Coulomb excitation of ^{200}Po studied at REX-ISOLDE with the Miniball γ spectrometer

Nele Kesteloot

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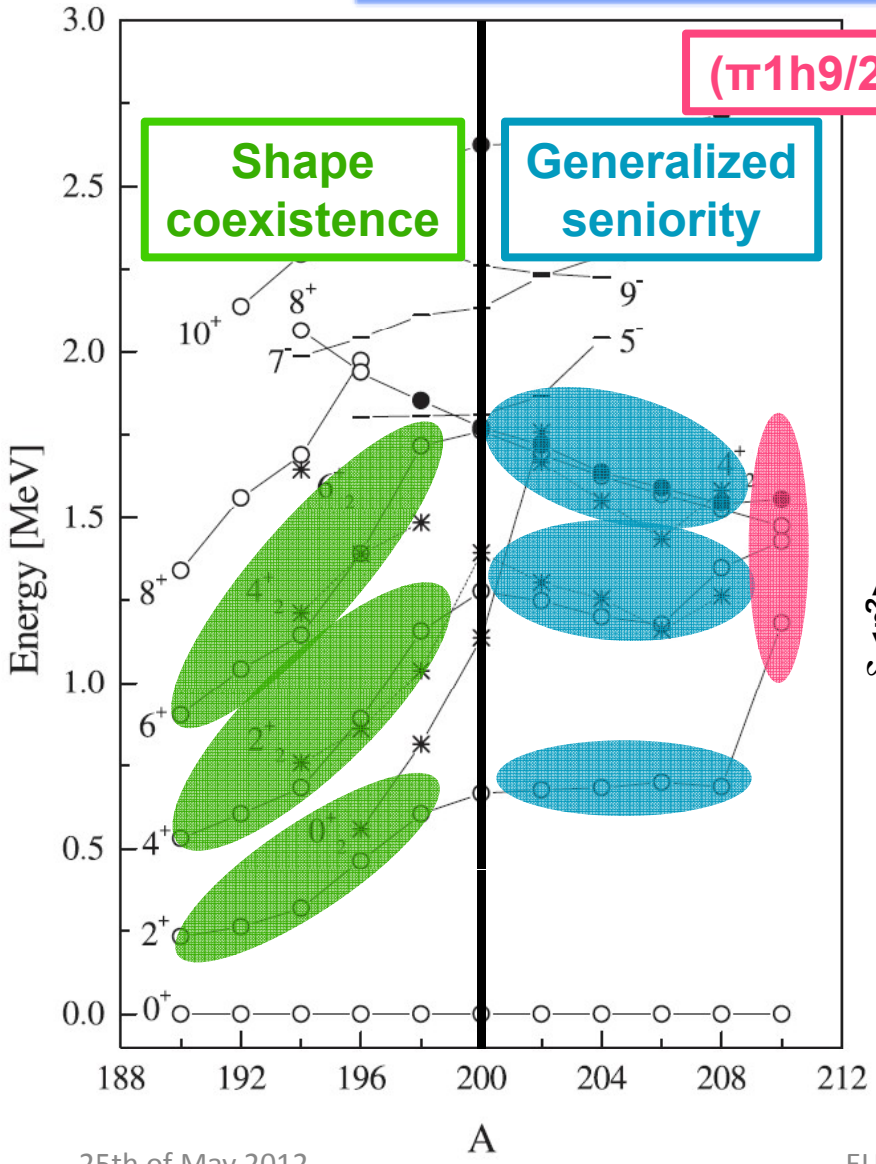
Outline

- The polonium isotopes
- Miniball at REX-ISOLDE
- Kinematics
- Gamma spectra
- Gosia analysis
- Future perspectives

The polonium isotopes

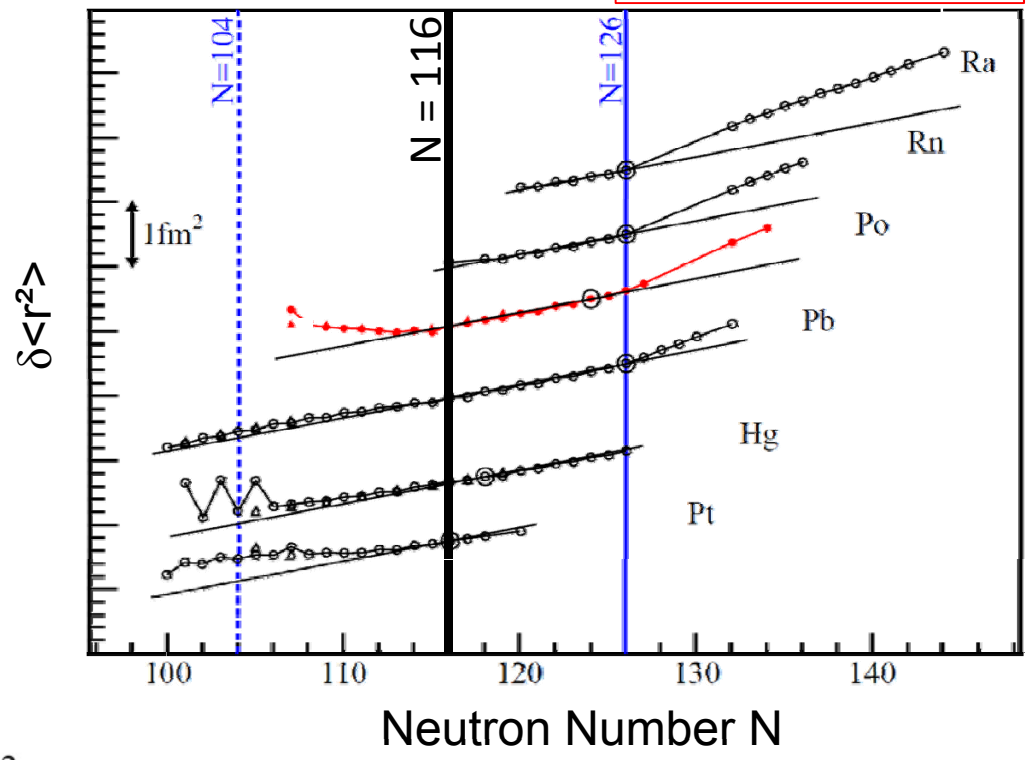


A.M. Oros et al NPA 645:107 (1999)
R. Julin et al JPG 27:R109 (2001)

Change in nuclear structure

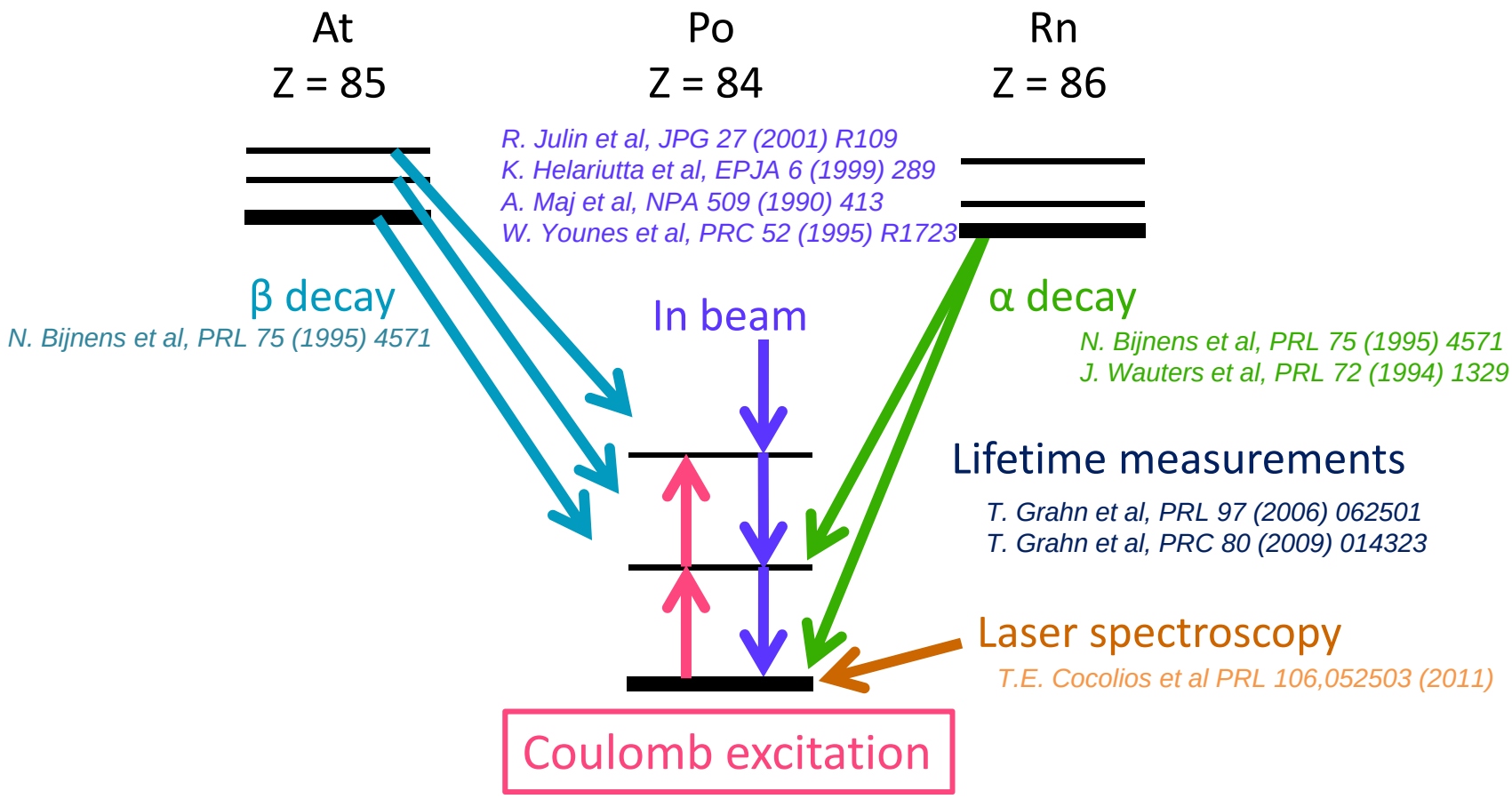
T.E. Cocolios et al. PRL 106:052503 (2011)
M.D. Seliverstov et al., in preparation

Poster 2 T.E. Cocolios

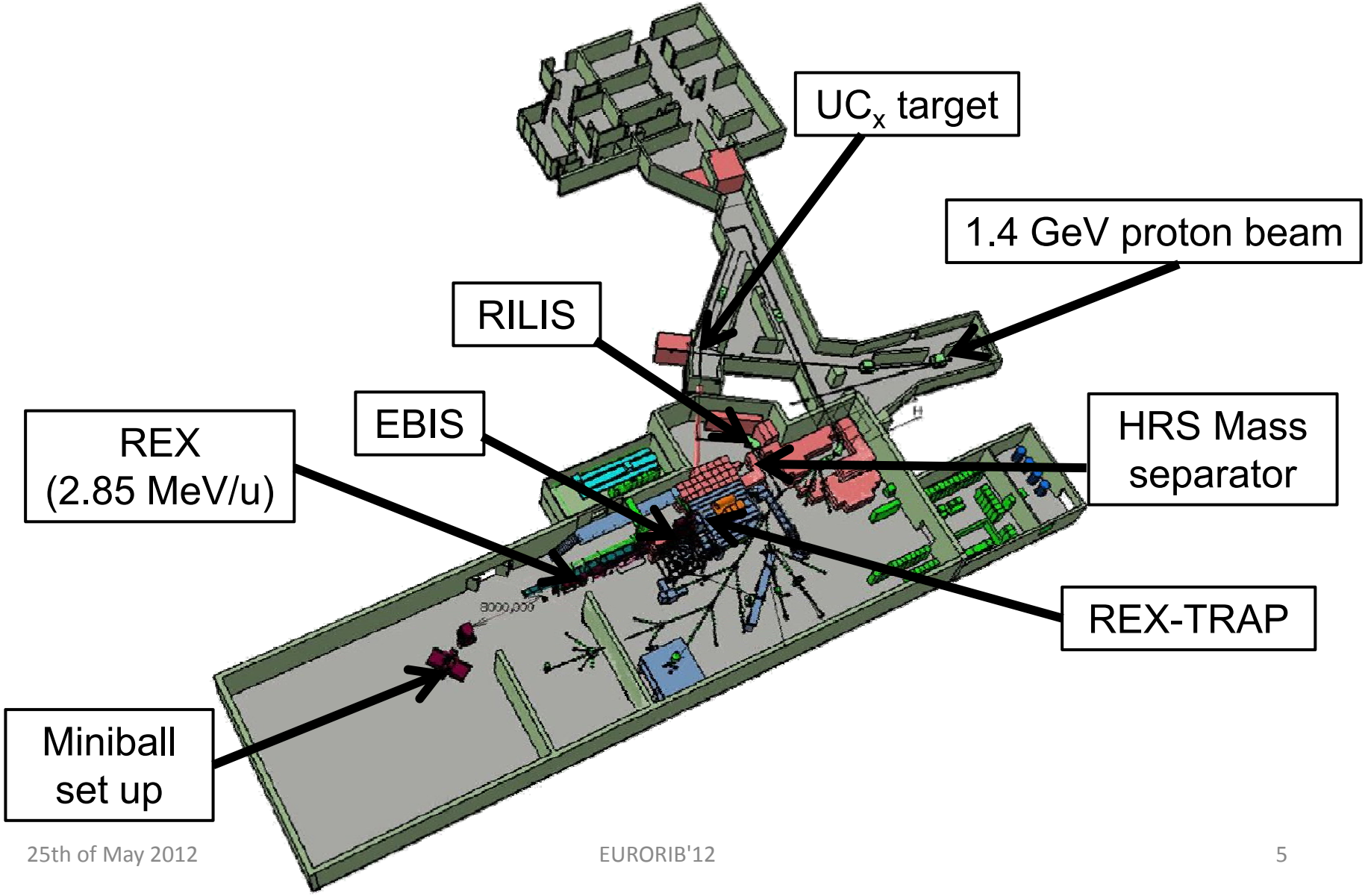


Transition expected around ^{200}Po

Why Coulomb excitation?

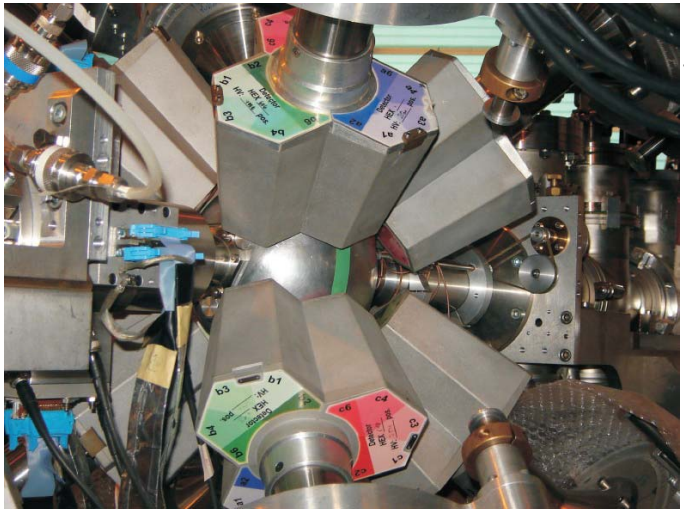


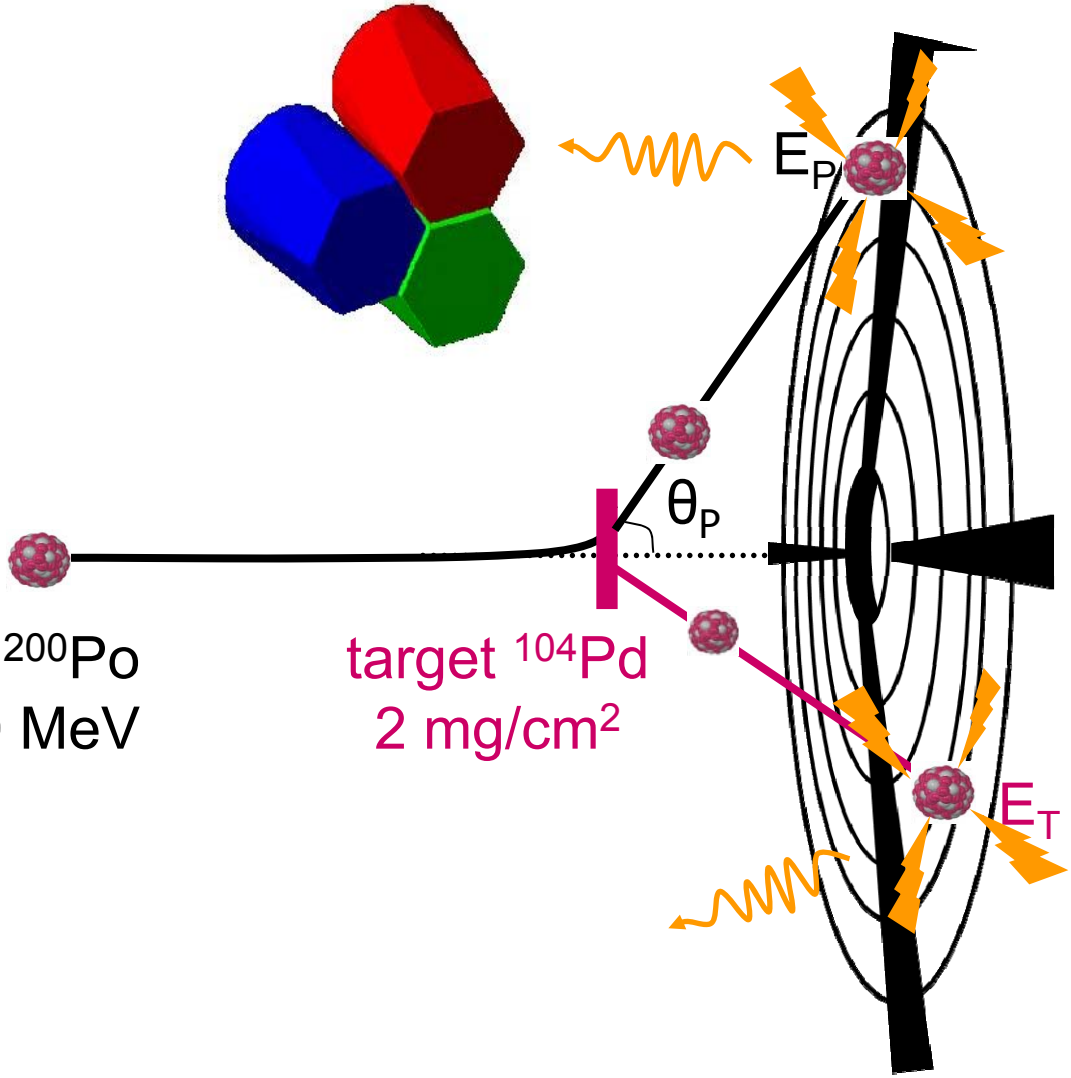
REX-ISOLDE at CERN



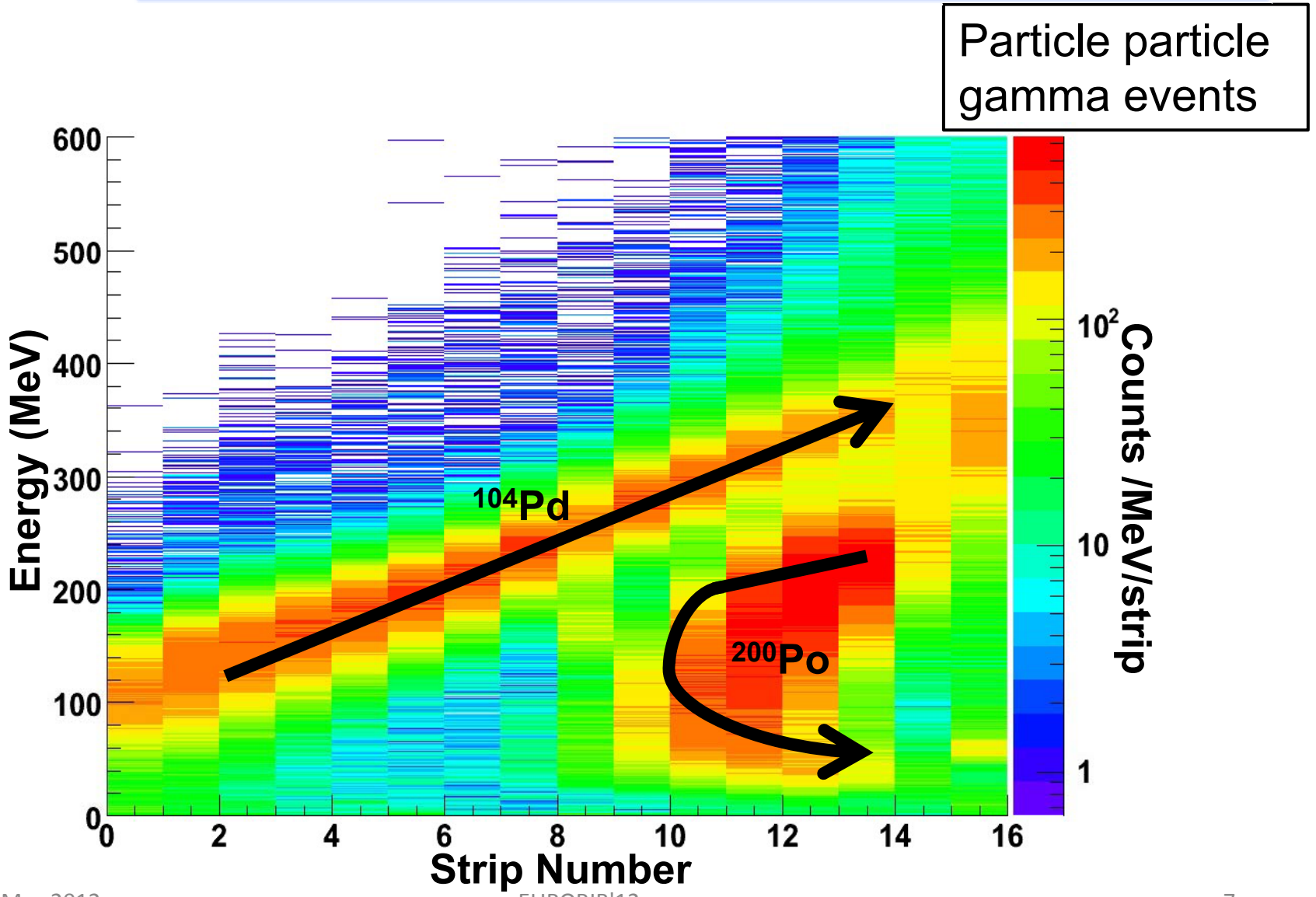
Miniball at REX-ISOLDE

- IS479 (September 2009)
  - Beam purity of 98.8(9)%
  - ~ 10^6 pps at Miniball



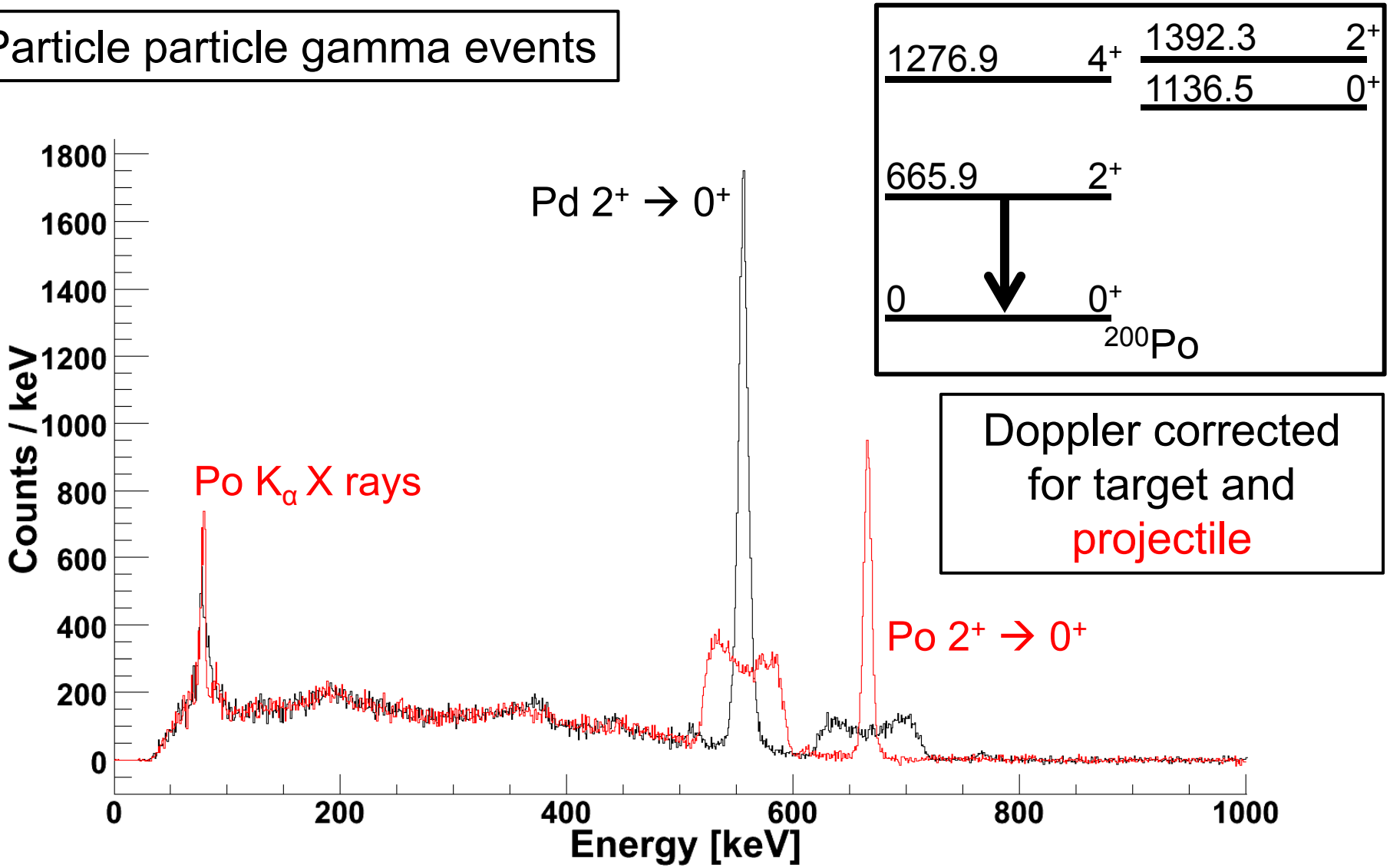


Kinematics


Particle particle gamma events
Energy (MeV)
Strip Number
Counts /MeV/strip
^{104}Pd
^{200}Po
0
100
200
300
400
500
600
0
2
4
6
8
10
12
14
16
1
10
10^2

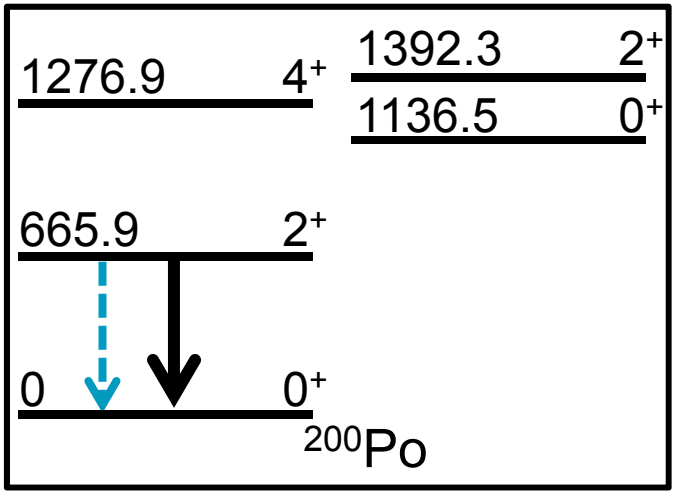
Gamma spectra

Particle particle gamma events



Doppler corrected for target and projectile

X rays



X rays
$1.88(13).10^4$

Conversion of $2^+ \rightarrow 0^+$

$\alpha_K = 0.0125$
➔ 856(23)

Internal conversion of other gamma lines

Other gammas unobserved

Atomic production of K vacancy in ion-atom collision

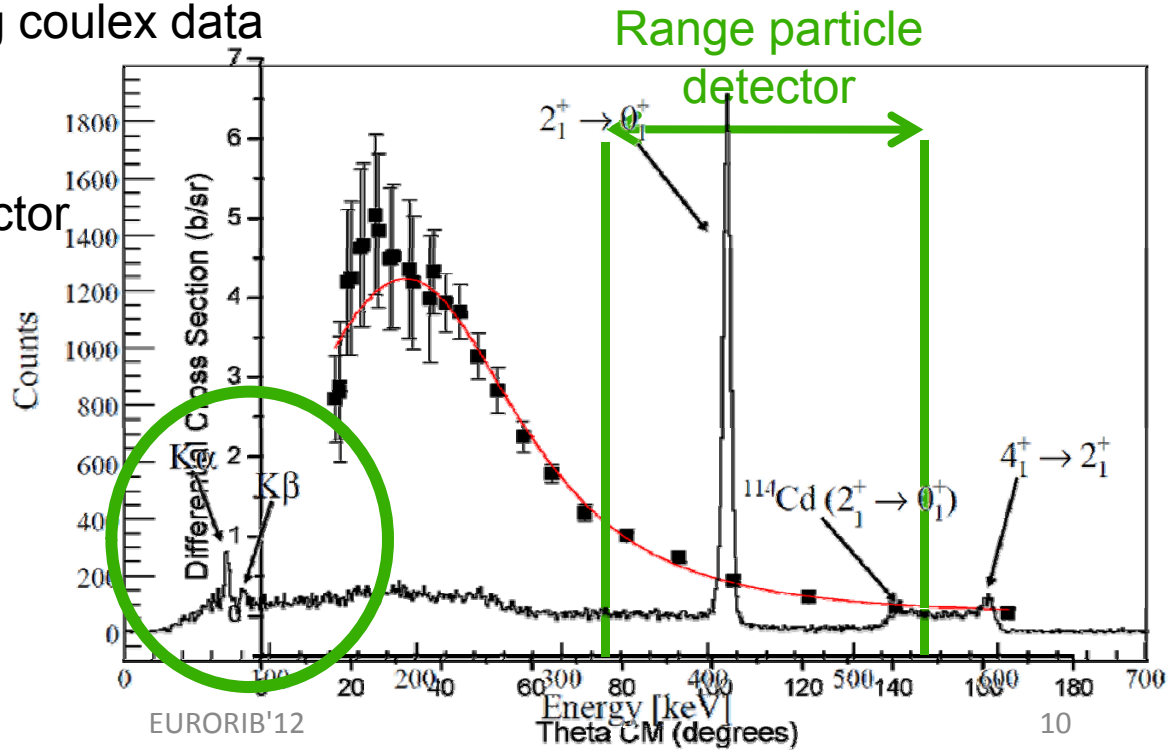
Atomic production of K-vacancy in ion-atom collision

- Theoretical formula

$$\sigma = Z_t^2 \frac{1}{\left(I_K^{0.95}\right)^2} \exp\left[\sum_{i=0}^{5} b_i \left(\ln\left(\frac{E_p}{\left(I_K^{0.95}\right)^2}\right)\right)\right]$$

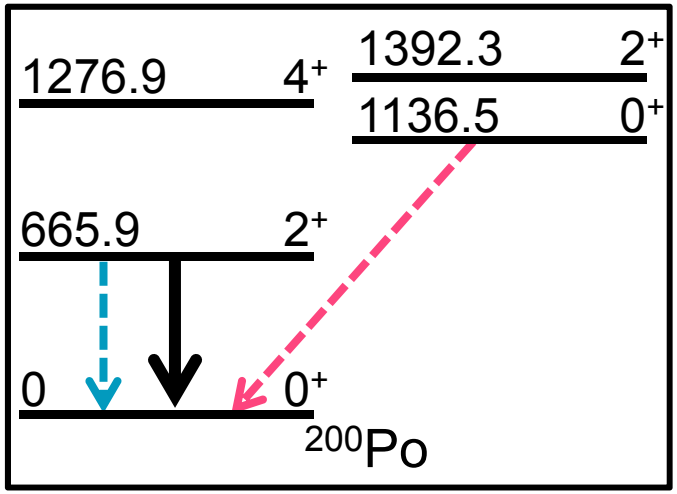
J.D. Garcia et al, RMP 45 No 2 (1973) 111

- Empirical correction
  - Based on experimental data in Po region
  - Comparison with ^{188}Hg coulex data
- Geometrical correction
  - Range of particle detector
- Estimate: 5.6(21).10^3



Method: N.Bree 2010

X rays



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Internal conversion of other gamma lines

Other gammas unobserved

Atomic production of K vacancy in ion-atom collision

Theoretical formula + corrections

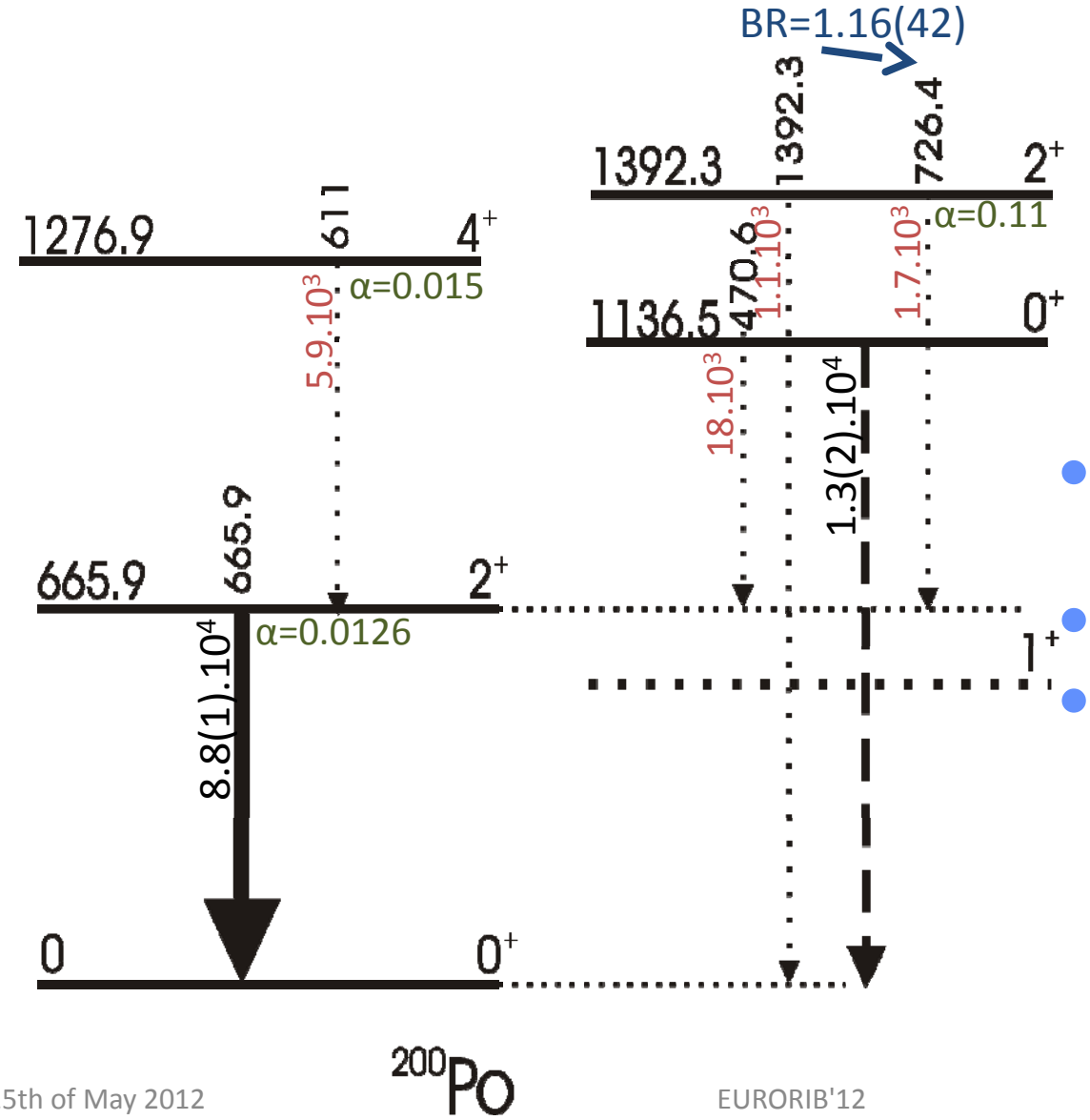
➔ $5.6(21).10^3$

Method: N.Bree 2010

E0 transition $0^+_2 \rightarrow 0^+_1$

➔ $1.3(2).10^4$

Gosia analysis



- E0
- Unobserved
- 6.10^3 Upper limit
- 0.11 Conversion coefficient

- Normalisation to target excitation
- Virtual 1^+ state
- Buffer states

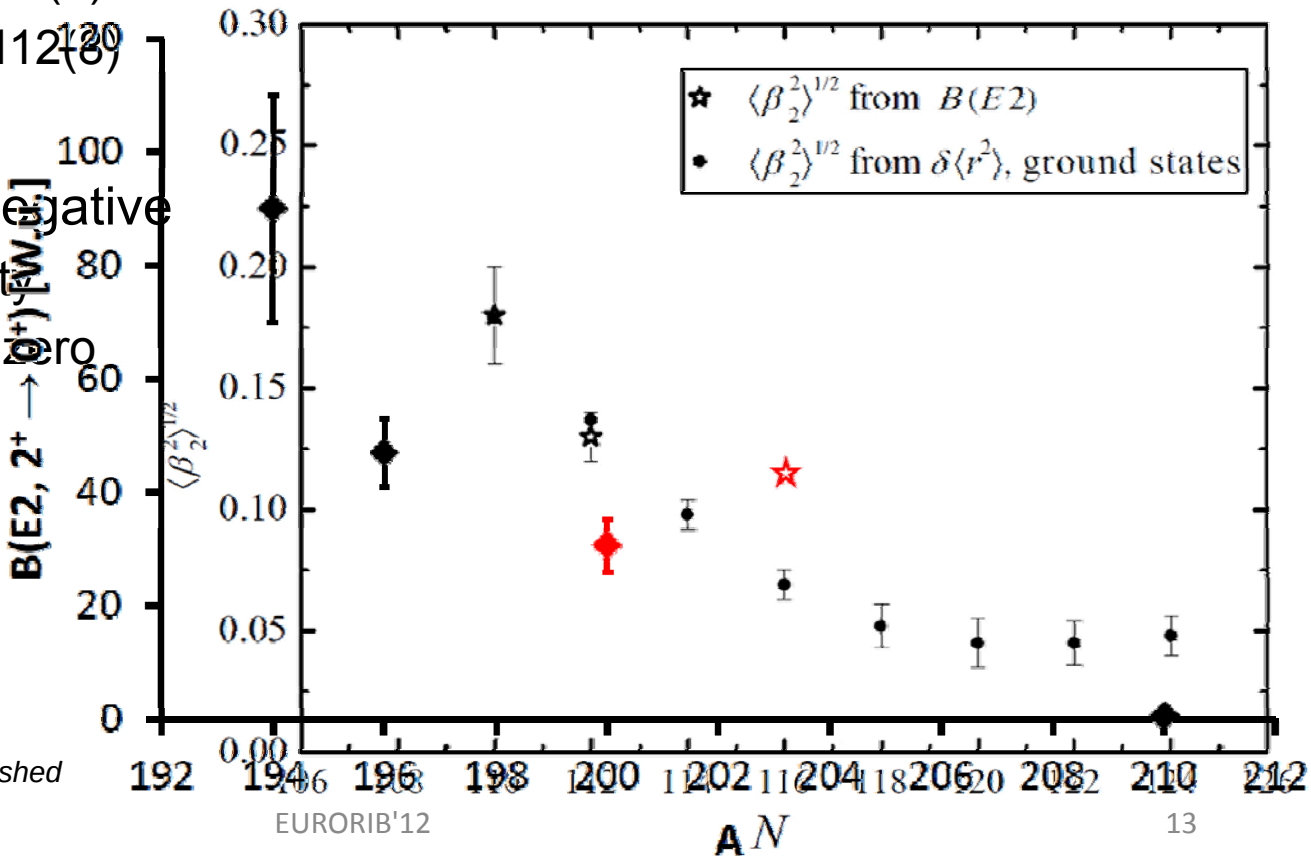
Gosia: T. Czosnkyka, D. Cline, C.Y. Wu
Bull. Amer. Phys. Soc. 28, 745 (1983)

Preliminary results of the Gosia analysis

- Gosia 1 & 2 analysis in progress

- $<0^+_1||E2||2^+_1>$ is stable
  - B(E2;$0^+ \rightarrow 2^+$) = 35(5) W.u.
  - $< \beta_2^2 >^{1/2}$ = 0.112(8)

- $<2^+_1||E2||2^+_1>$ is negative
  - Large uncertainty
  - Consistent with zero



M.D. Seliverstov et al, to be published

Future perspectives

- Beam time will be scheduled in fall 2012 (16.5 shifts) @ ISOLDE
  - Coulomb excitation of ^{196,198,202}Po
  - Higher mass Po isotope: atomic X rays
- Gosia analysis needs complete picture
  - Beta decay of ^{196,198}At
    - Conversion coeficients, branching ratios
  - Lifetimes of ^{198,200,202}Po

Thank you for your attention!

Questions?