WS101-11: Single exposure, ultra-high dose rate radiobiology experiments employing laser-driven ions

M. Borghesi[1], P. Chaudhary[2], H. Hamad[1], D. Doria[1,3], G. Milluzzo[1], F. Hanton[1], D. Gwynne[1], C. Maiorino[2], K. Polin[1], P. P. Rajeev[4], P. McKenna[5], S. Kar[1], L. Romagnani[6], K. Prise[2]

[1]*Centre for Plasma Physics, Queen's University Belfast, UK*

[2]*Centre for Cancer Research and Radiation Biology, Queen's University Belfast, UK*

[3]*Extreme Light Infrastructure – Nuclear Physics (ELI-NP), Horia Hulubei Institute for Nuclear Physics (IFIN-HH), Bucharest (Romania)*

[4]*Central Laser Facility, Science and Technology Facilities Council, Rutherford Appleton Laboratory, Didcot, UK.*

[5]*Department of Physics, SUPA, University of Strathclyde, Glasgow, UK*

[6]*Laboratoire Pour l' Utilisation des Lasers Intenses (LULI), Ecole Polytechnique, Palaiseau, France*

The acceleration of ions using high power lasers is attracting significant interest as an alternative source for future therapeutic applications, and several projects worldwide (including the UK-wide A-SAIL project) are devoted to developing laser-based accelerator technologies and assess their promise for future medical use.

In this context, a key area of research is the investigation of the biological effects, in cell and tissue models, of the short bursts of ions produced by laser-driven sources. This activity serves a dual purpose: on one hand, any future use of laser-accelerated ions will require prior validation of their biological effects on appropriate models; on the other hand, by exploiting these unique beam properties, one can access unexplored regimes of radiation interaction with living systems.

In experiments carried out the dose required to trigger meaningful effects on cell samples has been either fractionated in a number of consecutive pulses, or delivered as a single pulse exposure, typically depositing ~Gy doses at dose rates exceeding 109 Gy/s.

The work of the A-SAIL consortium has focused so far on this second approach, which is more appropriate to the type of laser sources available for our activities, but is also, arguably, more suited to reveal any high dose rate effects. The talk will review the approaches taken for adapting cell exposure techniques to the non-conventional environment of a large laser facility, and will discuss the results of recent experiments carried out on large laser systems such as GEMINI and VULCAN at the Rutherford Appleton Laboratory.