Measurements of competing structures of neutron-deficient Pb isotopes by employing Coulomb excitation

Janne Pakarinen, Tuomas Grahn

CERN-ISOLDE, Geneva, Switzerland
&
Collaborators

ISOLDE-WORKSHOP
December 8-10, 2010

Outline

Chart of nuclides in the vicinity of light Pb nuclei

- Unique laboratory to study shape-coexistence phenomena
- Beam time granted for ^{188}Pb, ^{190}Pb and ^{192}Pb
- Isotope ^{192}Pb measured in August 2010

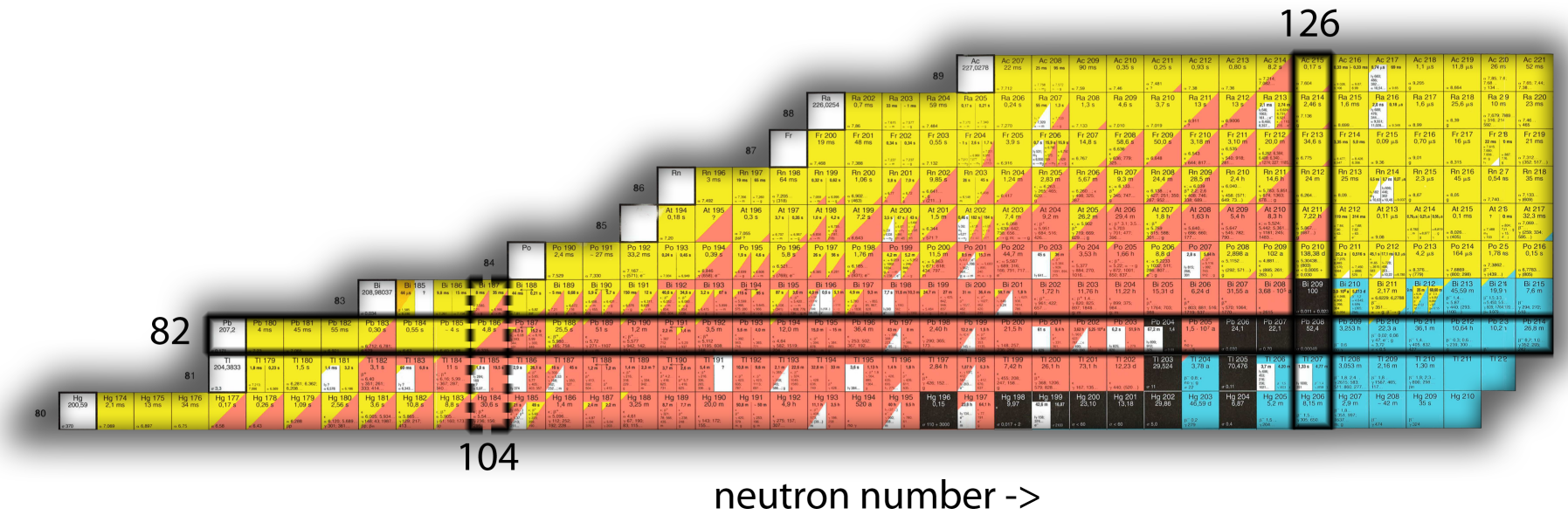


Chart of nuclides in the vicinity of light Pb nuclei

- Unique laboratory to study shape-coexistence phenomena
- Beam time granted for ^{188}Pb,^{190}Pb and ^{192}Pb
- Isotope ^{192}Pb measured in August 2010

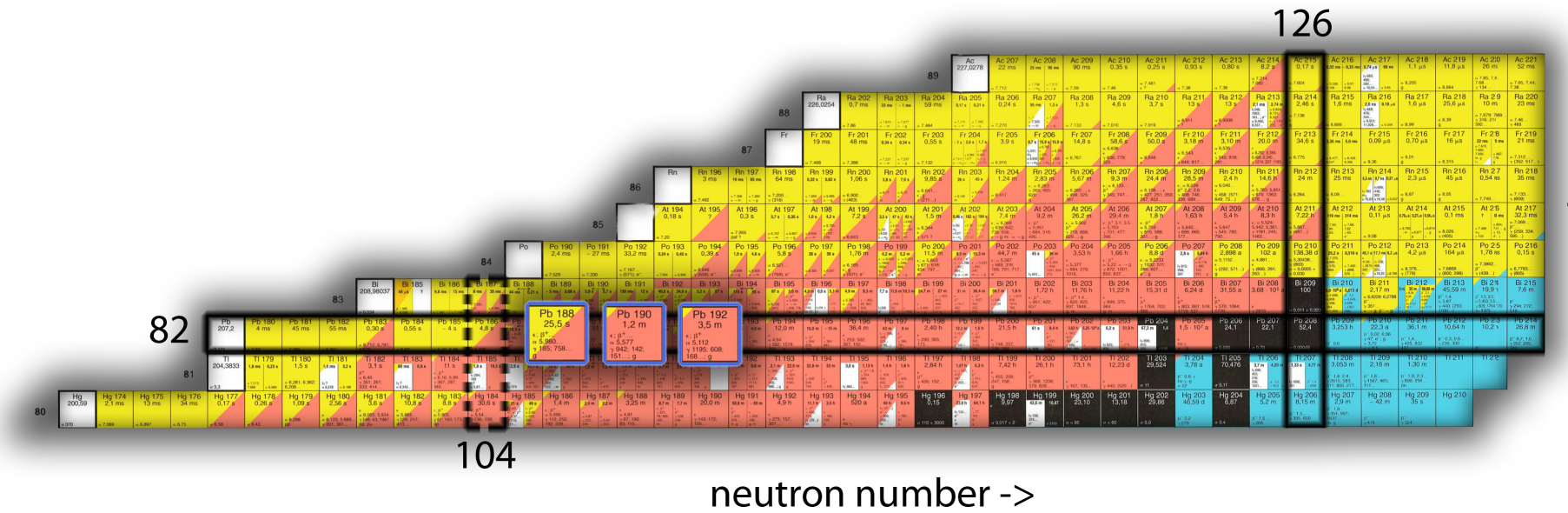
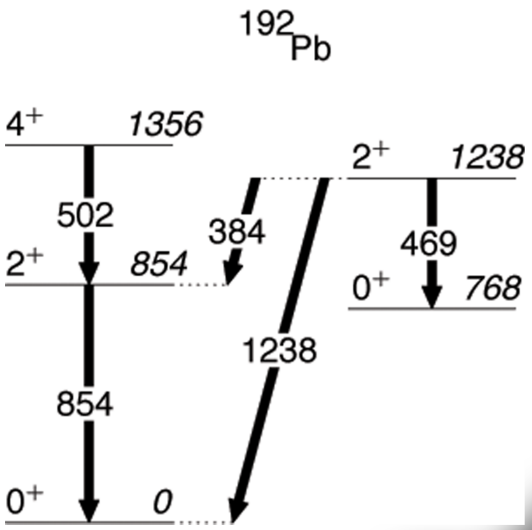
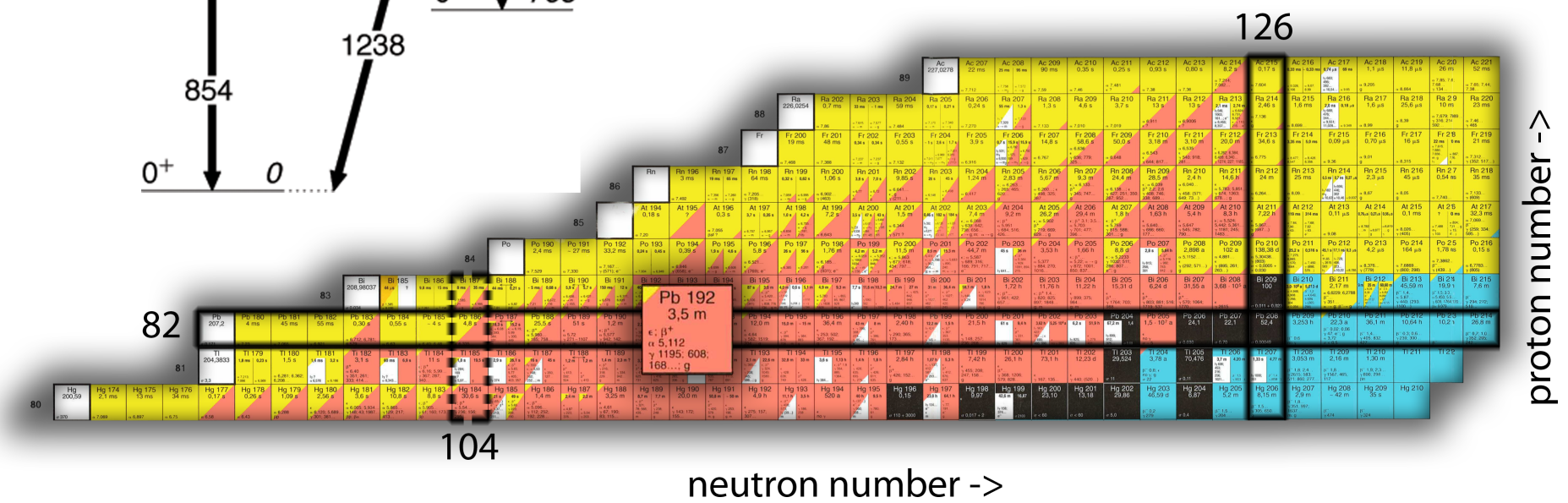


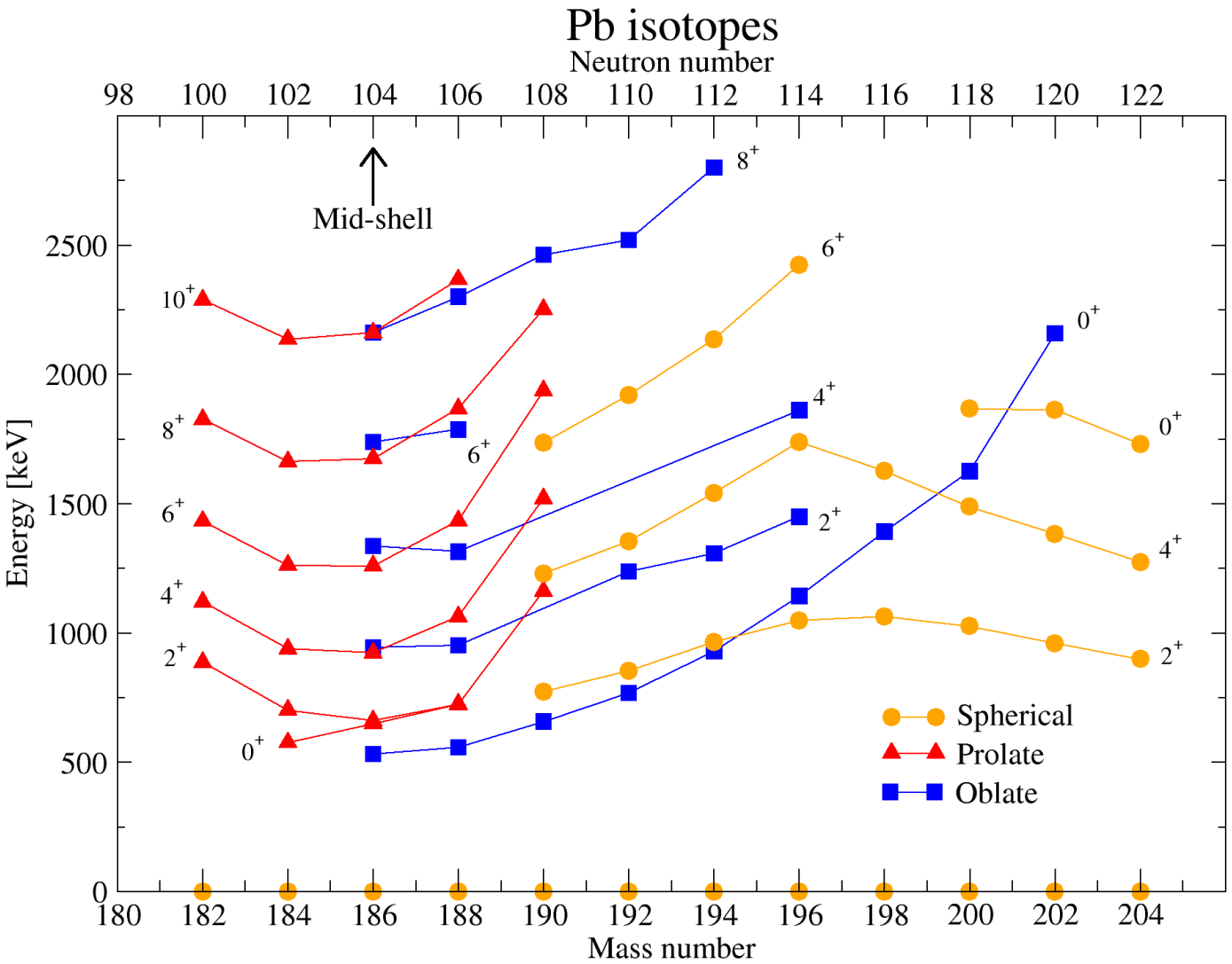
Chart of nuclides in the vicinity of light Pb nuclei

- Unique laboratory to study shape-coexistence phenomena
- Beam time granted for ^{188}Pb, ^{190}Pb and ^{192}Pb
- Isotope ^{192}Pb measured in August 2010

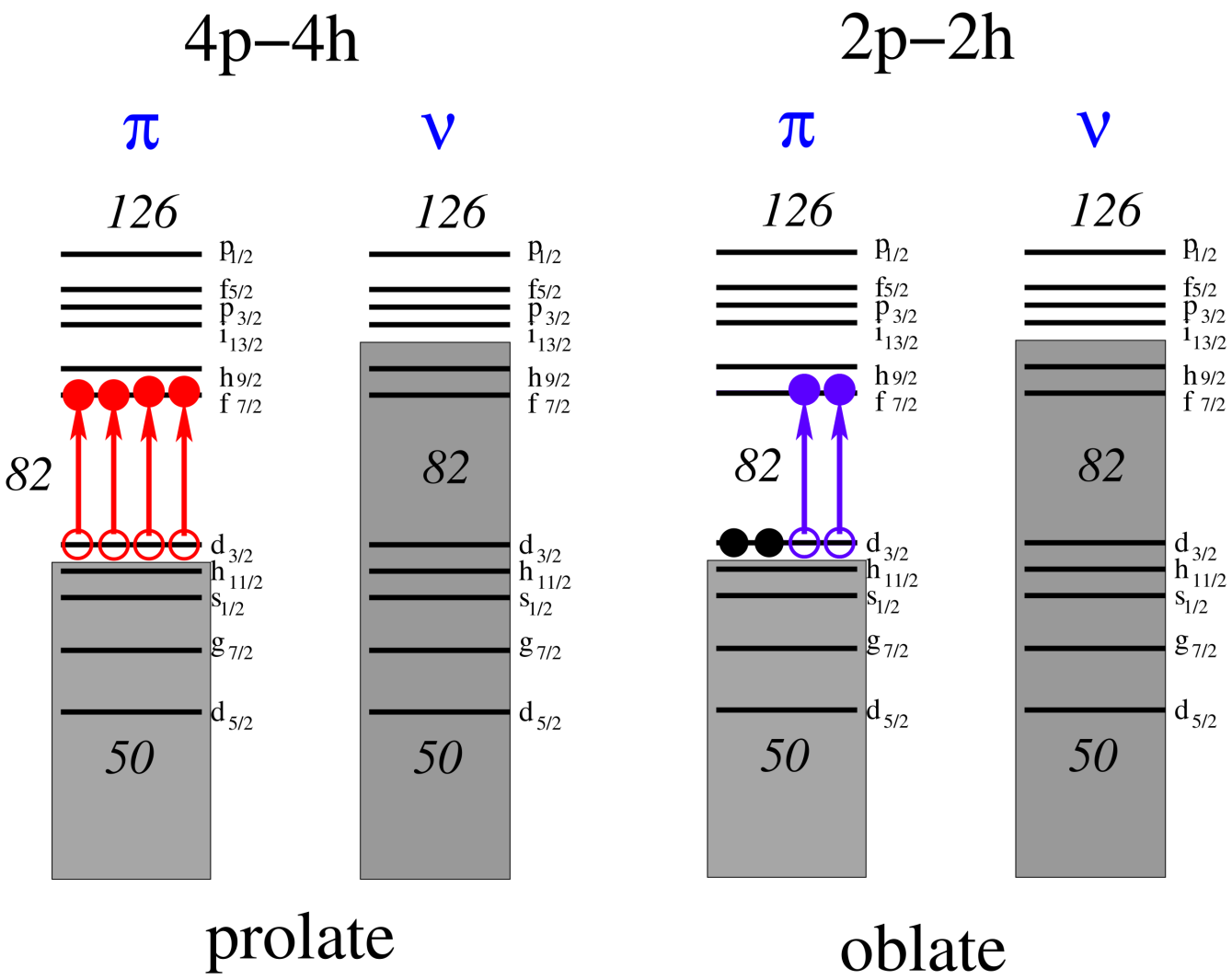




Level energy systematics for Pb isotopes

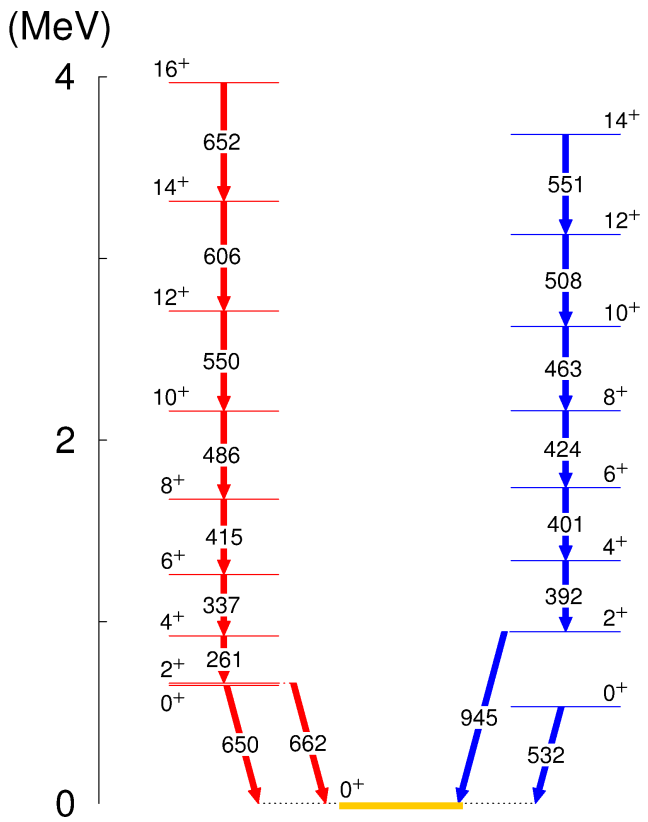


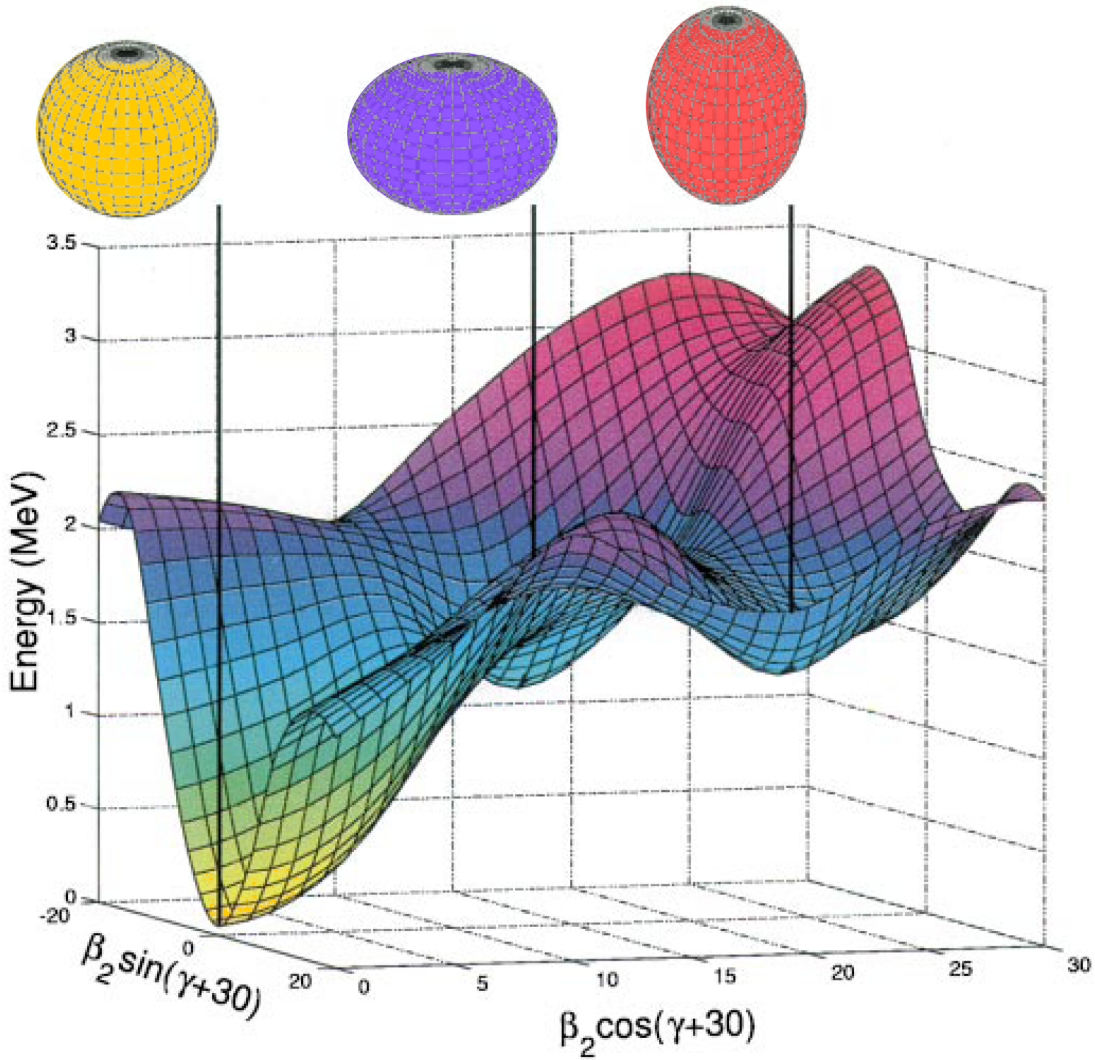
Shape coexistence in neutron-deficient Pb isotopes



Courtesy of P. Greenlees, see e.g. J.L. Wood *et al.*, Phys. Rep. **215**, 101 (1992).

Triple-shape coexistence in ^{186}Pb





A.N. Andreyev *et al.*, Nature **405**, 430 (2000).

J. Pakarinen *et al.*, Phys. Rev. C **75**, 014302 (2007).

Open questions related to neutron-deficient Pb isotopes

- Confirmation of three different shapes in the same nucleus
- Systematic behaviour of mixing between different shape coexisting structures
- Why is the collectivity of the prolate yrast bands in Pb nuclei higher than that of the identical prolate bands in Hg and Pt nuclei

Open questions related to neutron-deficient Pb isotopes

- Confirmation of three different shapes in the same nucleus
- Systematic behaviour of mixing between different shape coexisting structures
- Why is the collectivity of the prolate yrast bands in Pb nuclei higher than that of the identical prolate bands in Hg and Pt nuclei

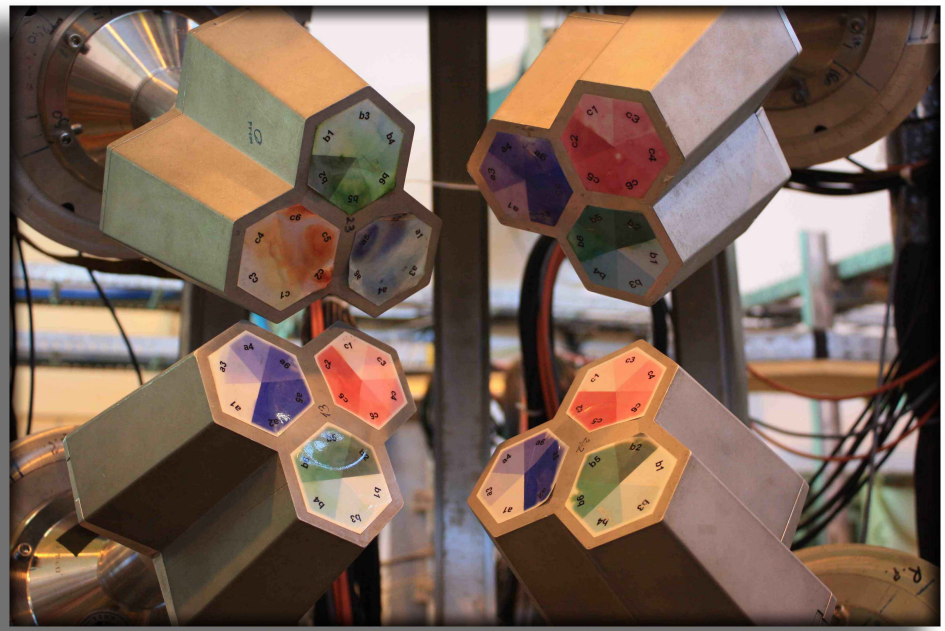
Open questions related to neutron-deficient Pb isotopes

- Confirmation of three different shapes in the same nucleus
- Systematic behaviour of mixing between different shape coexisting structures
- Why is the collectivity of the prolate yrast bands in Pb nuclei higher than that of the identical prolate bands in Hg and Pt nuclei

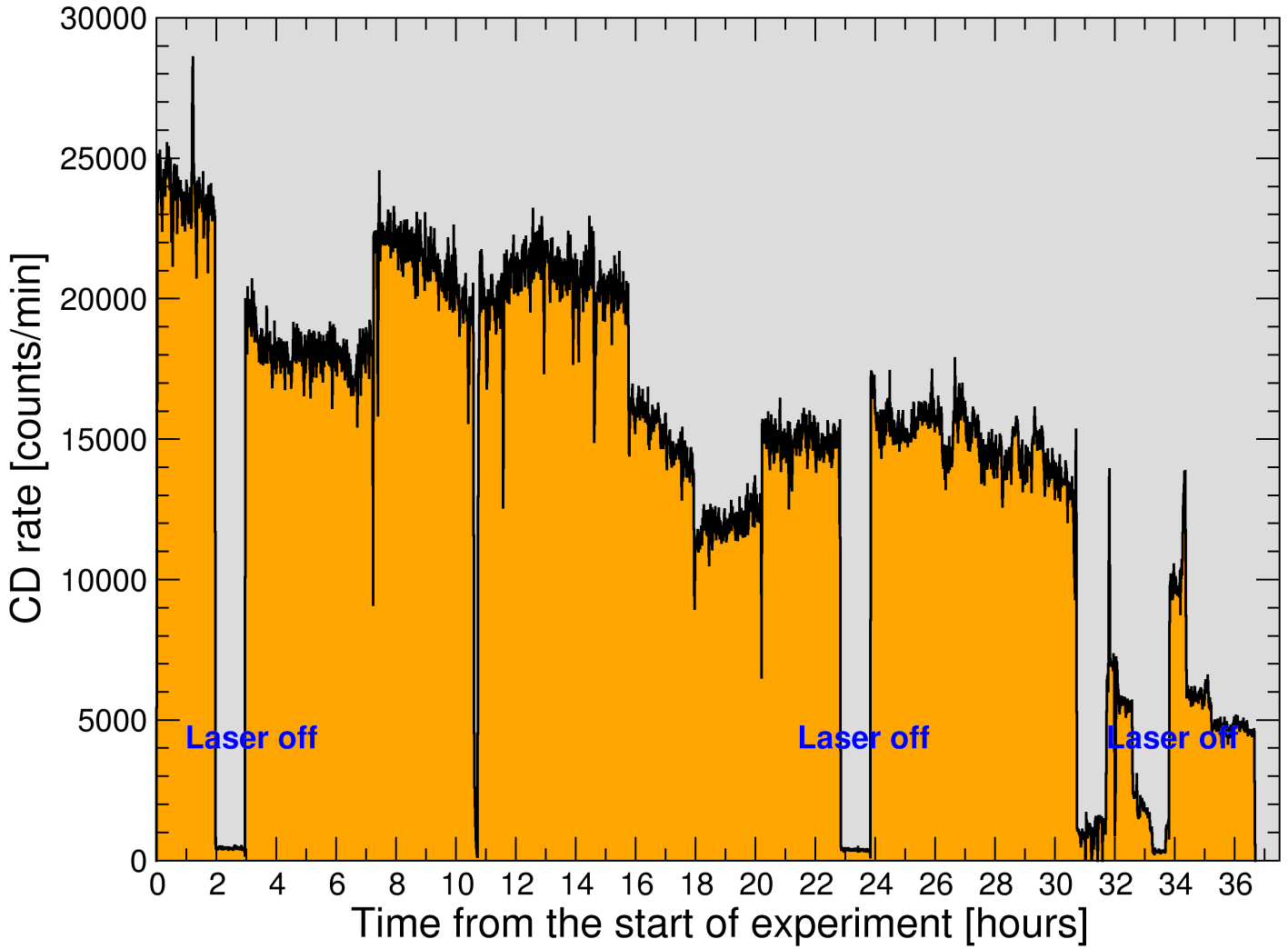
Outline

Experimental details

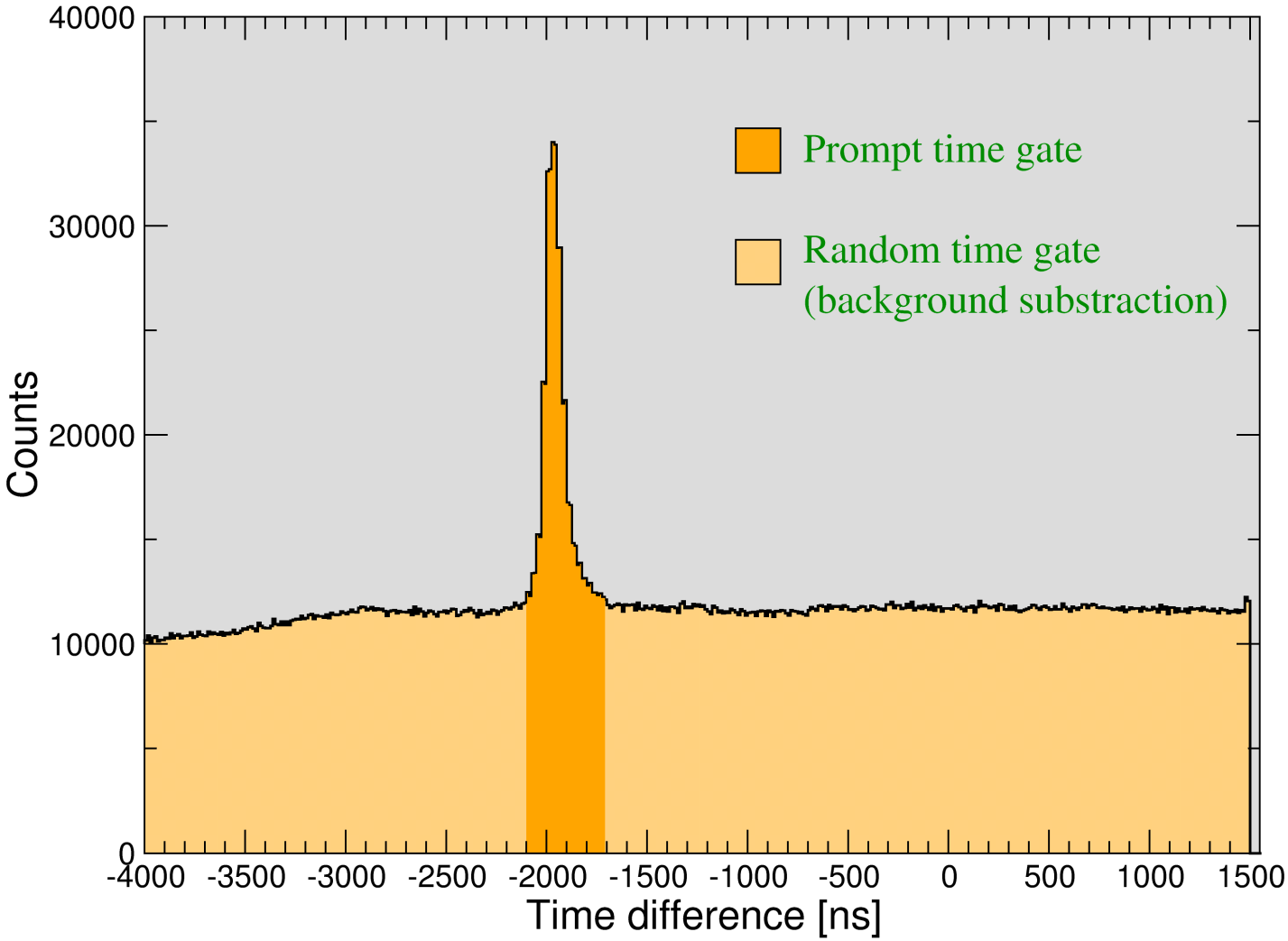
- ^{192}Pb beam on ^{112}Cd target
- Beam energy: 2.84 MeV/u
- Beam intensity: 5x10^5 pps
- Target thickness 2 mg/cm^2
- Beam on target: 37 hours
- $T_{1/2}(^{192}Pb)$: 3.5 min



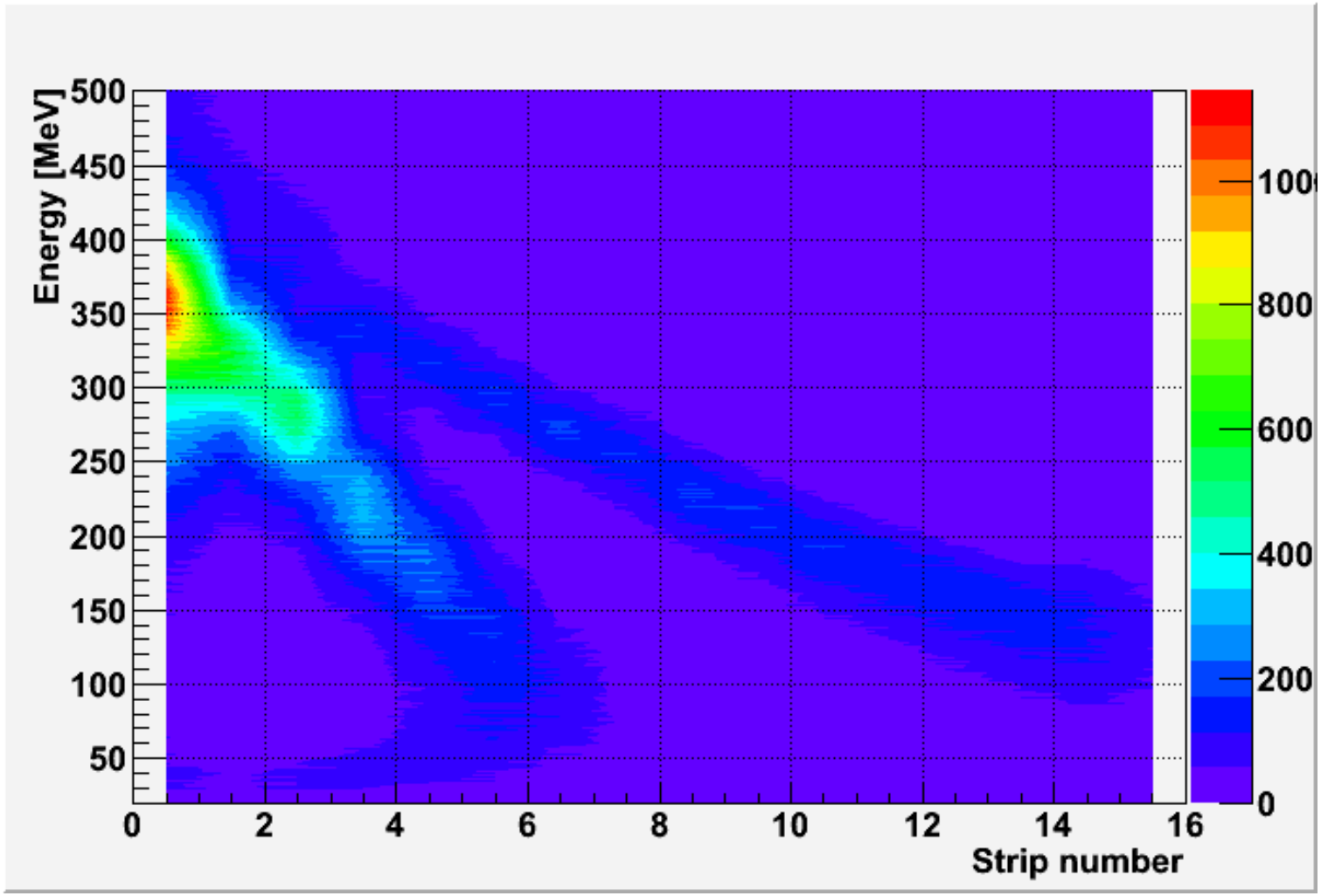
CD rates through the experiment



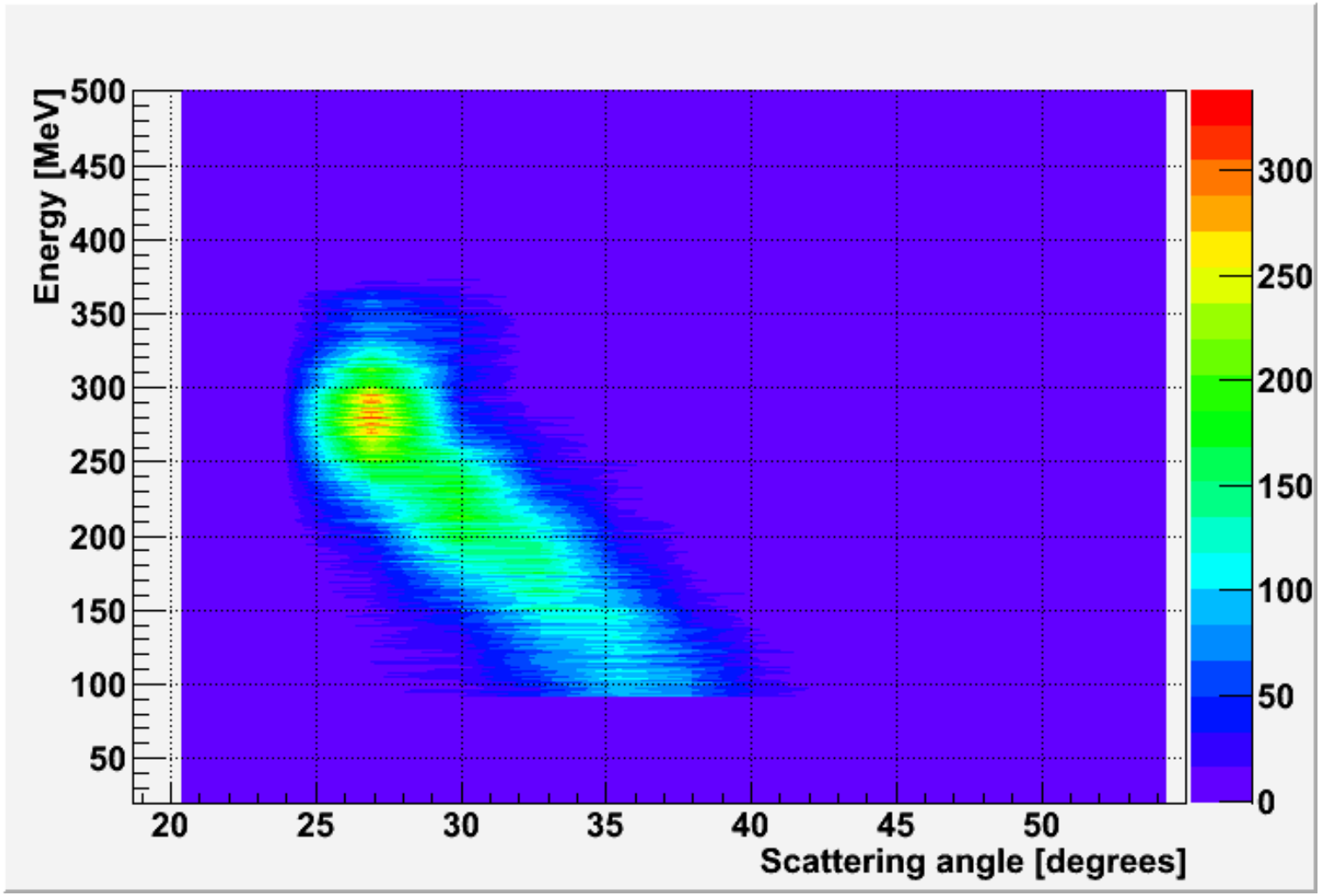
Gate on time difference between particles and γ-rays



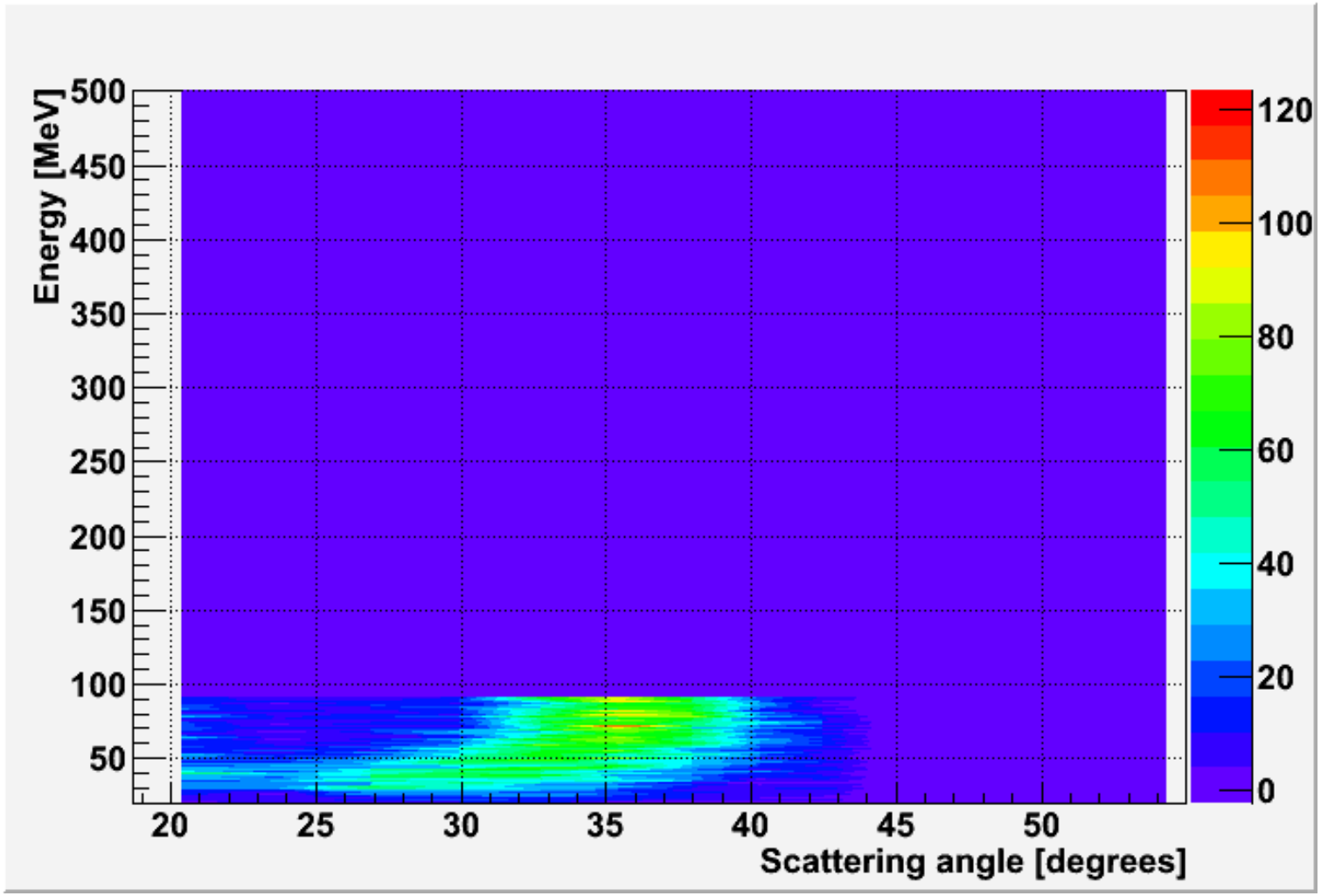
1-particle hits in the CD detector



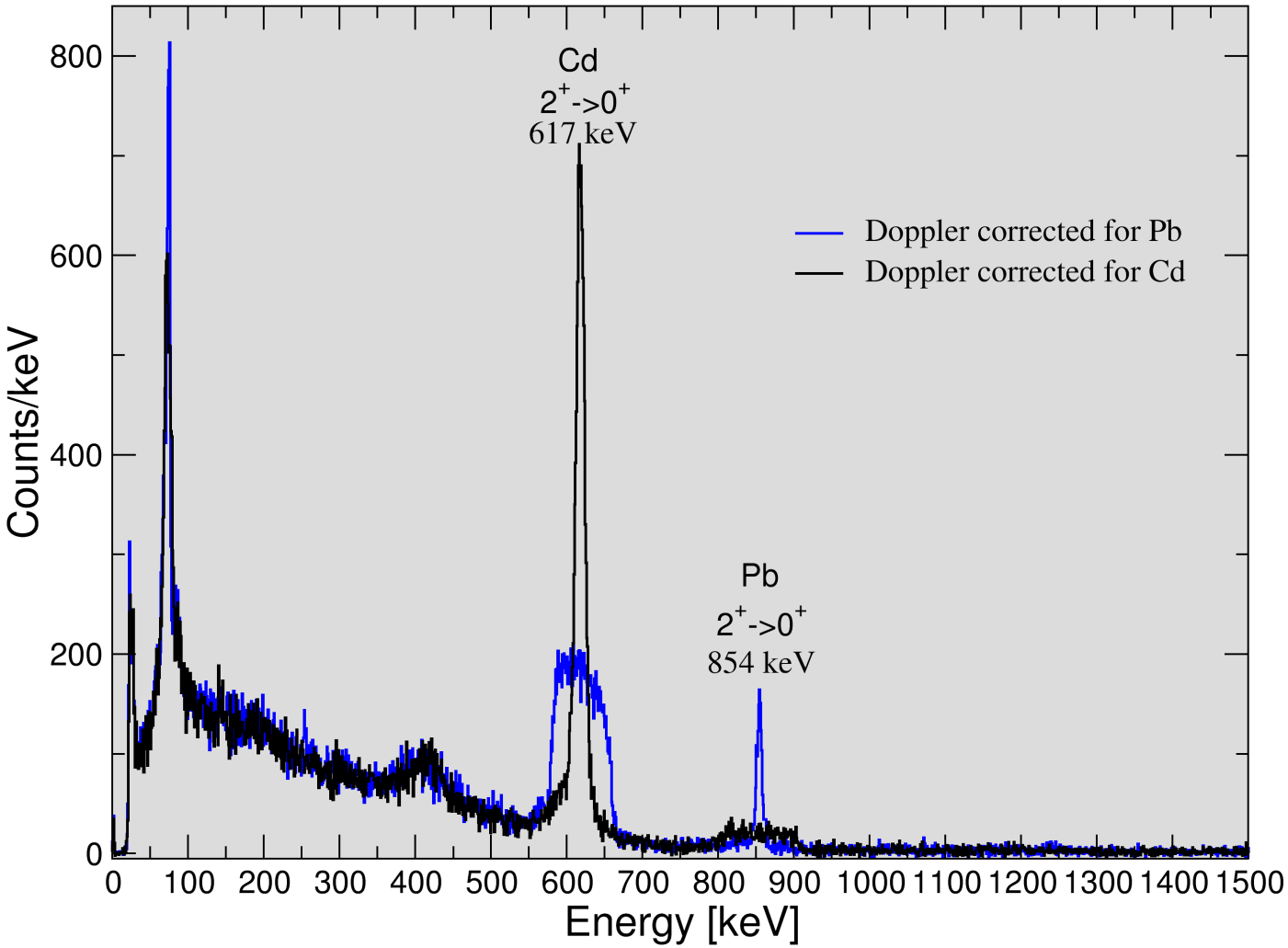
Gate on low CoM angle



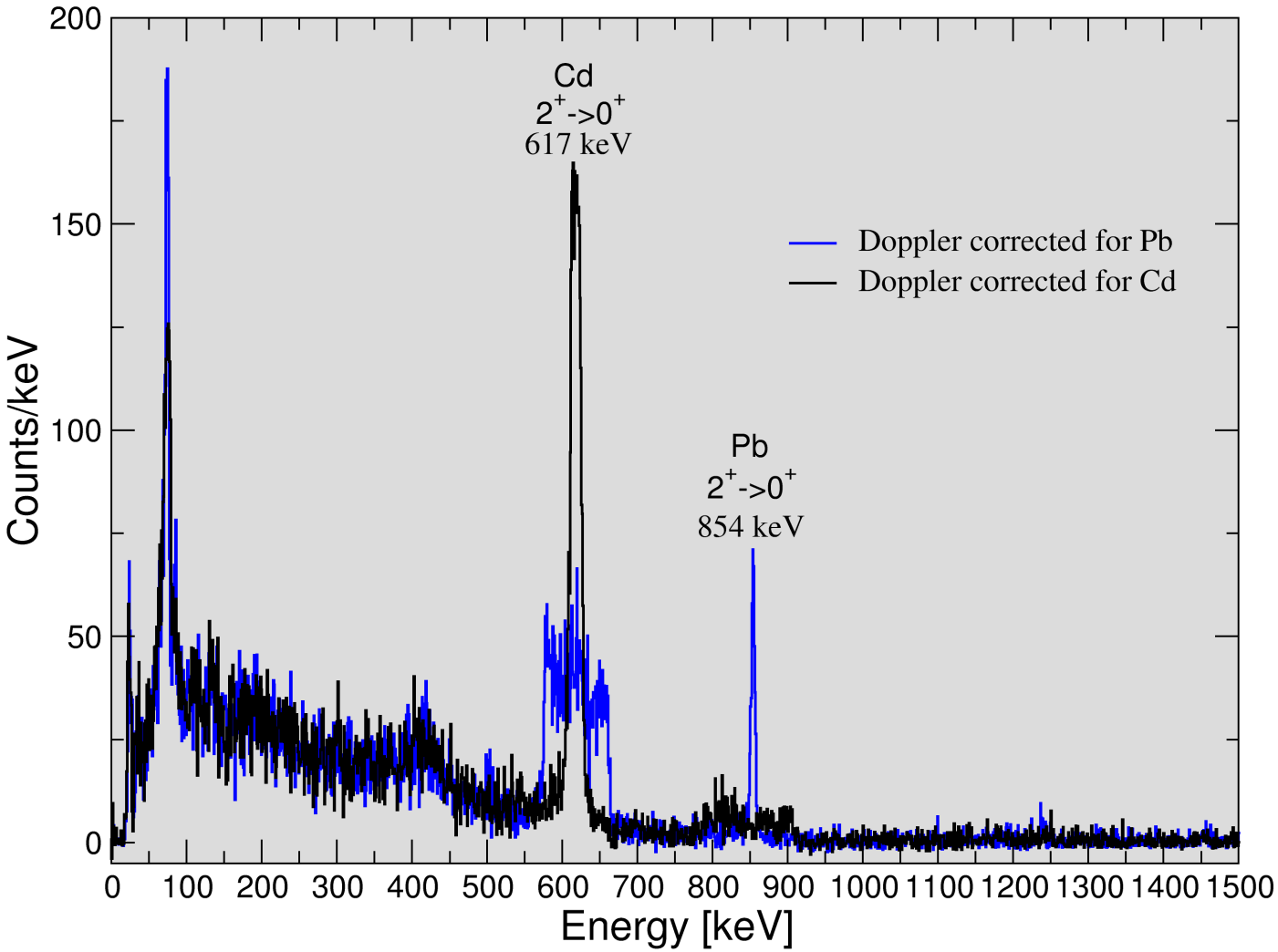
Gate on high CoM angle



DC γ-ray spectra for Pb detected in low CoM angles

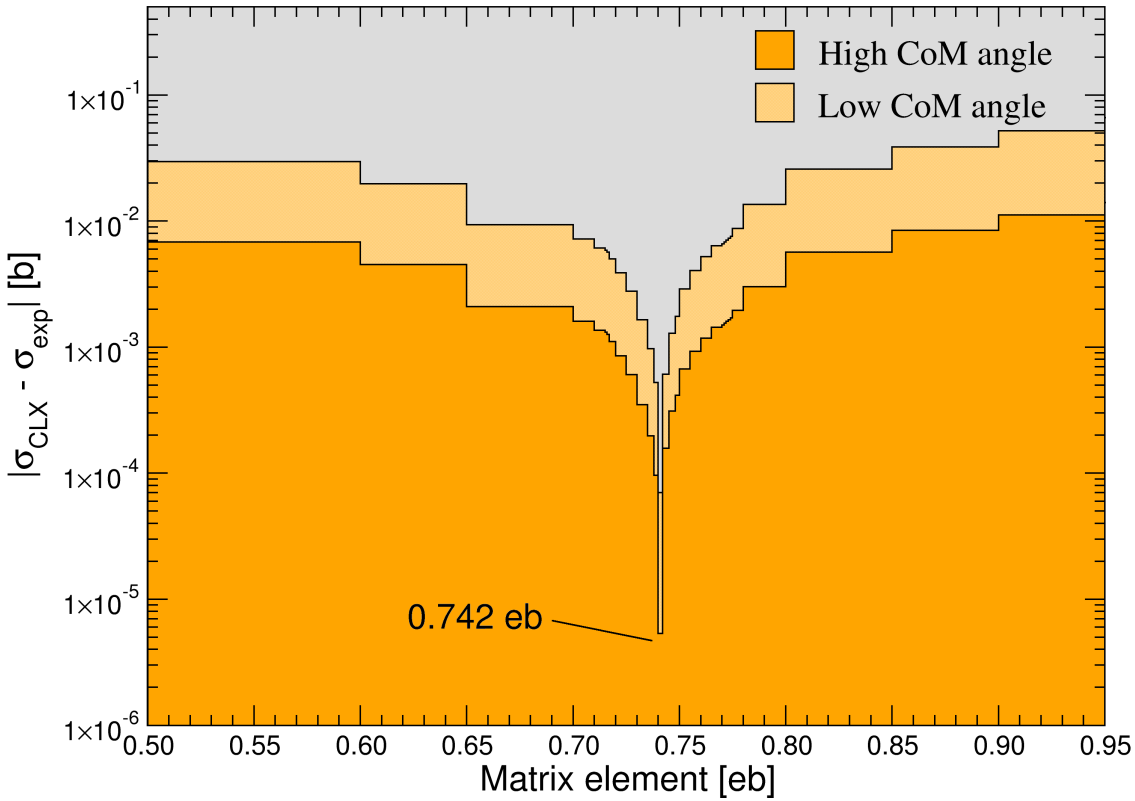


DC γ-ray spectra for Pb detected in high CoM angles



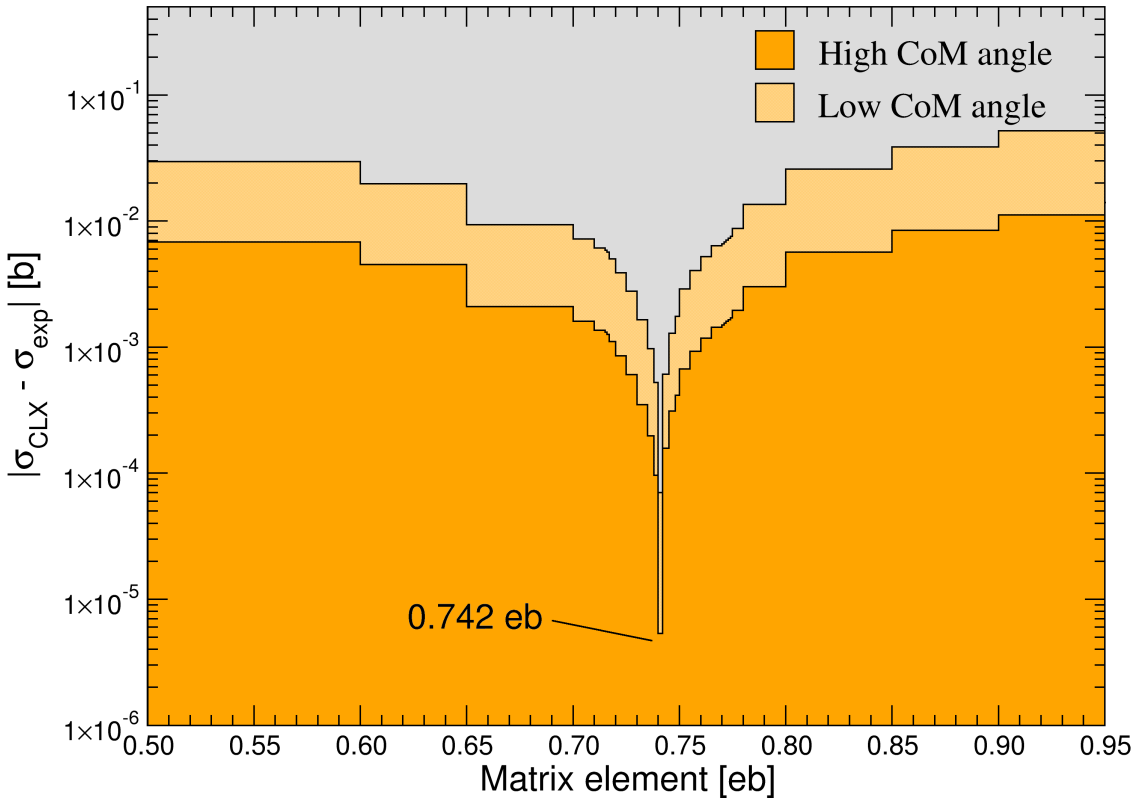
Extracting the $B(E2)$ value from ^{192}Pb data

- CLX code
- Matrix element
  $\sim$0.742 eb
  <=>
  $B(E2)$ $\sim$17 W.u.

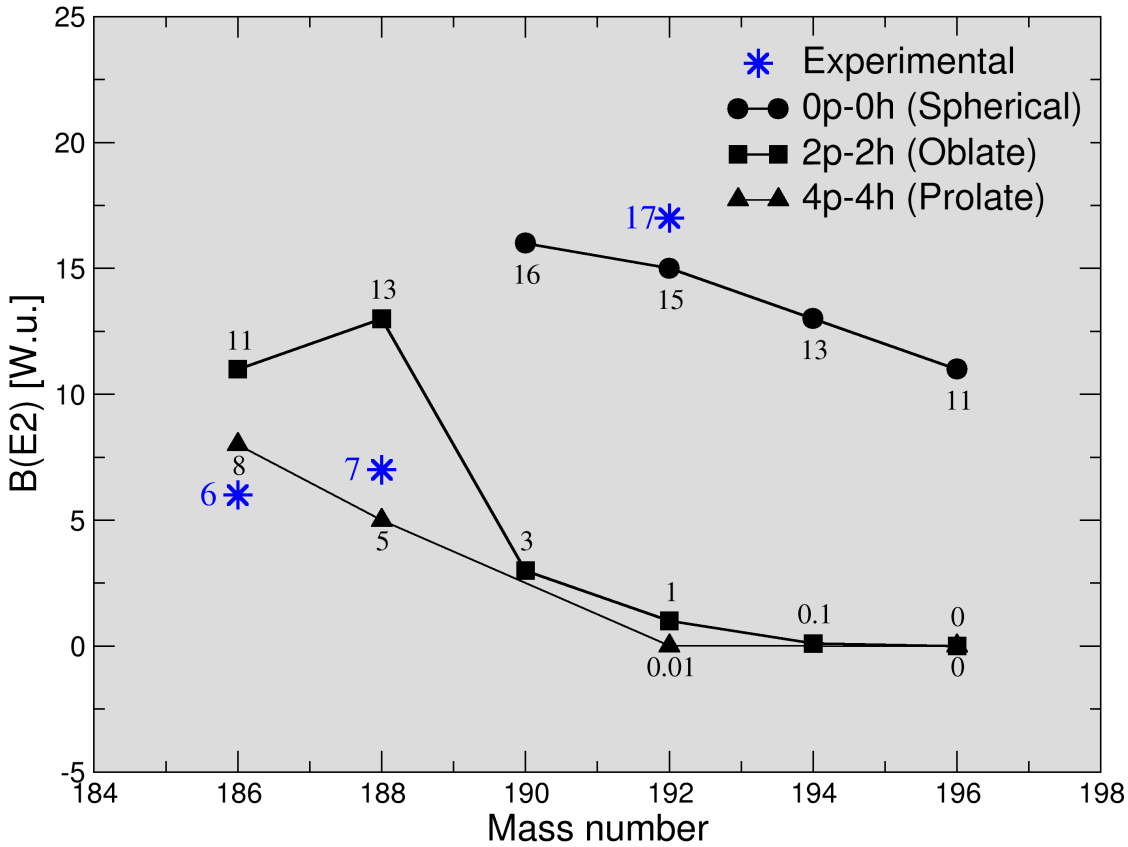


Extracting the $B(E2)$ value from ^{192}Pb data

- CLX code
- Matrix element
  $\sim$0.742 eb
  <=>
  $B(E2)$ $\sim$17 W.u.



Systematics of the $B(E2)$ values in Pb isotopes



V. Hellemans *et al.*, Phys. Rev. C **77**, 064324 (2008).
T. Grahn *et al.*, Phys. Rev. Lett. **97**, 062501 (2006).

Outline

Summary

- The first Coulex experiment of neutron-deficient Pb isotopes
- Preliminary B(E2) value of 17 W.u. obtained for the 2_1^+ state in ^{192}Pb
- Close to predicted value for the 0p-0h $2_1^+ \rightarrow 0_{g.s.}^+$ in the IBM framework.

Summary

- The first Coulex experiment of neutron-deficient Pb isotopes
- Preliminary B(E2) value of 17 W.u. obtained for the 2_1^+ state in ^{192}Pb
- Close to predicted value for the 0p-0h $2_1^+ \rightarrow 0_{g.s.}^+$ in the IBM framework.

Summary

- The first Coulex experiment of neutron-deficient Pb isotopes
- Preliminary B(E2) value of 17 W.u. obtained for the 2_1^+ state in ^{192}Pb
- Close to predicted value for the 0p-0h $2_1^+ \rightarrow 0_{g.s.}^+$ in the IBM framework.

Participants

CERN
T. Cocolios, **J. Pakarinen**

Katholieke Universiteit Leuven
N. Bree, J. Diriken, B. Lannoo

University of Liverpool
L. Gaffney

University of Jyväskylä
T. Grahn, P. Rahkila

University of Warsaw
K. Hadynska-Klek, M. Zielinska

Universität zu Köln
M. Seidlitz, N. Warr

Technische Universität Darmstadt
M. Scheck

Acknowledgement: Marie Curie Intra-European Fellowship of the EC's FP7