3- 82 Study of Particle Fragments and Its Contribution in Carbon Ion Therapy

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Carbon ions offer significant advantages for deep-seated local tumors therapy due to their physical and biological properties, for heavy ions has a fixed range in the target matter, and characterized by a small entrance dose and a distinct maximum (Bragg peak) near the end of range. In 2006, IMP carried out some heavy ion cancer therapy experiments. During the process of carbon ions cancer therapy, various kinds of secondary particle fragments are created from heavy ion reaction which will influence the treatment dose and healthy tissue of patient. Neutron is the most abundant secondary particles in heavy ion reaction, which may influence largely patient body due to its strong penetrating power. Thus it is important to know the neutron contribution in heavy ion therapy to evaluate the neutron impact and assess the patient safety. Particle fragments and its contribution from 430 MeV/u carbon ions stopping in thick water target were calculated by Fluka Monte Carlo code[1].

Fig. 1 shows the neutron flux density distribution in and out the water target. Along the beam direction in the water target, neutron yields increased first and then decreased, and neutron yield is lower in the place where lateral from the beam direction is farther. Fig. 2 shows that the calculated values is the energy deposition when 430 MeV/u carbon ions bombarded on water target with unit GeV/cm^3, the solid line represent the all energy deposition, dash line shows the carbon energy deposition, and the dot line is the neutron energy deposition. The potion between solid and dash line, especially beyond the Bragg peak is entirely due to the contribution of the fragmentation which come from nuclear reactions. The neutron contribution is no more than 1/1 000 in the Bragg peak area. Fig. 3 shows the particle fragments yields in the beam direction, and the neutron and proton yields is larger, but in Fig. 4 the energy deposition is mainly due to the contribution of hydrogen and helium, which is about 10%. In this work we will get better understand of the physical process of carbonion therapy, and this research may provide basic date for safety assessment in carbon ion cancer therapy.

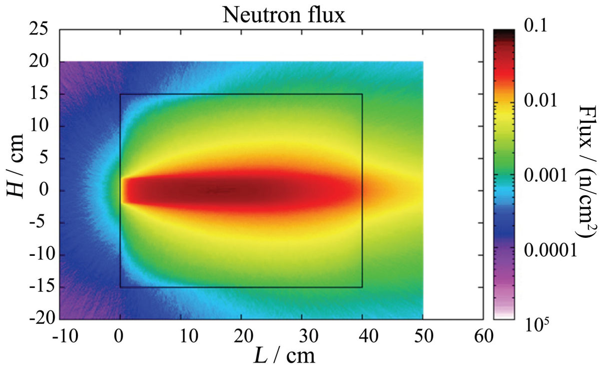

Fig. 1 (color online) Neutron distribution in and out of the water target.

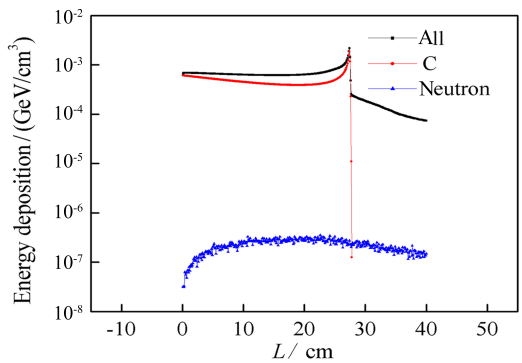

Fig. 2 (color online) Neutron contribution during therapy.

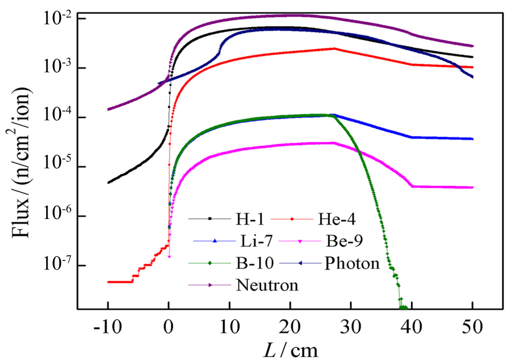

Fig. 3 (color online) Particles fragments flux density distribution in water target with beam direction.

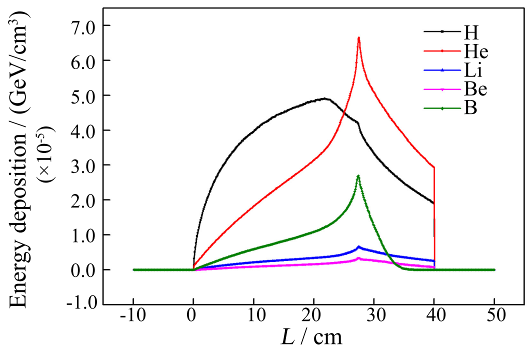

Fig. 4 (color online) Energy deposition of particles fragment.

Reference

[1] http://www.fluka.org/fluka.php.