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Numerical Calculation of the Deflected Path of Electrons through Water under External Magnetic Fields

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The study on magnetic field combined radiation therapy, as a new technique to modify the dose distributions using external magnetic field, has been investigated. The goal of the study is to develop the techniques for dose localization, as a particle beam, from the strong magnetic fields. In this study, in order to study the principle of dose deposition in external fields, as a basic approach, we have calculated approximately the paths of traveling electrons in water under external magnetic fields with numerical methods. The calculations are performed for a primary particle by cumulating the steps which are defined as small path lengths which energy loss can be ignored. In this calculation, the energy loss and direction change for a step was calculated by using total stopping power and Lorentz force equation respectively. We have examined the deflected paths of the electron through water as a function of external magnetic field and incident electron's energy. Since we did not take account of the multiple scattering effects for electrons through water, there are errors in this calculation. However, from the results we can explain the principle of dose variation and dose focusing for electron beams under strong magnetic fields in water.

Key words: Magnetic field, Electron beam, Deflected path