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LhARA: The Laser-hybrid Accelerator for Radiobiological Applications

Galen Aymar[1], Tobias Becker[2], Stewart Boogert[3], Marco Borghesi[4], Robert Bingham[1,5], Ceri Brenner[1], Philip N. Burrows[6], Oliver C. Ettlinger[7], Titus Dascalu[8], Stephen Gibson[3], Timothy Greenshaw[9], Sylvia Gruber[10], Dorothy Gujral[11], Claire Hardiman[11], Jonathan Hughes[9], W. G. Jones[8,12], Karen Kirkby[13], Ajit Kurup[8], Jean-Baptiste Lagrange[1], Kenneth Long[1,8], Wayne Luk[8], John Matheson[1], Paul McKenna[5,14], Ruth McLauchlan[11], Zulfikar Najmudin[7], Hin T. Lau[8], Jason L. Parsons[15,16], Jaroslaw Pasternak[1,8], Juergen Pozimski[1,8], Kevin Prise[17], Monika Puchalska[18], Peter Ratoff[14,19], Giuseppe Schettino[20,21], William Shields[3], Susan Smith[22], John Thomason[1], Stephen Towe[23], Peter Weightman[8], Colin Whyte[5] and Rachel Xiao[24]*

[1] STFC Rutherford Appleton Laboratory, Didcot, United Kingdom, [2] Maxeler Technologies Limited, London, United Kingdom, [3] John Adams Institute for Accelerator Science, Royal Holloway, University of London, Egham, United Kingdom, [4] Centre for Plasma Physics, Department of Physics, Queens University Belfast, Belfast, United Kingdom, [5] Department of Physics, SUPA, University of Strathclyde, Glasgow, United Kingdom, [6] John Adams Institute for Accelerator Science, University of Oxford, Oxford, United Kingdom, [7] John Adams Institute for Accelerator Science, Imperial College London, London, United Kingdom, [8] Department of Physics, Imperial College London, London, United Kingdom, [9] Department of Physics, University of Liverpool, Liverpool, United Kingdom, [10] Christian Doppler Laboratory for Medical Radiation Research for Radiation Oncology, Medical University of Vienna, Vienna, Austria, [11] Imperial College Healthcare NHS Trust, The Bays, St Mary's Hospital, London, United Kingdom, [12] Imperial Patient and Public Involvement Group, Imperial College London, London, United Kingdom, [13] Division of Cancer Sciences, School of Medical Sciences, University of Manchester, Manchester, United Kingdom, [14] Daresbury Laboratory, Cockcroft Institute, Sci-Tech Daresbury, Liverpool, United Kingdom, [15] Institute of Translational Medicine, Department of Molecular and Clinical Cancer Medicine, University of Liverpool, Liverpool, United Kingdom, [16] The Clatterbridge Cancer Centre, Liverpool, United Kingdom, [17] Centre for Cancer Research Cell Biology, School of Medicine, Dentistry and Biomedical Sciences, Queens University Belfast, Belfast, United Kingdom, [18] Atominstitut, Technische Universität Wien, Vienna, Austria, [19] Physics Department, Lancaster University, Lancaster, United Kingdom, [20] National Physical Laboratory, London, United Kingdom, [21] University of Surrey, London, United Kingdom, [22] STFC Daresbury Laboratory, Liverpool, United Kingdom, [23] Leo Cancer Care, London, United Kingdom, [24] Corerain Technologies, Shenzhen, China

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Vincenzo Patera, Sapienza University of Rome, Italy

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Lorenzo Manti, University of Naples Federico II, Italy
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***Correspondence:**
Ajit Kurup
a.kurup@imperial.ac.uk

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The "Laser-hybrid Accelerator for Radiobiological Applications," LhARA, is conceived as a novel, flexible facility dedicated to the study of radiobiology. The technologies demonstrated in LhARA, which have wide application, will be developed to allow particle-beam therapy to be delivered in a new regimen, combining a variety of ion species in a single treatment fraction and exploiting ultra-high dose rates. LhARA will be a hybrid accelerator system in which laser interactions drive the creation of a large flux of protons or light ions that are captured using a plasma (Gabor) lens and formed into a beam. The laser-driven source allows protons and ions to be captured at energies significantly above those that pertain in conventional facilities, thus evading the current space-charge limit on the instantaneous dose rate that can be delivered. The laser-hybrid approach, therefore, will allow the radiobiology that determines the response of tissue to ionizing radiation to be studied with protons and light ions using a wide variety of time structures, spectral distributions, and spatial configurations at instantaneous dose rates up to and significantly beyond the ultra-high dose-rate "FLASH" regime. It is proposed that LhARA be developed in two stages. In the first stage, a programme of *in vitro* radiobiology will be served with proton beams with energies between 10 and 15 MeV. In stage two, the beam will be accelerated using a fixed-field