Secondary Neutron Energy Spectra Measurements with the 1020 Array on OMEGA

The 1020 Array in the MEDUSA Shack (formerly LANL Tion array from Nova)



Secondary neutron spectrum 200 DT yield/0.2 MeV $(\times 10^4)$ CH[20]D₂(15) shot #32184 150 **Cryo shot** #31281 100 **50** 12 14 16 18 20 10 Energy (MeV)

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The 1020 array was installed to measure secondary neutron spectra from D₂ cryogenic targets on OMEGA

- The 1020 array was refurbished, equipped with new, faster TDC electronics and a new data acquisition and data analysis program.
- Each channel of the 1020 array was calibrated with a radioactive source, and the whole array was calibrated with DD and DT neutrons.
- The secondary DT neutron energy spectra were measured from DD-filled glass, plastic, and cryogenic targets on OMEGA.
- The secondary neutron spectra from cryogenic DD implosions show a significant narrowing, indicative of the higher fuel ρR.
- The 1020 array is now ready for installation on the NIF.

The secondary neutron spectra were proposed for measurements of fuel areal density in ICF



The 1020 array was shipped from LLNL, refurbished at LLE, and installed on OMEGA



Each 1020 array channel was individually calibrated with ¹³⁷Cs source for 3- to 4-HV settings



MCA channel

MCA channel



Counts

MCA channel

The 1020 array's sensitivity is ideally matched to OMEGA's direct-drive cryogenic DD implosions

 $Y_{DT} = 2.1 \times 10^{8}$ $Y_{DD} = 2.4 \times 10^{10}$ Cryogenic shot 31927 1000 X ray Channels 900 (DD)(DT n n 800 1000 0 500 Time (ns)

With timing calibration the 1020 array resolution is adequate to infer implosion ion temperature



The 1020 array was calibrated with primary DD and secondary DT neutrons using OMEGA nTOF detectors UR



The secondary neutron spectra are mostly flat for DD-filled glass and plastic shells



The 1020 data show a narrower secondary neutron spectrum for a cryogenic target than for a CH target



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