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Intra-operative radiation therapy with laser-accelerated carbon ions

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Laser accelerators have long been proposed as beam source for hadron therapy.
However, the high particle energies required for the treatment of deep-lying tumours, combined with stringent requirements on the beam quality, are still a severe challenge.
In the present work, we discuss the applicability of laser-accelerated carbon ions at modelate energies to the irradiation of superficial lesions, a new therapeutic modality which combines the versatility of Intra-Operative Radiation Therapy (IORT) with the advantages of carbon ions as compared to photon and electron radiation.

To justify this idea a feasibility study has been done, which is focused on the uniformity of the dose deposition in depth and the physical (LET) and biological (RBE, OER) characteristic aspects of the carbon ion source. For superficial radiation treatment a maximum penetration depth of 5 mm is required, which implies an energy rate of 10 Hz for typical IORT treatment is needed. With those specifications a GATE simulation has been performed, showing an approximately uniform depth-dose profile, maintaining a radiation boost of 10 Gy.

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