

# Study of collisions of $^{136}\text{Xe}+^{198}\text{Pt}$ for the KEK isotope separation system

## Collaborators

<b>KEK</b>	<u>Y.X. Watanabe</u> , Y. Hirayama, N. Imai, H. Ishiyama, S.C. Jeong, H. Miyatake
<b>GANIL</b>	E. Clement, G. de France, A. Navin, M. Rejmund, C. Schmitt
<b>Torino</b>	G. Pollarolo
<b>LNL</b>	L. Corradi, E. Fioretto
<b>Padova</b>	D. Montanari
<b>Seoul</b>	S.H. Choi, Y.H. Kim, J.S. Song
<b>IPN</b>	M. Niikura, D. Suzuki
<b>Osaka</b>	H. Nishibata, J. Takatsu

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# KEK Isotope Separation System (KISS)

## Collaborators

KEK Y. Hirayama, N. Imai, H. Ishiyama, S.C. Jeong, H. Miyatake, M. Oyaizu, Y.X. Watanabe  
RIKEN Y. Matsuo, T. Sonoda, M. Wada  
K.U. Leuven M. Huyse, Yu. Kudryavtsev, P. Van Duppen

at RIKEN

### Focusing chamber

- Electric-Q triplet
- Electric deflector
- Slit
- Monitors

### ISOL (Ion Separator On-Line) (A selection)

- Electric-Q doublet
- Magnetic dipole
- Magnetic-Q doublet

### Extraction chamber

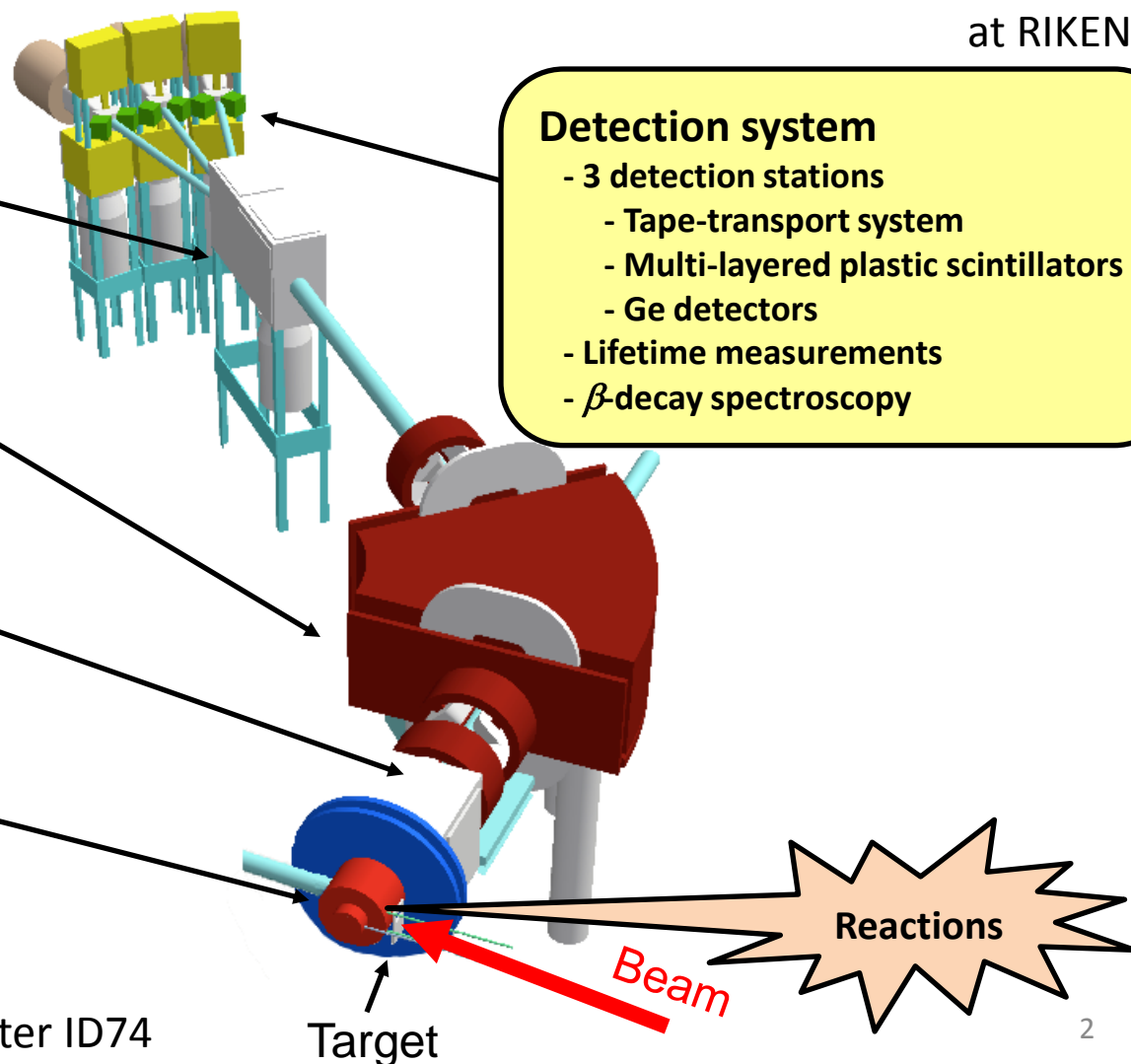
- Electric lens
- Monitors

### Gas catcher system

- Gas cell (Ar gas, **neutralization**)
- Laser resonance ionization  
(Z selection)
- SPIG (SextuPole Ion Guide)

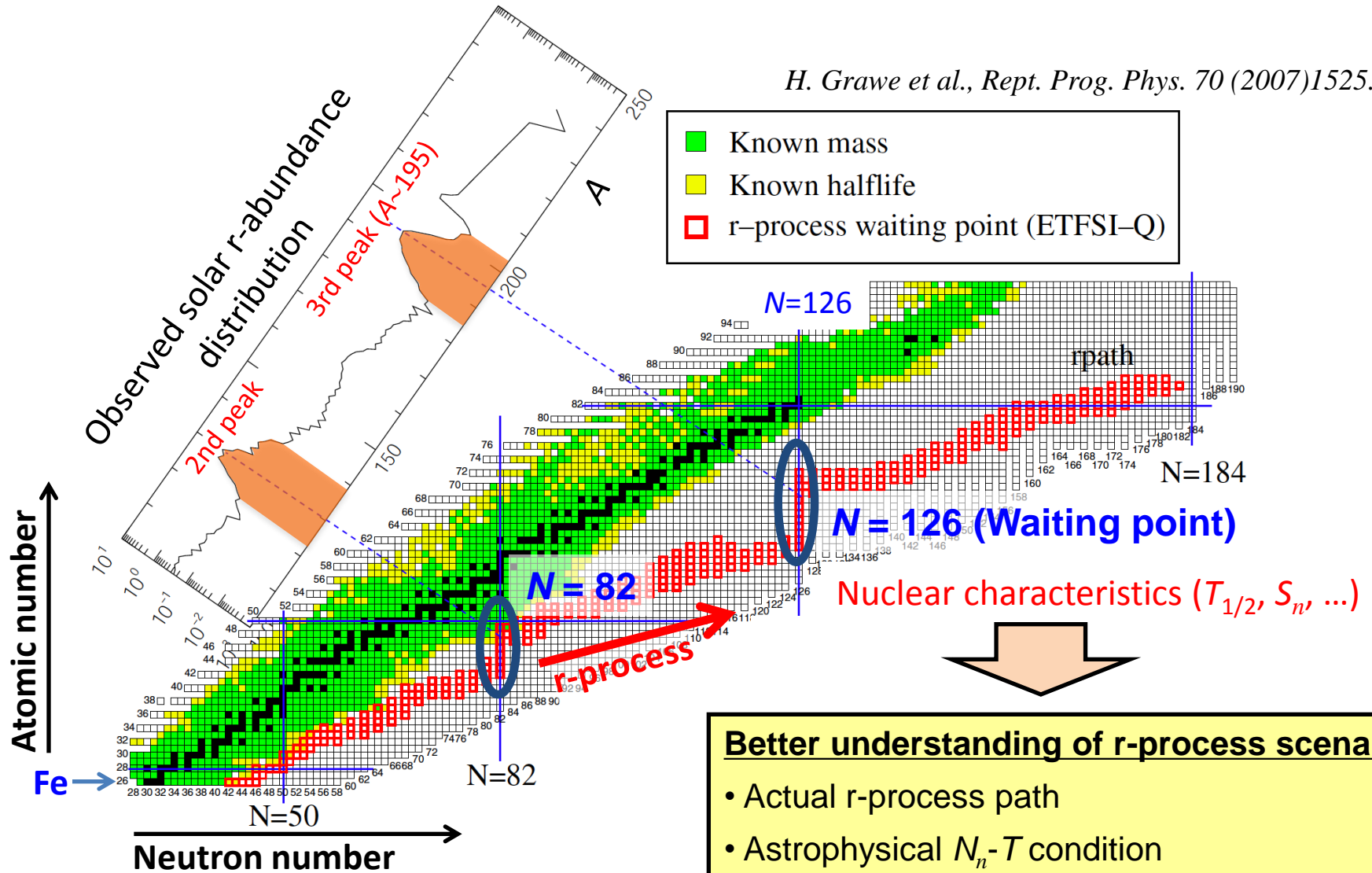
### Detection system

- 3 detection stations
- Tape-transport system
- Multi-layered plastic scintillators
- Ge detectors
- Lifetime measurements
- $\beta$ -decay spectroscopy



# Astrophysical nucleosynthesis by r-process

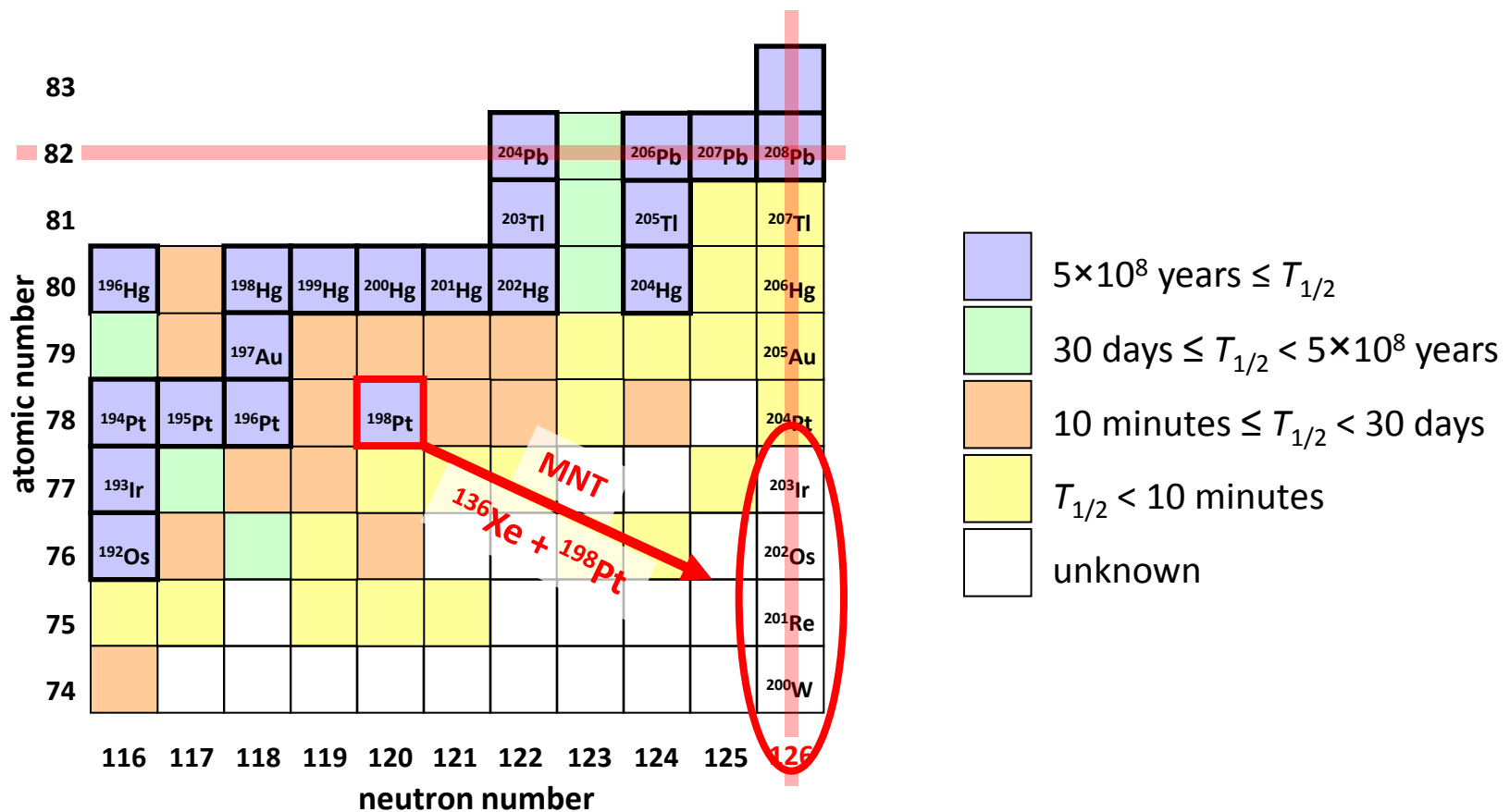
H. Grawe et al., Rept. Prog. Phys. 70 (2007)1525.



Lifetime measurements around  $N=126$   
 → Astrophysical environments of r-process

- Better understanding of r-process scenario**
- Actual r-process path
  - Astrophysical  $N_n$ - $T$  condition
  - Duration time passing through waiting point
  - Actinide element production rate

# Lifetime measurements around $N=126$ nuclei



- five-year project since FY2010: Lifetime measurements of  $N=126$  nuclei
- **Multinucleon transfer (MNT) reaction** to access  $N=126$  nuclei  
*C.H. Dasso et al., Phys. Rev. Lett. 73 (1994) 1907.*  
*V. Zagrebaev and W. Greiner, Phys. Rev. Lett. 101 (2008) 122701.*  
*L. Corradi et al., J. Phys. G: Nucl. Part. Phys. 36 (2009) 113101.*
- From  $^{203}\text{Ir}$  down to  $^{200}\text{W}$  by  $^{136}\text{Xe} + ^{198}\text{Pt}$  MNT reaction

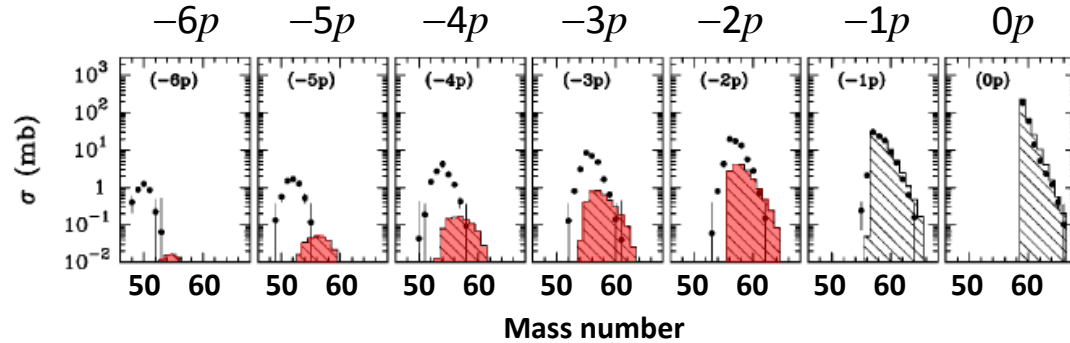
# MNT reactions

$^{58}\text{Ni} + ^{208}\text{Pb}$  ( *L. Corradi et al., Phys. Rev. C66 (2002), 024606.* )

Isotopic distributions of PLFs (**proton stripping** channels)

calculation

Independent  
single-nucleon transfer  
modes



50 60 50 60 50 60 50 60 50 60 50 60 50 60  
Mass number

50 60 50 60 50 60 50 60 50 60 50 60 50 60  
Mass number

For better description

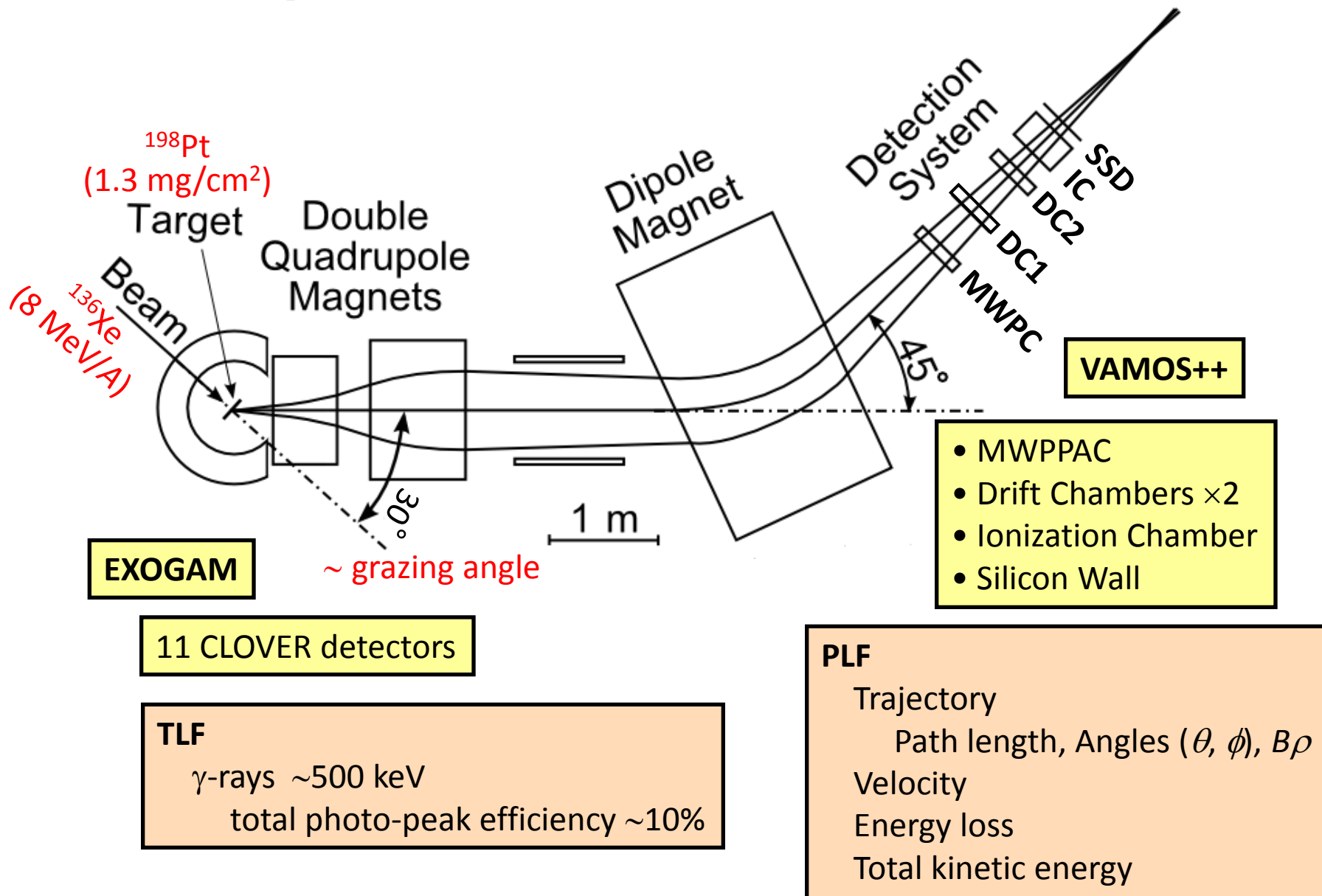
Absolute cross sections ← Pair transfer

Isotopic distributions ← Energy dissipation (Evaporation)

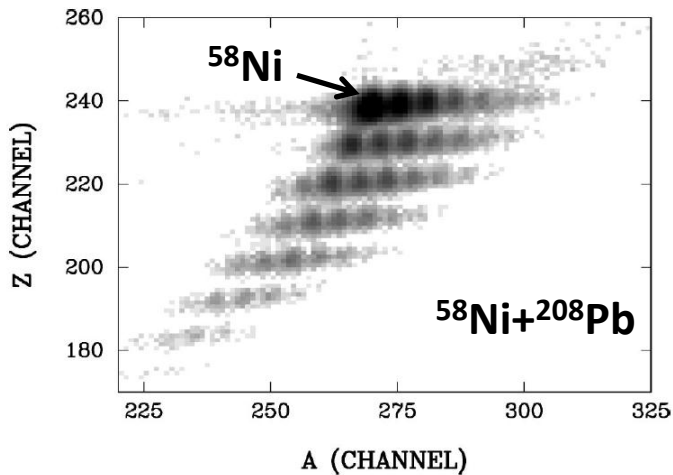
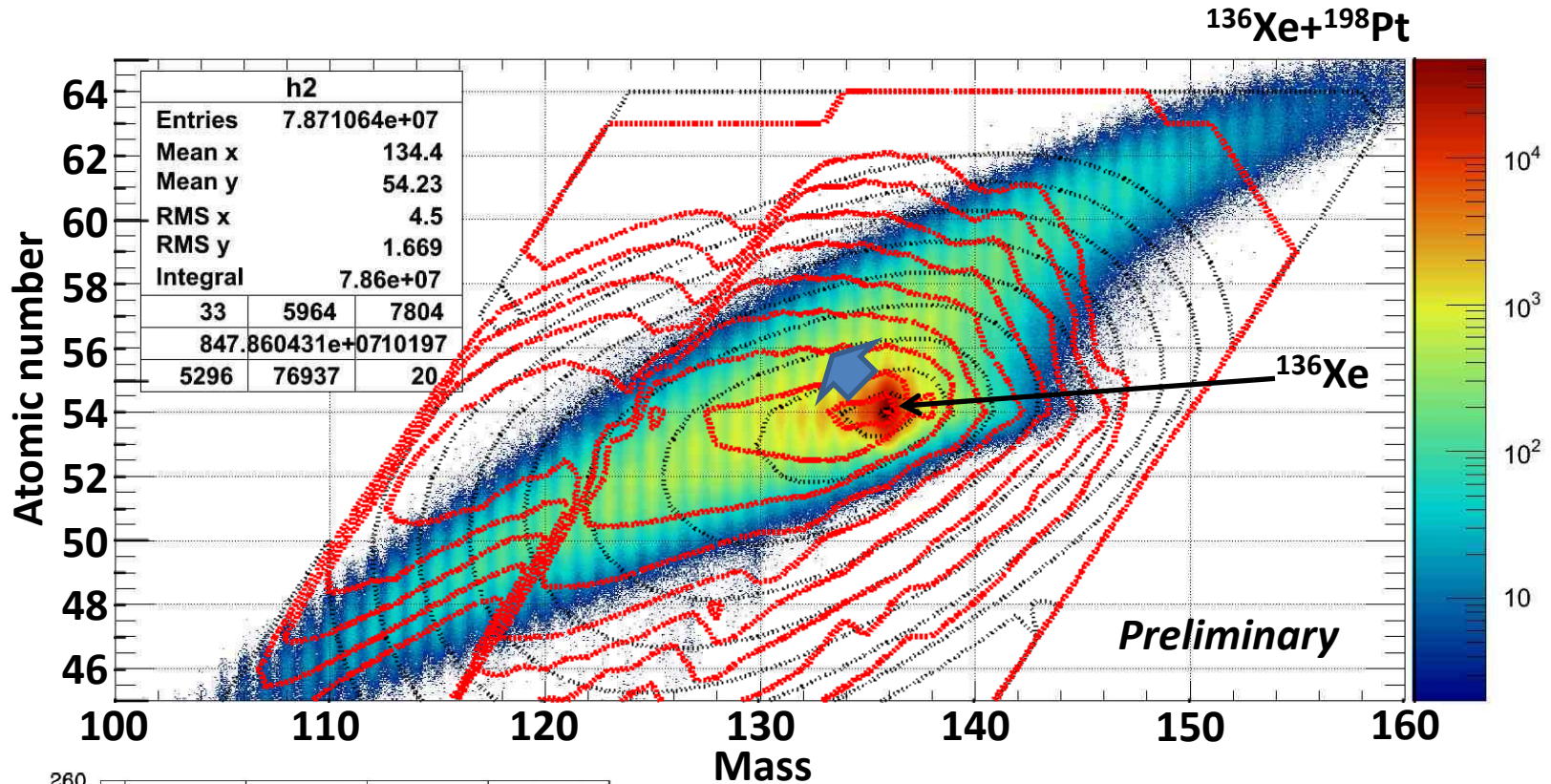


$^{136}\text{Xe}$  : heavy neutron-rich beam

# Experiment with VAMOS++ at GANIL



# A-Z distribution



**GRAZING (w/o evaporation)**

**GRAZING (w/ evaporation)**

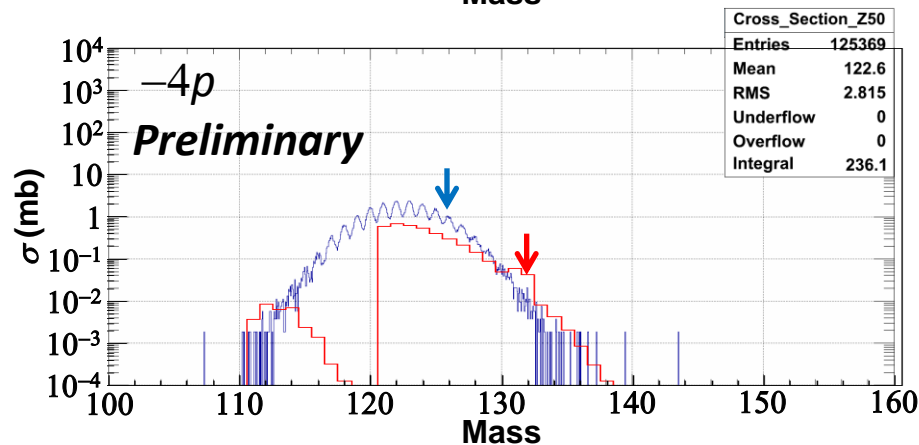
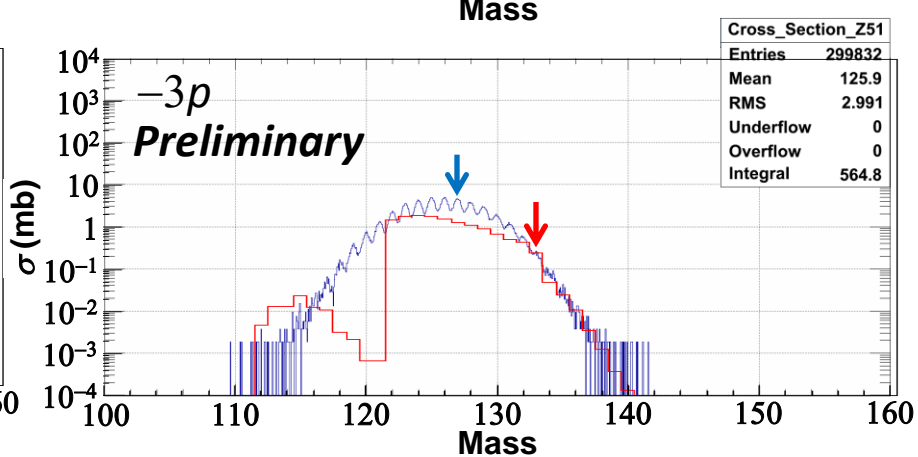
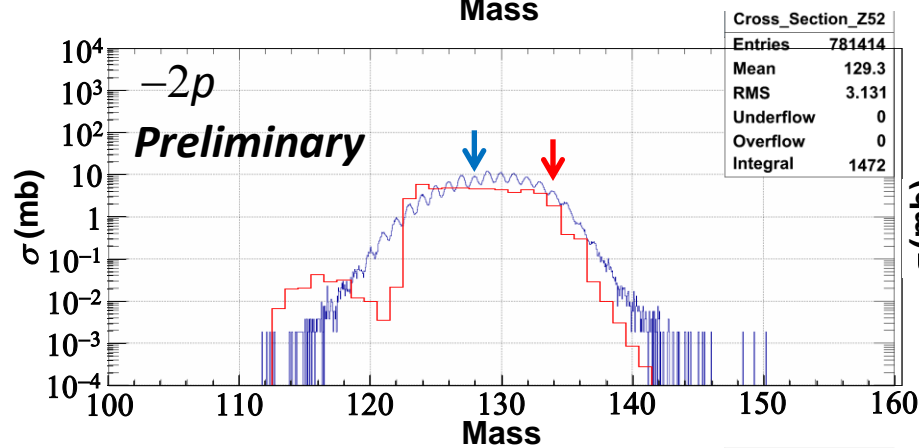
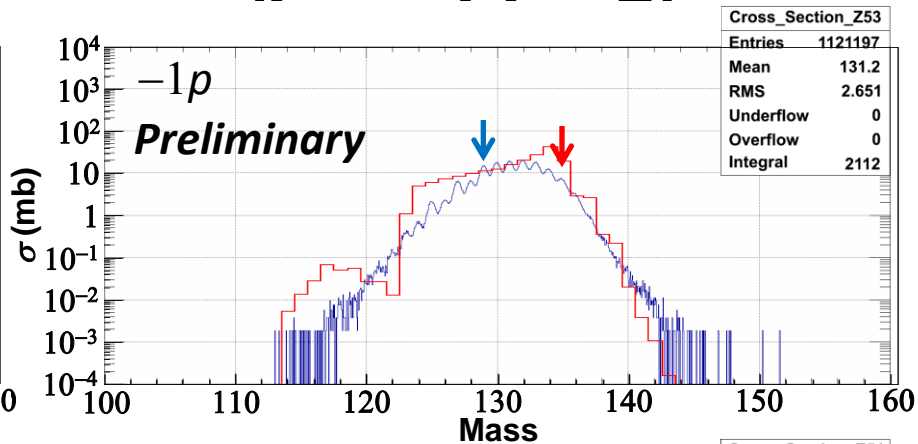
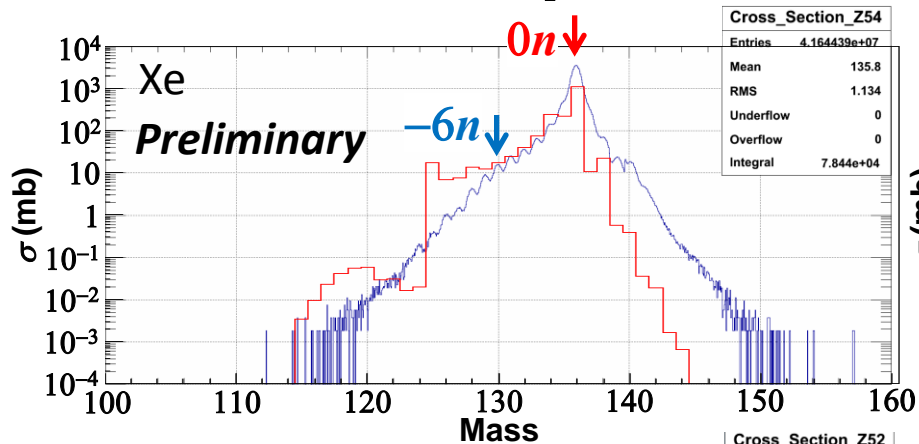
*A. Winther, Nuclear Physics A572 (1994) 191*

*A. Winther, Nuclear Physics A594 (1995) 203*

*<http://personalpages.to.infn.it/~nanni/grazing>*

*L. Corradi et al., Phys. Rev. C66 (2002), 024606.*

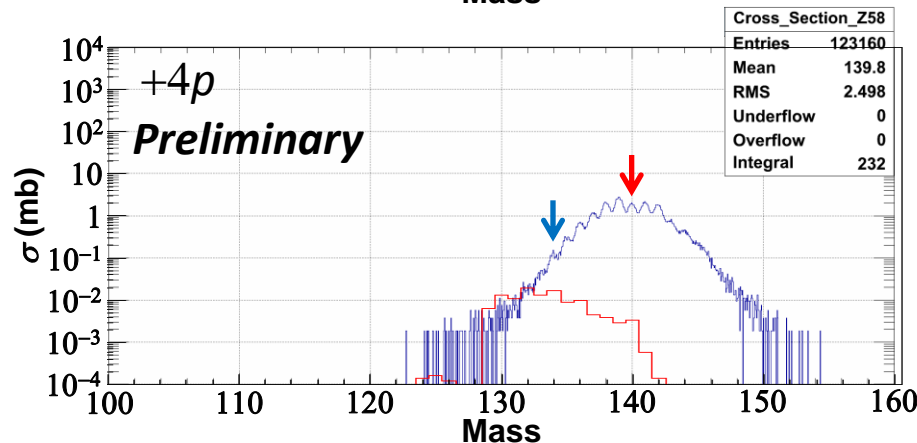
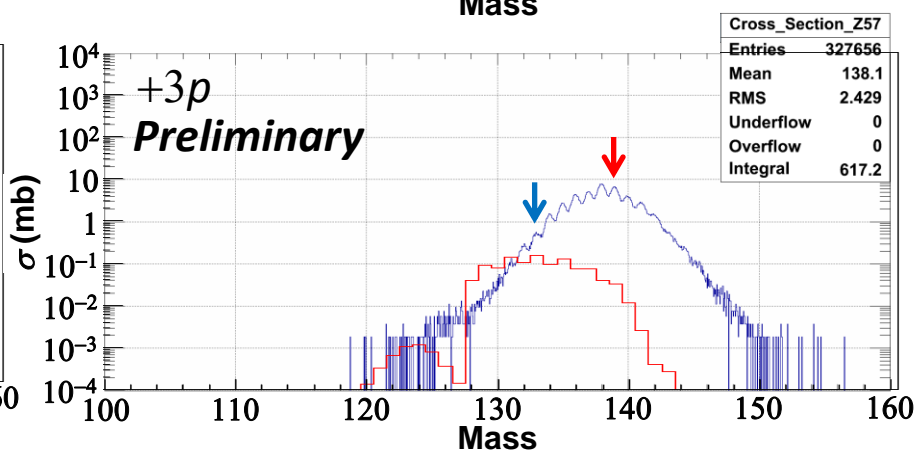
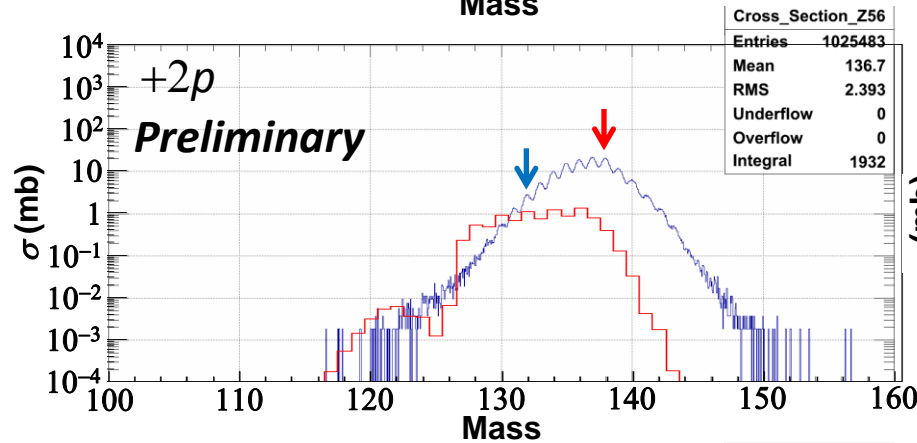
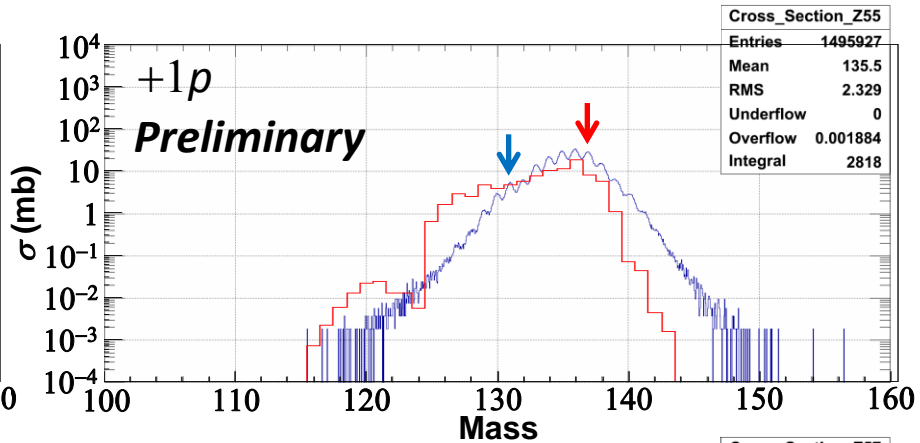
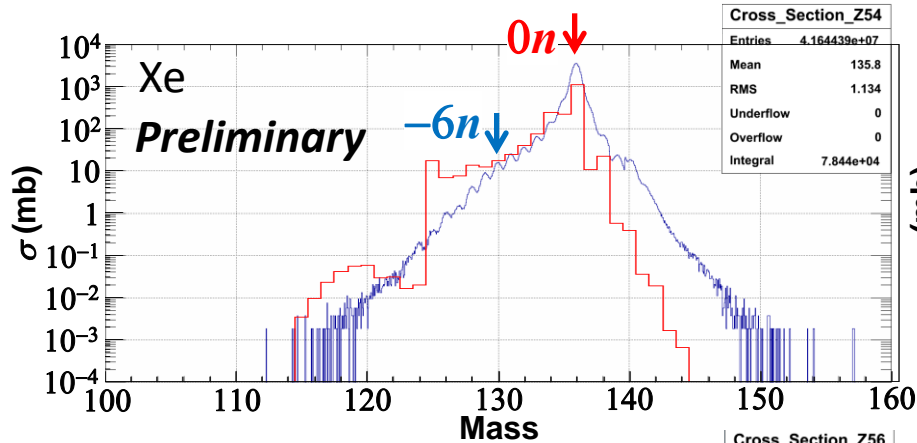
# Isotopic distributions ( $p$ -stripping)



- Accepted cross sections by VAMOS  $\times 15$   
(Efficiency = 5~9%)
- Production cross sections by GRAZING



# Isotopic distributions ( $p$ -pickup)



- Accepted cross sections by VAMOS  $\times 15$  (Efficiency = 5~9%)
- Production cross sections by GRAZING

- Enhanced  $p$ -pickup channels
- More neutrons would be picked up

# Summary

- **KEK Isotope Separation System (KISS) at RIKEN**  
Investigation of astrophysical environment of r-process  
Lifetime measurements for nuclei around  $N=126$
- **Nuclear production by MNT reactions of  $^{136}\text{Xe}+^{198}\text{Pt}$**   
Cross section measurements by VAMOS++ at GANIL
- **$p$ -stripping channels for  $^{136}\text{Xe}+^{198}\text{Pt}$**   
Comparative to GRAZING calculations  
Cross sections  
Isotopic distributions
- **$p$ -pickup channels for  $^{136}\text{Xe}+^{198}\text{Pt}$**   
Cross sections greater than GRAZING calculations  
 $n$ -pickup channels would accompany