

Characterization of **Incomplete fusion**

reactions using **DIAMANT(CsI)** and

AFRODITE detectors

PRESENTER: Bongani Maqabuka

SUPERVISOR: Dr S.M. Mullins (iThemba labs)

CO-SUPERVISOR: Prof S. H. Connell (University
of Johannesburg)

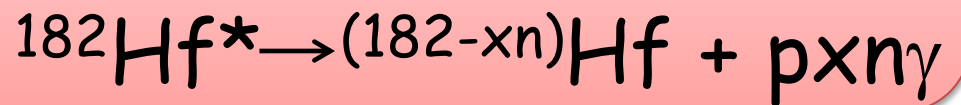
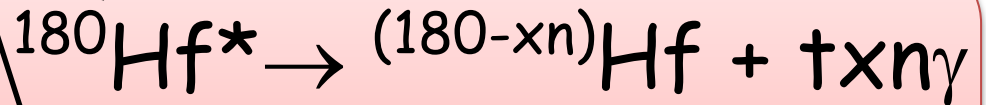
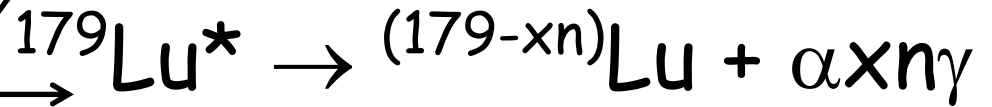
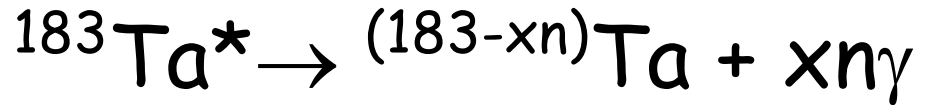
AIMS:

- To investigate incomplete fusion with much higher sensitivity.
- Investigate evidence for reaction-dependent spin population in ^{178}Hf isotope.
- This is a **nuclear physics experiment** to determine the reaction dynamics – get new insights into competing reaction characteristics.

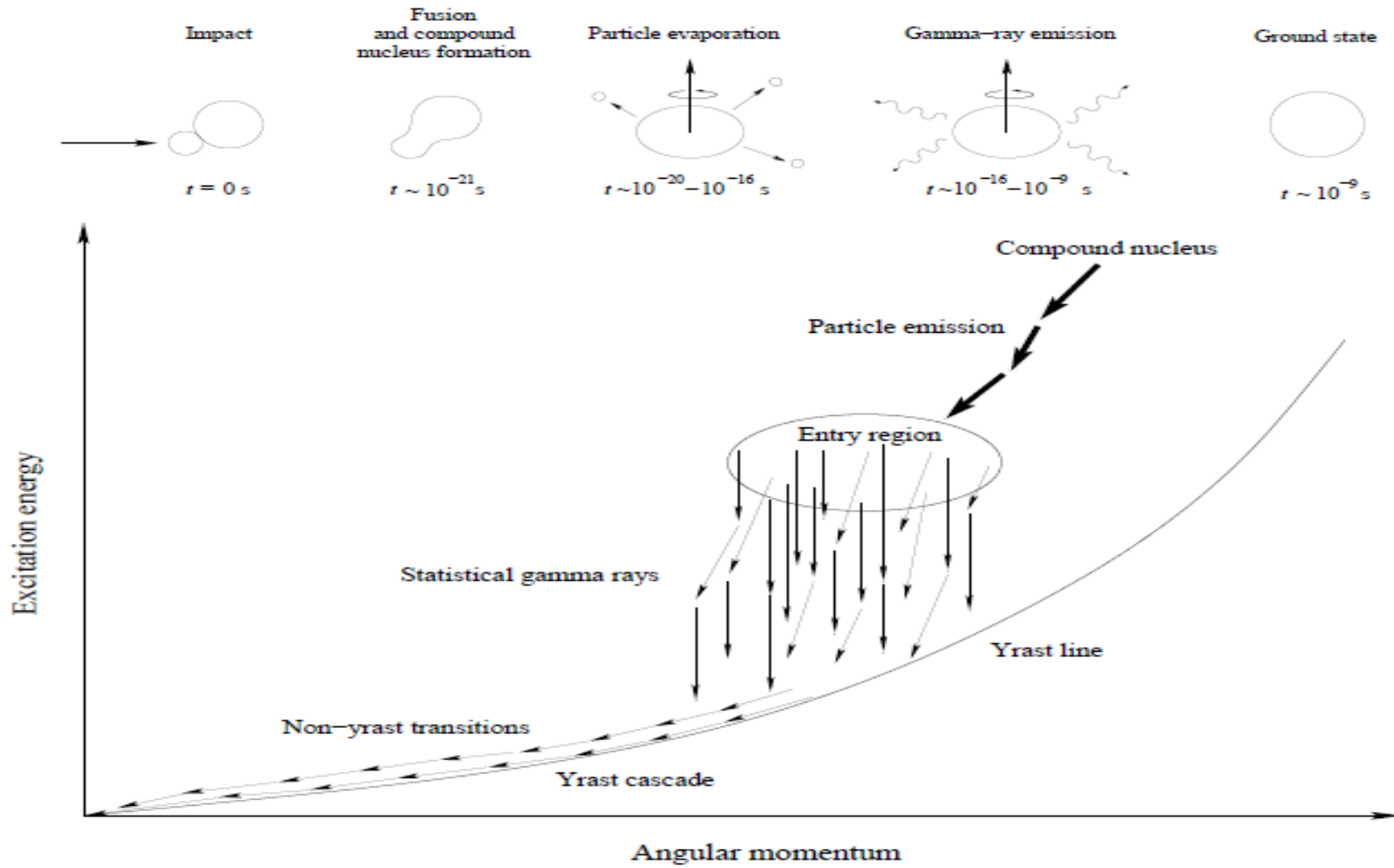
Possible reactions:



${}^7\text{Li} (\alpha + t) + {}^{176}\text{Yb} @ 50\text{MeV}$
 $Q \cong -2.5 \text{ MeV}$



Stages of evaporation fusion reactions

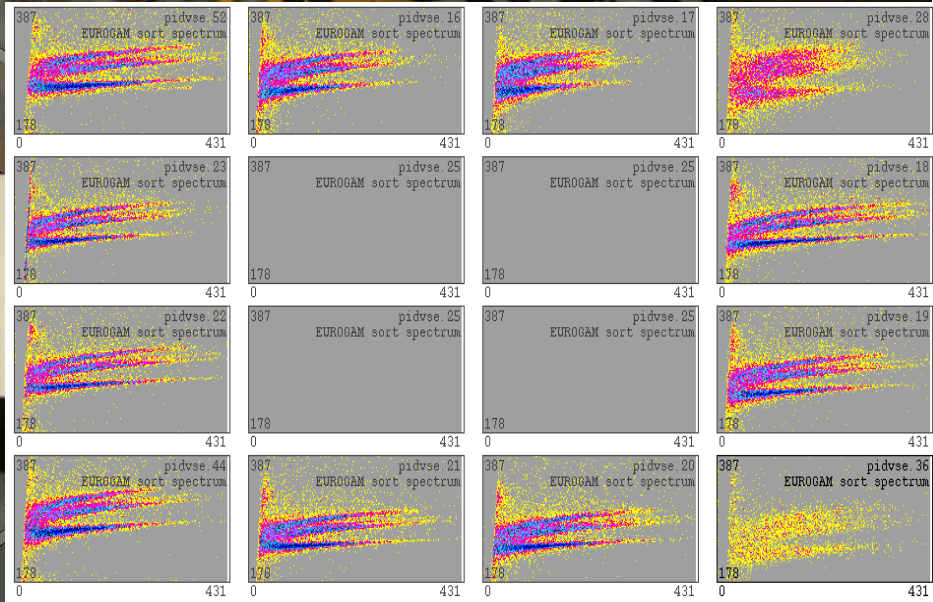
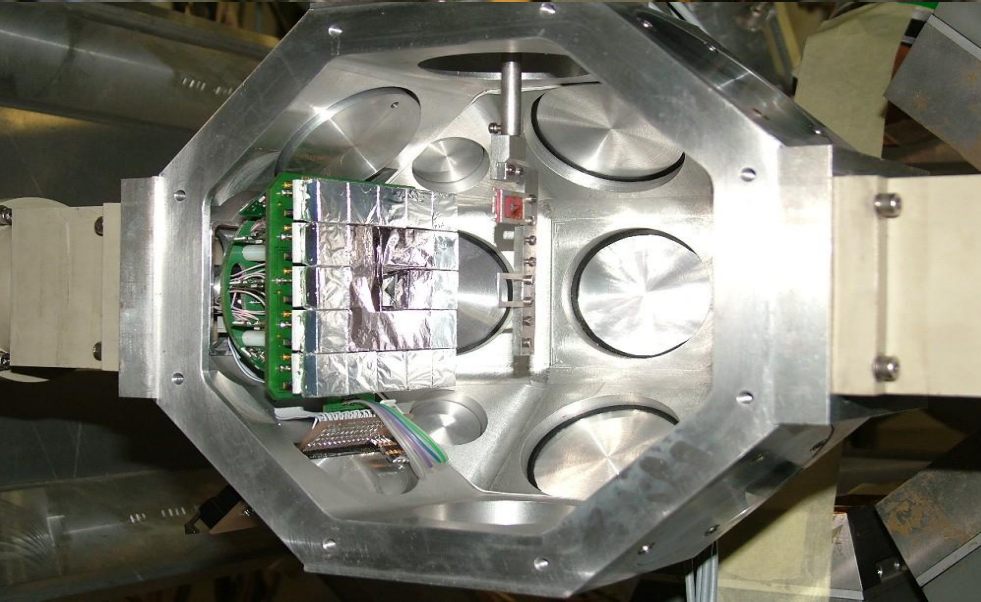


$$E^* = \frac{A_t}{A_b + A_t} E_{lab} + Q$$

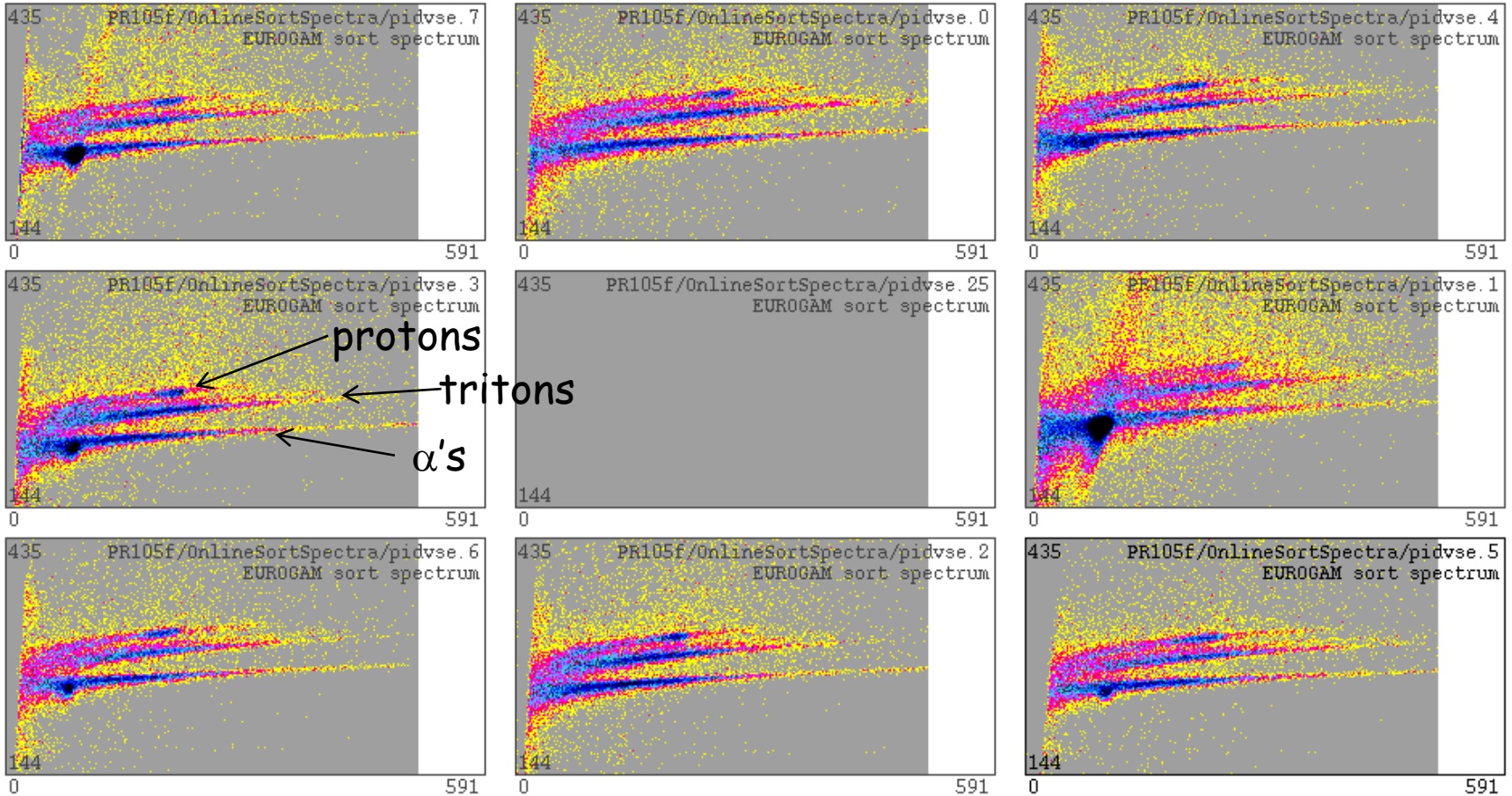
$$L = pb = b\sqrt{2mE},$$

Data analysis:

- Data sorted into ungated, α -gated, triton-gated, proton-gated E_{γ} - E_{γ} matrices
- Construct level schemes
- Extract Proton/Triton_{forward} intensity ratios (-From 2 matrices):
 - One generated when the **proton** particle was detected in the **forward** section.
 - The other when an **triton** particle was detected.
- Make plots of the Intensity ratios vs. Spin/Excitation energy.

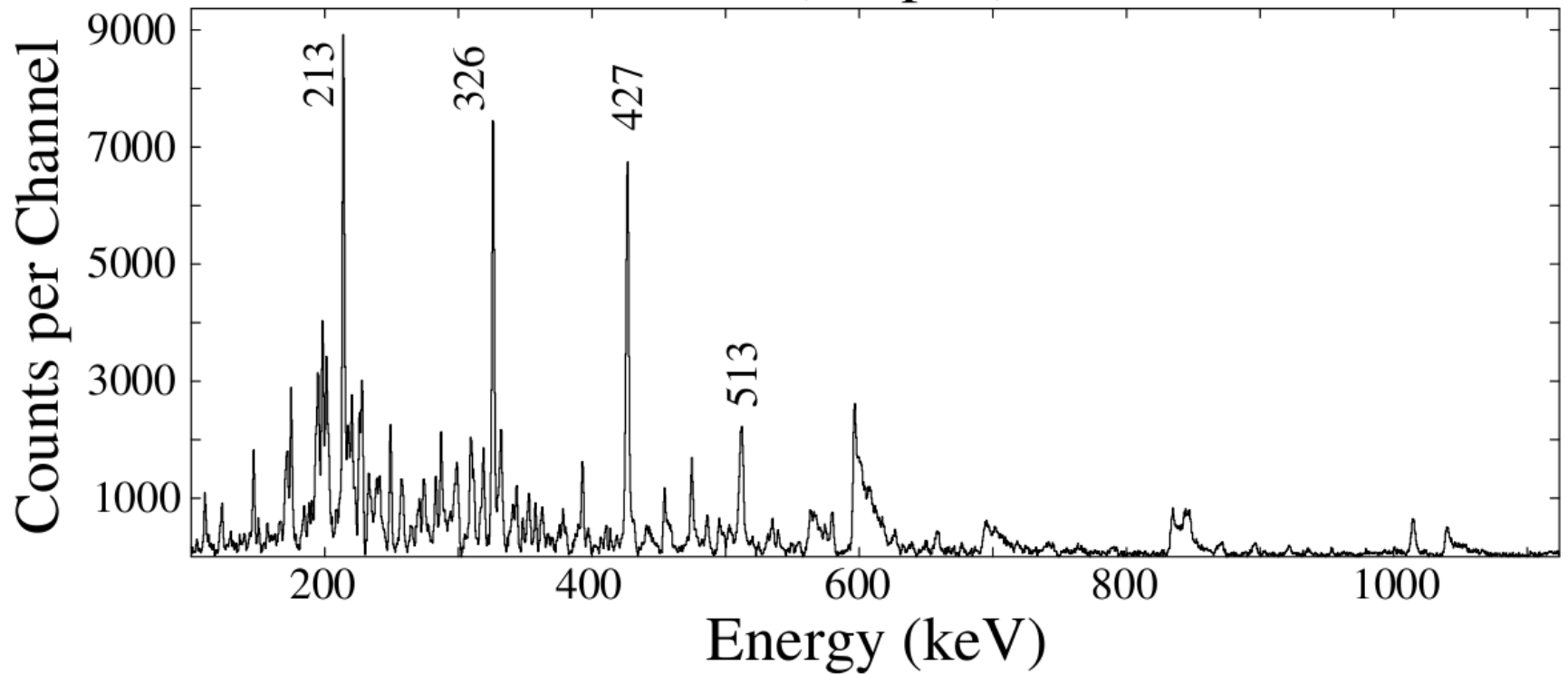


Mini-chessboard for particle Identification

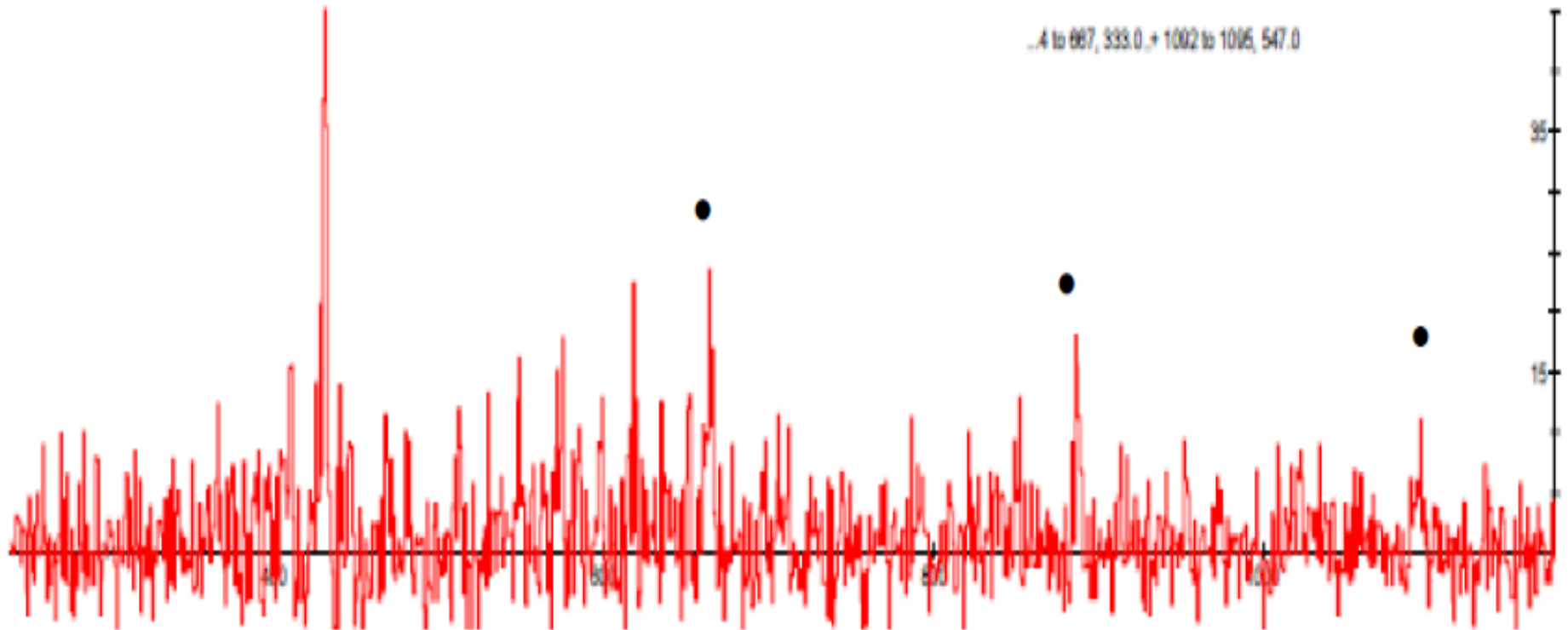


Particle tagged $E_{\gamma}-E_{\gamma}$ spectrum

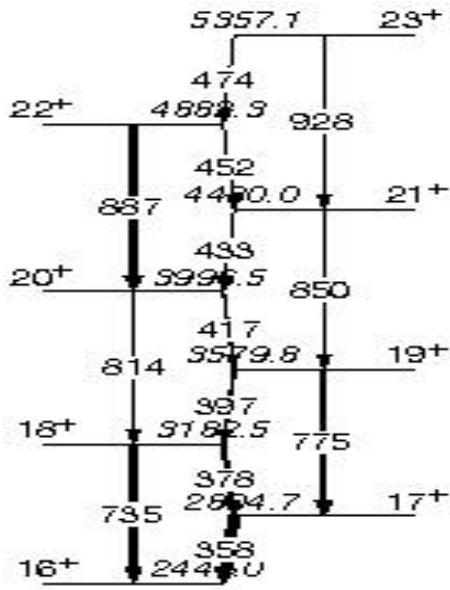
$^{176}\text{Yb}(^7\text{Li},\text{pxn})^{178}\text{Hf}$



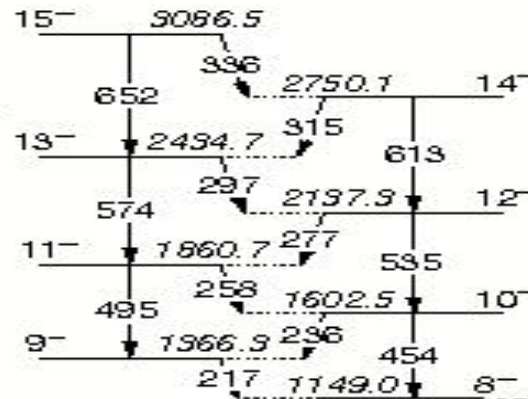
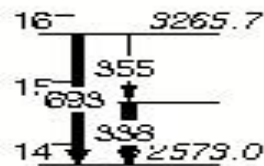
Sum of gates for the ground-state band of ^{180}Hf obtained from the proton-gated matrix



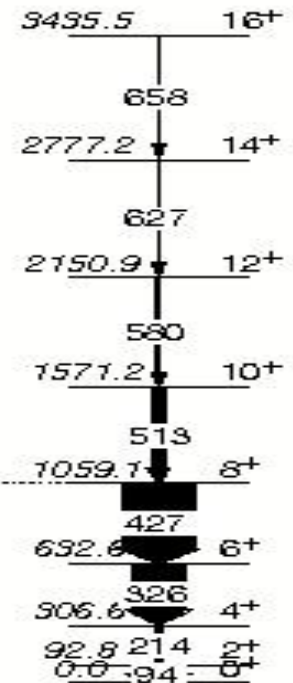
^{178}Hf level scheme : DIAMANT- AFRODITE



16⁺ Band

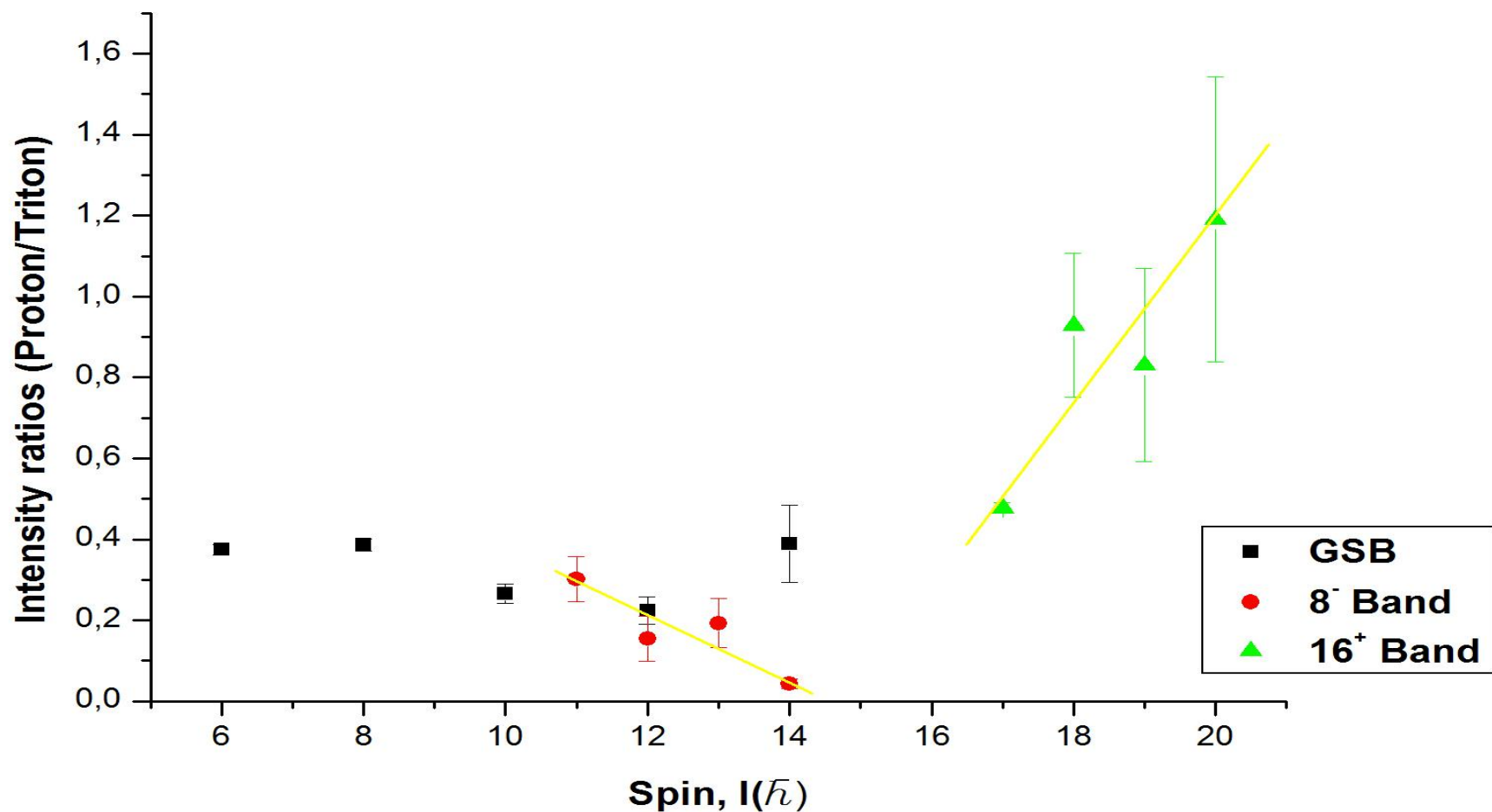


8⁻ Band



GSB

$$\frac{{}^{176}\text{Yb}({}^6\text{He}, p4n){}^{178}\text{Hf}}{{}^{176}\text{Yb}({}^4\text{He}, t2n){}^{178}\text{Hf}}$$



CONCLUSION:

- It has been possible to extract the level scheme exclusive to a particular channel for the production of the ^{178}Hf
- The relative cross section for various reaction channels could therefore be extracted.
- There are interesting variations observed between the **proton/triton at forward angles** and the **angular momentum** of the residual nucleus.
- In the backward angles- there were data problems.
- This work has therefore produced data which gives insight to the reaction mechanisms for **incomplete fusion processes**.

Thank you for your
attention.

End!!