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Designing a Fast-Gated Scintillator-Based Neutron and Gamma Imaging System

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The Los Alamos National Laboratory Advanced Imaging Team is designing two novel neutron and gamma imaging systems being built to image inertial confinement fusion processes at the National Ignition Facility. While the immediate application of the design is in fusion diagnostics, the lessons learned will be transferable to any fast-gated radiographic imaging system. The stringent requirements for the detectors include sub-millimeter spatial resolution, sufficient cross section to allow neutron imaging at 10^6 neutrons/cm² in total, efficient light collection, and stable noise properties. Since the systems will be gated to allow the collection of frames at different neutron energies, fast scintillator timing characteristics in the nanosecond range and minimal secondary decay are a must. A comprehensive study of scintillator materials at two different neutron sources, the Los Alamos Neutron Science Center and the OMEGA laser facility in Rochester, NY, have influenced key design decisions. The recently concluded experimental campaigns have shown the benefits of lens-coupled monolithic scintillator systems over pixelated fiber arrays. Ongoing work includes the custom design of telecentric large aperture lenses required for the novel systems.

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