

***Measurement of octupole collectivity
in $^{220,222}\text{Rn}$ and $^{222,224}\text{Ra}$
using Coulomb excitation***

M.Scheck & P.A.Butler
University of Liverpool

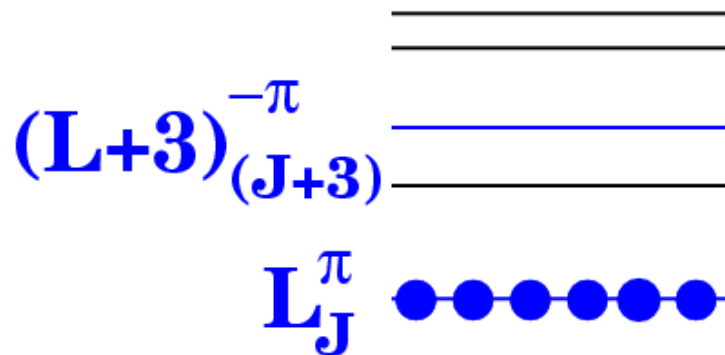
New Opportunities in Physics Landscape at CERN
CERN – Geneva
May 10th–13th 2009

**CERN-ISOLDE, Cologne, Daresbury, Edinburgh,
GANIL, Guelph, Jyvaskyla, Kentucky, Leuven,
Livermore, Liverpool, TU Munich, Oslo, Rochester,
Saclay, Warsaw & York**

Octupole collectivity in nuclei

Microscopic

Nuclear shell structure

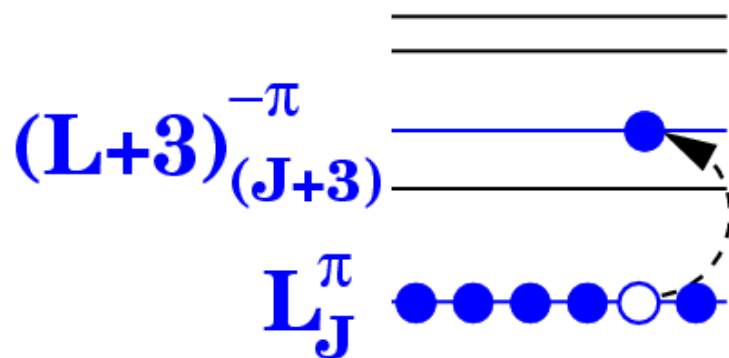


Octupole collectivity in nuclei

Microscopic

$$\Delta[E((J+3)_{(L+3)}^-) - E(J_L^+)] \ll$$

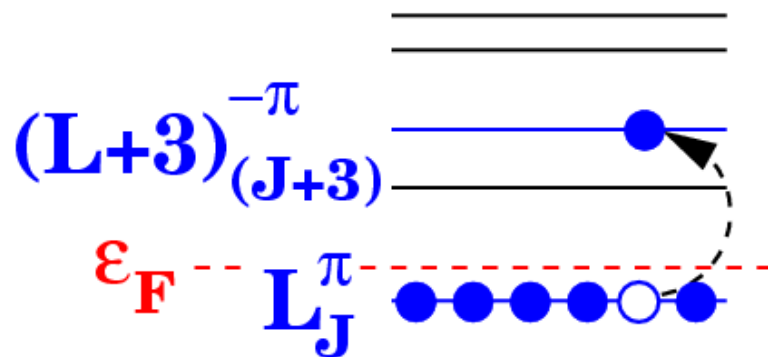
Nuclear shell structure



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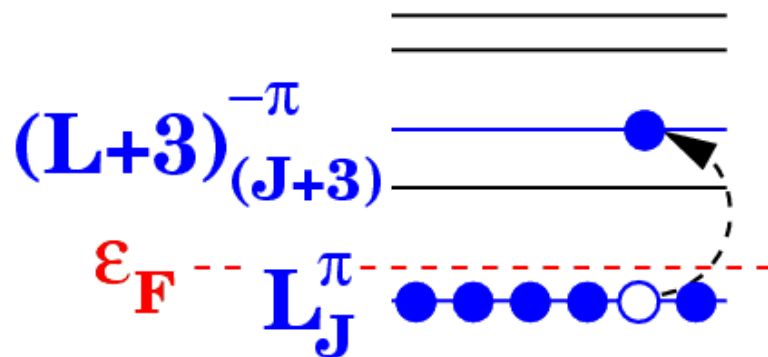
$$E(J_L^+) \leq \epsilon_F \leq E((J+3)_{(L+3)}^-)$$

Strong **octupole** correlation

Octupole collectivity in nuclei

Microscopic

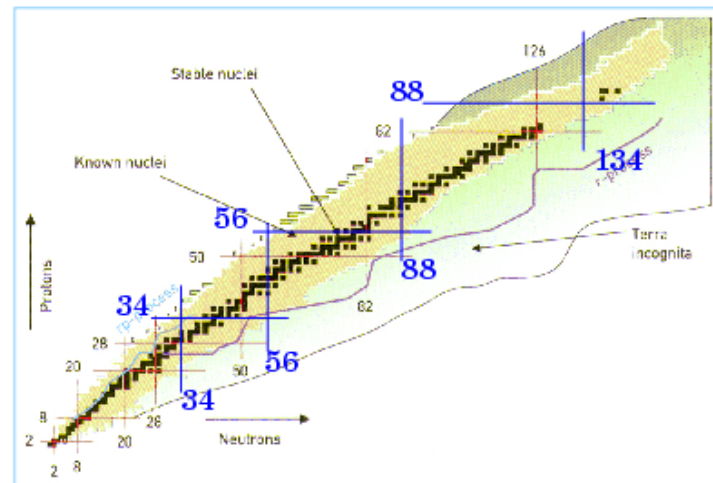
Nuclear shell structure



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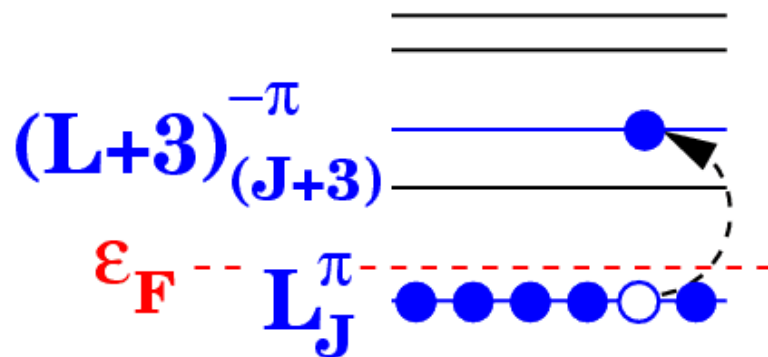
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Octupole collectivity in nuclei

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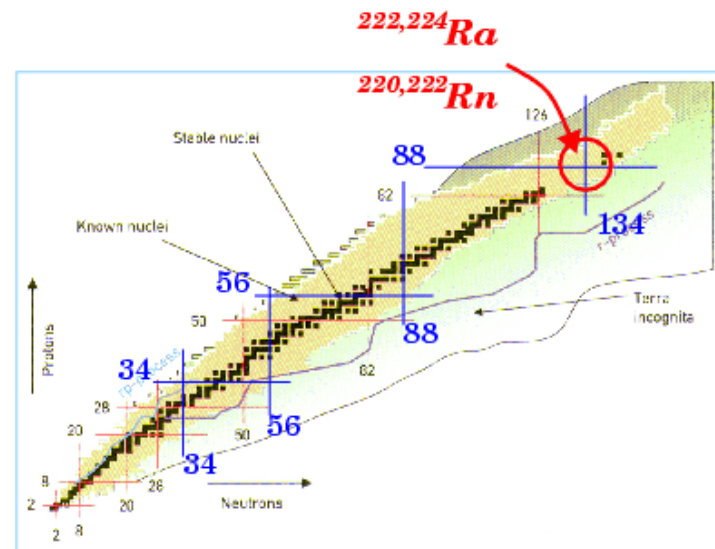
Nuclear shell structure



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Strong **octupole** correlation



Octupole collectivity in nuclei

Macroscopic

Nuclear Shape:

2^L -pole

L=3: **Octupole**

PEAR shape



Octupole collectivity in nuclei

Macroscopic

Nuclear Shape:

2^L -pole

L=3: Octupole



reflection asymmetric

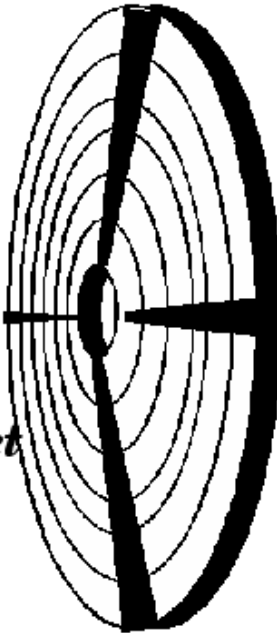
Coulex at REX-ISOLDE

Miniball 4 π Array



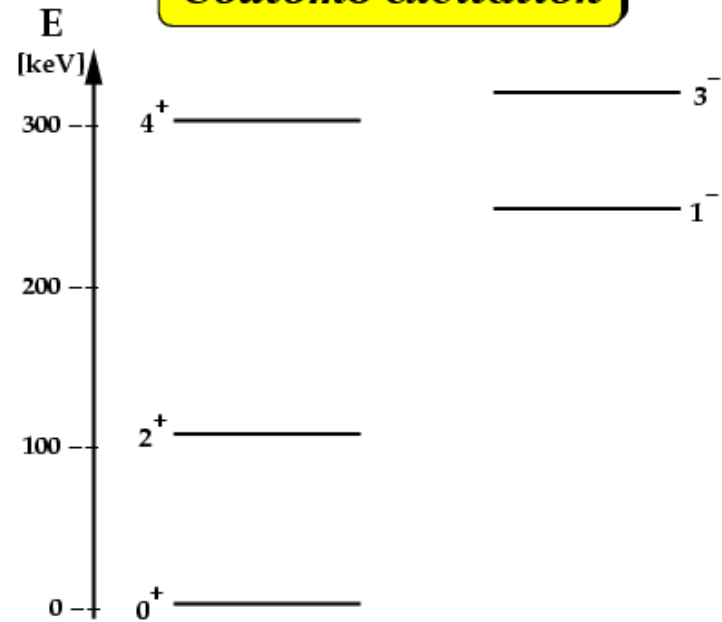
*Rn/Ra
Beam*

*¹¹⁴Cd
Coulex Target*



DSSD Particle Detector

Coulomb excitation



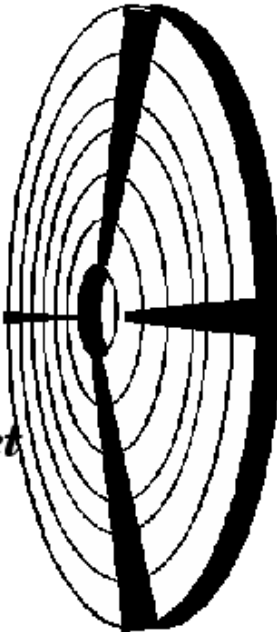
Coulex at REX-ISOLDE

Miniball 4 π Array



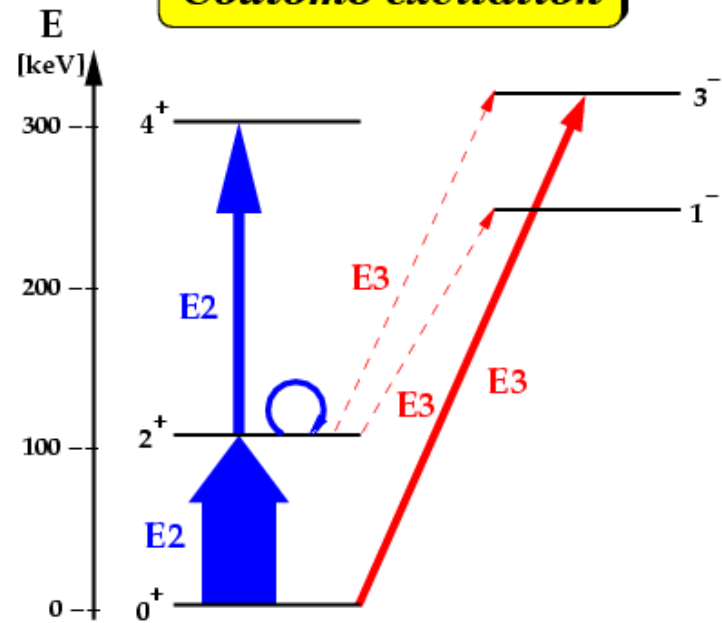
*Rn/Ra
Beam*

*¹¹⁴Cd
Coulex Target*



DSSD Particle Detector

Coulomb excitation



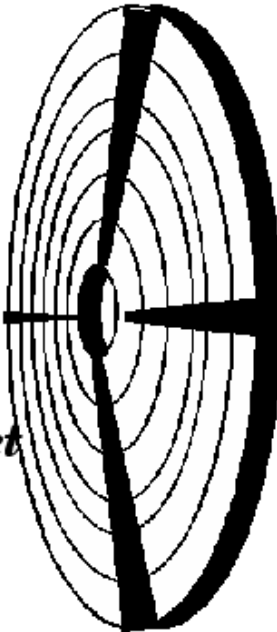
Coulex at REX-ISOLDE

Miniball 4 π Array



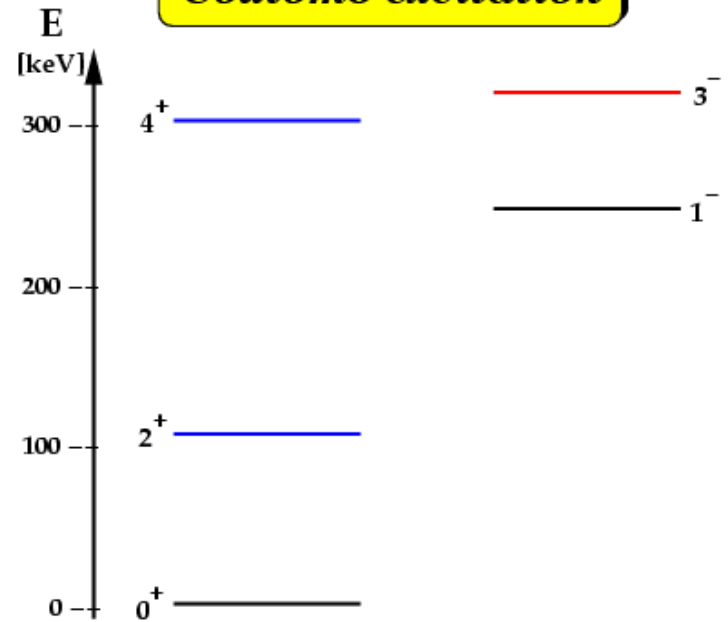
*Rn/Ra
Beam*

*^{114}Cd
Coulex Target*



DSSD Particle Detector

Coulomb excitation



Coulex at REX-ISOLDE

Miniball 4π Array



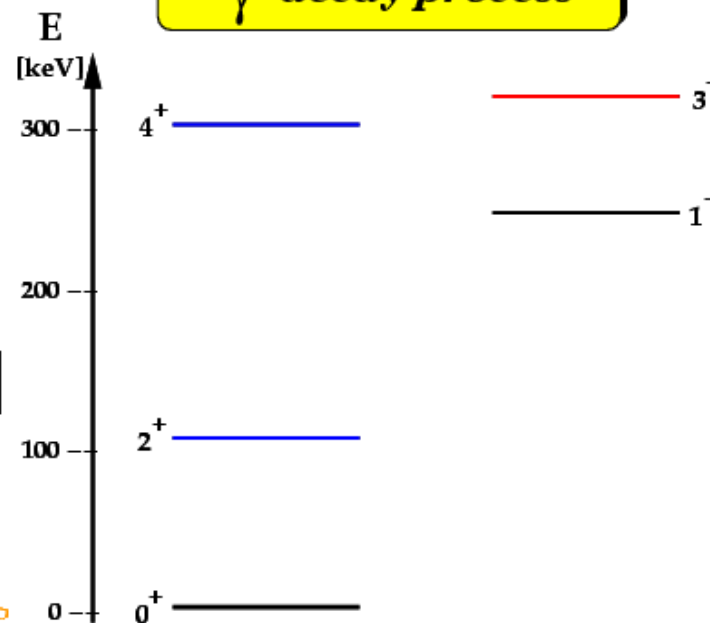
Rn/Ra
Beam

^{114}Cd
Coulex Target



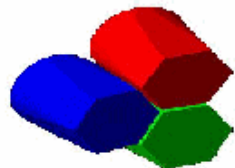
DSSD Particle Detector

γ -decay process



Coulex at REX-ISOLDE

Miniball 4 π Array



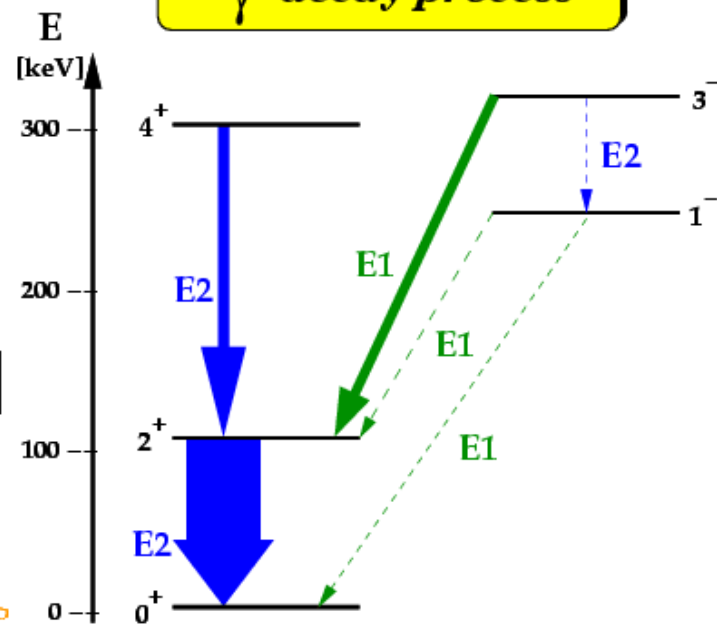
Rn/Ra Beam

^{114}Cd Coulex Target



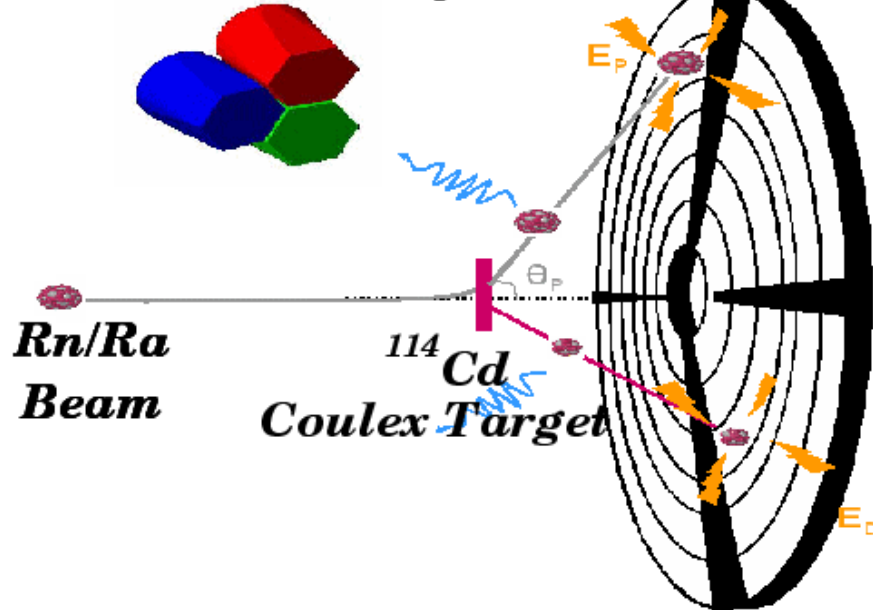
DSSD Particle Detector

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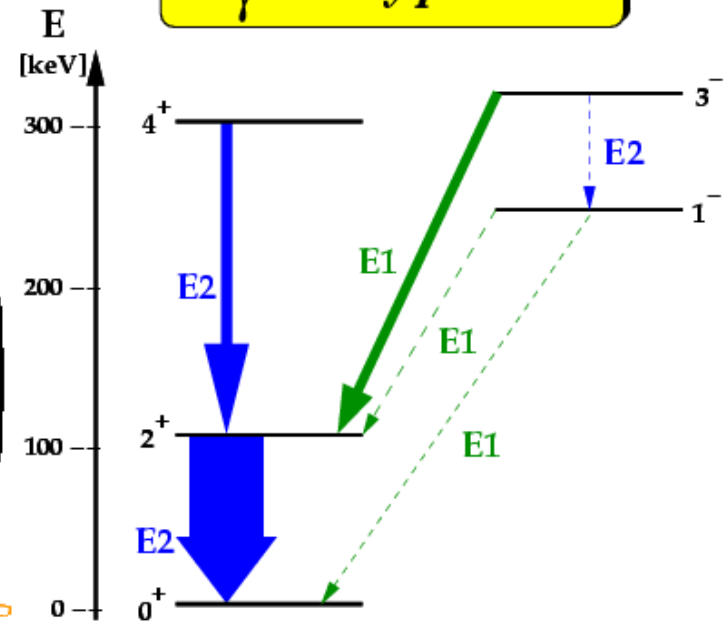


Coulex at REX-ISOLDE

Miniball 4 π Array



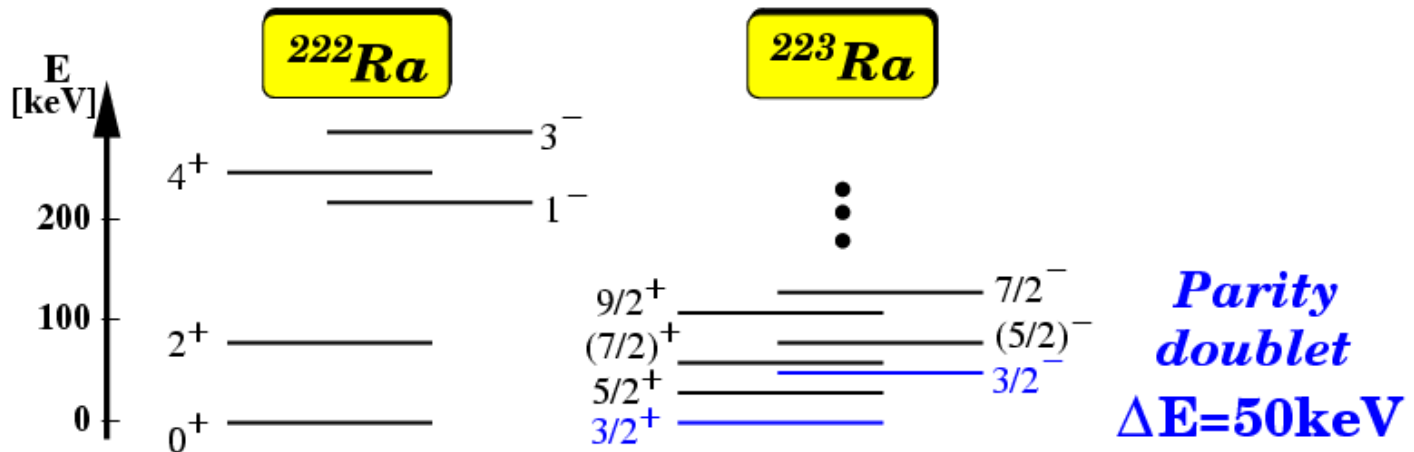
γ -decay process



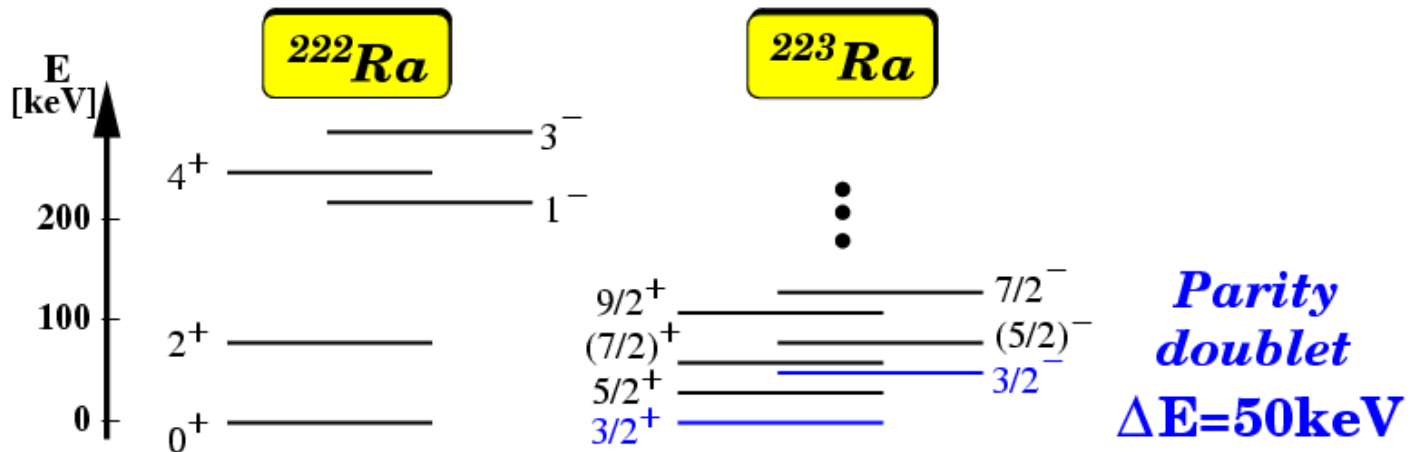
$$I(E1) \downarrow \propto I(E3) \uparrow$$

$$\propto B(E3, 0^+ \rightarrow 3^-) \propto \beta_3$$

Octupole collectivity and fundamental symmetries



Octupole collectivity and fundamental symmetries

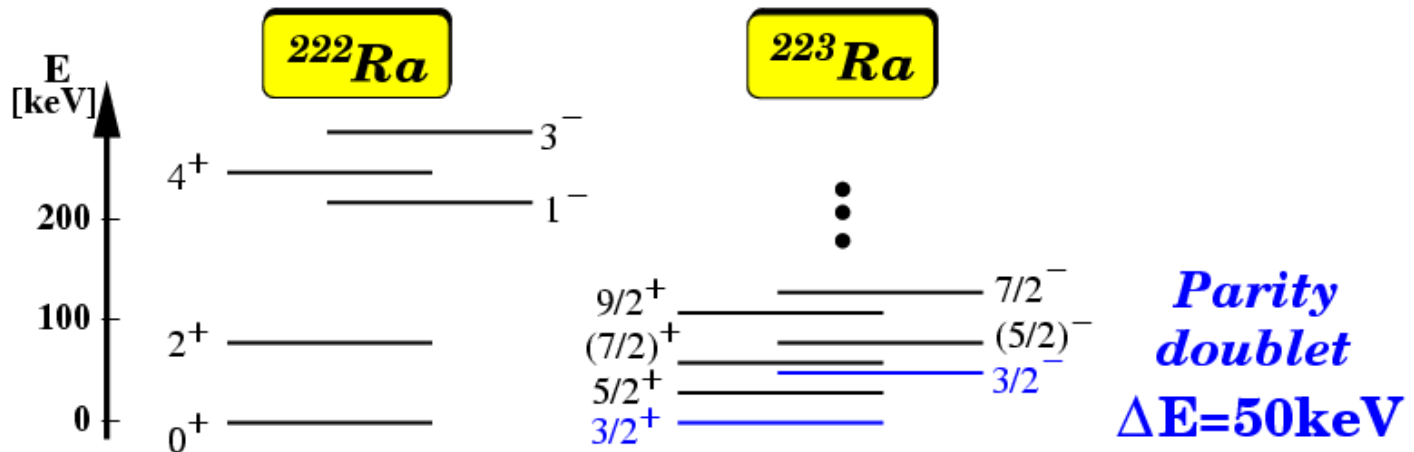


Schiff Moment:

$$S = \sum \frac{\langle +_{gs} || \hat{S}_z || - \rangle \langle - || \hat{V}_{PT} || +_{gs} \rangle}{E_0 - E_i} + c. c.$$

J.Dobaczewski & J.Engel, PRL 94, 232502 (2005)

Octupole collectivity and fundamental symmetries

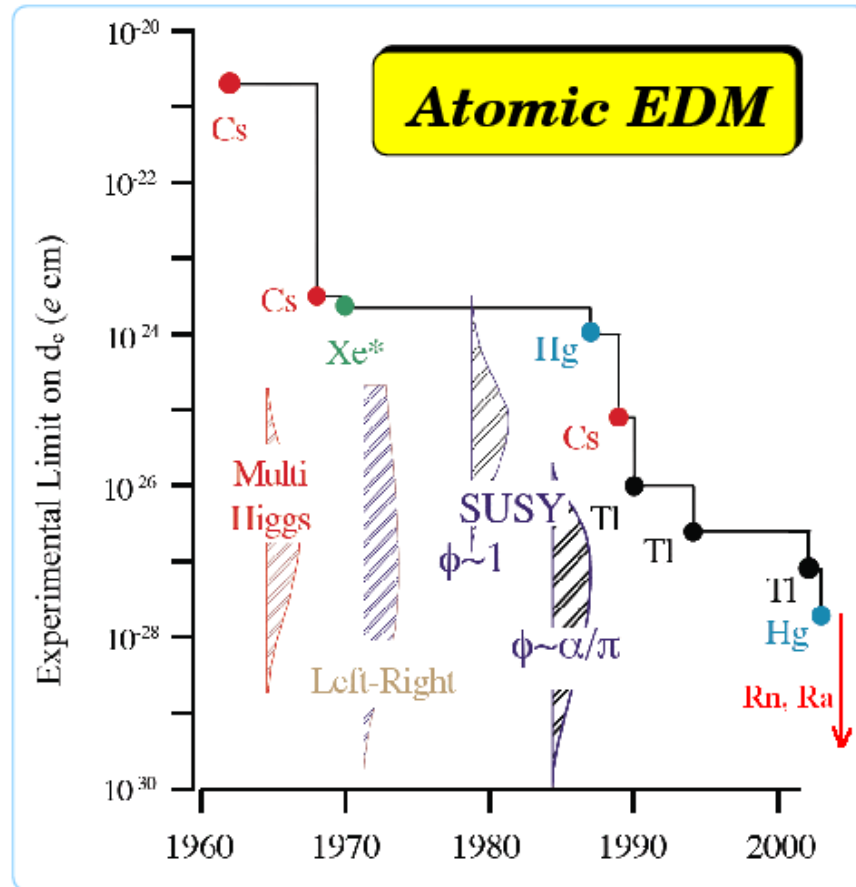


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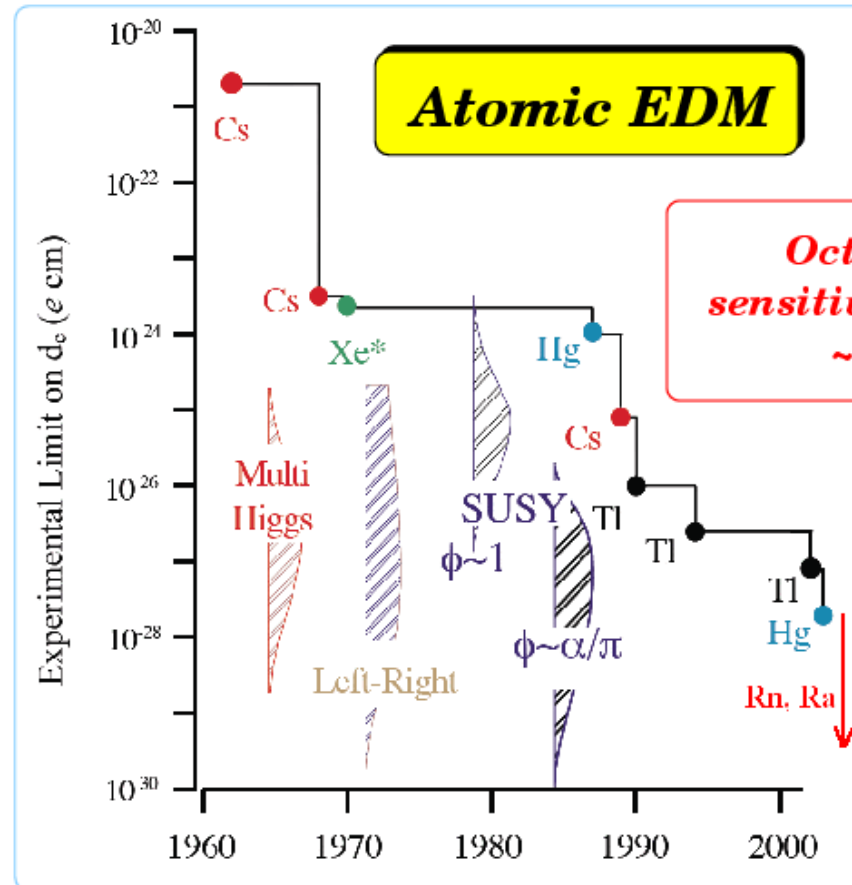
Proton asymmetric pear shape:
$$\hat{S}_z = \frac{e}{10} \sum_{\pi} (r_{\pi}^2 - \frac{5}{3} \bar{r}_{ch}^2) z_{\pi}$$

J.Dobaczewski & J.Engel, PRL 94, 232502 (2005)

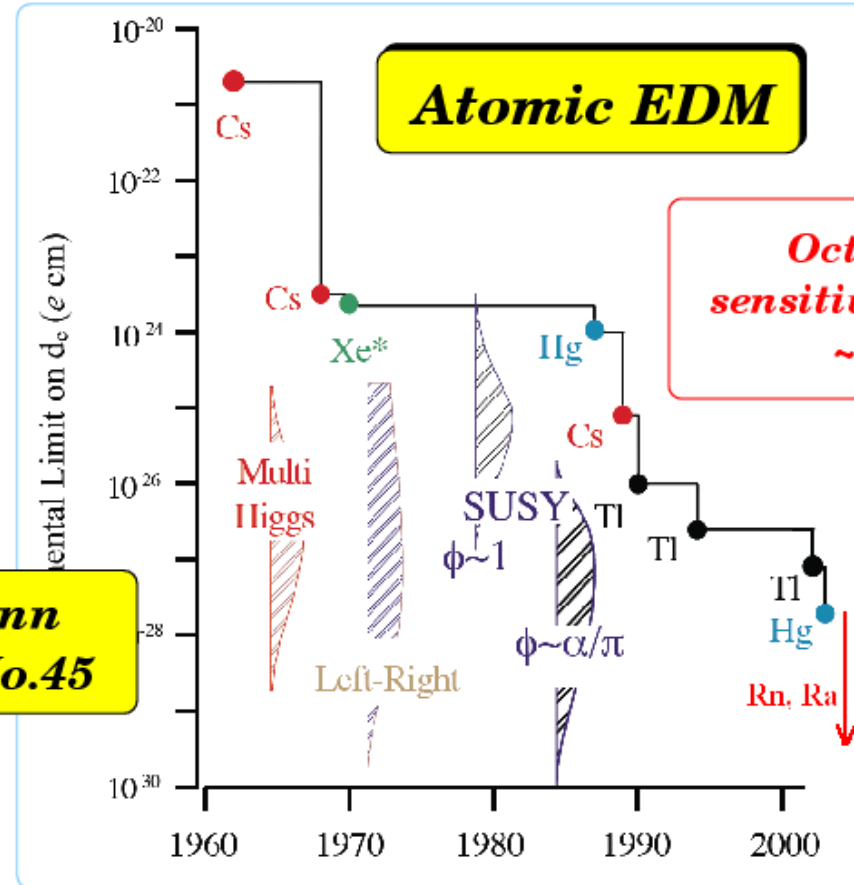
Octupole collectivity and fundamental symmetries



Octupole collectivity and fundamental symmetries



Octupole collectivity and fundamental symmetries



**L. Willmann
Abstract No.45**