Pressemitteilung

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New laser technology for future radiation therapy

Currently, new treatment facilities for radiation therapy with ions are built all over the world. These particles destroy cancer cells and have a better ability to spare the surrounding healthy tissue than other techniques. Today, accelerated hydrogen and carbon ions are mainly used to treat inoperable tumors in organs like the brain and bone marrow, which are sensitive to radiation therapy. A new technology for this kind of treatment is developed by researchers of the OncoRay center in Dresden and of the research center Forschungszentrum Dresden-Rossendorf (FZD): in their concept the ion beams are accelerated by a compactlaser, and not in 'normal' accelerators. They published their first results of cell irradiations using ions in the "New Journal of Physics".

Traditional proton and ion accelerators are large and expensive, which is why the new therapy making use of accelerated proton and ion beams can only be applied in a few clinics like the Heidelberg Ion-Beam Therapy Center (HIT). Yet there is a big world-wide interest in compact and flexible facilities for proton and ion acceleration for therapy, as experts expect the proof of the advantages of proton and ion therapy for an increasing group of different cancer diseases in the future leading to widespread clinical application. The Dresden OncoRay center, which is carried by the research center Forschungszentrum Dresden-Rossendorf (FZD), University Hospital Dresden and TU Dresden, now achieved an important step towards compact radiation facilities for cancer treatment.

The high-power laser DRACO at the FZD generates protons, accelerating them on a very short scale of less than ten micrometers (which is about one tenth of the thickness of a single human hair). For their current results, the team of researchers led by Dr. Ulrich Schramm (FZD) and Dr. Jörg Pawelke (OncoRay) irradiated cancer cells with protons, i.e. hydrogen atoms where the electron is missing. The scientists are also investigating the impact of radiation on cells under controlled conditions, for which they developed a special device enabling them to precisely measure the dose of the irradiated cells. The dose of the irradiations at the FZD ranged between 1.5 and 4 gray - an area particularly relevant for clinical application of proton beams. What is more, the energy of the laser accelerated ion beam is high enough for the first time for the beam to be able to penetrate into tissue, but also into other materials, enabling exact dose detection. Up to 20 mega electron volts were achieved in the experiments.

60 percent of cancer patients receive traditional radiation therapy

The advantage of accelerated ion beams is that they have their highest impact in the tumor and, thus, have a better ability to spare healthy tissue. Today, more than 60 percent of cancer patients undergo radiation therapy. While, in traditional therapy, a considerable part of the energy of photon beams generated in modern clinical linear accelerators is emitted on their way through healthy tissue, ion beams can be

Pressemitteilung

stopped right in the tumor with utmost precision, where their damaging impact is released on all tumor cells. This new method was successfully tested in the heavy ion therapy project at GSI, Darmstadt, among other things. About 400 patients were treated and about 70 percent of them were cured. FZD scientists collaborated in this project and are also significantly involved in the Heidelberg HIT center.

New kinds of radiation to combat cancer

There is still a lot of basic research to be done until the first clinical applications of high-power lasers. Scientists from Dresden are strongly involved in this and are likely to make essential contributions to the world-wide run for new applications, drawing on the close collaborations of medical scientists, physicists, biologists and mathematicians in Dresden. The OncoRay center forms a unique cluster for radiation research in oncology in Dresden and has made a name for itself on an international level. OncoRay scientists at the university hospital, FZD and TU Dresden are focused on translational research, which means that results from basic research are to be transferred to clinical applications as soon as possible. The first compact irradiation facility applying laser technology could be put up in hospitals in ten to fifteen years.

The next step towards clinical application is to carry out detailed studies comparing the impact of laser accelerated ion beams with radiation traditionally used in cancer therapy. In addition, scientists from Dresden and of the Friedrich-Schiller-Universität and the Fraunhofer Institute in Jena are accomplising studies in order to increase the energy of the radiation, in the framework of the “onCOOPtics” project. Researchers also aim at developing a prototype for laser based radiation therapy to be installed at a new joint center for radiation therapy in oncology in Dresden.

Publication

„Dose dependent biological damage of tumour cells by laser-accelerated proton beams”, S. D. Kraft, C. Richter, K. Zeil, M. Baumann, E. Beyreuther, S. Bock, M. Bussmann, T. E. Cowan, Y. Dammene, W. Enghardt, U. Helbig, L. Karsch, T. Kluge, L. Laschinsky, E. Lessmann, J. Metzkes, D. Naumburger, R. Sauerbrey, M. Schürer, M. Sobiella, J. Woithe, U. Schramm, J. Pawelke, New Journal of Physics, 12, 085003 (2010), DOI: 1088/1367-2630/12/8/085003 (http://iopscience.iop.org/1367-2630/12/8/085003)

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