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.

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My main take-away point

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

- It's 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:

- Simulated source spectrum
- Predicted data
- Actual data
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 cm²), 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.
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, D³He 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.
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.
Brent Jones presented the Diagnostic Value of using Tritium on Z

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<th>Physics</th>
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<td>Sampling of tritium contamination, migration</td>
<td>&lt;0.1% 0.1% 1%</td>
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<td>Liner/fuel density, non-thermal effects (peak shifts)</td>
<td>Compact/Magnetic Recoil Spectrometer (CRS/MRS), precision nTOF</td>
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This could get us to Omega DT yield levels where then the same diagnostic techniques could be applied.
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 pR 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)
The implementation and use of the Dual-Clover gamma-ray assay system at the NIF seems absolutely essential.