Nuclear Data for Radiation Therapy

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The presence of a Bragg peak makes charged particles advantageous to treat deep-seated tumors. Especially, heavy ions, from carbon down, are expected to improve the therapeutic results due to sharper dose localization and optimum biological effectiveness in the target volume.

To make best use of the advantage, some problems still remain to be solved in the fields of engineering, physics, biology and medicine. Among them, fragmentation of the incident beam is one of the most important reactions to be considered concerning their medical applications from a basic standpoint. Due to widely spread fragments in both the axial and lateral directions, the resultant therapeutic beam has a complex spatial distribution of the radiation quality in a patient's body.

The biological effectiveness of charged particles is expressed as functions of not only the deposited energy, but also the particle species. This fact results in a requirement concerning information about the radiation quality (fluence and energy distribution) for an estimation of the clinical effect of the beam.

For the time being heavy ion therapy has been carried out in Japan (NIRS and Hyogo) and Germany (GSI). The scheme to estimate the biological effect of the heavy ion is, however, different in both countries. The models will be introduced with required physical information about the therapeutic beam.

Recent improvements in charged-particle therapy have helped to realize more localized dose delivery to tumours such as by using treatment planning with a pencil beam or a Monte-Carlo algorithm or beam delivery with a scanning system. From these points of view, it is required to understand spatial information concerning the radiation quality to make the best use of the advantage of heavy ions. On the other hand, it has been extensively studied to understand the biological effect of heavy ions from microscopic energy deposition pattern. Such recent improvements on the modeling will be mentioned in the talk.