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10.38 Ab Initio Response Functions for Cherenkov-based Neutron Detectors

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Neutron time-of-flight (nToF) diagnostics at the NIF were recently outfitted with novel Cherenkov detectors. A quartz radiator delivers sub-nanosecond response time and is optically coupled to a MCP-PMT with gain ˜1 to 10ˆ4. Capitalizing on its fast response time, its sensitivity to gamma particles, and customized digitization, these systems provide better than 50 ps precision in measured moments of neutron distribution functions. An effort is underway to generate ab initio instrument response functions (IRF) to support the <1% uncertainty needed to resolve these moments. A combination of Monte Carlo modeling, benchtop characterization, and in-situ comparison is employed. Close agreement is shown between modeled IRFs and in-situ measurements using the NIF's 10-ps pulse capability. Calculated 1st and 2nd moments from DT neutron spectra agree well with established scintillator measurements, and show reduced dependence on IRFs. Next steps for optimized design and modeling will be discussed. Work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory, under contract DE-AC52-07NA27344. IM release: LLNL-ABS-744408

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