The evolution of nuclear structure in light osmium isotopes; gamma ray spectroscopy of ^{163}Os and ^{165}Os

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Overview

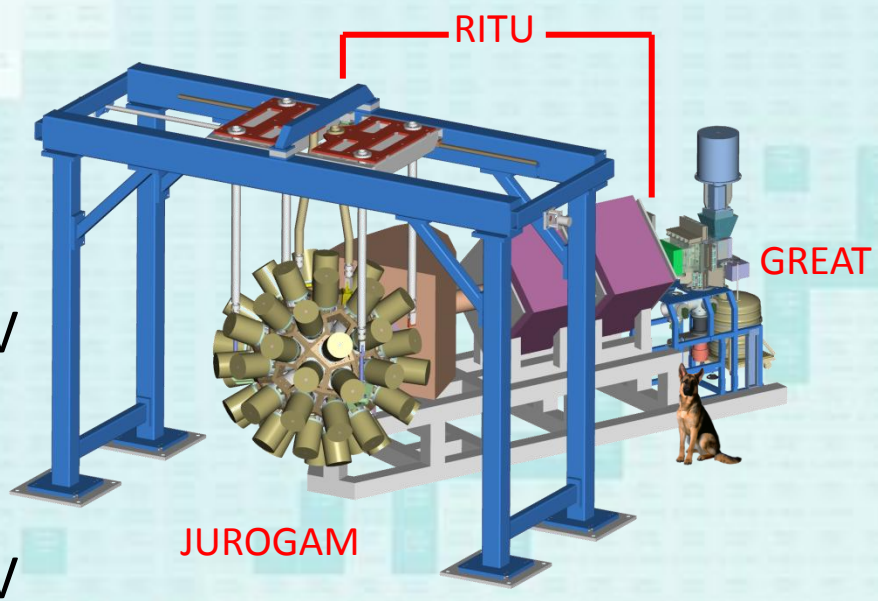
- Introduction & Motivation
- Experimental Setup
- RDT + escapes
- Results
  - ^{165}Os
  - ^{163}Os
- Discussion
- Conclusions

Introduction & Motivation

- Osmium isotopes are known to exist down to mass number 161.
- Although ^{165}Os has been studied previously by D.E. Appelbe et al., a gamma coincidence analysis was not performed.
- Gamma rays for ^{163}Os have been identified for the first time using the Recoil Decay Tagging (RDT) method.
- A gamma coincidence analysis has been performed on both nuclei in separate experiments and level schemes for both nuclei have been constructed.
- Studying these odd mass nuclei give indications of configurations of neighbouring even mass osmium isotopes.

Experimental Details

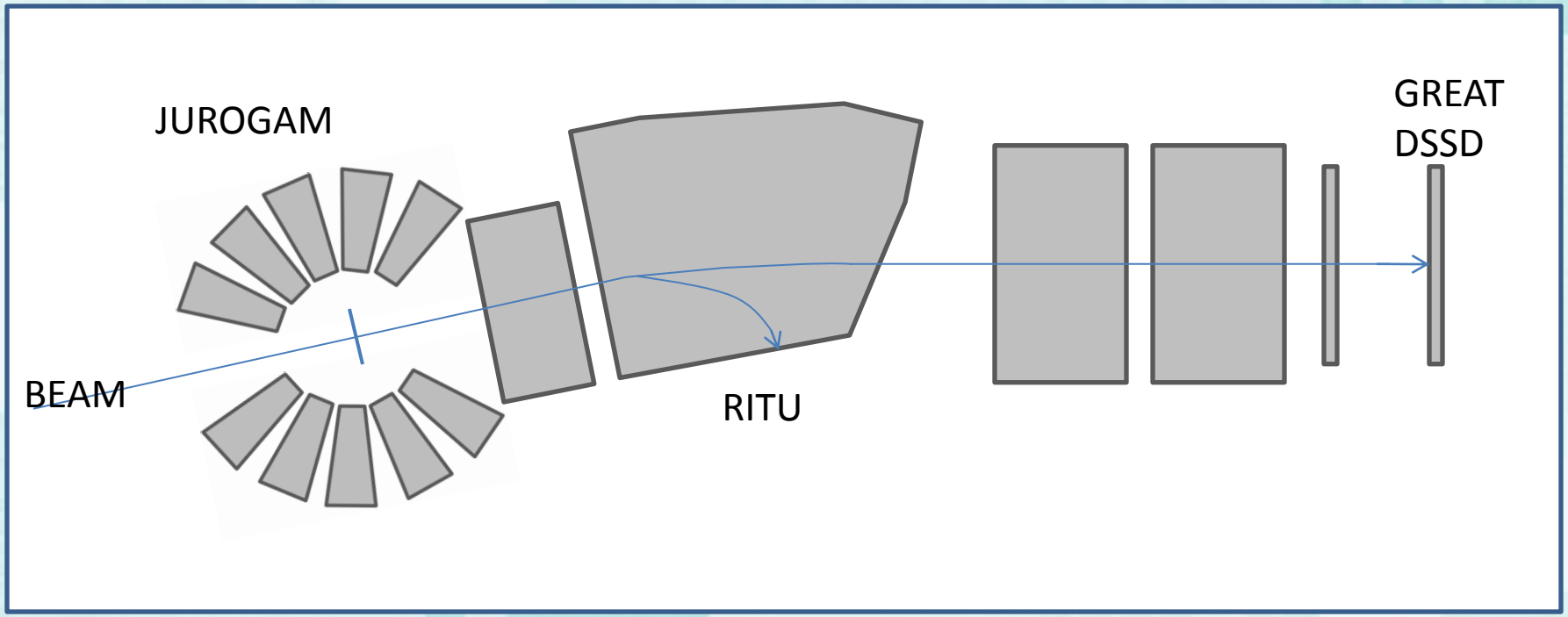
- Using JUROGAM-RITU-GREAT setup at Jyvaskyla.
- $^{106}Cd(^{60}Ni,3n)^{163}Os$
  Bombarding energy of 270 MeV target thickness of 1.1 mg/cm^2.
- $^{92}Mo(^{78}Kr,2p3n)^{165}Os$
  Bombarding energy of 357 MeV with a target thickness of 0.5 mg/cm^2 and 1 mg/cm^2



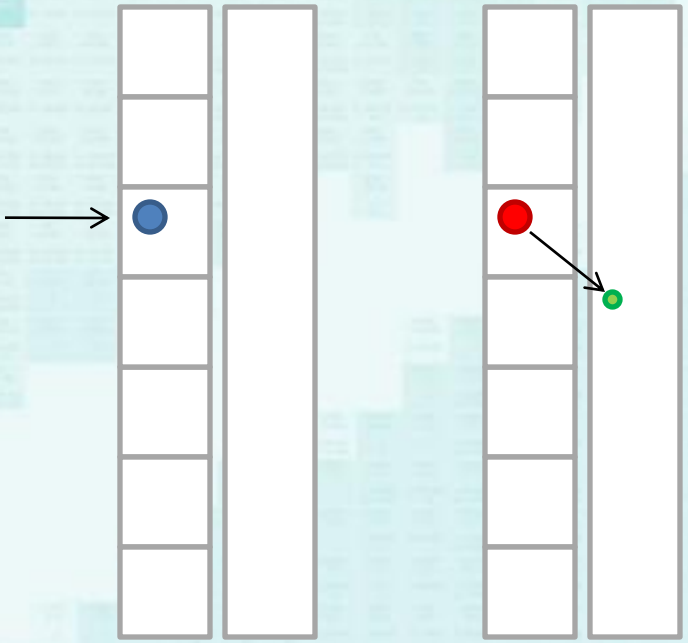
- 43 Compton suppressed germanium detectors at target position
- MWPC and DSSD at focal plane used for spatial and temporal correlations.

Recoil Decay Tagging (RDT)

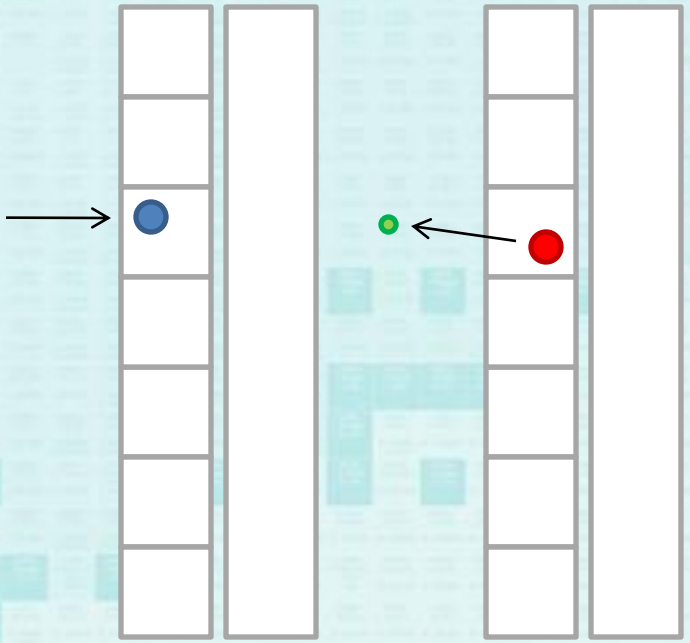
Gamma rays detected by JUROGAM are correlated with nuclei by their subsequent alpha decay at the focal plane



Alpha escapes



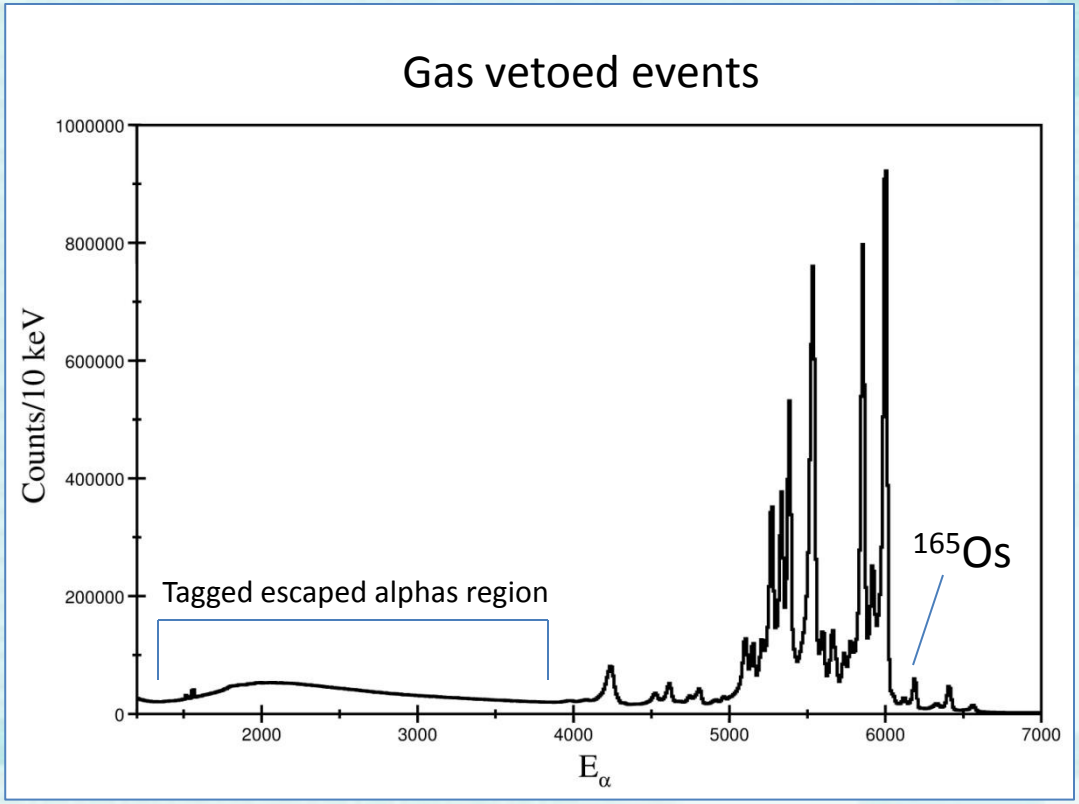
Recoil implantation followed by alpha decay, alpha particle stops within DSSD. Full energy deposited.



Recoil implantation followed by alpha decay, alpha particle escapes DSSD. Partial energy deposited.

RDT + Escapes

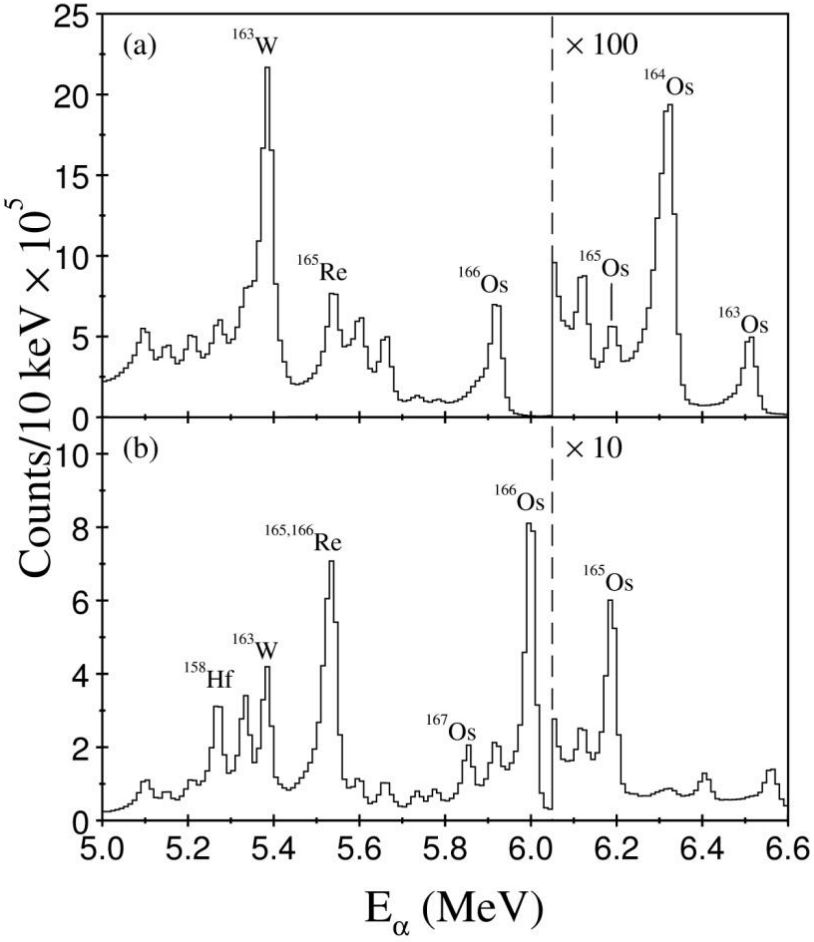
- The normal recoil decay method was used.
- Plus lost counts were recovered through tagging on escaped alpha events.
- Alpha particles can escape the DSSDs and only deposit a fraction of the full energy.
- If an event within the continuum caused by escapes is followed by the daughter decay, then Jurogam events are stored.
- Adds about 20% to coincidence data



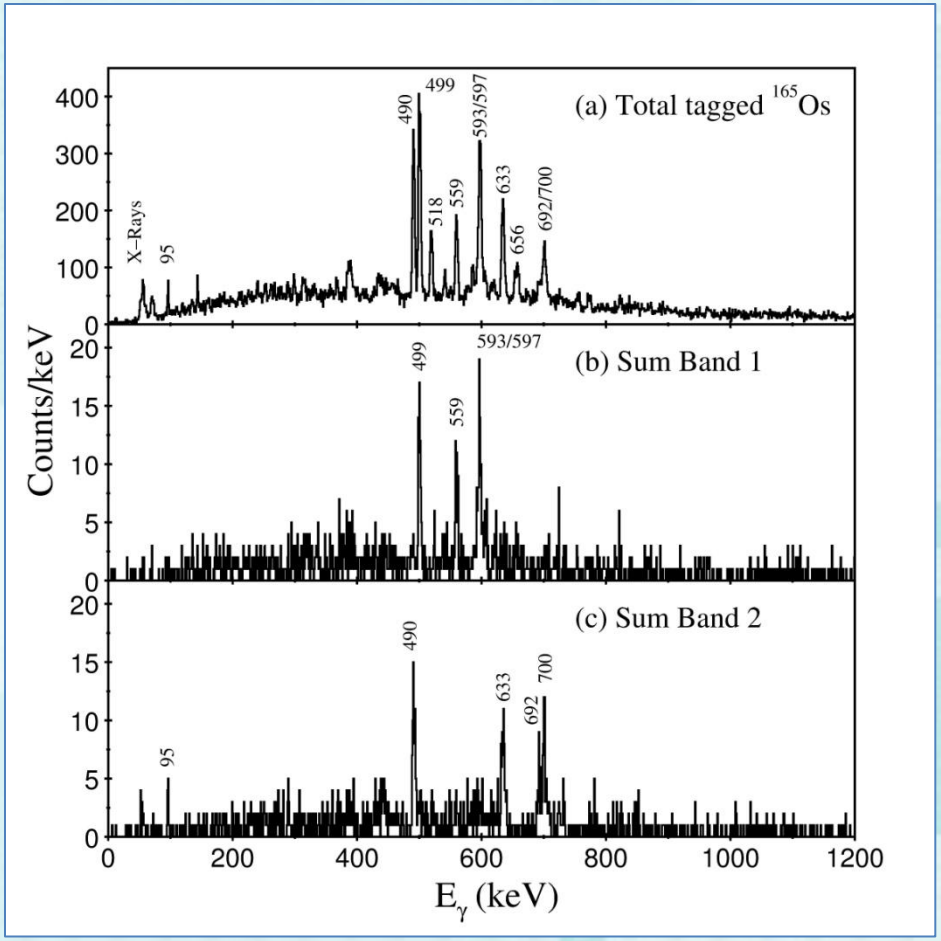
Results

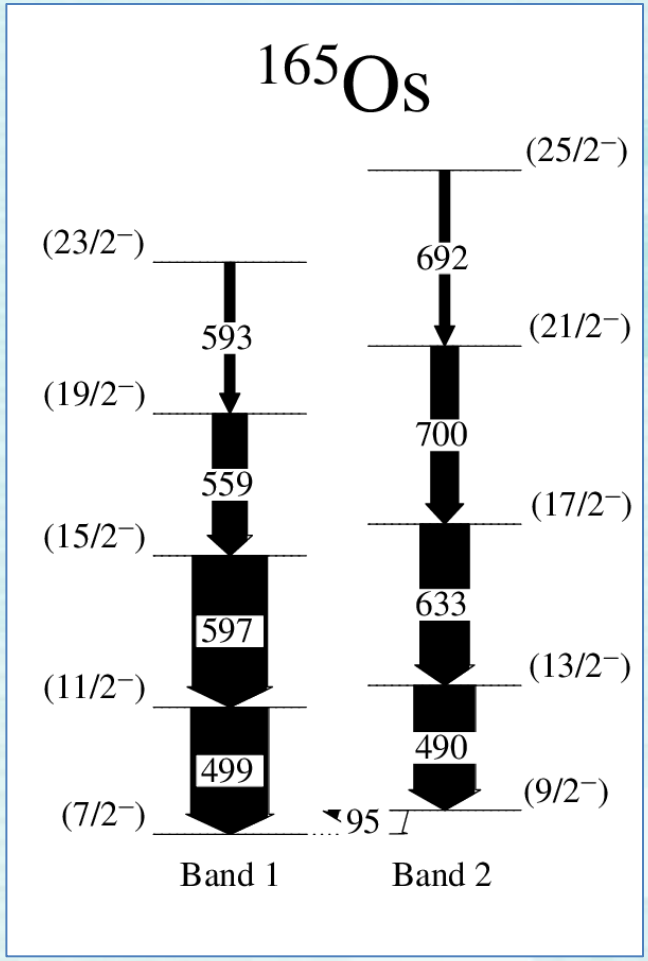
- The spectra on the right show alpha events of in the DSSD of the GREAT spectrometer.
- The number of alpha particles for both ^{163,165}Os are less than 1% of the total alpha events in both reactions.
- This makes it impossible to do gamma ray spectroscopy without recoil decay tagging

Alpha spectra of ^{106}Cd(^{60}Ni,3n)^{163}Os and ^{92}Mo(^{78}Kr,2p3n)^{165}Os respectively

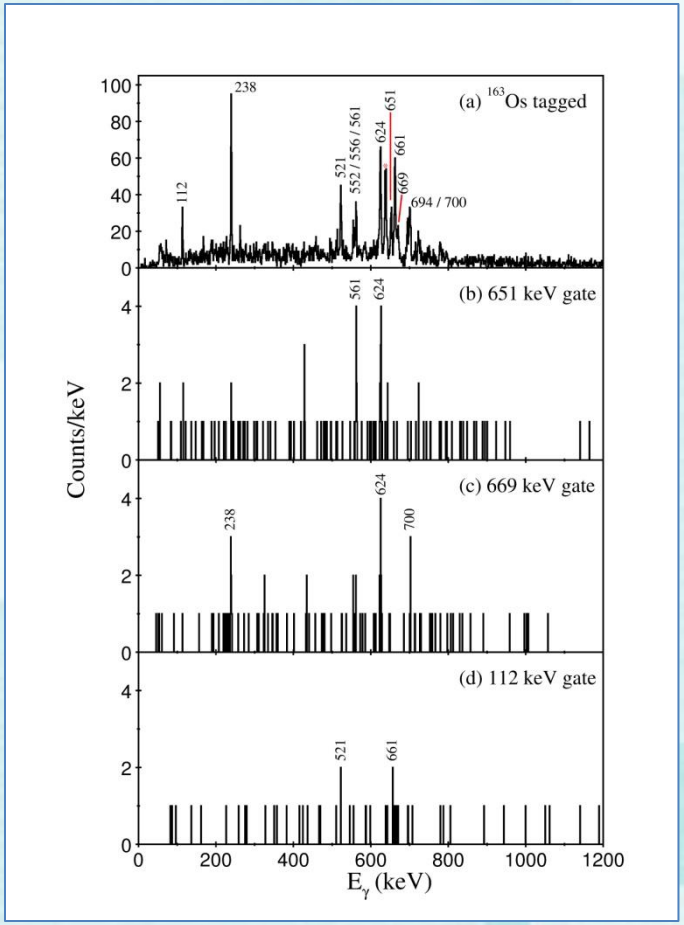


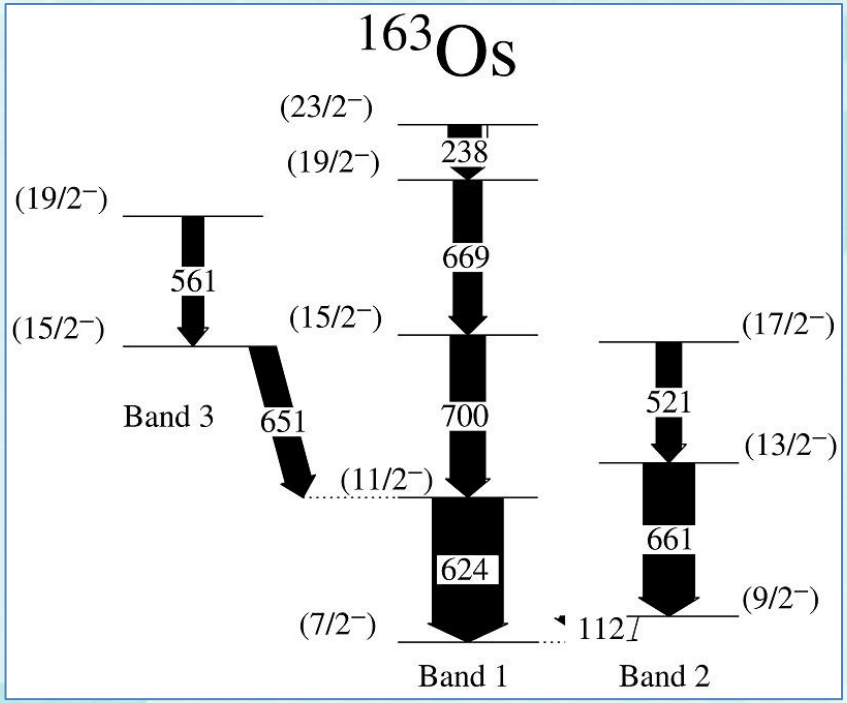
Results – ^{165}Os



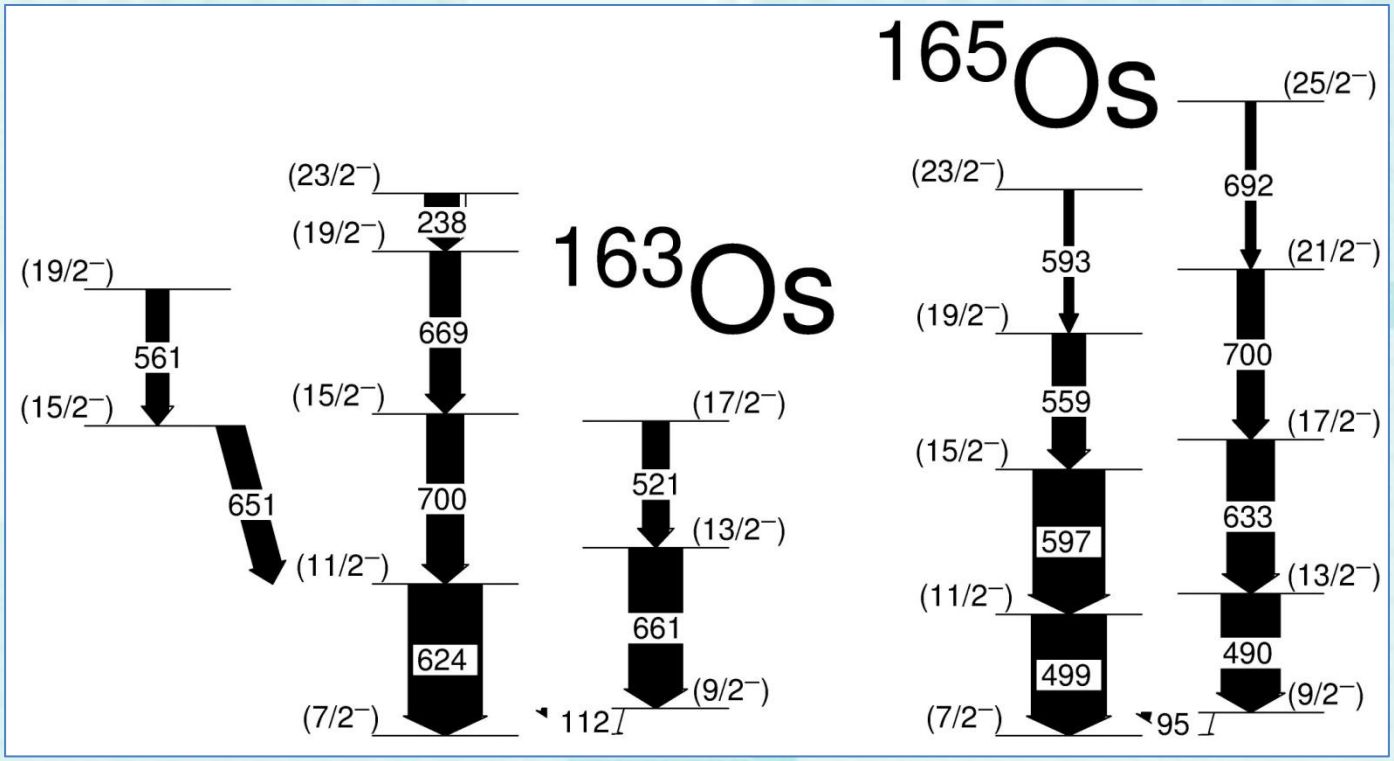


Results – ^{163}Os



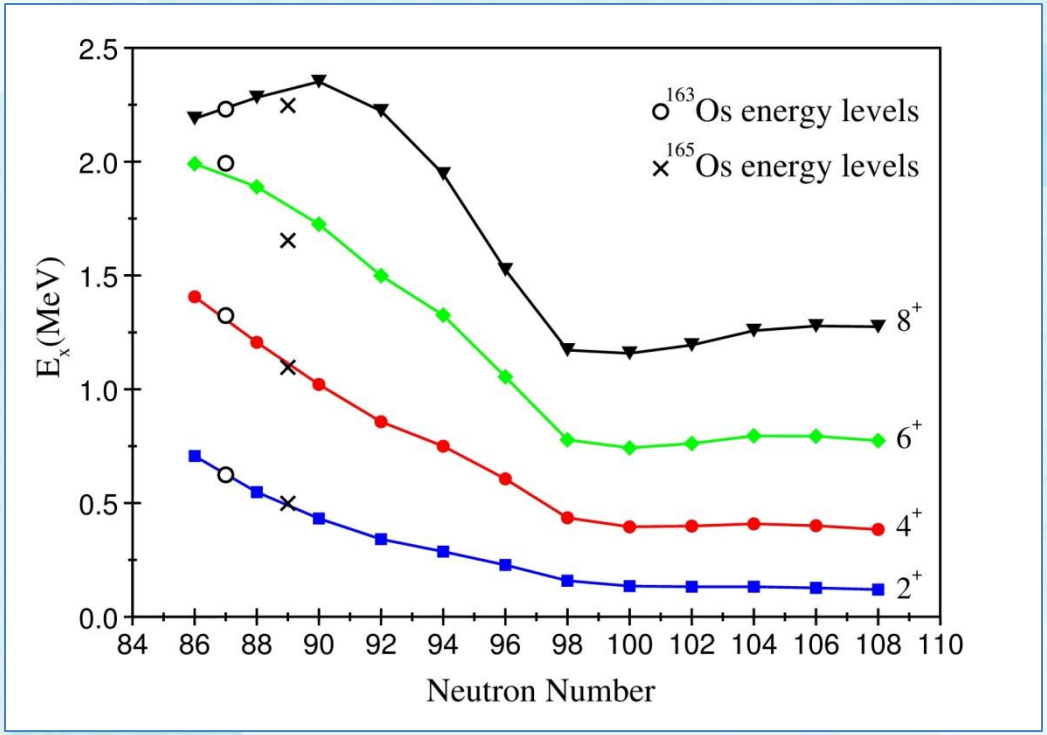


Results


^{165}Os
^{163}Os
(25/2$^-$)
692
(23/2$^-$)
593
(21/2$^-$)
700
(19/2$^-$)
559
(17/2$^-$)
633
(15/2$^-$)
597
(13/2$^-$)
490
(11/2$^-$)
499
(9/2$^-$)
(7/2$^-$)
95
(23/2$^-$)
238
(19/2$^-$)
669
(19/2$^-$)
561
(17/2$^-$)
521
(15/2$^-$)
700
(15/2$^-$)
651
(13/2$^-$)
661
(11/2$^-$)
624
(9/2$^-$)
(7/2$^-$)
112

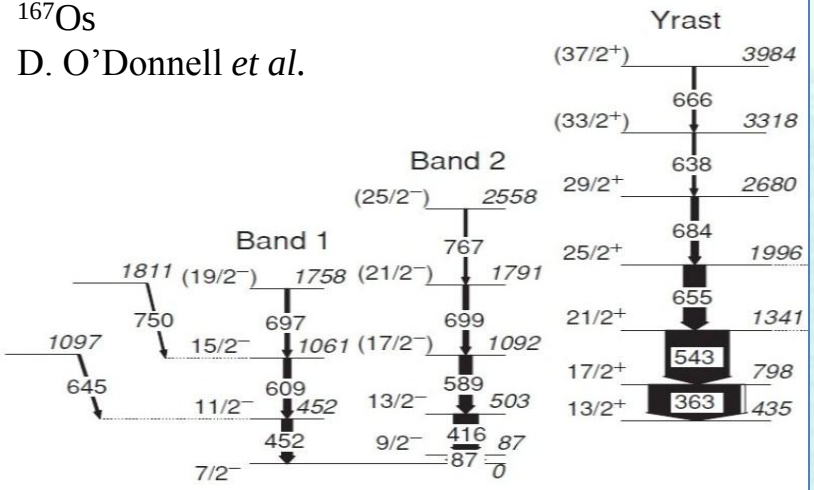
Discussion - Systematics

- Plot shows excited states of ground state band in even osmium isotopes.
- ^{163,165}Os fit in very well with systematics, implying that the odd neutron (87th and 89th) acts as a spectator neutron

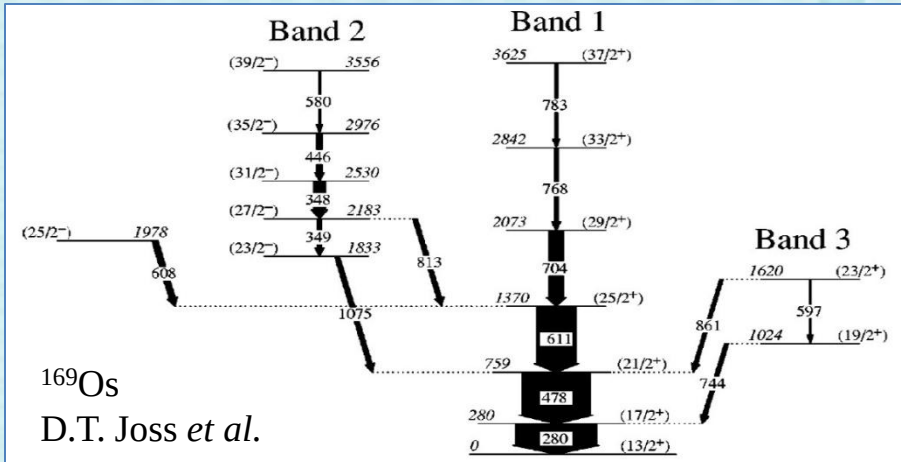


Discussion – Configuration

^{167}Os
D. O'Donnell *et al.*

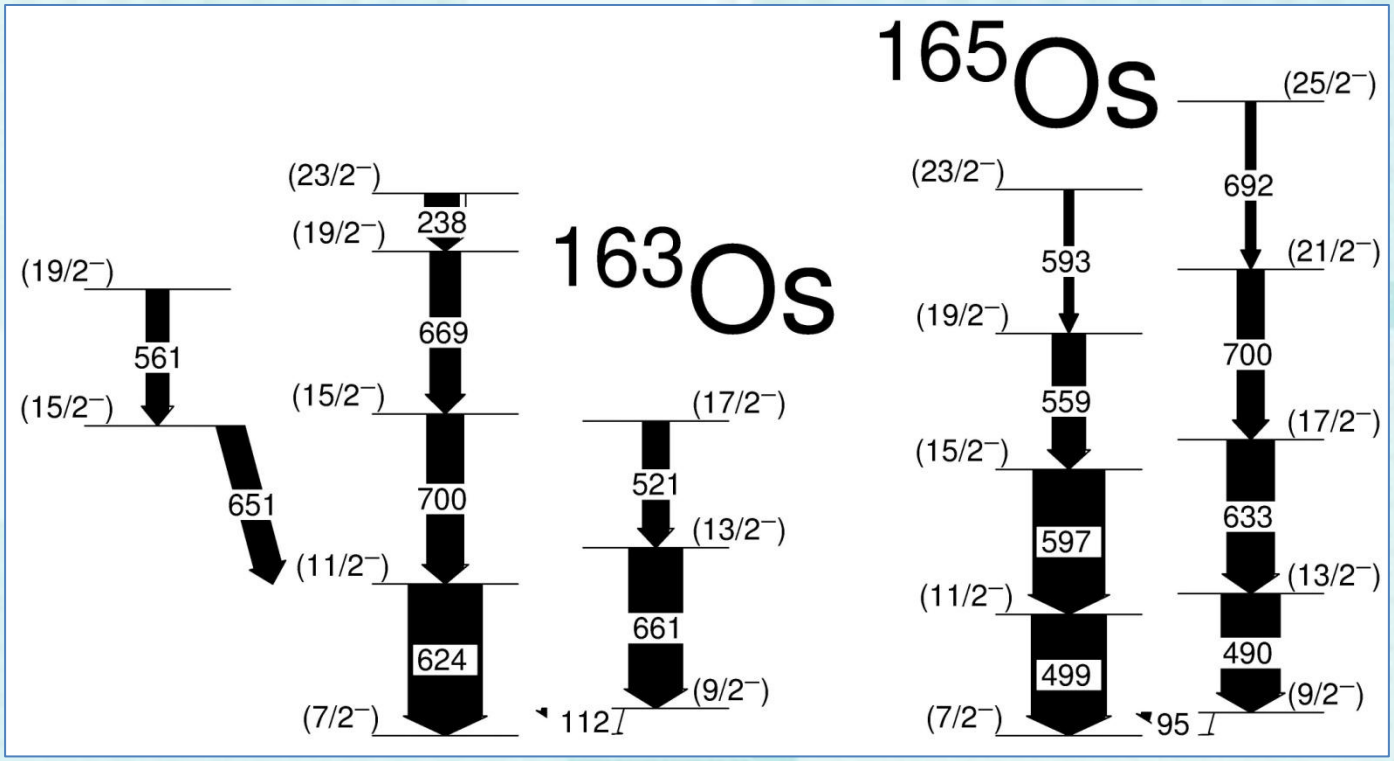


^{169}Os
D.T. Joss *et al.*

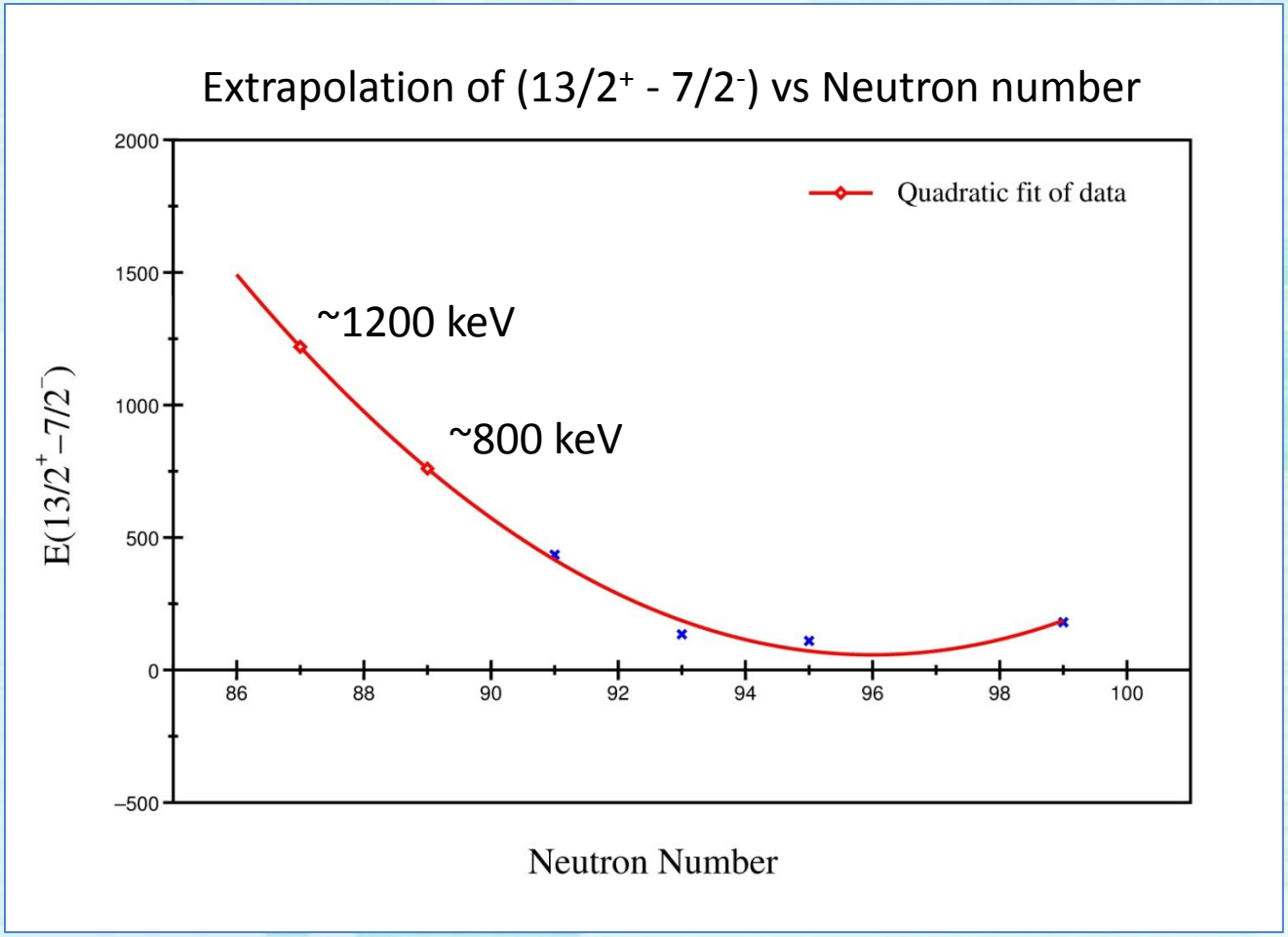


The yrast band is built on the $i_{13/2}$
At lower masses the $f_{7/2}$ and $h_{9/2}$ structures are observed

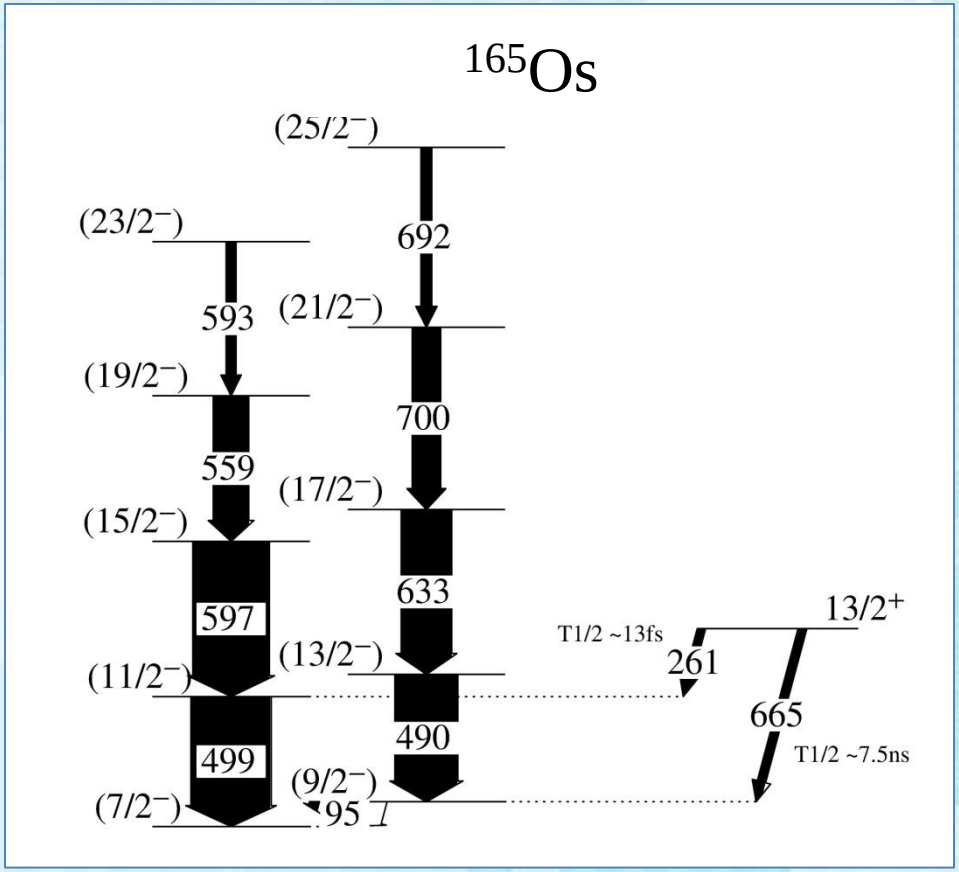
Discussion - Configuration



Discussion – configuration



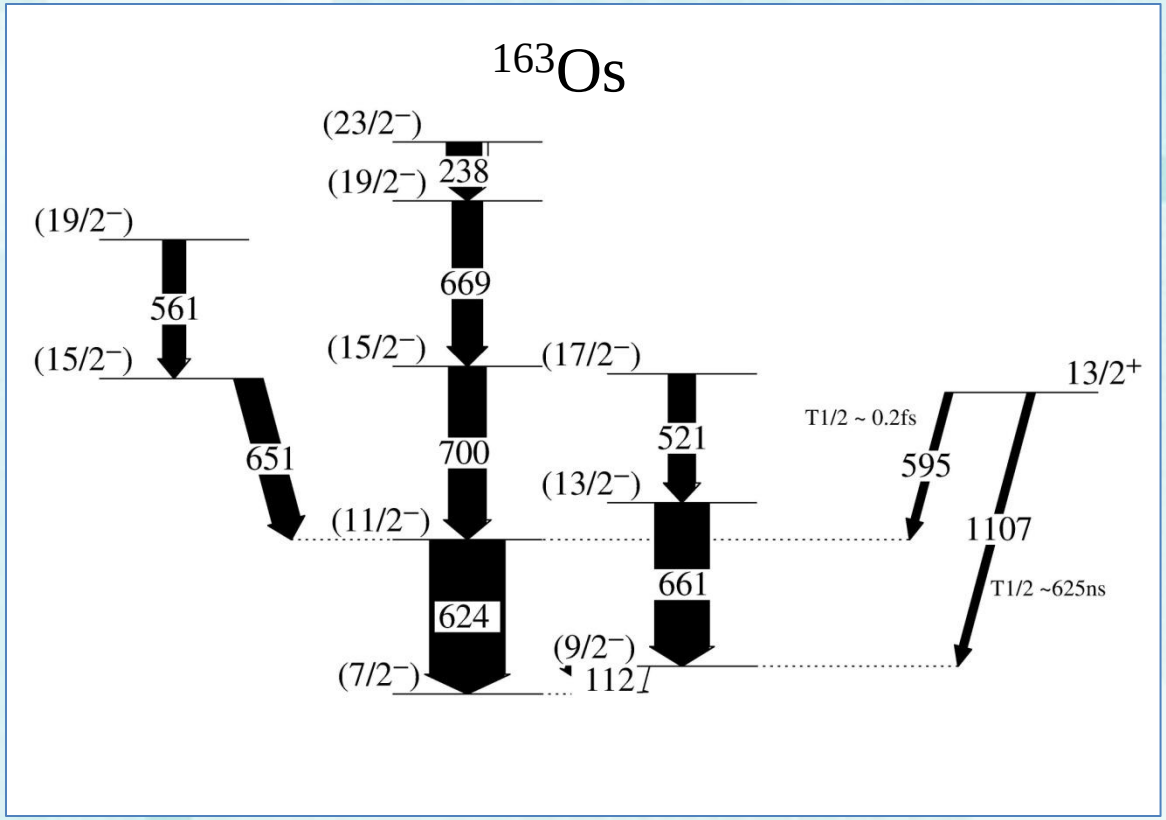
Discussion – Configuration



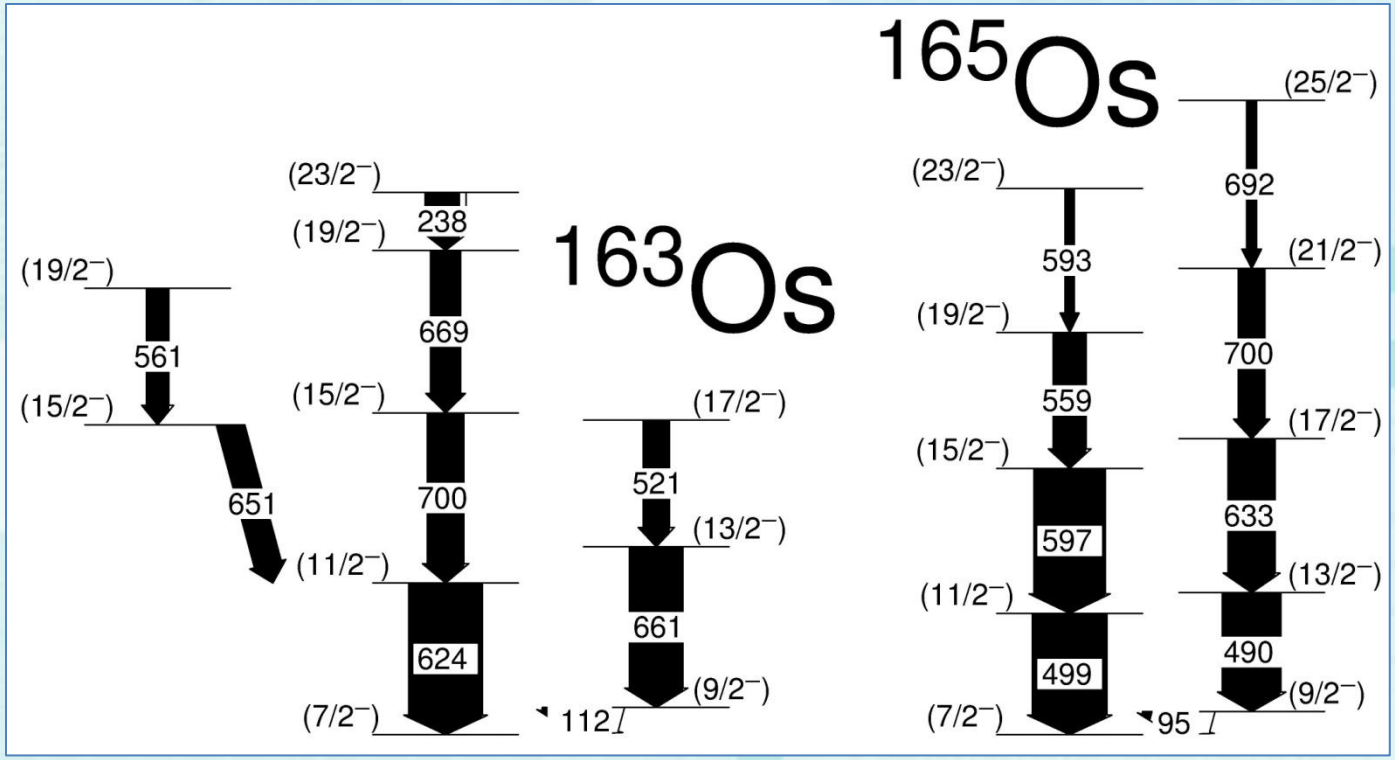
- The $13/2^+$ band head lies higher in energy than $11/2^-$
- Although a crude extrapolation this effect has been observed in other nuclei in this region.

Discussion – Configuration

- Based on the extrapolation, the energy of the $i_{13/2}$ band head is too high to be populated.



Conclusions



- Level schemes have been built for the first time.
- Both nuclei are tentatively assigned a (7/2$^-$) ground state band.
- The configuration of the ground state band $\upsilon(f_{7/2}h_{9/2}{}^2)$

Collaborators

D.T. Joss, R.D. Page, D. O'Donnell, C. Scholey, K. Andgren, L. Bianco, B. Cederwall, I.G. Darby, S. Eeckhaudt, M.B. Gomez-Hornillos, T. Grahn, P.T. Greenlees, B. Hadinia, P.M. Jones, R. Julin, S. Juutinen, S. Ketelhut, M. Leino, A.-P. Leppänen, M. Nyman, J. Pakarinen, P. Rahkila, N. Rowley, M. Sandzelius, P. Sapple, J. Saren, J. Simpson, J. Sorri, A. Steer, J. Uusitalo, and M. Venhart

Thanks for listening

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