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Proton acceleration and detection for clinical and preclinical research

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Research at the Institute for Instrumentation in Molecular Imaging (i3M, Valencia) is related to the development of diagnostic systems and clinical or preclinical applications of nuclear physics techniques. We present two recent advances related to particle therapy. The necessity for online range measurement for the real-time determination of the position of the Bragg peak has been much discussed throughout the last decade. We have developed a beam trigger detector based on scintillating fibres which can be used for precise coincidence timing at clinical beam intensities and thereby allows for background suppression in prompt-gamma detection and spectroscopy. Tests with an upgrade version are ongoing.
The second research topic relies on proton and ion acceleration with ultra-short laser pulses. This type of radiation sources generate ultra-intense particle bunches and have attracted much attention as a tool for investigating radiobiological effects in the ultra-high dose rate (UHDR) regime. In close collaboration with IGFAE we have built an experimental arrangement for the irradiation of cell cultures with protons of about 5 MeV at the Laser Laboratory for Acceleration and medical Applications (L2A2, Santiago de Compostela). Our aim is to perform systematic studies of the cellular response to damage caused by different types of ionizing radiation (protons, x-rays) and their comparison to clinical radiation fields. This requires, among others, the measurement of the total dose deposition at ultra-high dose rates. First tests have been performed with a laser-based x-ray source using cell samples prepared and analysed by the Fundación Pública Galega de Medicina Xenómica (FPGMX, Santiago de Compostela).

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