Professor Dr. Markus Roth lecture

Laser-driven neutron beams for applications

Can lasers complement or even replace particle accelerators for radiation facilities?

When: 28.4. 2017 10:30

Where: ELI Beamlines, Dolní Břežany

About prof. Dr. Roth:

Professor Dr. Markus Roth has been the professor in University of Technology, Darmstadt, and Institute for Nuclear Physics, Radiation and Beam Physics since 2003, and has published a numerous papers in major international journals and in international conferences. He has worked mainly on energy loss of heavy ions in laser generated plasmas, high energy density in matter, particle acceleration by ultra-intense lasers, plasma physics with Terawatt and Petawatt lasers and laboratory astrophysics using laser and ion beams, etc.

Abstract:

The quest for laser-based high-energy ions and secondary radiation for applications like material research or even cancer treatment has been going on for some years. Recently, using high contrast short pulse lasers like the TRIDENT in the US or PHELIX laser in Germany laser and the concept of relativistic transparency, a breakthrough has been achieved with ion energies exceeding 100 MeV and the production of intense neutron pulses [1], only about three orders of magnitude weaker than the LANSCE neutron pulses.
Based on the new mechanism's advantages, a laser-driven deuteron beam is used to achieve a new record in laser-neutron production in intensity, energy and directionality. Thus, we demonstrated the use of short-pulse laser-driven neutrons to radiograph an unknown object and to determine its material composition [2]. Neutron generation, scale exponentially with energy of the deuterium beam, which scales with the energy of the accelerating laser and result in a collimated beam, allowing e.g. a much higher fraction of produced neutrons to be captured by the moderator and delivered to the application. With available laser power increasing and the prospected increase in repetition rate and therefore average power, pulsed neutron sources achieving the neutron output of LANSCE or even SNS are conceivable. Since comparably little shielding is required, targets for laser neutron sources can be very compact, allowing moderator to sample/detector distances of a meter or even less, further increasing the flux on the sample. Investment and operational cost as well as

real estate foot-print for the necessary laser systems are all a small fraction of those for the particle accelerators or reactors required for present neutron sources. We quantitatively compare the initial experiments in laser neutron generation with existing conventional sources. An overview and outlook on the developments in laser technology [4,5] will be presented and the potential for neutron production will be outlined.

References

[1] M. Roth et al., Phys. Rev. Lett., 110, p. 044802 (2013)
[2] D. Jung et al., Physics of Plasmas 20, 056706 (2013)
[3] ELI-BEAMS, L4 Beamline
[4] DIPOLE Laser system, Rutherford Appleton Laboratory,