Giant Monopole Resonance Studies with HRS

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Supported in part by the National Science Foundation

HRS Workshop, July 11, 2014

We know K_A from E_{GMR}:

$$E_{GMR} = \hbar\sqrt{\frac{K_A}{m\langle r^2\rangle}}$$

In an approximate way, K_A may be expressed as:

$$K_A \sim K_\infty (1 + cA^{-1/3}) + K_\tau ((N - Z)/A)^2 + K_{Coul} Z^2 A^{-4/3}$$

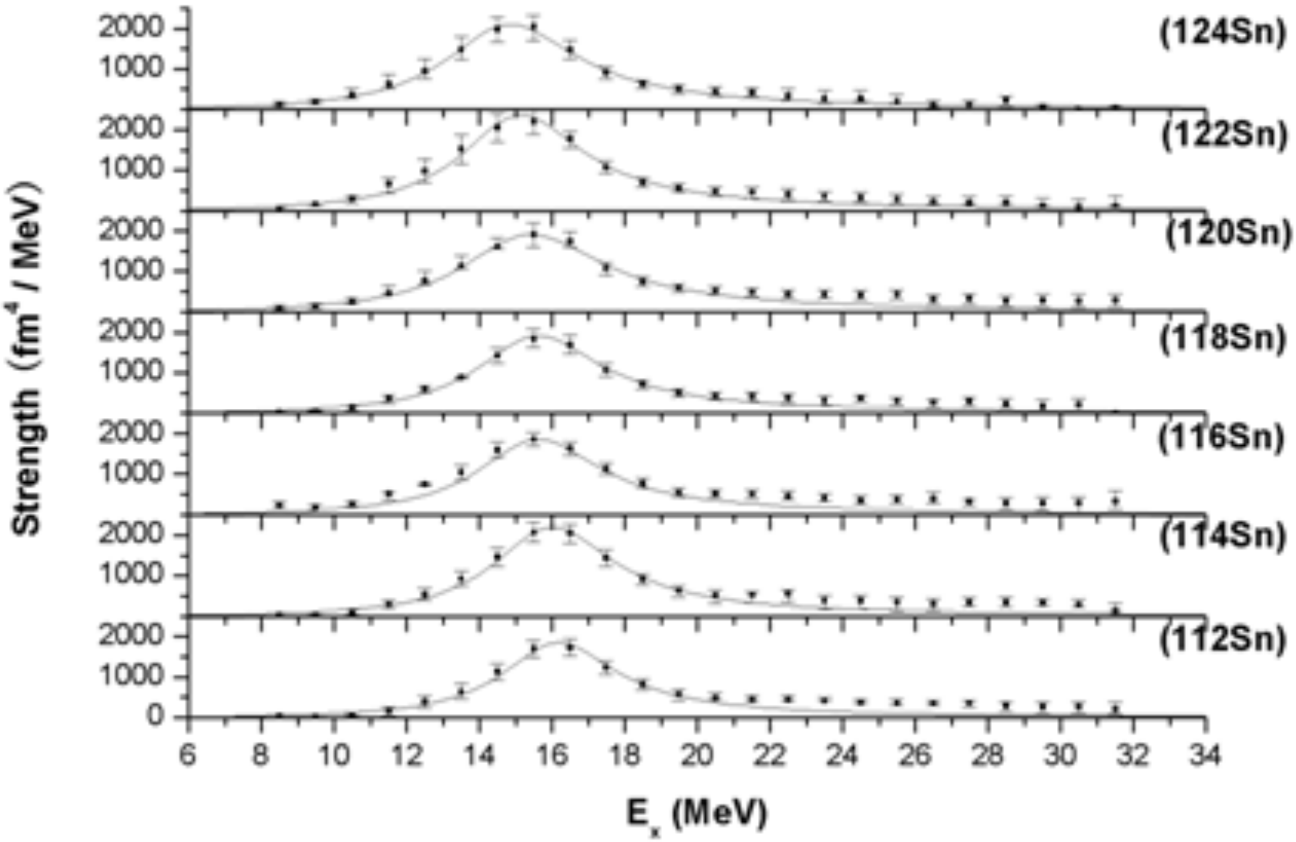
$c \sim -1$

K_{Coul} is, basically, model independent

K_τ ??

Measurements over a series of isotopes gives K_τ

K_τ is critical in our understanding the properties of neutron stars

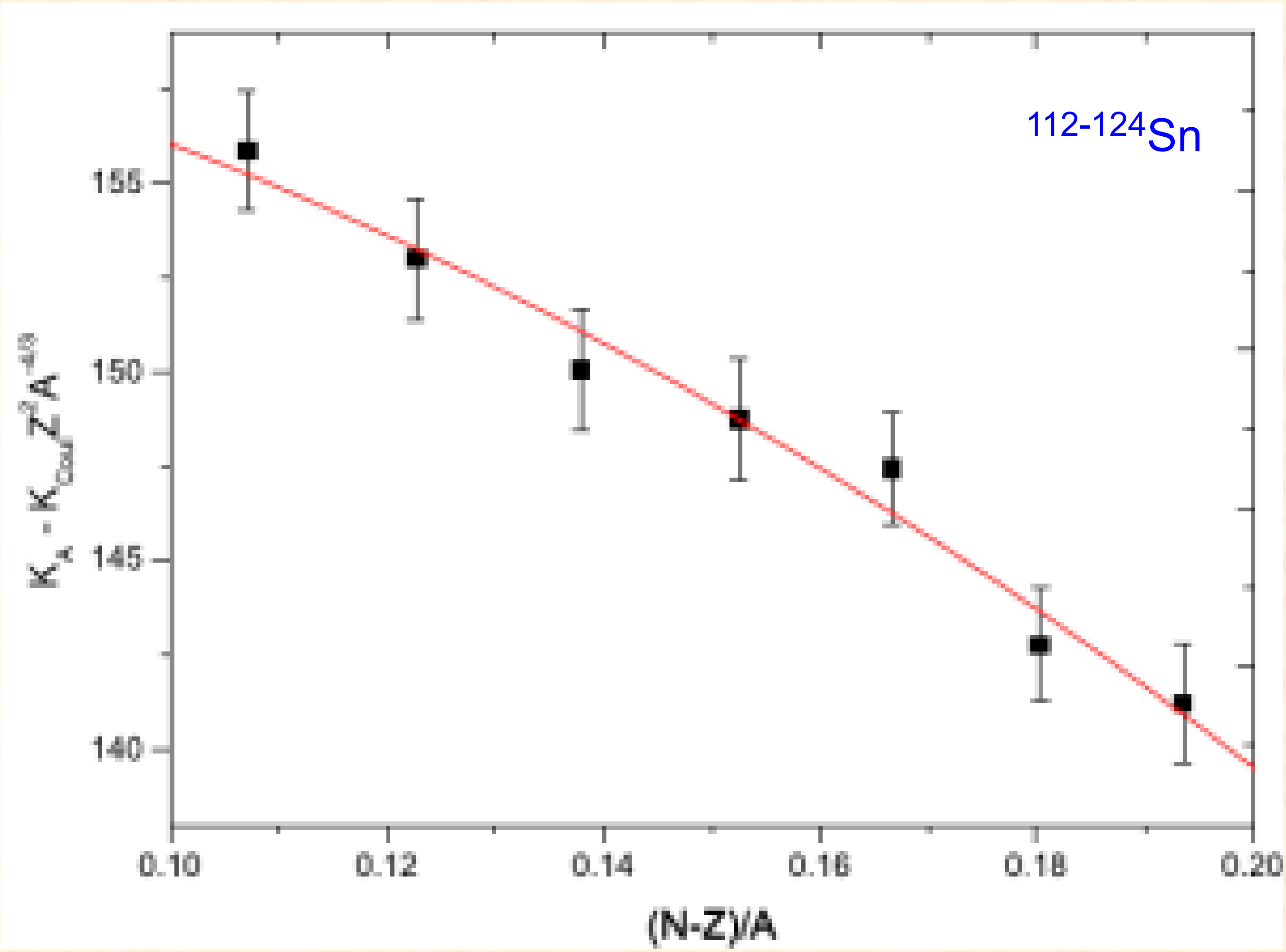

(124Sn)
(122Sn)
(120Sn)
(118Sn)
(116Sn)
(114Sn)
(112Sn)
2000
1000
0
6 8 10 12 14 16 18 20 22 24 26 28 30 32 34
Strength (fm4 / MeV)
Ex (MeV)

$$K_A \sim K_{vol}\,(1 + cA^{-1/3}) + K_\tau\,((N - Z)/A)^2 + K_{Coul}\,Z^2A^{-4/3}$$

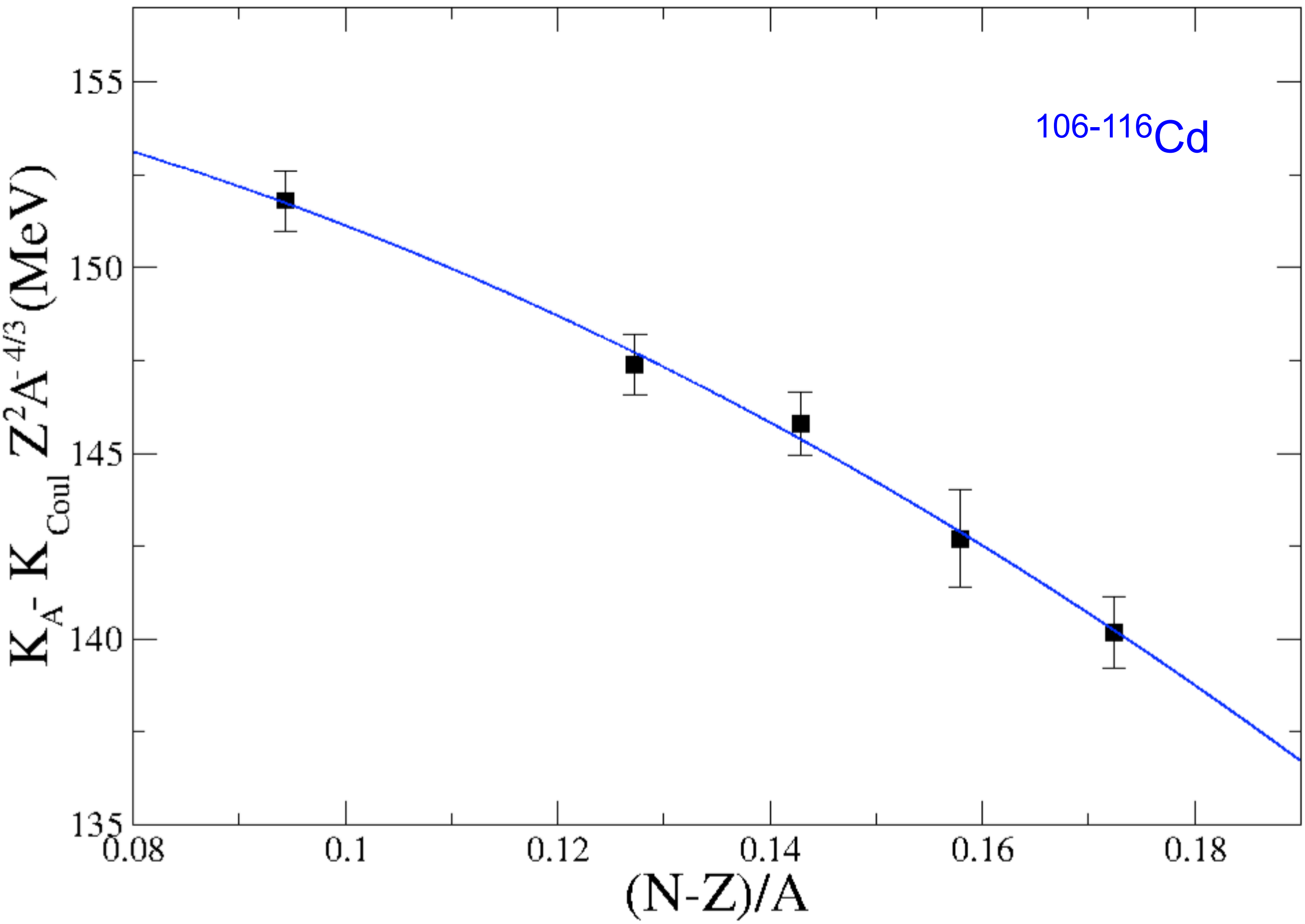
$$K_A - K_{Coul}\,Z^2A^{-4/3} \sim K_{vol}\,(1 + cA^{-1/3}) + K_\tau\,((N - Z)/A)^2$$

$$\sim \text{Constant} + K_\tau\,((N - Z)/A)^2$$

We use K_{Coul} = - 5.2 MeV (from Sagawa)



$$K_\tau = -550 \pm 100 \text{ MeV}$$



$K_\tau = -555 \pm 75$ MeV

Towards very neutron-rich nuclei

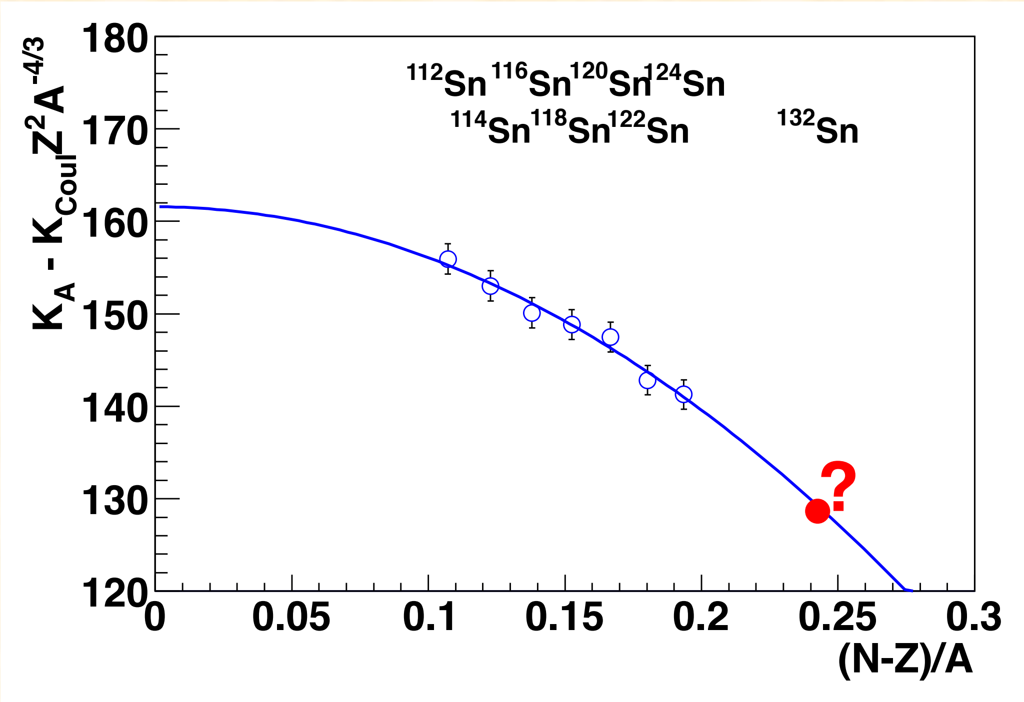
- K_{τ}
- K_{core} and K_{skin}

  "soft GMR" akin to pigmy GDR's.

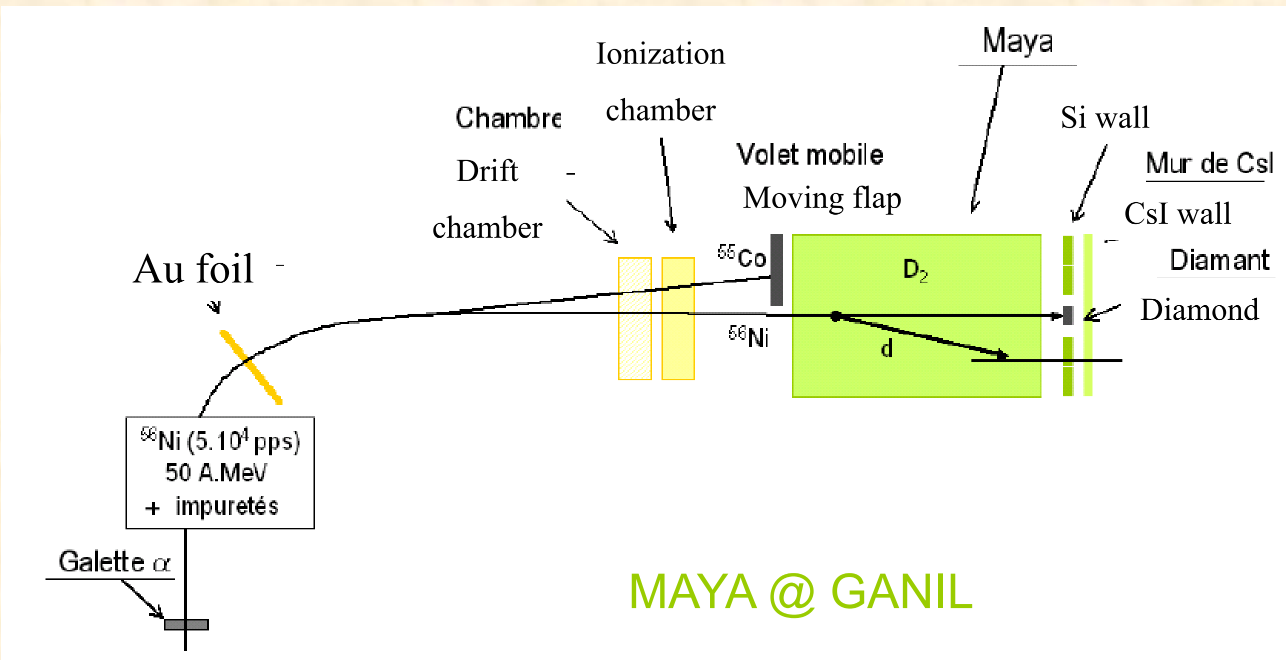
- Need inverse reactions
  ^{2}H, ^{4}He, or ^{6}Li targets
  beams of 35-100 MeV/A
- First experiments performed at GANIL

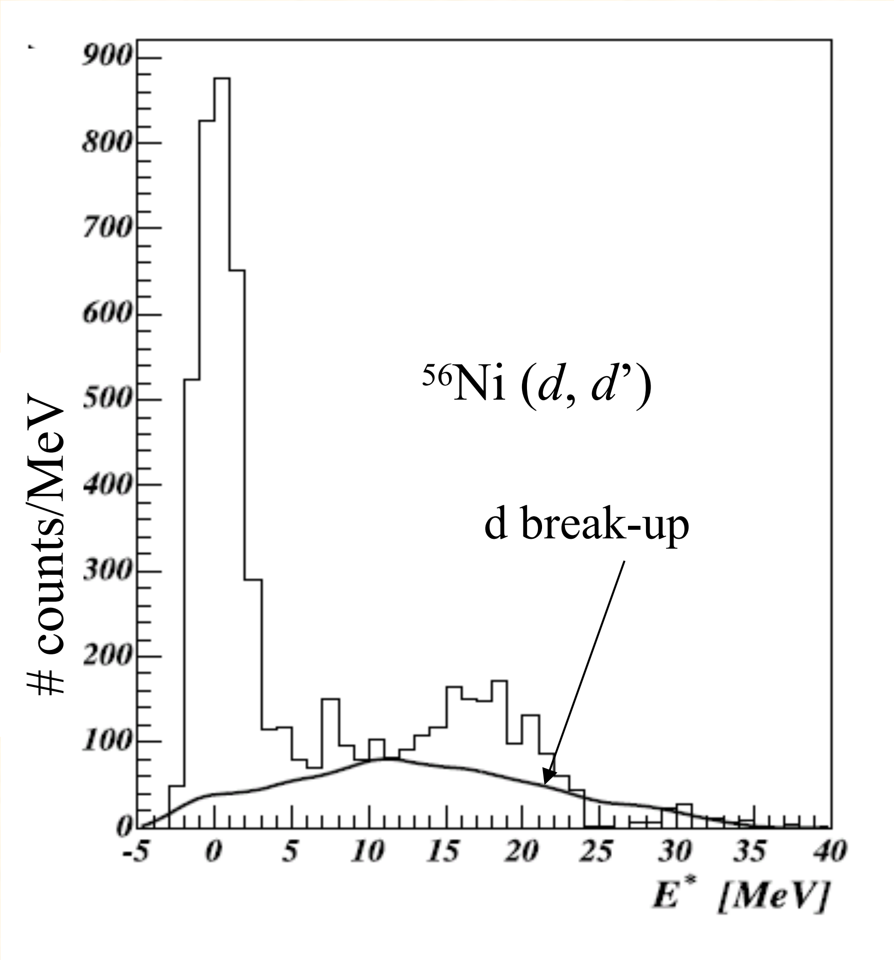
  $^{56}Ni + ^{2}H$, $^{68}Ni + ^{4}He$

  with active target MAYA



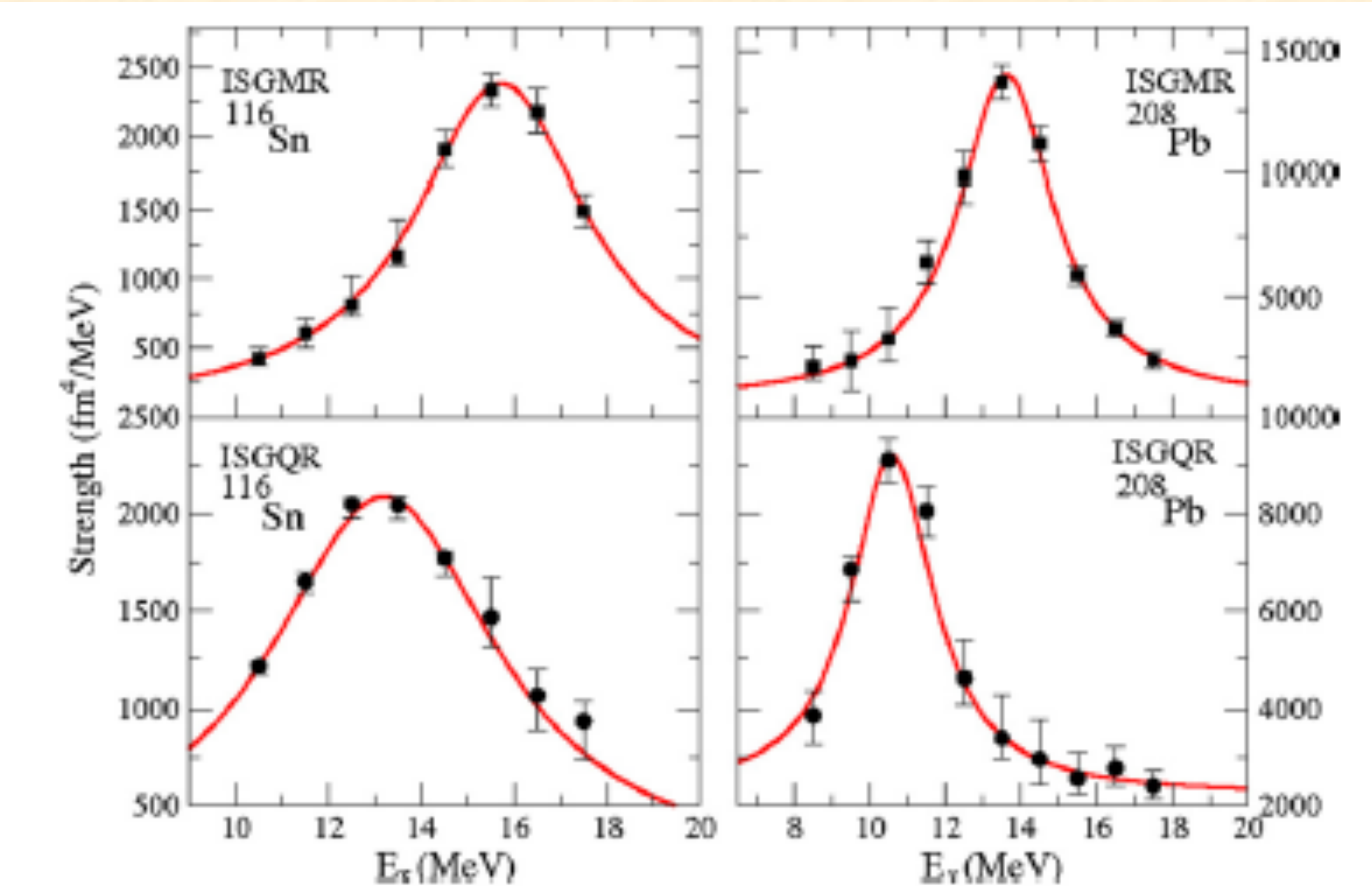
⇒ error of K_τ can be reduced to 50 MeV from 75+ MeV.


Ionization
chamber
Maya
Chambre
Drift
chamber
Si wall
Volet mobile
Moving flap
Mur de CsI
CsI wall
Au foil
^{55}Co
D_2
Diamant
Diamond
^{56}Ni
d
^{56}Ni (5.10^4 pps)
50 A.MeV
+ impuretés
Galette α
MAYA @ GANIL



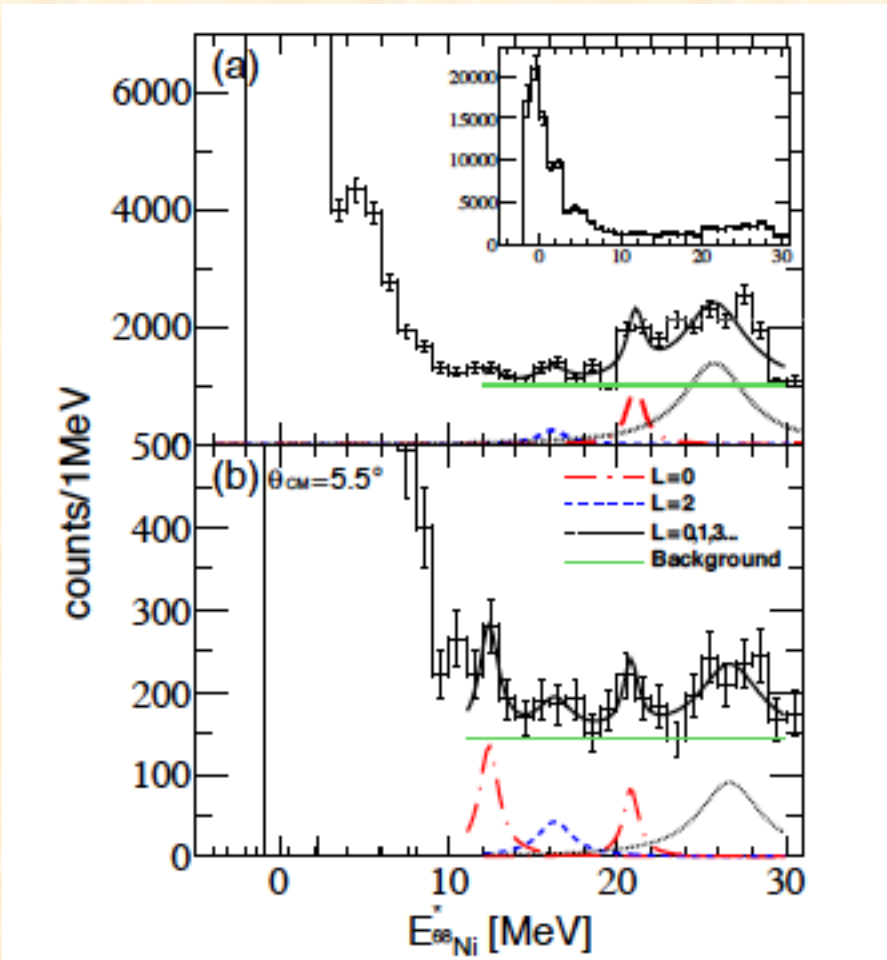
MAYA @ GANIL

C. Monrozeau *et al.*, Phys. Rev. Lett. **100**, 042501 (2008)



(d, d') @ 100 MeV/A

D. Patel *et al.*, PhysLett. B **735**, 387 (2014)



^{68}Ni (α, α') @ 50 MeV/A

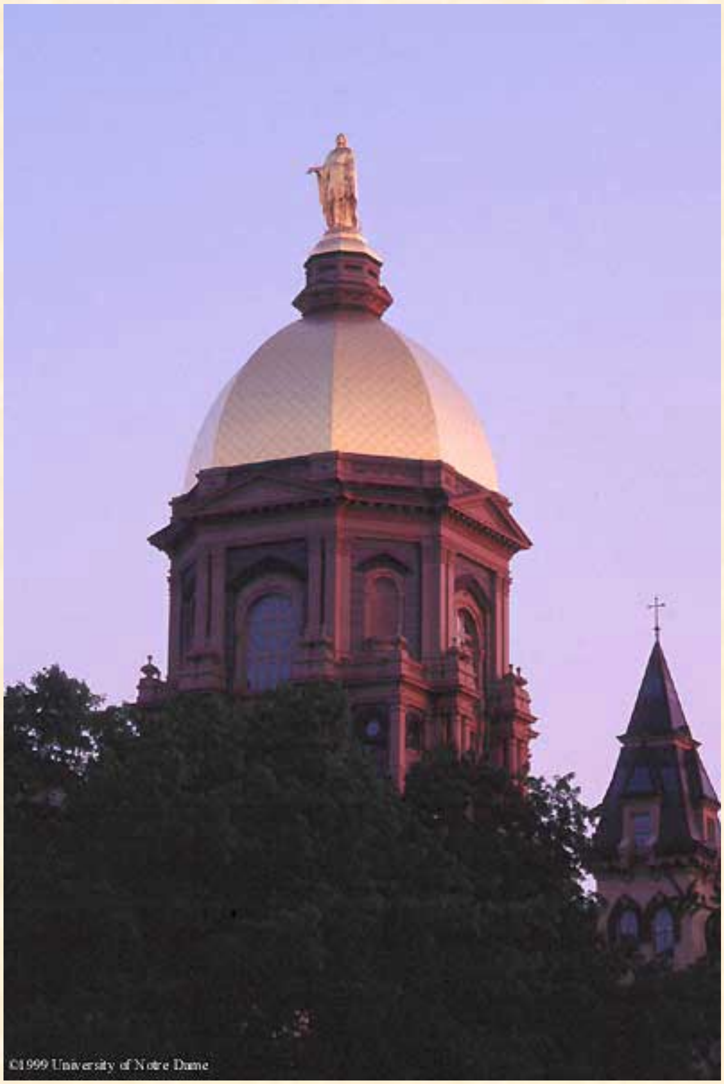
M. Vandebrouck *et al*., Phys. Rev. Lett. **(to appear)**

So, how can HRS help?

- ✓ For light nuclei (up to Z~28), one can use HRS in coincidence with charged-particle and neutron decays in forward detectors.
- ✓ Provide cleaner spectra by gating on beam-like particles.

धन्यवाद

Thanks!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