

CURRICULUM VITAE  
of  
DAVID WILLIAM KNOWLES

Life Sciences Division,  
Lawrence Berkeley National Laboratory  
University of California  
84R0171, 1 Cyclotron Road, Berkeley, CA 94720  
510-486-6082  
DWKnowles@lbl.gov  
<http://dwknowles.lbl.gov/>  
<http://big.lbl.gov/>

**Education:**

**Ph.D., 1992**, Physics, University of British Columbia, BC, Canada  
**B.Sc.-Honours, 1982**, Physics, University of New South Wales, Australia  
**1976**, Sydney Grammar School, NSW, Australia

**Experience:**

**Biophysicist, Scientist**  
Lawrence Berkeley National Laboratory, Berkeley, CA 1999 – present

**Post Doctoral Fellow**  
Lawrence Berkeley National Laboratory, Berkeley, CA 1994 – 1998

**Physics Instructor**  
Physics Dept., University College of the Cariboo, Kamloops B.C. 1993

**Sessional Lecturer**  
Physics Dept., University of British Columbia, Vancouver, Canada 1992

**Graduate Student**  
Physics Dept., University of British Columbia, Vancouver, Canada 1987 – 1992

**Awards and Honors:**

Recipient, NIH, GMS R01 Competitive Renewal Award #1R01GM085298 2014 – 2017  
Recipient, National Institutes of Health, GMS Award #1 R01 GM085298-01A1 2010 – 2014  
Recipient, National Institutes of Health, NCI Award #1 R33 CA118479-01 2006 – 2010  
Member, Breast Oncology Research Program, UCSF, San Francisco, CA, 2004 – present  
Recipient, Breast Cancer Research Program Idea Award #DAMD170210440 2003 – 2006  
Recipient, Graduate Scholarship, School of Physics, UBC, BC, Canada 1987 – 1992

**Invited Talks:**

**2011, Invited Book Chapter, David W. Knowles**, *Three-dimensional morphology and gene expression mapping for the Drosophila blastoderm*. In: *Imaging in Developmental Biology*. Ed. James Sharpe and Rachel O. Wong. Cold Spring Harbor Laboratory Press.

**May 9-12, 2010 Invited Speaker**, *A 3D cellular gene expression atlas for Drosophila embryogenesis*, at HHMI Janelia Farm Conference: Turning Images to Knowledge

**21st Feb 2007, Invited Speaker**, UCSF Biological Imaging Development Center *Three-dimensional morphology and gene expression in the Drosophila blastoderm at cellular resolution*.

**7th Feb 2007, Invited Speaker**, UCSF Comprehensive Cancer Center: Breast Oncology Program. *Novel Image-based Screen of Mammary Tumors*

**April 2006, Invited Speaker**, Basic Medical Sciences Departmental Seminar Series, Purdue University *Novel Image-based Screen of Mammary Tumors*

**October 2005**, Genome Informatics, Cold Spring Harbor, New York, Invited Speaker, *Berkeley Drosophila transcription network project: 3D blastoderm gene expression atlas*

**8th August 2005**, IEEE Computational Systems Bioinformatics Conference August 8-11, Stanford University. **Invited tutorial speaker**: *Novel Visualization and Quantitative Analysis Methods in BiImaging*

## Service:

**Scientific Study Section Review Panel Adhoc Member:** NIH, NCI, Innovative Molecular Analysis Technologies (IMAT). 2000-present

**Program Committee Member:** Workshop on Multiscale Biological Imaging, Data Mining & Informatics, Santa Barbara, CA, USA, Sept 7-8, 2006

**Instructor:** Optical Microscopy, Life Sciences Division, LBNL 2002-present

**Scientific Reviewer:** multiple journals, Bioinformatics, Nature Reviews, ..

**Middle School Instructor:** Physics for 5th Grade

**Instructor,** Daughters and Sons to Work, LBNL, 2003, 2004

**Lecturer,** Friends of LBNL, 2005

**Lecturer,** Center for Science & Engineering Education, at Elizabeth Elementary School and George Washington High School. 2003

**Building Manager and Safety Coordinator (Bld74 & 84),** Lawrence Berkeley National Lab, 1999 - present.

**LSD EH&S Committee Member,** 2006- present

## Post Doctoral Research:

As postdoctoral fellow I developing an image-based microrheology experiment where a controlled deformation was applied to the cytoskeleton of human red blood cells and the resulting reorganization of fluorescently labeled membrane components measured. Using this technique, I showed that vesiculation in red cells involves the uncoupling of the cytoskeleton from the lipid bilayer and this process provides an effective mechanism for selectively sorting and trafficking membrane proteins [Knowles et al. 1997]. I also used the techniques to reveal dynamical properties of the water-channel protein [Cho et al. 1998] and the ion channel Band 3 [Van Dort et al. 2001].

## Ph.D. Research:

For my Ph.D. I build a fluorescence recovery after photobleaching experiment to measure the *in situ* lateral diffusivity of specific membrane components of the human red blood cell. The work revealed a cooperative action between membrane receptor-proteins which resulted in the transduction of a mechanical signal from outside to inside of a cell causing increased rigidity of the cell's cytoskeleton [Knowles et al. 1994]. The idea that transmembrane proteins profoundly influence the rigidity of the skeletal-network was used to elude a mutation in band 3 responsible for the red blood cell disorder South Asian Ovalocytosis, which because of increased membrane rigidity is resistant to invasion by malaria parasites [Mohandas et al. 1992].

## Publications:

1. JT Barron, MD Biggin, P Arbelaez, **D.W. Knowles**, SVE Keranen, J Malik **2013** *Volumetric semantic segmentation using pyramid context features* **Computer Vision (ICCV)**, 2013 IEEE International Conference on, 3448-3455
2. **D.W. Knowles**, MD Biggin **2013** *Building quantitative, three-dimensional atlases of gene expression and morphology at cellular resolution* **Wiley Interdisciplinary Reviews: Developmental Biology** 2 (6), 767-779
3. **D.W. Knowles** **2012** *3D Image-Based Whole Embryo Morphology and Gene Expression Mapping for the Drosophila Blastoderm* **Cold Spring Harbor Protocols** 2012 (2), 150
4. Oliver Rübél, Soile VE Keränen, Mark Biggin, **David W Knowles**, Gunther H Weber, Hans Hagen, Bernd Hamann, E Wes Bethel **2012** *Linking Advanced Visualization and MATLAB for the Analysis of 3D Gene Expression Data* **Visualization in Medicine and Life Sciences II**, 265-283
5. Min-Yu Huang, Lester Mackey, Soile VE Keranen, Gunther H Weber, Michael Jordan, **David W Knowles**, Mark D Biggin, Bernd Hamann **2011** *Visually Relating Gene Expression and in vivo DNA Binding Data* **Bioinformatics and Biomedicine (BIBM)**, 2011 IEEE International Conference on
6. Charless C Fowlkes, Kelly B Eckenrode, Meghan D Bragdon, Miriah Meyer, Zeba Wunderlich, Lisa Simirenko, Cris L Luengo Hendriks, SV Keränen, Clara Henriquez, **David W Knowles**, Mark D Biggin, Michael B Eisen, Angela H DePace **2011** *A conserved developmental patterning network produces quantitatively different output in multiple species of Drosophila* **PLoS Genet** 7 (10), e1002346

7. Anil Aswani, Soile V.E. Keranen, James Brown, Charless C. Fowlkes, **David W. Knowles**, Mark D. Biggin, Peter Bickel and Claire J. Tomlin 2010. *Nonparametric identification of regulatory interactions from spatial and temporal gene expression data*. **BMC Bioinformatics** **2010**, **11:413**
8. Oliver Rubel, Gunther H. Weber, Member, Min-Yu Huang, E. Wes Bethel, Mark D. Biggin, Charless C. Fowlkes, Cris L. Luengo Hendriks, Soile V. E. Keranen, Michael B. Eisen, **David W. Knowles**, Jitendra Malik, Hans Hagen, and Bernd Hamann **2010** *Integrating Data Clustering and Visualization for the Analysis of 3D Gene Expression Data*. **IEEE/ACM Transactions on Computational Biology and Bioinformatics**, Vol 7, No. 1, January-March 2010
9. Stewart MacArthur, Xiao-Yong Li, Jingyi Li, James B. Brown, Hou Cheng Chu, Lucy Zeng, Brandi P. Grondona, Aaron Hechmer, Lisa Simirenko, Soile V.E. Keränen, **David W. Knowles**, Mark Stapleton, Peter Bickel, Mark D. Biggin and Michael B. Eisen 2009. *Functionally distinct transcription factors show a quantitative continuum of binding and function to highly overlapping sets of thousands of genomic regions in the *Drosophila melanogaster* blastoderm*. **Genome Biology** **2009**, **10:R80**
10. Gunther H. Weber, Oliver Rubel, Min-Yu Huang, Angela H. DePace, Charless C. Fowlkes, Soile V. E. Keranen, Cris L. Luengo Hendriks, Hans Hagen, **David W. Knowles**, Jitendra Malik, Mark D. Biggin, Bernd Hamann **2009** *Visual Exploration of Three-dimensional Gene Expression Using Physical Views and Linked Abstract Views* **IEEE/ACM Transactions on Computational Biology and Bioinformatics**. **6:296-309, 2009**
11. Charless C. Fowlkes, Cris L. Luengo Hendriks, Soile V. E. Keränen, Gunther H. Weber, Oliver Rubel, Min-Yu Huang, Clara Henriquez, Lisa Simirenko, Mike B. Eisen, Bernd Hamann, **David W. Knowles**, Mark D. Biggin, Jitendra Malik **2008** *A quantitative spatiotemporal atlas of gene expression in the *Drosophila* blastoderm* **Cell** **133:364-374 April 18, 2008**  
Stories by:  
 (i) Eileen E.M. Furlong **2008**, *A Topographical Map of Spatiotemporal Patterns of Gene Expression*, **Developmental Cell** **14, May 2008**, DOI 10.1016/j.devcel.2008.04.007  
 (ii) Natalie de Souza **2008**, *A map for fly explorers*, **Nature Methods** **5:446, June 2008**.
12. Xiaoyong Li, Stewart MacArthur, Richard Bourgon, David Nix, Daniel A. Pollard, Venky N. Iyer, Aaron Hechmer, Lisa Simirenko, Mark Stapleton, Cris L. Luengo Hendriks, Hou Cheng Chu, Nobuo Ogawa, William Inwood, Victor Sementchenko, Amy Beaton, Richard Weiszmann, Susan E. Celniker, **David W. Knowles**, Tom Gingeras, Terence P. Speed, Michael B. Eisen and Mark D. Biggin **2008** *Transcription Factors Bind Thousands of Active and Inactive Regions in the *Drosophila* Blastoderm* **PLoS Biol.** **6, e27 (2008)**  
Story by: Magdalena Skipper **2008**, *Gene expression: Of ChIPs and flies*, **Nature Reviews Genetics** **April 2008**. <http://www.nature.com/nrg/journal/v9/n4/full/nrg2343.html>
13. Cris L. Luengo Hendriks, Soile V. E. Keränen, Mark D. Biggin and **David W. Knowles** **2007** *Automatic channel unmixing for high-throughput quantitative analysis of fluorescence images* **Optics Express** **15(19):12306-12317**
14. Luengo Hendriks C.L. & **Knowles D.W.** **2007** *Comments on the paper 'A novel 3D wavelet-based filter for visualizing features in noisy biological data', by Moss et al.* **J. Microscopy**, **225:104–107, 2007**
15. Cris L Luengo Hendriks, Soile VE Keranen, Charless C Fowlkes, Lisa Simirenko, Gunther H Weber, Angela H DePace, Clara Henriquez, David W Kaszuba, Bernd Hamann, Michael B Eisen, Jitendra Malik, Damir Sudar, Mark D Biggin and **David W Knowles** **2006** *3D morphology and gene expression in the *Drosophila* blastoderm at cellular resolution I: data acquisition pipeline* **Genome Biology** **2006, 7:R123**  
Stories by:  
 (i) Louisa Flintoft **2007**, *Developmental networks in time and space*, **Nature Reviews Genetics** **January 2007**. <http://dwknowles.lbl.gov/nrgFeb2007.pdf>  
 (ii) Felice Frankel **2007**, *Expressing Genes*, **www.AmericanScientist.org**, **February 2007** <http://dwknowles.lbl.gov/AmericanScientistJan07.pdf>  
 (iii) Melissa Lee Phillips **2007**, *Deciphering Development: Quantifying Gene Expression through Imaging*, **www.BioscienceMag.org**, **September 2007** <http://dwknowles.lbl.gov/BioScience2007.pdf>
16. Soile VE Keranen, Charless C Fowlkes, Cris L Luengo Hendriks, Damir Sudar, **David W Knowles**, Jitendra Malik and Mark D Biggin **2006** *3D morphology and gene expression in the *Drosophila* blastoderm at cellular resolution II: dynamics* **Genome Biology** **2006, 7:R124**

17. Fuhui Long, Hanchuan Peng, Damir Sudar, Sophie A. Lelièvre, and **David W. Knowles** 2007 *Phenotype Clustering of Breast Epithelial Cells in Confocal Images based on Nuclear Protein Distribution Analysis* **BMC Cell Biology** 2007, 8(Suppl 1):S3
18. Gurushankar Chandramouly, Patricia C. Abad, **David W. Knowles**, and Sophie A. Lelièvre 2007 *Nuclear organization and tissue polarity cooperate to control cell fate in mammary acini* **J. Cell Sci.** 120, 1596-1606 (2007)
19. Patricia C. Abad, Jason Lewis, I. Saira Mian, **David W. Knowles**, Jennifer Sturgis, Sunil Badve, Jun Xie, Sophie A. Lelièvre 2007 *NuMA Influences Higher Order Chromatin Organization in Human Mammary Epithelium* **Mol. Biol. Cell**, 18:348-361 2007
20. **David W. Knowles**, Damir Sudar, Carol Bator-Kelly, Mina J. Bissell, and Sophie A. Lelièvre 2006 *Automated local bright feature image analysis of nuclear protein distribution identifies changes in tissue phenotype* **Proc. Natl. Acad. Sci. USA** 103, 4445-4450  
Press release, **March 2006**, *New cell imaging method identifies aggressive cancer cells early*  
<http://news.uns.purdue.edu/UNS/html3month/2006/060306.Lelievre.fluo.html>
21. Koei Chin, Carlos Ortiz de Solorzano, **David Knowles**, Arthur Jones, William Chou, Enrique Garcia Rodriguez, Wen-Lin Kuo, Britt-Marie Ljung, Karen Chew, Kenneth Myambo, Monica Miranda, Sheryl Krig, James Garbe, Martha Stampfer, Paul Yaswen, Joe W. Gray, and Stephen J. Lockett 2004 *In situ analysis of genome instability in breast cancer* **Nat Genet.** 2004 36:984-8.
22. Heidi M. Van Dort, **David W. Knowles**, Joel A. Chasis, Gloria Lee, Narla Mohandas, and Philip S. Low 2001 *Analysis of integral membrane protein contributions to the deformability and stability of the human erythrocyte membrane* **J Biol Chem** 2001 276:46968-74
23. Michael R. Cho, **David W. Knowles**, Barbara L. Smith, John J. Moulds, Peter Agre Narla Mohandas, David E. Golan 1998 *Membrane dynamics of the water transport protein AQP1 in intact human red cells* **Biophys. J.** 76:1136-1144
24. **Knowles D.W.**, Tilley L., Mohandas N., Chasis J.A. 1997 *Erythrocyte membrane vesiculation: Model for the molecular mechanism of protein sorting.* **Proc. Natl. Acad. Sci.** 94:12969-12974
25. **Knowles D.W.**, Chasis J.A., Evans E.A., Mohandas N. 1994 *Cooperative action between band 3 and glycophorin A in human erythrocytes: Immobilization of band 3 induced by antibodies to glycophorin A* **Biophys. J.** 66:1726-1732  
Knowles et al. 1994 resulted in a story by David E. Golan and Nobel Laureate, Peter Agre, *Action at a distance: another lesson from the red cell.* **Biophys J.** 66:1271-1272, 1994.
26. Mohandas N., Winardi R., **Knowles D.**, Leung A., Parra M., George E., Conboy J., Chasis J. 1992 *Molecular basis for membrane rigidity of hereditary ovalocytosis: A novel mechanism involving the cytoplasmic domain of band 3* **J. Clin. Invest.** 89:686-692.

#### Peer-Reviewed Proceedings and Book Chapters:

27. **David W. Knowles** 2010 *Three-dimensional morphology and gene expression mapping for the Drosophila blastoderm.* In: *Imaging in Developmental Biology.* Ed. Rachel Wong and James Sharpe. Cold Spring Harbor Laboratory Press, 2010
28. O. Rübél, G.H. Weber, S.V.E. Keränen, C.C. Fowlkes, C.L. Luengo Hendriks, L. Simirenko, N.Y. Shah, M.B. Eisen, M.D. Biggin, H. Hagen, D. Sudar, J. Malik, **D.W. Knowles** and B. Hamann, 2006 *PointCloudXplore: Visual Analysis of 3D Gene Expression Data Using Physical Views and Parallel Coordinates* in: H. Hagen, A. Kerren and P. Dannenmann (eds.), *Visualization of Large and Unstructured Data Sets, Lecture Notes in Informatics, Vol. S-4*, pp. 107-117
29. **Knowles, David W.**, Keranen, Soile, Biggin, Mark D., Sudar, Damir 2002 *Mapping organism expression levels at cellular resolution in developing Drosophila* In *Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing IX*, Jose-Angel Conchello; Carol J. Cogswell; Tony Wilson; Eds. Proc. SPIE Vol. 4621:57-64
30. **Knowles D.W.**, Keranen S., Biggin M., Sudar S. 2002 *Mapping organism expression levels at cellular resolution in developing Drosophila* In *Optical Diagnostics of Living Cells III*, Proceedings of SPIE.
31. **David W. Knowles**, Mark D. Biggin, Stephen Richards, Damir Sudar 2001 *Mapping organism expression levels at cellular resolution in developing drosophila* *Microsc. Microanal.* 7:10-11
32. **David W. Knowles**, Sophie A. Lelièvre, Carlos Ortiz de Solórzano, Stephen J. Lockett, Mina J. Bissell, Damir Sudar 2001 *Quantitative model-based image analysis of NuMA distribution links nuclear organization with cell phenotype* *Microsc. Microanal.* 7:578-579

33. D. Sudar, D. Callahan, B. Parvin, **D. Knowles**, C. Ortiz de Solorzano, M.H. Barcellos Hoff **2001** *Design of a microscopy system for quantitative spatial and temporal analysis of multicellular interactions* Microsc. Microanal. 7:32-33
34. Rodrigo Fernandez-Gonzalez, Arthur Jones, Enrique Garcia-Rodriguez, **David Knowles**, Damir Sudar, Carlos Ortiz de Solorzano **2001** *A system for computer-based reconstruction of 3-dimensional structures from serial tissue sections: An application to the study of normal and neoplastic mammary gland biology* Microsc. Microanal. 7:964-965
35. **Knowles D.W.**, Ortiz de Solorzano C., Jones A., Lockett S.J. **2000** *Analysis of the 3D spatial organization of cells and sub cellular structures in tissue* In Optical Diagnostics of Living Cells III, Daniel L. Farkas, Robert C. Leif Editors Proceedings of SPIE. Vol 3921:66-73
36. Ortiz de Solorzano C., Chin K., Chou W.S., **Knowles D.**, Gray J.W., Lockett S.J. **1999** *Measurement of genetic instability in breast cancer by confocal microscopy and 3D image analysis* Proceedings BMES/EMBS
37. **Knowles D.W.**, Mohandas N., Ortiz de Solorzano C., Lockett S.J. **1999** *Imaging the lateral distribution of fluorescently labeled membrane components of human erythrocytes under deformation* Microsc. Microanal. 5, 1044-1045
38. Ortiz de Solorzano C., Chin K., **Knowles D.**, Jones A., Garcia E., Gray J.W. Lockett S.J. **1999** *3D confocal microscopy and image analysis for measurement of genetic instability* Microsc. Microanal. 5, 1022-1023
39. Lockett S.J., **Knowles D.W.**, Pinkel D., Ortiz de Solorzano C. **1999** *Quantitative 3D analysis of intranuclear organization in the tissue context* Microsc. Microanal. 5, 1320-1321