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Ion Acceleration and Neutron Production Based on Relativistic Transparency of Solids

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We present experimental results on the first short pulse laser driven neutron source powerful enough for applications. For the first time an acceleration mechanism based on the concept of relativistic transparency has been used to generate neutrons. This mechanism not only provides much higher particle energies, but also accelerated the entire target volume, thereby circumventing the need for complicated target treatment and no longer limited to protons as an intense ion source. We demonstrated proton beams of up to 150 MeV and deuteron beams up to 180 MeV driven by the 80 J, 200 TW TRIDENT laser at Los Alamos National Laboratory. As a consequence we have demonstrated a new record in laser-neutron production, not only in numbers, but also in energy and directionality based on an intense deuteron beam. This enabled the use in imaging applications with high temporal resolution.
The beam contained, for the first time, neutrons with energies in excess of 200 MeV and showed pronounced directionality, which makes them extremely useful for a variety of applications.
The results also address a larger community as it paves the way for short pulse lasers as a neutron source and open up research to a broad academic community.

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