Fast Neutron Source Driven by Laser Plasma Electron Accelerator

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With the development of ultra-short ultra-intense laser technology, laser-driven plasma electron acceleration is becoming increasingly mature. Compared with traditional radio-frequency accelerator, this plasma acceleration method has significant characteristics - three orders of magnitude higher acceleration gradient. It is precisely because of its ultra-high acceleration gradient that the accelerated electron beam can achieve some special characteristics such as ultra-short pulse duration 10s femtosecond, ultra-dense 1e20 cm^{-3}, and ultra-high peak current 10s kilo-Ampere.

This paper will introduce the results we have achieved in recent years at Shanghai Jiao Tong University, using laser plasma acceleration electron beams to drive photonuclear fast neutron source. Firstly, we will introduce the generation of an ultra-short pulsed neutron source, and the measurement of its ultra-short pulse duration ~36 picosecond; Secondly, we will introduce the precise measurement of the photonuclear neutron source energy spectrum based on the technology of single-neutron-counting; Lastly, we will demonstrate the potential application of this ultra-short pulsed neutron source in fast neutron absorption spectroscopy with high energy-resolution.