

Laser-hybrid Accelerator for Radiobiological Applications (LhARA)

The LhARA collaboration

H. Ahmed¹, P. Allport², R. Amos^{3,4}, C. J. Baker⁵, J. Bamber⁶, T. Becker⁷, W. Bertsche^{8,9}, R. Bingham^{10,11},
N. Bliss¹², E. Boella^{13,9}, S. Boogert^{8,9}, M. Borghesi¹⁴, C. Burne², P.N. Burrows^{15,16}, M. Charlton⁵,
J. Clarke¹⁷, B. Cox³, T.S. Dasalu^{13,9}, M. Dosanjh^{15,16}, N.P. Dover^{18,19}, S. Eriksson⁵, O.C. Ettlinger^{18,19}, A.
5 Fernandez-Rodriguez^{20,21}, A. Giaccia^{22,23}, S. Gibson^{24,25}, R. Gray^{10,26}, S. Green²⁷, T. Greenshaw²⁸,
D. Gujral²⁹, H.C. Hall³⁰, E.M. Hammond²², C. Hardiman³¹, E.J. Harris⁶, P. Hobson³², L. Holland³³,
A. Howard¹⁸, A. Howard^{18,19}, R.P. Hugtenburg³⁴, A. Isaac⁵, S. Jamison¹³, W.G. Jones^{18,35}, K.J. Kirkby^{36,37},
A. Kirkland^{33,38}, A. Knoll³⁹, N. Kumar^{40,9}, T.J. Kuo^{18,19}, A. Kurup^{18,19}, J.B. Lagrange⁴¹, H.T. Lau¹⁸,
H.T. Lau^{18,19}, K.R. Long^{18,19}, W.G. Luk⁴², A.E. MacIntosh-LaRocque^{18,19}, T. Masilela²⁰, M. Maxouti^{18,19},
10 J.M. McGarrigle^{18,20}, A. McIlvenny⁴³, P. McKenna^{10,26}, R. McLauchlan^{31,44}, I. McNeish⁴⁵, M. Merchant³⁶,
Z. Najmudin^{18,19}, O. Nicholas⁵, S.R. O'Neill^{13,9}, L. Obst-Huebl⁴³, U. Oelfke⁶, H. Owen¹⁷, C. Palmer¹⁴,
J.L. Parsons⁴⁶, J. Pasternak^{18,19}, M. Patel^{40,9}, R. Pattathil¹, M. Pereira^{24,25}, H. Poptani⁴⁷, F. Pouzoulet²⁰,
J. Pozimski^{18,19}, J. Prado Pico⁴⁸, Y. Prezado^{20,21,49}, P. Price⁴⁵, T. Price², K.M. Prise⁵⁰, P. Ratoff^{13,9},
C.T. Rogers⁴¹, F. Romano⁵¹, P. Ruksasakchai⁵, G. Schettino^{52,53}, W. Shields^{24,25}, B. Smart⁵⁴, R.A. Smith¹⁸,
15 A. Snijders⁴³, D. Spiers^{10,26}, R. Taylor^{18,19}, J.W.G. Thomason⁴¹, S. Towe⁵⁵, M. Turner⁴⁸, P. Underwood⁵⁵,
A. Vikhoreva¹², P. Weightman²⁸, C.P. Welsch^{40,9}, C. Wheldon², C. Whyte^{10,26}, R. Wilson¹⁰, R. Xiao⁵⁶

¹ Central Laser Facility, STFC Rutherford Appleton Laboratory, Harwell Oxford, Didcot OX11 0QX, UK

² School of Physics and Astronomy, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK

³ Dept of Medical Physics and Biomedical Engineering, University College London, WC1E 6BT

⁴ nan

⁵ Department of Physics, Faculty of Science and Engineering, Swansea University, Singleton Park, Swansea, SA2 8PP

⁶ The Institute of Cancer Research, 123 Old Brompton Road, London, SW7 3RP, UK

⁷ Maxeler Technologies Limited, 3 Hammersmith Grove, London W6 0ND, UK

⁸ Department of Physics and Astronomy, The University of Manchester, Oxford Rd, Manchester, M13 9PL, UK

⁹ Cockcroft Institute, Sci-Tech Daresbury, Keckwick Lane, Warrington WA4 4AD, UK

¹⁰ Department of Physics, SUPA, University of Strathclyde, Glasgow G4 0NG, UK

¹¹ Central Laser Facility, STFC Rutherford Appleton Laboratory, Harwell Oxford, Didcot OX11 0QX, UK

¹² STFC Daresbury Laboratory, Daresbury, Cheshire, WA4 4AD, UK

¹³ Department of Physics, Lancaster University, Bailrigg, Lancaster LA1 4YW, UK

¹⁴ School of Mathematics and Physics, Queen's University Belfast, University Road, Belfast, BT7 1NN, Northern Ireland, UK

¹⁵ Particle Physics, Denys Wilkinson Building, Keble Rd, Oxford, OX1 3RH

¹⁶ John Adams Institute, University of Oxford, Keble Rd, Oxford, OX1 3RH.

¹⁷ STFC Daresbury Laboratory, Daresbury, Cheshire, WA4 4AD, UK

¹⁸ Department of Physics, Imperial College London, Exhibition Road, London SW7 2AZ, UK
¹⁹ The John Adams Institute for Accelerator Science, Department of Physics, Imperial College London, Exhibition Road, London SW7 2AZ, UK
²⁰ Institut Curie-Orsay Research Center, Bat a Campus d'Orsay, 91400 Orsay, France
²¹ Institut Curie, Universit PSL, CNRS UMR3347, Inserm U1021, Signalisation Radiobiologie et Cancer, 91400 Orsay, France
²² Department of Oncology, University of Oxford, Old Road Campus Research Building, Roosevelt Drive, Oxford, OX3 7DQ, UK
²³ Department of Radiation Oncology, Stanford University, Stanford, CA 94305, USA
²⁴ Department of Physics, Royal Holloway University of London, Egham, Surrey, TW20 0EX, UK
²⁵ John Adams Institute, Royal Holloway University of London
²⁶ Cockcroft Institute for Accelerator Science, Keckwick Ln, Daresbury, Warrington WA4 4AD
²⁷ Department of Medical Physics, University Hospital Birmingham Foundation NHS Trust, Edgbaston, Birmingham, B15 2TH
²⁸ Department of Physics, University of Liverpool, Liverpool L69 7ZE, UK
²⁹ Imperial College NHS Healthcare Trust, Department of Clinical Oncology, Charing Cross Hospital, London W6 8RF, UK
³⁰ Imperial College London, CRUK PPI group, Charing Cross Hospital, London W6 8RF
³¹ Dept. Radiation Physics and Radiobiology, Imperial College Healthcare NHS Trust, London, UK
³² School of Physical and Chemical Sciences, Queen Mary University of London, Mile End, London E1 4NS, UK
³³ Rosalind Franklin Institute, Harwell Campus, Didcot, OX11 0QX, UK
³⁴ Department of Biomedical Sciences, Faculty of Science and Engineering, Swansea University, Singleton Park, Swansea, SA2 8PP
³⁵ Imperial College London, CRUK PPI group, Charing Cross Hospital, London W6 8RF
³⁶ Division of Cancer Sciences, Faculty of Biology, Medicine and Health, The University of Manchester, The Christie Proton Therapy Centre, The Christie NHS Foundation Trust, Wimslow Rd, Manchester M20 4BX
³⁷ Christie NHS Foundation Trust, Wilmslow Rd, Manchester, M20 4BX
³⁸ Department of Materials, University of Oxford, Parks Road, Oxford OX1 3PH, UK
³⁹ Department of Aeronautics, Imperial College London, Exhibition Road, London SW7 2AZ, UK
⁴⁰ Department of Physics, University of Liverpool, Liverpool L69 7ZE, UK
⁴¹ ISIS Neutron and Muon Source, STFC Rutherford Appleton Laboratory, Harwell Oxford, Didcot OX11 0QX, UK
⁴² Department of Computing, Imperial College London, Exhibition Road, London SW7 2AZ
⁴³ Berkeley, USA
⁴⁴ Department of Physics, Imperial College London, Exhibition Road, London SW7 2AZ, UK
⁴⁵ Department of Surgery and Cancer, Imperial College, Hammersmith Hospital London W12 0NN
⁴⁶ Department of Cancer and Genomic Sciences, College of Medicine and Health, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK
⁴⁷ Institute of Systems, Molecular and Integrative Biology, University of Liverpool, Biosciences Building, Crown Street, Liverpool L69 7BE
⁴⁸ DG Unit, CERN, CH-1211 Geneva 23, Switzerland
⁴⁹ University of Santiago de Compostela, Center for Research in Molecular Medicine and Chronic diseases, 15782, Santiago de Compostela, Spain
⁵⁰ Patrick G Johnston Centre for Cancer Research, Queens University Belfast, 97 Lisburn Road, Belfast, BT9 7AE
⁵¹ INFN Catania, Via Santa Sofia, 64 - 95123 Catania - Italy
⁵² Department of Physics, University of Surrey, 388 Stag Hill, Guildford, GU2 7XH, UK
⁵³ National Physical Laboratory, Hampton Road, Teddington, TW11 0LW, UK
⁵⁴ Particle Physics Department, STFC Rutherford Appleton Laboratory, Harwell Oxford, Didcot OX11 0QX, UK
⁵⁵ Leo Cancer Care, Broadview, Windmill Hill, Hailsham, East Sussex, BN27 4RY, UK
⁵⁶ Corerain Technologies, 14F, Changfu Jinmao Building (CFC), Trade-free Zone, Futian District, Shenzhen, Guangdong, China