A New Neutron Time-of-Flight Detector for DT Yield and Ion-Temperature Measurements on OMEGA

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Charge (pC)

0 2 4 6 8 10

Cu activation DT neutron yield ($\times 10^{13}$)

15.8-m nTOF
Linear fit
Summary

A new neutron time-of-flight (nTOF) detector for DT yield and $T_i$ measurements was implemented on OMEGA

- The new 15.8-m nTOF detector has a 40 $\times$ 20-mm BC-422Q scintillator, ND2 filter, and PMT-140 photomultiplier in a lead-shielded housing
- It provides a second line of sight (LOS) for DT yield measurements from $1 \times 10^{12}$ to $2 \times 10^{14}$ and $T_i$ measurements from 2 to 20 keV
- The 15.8-m nTOF detector measures yield with $\sim$1% precision and ion temperature with better then 3% precision
- Large differences in the $T_i$ in different directions suggest bulk fuel flows in cryogenic implosions
Collaborators

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The design of the 15.8-m nTOF is similar to the 12-m nTOF* with some shielding thickness adjustments.

- The front shielding has removable 10-mm-thick lead plates with three plates maximum; one plate is now in use.

A new 15.8-m nTOF detector was installed on the west wall above the OMEGA viewing gallery.

- The 15-m Heliax cable, four-way splitter, and 1-GHz, 10 GS/s Tektronix DPO7104 scope are used with the 15.8-m nTOF detector.
The 15.8-m nTOF has the longest distance from target chamber center (TCC) of all the nTOF detectors on OMEGA.
The 15.8-m nTOF detector is capable of measuring DT yields from $1 \times 10^{12}$ to at least $2 \times 10^{14}$.

To avoid photomultiplier tube (PMT) saturation at high DT yields, an ND2 filter was placed between the scintillator and the PMT, and the PMT was operated at low gain.
The 15.8-m nTOF detector was calibrated against copper activation neutron yields from room-temperature targets.

The nTOF detectors on OMEGA measure high DT yield with high precision.
The 15.8-m nTOF and 12-m nTOFN detectors measure ion temperature with better than 3% precision.

All data on this slide were recorded during room-temperature target implosions.
The $T_i$ ratio in different LOS varies more in cryogenic implosions than in room-temperature targets.

The large difference in $T_i$ measured from separate LOS in cryogenic implosions suggests bulk fuel flows caused by either perturbation growth or nonuniform drive.
Bulk fuel flows during an implosion may create different $T_i$ in different LOS.
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- The new 15.8-m nTOF detector has a 40 × 20-mm BC-422Q scintillator, ND2 filter, and PMT-140 photomultiplier in a lead-shielded housing.
- It provides a second line of sight (LOS) for DT yield measurements from $1 \times 10^{12}$ to $2 \times 10^{14}$ and $T_i$ measurements from 2 to 20 keV.
- The 15.8-m nTOF detector measures yield with ~1% precision and ion temperature with better than 3% precision.
- Large differences in the $T_i$ in different directions suggest bulk fuel flows in cryogenic implosions.