Gamma-ray spectroscopy of excited states in the highly neutron-deficient nucleus ^{158}W

UNIVERSITY OF
LIVERPOOL

LILIANA DONOSA

Outline

➢ Physics Motivation

➢ Technique: Recoil decay tagging

➢ Set-up

➢ Results

Motivation

➢ Near closed shells angular momentum is generated by aligning the spins of a small number of valence nucleons.

➢ Establishing level schemes allows the specific orbital configurations to be determined.

➢ Tests of shell model predictions.

➢ Difficult to investigate heavy $N \approx 82$ nuclei.
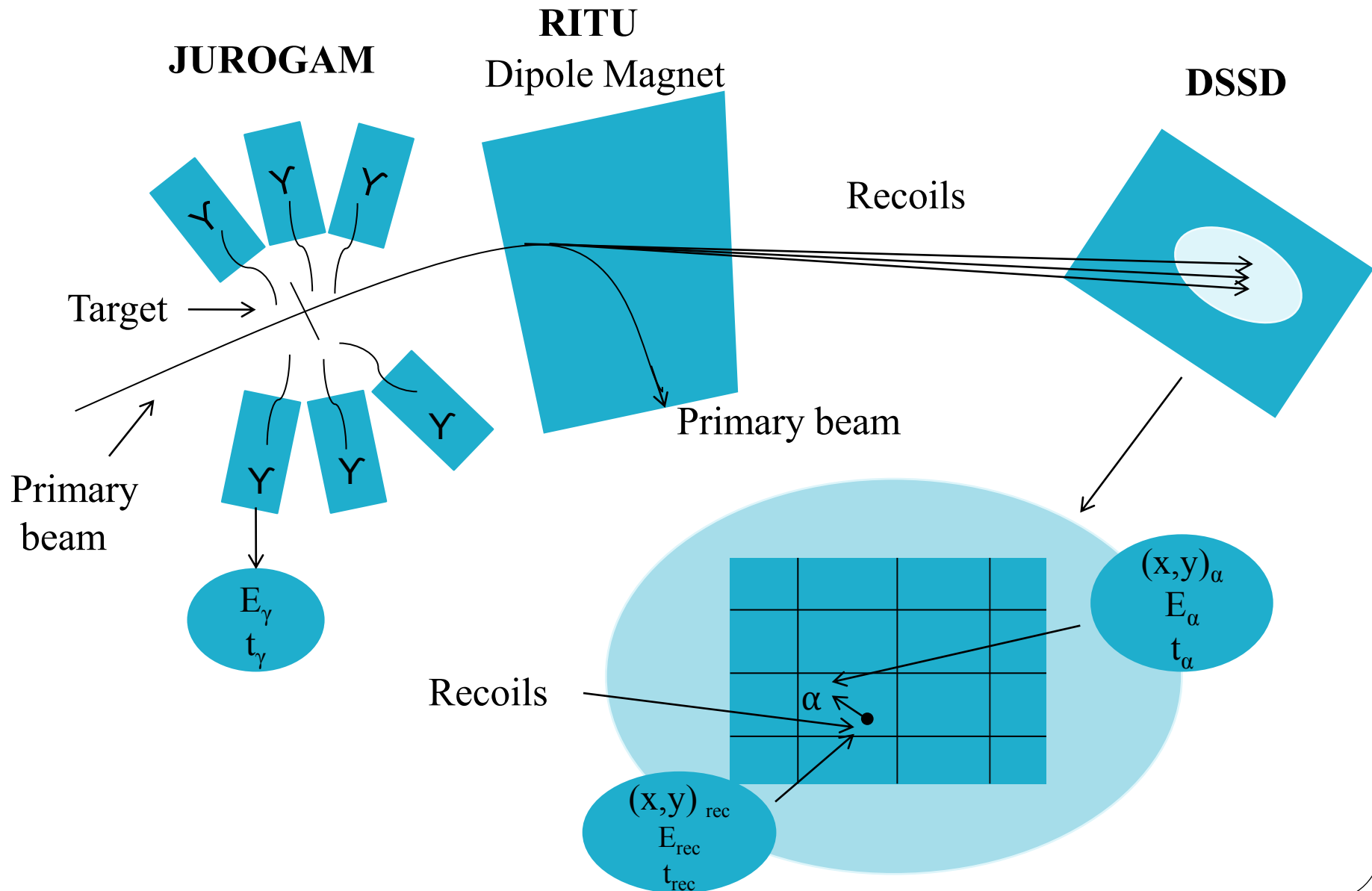
Physics Motivation
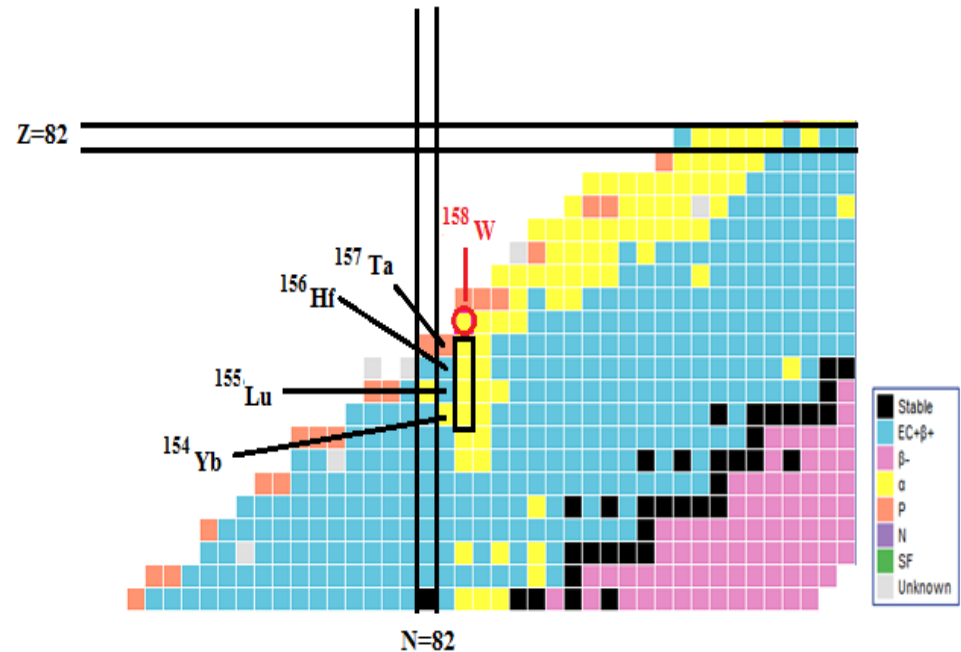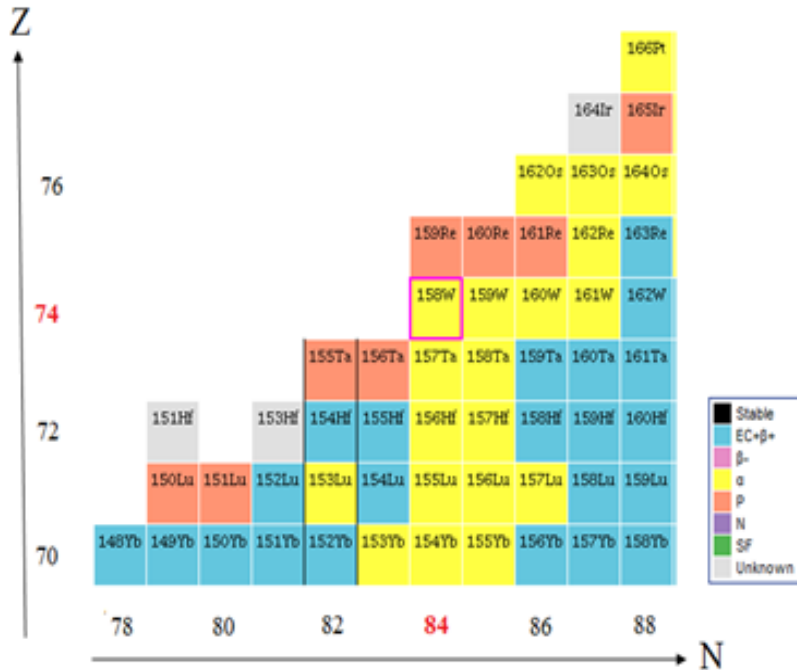
➢**α emitters**
- distinct energies
- short half lives
- high decay branching ratios

➢ **2 neutrons far from N= 82 but 158W has:**
- Cross section very low
- Generate a number of reaction channels in fusion evaporation reaction
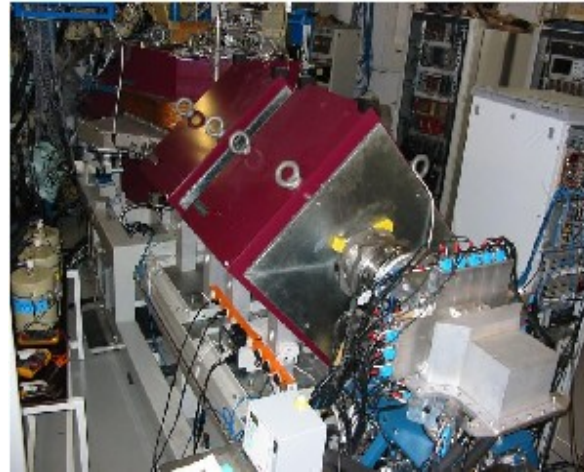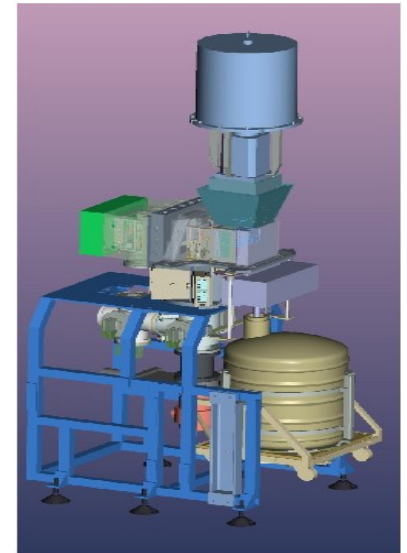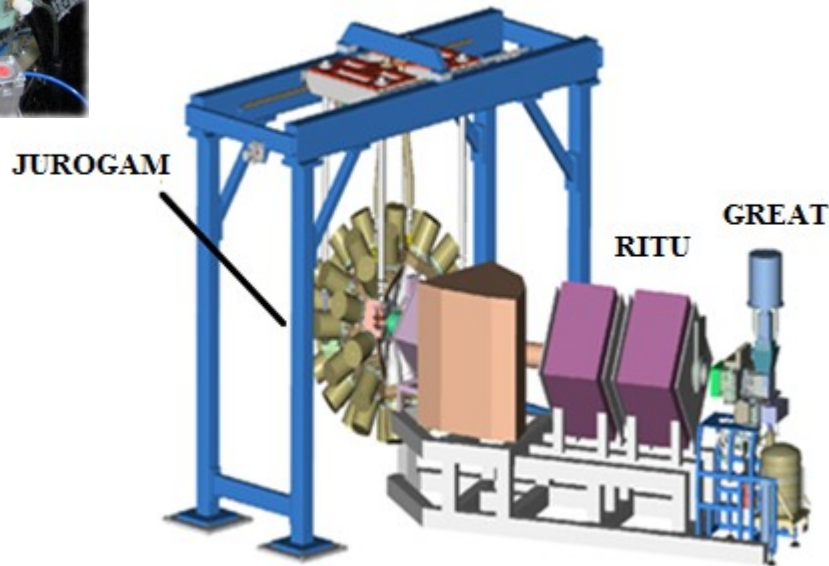- Large γ-ray background

Recoil Decay Tagging

JUROGAM

RITU
Dipole Magnet

DSSD

Recoils

Target

Primary beam

Primary beam

Primary beam

Recoils

E_γ
t_γ

E_{rec}
t_{rec}
$(x,y)_{rec}$

$(x,y)_\alpha$
E_α
t_α

α

Experimental Set-Up

RITU

GREAT

JUROGAM

RITU

GREAT

^{102}Pd (^{58}Ni , 2n) ^{158}W*

(E_{beam} ~ 280 MeV, I_{beam} = 6 pna)

S. Hofmann et all, Z. Phys. **A. 333**, (1989) 107
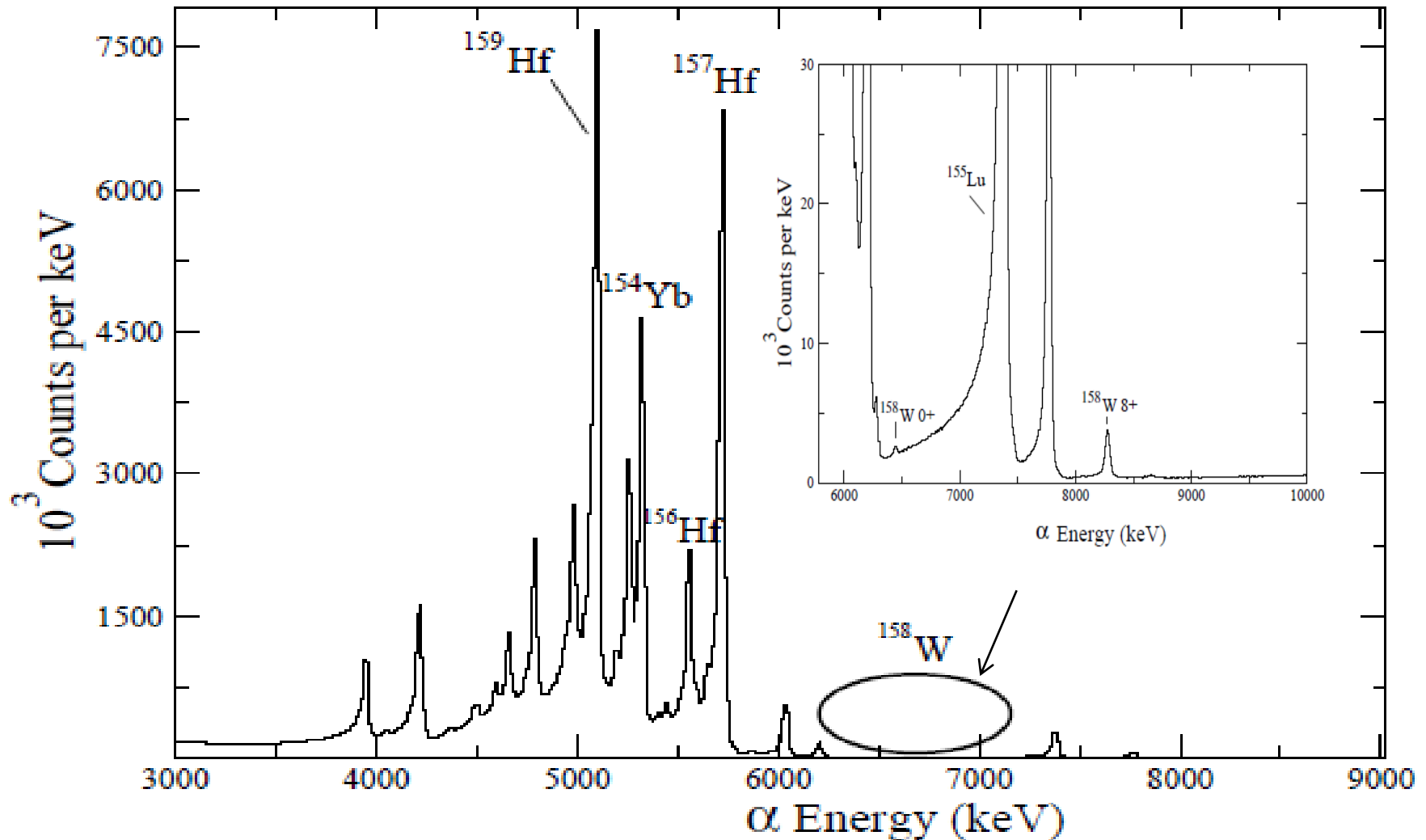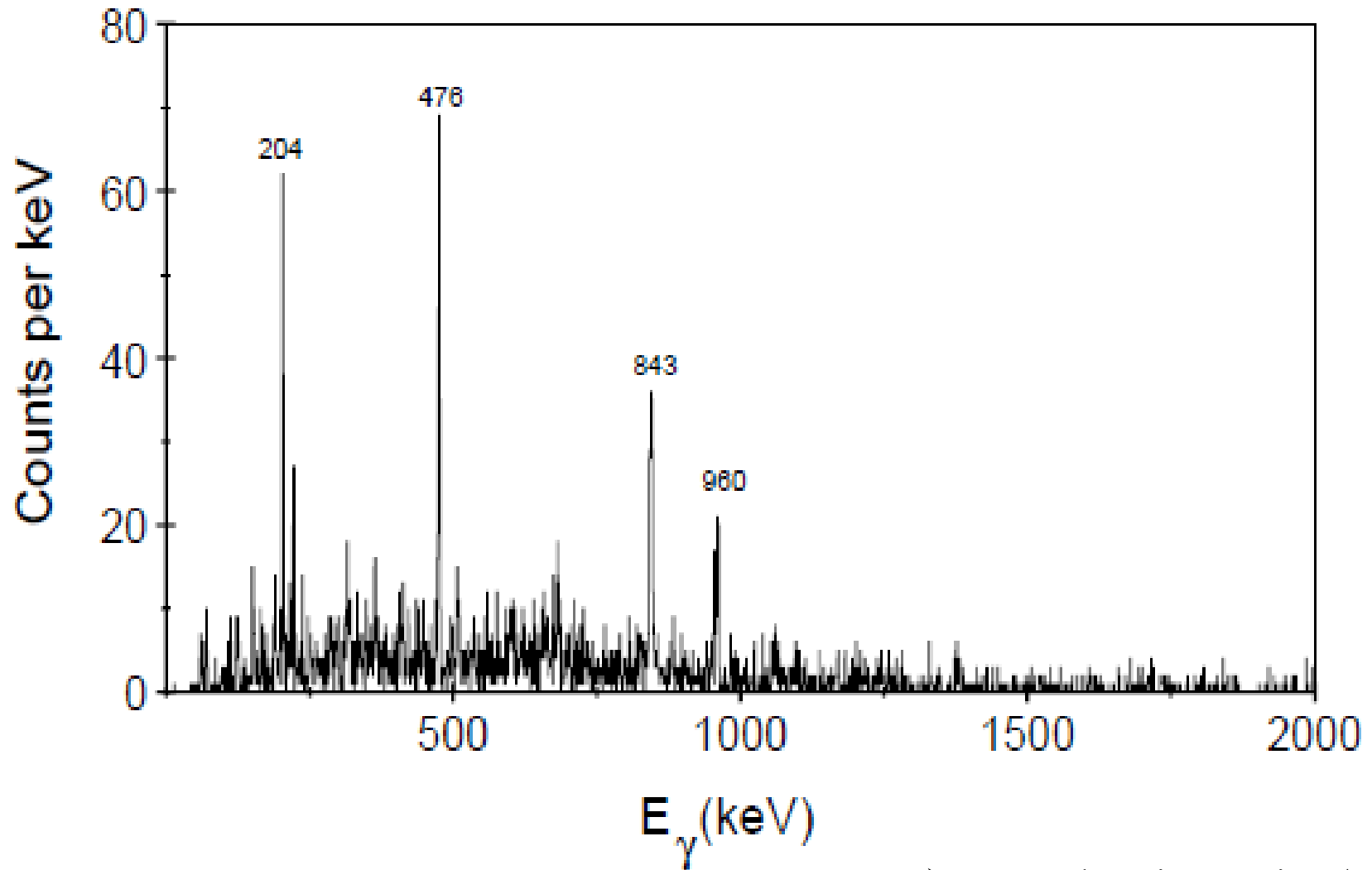
Isomeric 8+ State

> Tagged on isomeric 8^+ state with : $E_\alpha = 8280$ keV
> $t_{1/2} = 0.16$ ms
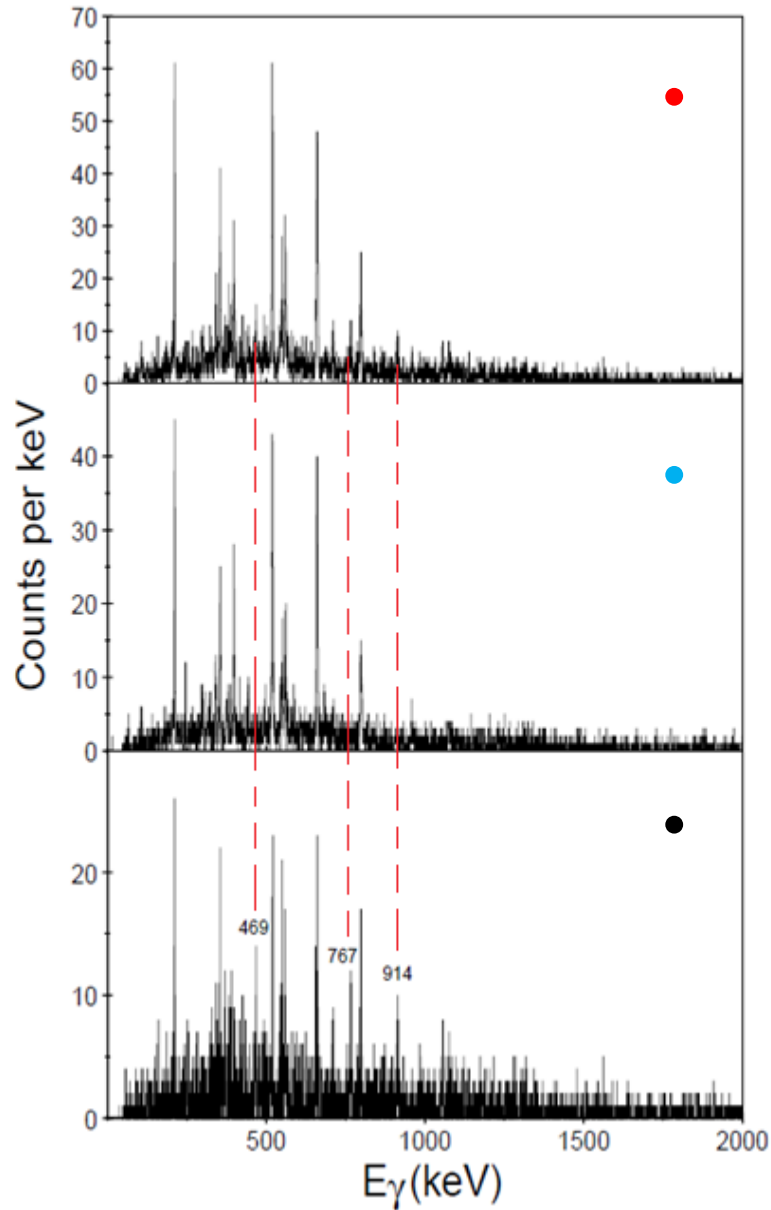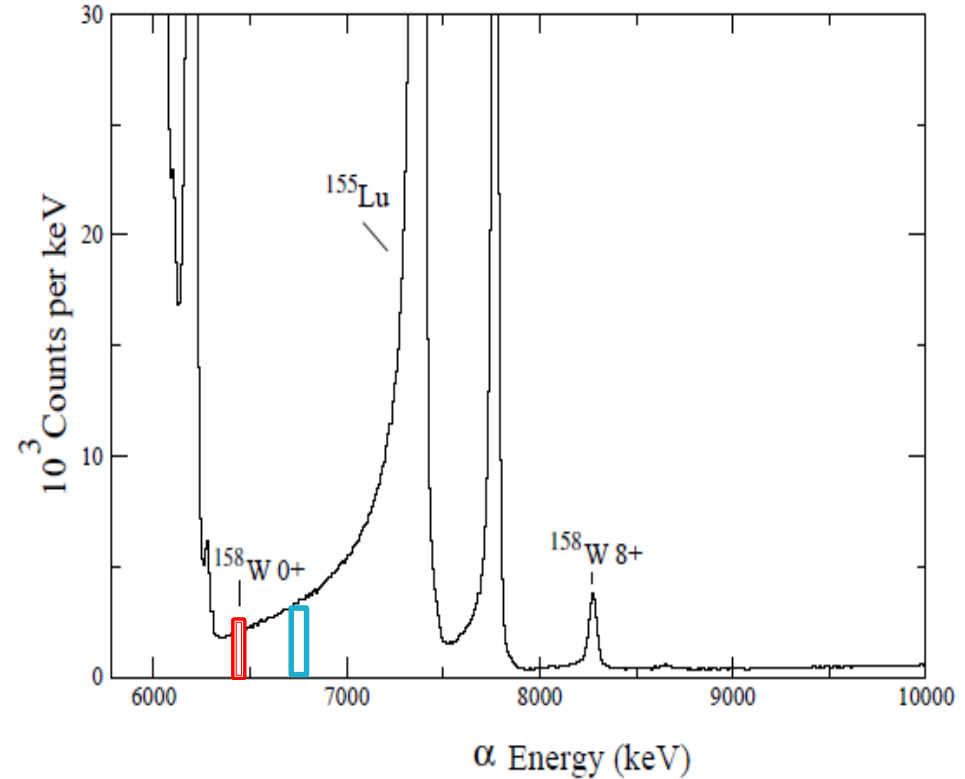
Coincidence Spectrum

➢ γγ coincidance spectra for 204, 476 or 843 keV transitions.
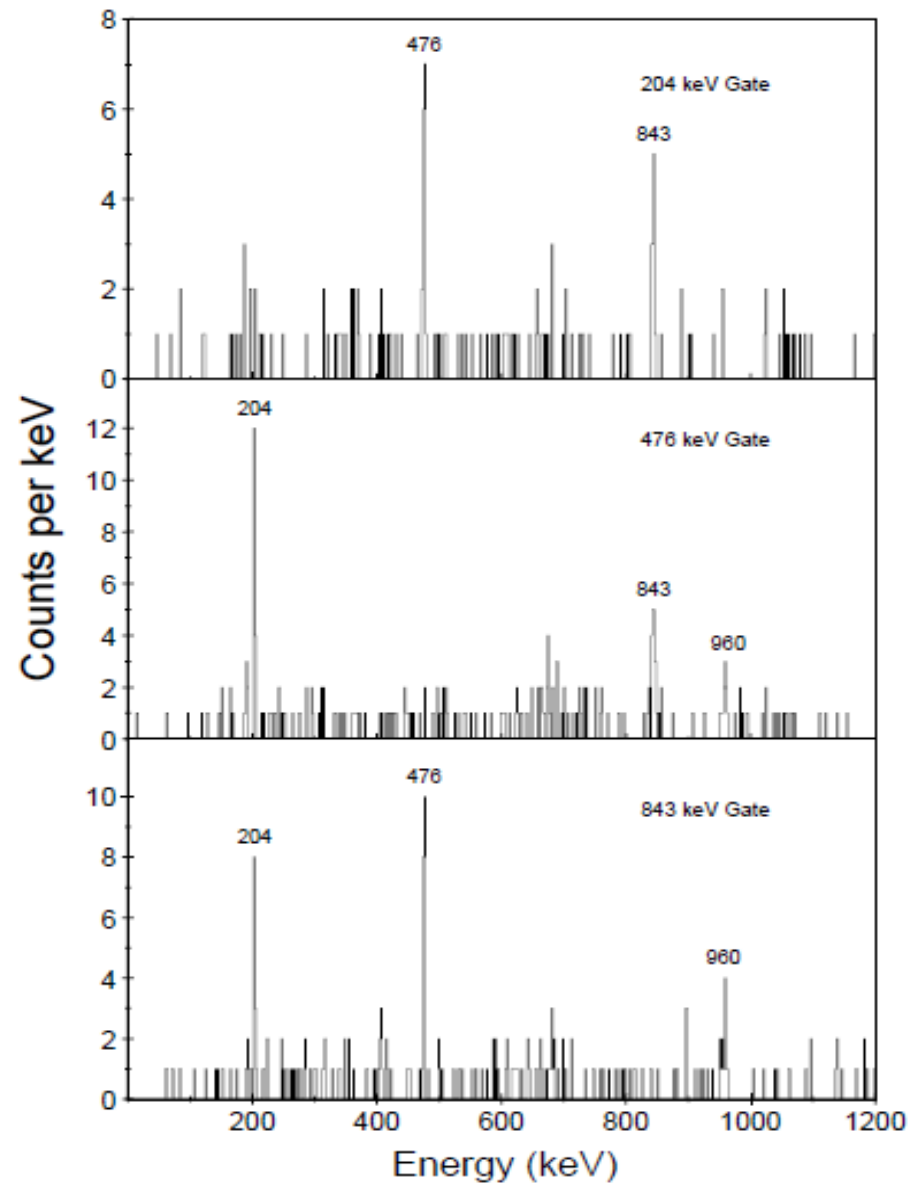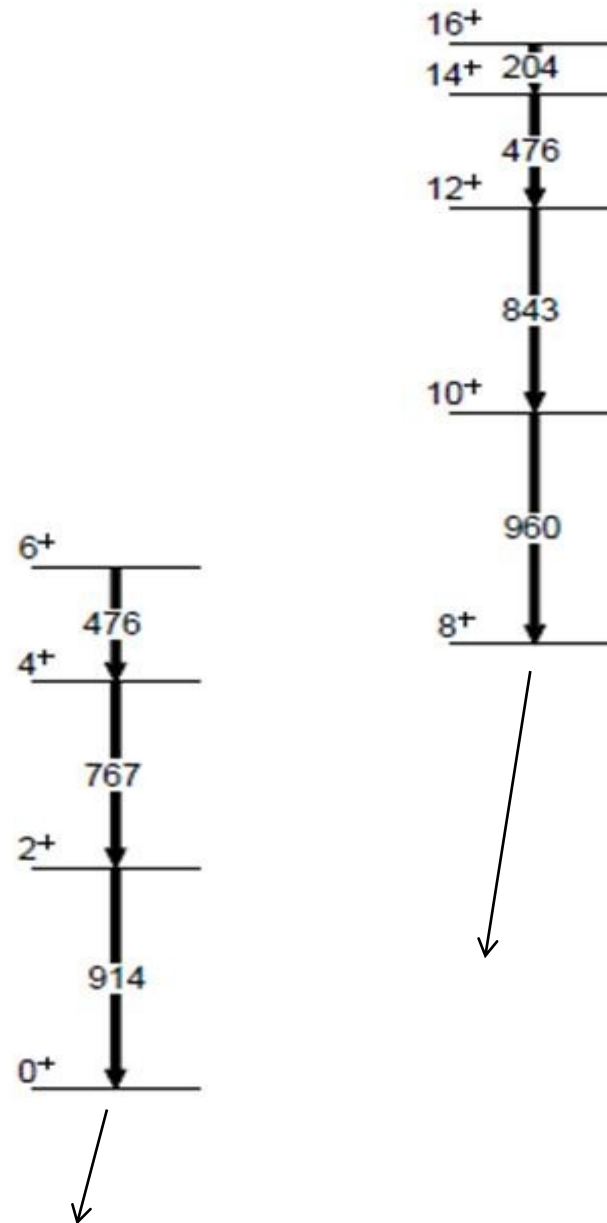
Ground State

- **(red)** Alpha tagged single
  ^{158}W ($E_\alpha = 6442$ keV; $t_{1/2} = 0.9$ ms)
- **(cyan)** Alpha tagged single
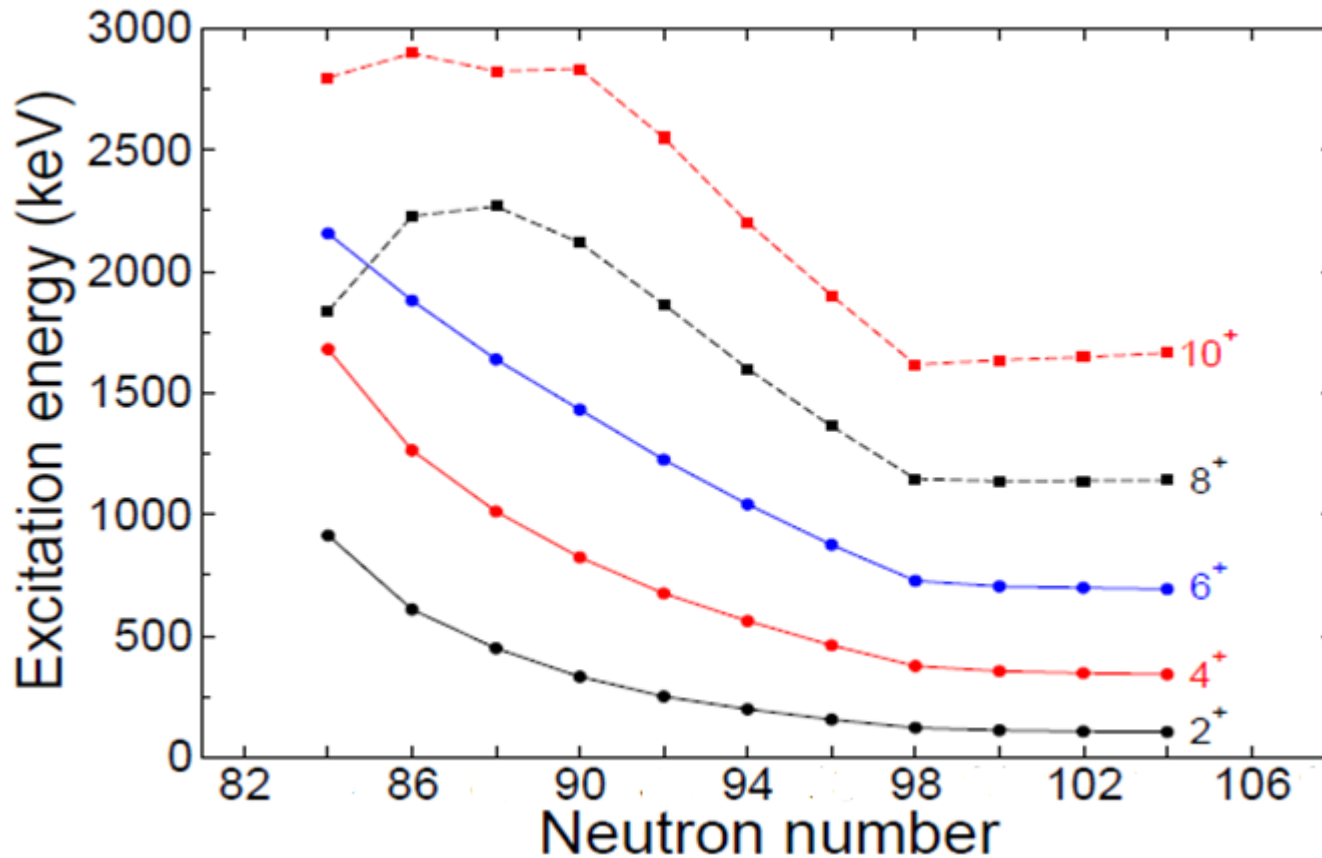 ^{155}Lu ($E_\alpha = 7390$ keV; $t_{1/2} = 2.71$ ms)
- **(black)** $^{158}W - ^{155}Lu$

Level Scheme of ^{158}W

➤ The level scheme of ^{158}W showing the decay from the 8^+ isomeric state and the ground state.

Even – Even Systematic
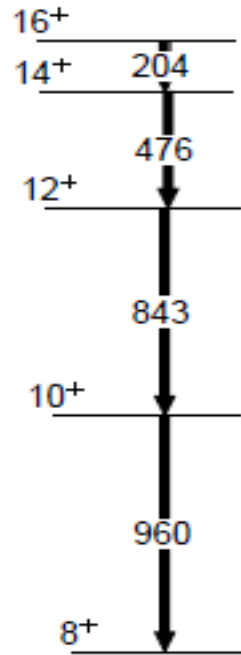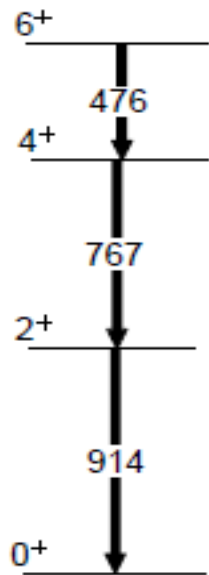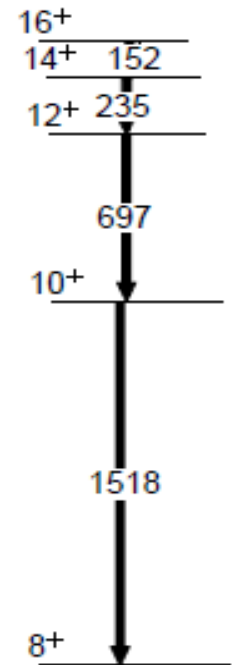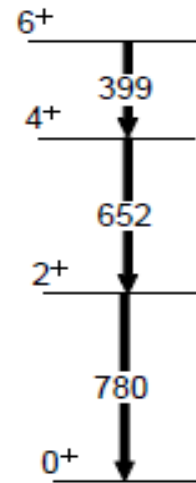

➢ Decrease of the [ν f$_{7/2}$ h$_{9/2}$]$_{8+}$ state can be understood by **interaction of the h$_{9/2}$ neutrons with h$_{11/2}$ protons, as the π h$_{11/2}$ subshell is filled.**

Experimental   Theory - OXBASH

Conclusions

➢ Excited states of 0^+ and 8^+ states.

➢ Level Scheme of ^{158}W obtained for first time.

➢ Shell model calculation.

Collaborators

D.T. Joss, R.D. Page,

J. Simpson,

M.P. Carpenter,
D. Seweryniak,

J. Uusitalo, S. Eeckhaudt, T. Grahn,
P.T. Greenlees, P.M. Jones, R. Julin,
S. Juutinen, H. Kettunen, M. Leino,
P. Nieminen, M. Nyman, J. Pakarinen,
P. Rahkila,

K. Andgren, B.
Cederwall, B. Hadinia,
C. Ishida, M. Sandzelius,