Contribution ID: **1634** Contribution code: **THPL106** Type: **Poster Presentation**

Three-stage simulation for the development of an ion-acoustic dose-deposition mapping system for LhARA

Thursday 11 May 2023 16:30 (2 hours)

LhARA, the Laser-hybrid Accelerator for Radiobiological Applications, *is a proposed facility for the study of proton and ion radiation biology. The accelerator is designed to deliver a variety of ion species over a wide range of spatial and temporal profiles at ultra-high dose rates. The facility requires that the deposited dose distribution be measured in real-time. For this purpose, an ion-acoustic dose mapping system has been developed that, exploits the ultrasound waves generated by the ion beam**. The feasibility of this approach is being evaluated using a two-stage simulation.

A water phantom modelled in Geant4 with beam energies up to 250 MeV is used to calculate the energy deposited by the beam as a function of position and time. The time-dependent 3D energy distribution is then used as the source in k-Wave to simulate the ion energy generation of acoustic (pressure) waves and their propagation in the three-dimensional space. A hemispherical acoustic sensor array is also simulated and its ability to reconstruct the generated pressure distribution is evaluated.

The results show that the 3D deposited-energy distribution can be reconstructed with sub-millimetre accuracy and suggest, that further development of the system can lead to real-time, non-invasive Bragg peak localization and dose deposition profile measurement during ion-beam therapy.

Funding Agency

Science and Technology Facilities Council (STFC)

Footnotes

- Aymar G. et al. Front Phys. 2020;0:432. ** Haffa D. et al. Sci Rep. 2019;9(1):6714. *** Allison J. et al. Nucl. Instrum. Meth. A. 2016;835:186-225. **** Treeby BE, Cox BT. J. Biomed. Opt. 2010;15(2):021314.

I have read and accept the Privacy Policy Statement

Yes

Author: MAXOUTI, Maria (Imperial College London)

Co-authors: LAU, Hin Tung (Imperial College London); MCGARRIGLE, Josie (Imperial College London); MACINTOSH-LAROCQUE, Anthea (Imperial College of Science and Technology); HARRIS, Emma (The Joint Department of Physics, Institute of Cancer Research and Royal Marsden NHS Foundation Trust); WHYTE, Colin (University of Strathclyde); MATHESON, John (Science and Technology Facilities Council); BAMBER, Jeffrey (The Joint Department of Physics, Institute of Cancer Research and Royal Marsden NHS Foundation Trust); COX, Ben

(Department of Medical Physics and Biomedical Engineering); LONG, Kenneth (Imperial College of Science and Technology)

Presenter: MAXOUTI, Maria (Imperial College London)

Session Classification: Thursday Poster Session

Track Classification: MC6: Beam Instrumentation, Controls, Feedback and Operational Aspects: MC6.T03: Beam Diagnostics and Instrumentation