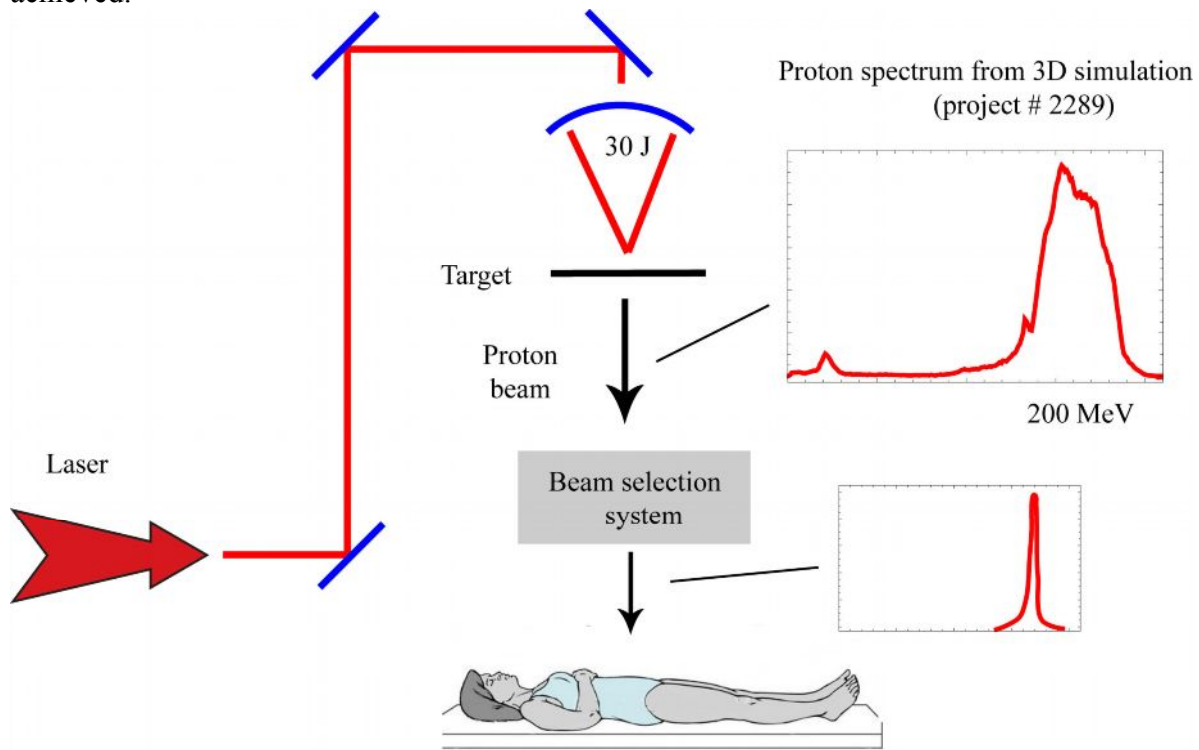


A recent revolution in laser technology has opened the door to the generation of pulses of light that can produce high-energy protons. Short intense lasers could offer tremendous benefits to society from improvement of oncology treatment by means of laser-based proton therapy. However, the way is hard to make this idea true. Scientists from RFNC-VNIITF and Lebedev Physics Institute who are engaged in the study of mechanism of particles generation by femtosecond high-intense laser pulses have performed a unique research (Project # 2289, "Theoretical and Computer Simulation Study of High Energy Ion Acceleration with Short Intense Laser Pulses") in order to prove the feasibility of the laser-based proton therapy.

There are many mechanisms and regimes of proton acceleration by laser pulses and finding the most effective ones was the main aim of the work. It is complicated by the requirement that the laser-based proton source be competitive with conventional accelerators but at a much lower cost. The unique regime of proton acceleration, the so-called "Coulomb piston effect", from ultrathin mass-limited targets was discovered to be appropriate for the laser-based proton therapy with a total laser energy requirement not exceeding 100 J, which allows the overall installation cost to remain at a very competitive level. In this scheme a laser pulse drives out electrons from the target and the Coulomb field of bulk heavy ions accelerates protons in the direction of a laser pulse.

The research was being performed in tight collaboration with Canadian Collaborators and scientists from their groups. In particular, an important study of preplasma formation due to the finite contrast ratio was based on interpretation of the experiments performed in the group of Prof. Fedosejevs at the University of Alberta. These various schemes for high energy proton generation will be explored in the near future at the largest Canadian laser facility, the Advanced Laser Light Source (ALLS, 21 M\$), using very high laser intensities of up to 10^{22} W/cm^2 on various targets. It is expected that high efficiency generation of quasi-monoenergetic proton beams suitable for proton therapy will be achieved.



Laser-proton therapy system