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Focusing of high energy electron beam using crystal lenses for applications in radiotherapy - feasibility study

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The two dominant radiotherapy methods are either simplified in terms of beam generation and handling, which compromises the energy deposition curve in tissues (photon therapy) or require extensive accelerator facilities and complex beam delivery systems to provide a favourable shape of the energy deposition curve (hadron therapy). The advantages of both of these methods, such as the low cost of the apparatus, ease of beam generation and a suitable shape of the energy deposition curve in tissues, can potentially be achieved by using a high-energy electron beam (beam energy in the order of a few hundreds of MeV) focused on the area of the tumour lesion. However, focusing of the beam is usually done with the use of quadrupole magnets which makes the beam delivery system complex and challenging from the engineering point of view. In this paper, we explore the feasibility of an alternative solution, where focusing is performed by a bent silicon crystal with an appropriate shape of its exit face. Such a crystal lens can be a very light object (mass in the order of grams), allowing for much simpler beam delivery systems of radiotherapy facilities.

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Footnotes

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