

Aiming to measure cluster DNA damage, proposal for experiment systems using XFEL and laser driven ion beams

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Abstracts: We propose some experiment systems to measure cluster DNA damage created from the heavy ion irradiation. In our proposal, the combination of XFEL and laser driven ion beams is employed. This combination may allow us to analyze the cluster DNA damage with high time and space resolution.

Heavy ions are a good research tool in the field of bio-physics, material science, medical science. For example, in bio-physics, the important phenomenon of relative biological effectiveness (RBE) has been not yet fully understood. The understanding of RBE is directly connected to understand why heavy ion beam cancer therapy has higher efficiency than the other radiation cancer therapy. This phenomenon (RBE) may come from the fact that carbon ions produce larger number of clustered DNA damages that are defined as multiply damaged sites within a region of several nm length of DNA. Although evidence on the biological significance of clustered DNA damage has been accumulated, it remains largely unknown how clustered DNA damage is generated after irradiation.

In this report, we propose some experiment systems to apply the combination of XFEL and laser driven ion beams to study the physical phenomena caused from the ion irradiation. We utilize advantages of this combination: (i) all sources can become short pulse (ps - ns) and (ii) XFEL has very high brightness. Therefore, pump-probe methods may allow us to measure the structure of cluster DNA damage with high time and space resolutions.

Fig.1 shows an example of our proposal for an experiment system. We may measure from experiments that we propose as follows: (1) the track structure of the incident ion, (2) the relationship between the production points of cluster DNA damage and (3) the incident ion path, and the different mechanisms of DNA damage between the irradiation of heavy ions and protons or x-rays.

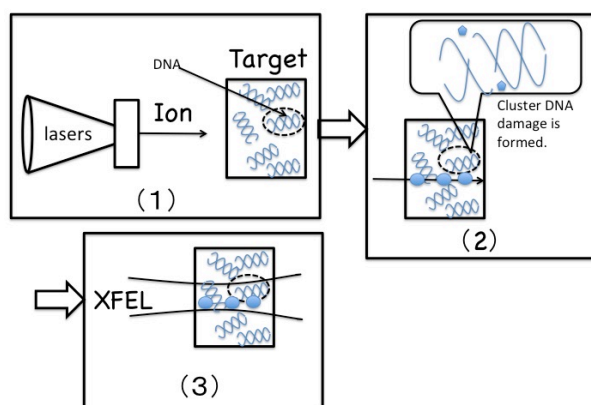


Fig.1 An example of our proposal for the experiment system: (1) DNA target is arranged and high intensity lasers drives ion beams, (2) this ion beam irradiates the target and cluster DNA damage is created, and (3) the structure of the cluster DNA damage is measured by XFELs.