SOURCE DEVELOPMENT AND NOVEL APPLICATIONS OF COHERENT X-RAYS AND ENERGETIC PARTICLE BEAMS USING HIGH PEAK POWER LASERS IN JAPAN ATOMIC ENERGY AGENCY

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Laser-driven particle and radiation sources, which are generated from laser-plasma interaction, have unique and attractive characteristics such as ultra-short duration, high peak brilliance and potentials of downsizing of the source etc. Recent advent of high peak power lasers toward peta-watt (PW) level makes it possible for us to realize these particle and radiation sources with higher energy region, and now we are on the stage to investigate the mechanisms in detail and to start the applications of these novel sources in material science, life-science, medical treatment, innovative drug development, and non-destructive assay etc.

In this presentation, first of all, recent research activities in major high peak power laser facilities in Japan will be introduced, and then we will present research highlights in the last few years on the source development and the applications using high peak power lasers in Japan Atomic Energy Agency (JAEA) based upon Japan-Russia collaborations: In the source development, the higher-order harmonics generation in several 100 eV region using a relativistic plasma, the first observation of x-ray mirage [1] in the soft x-ray laser gain medium plasma, and the energetic proton beam generation with the energy of 40 MeV are presented. In the application study, we will show the coherent soft x-ray probe of nano-scale surface dynamics in femto-second laser ablation and the demonstration of laser acceleration of highly charged heavy ions to explore new regime of nuclear physics. Finally we will mention our future plan: Now we are upgrading the ultra-intense Ti:Sapphire laser, “J-KAREN”, toward PW level to explore the possibility of laser-driven particle and radiation sources and open up their new applications.

References

1. Magnitskii *et al*. Nature Communications 4, 1936 (2013).