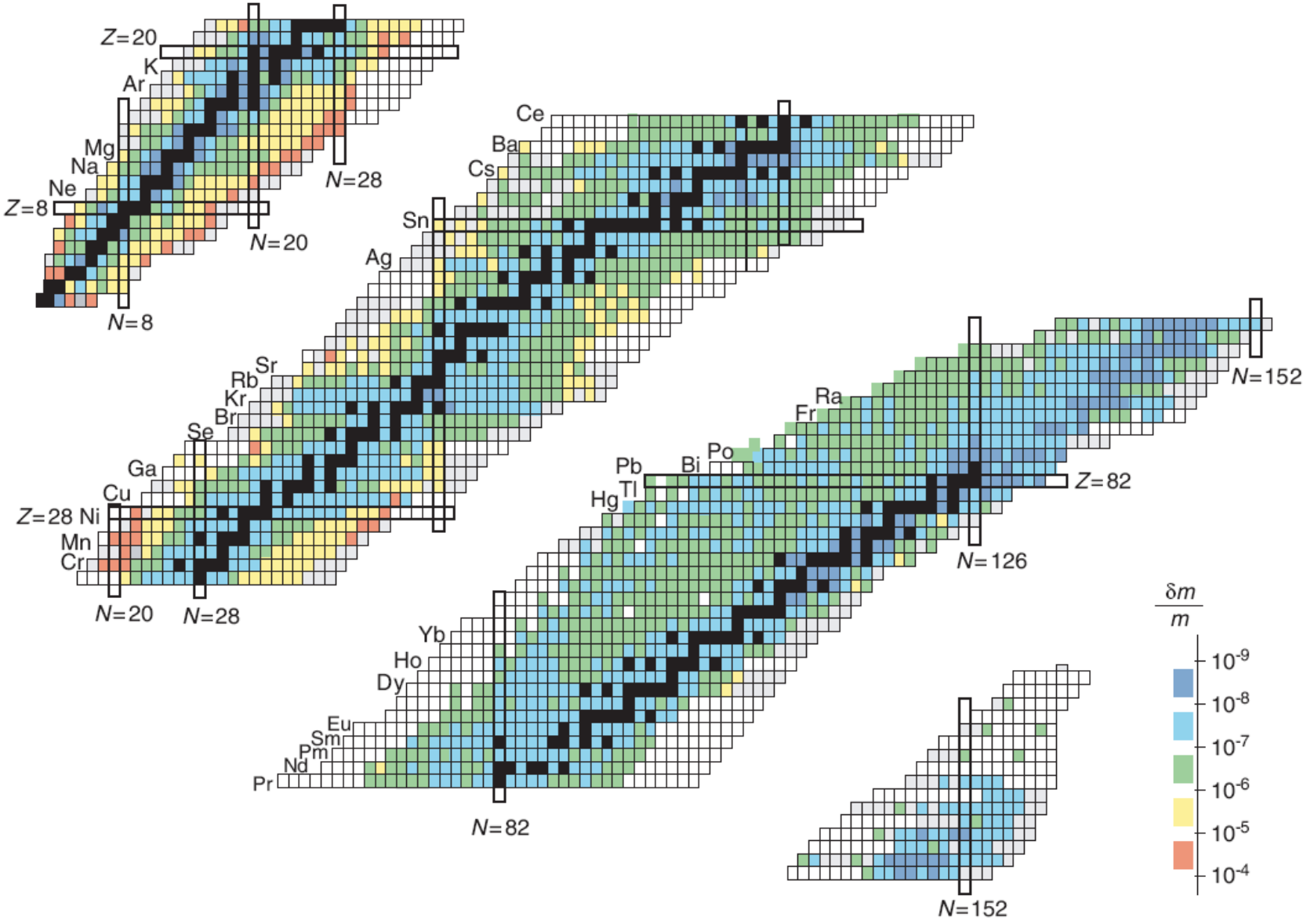
Introduction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Mg
Na
Ne
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Cs
Sn
Ag
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Rb
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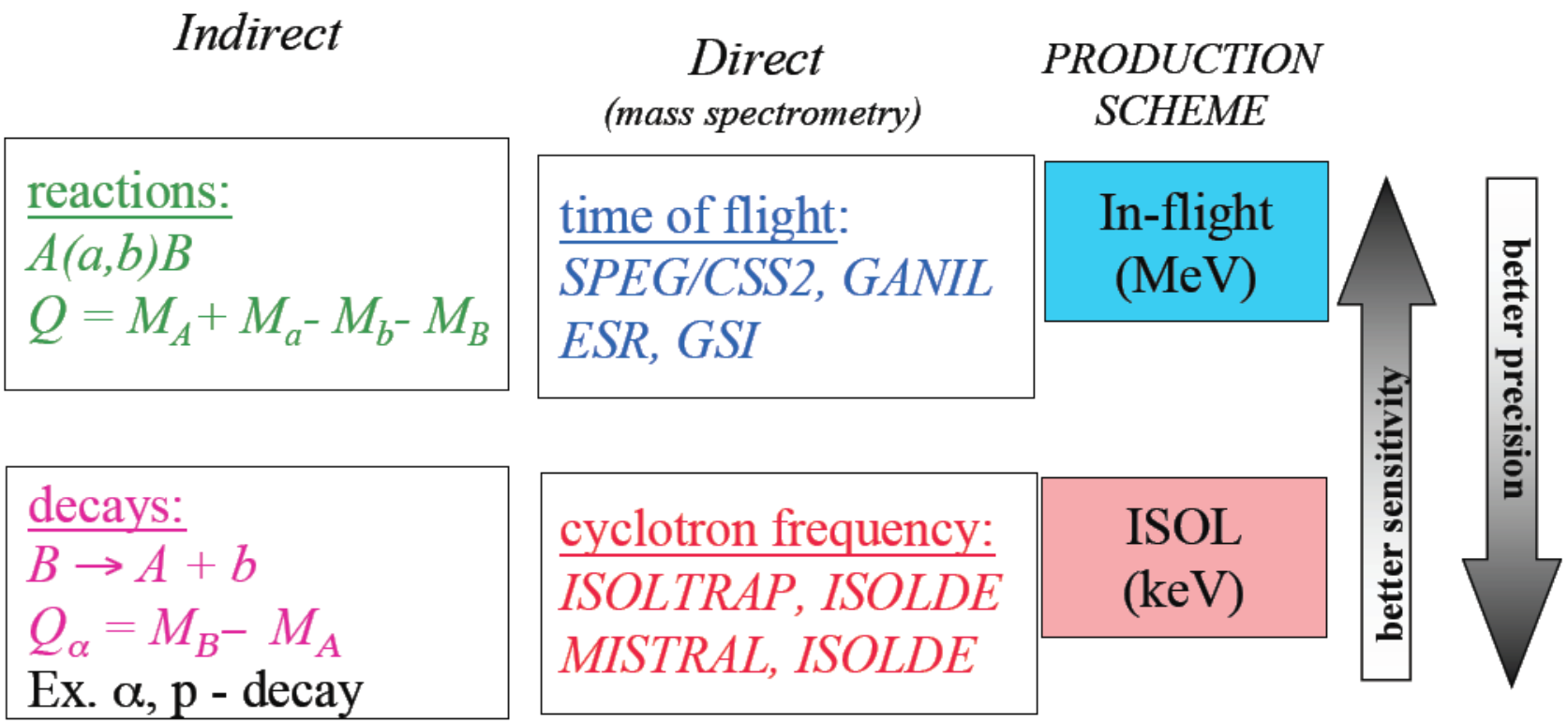
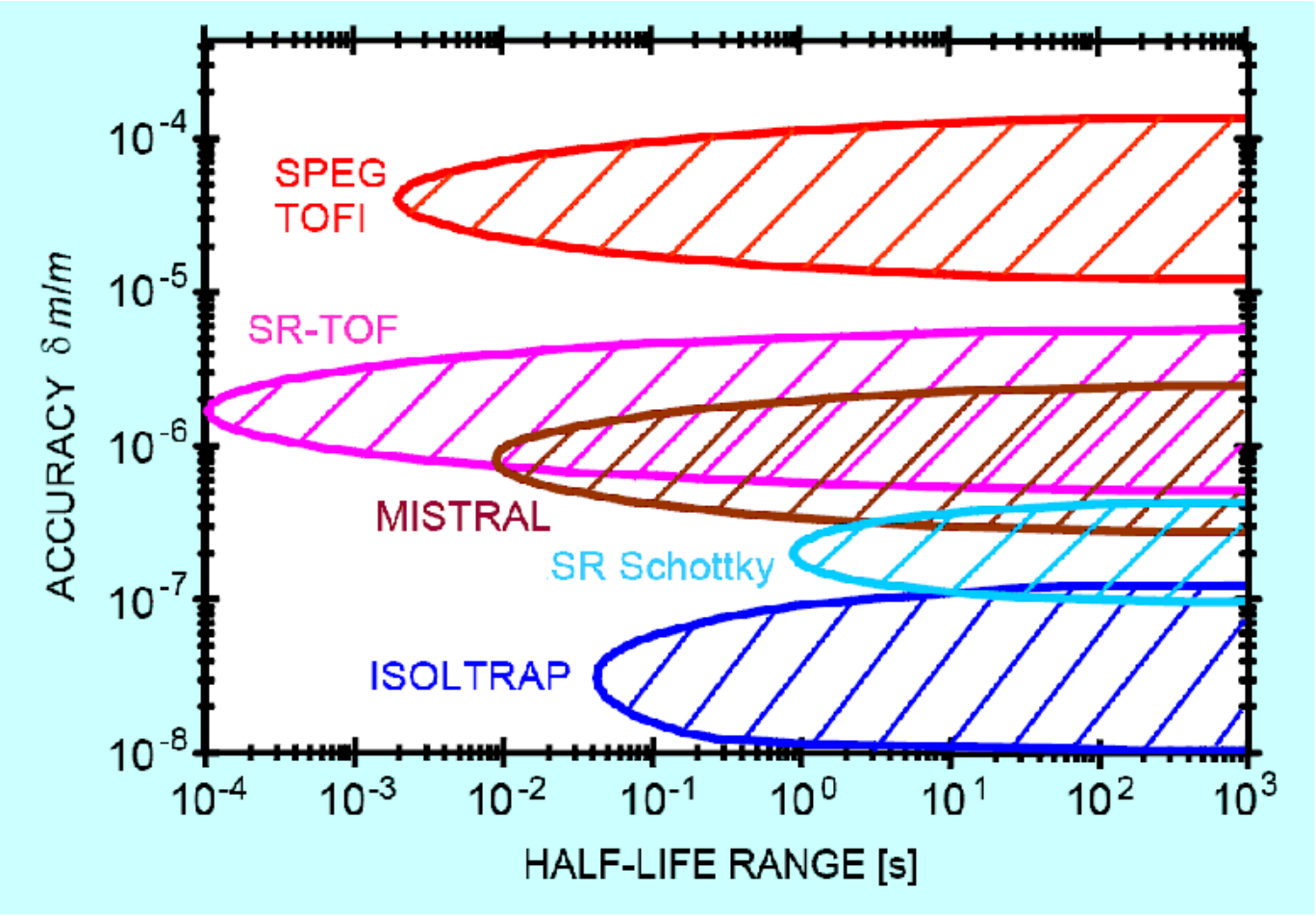
Br
Se
Ga
Cu
Z=28 Ni
Mn
Cr
N=20
N=28
Ra
Fr
Po
Pb
Bi
Tl
Hg
Z=82
N=152
N=126
Yb
Ho
Dy
Eu
Sm
Pm
Nd
Pr
N=82
N=152
δm/m
10-9
10-8
10-7
10-6
10-5
10-4

Methods of mass measurement



Comparison of the direct methods



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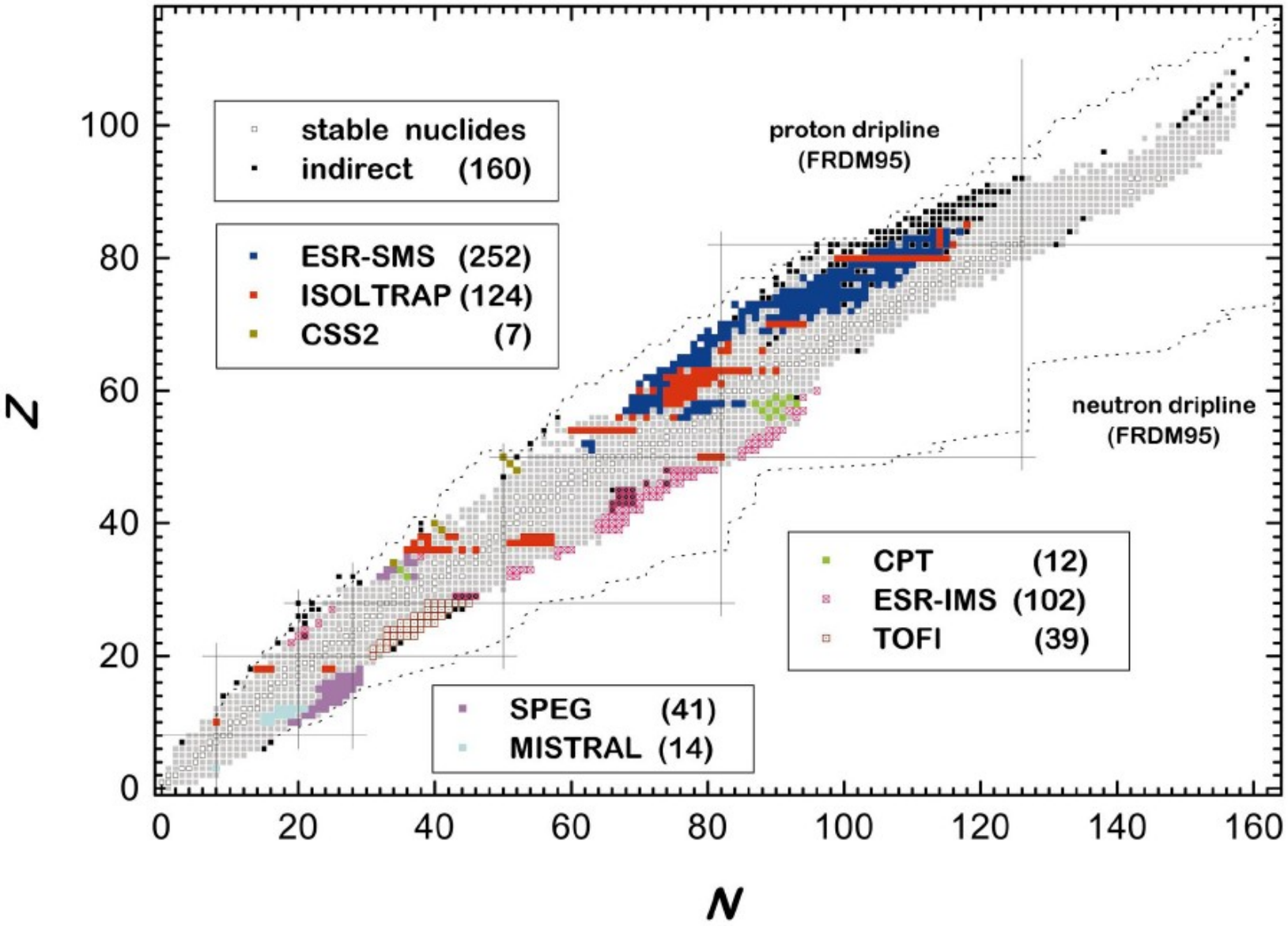
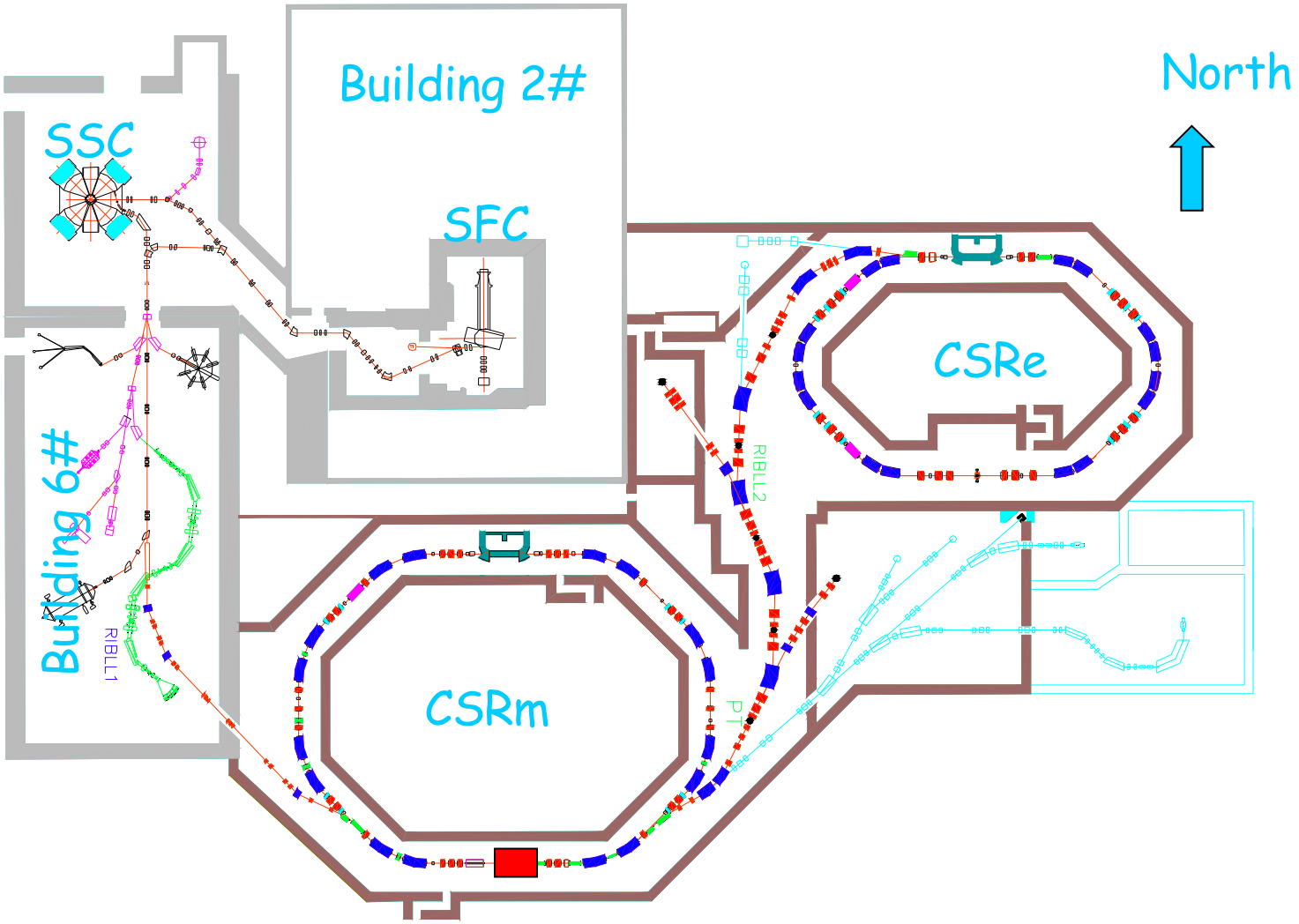


Methods of mass measurement at CSRe

HIRFL-CSR Complex



Methods of mass measurement with a storage ring

The revolution frequency of a stored particle

$$f = \frac{v}{C}$$

C is determined by

$$\alpha_p = \frac{1}{C} \oint \frac{D(s)}{\rho} ds = \frac{dC}{C} \frac{B\rho}{d(B\rho)}$$

$$B\rho = \frac{m}{q} \beta\gamma c \qquad \alpha_p = \frac{1}{\gamma_t^2}$$

$$\frac{df}{f} = -\frac{1}{\gamma_t^2}\frac{d(m/q)}{(m/q)} + \left(1 - \frac{\gamma^2}{\gamma_t^2}\right)\frac{dv}{v}$$

SMS: $dv \rightarrow 0$

IMS: $\gamma \rightarrow \gamma_t$

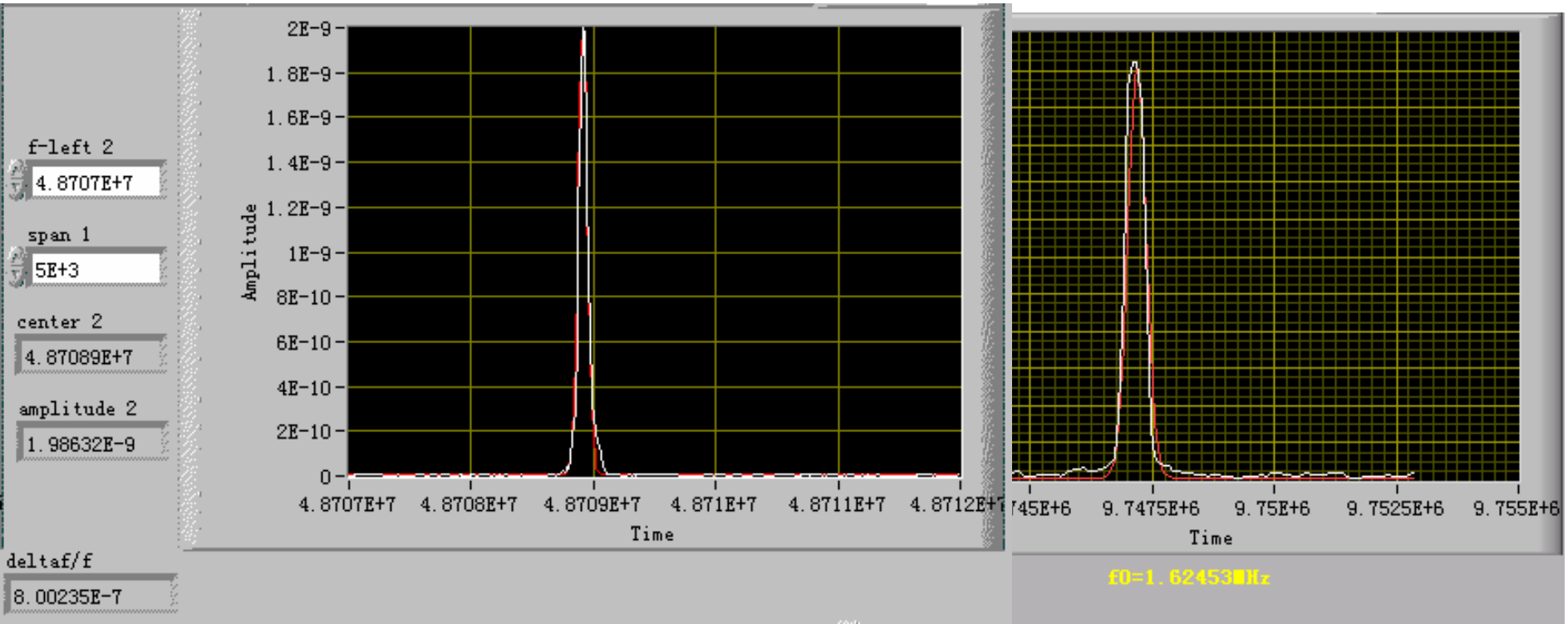
$$\frac{df}{f} = -\frac{1}{\gamma_t^2}\frac{d(m/q)}{(m/q)}$$

The test experiment

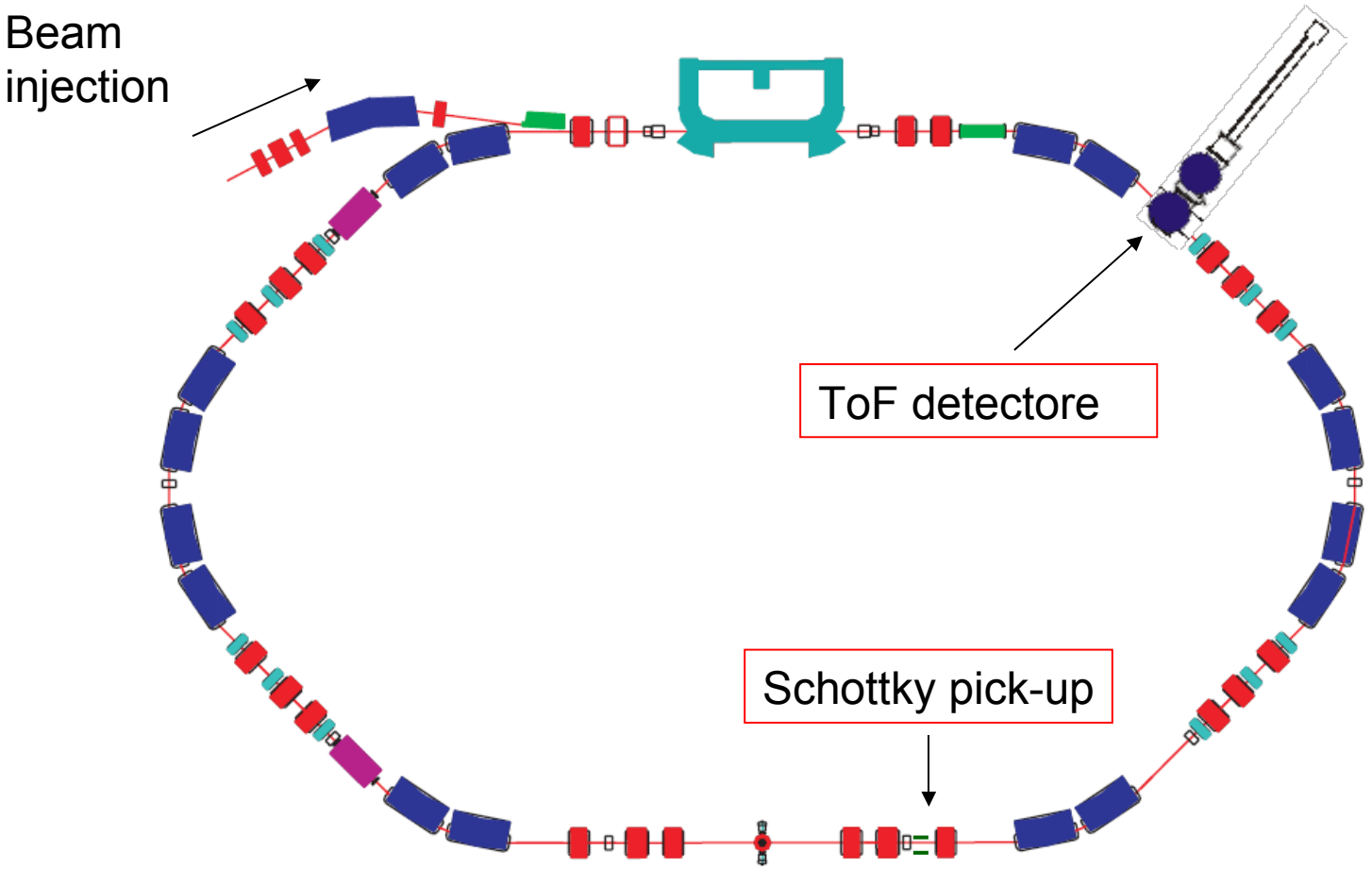
The experiment procedure

1.Confirm the isochronicity setting

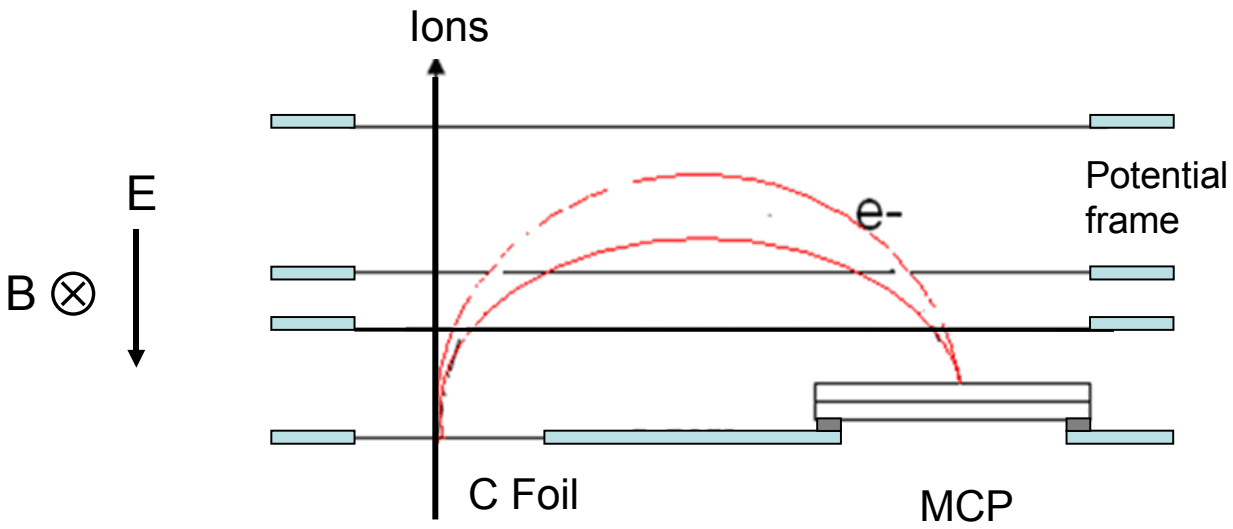
- CSRm 367.94 MeV/u $^{36}Ar^{18+}$
- RIBLL2: $B\rho$ ~ 6.039 Tm to transport the main beam
- CSRe in the isochronous mode t=1.395

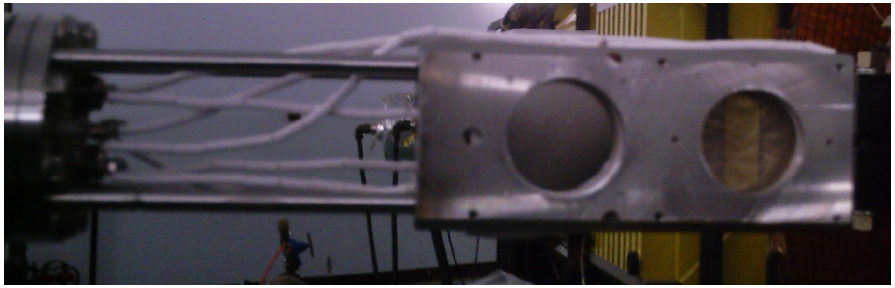


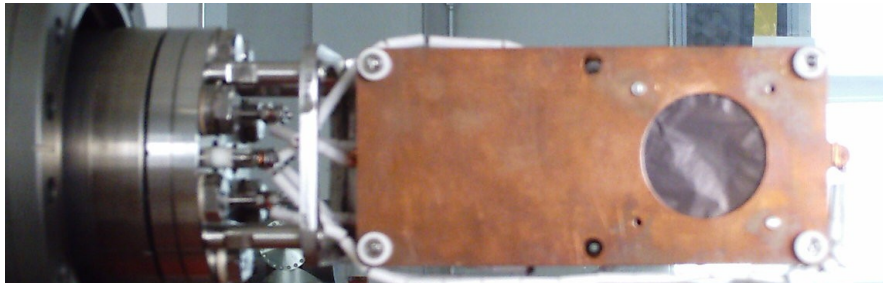
Layout of CSRe



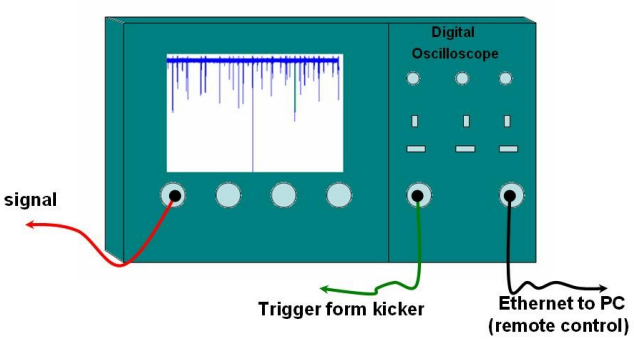
ToF detector





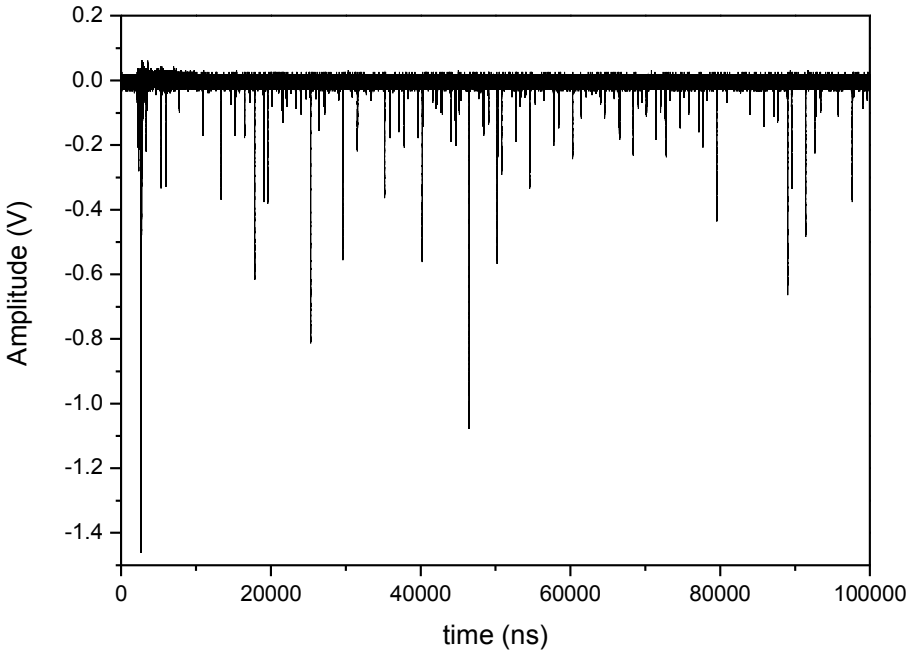


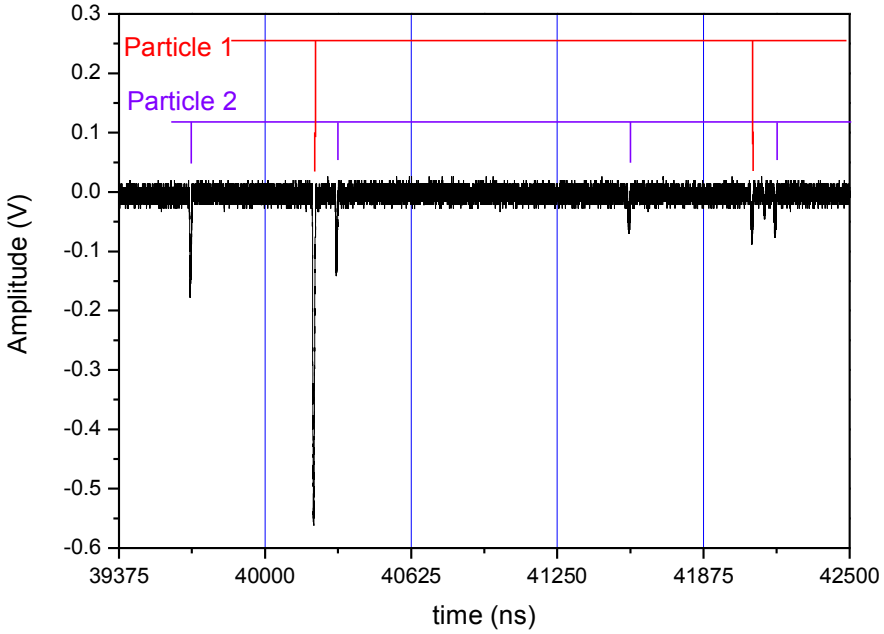
DAQ



Sampling rate 40GS/s

Measurement time 200μs





Data analysis

The process

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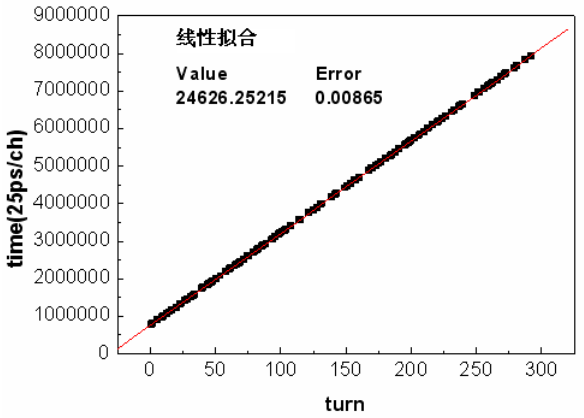
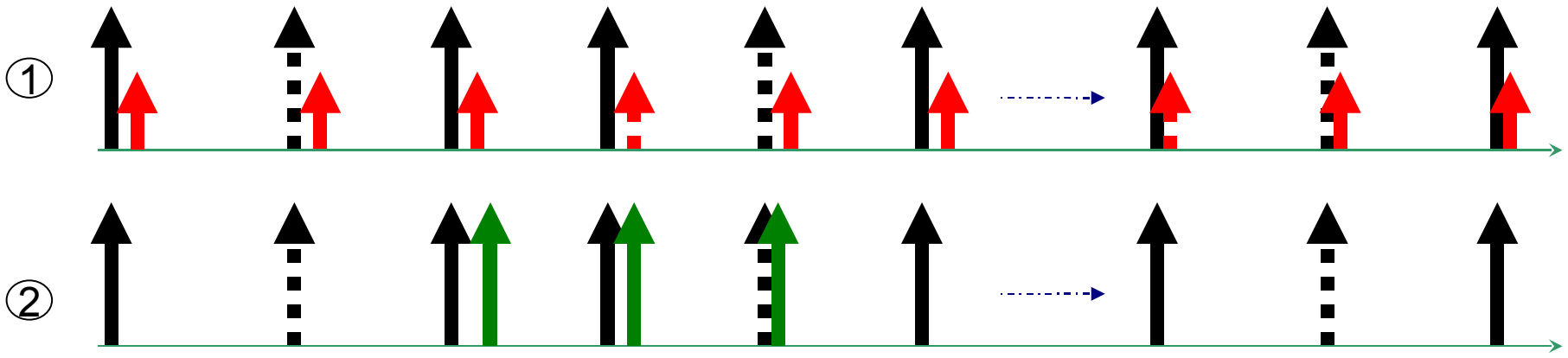
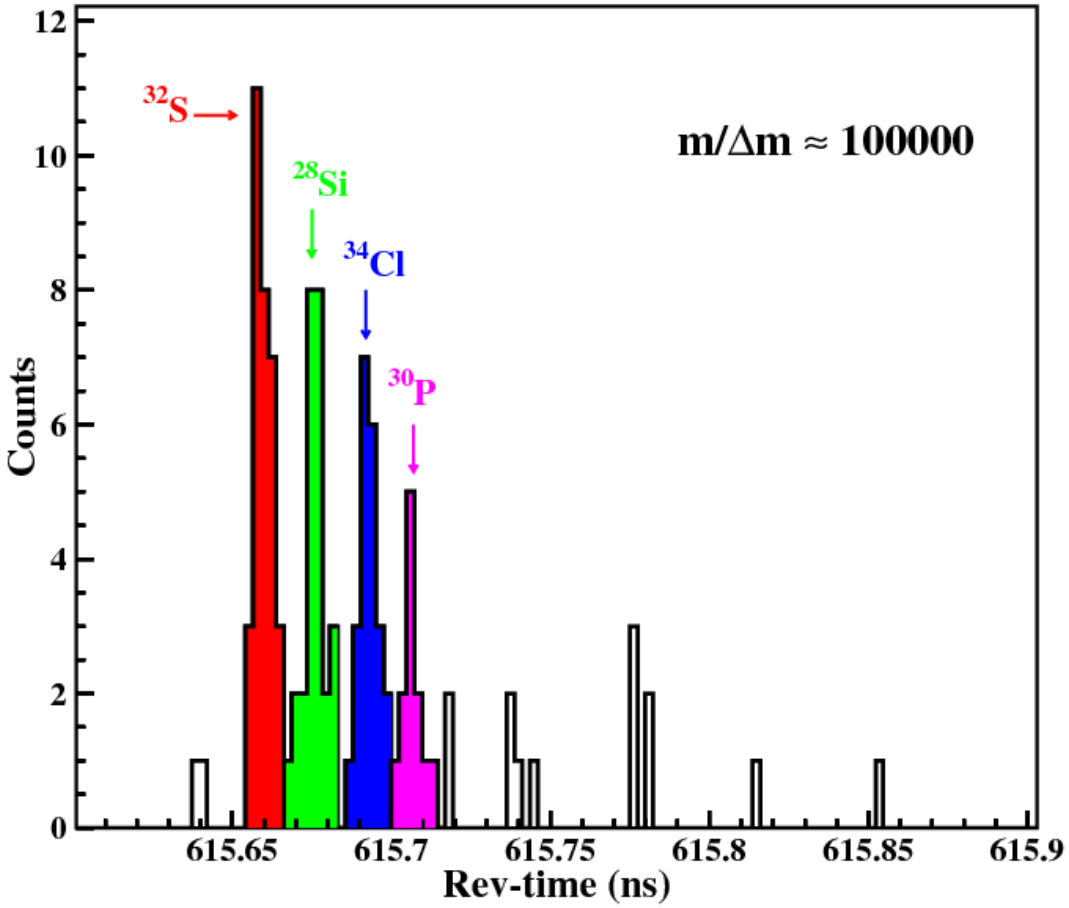
Linear fit





The last signal

Result of the test experiment



Summary

A pilot experiment of mass measurement was performed at CSRe with the method of isochronous mass spectrometry. The fragments of ^{36}Ar were injected in CSRe and stored. Their revolution frequencies were measured with a time-of-flight detector system. the mass resolution of about 10^5 for $m/\Delta m$ is achieved. The result shows the potential of CSRe for the mass measurements of short-lived nuclei.

Thank you !