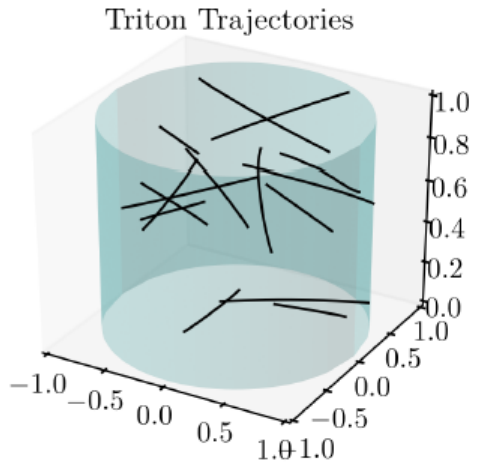
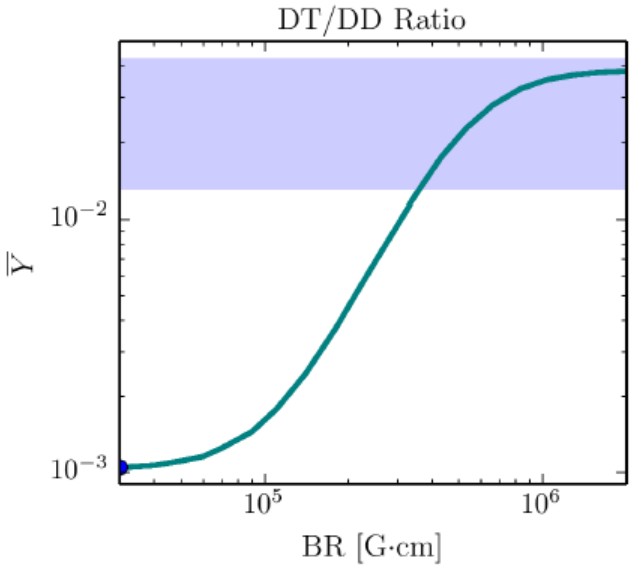
Neutron/Gamma 1 Outbrief

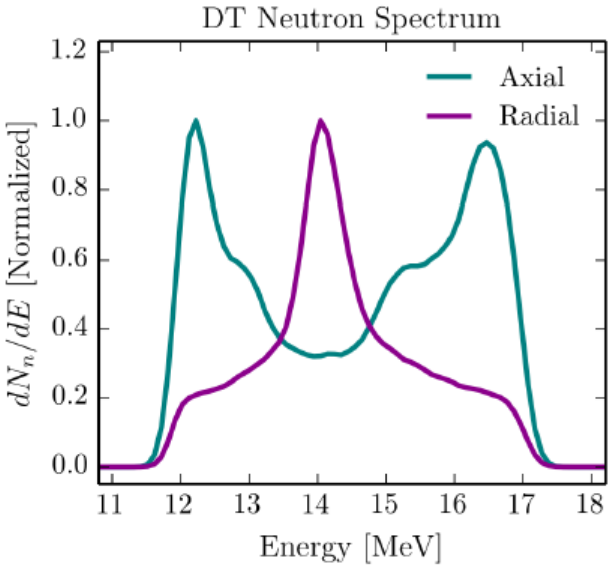
1. Paul Schmit (SNL) - Diagnosing magnetization with secondary DT neutrons
2. Maria Gatu-Johnson (MIT) - Compact DD neutron spectrometer
3. Maria Gatu-Johnson (MIT) - The MIT HEDP Accelerator Facility
4. Brent Jones (SNL) - Diagnostic Value of using Tritium on Z
5. Matthew Gooden (LANL) - Thulium and Bismuth as RIF diagnostics and the new Dual-Clover System

Summary

Paul Schmit gave a presentation on “Diagnosing magnetization with secondary DT neutrons”







The pre-imposed B_z field magnetizes the plasma trap the tritons and direct them axially in helical orbits.

BR is an important confinement parameter.

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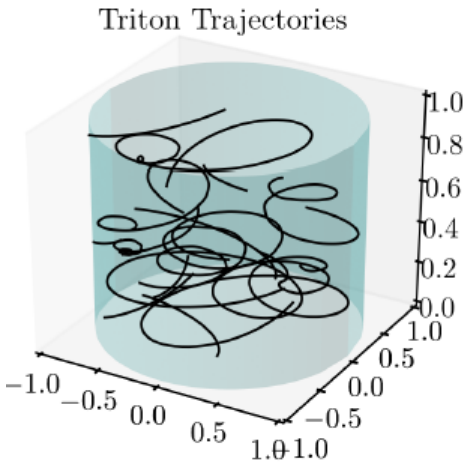

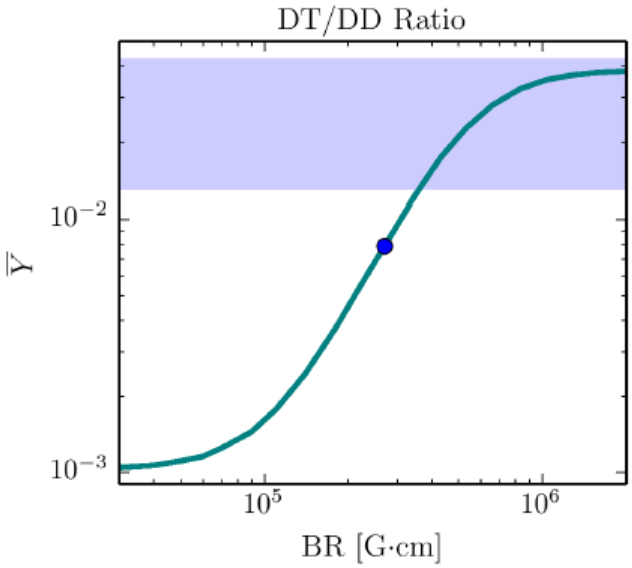

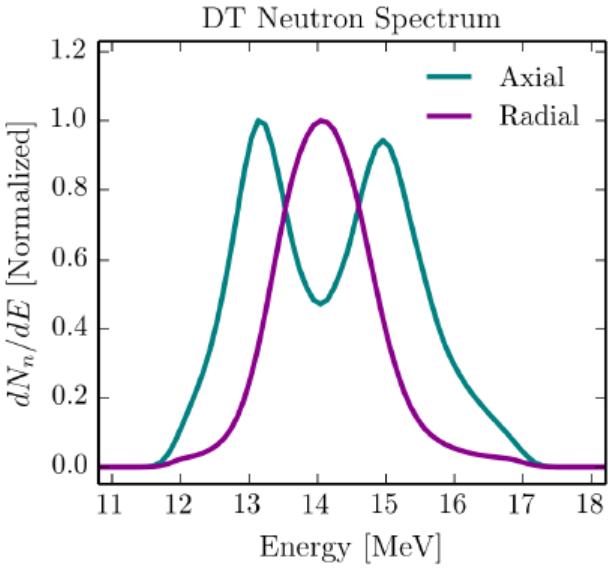

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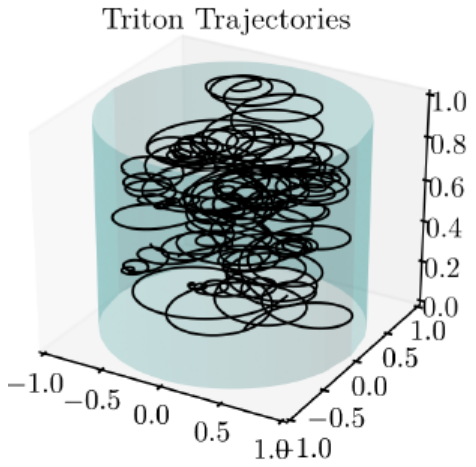

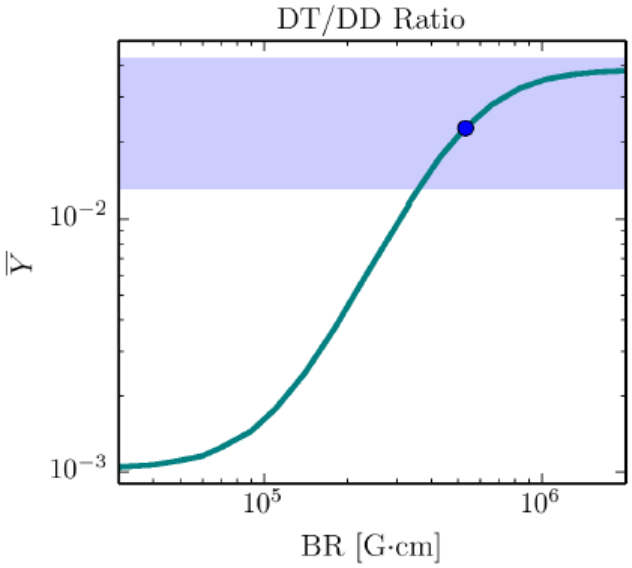

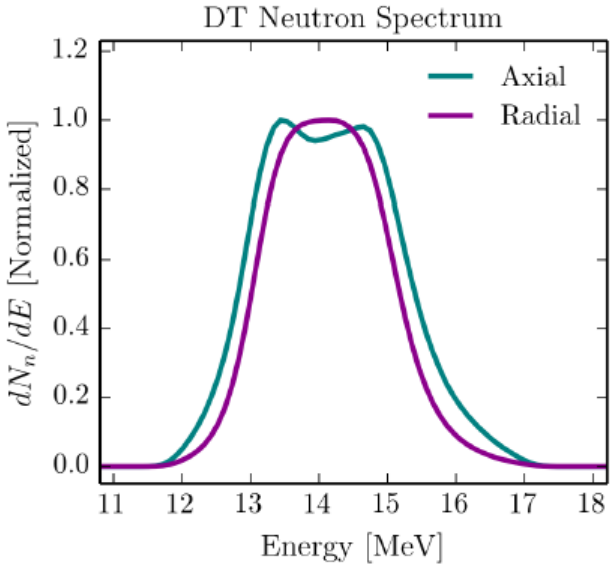

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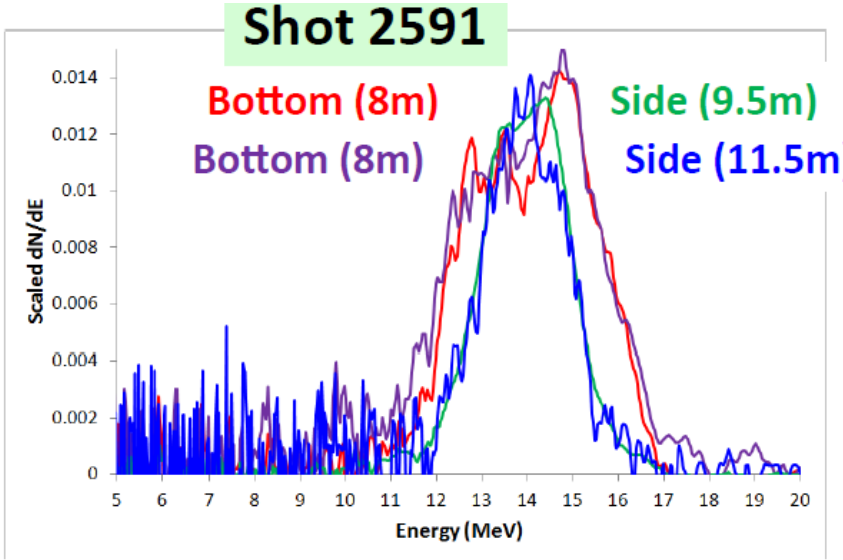


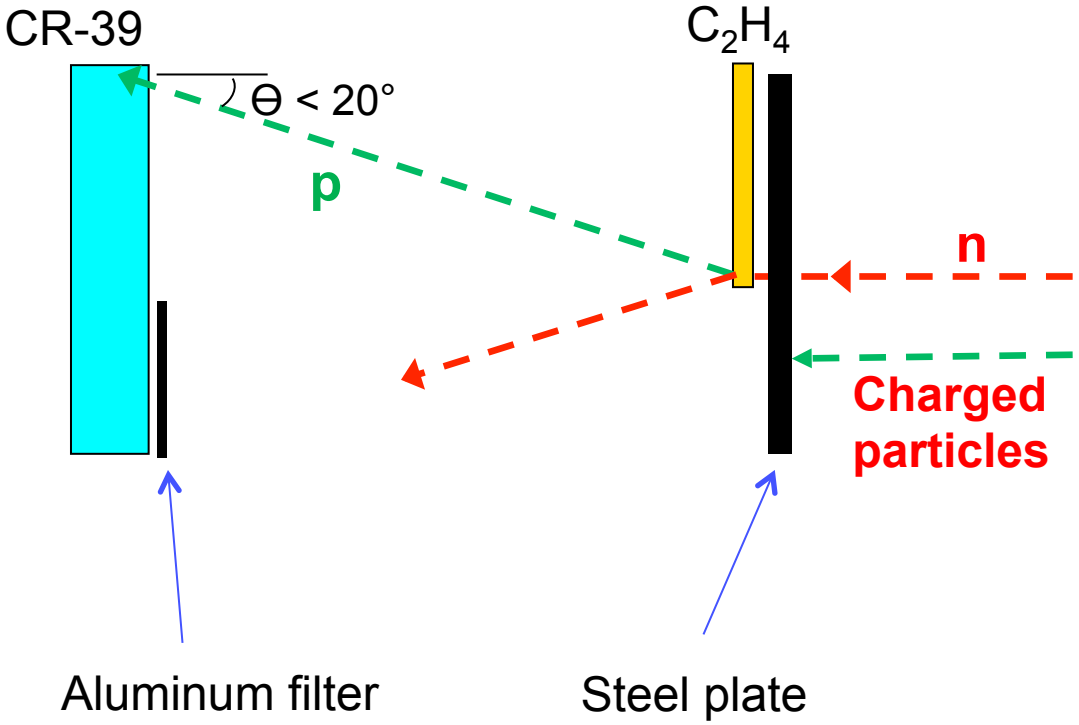
My main take-away point

Understanding BR and ρR through measurements of Y_{2n}/Y_{1n} and secondary DT-neutron spectrum is central to the MagLIF exps

- Its clear that better measurements of the secondary DT-neutron spectrum will provide new insights and push the science forward (how do we best do that?).
- This effort would benefit from a collaboration between SNL, LLNL, LLE and MIT, who have substantial expertise in this area.
- Implementation of better spectral measurements of the DT-secondary neutron spectrum should be considered as a broad diagnostics project, which will benefit from the attention from the National Diagnostic Working Group.

Summary

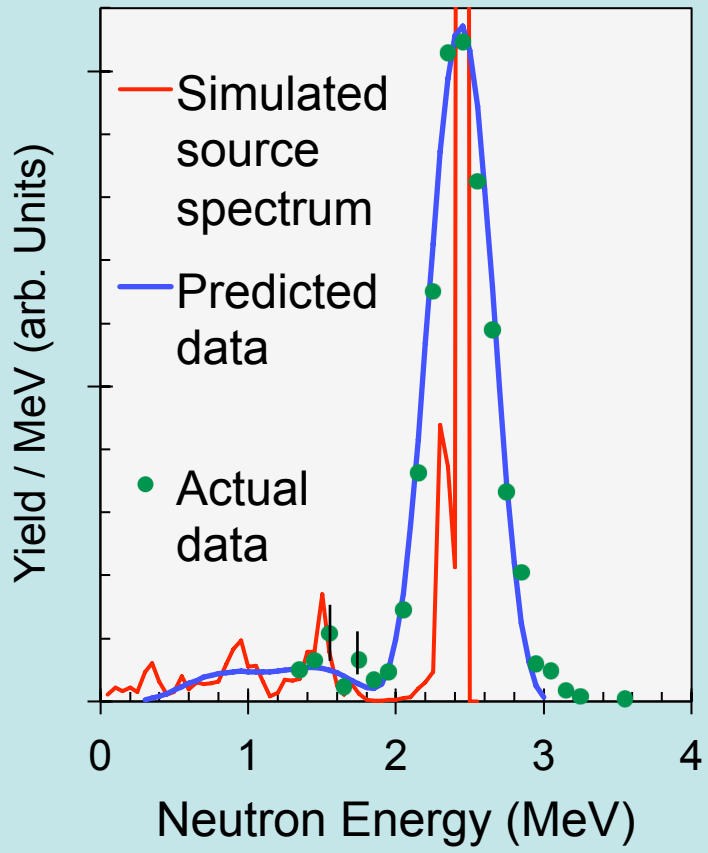
Maria Gatu-Johnson presented "A compact DD-n spectrometer for Z, NIF and OMEGA"



Proton energy will be determined based on track size on the CR-39

Neutron background will be reduced with coincidence counting

Proof-of-principle tests have been conducted on the MIT accelerator:



My main take-away point

Implementing compact DD-n spectrometers on OMEGA, NIF and Z will help the different programs

- The system has the potential to provide symmetry information on Yn, Ti and ρR at OMEGA, NIF and Z (not only for DD for DT as well).
- Due to its compactness (5×7 cm^2), a set of these spectrometers will in particular be ideal for probing MagLIF experiments at Z.
- This project has already been undertaken by MIT and SNL and initiated a deeper collaboration between these institutions.
- This effort should be considered as a broad diagnostics project.

Summary

Maria Gatu-Johnson gave a presentation on "The MIT HEDP Accelerator Facility"

- The facility is used to test and develop nuclear diagnostics using the same signal and background particles that are measured at OMEGA, NIF and Z.

  ✓ A linear accelerator generates DD, D^3He and DT fusion products
    - Absolute yields are determined using the associated particle method

  ✓ Three x-ray sources generate K,L-lines and/or continua with energies up to 225 kV

  ✓ A pulsed DT neutron source produces up to 6e8 n/s
    - DD capability (1e7 n/s) is being added

- An etch/scan lab allows for precision on-site CR-39 processing

- The lab has been essential for the successful deployment of diagnostics such as MRS, CPS, WRF, (Mag)PTOF, DD-n spectrometry etc.

My main take-away point

The MIT HEDP Accelerator Facility is an excellent capability that has been essential to the development of nuclear diagnostics

- This facility clearly has the potential of supporting the whole scientific HEDP/ICF community.

Summary

Brent Jones presented the Diagnostic Value of using Tritium on Z

Physics	Measurement	Tritium fuel content <0.1%	0.1%	1%
Behavior of tritium in the Z pulsed power environment	Sampling of tritium contamination, migration	■	■	■
Scaling of yield to DT—thermonuclear?	DT yield		■	■
Ion temperature and non-thermal population	Precision nTOF and DT/DD yield ratio		■	■
Liner/fuel mix	DT yield with tritiated gas fill and deuterated liner		■	■
Fuel morphology	Neutron imaging			■
Thermonuclear reaction history	Gamma Ray History/GCD, Thompson parabola			■
Liner/fuel density, non-thermal effects (peak shifts)	Compact/Magnetic Recoil Spectrometer (CRS/MRS), precision nTOF			■

This could get us to Omega DT yield levels where then the same diagnostic techniques could be applied.

My main take-away point

The introduction of tritium in MagLIF experiments would enable new measurements and experiments that cannot be made today

- To seek community input on the merits of using tritium on Z.
- Call out collaborations that SNL would like to build with the greater ICF diagnostic community. Several of these collaborations require tritium to have an impact.
- This discussion should be held at the National Diagnostic Working Group level.

Summary

Matthew Gooden presented the use of Thulium and Bismuth as RIF diagnostics, and the new Dual-Clover System

- LANL has developed a Dual-Clover Compton system that has made the neutron activation of Thulium at the NIF possible.
- The Thulium activation diagnostic is used to probe the Reaction-In-Flight neutrons from which Te and ρR can be determined.
- The addition of Bismuth (with a higher reaction threshold) as an activation diagnostic will help to unfold the RIF spectrum.
- The Dual-Clover Compton system is being replicated to extend the possibilities of what can be fielded at the NIF
  - Short half-life activation products (^{13}N)
  - Low-activity samples (^{166}Tm, ^{206}Bi)
  - Analysis of gaseous samples from the RAGS system (^{13}N, ^{79}Kr, Du Holhraum fission products)

My main take-away point

The implementation and use of the Dual-Clover gamma-ray assay system at the NIF seems absolutely essential

Dual-Clover gamma-ray assay system

State-of the Art Detection System:

Two 100% Clover HPGe detectors
Active 4π NaI(Tl) Compton Suppressor
Detector-target distance = 1.5 cm