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MAGAZINE

“Clean” nuclear fusion to fight tumors

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FBK participates in experiments on the application of boron-proton fusion in a potential new proton-therapeutic technique. The results have been published in Scientific Reports

For several years, the MNF (Micro-Nano Facility) division of FBK’s CMM is at the forefront of research into the development of advanced materials – produced in the **clean room** of Fondazione Kessler – for laser-assisted **clean nuclear fusion** applications.

In this context, FBK, in cooperation with national and European research organizations such as the INFN’s National Laboratories of the South in Catania (where the treatments were carried out), the ELI (Extreme Light Infrastructure) Institute in Prague, the Federico II University of Naples and others, has conducted in the last two years a series of experiments to verify whether the **proton-boron-11** fusion reaction could be effectively triggered on human tumor cells.

The new technique, called **PBCT** (Proton Boron Capture Therapy), involves the administration of a solution containing molecules consisting of boron-11 nuclei (boron’s main isotope) on a tumor mass. The latter is then treated with proton beams – whose energy and dose levels are typical of classical proton therapy – which trigger fusion by generating **alpha particles** (helium nuclei). Once produced, the alpha particles stop almost instantaneously inside the cells, releasing all their energy and causing damage and in some cases the destruction of the DNA of the tumor cells while preserving healthy tissue.

The results, published in the journal Scientific Reports, show that the bombardment with low energy alpha particles (about 4 megaelectronvolts) – which act as projectiles with mass four times greater than normal protons – generated **a 30% increase** in mortality of cancer cells.

«The principle behind these experiments was to transfer an idea that we had developed some years ago with the colleagues at the ELI institute in Prague in the field of research on clean laser fusion, applying it to the pre-clinical field of proton therapy» , explains A**ntonino Picciotto**, one of the authors of the article and a researcher at the MNF division. “Our hope is that this new approach, combined with the ballistic properties of standard proton therapy, can be used in the near future to increase the radiobiological effects of irradiation on particularly resistant and aggressive tumors. With effects that are certainly positive for the health of patients. ”

As for the measures and results obtained, on 5-6 April a mini-workshop organized by FBK entitled “**Towards Proton Boron Capture Therapy**” was held on April 5-6, that was attended by researchers from FBK, INFN-LNS of Catania, ELI Beamlines of Prague, Federico II University of Naples, CNR-Palermo, TIFPA-INFN of Trento and the Proton Therapy Center of Prague. The aim of the workshop was to involve the Italian and European community in a **discussion** on the results obtained as well as on the physics and medicine related issues and future perspectives of this new possible approach to therapy. In this context FBK, besides participating in this research, has played a fundamental role as a **nucleus** of condensation of the different national and international organizations engaged in proton therapy.

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