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## Design of an ion-acoustics proof-of-principle experiment for LhARA

*Wednesday, 22 May 2024 16:00 (2 hours)*

LhARA, the Laser-hybrid Accelerator for Radiobiological Applications, is a proposed facility for the study of radiation biology. The accelerator will deliver ions at ultra-high dose rates and requires real-time measurement of the dose distribution. We have developed an ion-acoustic dose mapping system that exploits the acoustic waves generated by the beam's energy deposition. A proposed proof-of-principle experiment is presented.

A water-based phantom features a beam entry window sealed with Kapton. Three ports located on three orthogonal sides mount transducer arrays for detecting the acoustic waves. To calibrate their acoustic response, a liquid scintillator will be added to the water and its luminescence arising from the energy deposited by the beam is imaged by two cameras, positioned perpendicularly to each other. The acoustic wave generation and detection have been simulated in Geant4 and k-Wave, and the optical system in OpticStudio.

The simulation shows precise reconstruction of the 3D deposited energy distribution using the acoustic and optical systems should be obtained in the proposed design. Combining these will yield a real-time calibrated dose map in the experiment.

### Footnotes

- 1 Aymar G. et al. *Front Phys.* 2020;0:432.
- 2 Haffa D. et al. *Sci Rep.* 2019;9(1):6714.
- 3 Allison J. et al. *Nucl. Instrum. Meth. A.* 2016;835:186-225.
- 4 Treeby BE, Cox BT. *J. Biomed. Opt.* 2010;15(2):021314.
- 5 Zemax. (n.d.). Zemax OpticStudio. [online] Available at: <https://www.ansys.com/products/optics-vr/ansys-zemax-opticstudio>

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