LNGS SEMINAR SERIES

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Gold Nano Particles as damage amplifiers in particle therapy: why and how?

Radiotherapy and Hadrontherapy are well known and widely used methods to treat cancer when surgery is not suitable or as a complement to a surgical intervention.
Both approaches rely on the damage caused to cells by ionizing radiation, which is released mostly on cancer cells by means of IMRT techniques (Radiotherapy) or energy tuning (Hadrontherapy).
Metallic nanoparticles have been demonstrated to act as radiosensitizers, enhancing the damage caused by particle therapy. However, there is no understanding of the physics processes that cause the increase in cellular damage and there is no validated method to accumulate metallic nanoparticles in the tumor at the cellular level.
The nATT project, funded and coordinated by the INFN with the participation of the CNR and the Universities of Torino and Pisa, is developing radiolabeled a-specific glucide- (FDG) and peptide-based (RGD) targeting agents linked to Gold NanoParticles (GNP) as a mean to concentrate GNPs in tumor cells. Gold is quite bio-compatible and its damaging action would only be triggered by treatment beams.
Meanwhile, a new protocol for the direct measurement of Reactive Oxygen Species production in conditions typical of radiotherapy sessions was developed: measurements taken at the Ospedale Mauriziano Radiotherapy facility (Torino) suggest that the increase in ROS production caused by GNPs is – if any – negligible. Therefore, ROS quantity is ruled out as radiosensitizing mechanism, leaving two open options: the extra damage is either caused by different ionizing patterns, with GNPs causing higher ionization density and therefore being more effective in the cell damage, or by another – unidentified – effect.
Preliminary results on in-vivo measurements are quite promising and – should they be confirmed by further measurements – could lead to significantly improved particle therapy protocols.

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