

P4.2023 Researches on laser driven neutron source and applications in Japan

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See full abstract here:

<http://ocs.ciemat.es/EPS2019ABS/pdf/P4.2023.pdf>

Laser driven neutron sources and their applications have been explored in the projects of the A-STEP program of the JST, since 2016 at ILE, Osaka University and GPI, Hamamatsu. In this paper, the status and prospects of the projects are overviewed.

In the neutron source research, the pitcher-catcher schemes with the LFEX laser at ILE and repetition rate short pulse laser at HPK and GPI were studied. In the LFEX experiments, we carried out the efficient laser ion acceleration experiments, where the 0.5-1 kJ, multi picosecond pulse irradiated CD thin foils for accelerating deuterons which are injected into the Be catcher. The total neutron yield reaches more than 10^{11} n/sr/shot (namely, 10^8 n/shot/sr/J) which is the world record of this type neutron source. Those neutrons were used to demonstrate the fast neutron imaging of infrastructure. The higher ion and neutron yield are realized by forming a pre-plasma in the TNSA in the preliminary experiments. The yield of proton beam of the energy higher than 10 MeV reaches 10^{14} /shot. The neutron yield will increase to higher than 10^9 n/J according to the simulation. The photo neutron produced by interaction of laser multi MeV gamma rays with high Z target is also investigated to develop a collimated short pulse neutron source.

The neutron is partially moderated by a compact moderator, therefore the pulse duration of the moderated neutron beam is much shorter than the accelerator driven neutron source. Therefore, X-ray image and neutron image can be taken by temporally resolved imaging. The actual example of the image will be discussed in the conference.

The neutron imaging technologies such as the nuclear resonance imaging, the compact moderator design for pulse laser neutron source and so on are also investigated. We will also present that the fast neutron imaging was demonstrated by using the RNSA neutron beam of RIKEN to achieve higher S/N with the fast imaging technique.

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