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Evolution of nuclear shape in the light Radon isotopes

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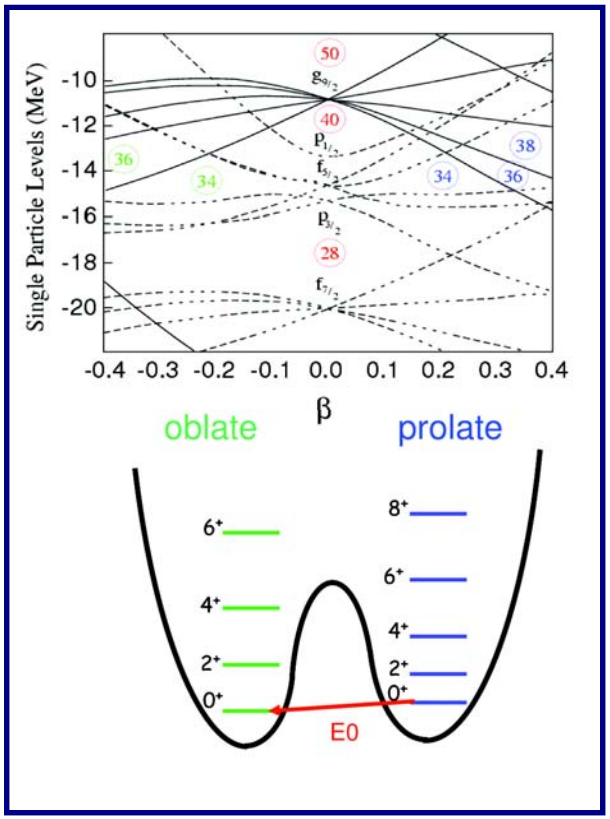
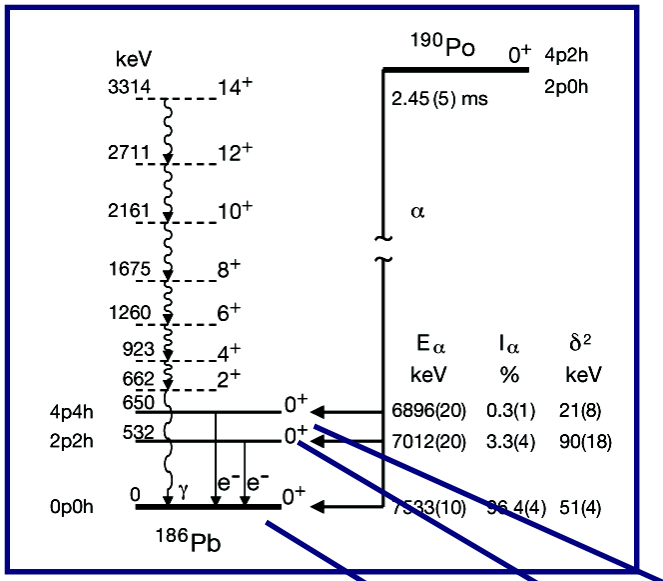
The Miniball Collaboration

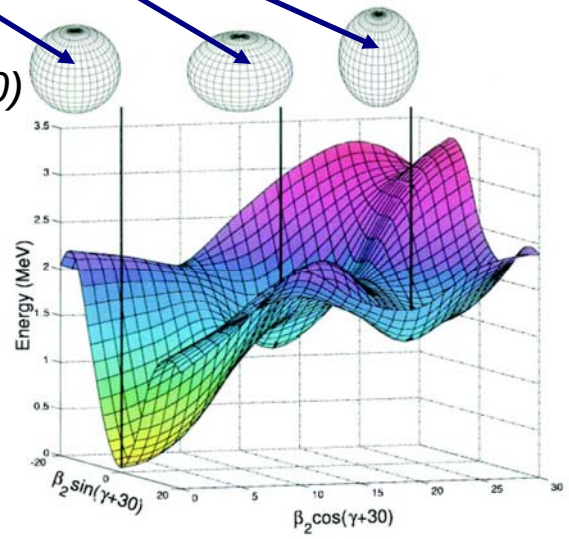
Shape Coexistence

Atomic nucleus minimises its energy by adopting different deformed mean-field shapes.





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



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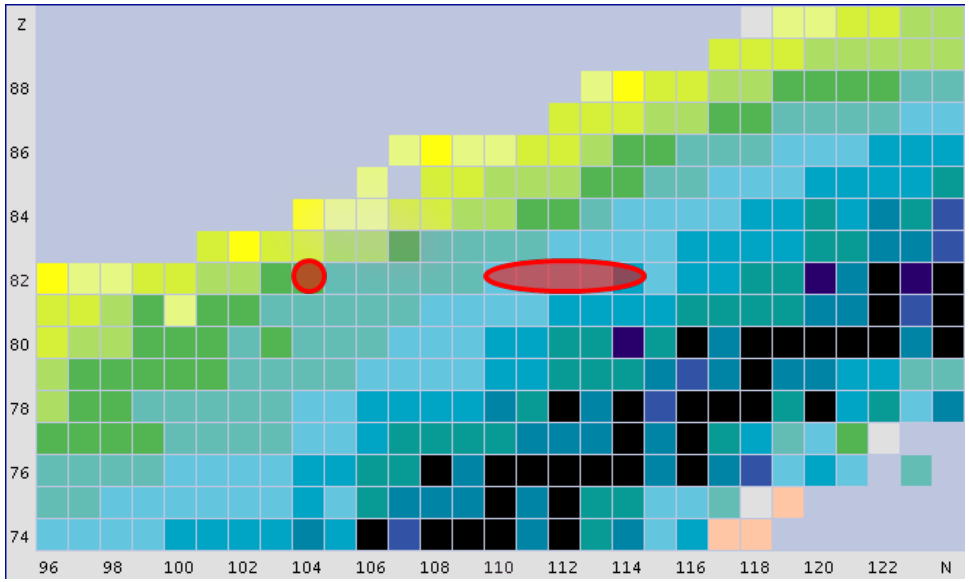
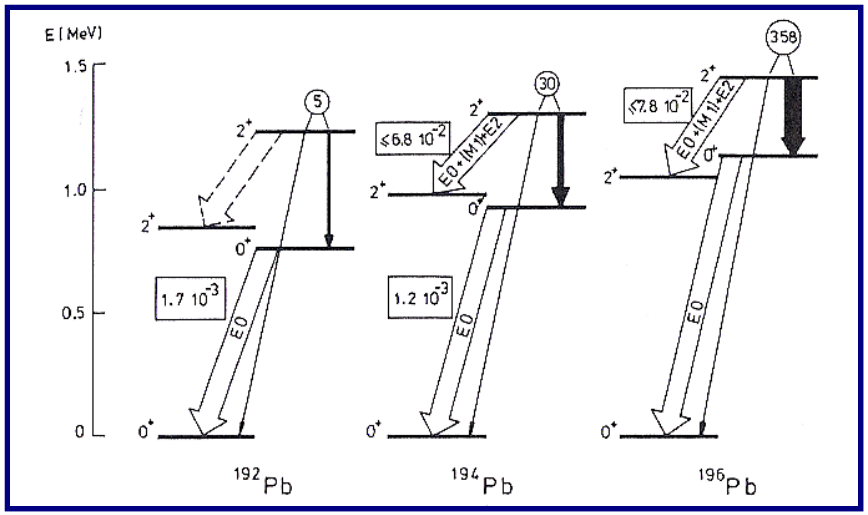
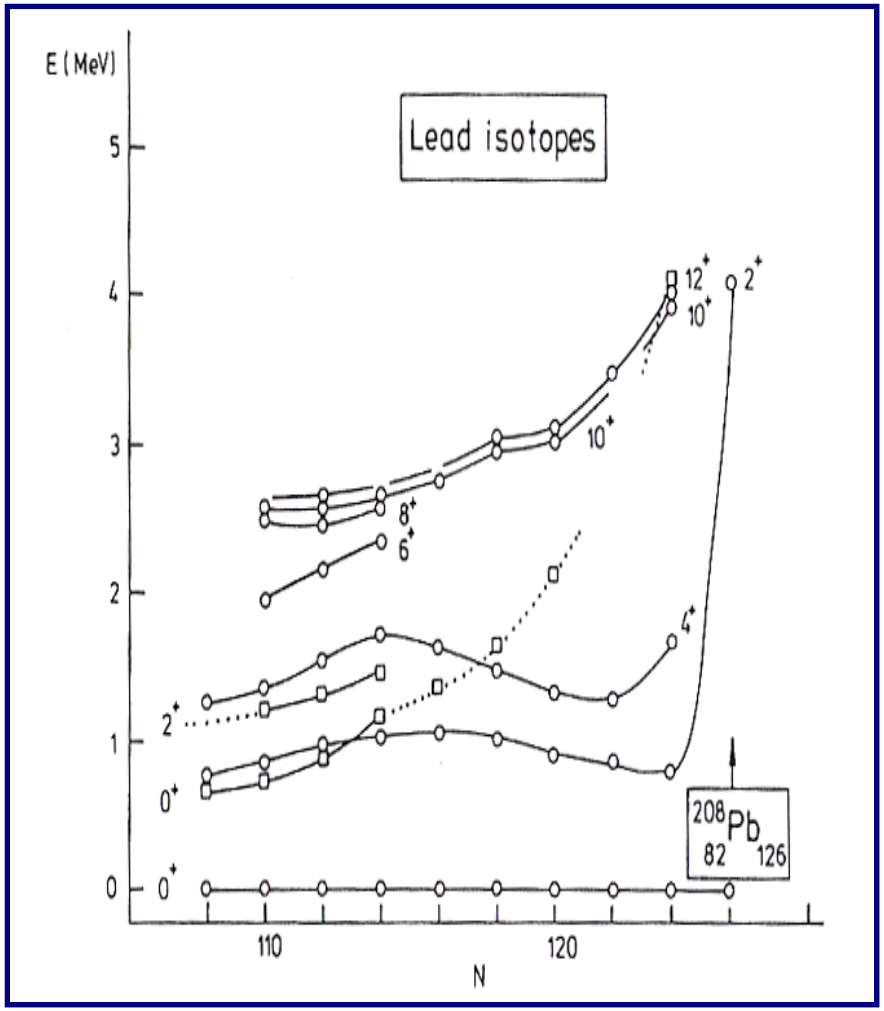
Light Pb isotopes

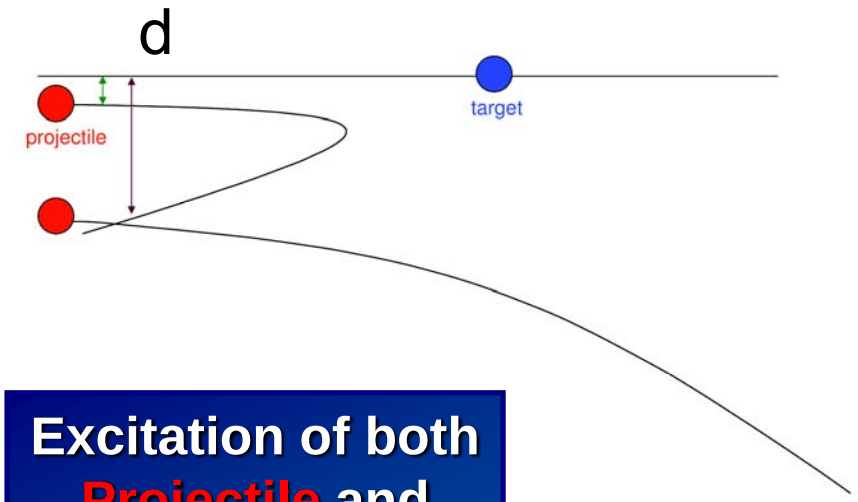






Coulomb Excitation (Coulex)

- Probe **collectivity** in nucleus.
- Extraction of electromagnetic matrix elements – **B(E2)**.
- Sensitive to the sign of **spectroscopic quadrupole** moment.
- Multi-step excitations.
- Preferentially excites states which are **strongly coupled** to the **ground state.**

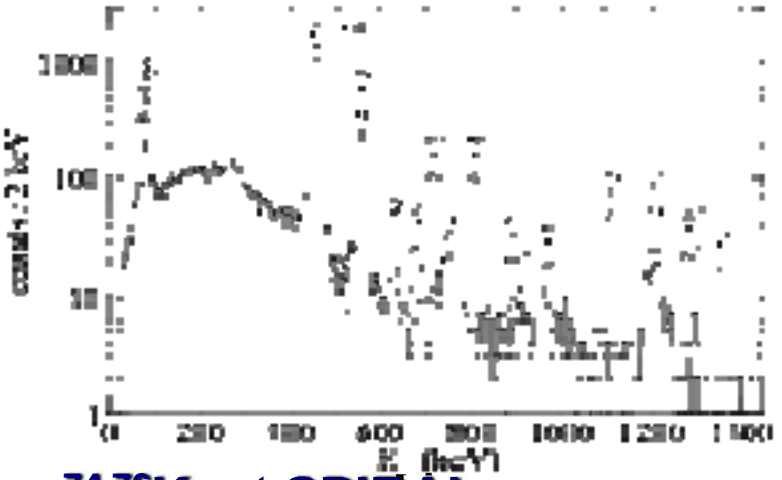


Excitation of both Projectile and Target particle

[fm]

Coulex with radioactive beams

Coulex with radioactive beams is a highly successful method for establishing the evolution of nuclear shape

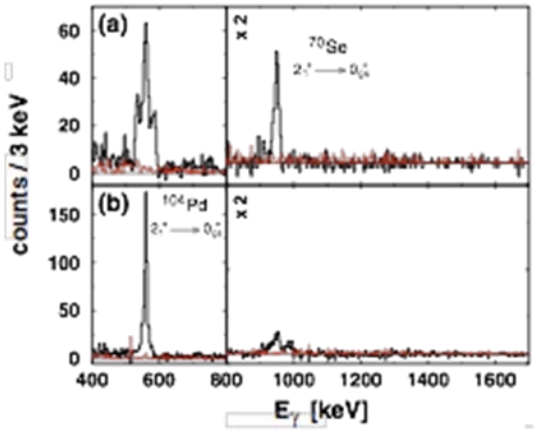


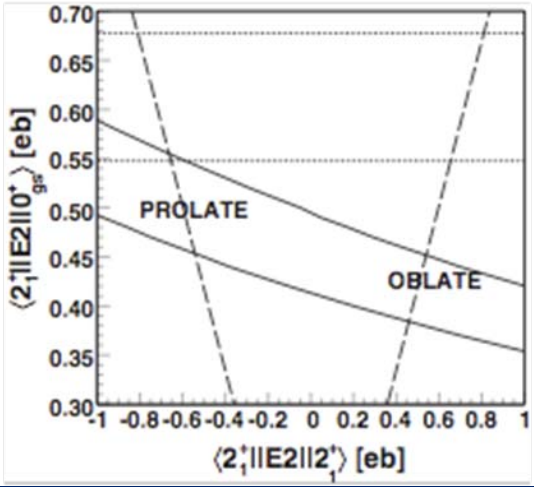
^{74,76}Kr at SPIRAL

E. Clement et al., PRC 75, 054313 (2007)

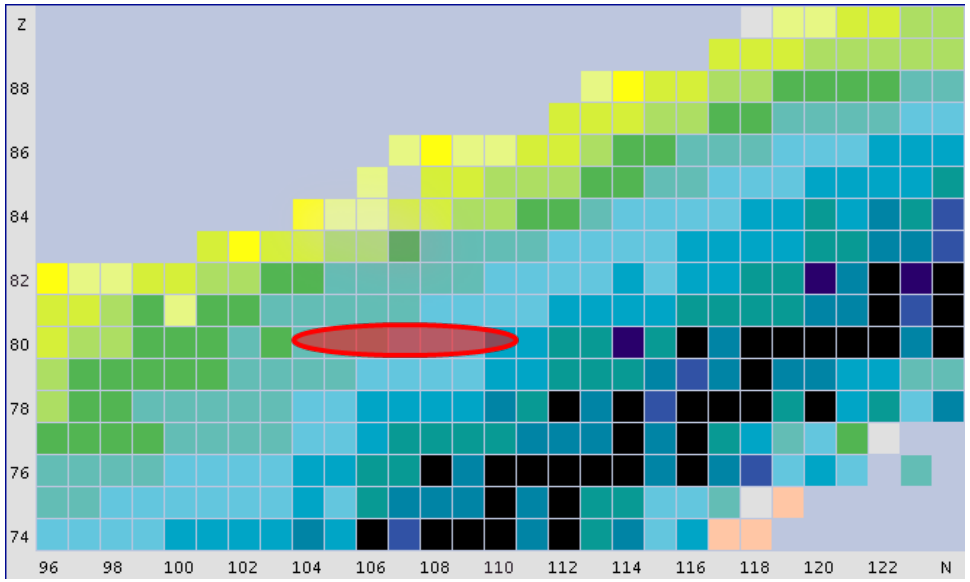
^{70}Se at REX-ISOLDE

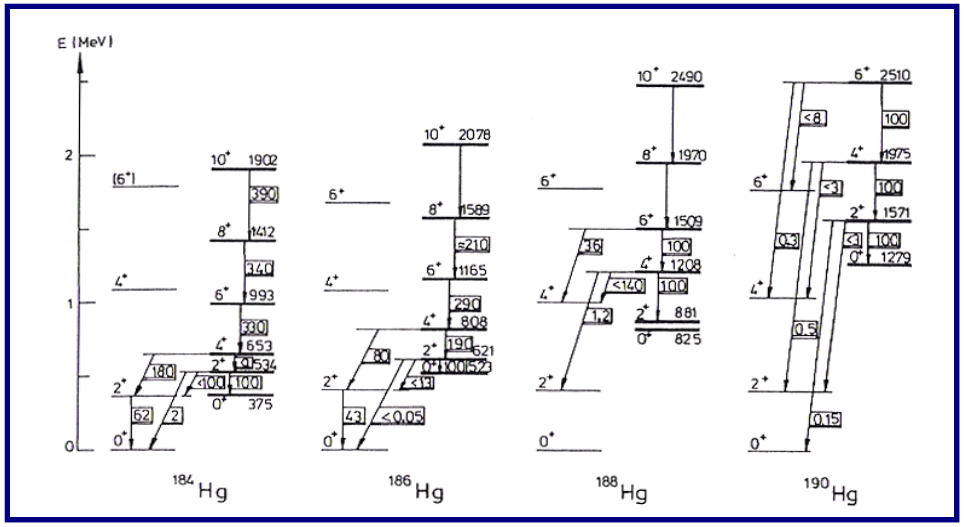
A.M. Hurst et al., PRL 98, 072501 (2007)





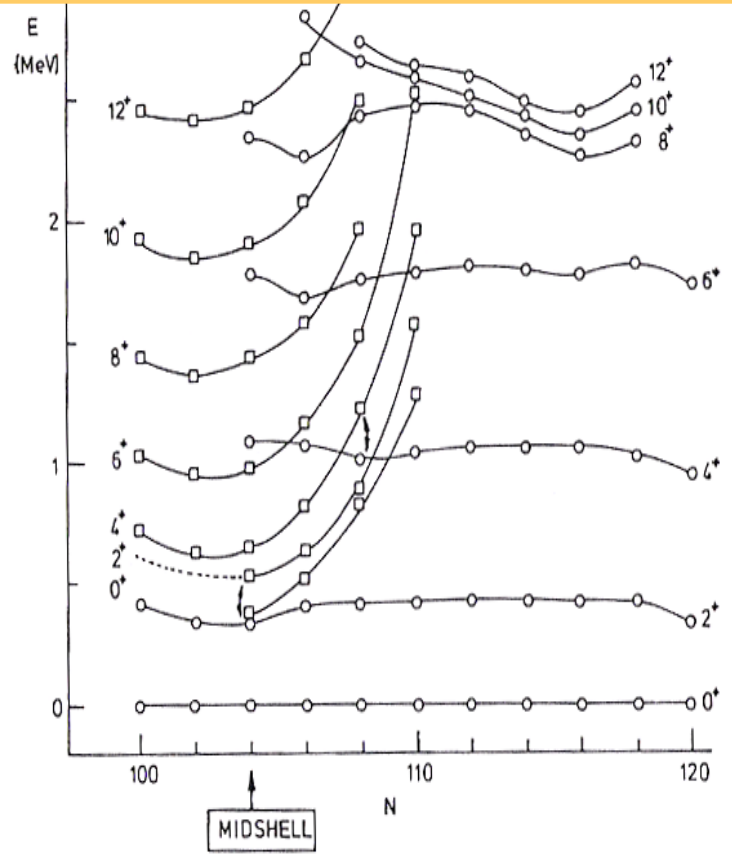
Mercury Isotopes





IS425

Andrew Petts – Next Talk !



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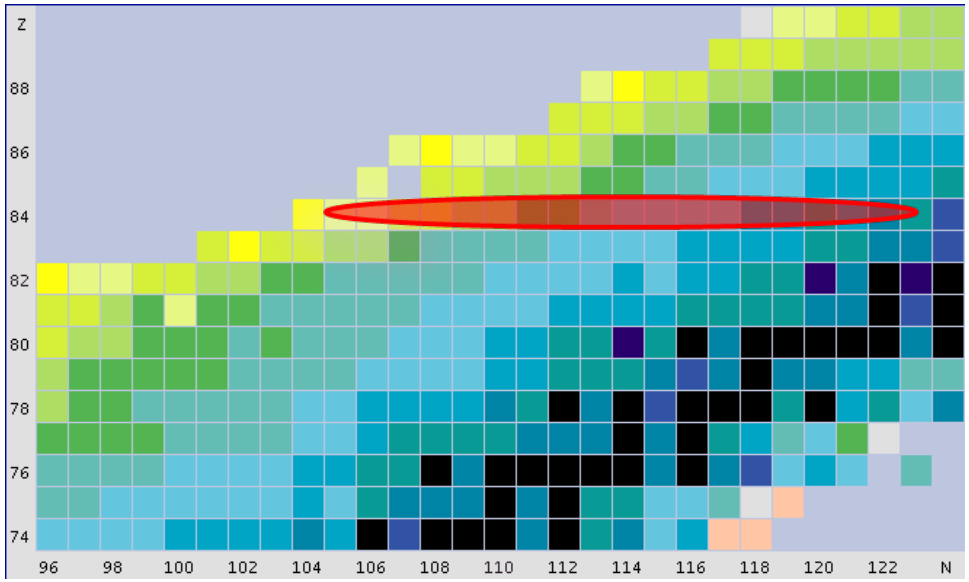
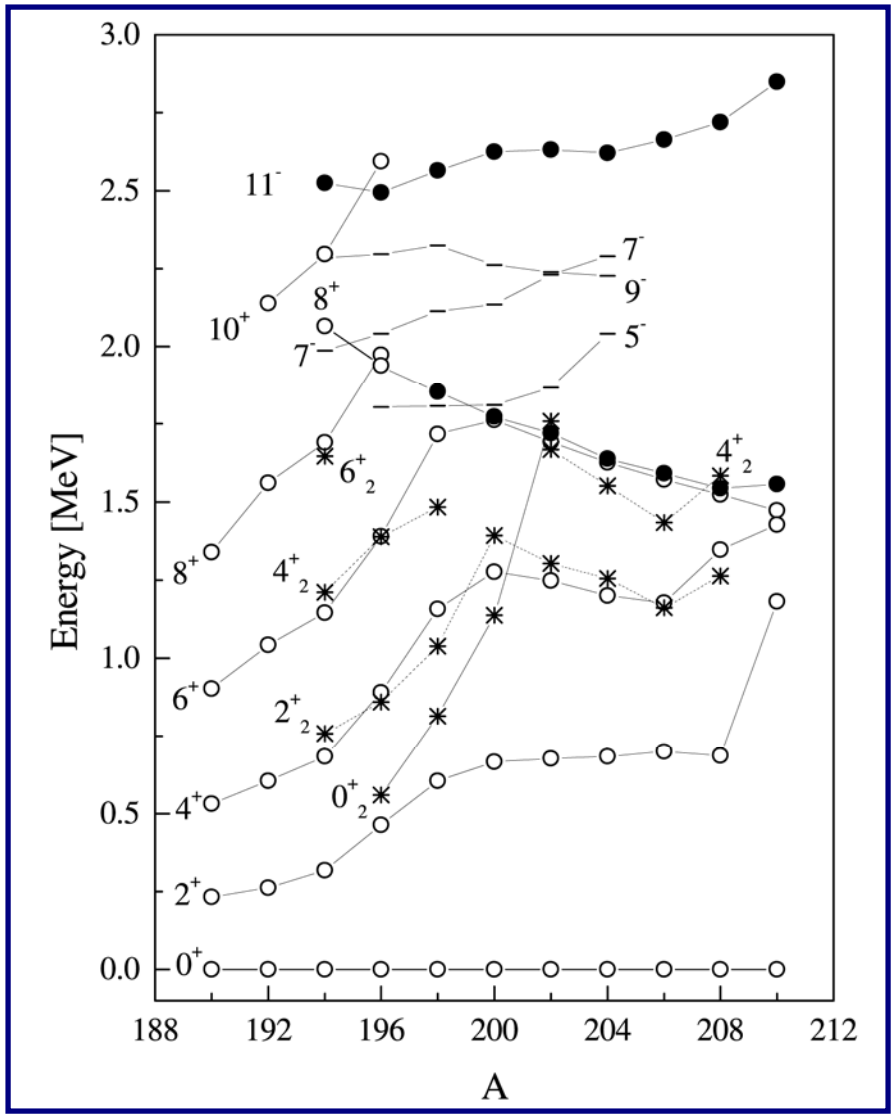
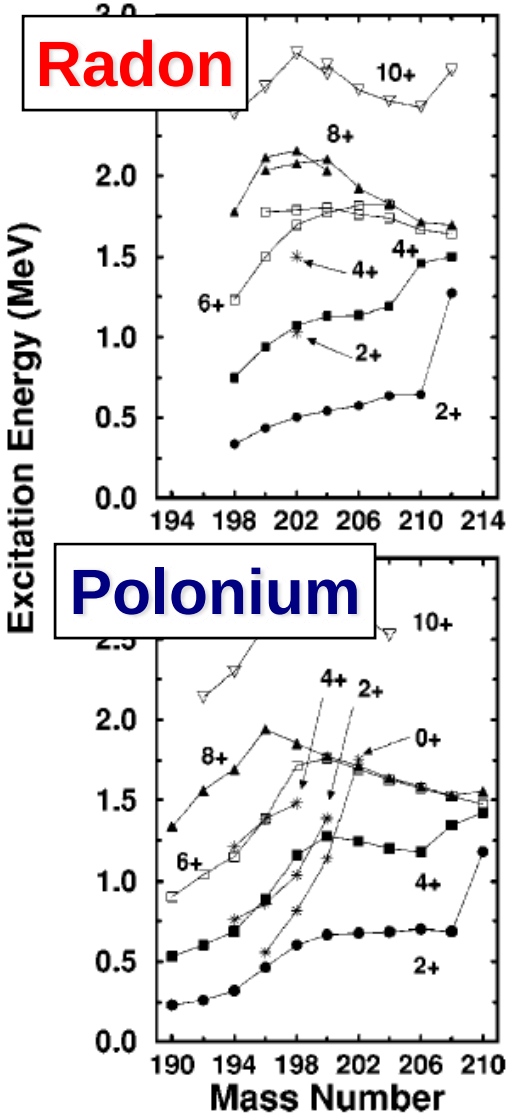
Light Polonium Isotopes





Radon Isotopes



Macroscopic-microscopic models predict that **deformed ground states** exist beyond ^{202}Rn.

E(4$^+$)/E(2$^+$) ratio for **^{198,200,202}Rn** typical of an **anharmonic vibrational** system.

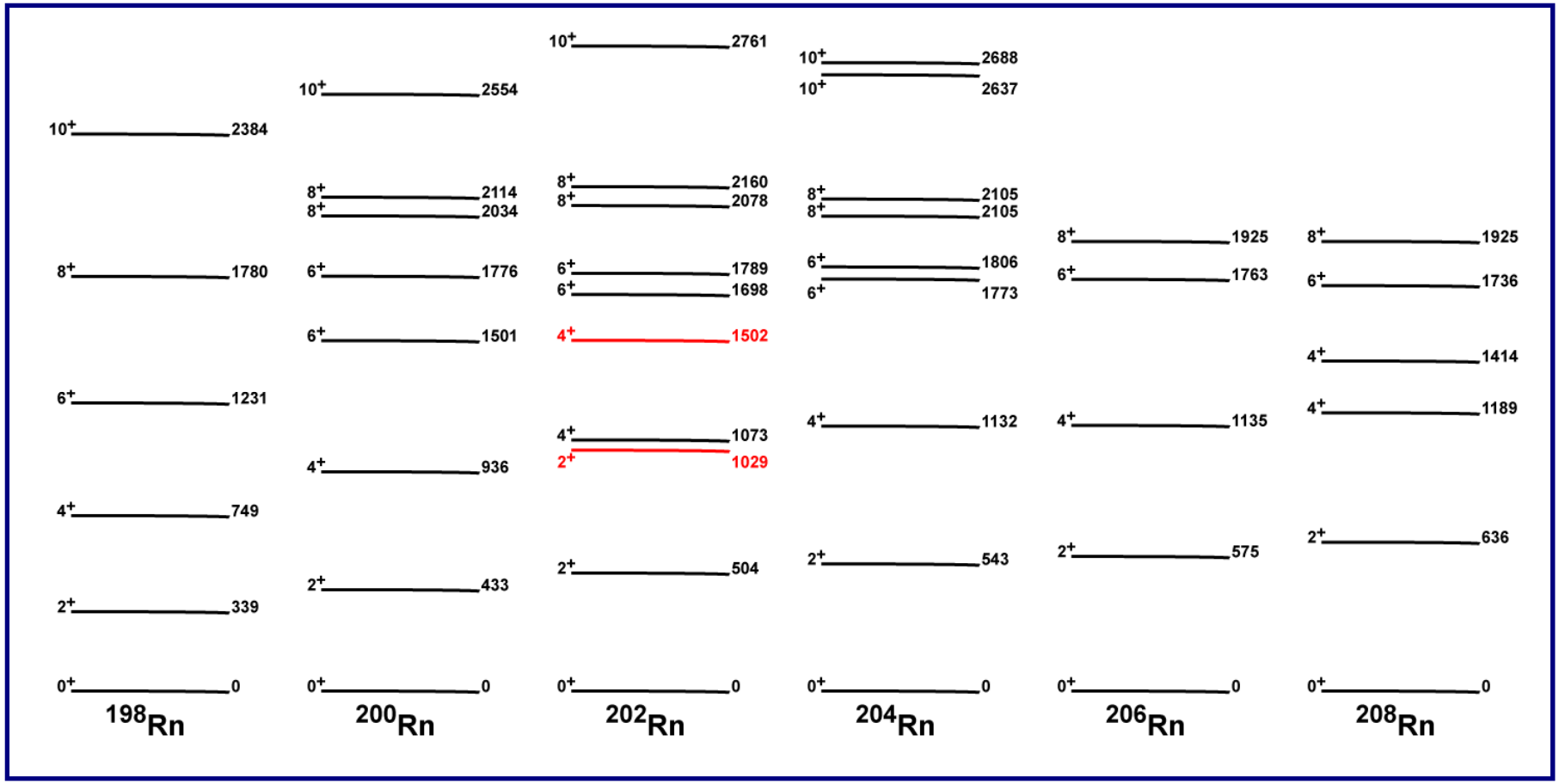
*S.J. Freeman et al., PRC **50** R1754 (1994)*

*R.B.E. Taylor et al., PRC **54**, 2926 (1996); PRC **59**, 673 (1999)*

Evidence found for deformed intruder states in **^{202,204}Rn** which coexist with spherical ground state.

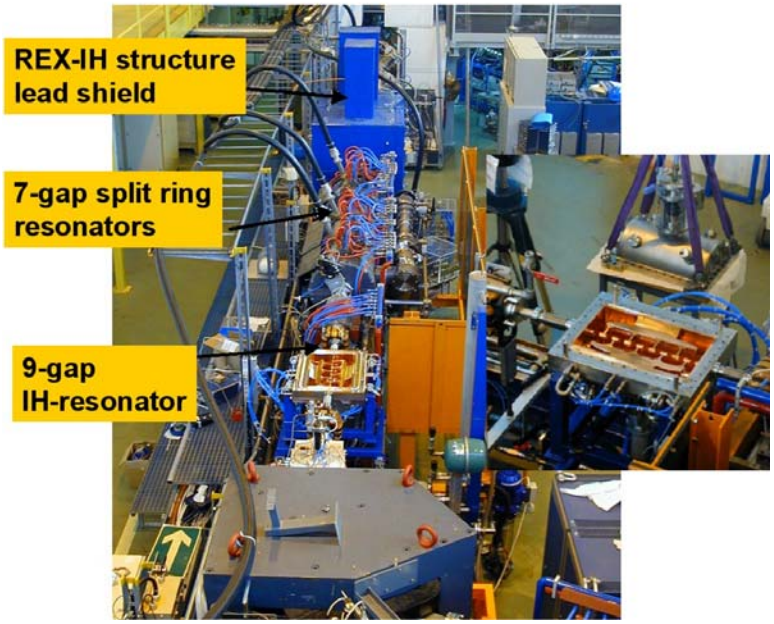
*D.J. Dobson et al., PRC **66** 064321 (2002)*

Low Lying Levels in Rn Isotopes



Radon Production

Noble gas – easily purified using **Plasma cooled** transfer line.



PS Booster and ThC target:

^{202}Rn - 9 x 10^{5} ions/μC

^{204}Rn - 2 x 10^{7} ions/μC

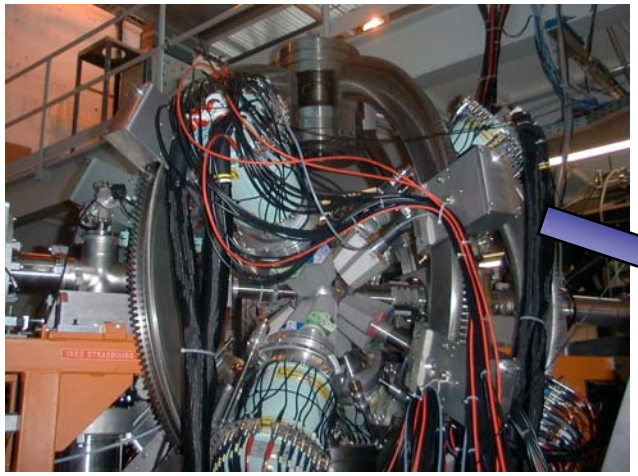
Intensity at Miniball:

^{202}Rn – 3 x 10^{4} ions / s

^{204}Rn – 2 x 10^{5} ions / s

	Energy	Hours
^{204}Rn	2.9 MeV / u	69
^{202}Rn	2.9 MeV / u	16
^{202}Rn	2.28 MeV / u	26

Experimental Technique

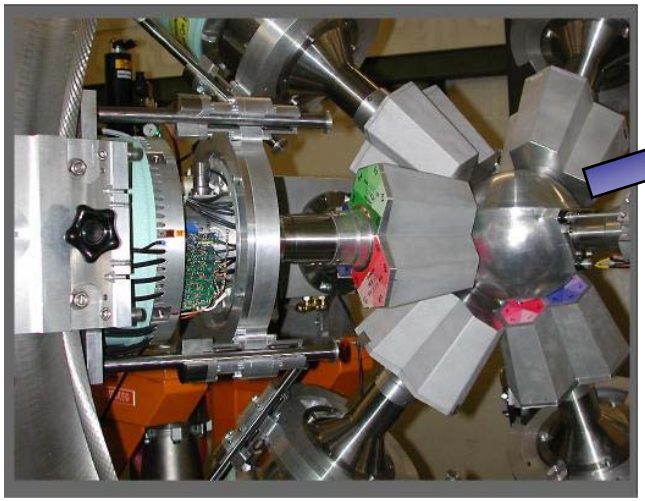


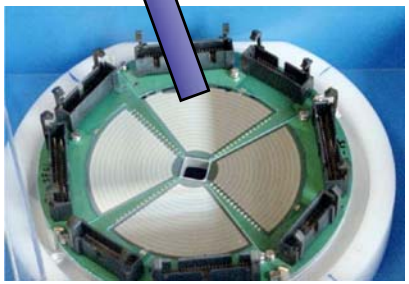
x8 Miniball clusters

CD detector
(16°-53°)

^{202,204}Rn from
REX-ISOLDE

^{120}Sn
2 mgcm^{-2}

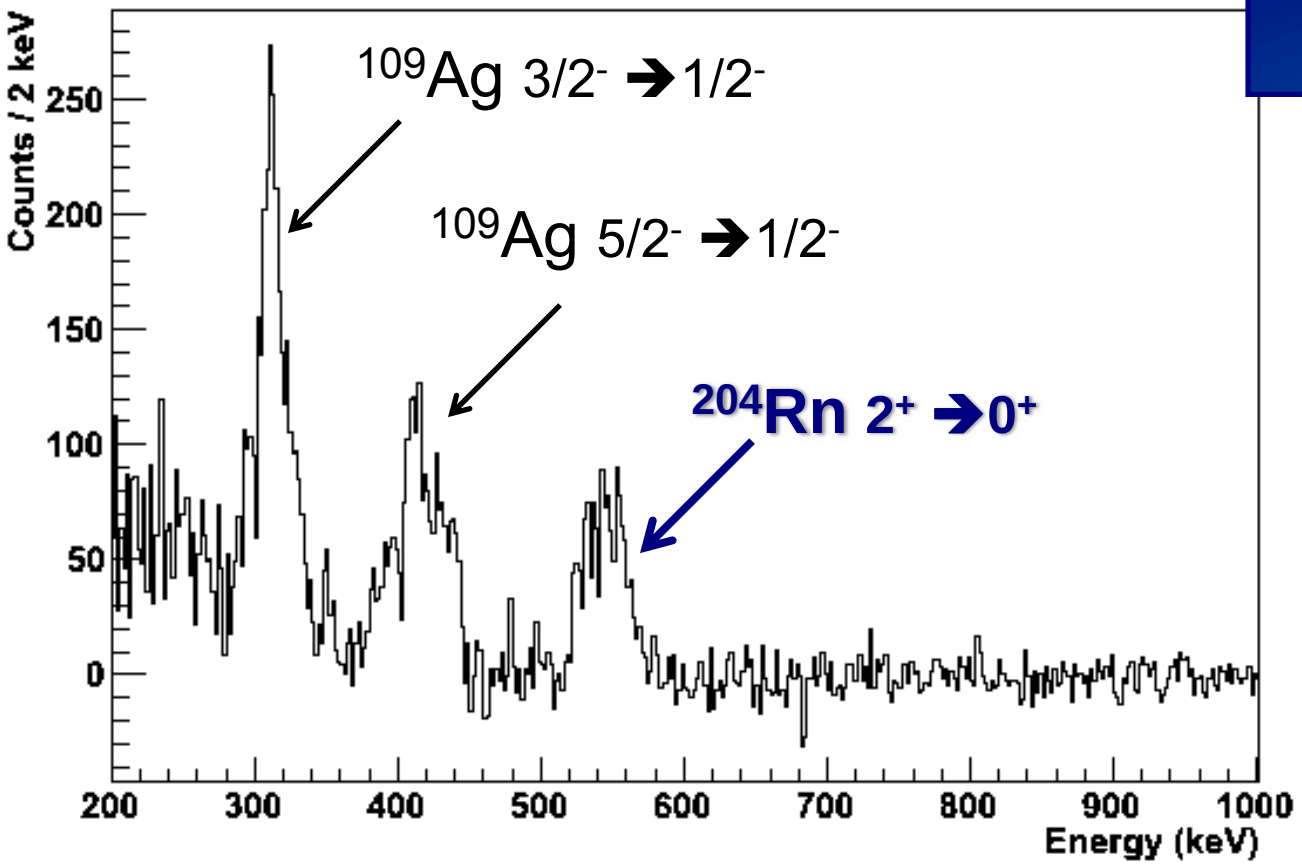


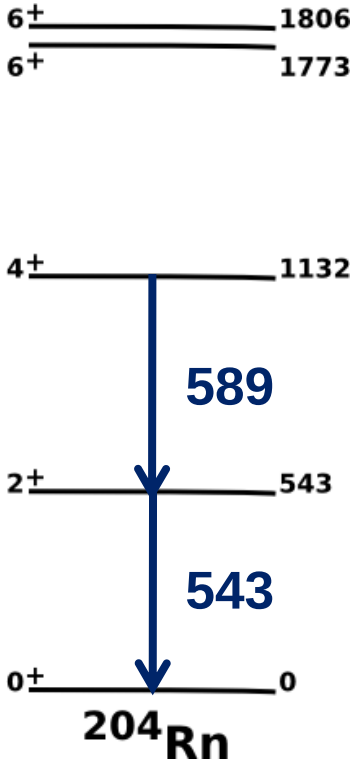


Preliminary Results: ^{204}Rn

^{204}Rn + ^{109}Ag

2.9 MeV / u





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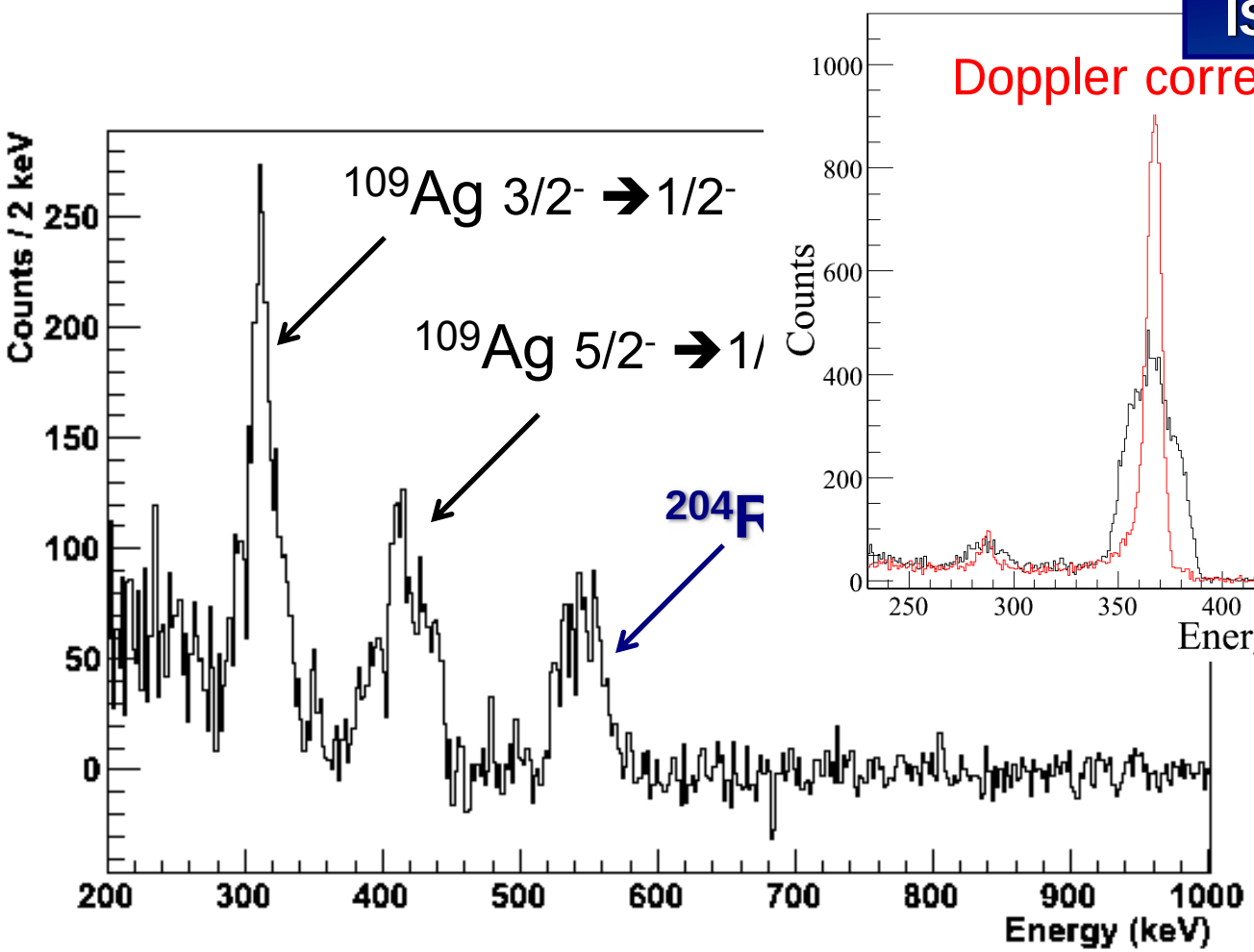
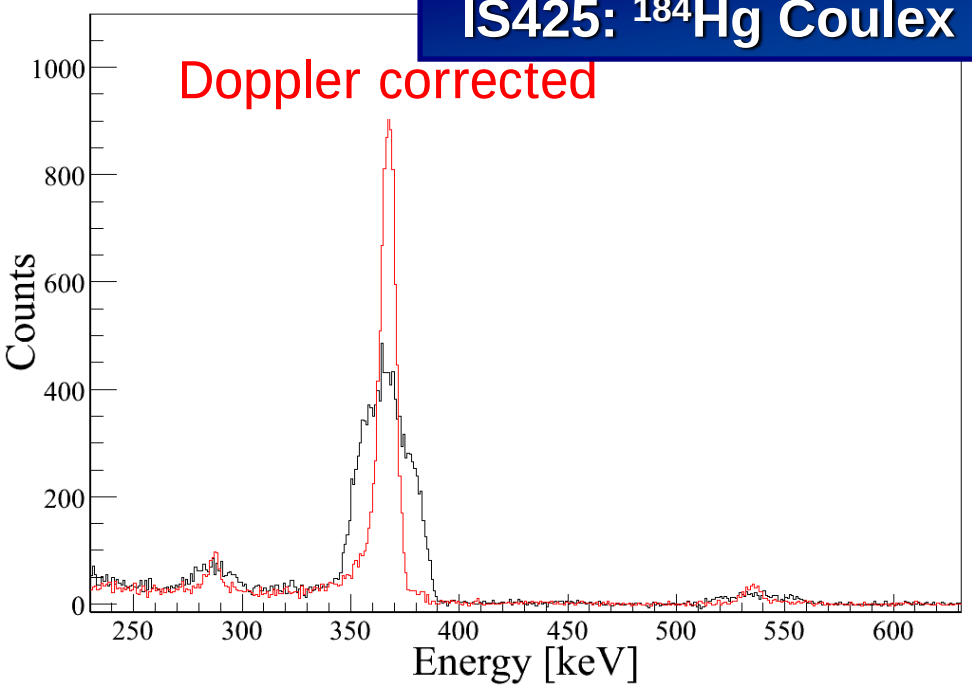
Preliminary Results: ^{204}Rn

IS425: ^{184}Hg Coulex

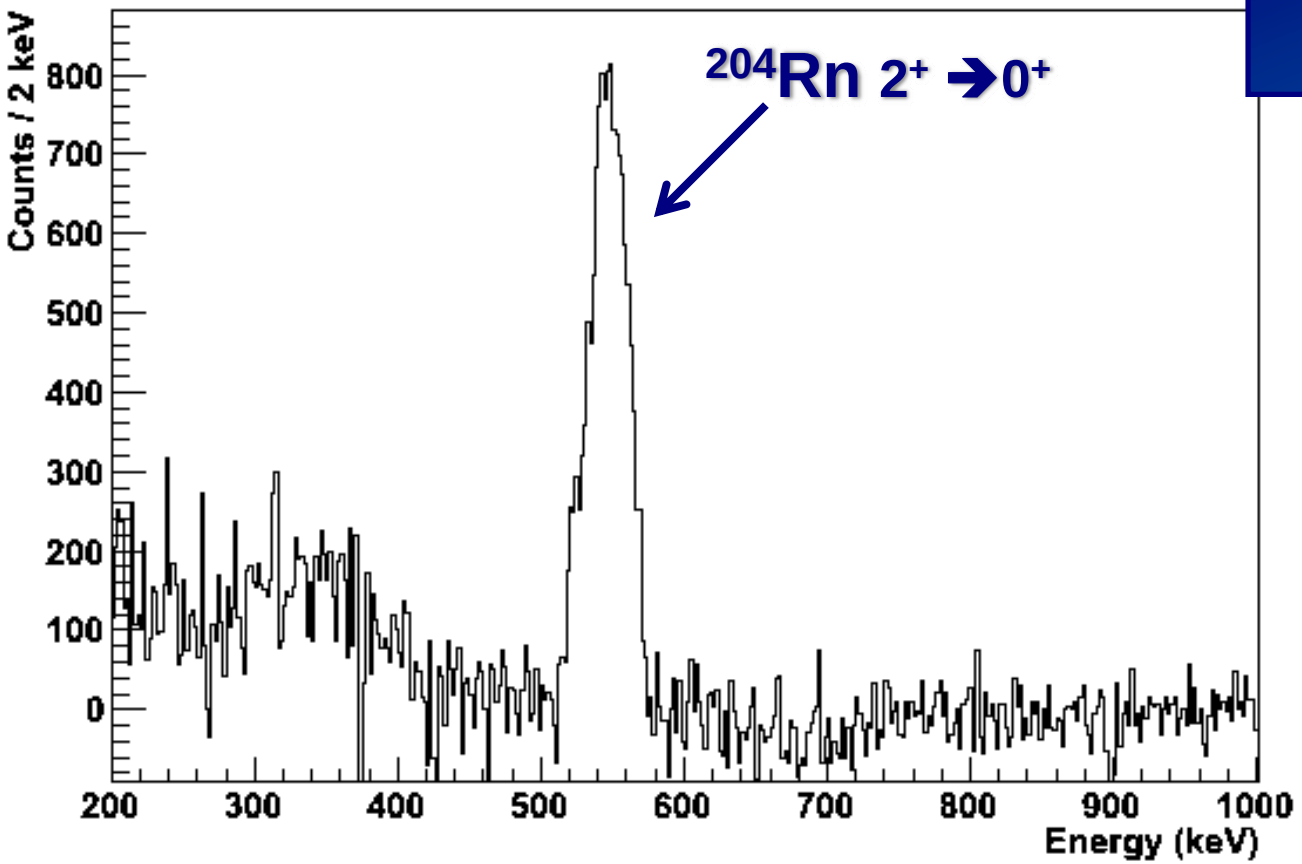


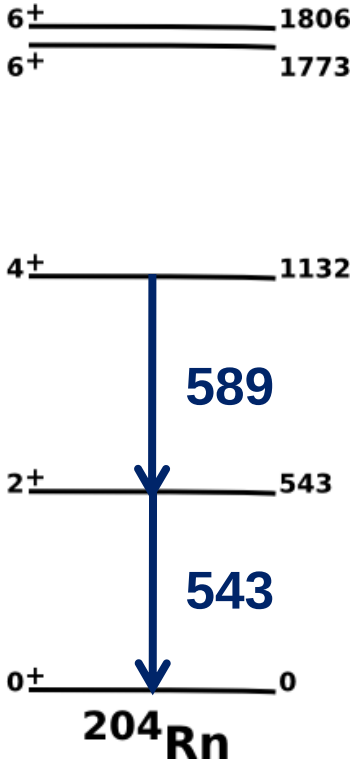


Preliminary Results: ^{204}Rn

^{204}Rn + ^{120}Sn

2.9 MeV / u





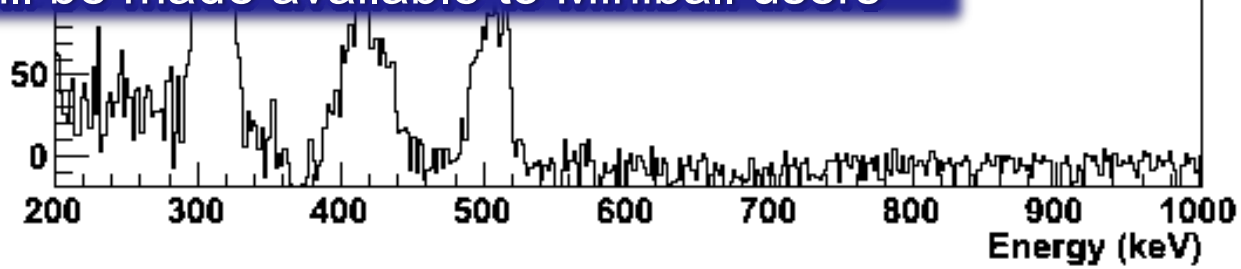
Preliminary Results: ^{202}Rn

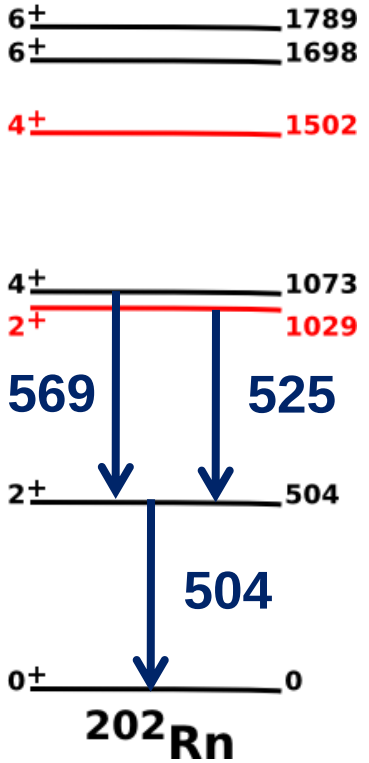
New Sorting Routine

- med file → **ROOT tree**
- **General purpose** sorting routine, **easily adapted** to variety of experiments.
- **Quick** → allow analysis of data during run. (Possibility to adapt for true online sort)
- Will be made available to Miniball users

^{202}Rn + ^{109}Ag

2.9 MeV / u

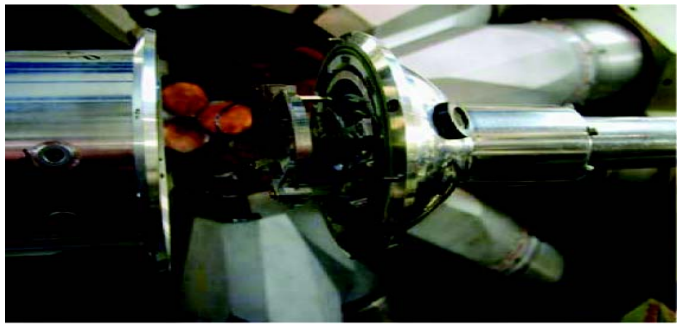




Summary

- Successfully post-accelerated **^{204}Rn** and **^{202}Rn** – **heaviest radioactive beam**.
- Observed Coulex of **^{204}Rn & ^{202}Rn**.
- Good data on **^{204}Rn** - extend work to **^{202}Rn Summer 2009**

Analysis is ongoing



Recoil Distance Method (RDM) measurements with plunger to obtain **independent lifetimes**.

Conversion electron studies, help to determine properties of **excited 0^+** states and **E0** content of **j ➔ j** transitions, related to **rms charge radius.**