Total kinetic energy detector

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BigRIPS analysis workshop, RIBF building, September 11, 2014

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- Motivation
- TKE detector
- Application
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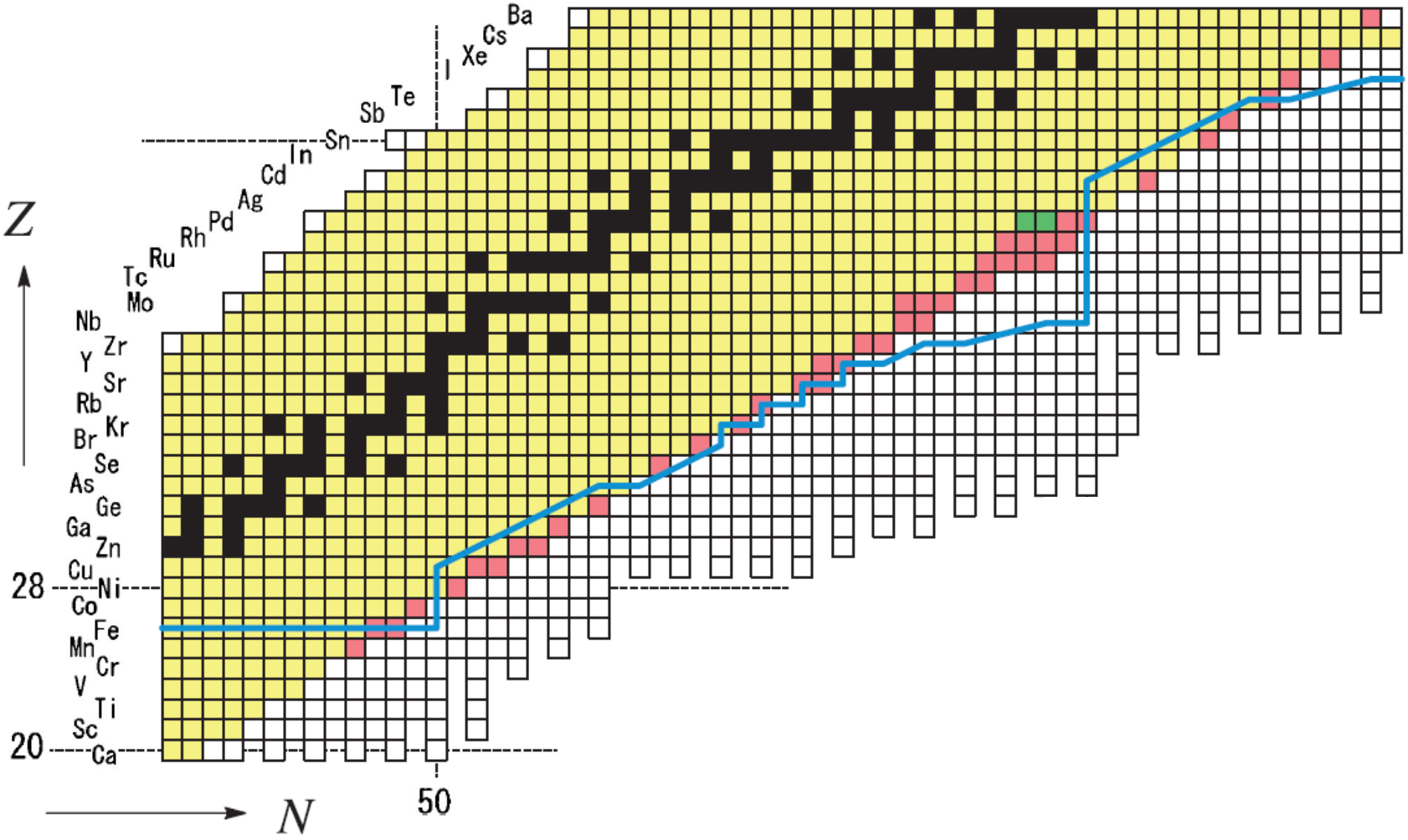
Motivation

Particle identification for heavy mass region



T. Kubo et al., Prog. Theor. Exp. Phys. 2012, 03C003(2012)
T. Ohnishi et al., J. Phys. Soc. Jpn. 79, 073201(2010).

PID in BigRIPS and ZeroDegree

Beam line detectors

PPAC

Plastic

Ion Chamber

$B\rho = A/Q \cdot \beta \cdot \gamma$ $\quad$ TOF=L/β $\quad$ $\Delta E = Z^2/\beta^2$

Atomic number *Z*

Mass-to-charge ratio *A/Q*

Charge states

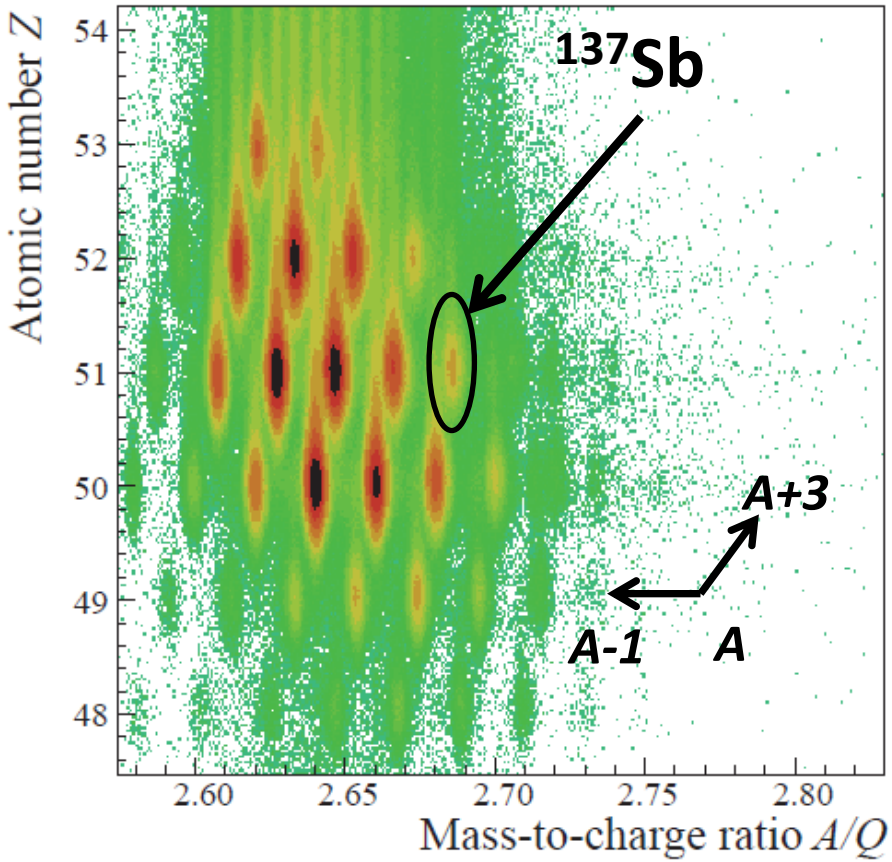
$^{137}Sb \rightarrow {}^{136}Sn$@230 *A*MeV

$^{136}Sn^{50+}$ and $^{133}Sn^{49+}$

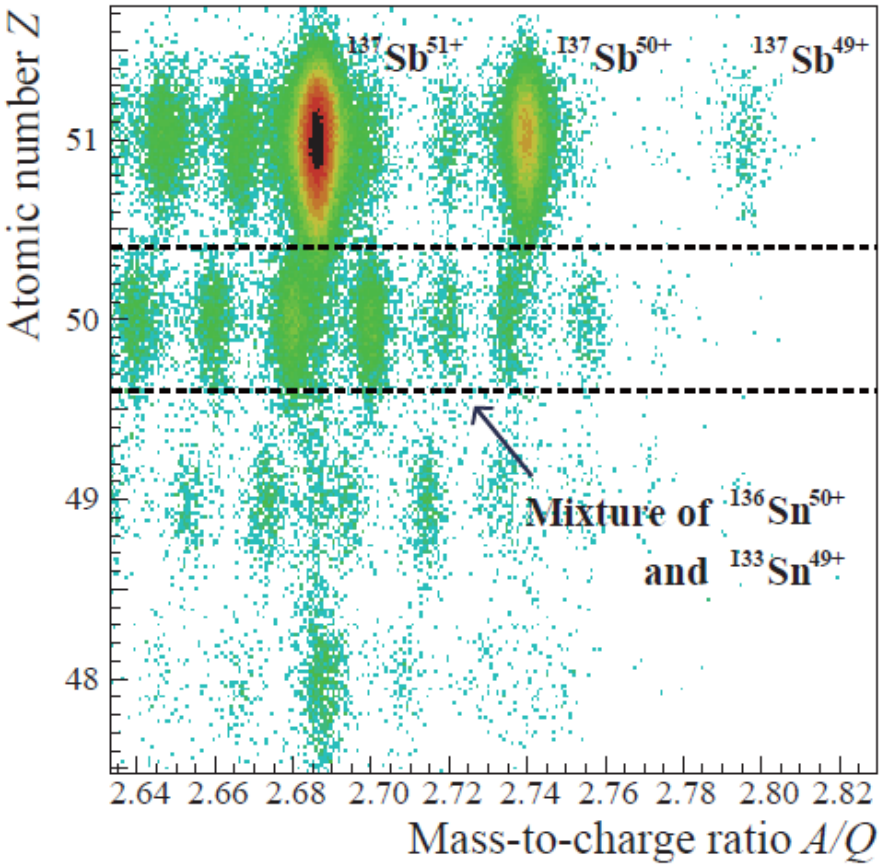
$\Delta A/Q = 136/50 - 133/49 = 5.7 \cdot 10^{-3}$

A/Q resolution $2.7 \cdot 10^{-3}$ (rms)

BigRIPS PID



ZeroDegree PID



PID in BigRIPS and ZeroDegree

Beam line detectors + TKE detector

PPAC

Plastic

Ion Chamber

$LaBr_3(Ce)$

$B\rho = A/Q \cdot \beta \cdot \gamma$ $\quad$ $TOF = L/\beta$ $\quad$ $\Delta E = Z^2/\beta^2$ $\quad$ $TKE \sim A \cdot \beta^2$

Atomic number Z

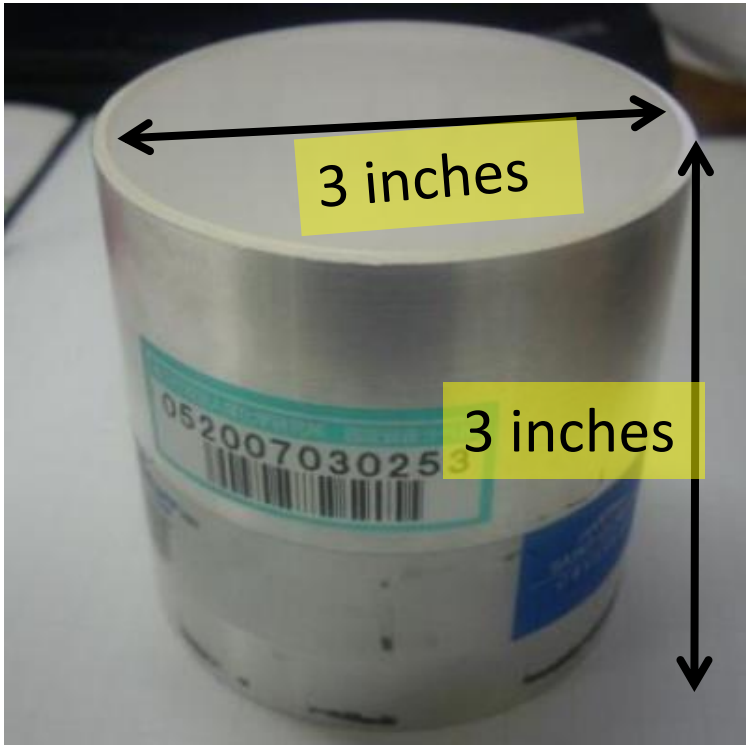
Mass-to-charge ratio A/Q

Mass number A

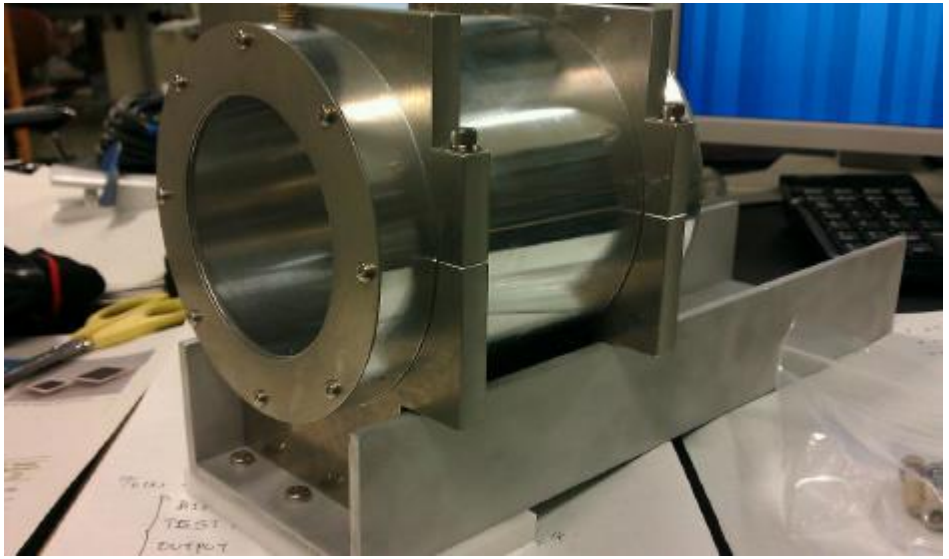
$Q \neq Z$

TKE detector --- scintillator

$LaBr_3$(Ce) scintillator
Saint-Gobain BrilLanCe™380



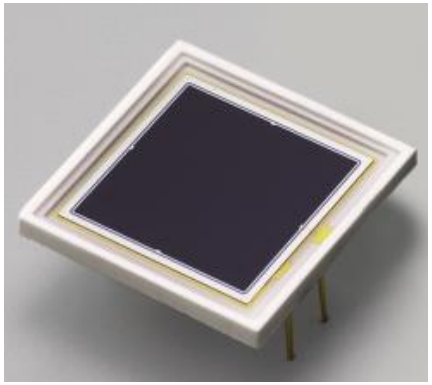
Shield



K. Kobayashi, master thesis, 2012

http://www.crystals.saint-gobain.com/BrilLanCe_380_Scintillator.aspx

TKE detector --- readout



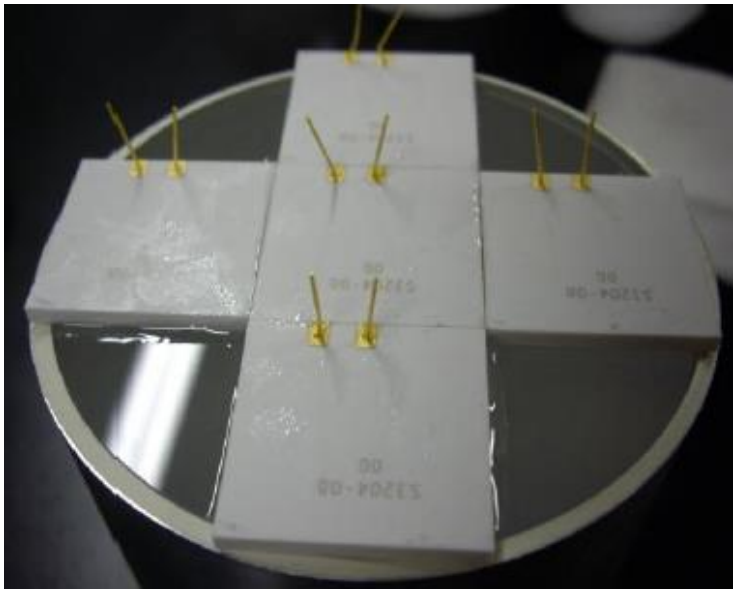
Si pin photodiode

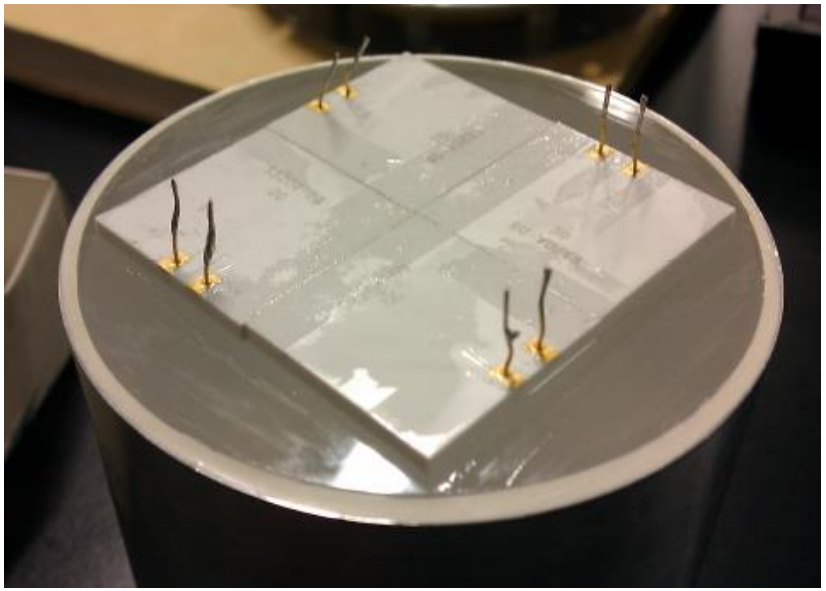
Type: Hamamatsu S3204-08

Sensitive area: 18·18 mm^2

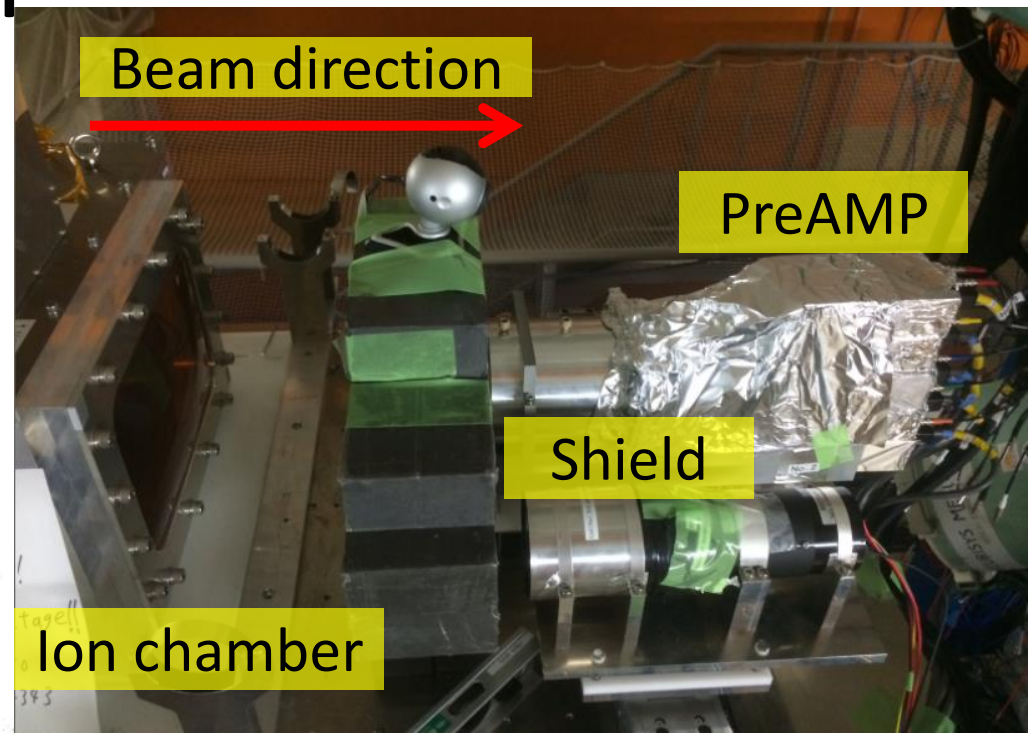
http://www.hamamatsu.com/jp/ja/product/category/3100/4001/4103/S3204-08/index.html

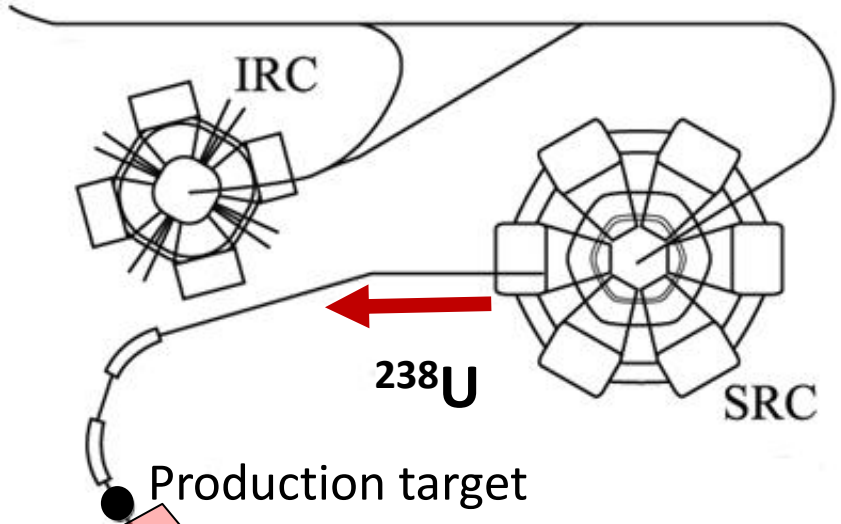
Readout configuration



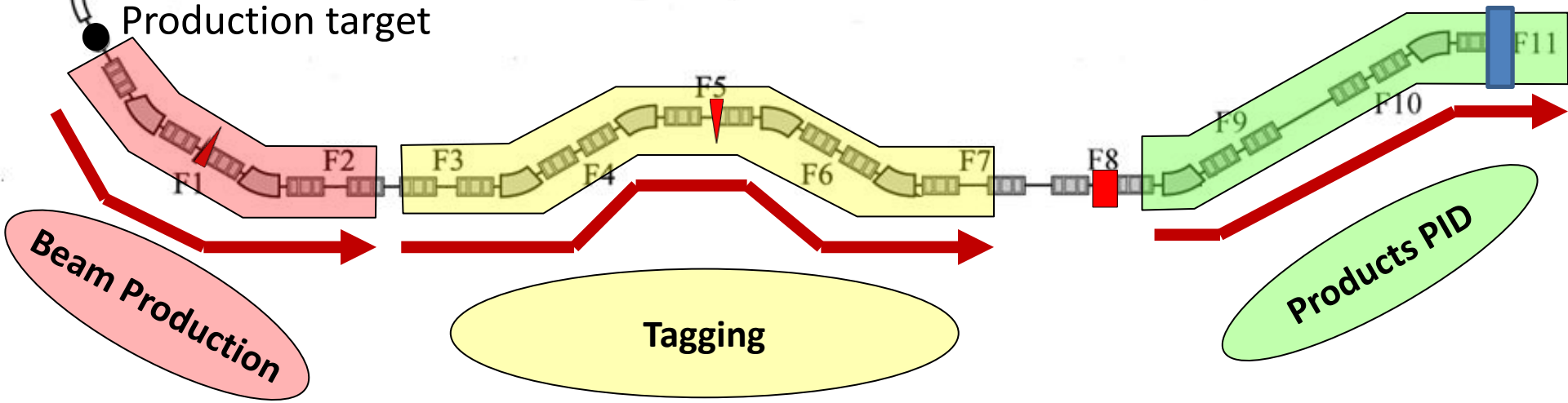


Experimental setup



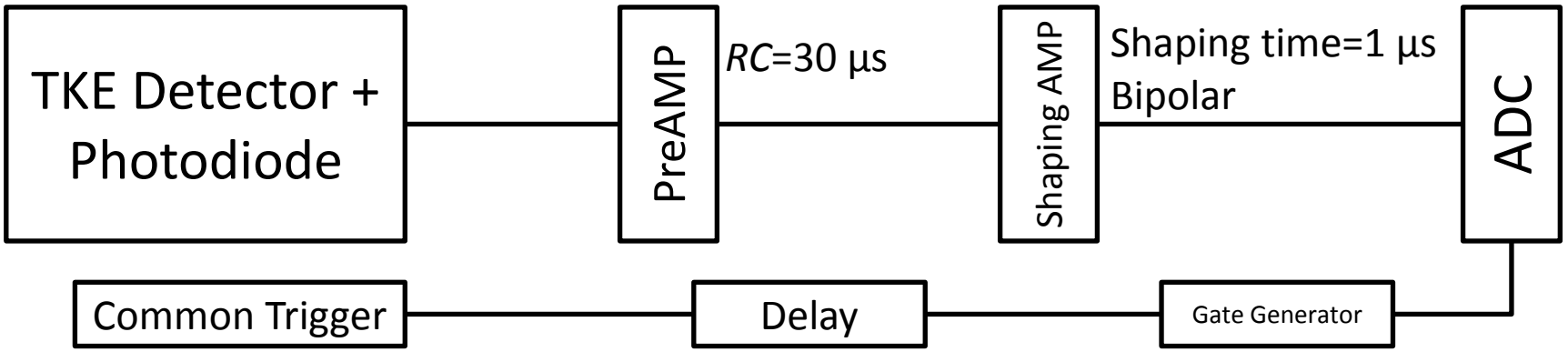


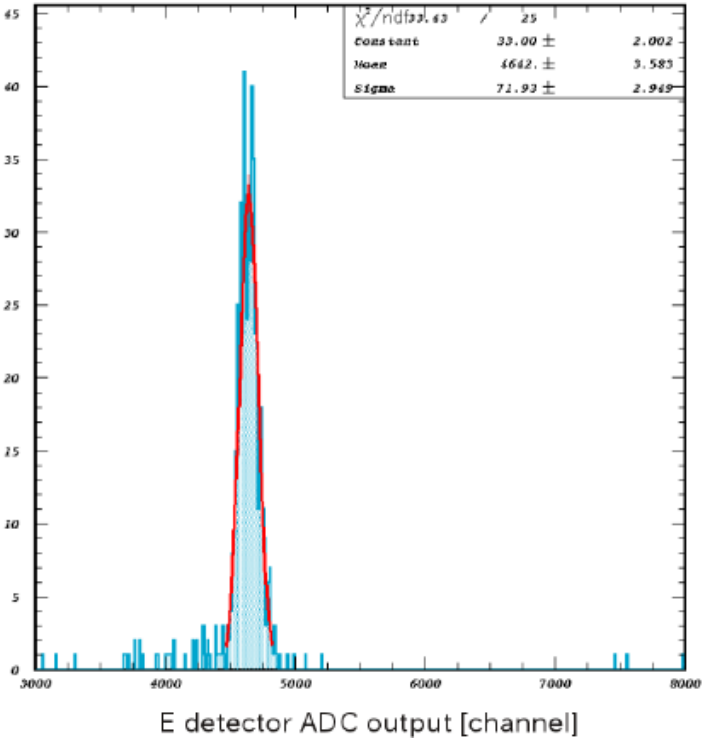
Production target



BigRIPS **ZeroDegree**

TKE detector signal





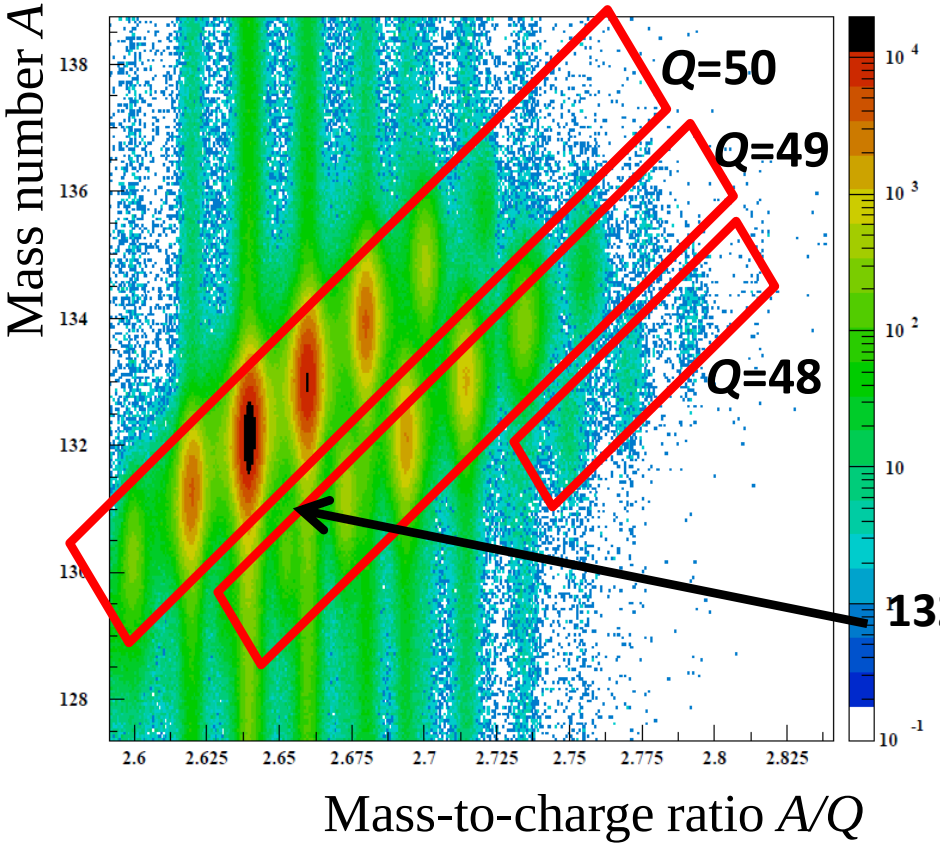
Energy resolution
1.6% (rms)

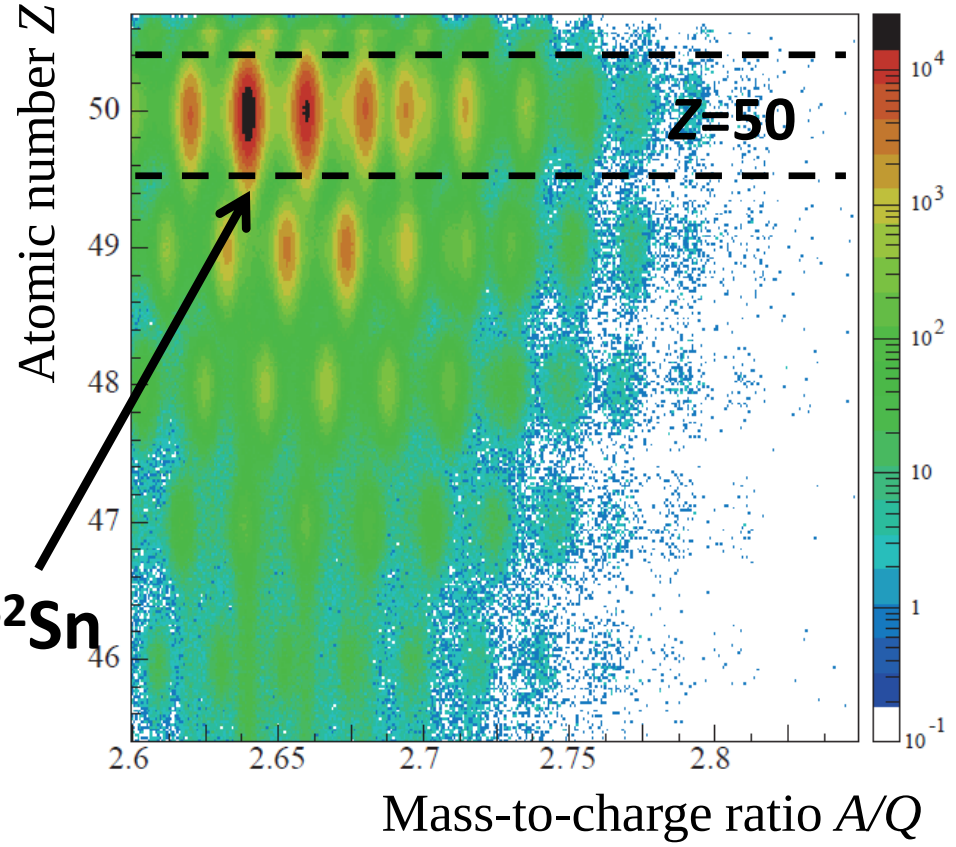
TKE detector signal

Bρ(D7)=5.6930 Tm

-- 200 *A*MeV for Sn (*Z*=50) isotopes

Resolution in *A* ~0.65 (rms)

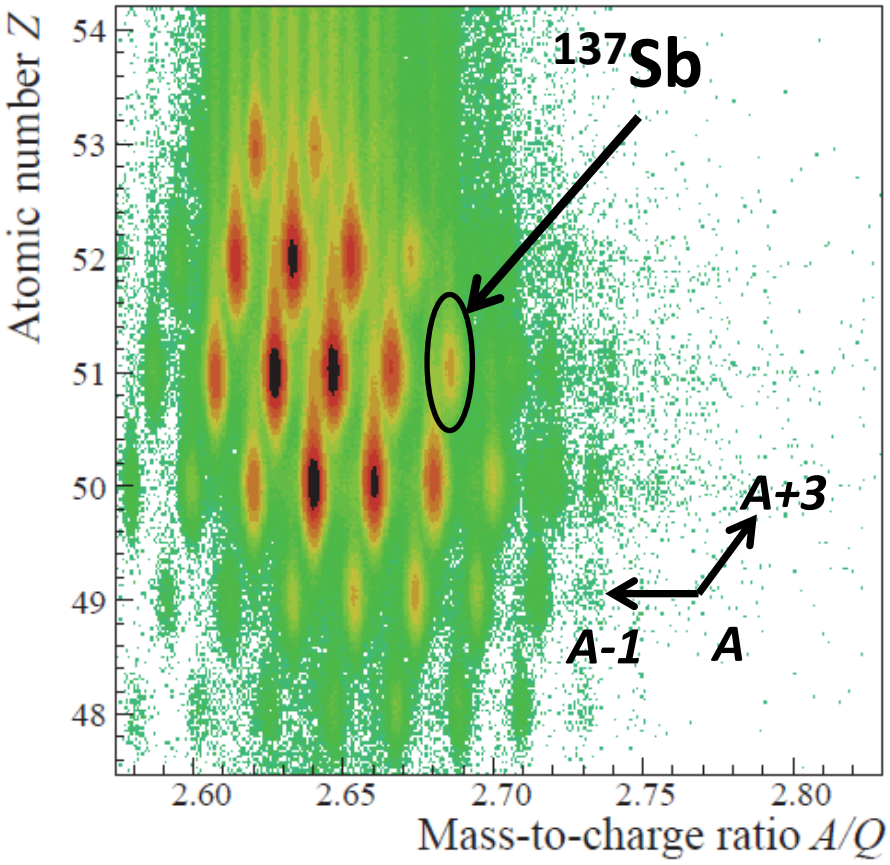




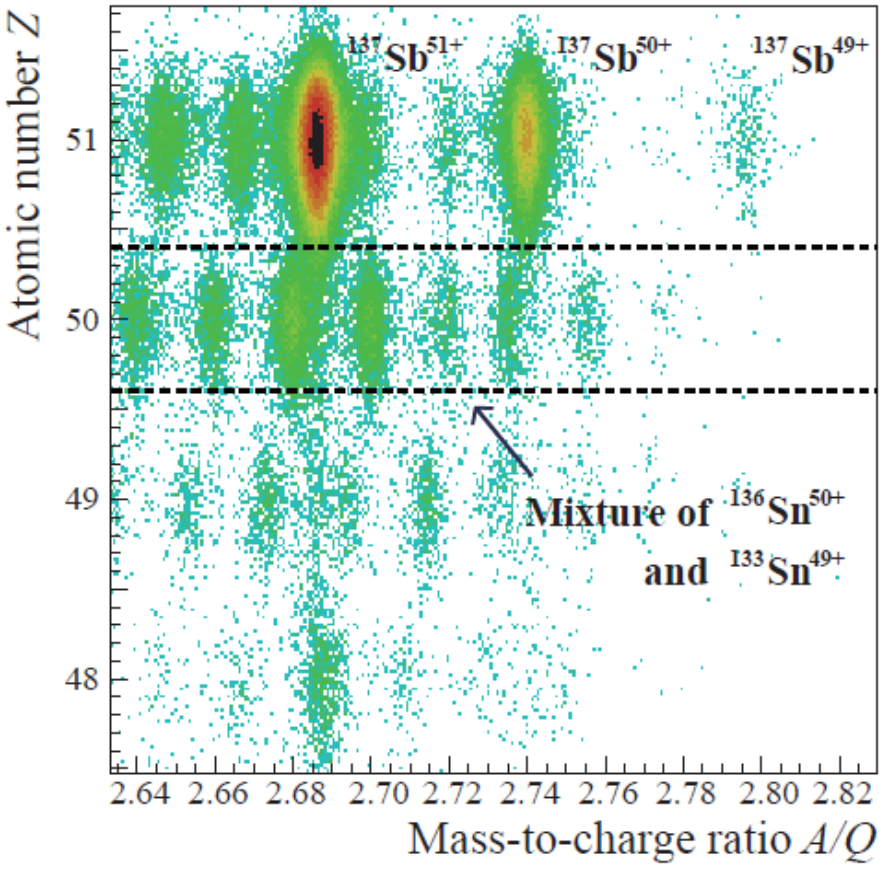
Application --- ^{136}Sn

^{137}Sb → ^{136}Sn@230 *A*MeV

BigRIPS PID



ZeroDegree PID

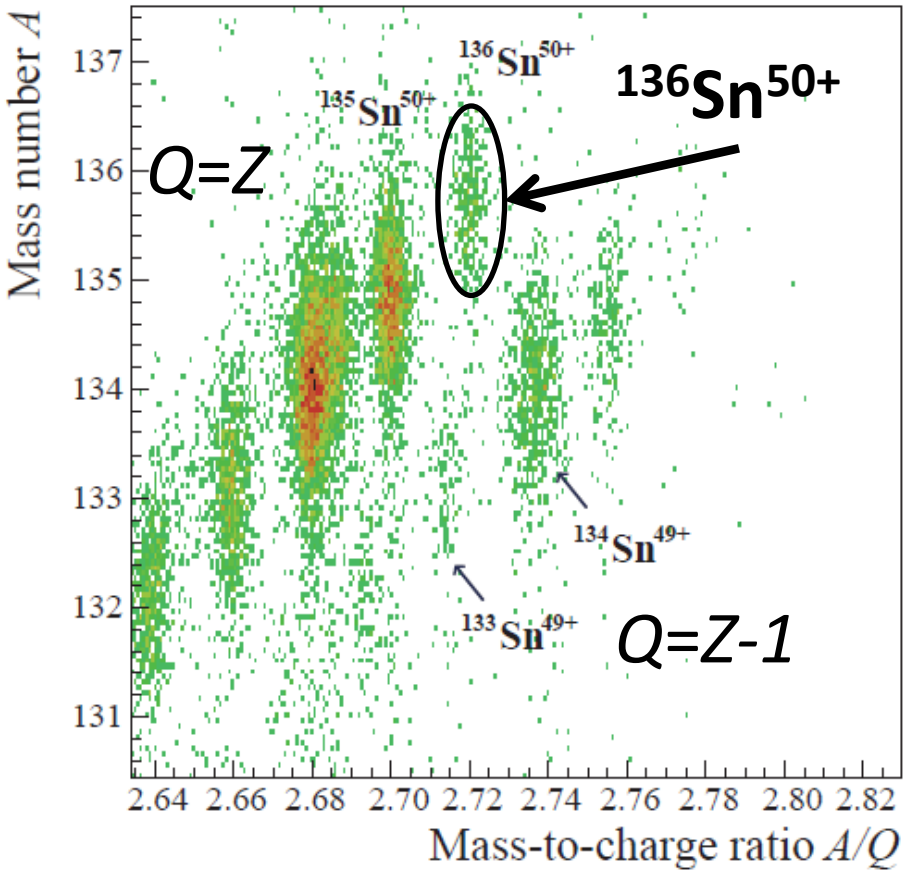


HW, N. Aoi, S. Takeuchi et al., Prog. Theor. Exp. Phys. 2014, 023D02(2014)

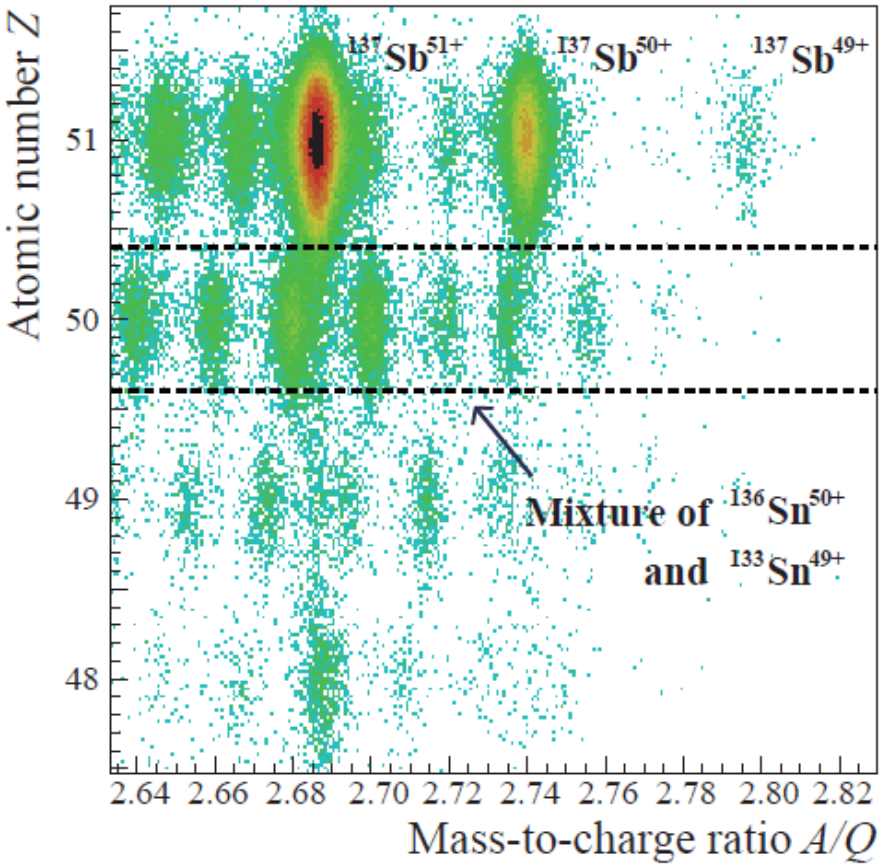
Application --- ^{136}Sn

Resolution in *A* ~0.65 (rms)

Charge State ID by TKE



ZeroDegree PID



TKE detectors at RIBF

Scintillator	Readout	Group in charge	Purpose
$LaBr_3(Ce)$	Si pin photodiode	RI Phys. Lab	ZDS PID
CsI	PMT	BigRIPS team	BigRIPS/ZDS PID
CsI(pure)	PMT	Tohoku Univ./SAMURAI team	SAMURAI PID
$LaBr_3(Ce)$	PMT	CNS	Heavy ion PID

Summary

- TKE detector for charge states identification
  $LaBr_3$(Ce) scintillator and photodiode readout

- Application for the *A*>132 region

- Other TKE detectors at RIBF
  Different combination of scintillator and readout
  =>Best resolution in *A*

Collaboration list

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Thank you for your kind attention.