

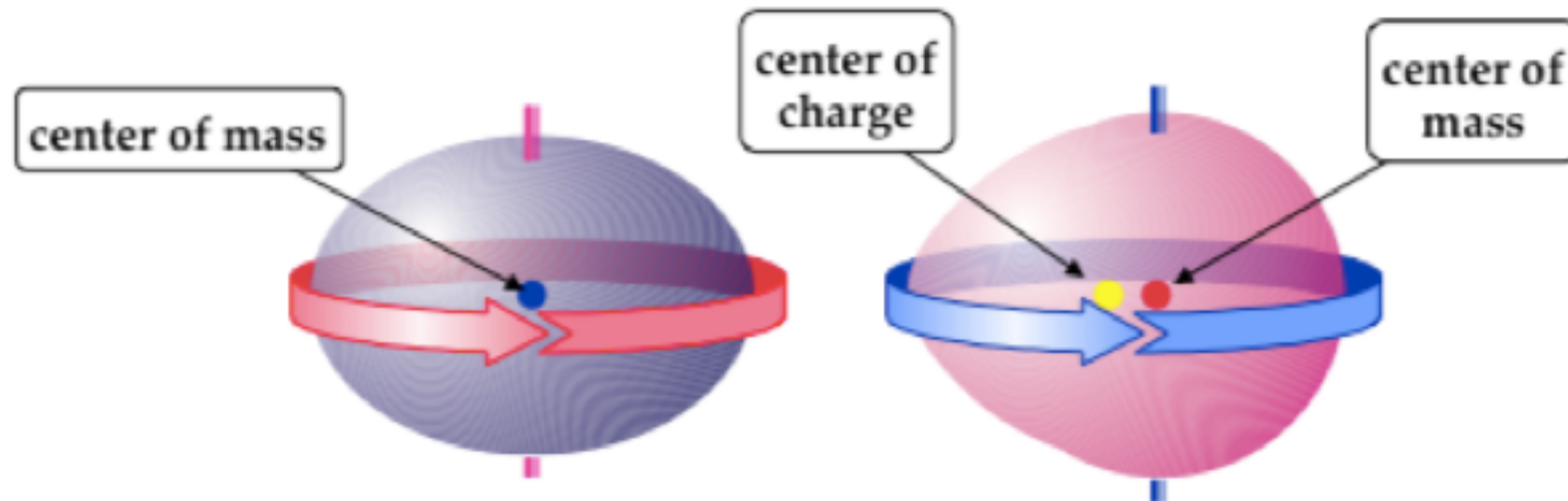
Why are Pear Shaped Nuclei Significant?

Devin Lake
5/01/18



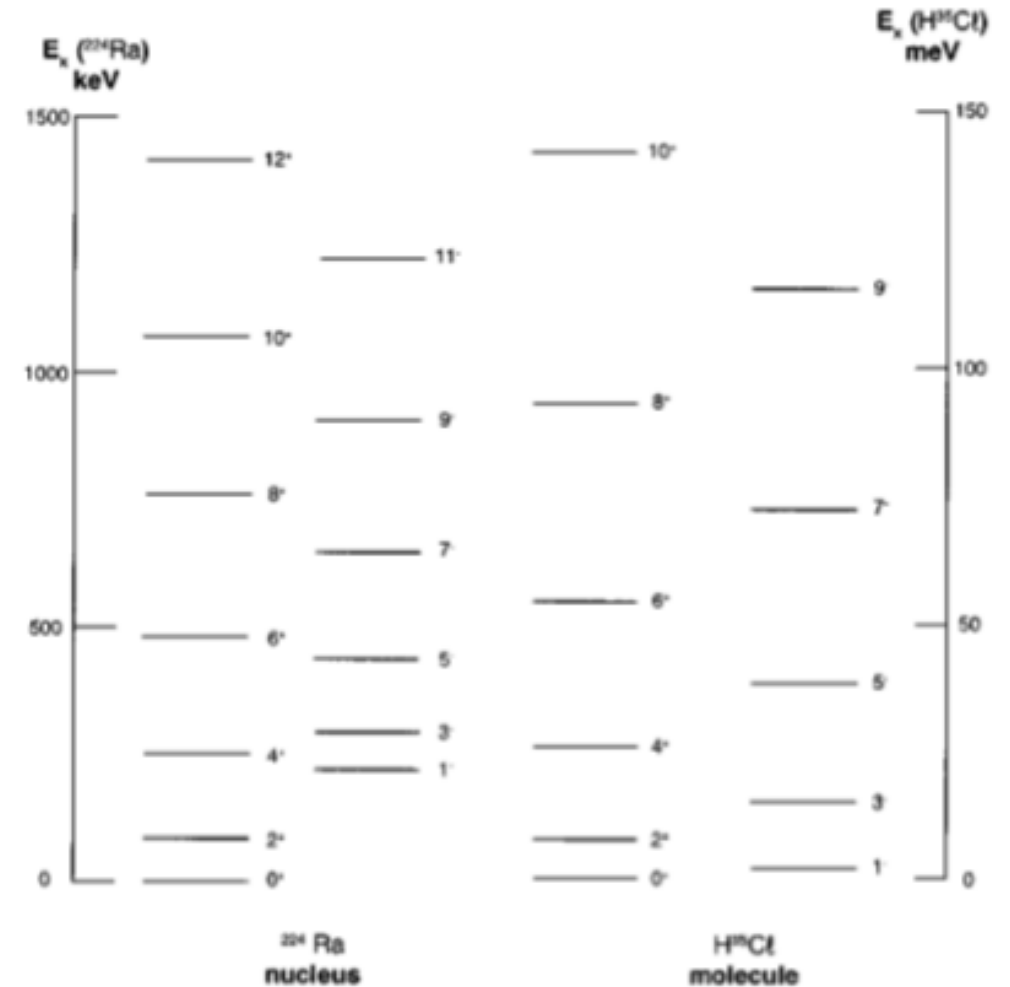
Causes of Deformation

- Strong Force $>$ Coulomb Force
 - Nucleons in the atom will fill quantum states
 - Jahn-Teller Effect
- Octupole-Octupole Interaction leads to Pear Shape
- ^{220}Rd and ^{224}Rd believed to be asymmetric
 - ^{224}Rd associated with octupole



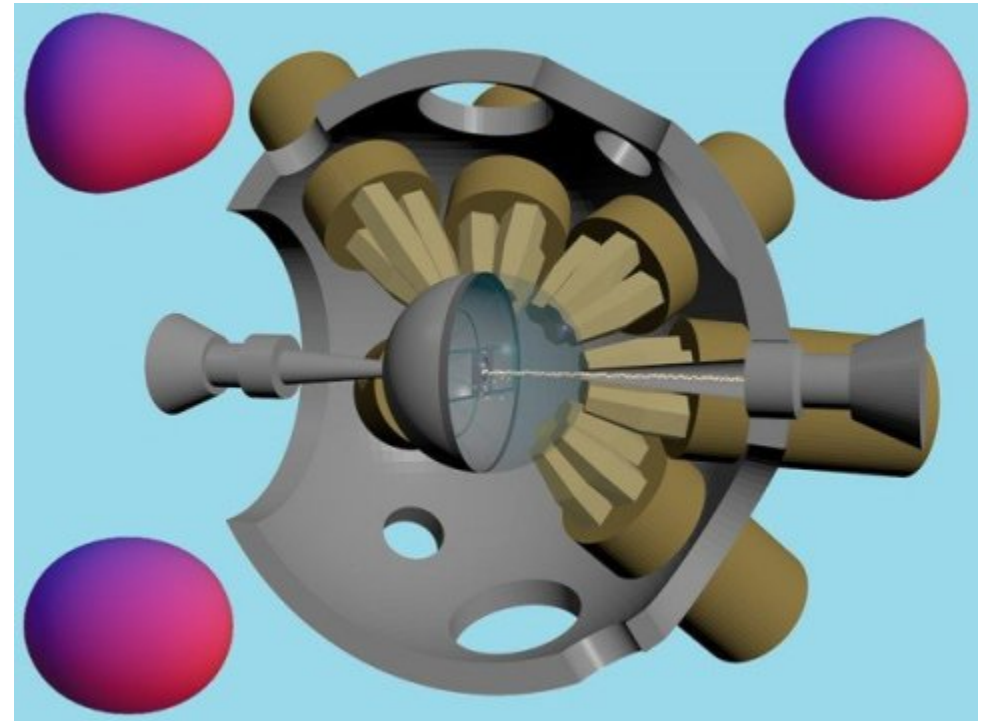
Spatial Asymmetric Nuclei

- ^{224}Ra and ^{220}Ra are spatial asymmetric
 - Measured using rotational spectrum
 - ^{224}Ra associated with octupole interaction
- In 2016 ^{144}Ba had its nucleus directly measured to be pear shaped
 - In 2017 ^{146}Ba was also added to this list



Measurement of Barium

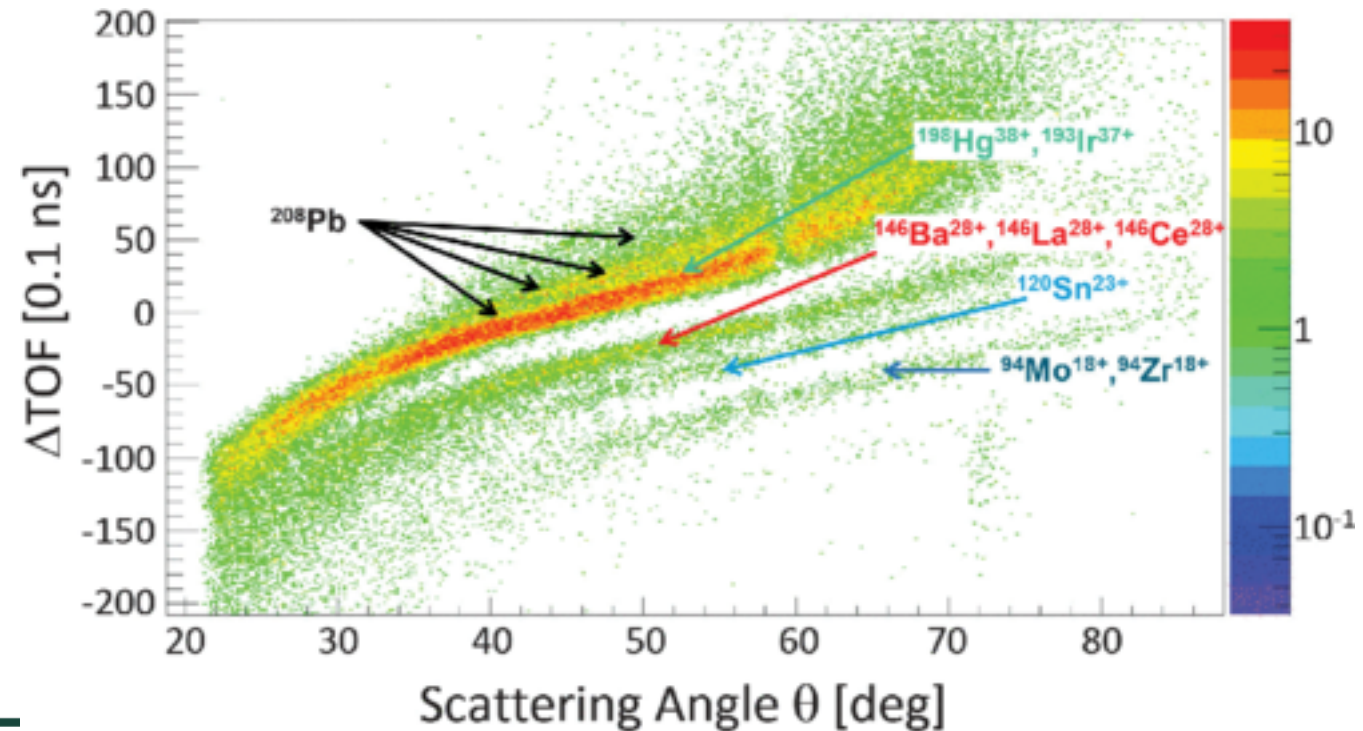
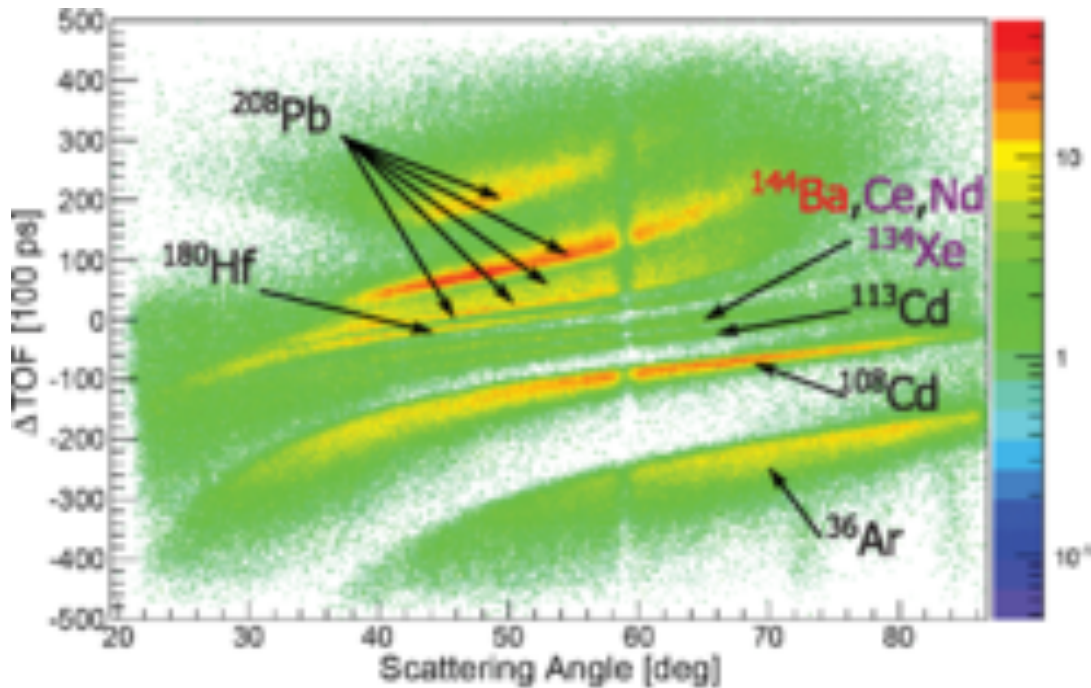
- Conducted at ATLAS
 - Californium Ion source created Ba Beam
- Used Pb target to measure scattering angle
- Used improved charged particle detectors to sort Ba nuclei
 - CHICO2



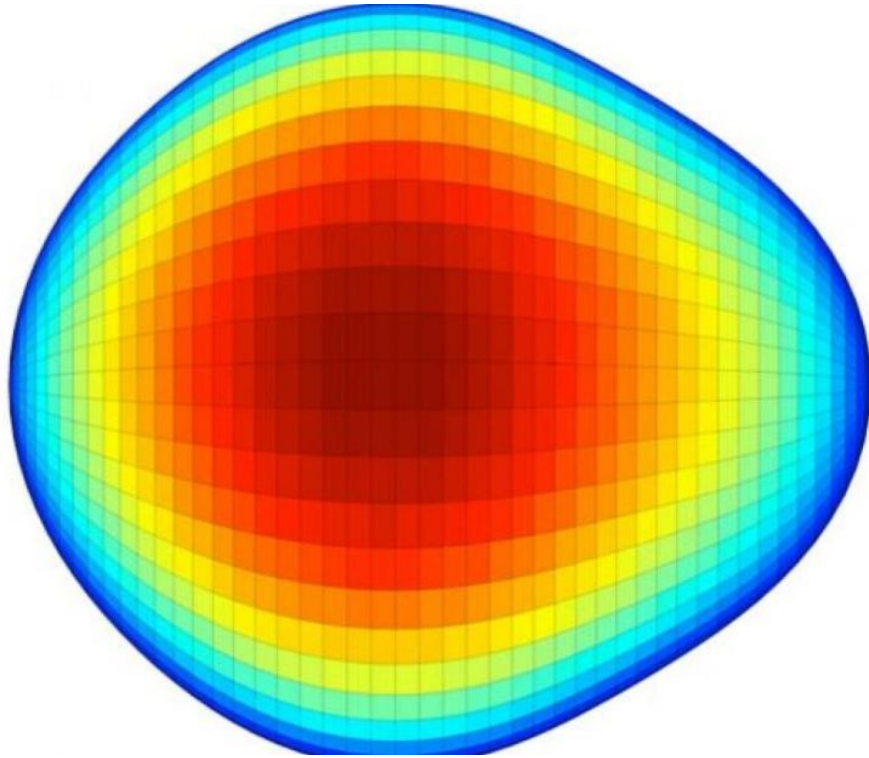
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Measurement of Barium Cont.

- Beam contained a large number of contaminants
 - Extra detectors were required to filter out the results



Significance



- May explain lack of antimatter
- CP-symmetry breaking
 - Implies there is CPT-symmetry breaking

References

1. Butcher *et al.* (2016). Direct Evidence of Octupole Deformation in Neutron-Rich ^{144}Ba . doi: 10.1103/PhysRevLett.116.112503
2. Butler, P.A., Nazarewicz, W. (1996). Intrinsic Reflection Asymmetry in Atomic Nuclei. doi: 10.1103/RevModPhys.68.349