Richard Lieu

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Academic Qualifications:

Oct., 1975 - June, 1978: BSc (1st class honors), Imperial College London, Major in Physics.

Oct., 1978 - June, 1981: DIC, PhD, Imperial College London. Thesis title: *Radiation Transport within the source of Hard Cosmic X-ray Photons.*

Career Record

21 June, 2008 - present: 10th Distinguished Professor and Chair of the Department of Physics, University of Alabama in Huntsville.

14 Sept., 2013 - 21 Jan., 2015, Chair of the Department of Physics, University of Alabama in Huntsville.

20 Aug., 2004 - 20 June, 2008: Professor at the Department of Physics, University of Alabama, Huntsville.

16 Aug., 1999 - present: Associate Professor at the Department of Physics, University of Alabama, Huntsville.

16 Aug., 1995 - 15 Aug., 1999: Assistant Professor at the Department of Physics, University of Alabama, Huntsville.

1 Nov., 1991 - 15 Aug., 1995: Assistant Research Astronomer at the Center for EUV Astrophysics, University of California, Berkeley.

1 Aug., 1985 - 31 Oct., 1991: Research Assistant at the Astrophysics Group, Blackett Laboratory, Imperial College, London, England.

1 Aug., 1981 - 30 June, 1985: Postdoctoral Research Fellow and Sessional Instructor at the Dept. of Physics and Astronomy, and at the Dept. of Electrical Engineering, University of Calgary, Alberta, Canada.

Awards and Prizes

UAH Foundation Researcher of the year award, April 2007.

Sigma Xi Huntsville chapter 'researcher of the year' award, with Lloyd W. Hillman, April 2005.

Three times 'Discovery of the year award', 1995, 1994, and 1993, Center for EUV Astrophysics, UC Berkeley.

'Outstanding software development of the year award 1993', with James W. Lewis, Center for EUV Astrophysics, UC Berkeley.

Seminal papers

212 publications (102 refereed); 2384 ADS citations (h-index 24, i-10 index 47).

'Discovery of 0.5 MK Gas in the Center of the Virgo Cluster', Lieu, R., Mittaz, J.P.D, Bowyer, S., Lockman, J., Hwang, C. -Y. & Schmitt, J.H.M.M., 1996, *ApJ*, **458**, L5 (143 citations).

'The Diffuse EUV Emission from the Coma Cluster - Evidence for a Cooler Component at sub-MK Temperatures', R. Lieu, J.P.D. Mittaz, S. Bowyer, J.O. Breen, F.J.Lockman, E.M. Murphy & C. -Y. Hwang, 1996, *Science*, **274**, 1335 (139 citations).

'The First EUVE Source Catalog', S. Bowyer, R. Lieu, M. Lampton, J. Lewis, X. Wu, J.J. Drake & R. Malina, 1993, *ApJS*, **93**, 569 (125 citations).

'EUV Emission from Clusters of Galaxies: Inverse Compton Radiation from a Relic Population of Cosmic Rays ?', C.L. Sarazin & R. Lieu, 1998, *ApJ*, 494, L17 (123 citations).

'Non-thermal Origin of the EUV and HEX Excess Emission of the Coma Cluster - the Nature of the Energetic Electrons', T.A. Ensslin, R. Lieu, & P.L. Biermann, 1999, *Astron Astrophys*, 344, 409 (109 citations).

Chief external lectures and committees

'In search of the missing baryons of the near Universe', on the occasion of the Symposium at Imperial College to mark the 80th birthday of Tom Kibble, March 2013.

'New Directions in Modern Cosmology', at the Lorentz Center, Leiden, the Netherlands, September, 2010.

Constellation X Facility Science Team 2006 and 2002; to advise NASA on critical scientific goal of the mission.

Lecture at the 'Physics of the 3rd Millennium', the Von Braun Civic Center, Huntsville, in celebration of the Einstein year of 2005.

XEUS science team 2002; to advise ESA on critical scientific goal of mission.

Panel reviewer of NASA proposals.

Frequent referee for the Astrophysical Journal, Astronomy & Astrophysics, and Royal Astronomical Society.

Internal committee & services

Served on a variety of University committees at the Department and College levels.

Participated in a wide spectrum of University service related activities at the Department and College levels.

Teaching record

Full-time courses at levels ranging from 100 General Physics to 700 quantum electrodynamics. Student ratings average at above 90 % among all the courses.

Graduated 4 PhD (Bonamente, Gogus, Jiang, and Lackeos) and one MSc (Bandas) students.

Chair or member of many PhD and MSc committees.

Conference organizing activities

'The Warm and Hot Universe', Columbia University, N.Y., May 2008, Chair of the SOC.

'Outstanding questions for the standard cosmological model', Imperial College London, UK. Chair of the SOC.

'Soft X-ray emission from clusters of galaxies and related phenomena', December 2002, Huntsville, AL, USA. Chair of the SOC.

'Particle acceleration in geospace and beyond', October 2002, Chattanooga, TN, USA. Member of the Scientific Organizing Committee (SOC).

Overseas Visiting Scholar

Tsinghua University, Beijing, China. Two months with the Physics Department in the summers of 2007 to 2012.

Institute Astrophysique Paris, France. One month Research Fellowship during the summer of 2000, at the invitation of Dr Florence Durret.

Institute of Space and Astronautical Science, Japan. Visited for 3 months in

the summer of 1982, on analysis of data from the X-ray Astronomy satellite HAKUCHO. Visited again for 3 months in the beginning of 1988, on analysis of magnetospheric electron data from the satellite EXOS-C.

Max Planck Institut fuer Aeronomie, Germany. Visited for several months every summer between 1987 and 1992, on analysis of magnetospheric data from the SPACELAB I mission, and on theoretical astrophysics research with Prof. W.I. Axford.

Max Planck Institut fuer Extraterrestriche Physik, Germany. Visited during three 6-weekly tours between 1991 and 1992, in the ROSAT Wide Field Camera Quick Look Facility.

References

Prof. T.W.B. Kibble FRS, Theoretical Physics, Blackett Laboratory, Imperial College, London SW7, 2BZ, U.K. (t.kibble@ic.ac.uk)

Prof. R.D. Blandford FRS, KIPAC/SLAC, Stanford University, Varian Physics Building, 382 Via Pueblo Mall, Stanford, CA 94305-4060 (rdb3@stanford.edu).

Dr. Christine Jones, Harvard-Smithsonian Center for Astrophysics 60 Garden Street, office B-401, Cambridge, MA 02138, MS-02 (cjones@cfa.harvard.edu).

Summary of Key Publications

Publications in Refereed Journals

[92] 'Exclusion of standard $\hbar\omega$ gravitons by LIGO observation', Lieu, R., 2018, CQG, 35, 19LT02

[91] 'Photon Flux and Bunching Noise from Measurement of the Shot Noise Variance', Lieu, R., Stefszky, M., & Shi, C. -H., 2018, ApJ, 862, 51

[90] 'Does Light from Steady Sources Bear Any Observable Imprint of the Dispersive Intergalactic Medium?' Lieu, R., & Duan, L., 2018, ApJ, 853, 135

[89] 'Large scale density perturbations from a uniform distribution by wave transport', Lieu, R., 2017, JCAP, 11, 013

[88] 'Improvement in the Accuracy of Flux Measurement of Radio Sources by Exploiting an Arithmetic Pattern in Photon Bunching Noise', Lieu, R., 2017, ApJ, 844, 50

[87] 'The Role of Cerenkov Radiation in the Pressure Balance of Cool Core Clusters of Galaxies', Lieu, R., 2017, ApJ, 838, L5

[86] 'Are Fast Radio Bursts the Birthmark of Magnetars?' Lieu, R., 2017, ApJ, 834, 199

[85] 'Measuring the brightness of classical noise dominated light at the shot noise limit?' Lieu, R., & Kibble, T. W. B., 2015, `arXiv:1409/7039`

[84] 'A Method to Improve the Sensitivity of Radio Telescopes' Lieu, R., Kibble, T. W. B., & Duan, L., 2015, ApJ, 798, 67

[83] 'Large pre-inflationary thermal density perturbations', Lieu, R., & Kibble, T. W. B., 2013, MNRAS, 436, L1

[82] 'Measurement of the Dispersion of Radiation from a Steady Cosmological Source', Lieu, R., Duan, L., & Kibble, T. W. B., 2013, ApJ, 778, 73

[81] 'Has inflation really solved the problems of flatness and absence of relics?' Lieu, R., 2013, MNRAS, 435, 575

[82] 'A New Way of Detecting Intergalactic Baryons', Lieu, R., & Duan, L., 2013, ApJ, 763, L44

[81] 'Dark matter interpretation of the origin of non-thermal phenomena in galaxy clusters' Colafrancesco, S., Lieu, R., Marchegiani, P., Pato, M., Pieri, L., & Buonanno, R., 2011, A & A, 527, A80

[80] 'The Non-thermal Intracluster Medium', Lieu, R., Quenby, J.J., & Bonamente, M., 2010, ApJ, 721, 1482

[79]'The Diffuse Soft Excess Emission in the Coma Cluster from the ROSAT All-Sky Survey', Bonamente, M., Lieu, R., & Bulbul, E., 2009, ApJ, 696, 1886

[78]'On the Absence of Shear from Complete Einstein Rings and the Stability of Geometry', Lieu, R. 2008, ApJ, 679, 25.

[77]' Strong lensing time delay: a new way of measuring cosmic shear', Lieu, R. 2008, ApJ, 674, 75

[76]'Time delay by primordial density fluctuations: its biasing effect on the observed mean curvature of the Universe', Lieu, R., & Mittaz, J.P.D., 2008, ApJ, 672, 1.

[75]'Soft and hard X-ray excess emission in Abell 3112 observed with Chandra', M. Bonamente, J. Nevalainen, Lieu, R. 2007, ApJ in press.

[74]'Possible non-thermal nature of the soft-excess emission in the cluster of galaxies Sersic 159-03', Werner, N., Kaastra, J.S., Takei, Y., Lieu, R., Vink, J., Tamura, T., 2007, A & A, 468, 849.

[73]'The Sunyaev-Zel'dovich effect in a sample of 31 clusters - a comparison between the X-ray predicted and WMAP observed CMB temperature decrement', Lieu, R., Mittaz, J.P.D., and Zhang, S.N., 2006, ApJ, 648, 176.

[72]'ROSAT observations of the soft X-ray background and of the cluster soft excess emission in the Hercules supercluster', Bonamente, M., Lieu, R., and Kaastra, J., 2005, Astron.Astrophys. 443, 29.

[71]'Average magnification of clumping of matter', T.W.B. Kibble and R. Lieu 2005, ApJ, 632, 718.

[70]'On the absence of gravitational lensing of the cosmic microwave background', R. Lieu and J.P.D. Mittaz 2005, ApJ, 628, 583.

[69]'Are the WMAP angular magnification measurements consistent with a critical density inhomogeneous Universe?', R. Lieu and J.P.D. Mittaz 2005, ApJ 623, L1.

[68]'Thermal and non-thermal nature of the soft excess emission from Sersic 159-03 observed with XMM-Newton', Bonamente, M., Lieu, R., Mittaz, J.P.D., Kaastra, J., and Nevalainen J., 2005, ApJ, 629, 192.

[67]WHIM emission and the cluster soft excess: a model comparison', Mittaz, J., Lieu, R., and Bonamente, M., 2004, ApJ, 617, 860.

[66]'The phase coherence of light from extragalactic sources - direct evidence against first order Planck scale fluctuations in time and space', 2003, ApJ, 585, L77.

[65]'Discovery of a massive and extended warm halo for the Coma cluster', Bonamente,

M., Lieu, R., and Joy, M.K., 2003, ApJ, 585, 722.

[64]'XMM/Newton confirmation of soft excess emission in clusters of galaxies - discovery of O VII emission from an extended warm component', Kaastra, J.S., Lieu, R., Tamura, T., Paerels, F.B.S., den Herder, J.W., 2003, A & A, 397, 445.

[63]'Soft X-ray excess emission in clusters of galaxies observed with XMM-Newton', Nevalainen, J., Lieu, R., Bonamente, M., and Lumb, D., 2003, ApJ, 584, 716.

[62]'Low energy X-ray emission from the A2199 cluster of galaxies', J.S. Kaastra, R. Lieu, J. Bleeker, R. Mewe, and S. Colafrancesco, 2002, ApJ, 574, L1.

[61]'The extreme ultraviolet excess emission in five clusters of galaxies', F. Durret, E. Slezak, R. Lieu, S. Dos Santos, and M. Bonamente, 2002, A & A, 390, 397.

[60]'The soft X-ray emission in a large sample of galaxy clusters with the ROSAT PSPC', M. Bonamente, R. Lieu, and M. Joy, 2002, ApJ, 576, 688.

[59]'The effect of space-time quantization on Lorentz invariance at extreme speeds', R. Lieu, 2002, ApJ, 568, L67.

[58]'Microscopic Relativity', R. Lieu, 2001, Foundations of Physics, 31, 1233 - 1250.

[57]'Sersic 159-03: discovery of the brightest soft X-ray excess emitting cluster of galaxies', M. Bonamente, R. Lieu, and J.P.D. Mittaz, 2001, ApJ, 561, L63.

[56]'Multiwavelength monitoring of QS Tel', S.R. Rosen, J.F, Rainger, M.R. Burleigh, J.P.D. Mittaz, D.A.H. Buckley, M.M. Sirk, R. Lieu, S.B. Howell, and D. de Martino, 2001, MNRAS, 322, 631.

[55]'Far Ultraviolet Spectroscopic Explorer (FUSE) detection of diffuse Galactic O VI emission toward the Coma and Virgo clusters', W.V.D. Dixon, S. Sallmen, M. Hurwitz, and R. Lieu, 2001, ApJ, 552, L69.

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[52]'The extreme ultraviolet excess emission of the Virgo and A1795 clusters: re-observation with in situ background measurements', M. Bonamente, R. Lieu, and J.P.D. Mittaz, 2001, ApJ, 547, L7.

[51]'The multiphase nature of the intracluster medium of some clusters of galaxies', M. Bonamente, R. Lieu, and J.P.D. Mittaz, 2001, ApJ, 546, 805.

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[46]'Non-thermal Origin of the EUV and HEX Excess Emission of the Coma Cluster - the Nature of the Energetic Electrons', T.A. Ensslin, R. Lieu, & P.L. Biermann, 1999, *Astron Astrophys*, 344, 409.

[45]'Non-thermal Origin of the EUV and Soft X-rays from the Coma Cluster - Cosmic Rays in Equipartition with the Thermal Medium', R. Lieu, W. -H. Ip, W.I. Axford & M. Bonamente, 1999, *ApJ*, 510, L25.

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[41]'Radiation by Charged Particles in Non-uniform Acceleration - the Inapplicability of Larmor's Formula', R. Lieu, W.I. Axford & J.F. McKenzie, 1997, *Phys. Rev. E*, **55**, 1872.

[40]'An All-Sky Catalog of Fainter EUV Sources', M. Lampton, R. Lieu, J.H.M.M. Schmitt, S. Bowyer, J. Lewis, X. Wu & W. Voges, 1997, *ApJS*, **108**, 545.

[39]'The Diffuse EUV Emission from the Coma Cluster - Evidence for a Cooler Component at sub-MK Temperatures', R. Lieu, J.P.D. Mittaz, S. Bowyer, J.O. Breen, F.J.Lockman,

E.M. Murphy & C. -Y. Hwang, 1996, *Science*, **274**, 1335.

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[36]'Io Torus EUV Emissions during the Comet Shoemaker-Levy/9 Impacts', D.T. Hall, G.R. Gladstone, F. Herbert, R. Lieu & N. Thomas, 1995, *GRL*, **22**, 3441.

[35]'An Optical and Far UV Study of the Field of the Source EUVE J1027+323', R. Genova, S. Bowyer, S. Vennes, R. Lieu, J.P. Henry and I. Gioia, 1995, *Astron. J.*, **110**, 788.

[34]'Evidence for a Large Thermal Pressure Imbalance in the Local Interstellar Medium', S. Bowyer, R. Lieu, S.D. Sidher, C. -Y. Hwang & J. Knude, 1995, *Nature*, **375**, 212.

[33]'Quantum Limited Synchrotron Radiation in Inhomogeneous Magnetic Fields', R. Lieu & W.I. Axford, 1995, *ApJ*, **447**, 302.

[32]'The First EUVE Source Catalog', S. Bowyer, R. Lieu, M. Lampton, J. Lewis, X. Wu, J.J. Drake & R. Malina, 1993, *ApJS*, **93**, 569.

[31]'EUVE First Light Observation of the Diffuse Sky Background', R. Lieu, S. Bowyer, M. Lampton, P. Jelinsky & J. Edelstein, 1993, *Ap. J.* **417**, L41.

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[29]'Maximum Entropy Methods when Prior Information consists of Inexact Constraints', R. Lieu and R.B. Hicks, 1994, *Ap. J.*, **422**, 845.

[28] 'Synchrotron Radiation - an Inverse Compton Effect', R. Lieu and W.I. Axford, 1993, *Ap.J.*, **416**, 700.

[27]'The ROSAT Wide Field Camera All Sky survey of Extreme UV sources', Pounds, K.A., Lieu, R. et al, 1993, *Mon. Not. Roy. Astr. Soc*, **260**, 77.

[26] 'Supernova seen at New Wavelength', a discovery made by A. Harris and R. Lieu was announced in the *New Scientist*, Dec. 6, 1990.

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[21] 'Enhanced Shock Acceleration in Relativistic Jets and Cosmic Ray Origin In Active Galactic Nuclei', J.J. Quenby and R. Lieu, 1989, Nature, **342**, 654.

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[19] 'Synchrotron Radiation by the Weizsacker-Williams Method of Virtual Quanta', R. Lieu, W.I. Axford and J.J. Quenby, 1989, Astron. Astrophys. **208**, 351.

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[8] 'Basic Conservation Laws in the Electromagnetic Theory of Cyclotron Radiation - Further Analysis', R. Lieu, D.A. Leahy and A.J. Evans, 1983, J. Phys. A **17**, l91.

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[6] 'A study of the Spectra and Pulse Profiles of Cen X-3 from HAKUCHO', R. Lieu, D. Venkatesan and K. Mitani, 1984, Ap. J. **282**, 709.

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