

## **OPENPET ENABLING PET IMAGING DURING RADIOTHERAPY**

Taiga Yamaya

National Institute of Radiological Sciences (NIRS) at the National Institutes for Quantum and Radiological Science and Technology (QST), Japan

Cancer is a major cause of death in developed nations, and the disease death rate continues to increase. Therefore, many efforts have been made toward better diagnosis and better treatment. Among diagnostic tools, positron emission tomography (PET), which can visualize functions such as metabolism by injecting radioisotope tracers labeled with positron emitters, is expected to enable earlier and more precise cancer diagnosis. For treatment, on the other hand, radiotherapy is essential for effective cancer treatment with minimized side effects. Specifically, particle treatments such as proton and carbon ion therapy are expected to be the ultimate radiotherapy because they can concentrate the dose even in a deep tumor. Thus there has been remarkable progress in PET and radiotherapy, but no one has looked into the great potential to be obtained by the combination of both. An open-type PET geometry (OpenPET) is our new idea to visualize a physically opened space between two detector rings, which will move researchers toward a future joint PET imaging and radiotherapy system. OpenPET is expected to achieve in-beam PET, which is a method to monitor *in situ* charged particle therapy. Without injecting any PET tracer, positron emitters are produced through fragmentation reactions between the projectiles and the atomic nuclei of the tissue during patient irradiation. Compared with conventional radiation therapy, charged particle therapy can highly concentrate the dose in a tumor. This means if there is any difference between the actual irradiation and the treatment plan, the tumor treatment will be compromised, and the normal tissue around the tumor will be damaged. Therefore, quality of treatment is expected to be assured by in-beam PET.