Charged particle accelerator development using intense laser-driven plasma

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Intense laser-driven charged particle acceleration is becoming a promising tool for downsizing radio-frequency based particle accelerators because of recent technological progress. At the QST we are developing both the ion and electron laser based accelerators. For the ions, the QST institute has formulated several facility generations to be used for heavy ion cancer therapy. The 1st and 2nd facility generations already exist or are under construction in Japan. They are based on linear accelerator and synchrotron accelerator concepts. In the 5th generation facility we will provide 4 MeV/u, 10^8 carbon ions per second in 1% bandwidth for downsizing the injector to be used for the synchrotron accelerator. In the laser based accelerator currently we are using so called the target normal sheath acceleration (TNSA) scheme, where the quasi-static electric field is formed at the rear side of a thin foil irradiated by an intense laser. For electron acceleration, we employ the laser wake-field acceleration scheme when the plasma waves driven by the ponderomotive force of the short intense laser pulse in tenuous plasma are used to accelerate the electrons. Our approach is based on the staging or on the cascading of the acceleration stages intended to generate the high-quality, reproducible electron beams. Such the electron beams will be used to drive a compact X-ray free-electron laser.

In the presentation our recent experimental results will be overviewed.