

## **Curriculum Vitae: Professor John C.H. Spence, F.R.S. (ForMem) Aug 2015.**

**Professional Preparation** Ph.D. 1973 Physics. Melbourne University, Australia.

**Present positions:** John Spence is Richard Snell Professor of Physics at Arizona State University, jointly appointed at Lawrence Berkeley National Laboratory, Berkeley, Ca. USA. He is Director of Science for the NSF Science and Technology Center for application of X-ray lasers to biology (BioXFEL, see <http://www.bioxfel.org>).

**Previous positions include:** Postdoctoral Research Fellow, Oxford University, U.K.

**Honors.** Fellow of the Royal Society (Foreign Member). Buerger Medal of the American Crystallography Association (2012). Cowley Medal of International Federation of Electron Microscopy Societies. Distinguished Scientist Medal of the Microscopy Society of America (2006). Burton Medal of the Electron Microscopy Society of America (1980). Fellow, American Association for the Advancement of Science (2008). Fellow, American Physical Society. (1991), Fellow, Institute of Physics UK (FInstP), Fellow, Churchill College, Cambridge, UK. Fellow, Microscopy Society of America (2009). Fellow, American Crystallographic Association. Miller Fellowship, UCB Ca., Kernot Research Scholarship in Physics, (1971), National Science Foundation Creativity Award (1983), Alexander von Humboldt Senior Scientist Award (1991). Morrison Lecturer, MacMaster University (2001), FEMS Distinguished Lecture Award (2003), FASR Distinguished Lecturer, Cornell Physics/CHESS (2005). 2013 Appointed Main Editor of IUCRJ, Open Access Journal; Physics and XFEL Science. A Festschrift special issue of the journal Ultramicroscopy appeared on the occasion of Spence's 65th birthday in June 2011 (Vol 111, Issue 7) containing articles by his colleagues. Our bioXFEL paper (L. Redecke et al Science 2012) was listed among the top ten breakthroughs in research for 2012 by Science magazine. (<http://www.sciencemag.org/site/special/btoy2012/>)

A popular review of our BioXFEL work appeared in Nature Jan 30, 2014.

**Patents:** 3 awarded (including XFEL sample delivery injector), 3 pending

**Recent Books and Publications.** See <https://physics.asu.edu/people/faculty/john-spence-frs> for full CV. H index 59. Over 450 publications (Nature, Science, Phys Rev. Letts etc) including "Femtosecond X-ray Protein Nanodiffraction" H. Chapman.....J. Spence. Nature, 470, 73 (2011). "X-ray lasers for structural and dynamic biology". J.C.H.Spence, U. Weierstall and H.N.Chapman. Rep. Prog. Phys. **75**, 102601 (2012) .

"Electron Microdiffraction". J. Spence and J. Zuo. 1992. Plenum. New York.

"High resolution electron microscopy" J.Spence.Ox.Univ.Press.4th Ed. '13.(Russian, Chinese Eds)

"Science of Microscopy". Two volumes. Springer 2006. P. Hawkes and J. Spence.

"Direct Observation of d holes and Cu-Cu bonding in Cu<sub>2</sub>O". J. Zuo et al Nature, 401, 49 (1999).

"Phase measurement for accurate mapping of chemical bonds." M. Spackman, B.Jiang, T. Groy, H. He, A.E.Whitten, J.C.H.Spence. Phys Rev Letts. **95**, 085502 (2005)

"Single Molecule Diffraction" Spence and Doak. Phys Rev Letts. **92**, 198102 (2004)

"Dislocation core structure". Chapter in "Dislocations in Solids" eds Nabarro & Hirth V13(2006).

"International Tables for Crystallography". Authored several sections (diffraction physics).

"A new technique for locating foreign atoms in crystals", Spence, Tafto. J. Micros, **130**, 147 (1983)

**Professional Activities:** Member, BESAC, DOE Basic Research Advisory Committee for the US National Laboratories; Chairman, Int. Union of Crystallography Commission on Electron Diffraction ; Member, Int. Union of Crystallography Commission on Charge, Spin and Momentum densities; US National Committee for Crystallography (USNCCr) of NAS; Director, Xradia Inc. Ca.; Scientific Advisory Committees. Advanced Light Source, LBNL; Molecular Foundry, LBNL, Berkeley. Co-Editor for North America "Acta Crystallographica A" (Diffraction Physics) 1990-2000; Chair, Gordon Conference on Charge, Spin and Momentum densities (2006). In 2001 Spence

initiated the biannual series of international conferences in the new field of Coherent Lensless X-ray Imaging. In 2011, Spence initiated the first international conference in the new field of X-ray Lasers for Biology (at LBNL). More have followed, hosted by the Royal Society (UK) in October 2013 and in Puerto Rico 2015 and 2015.

**Students, Teaching, Grants** 28 PhD and 4 MSc students graduated, 18 Post-doctoral fellows mentored. Current grants: NSF, DOE plus LBL, LLNL collaborations. NSF funding since 1979.

**Selected publications** (full list:<https://scholar.google.com/citations?user=UxmHb8sAAAAJ&hl=en>)

#### **Book reviews**

"The age of wonder". R. Holmes. "Physics Today" (2009)

"The Battery" Physics Today (2010).

#### **X-ray lasers for biology - biophysics.**

*Femtosecond pulses from free-electron X-ray lasers make molecular movies.*

406 "Femtosecond X-ray Protein Nanodiffraction" Chapman.....Spence. Nature, 470, 73 (2011).

412 "Phasing of coherent femtosecond X-ray diffraction from size-varying nanocrystals". J. Spence et al Optics Express 19, 2866 (2011)

409 "Single virus imaged on-the-fly with an X-ray laser". M. Seibert et al. Nature 470, 78 (2011)

401 "Femtosecond protein nanocrystallography - data analysis". R. Kirian, J. Spence et al. Optics Express 18, 5713 (2010).

436 "Time-resolved protein nanocrystallography using an X-ray free-electron laser". Andrew Aquila, Optics Express **20**, 2706 (2012), and Tenboer et al Science, 346, 1242 (2014).

439. "X-ray lasers for structural and dynamic biology". J.C.H.Spence, U. Weierstall and H.N.Chapman. Rep Prog Phys. **75**, 102601 (2012)

444. "*Trypanosoma brucei* procathepsin B structure solved to 2.1 Å using an X-ray laser". L. Redecke et al. Science, 339, 227 (2013).

#### **Sample delivery for bioXFEL experiments - biophysics.**

395 "Powder diffraction from a continuous microjet of submicron protein crystals". D. Shapiro, H. Chapman, D. DePonte, R. Doak, P. Fromme, G. Hembree, M. Hunter, S. Marchesini, K. Schmidt, J. Spence, D. Starodub and U. Weierstall. J. Synch. Rad. 15, 593 (2008).

429 "Injector for scattering measurements on fully solvated species" U. Weierstall, J.C.H.Spence and R.B.Doak. Rev. Sci Instr. 83, 035108 (2012).

#### **Lensless (diffractive) imaging with X-rays.**

*We use a computer instead of a lens to reconstruct 3D images of nanoscale objects.*

336 "High resolution three-dimensional X-ray diffraction microscopy". H. Chapman, A. Barty, T. Beetz, C. Cui, H. He, M. Howells, S. Marchesini, A. Noy, R. Rosen, J. Spence, U. Weierstall, T. Beetz, C. Jacobsen and D. Shapiro. J. Opt. Soc. Am. 23, p. 1179 2006.

410 "Ab-initio structure determination of one particle from scattering fluctuations of many copies". D. Saldin.....J. Spence. Phys Rev Letts. 106, 115501 (2011)

#### **Condensed Matter, Ab-initio Quantum Molecular Dynamics for defects.**

*We predict mechanical properties of materials using atomistic quantum mechanical calculations.*

25. "Electronic structure of the unreconstructed 30 partial dislocation in silicon", J.E. Northrup, M.L. Cohen, J.R. Chelikowsky, J. Spence and A. Olsen, Phys. Rev. B24, 4623 (1981).

120. "Lattice trapping and surface reconstruction for silicon cleavage on (111)". J. Spence, Y. Huang and O.Sankey. Acta Met. 41, p. 2815 (1993)

#### **Ordering in Glasses.**

*"The most important unsolved problem in Condensed Matter Physics" (P. Anderson).*

261 "Long range structural fluctuations in a CaO glass by spatially resolved near-edge spectroscopy. N. Jiang, J. Qiu and J.C.H.Spence. Phys Rev B66, p.054203 (2002).

#### **Biophysics, Cryomicroscopy, low-voltage point-projection imaging in biology.**

*"New solution to the phase problem speeds up 3D cryo-em. Imaging TMV at 40 eV"*

- 288 "Three-dimensional diffractive imaging for crystalline monolayers with one-dimensional compact support". J. Spence, U. Weierstall, K. Downing, R. Glaeser. *J. Struct. Biol.* 2003.  
193 "Point-projection electron imaging of TMV at 40eV electron energy". U. Weierstall, J.C.H. Spence, M. Stevens, K.H. Downing. *Micron* 30(4) p.335-338 (1999)

### **Bonding in solids. Electron Microdiffraction.**

- We image the chemical bonds which glue atoms together in solids, and test many-electron theory.*  
177. "Charge density of MgO: Implications of precise new measurements for theory". J.M.Zuo, M. O'Keefe, P. Rez, J. Spence. *Phys Rev Letts.* 78, p. 4777-4780. (1998) .  
82. "Bonding in GaAs", J.Zuo, J. Spence and M.O'Keefe. *Phys. Rev. Letts* 61, p. 353 (1988).  
104. "Bonding in Cu<sub>2</sub>O". J. Zuo, Y.Kim, M.O'Keefe, J. Spence. *Nature* 401, p.49, (1999).

### **Coherent Bremsstrahlung**

- Charged particles buzzing through crystals create tunable coherent X-rays at buzz frequency*  
68. "Pendellosung Radiation and Coherent Bremsstrahlung", J.C.H. Spence and G. Reese, *Acta Cryst. (P. Ewald Festschrift)* 1986 *Acta Cryst. A*42, p. 577-585, NSF

### **Electron energy -loss spectroscopy.**

- Similar information to soft-Xray absorption spectra, with nanometer spatial resolution.*  
2. "Observation of double plasmon excitation in aluminium", J.C.H. Spence and A.E.C. Spargo, *Phys. Rev. Letters* 26, 985 (1971).  
33. "STEM Microanalysis by Transmission Electron Energy Loss Spectroscopy in Crystals", J.C.H. Spence and J. Lynch, *Ultramicroscopy*, 9, 267 (1982)

### **Channeling effects on secondary processes, internal source holography**

- Electron standing waves in crystals locate foreign dopant atoms by X-ray fluorescence.*  
47. "ALCHEMI - a new technique for locating atoms in small crystals", J.C.H Spence and J. Taftø, *J. Microsc.* 130, 147 (1983), NSF 80.

### **In-situ observation of STM operation in a TEM**

- Manipulate atoms by STM and watch simultaneously by TEM*  
124 Investigation of STM image artifacts by in-situ reflection electron microscopy. W. Lo and J. Spence. *Ultramic.* (1992). 48, p.433.

### **Atomic-scale imaging of defects, ordering. High T<sub>c</sub>, Dislocation kink dynamics.**

- The atomic structure of defects controls many materials properties. First direct observation of a dislocation kink, the atomistic defect which controls the strength of materials.*  
154 "Observation of moving dislocation kinks and pinning". H. Kolar, J. Spence and H. Alexander. *Phys. Rev. Letts.* 77, p. 4031-4034 (1996).

### **Field emission nanotips, electron antibunching, low energy electron holography in biology.**

- New electron sources can field-emit from just a few atoms, and be controlled by laser.*  
131 "Brightness measurement of nanometer sized field emission electron sources". W. Qian, M. Scheinfein and J. Spence. *J. Appl. Phys.* 73, 7041 (1993).  
396 "A coherent photofield electron source for fast diffractive and point-projection imaging". J.C.H. Spence, T. Vecchione and U. Weierstall. *Phil Mag.* 90, 4691. (2010)

**Further papers not listed are on New electron detectors, Electron holography, Atom probe STM, Inversion problem of multiple scattering, X-ray holography, diffractive imaging, Cathodoluminescence.** <https://scholar.google.com/citations?user=UxmHb8sAAAAJ&hl=en>

Extra curricular: Classical piano, Flute, Pilot (large gliders), Sailing (Etchells, Flying Dutchman)