The T + T → ^{4}He + 2n fusion reaction is really several two-body reactions

(and how this affects the neutron emission energy spectrum)

Observations of the ^{5}He resonance in TT fusion reactions at JET

Background

Two tritons can fuse to form a **three-body end state**

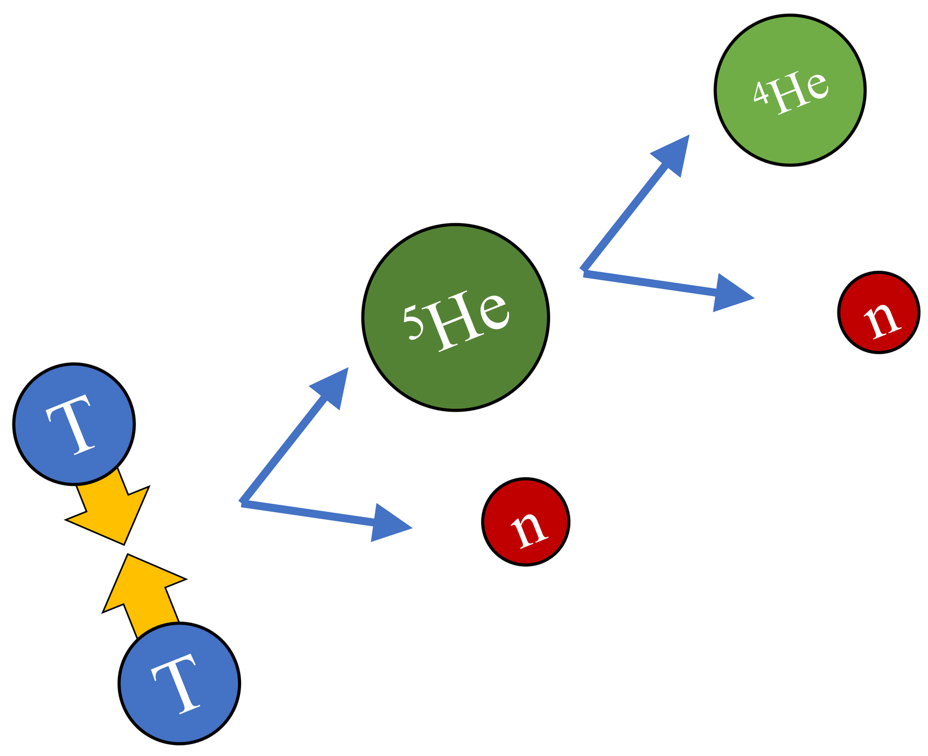
- $T + T \rightarrow {}^4He + 2n$

There are indications of **intermediate two-body states**

- $T + T \rightarrow {}^5He + n$
- ${}^5He \rightarrow {}^4He + n$

We measured the TT **neutron emission spectrum**

- What? Pure T fusion plasmas $n_T/(n_T + n_D) \sim 0.99$
- Where? At the Joint European Torus
- How? Neutron time-of-flight spectrometry

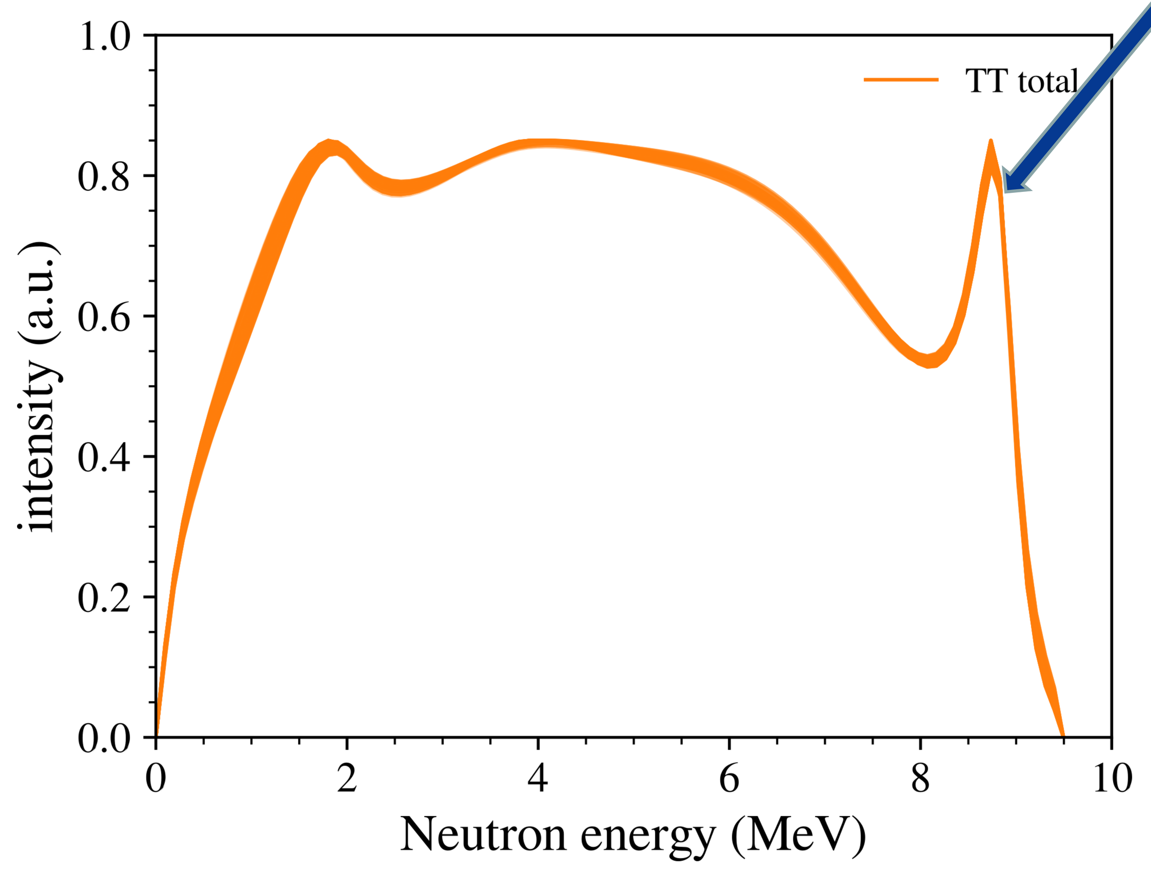


Why is this important?

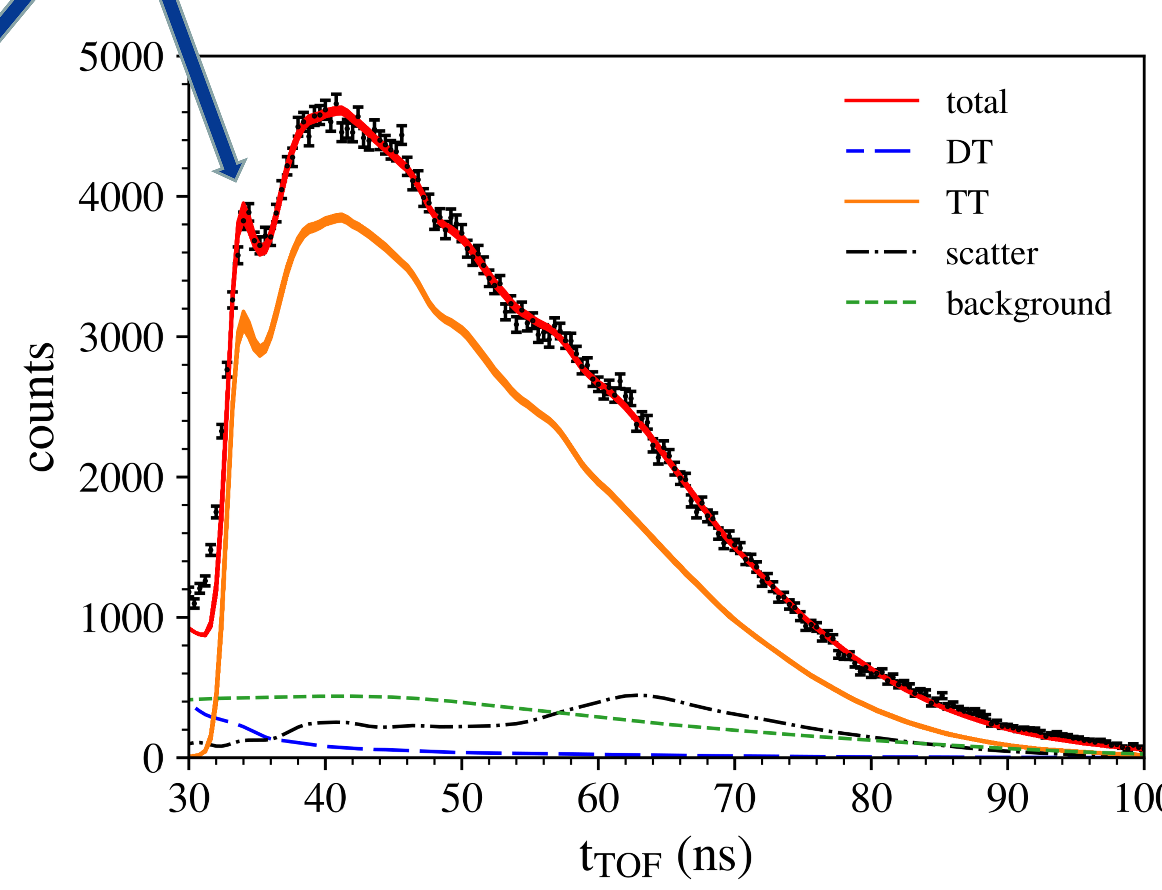
- Fusion fuel ion ratio
- Radiation safety / activation of materials
- Mirror reaction (solar PP chain) $^3He + {}^3He \rightarrow {}^4He + 2p$

Results

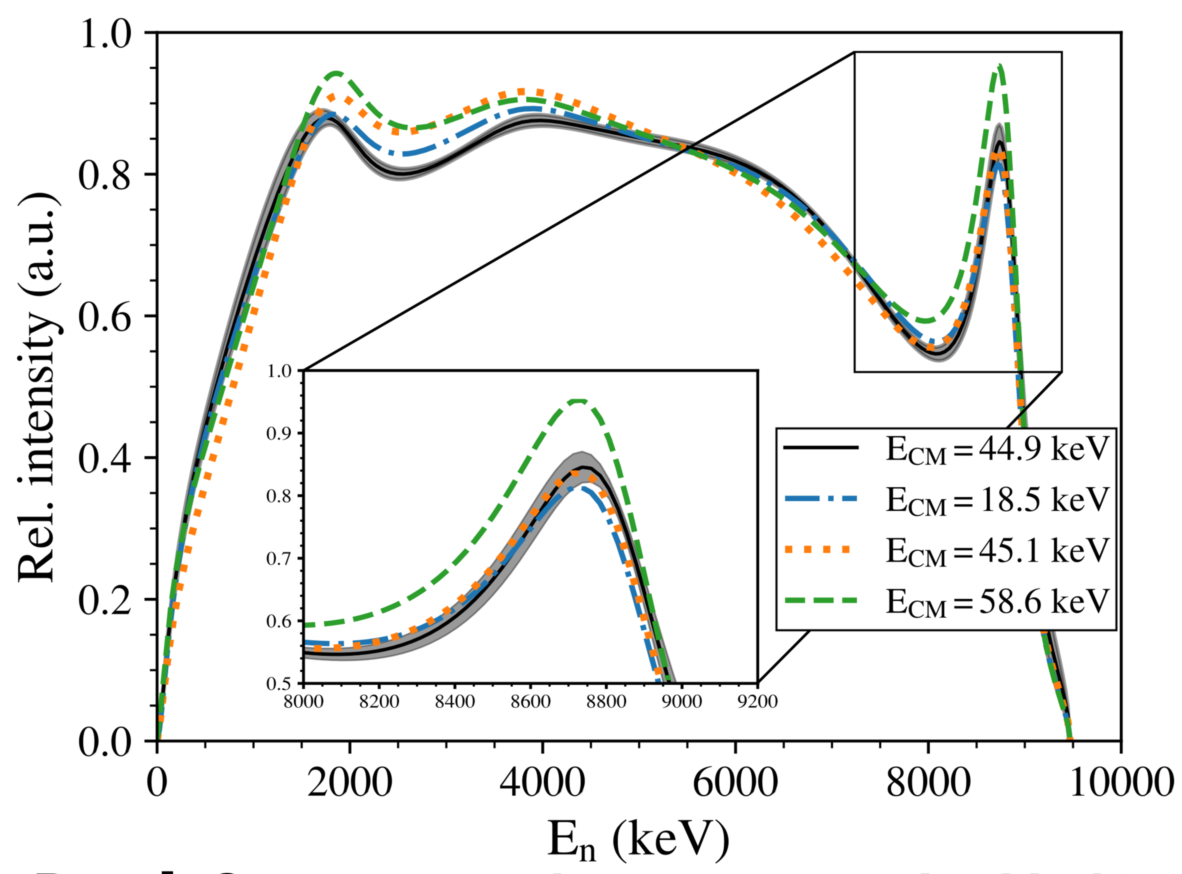
Peak from the neutron produced in $T + T \rightarrow {}^5He + n$



Result 1: Modeled TT neutron emission energy spectrum using R-matrix formalism.



Result 2: Measured TT neutron time-of-flight spectrum with the model applied to it.



Result 3: Comparison between our results (black) and measurements from NIF at various E_{CM}.

Conclusions

1. We can model the TT neutron emission spectrum adequately.
2. We can use the modeled TT spectrum to improve n_T/n_D measurements.
3. Our results are consistent with an energy-dependence in the spectral shape.

Additional information

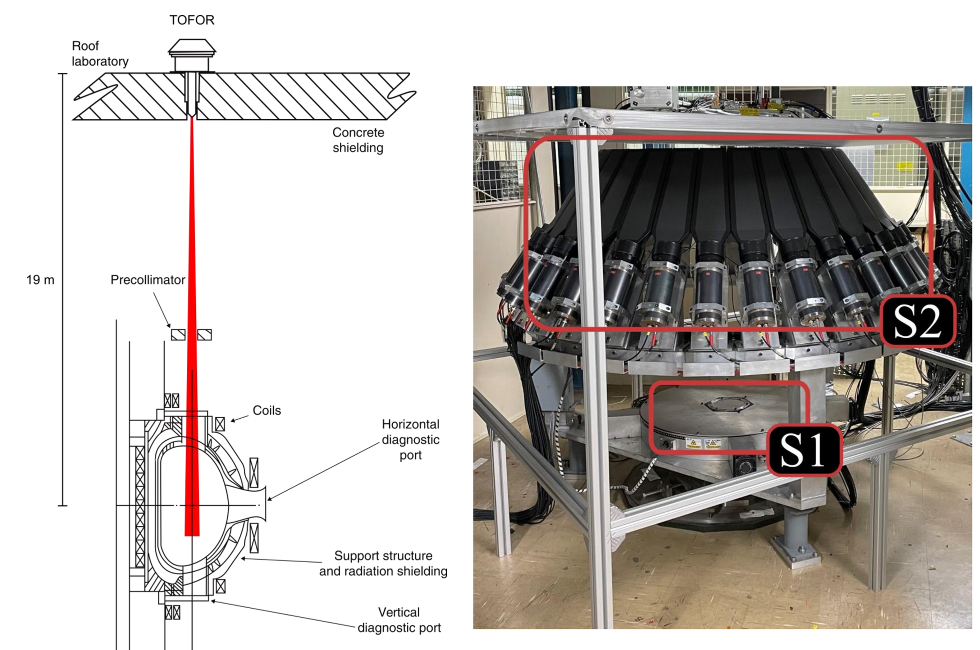


Figure 1: The TOFOR neutron time-of-flight spectrometer at JET.

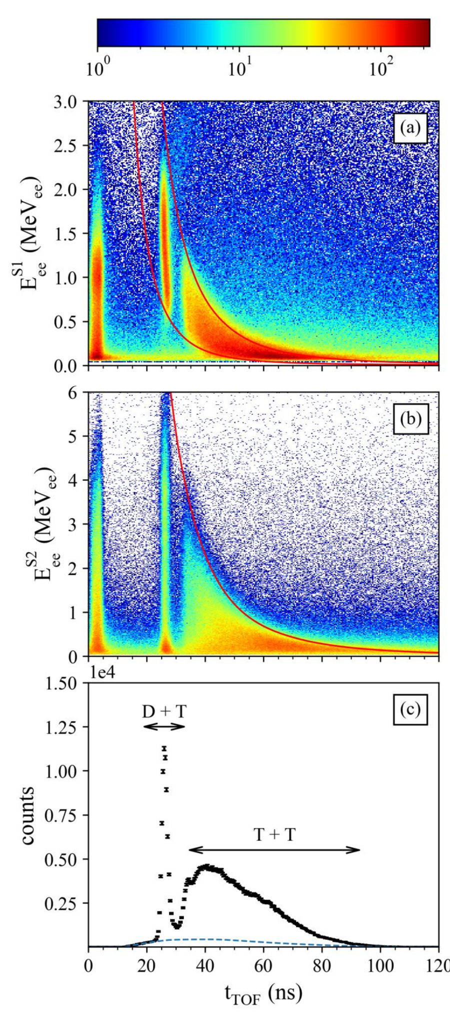


Figure 2: Experimental TOF spectrum and 2D histograms.

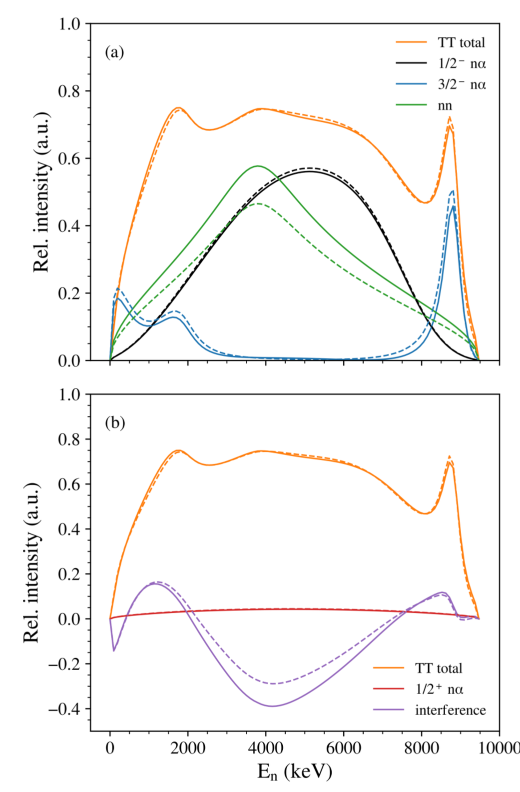


Figure 3: Modeled TT neutron emission components.

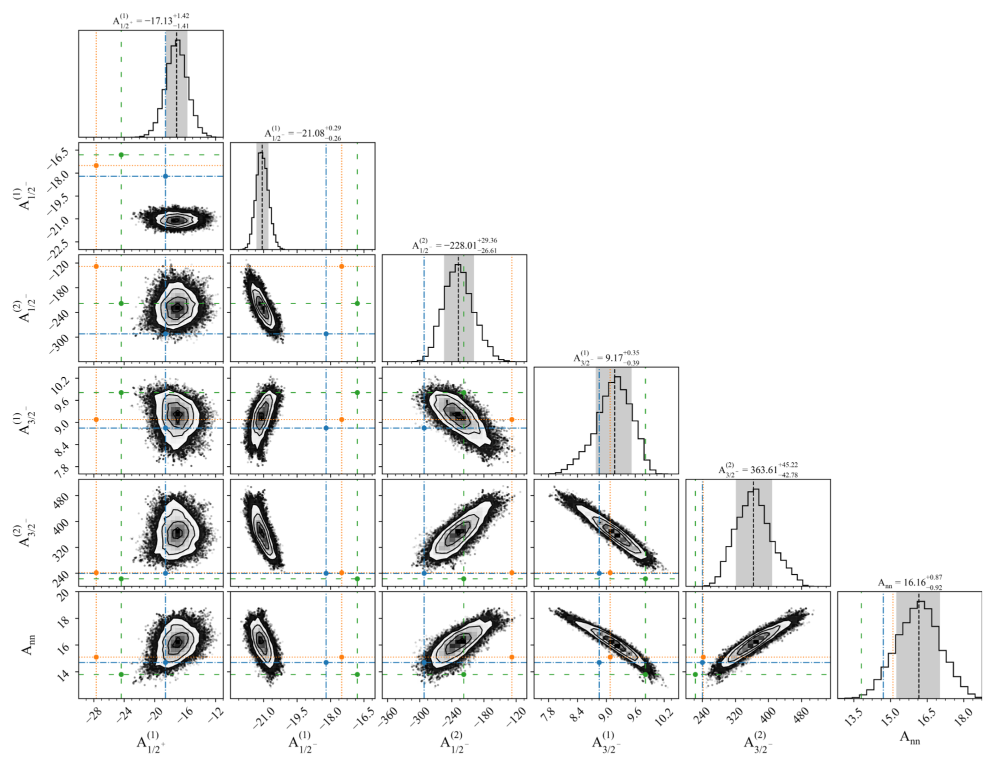


Figure 4: Triangle plot of model fit parameters determined using Markov Chain Monte Carlo methods.

Authors

B. Eriksson[a,*], S. Conroy[a], G. Ericsson[a], J. Eriksson[a], A. Hjalmarsson[a], C. Brune[b], M. G. Johnson[c], JET contributors[d]

[a]*Department of Physics and Astronomy, Uppsala University, Lägerhyddsvägen 1, Uppsala, 752 37, Sweden*

[b]*Department of Physics and Astronomy, Ohio University, Athens, OH 45701, USA*

[c]*Plasma Science and Fusion Center, Massachusetts Institute of Technology, Cambridge, MA 02139, USA*

[d]*See the author list of 'Overview of JET results for optimising ITER operation' by J. Mailloux et al. 2022 Nucl. Fusion 62 042026*

*Corresponding author: benjamin.eriksson@physics.uu.s

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