Modelling ion beam therapy

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Hadron beam therapy, which is often used to treat solid tumours, involves irradiating a tumour with a beam of high-energy charged particles, most often protons; these transfer their energy to the tumour cells, destroying them. It is important to understand the precise physics of this energy transfer so the tumour can be targeted precisely. Pablo de Vera of MBN Research Center, Frankfurt, Germany and co-workers in the Universities of Murcia and Alicante, Spain, have produced a consistent theoretical interpretation of the most accurate experimental measurements of ion beams energy deposition in liquid water jets, which is the most relevant substance for simulating interactions with human tissue. Their work is published in The *European Physical Journal D*.

When a beam of ions enters a patient's body, it transfers its kinetic energy to the tissue, producing electronic excitations; the maximum dose of cell-destroying radiation is delivered at the point when it stops. Predicting how to hit the tumour precisely, reducing or avoiding energy transfer to adjacent normal tissue, requires a precise understanding of this 'electronic stopping power'. Until now, theoretical models of the interaction have not quite matched the few available experimental measurements.

The most common method of modelling the energy loss when high-energy ions pass through a material is Monte Carlo simulation. De Vera and his co-workers used their own Monte Carlo method, which takes into account several different types of interaction between the ions and the material as well as the detailed geometry of the target—here a liquid water jet. They found that once the diameter of the jet was slightly

reduced, as might easily happen with evaporation, the simulations almost exactly reproduced experimental results. De Vera and his colleagues now intend to use their code to study the generation of secondary electrons by ion beams in tissue and thus gain an even better understanding of the physical mechanisms underlying this powerful type of cancer treatment.

More information: Pablo de Vera et al, Simulation of the energy spectra of swift light ion beams after traversing cylindrical targets: a consistent interpretation of experimental data relevant for hadron therapy, *The European Physical Journal D* (2019). DOI: 10.1140/epjd/e2019-100083-4

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