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Measurements of DD Neutron Yield and Down-scattered DT Neutrons Using Cherenkov Detectors MICHAEL RUBERY, WARREN GARBETT, MATTHEW HILL, AWE PLC, ZAARAH MOHAMED, JAMES KNAUER, CHAD FORREST, LLE, ALASTAIR MOORE, EDWARD HARTOUNI, DAVID SCHLOSSBERG, LLNL, ANDREW SORCE, LLE, AWE PLC COLLABORATION, LLE COLLABORATION, LLNL COLLABORATION — Nuclear diagnostics are essential to infer inertial confinement fusion (ICF) plasma conditions, such as ion temperature, areal density and implosion shape, during burn and stagnation. Traditional neutron time-of-flight (nToF) detectors use plastic scintillators to detect neutrons with high efficiency, but with the complexity of a multi-component >1 ns decay tail. To study details in the down-scattered neutron spectrum, such as the n-T and n-D edges, and the DD neutron signal, requires the disambiguation of the 14.1 MeV DT neutron scintillator decay tail which can be >1000X brighter and persists for several hundred nanoseconds. In this work we present the physics basis of using quartz, sapphire and/or undoped Yttrium Aluminium Garnet (YAG) to detect low energy neutrons (<10 MeV) through the Cherenkov effect, where the light emission is below the response time (~100 ps) conventional 10 mm micro-channel plate (MCP) photomultiplier tubes (PMT), thereby removing the complexity of the tail and allowing clean measurements of the DD yield, and n-T/D edges to be made. Preliminary measurements at Omega using the Diagnostic for Areal Density (DAD) as a surrogate neutron detector are also presented.

Michael Rubery
AWE PLC

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