Cluster fusion experiment on the Texas Petawatt

Woosuk Bang
Fusion Research Center The University of Texas at Austin

Abstract

When an intense, femtosecond pulse irradiates van der Waals bonded atomic clusters, the laser pulse energy can be absorbed very efficiently. This allows the laser to produce plasma with ion temperature higher than a few keV. When an energetic deuterium ion collides with another deuterium ion, a nuclear fusion reaction can occur, generating a 2.45 MeV neutron. By shooting cryogenically cooled deuterium clusters with the Texas Petawatt laser, we were able to observe nuclear fusion reaction happening inside our target chamber. The most readily measured signature of DD fusion comes from one branch of the fusion reaction, D + D -> He3 + n, in which a neutron carries 2.45MeV kinetic energy. We were able to detect these monoenergetic neutrons using our calibrated plastic scintillation detectors. One driving goal of this research is to produce a sub-nanosecond quasi-monoenergetic neutron source that is strong enough to be used for radiography or material damage studies.