

## **Bob Eisenberg**

*(more formally, Robert S. Eisenberg)*

*Curriculum Vitae*

*September 19, 2011*

### ***Work co-ordinates***

#### ***Address***

Department of Molecular Biophysics and Physiology  
Rush Medical College  
1750 West Harrison, Room 1291 Jelke  
Chicago IL 60612

#### ***Phone numbers***

Voice: (312)-942-6467  
Department FAX: (312)-942-8711  
FAX to email: (801)-504-8665  
Skype Phone Number (708)-459-8089  
Email: [beisenbe@rush.edu](mailto:beisenbe@rush.edu)

### ***Short Scientific Biography***

I received my A.B. (summa cum laude) at Harvard College after three years of study with John Edsall as tutor. I started studying electrical properties of cells at Harvard Medical School (Physiology) with John Pappenheimer and at his recommendation I was accepted into Steve Kuffler's Nerve Muscle Training Program at the Marine Biological Laboratory, Woods Hole. At the MBL for three summers, I got to know Alan Hodgkin, Bob Taylor, K.C. Cole, John Moore, and too many others to name. I went to University College London for my Ph.D. with Paul Fatt as supervisor, where Bernard Katz was Chairman. Alan Hodgkin was my external examiner (and scientific hero!) and Andrew Huxley my mentor, for many years. My Ph.D. thesis and later work for a decade or two used engineering methods (impedance measurements: dielectric spectroscopy of single cells) to determine the electrical structure of cells and tissues (skeletal muscle, cardiac muscle, lens of the eye). I developed mathematical models to describe the electrical and physical structure mostly using methods of singular perturbation theory (working with Julian Cole, Victor Barcilon, and Art Peskoff). I helped Brenda Eisenberg use statistical sampling methods of stereology to measure the structure. As a postdoc at Duke (Physiology), Brenda and I showed that glycerol treatment disconnected the T-tubular system of skeletal muscle, and Peter Gage and I studied the electrical properties of the resulting detubulated preparation. I rose through the academic ranks at UCLA, and was appointed the first Chairman of the Department of Physiology at Rush Medical College in Chicago when I was 33 years old. I am still there, in the same position.

I served as Chairman of the Physiology Study Section of the NIH for several years, and Director of Research (etc) for the American Heart Association (Chicago Branch). After single channel recording was discovered, I introduced Alan Finkel (Axon Instruments), Rick Levis, and Jim Rae to the patch clamp technique, and invented the integrating headstage after thinking hard about how to increase the impedance and reduce the noise of the feedback element in a current to voltage converter. Together we designed the Axopatch amplifier that is used by thousands of

channologists to this day.

I have spent many years working on ion channels, which are protein nanovalves that control an enormous range of biological function. I am trying to understand the current that flows through the channel, in a range of solutions of different composition, over a range of voltages. Working with Zeev Schuss, I showed how the flux over a potential barrier of any shape could be evaluated analytically, starting from a description of the stochastic trajectories of diffusion. ‘Eyring models’ of transition state theory arise as a special case of very high symmetrical barriers and it is hardly easier to compute than the general formulas.

Working with Wolfgang Nonner, then Dirk Gillespie, Dezső Boda, Doug Henderson and others), I showed how the properties of concentrated electrolytes (as summarized in the primitive model of ionic solutions) can account for selectivity of two important types of channels, the L-type calcium channel of the heart and the voltage activated  $\text{Na}^+$  channel of nerve.

Zeev Schuss, Boaz Nadler, Amit Singer, and I went on to show how mean field models can be derived from a model of the stochastic trajectories of ions in solution, using the techniques of probability theory and a classical closure approximation.

I also

- (1) helped design and build selective channels using nonselective bacterial channels (ompF porin) as the ‘substrate’ (with Hank Miedema, et al, from Groningen),
- (2) helped design and build abiotic ionic channels (which Zuzanna Siwy builds),
- (3) helped Weishi Liu apply geometric perturbation theory to ion channels,
- (4) used the mathematics of inverse problems to design the selectivity and permanent charge of channels, assisting Heinz Engl and Martin Burger. This paper is particularly unusual since it is one of the few cases in which an inverse problem of significance to biology could be solved in detail and with quite robust results.
- (5) worked with Dezső Boda, Doug Henderson, Dirk Gillespie and Wolfgang Nonner to extend the crowded charge model of selectivity from calcium channels to the Na channel of nerve, showing that the same model can explain both (very different) types of channels *without changing any parameters*, just by reproducing the mutation (known from experiment) to change one channel type into another, EEEA  $\leftrightarrow$  DEKA, i.e. Glu-Glu-Glu-Ala  $\leftrightarrow$  Asp-Glu-Lys-Ala. This work shows that a single model with just one set of never changing parameters can account for the selectivity properties of two very different types of channels (Na channel of nerve and Ca channel of muscle). When the side chains in the channel protein are changed in the model, the protein changes selectivity just as it does in life. This work also reveals control parameters for the Na channel: the dielectric coefficient changes the contents of the channel, and has almost no effect on  $\text{Na}^+$  vs.  $\text{K}^+$  selectivity. The diameter of the selectivity filter changes the  $\text{Na}^+$  vs.  $\text{K}^+$  selectivity and has almost no effect on the contents of the channel.
- (6) showed (with the same collaborators) that calcium selectivity does not arise from models of the L-type Ca channel that do not allow Glu residues to mix with ions.
- (7) suggested that the simple model of selectivity works so well because it computes the important structures of the selectivity filter. These models put the ‘side chains’ into their optimal position (with minimal free energy) and thus determines the ‘optimal’ relation of side chains and permeating ions. These methods compute a self-organized selectivity filter in which the induced fit of side chains and ions is determined by the positions of the ions and side chains at

thermodynamic equilibrium. The model computes the structure of the selectivity filter and that structure changes significantly from one solution to another.

(8) started to apply the energy variational principle developed by Chun Liu and collaborators to problems in ion permeation, selectivity, gating (with YunKyong Hyon and Chun) and to new subjects of water movement (with Yoichiro Mori and Chun) and vesicle formation and fusion (with Fred Cohen, Rolf Ryham, and Chun). The variational principle allows the coupling of different interacting structures and different physical properties of a single system in a mathematically well defined and (automatically) self-consistent way. It produces different partial differential equations and boundary conditions depending on the structures, physics, and coupling included in the underlying model. It thus seems ideally suited to the complexity of ions and water in solution, channels, and tissues, as well as to the interactions of multiple systems and physics that produce flow of ions and water and movement of membranes and cells and tissues in biological systems.

(9) Along the way, I helped Amit Singer (working with Zeev Schuss) show why the charge distribution of table salt (NaCl) does not produce sparks and electrocute those who touch it. Safety in salt is a consequence of probability theory, among other things, as all salt eaters should be glad to know.

(10) Moving to new methods and questions, I grew curious about the density of charged amino acids in active sites. The density of charge is enormous in ion channels and I wondered if it was also high in active sites of enzymes in general. Jie Liang, David Jimenez-Morales and I have used some wonderful search algorithms designed and implemented by Jie and David and found huge densities of acid (presumably negative) and basic (presumably positive) side chains in active sites, some 20 Molar (for comparison solid sodium chloride is 37 Molar). This very special charged environment seems likely to have been selected by evolution for a particular physical reason that we do not know.

(11) The traditional laws of chemistry do not apply well in environments as crowded as ion channels or active sites so I looked up the derivation of the classical ‘law’ of mass action that is taught to every graduate student in chemistry and most undergraduates as well. I found to my horror that the law is true (with constant rate constants) only when solutions are infinitely dilute and have no interactions between solutes. Since all ionic solutions have solutes that interact through the electric field, ionic solutions should not be described as they almost always have been in biochemistry and physiology. Ionic solutions do not obey the ‘law’ of mass action (with constant rate constants). Thousands of papers explain interactions by invoking conformation changes of enzymes and channels, or assuming complex reaction schemes and allosteric interactions (for example). Those explanations and schemes nearly always use rate constants that are constant. If they used variable rate constants that capture physical interactions of ions, the schemes and explanations would surely change dramatically, and might disappear altogether in some cases.

## ***Internet Coordinates***

### ***Web Sites***

(1) Departmental Site: <http://www.rushu.rush.edu/molbio/>  
with a ‘Chairman’s Message’ at <http://www.phys.rush.edu/physiomsg.html>  
leading to Personal Site <http://www.phys.rush.edu/RSEisenberg/index.html>

- (2) Thanks to Nanohub at Purdue University, a lecture of mine from 2008 is available for viewing at <http://www.nanohub.org/resources/4726/> [Talk]: Ionic Selectivity in Channels: complex biology created by the balance of simple physics. Nanotechnology 501 Lecture Series: Purdue University.
- (3) Thanks to Institute for Mathematics and its Applications, University of Minnesota, my lecture of December 2008 is available (with slides) at [Talks and PDF], i.e., <http://www.ima.umn.edu/2008-2009/W12.8-12.08/abstracts.html#Eisenberg-Robert>
- (4) Thanks to the Mathematical Biology Institute, Ohio State University, my lecture (with slides) from April 2011 is available at [MBI April 2011](http://beta.mbi.ohio-state.edu/video/player/?id=549&title=Ions+in+Channels%3A+important+biology+ready+for+mathematical+analysis), i.e., <http://beta.mbi.ohio-state.edu/video/player/?id=549&title=Ions+in+Channels%3A+important+biology+ready+for+mathematical+analysis>
- (5) Thanks to Lancaster University Physics Department. Slides from Bob's lecture of July 2011 at [Lancashire July 2011](http://www.physics.lancs.ac.uk/FluctuationsConference2011/talks.htm). i.e., [www.physics.lancs.ac.uk/FluctuationsConference2011/talks.htm](http://www.physics.lancs.ac.uk/FluctuationsConference2011/talks.htm)

**PNP Online** <http://www.pnponline.org/> Interactive software for running Poisson Nernst Planck theory, with Brice Burgess.

### **FTP Sites**

- 1) [Reprints](#) available on this [hyperlink](#) or by anonymous ftp from <ftp.rush.edu>.  
(sign on as anonymous,, for password; use your email address)  
Migrate to [/molebio/Bob\\_Eisenberg/Reprints](#) or just click on this hyperlink
- 2) PNP is available in various flavors,
  - a. PNPonline is at <http://www.pnponline.org/> thanks to Brice Burgess
  - b. from <ftp.rush.edu> at [/pub/PNP/](#); [/pub/Hollerbach/](#); [/pub/Nonner/](#),  
thank you: D. Chen, U. Hollerbach, W. Nonner and S-W. Chiu.
  - c. See a much more modern (2008) version from Department of Chemistry, Northwestern University, Laboratories of Mark Ratner and George Schatz labs <https://www.nanohub.org/resources/2469>
- 3) Files of single channel currents with noise are in [/pub/Noise](#), written in collaboration with Rick Levis (*deceased, 2005*).

### **Education**

Elementary School: New Rochelle, New York

High School, 1956-59. Horace Mann School, Riverdale, New York City, graduated in three years with honors and awards in Biology, Chemistry, Physics, Mathematics, Latin, English and History.

Undergraduate, 1959-62. Entered Harvard College with Advanced Placement as a sophomore, concentrated in Biochemical Sciences, Prof. J.T. Edsall tutor and mentor; advisor in Physiology Prof. J.R. Pappenheimer; graduated in three years A.B., *summa cum laude*.

Summer work, 1960-61. Nerve Muscle Program at Marine Biological Laboratory directed by Prof. S.W. Kuffler.

Doctoral work: University College London 1962-65 (Ph.D. in Biophysics: B. Katz, Chairman); Supervisor, P. Fatt; External Examiner, A.L. Hodgkin. Mentor (over several decades): A.F. Huxley.

## ***Personal***

### *Home co-ordinates:*

Address: 7320 Lake Street, Unit 5, River Forest IL 60305

Phone: (708)-366-6332

Personal FAX: (801)-504-8665 and also (775)-256-9463

Born in Brooklyn, New York, April 25, 1942: Citizen of the United States.

Social Security Number 075-xx-xxxx.

Married Ardyth Eisenberg, 1991.

Children (mother, Brenda Russell):

Benjamin Russell Eisenberg, born March 17, 1969.

*Grandchild, mother Angelle Moutoussamy*

Crystal Lynn Moutoussamy, born March 19, 1994

Emily Ruth Eisenberg, born February 8, 1973. Husband, Benjamin Taylor

Jill Anna Trowbridge (formerly Eisenberg), born November 7, 1974.

*Grandchildren, father John Trowbridge*

James Louis Trowbridge, born August 15, 1997.

Holly Sophia Trowbridge, born July 11, 2000.

Henry Samuel Trowbridge, born January 15, 2004.

Alastair Solomon Trowbridge, born January 10, 2006

Sally Lynn Eisenberg, born June 20, 1979.

*Family Christmas Letters:* [\[2001\]](#) [\[2003\]](#) [\[2004\]](#) [\[2005\]](#) [\[2006\]](#) [\[2007\]](#) [\[2008\]](#) [\[2009\]](#)  
[\[2010\]](#)

## ***Academic Positions***

### *Main Positions*

Rush Medical College, Chicago IL. Rush Employee ID 010207

1995- ... Chairman of Molecular Biophysics and Physiology

1976 -... Endowed Chair "The Francis N. and Catherine O. Bard Chair of Physiology "

1976-1995 Chairman of Physiology

## University of California at Los Angeles

1975-1976 Professor of Biomathematics and Physiology,  
Chairmen: Carol Newton, W. Mommaerts  
1970-1975 Associate Professor, Department of Physiology  
1968-1970 Assistant Professor, Department of Physiology

## Duke University, Durham NC

Associate, 1965-1968. Department of Physiology, Duke University,  
Chairman: D. Tosteson. Post-doctoral fellow of P. Horowicz, along with P. Gage,  
C. Armstrong, etc.

*Secondary Positions*

Visiting Scholar, Department of Mathematics, Pennsylvania State University, 2011 – ...,  
PSU ID 9 82583348  
Adjunct Professor, Department of Bioengineering, University of Illinois Chicago 2007- ...  
UIN 658809751  
Senior Scientist, Argonne National Laboratory (Mathematics and Computer Science Division,  
2005 - ... Badge number B0 56980 A  
Schlumberger Visiting Professor, University of Cambridge (UK) 2002  
Visiting Fellow, Corpus Christi College, University of Cambridge (UK) 2002  
Visiting Professor, 2000-2003 Computational Electronics, Beckman Institute, University of  
Illinois, Urbana Champaign  
Visiting Scientist, 1991-1995. Department of Physics, Brookhaven National Laboratory,  
Upton, Long Island, NY.

**Honors**

Editorial Board, Journal of General Physiology, 1970-1991  
Editorial Board, Journal of Computational Electronics, 2001-...  
Associate Editor, Comments on Theoretical Biology, 1987-...  
Associate Editor, News in Physiological Sciences, 1988-1992  
Harvard College Scholarship  
A.B. received *summa cum laude*  
Phi Beta Kappa: member of “Senior Sixteen”  
L.J. Henderson award for thesis in Biochemical Sciences  
Senior Common Room Award for “Most Promising Scholar”  
Schlumberger Visiting Professor, University of Cambridge (UK)  
Visiting Fellow, Corpus Christi College, University of Cambridge (UK)  
Schlumberger Medal, Physical Chemistry  
Plenary Lecture at European Mathematics Society/AMAM 2003  
Member Executive Board, American Physical Society (2002-2004)  
Fellow, American Physical Society (Division of Biological Physics)  
Argonne National Laboratory: Director’s Seminar

Senior and Life Member of the IEEE  
 Institute of Medicine of Chicago  
 Keynote Speaker, Oak Ridge National Laboratory and University of Tennessee, Knoxville.  
 Summer School on Biophysics: Computational and Theoretical Challenges (2010).  
 Keynote Speaker, Lancaster University: Conference on Fluctuations and Coherence. (2011)  
 see [www.physics.lancs.ac.uk/FluctuationsConference2011/talks.htm](http://www.physics.lancs.ac.uk/FluctuationsConference2011/talks.htm)

### ***Grant Support***

Continuous Grant Support (without interruption) thanks to a combination of NSF, NIH, and DARPA from approximately 1970 to present. Miscellaneous additional grants from AHA, MDA, Chicago Heart, etc.

### ***Scientific Administration***

**FIRST CHAIRMAN OF DEPARTMENT OF MOLECULAR BIOPHYSICS AND PHYSIOLOGY**, appointed 1976, thriving, if not burgeoning, see science at <http://www.phys.rush.edu/physiofac.html>

#### **AMERICAN PHYSICAL SOCIETY**

Councilor (First term: 2000-2004)  
 Councilor (Second term: 2005-2009)  
 Member of Executive Board (2002-2004)  
 Member, Committee on Committees (2003- 2006, 2009)  
 Member, Audit Committee (2004 - 2007), Chair Audit Committee (2005 – 2006)  
 Division of Biological Physics  
 Executive Board (2001- ...)

#### **BIOPHYSICAL SOCIETY**

Member of U.S. National Committee International Union of Pure and Applied Biophysics (1978-1983)  
 Member of Council (1983-1986).  
 Member of Executive Board (1983-1986).  
 Member of Program Committee (1984).  
 Chairman of Nominating Committee (1985).  
 Chairman of Science Public Policy Committee (1985-1987).

#### **CHICAGO CHAPTER OF SOCIETY FOR NEUROSCIENCE**

Member of Council (1981-1984), Meeting Organizer, then President.

#### **CHICAGO HEART ASSOCIATION**

Member, Vice Chairman, then Chairman of the Research Council (1982-1986).  
 Member, Vice Chairman, then Chairman of Research Review Committee (1976-1986; 1989).

#### **NATIONAL INSTITUTES OF HEALTH**

Member (1979-1981), then Chairman (1981-1983) of Physiology Study Section.  
 Member *ad hoc* (2004) Modeling and Analysis of Biological Systems (MABS) Study Section.

**NATIONAL SCIENCE FOUNDATION**

Member, Steering Committee on Biology and Mathematics (1989, 1996).

**PENNSYLVANIA MUSCLE INSTITUTE**

Member (1980-1982; 1989-1990), then Chairman (1982-1987; 1989-1990) of the External Advisory Board, University of Pennsylvania, Director: A. Somlyo (1980-1987); Y. Goldman (1989-1990).

**SOCIETY OF GENERAL PHYSIOLOGISTS**

Councilor; Chairman, Membership Committee.

**UNIVERSITY OF MIAMI**

External review of Graduate Program, Department of Physiology (1988).

***Invited Lectures***

Albert Einstein College of Medicine

American Chemical Society, National Meeting, Division of Physical Chemistry

American Chemical Society, National Meeting, 2008, Division of Physical Chemistry

Symposium: Water Mediated Interactions, Dor Ben-Amotz, H. Asbaugh,  
Organizers.

American Heart Association

AMA Institute (1966)

American Physical Society (Division of Biological Physics) March Meeting, 2000

American Physical Society (Division of Biological Physics) March Meeting, 2006

American Physical Society (Division of Biological Physics) March Meeting 2009

American Chemical Society Meeting, San Francisco, 2000

American Physiological Society Meeting: 1978, 1979, 1983

Argonne National Laboratory Chemical Sciences

Argonne National Laboratory Material Sciences Division

Argonne National Laboratory Mathematics and Computer Sciences Division

Argonne National Laboratory Biology Division

Argonne National Laboratory: Director's Seminar

Association of Chairmen of Departments of Physiology

Australian National University (Canberra)

Baylor University

Biological Chemists of the Federal Republic of Germany

Biophysical Society, 1991: *in* Symposium on Ion Channels in Intracellular Membranes

Biophysical Society, 2007: *in* Symposium on Modeling as a Tool in Biophysics; Sponsor

American Physical Society (Division of Biological Physics)

Biozentrum (Basel, Switzerland): Minicourse on Electrophysiology

Biozentrum (Basel, Switzerland): Selectivity in Channels (Seminar in Structural Biology)

Boston University (Department of Mathematics)

Brandeis University (Department of Biochemistry, Host: Chris Miller, 1986;

Department of Chemistry, Host: Judy Herzfeld, 2008)

Brigham Young University (Zoology), ~1998

Brigham Young University (Chemistry), 2010

Brigham Young University (Computer Science), 2010

Brigham Young University (Zoology and Neuroscience), 2010



Brookhaven National Laboratory (Department of Physics)  
 California Institute of Technology (Biology)  
 California Institute of Technology (Applied Mathematics)  
 Cambridge University (England) Physiology: Foster Club  
 Cambridge University (England) Chemistry, *in* the “Lennard Jones Lecture Series”  
 Cambridge University (England) Pharmacology  
 Cambridge (England): Schlumberger Lecture, 2002  
 Cambridge University (England) Centre for Computational Chemistry  
 CCNY, Department of Physics, Mike Lubell Chairman  
 CECAM: Ionic Transport: from Nanopores to Biological Channels (Organizers Mounir  
     Tarek and Mark Sansom, Lyon (2007)  
 Centro de Investigacion y de Estudios del Avanzados (Mexico City)  
 Chicago Heart Association Cardiovascular Research Forum  
 Chicago Medical School  
 City of Hope, Duarte, California  
 K.S. Cole Symposium (FASEB, 1974)  
 Colorado State University (Fort Collins: Department of Chemistry)  
 Columbia University, Department of Chemical Engineering  
 Conference on Fluctuations, Escape, and Optimal Control Traverse City MI  
 Conference of N.Y. Academy of Science, 1977  
 Cornell University Medical School: Department of Physiology  
 Cornell University: Department of Chemistry  
 Courant Institute (NYU) Seminar “Mostly Biomathematics” (2004)  
 Courant Institute (NYU) Joint Seminar with Chun Liu, Yoichiro Mori, “Mostly  
     Biomathematics (2010)  
 DARPA (Defense Advanced Research Projects Agency)  
     Many workshops.  
     Director’s Seminar, 2001  
 DSRC (Defense Sciences Research Council) Workshop on Biosensors  
 Dominican University (River Forest IL)  
 Duke University Department of Physiology. Hosts Dan Tosteson and Paul Horowicz, 1964.  
 DuPont Experimental Station, Wilmington DE  
 European Mathematics Society: Plenary Lecture at AMAM 2003 (Applied Math ...)  
 Participant (not speaker) at EMBO Meeting in honor of retirement of Max Perutz  
     at Kings College, Cambridge, 1980  
 Emory University  
 Fine Structure Society (Rosemont IL 1995)  
 Florida State University: Inaugural Workshop for Computational Science, 2000  
 FOCUS 2000, DARPA workshop, Session Leader, Speaker, Plenary Session  
 Fordham University, Biology and Mathematics Seminar October 2010  
 Frontiers in Mathematical Biology: NSF-NIH Meeting, 2010 CSCAMM University of  
     Maryland , Invited Speaker  
 Free University of Berlin Institute of Chemistry and Biochemical Modeling  
 Fudan University, Shanghai, Department of Mathematics, Lectures on Biomathematics,  
     2011, organizer Chun Liu.  
 Gordon Conference on Smooth Muscle, 1973  
 Gordon Conference on Skeletal Muscle, 1980  
 Gordon Conference on Skeletal Muscle, 1983

Gordon Conference on Skeletal Muscle, 1985  
 Gordon Conference on Solid State Ionics, 1990  
 Gordon Conference on Ion Channels, 1998  
 Gordon Conference on Ion Channels, 2000  
 Gordon Conference on Water, 2010  
 Grinnell College, Department of Biology  
 Harvard University (Neurobiology)  
 Hebrew University, Jerusalem: Fritz Haber Lecturer in Physical Chemistry  
 Hebrew University, Jerusalem: Bat Sheva (de Rothschild) Seminar  
 Hebrew University, Jerusalem: Protein Dynamics and thermodynamics, participant and session chair.  
 Henderson Symposium (Basic and Applied Statistical Mechanics of Condensed Matter, Brigham Young University, 2004)  
 HRL (formerly Hughes Research Lab) Malibu: Physics Colloquium, 1999.  
 HRL (formerly Hughes Research Lab) Malibu: Colloquium, 2005.  
 ICIAM 6<sup>th</sup> International Congress on Industrial & Applied Mathematics Zurich 2007, Co-organizer, two minisymposia: Direct and inverse problems in channels and membranes. Organizer Martin Burger, Co-organizer Heinz Engl.  
 IEEE International Conference on Pattern Recognition (1994), presented by Amir Averbuch and Moshe Israeli  
 IIT (Illinois Institute of Technology) Department of Biological, Chemical and Physical Science (Hosts: Grant Bunker and Larry Scott)  
 IIT (Illinois Institute of Technology) Department of Electrical and Computer Engineering (Host: Marco Saraniti).  
 IIT (Illinois Institute of Technology) Department of Chemical and Biological Engineering (Host: Darsh Wasan)  
 IIT (Illinois Institute of Technology) Department of Mathematics (Host: Shuwang Li)  
 Intel Workshop on Early Disease Detection (Sept 2002)  
 Institute for Mathematics and its Applications (IMA), Solvation Workshop (December 2008) see link [\[Talks and PDF\]](#) or address <http://www.ima.umn.edu/2008-2009/W12.8-12.08/abstracts.html#Eisenberg-Robert>  
 Institute for Pure and Applied Mathematics, IPAM, UCLA, Ion Channels (2002)  
 Institute for Pure and Applied Mathematics, IPAM, UCLA, Inverse Problems, Lecture and Workshop (2003)  
 Institute for Pure and Applied Mathematics, IPAM, Lake Arrowhead UCLA Conference: Inverse Problems Reunion (2005)  
 Institute for Pure and Applied Mathematics, IPAM, Lake Arrowhead UCLA Conference: Inverse Problems Reunion (2006)  
 Institute for Theoretical Physics, University of California, Santa Barbara, Conference on Electrostatic Effects in Complex Fluids and Biophysics, 1998  
 International Conference on Circuit/System Theory, Sydney, Australia (1970)  
 International Conference on Computational Nanoscience  
 International Conference on Unsolved Problems of Noise and fluctuations in physics, biology, and high technology, Bethesda, 2002  
 International Filter Symposium, Santa Monica, CA, 1972  
 International Workshop on Computational Electronics: IWCE-5, 1997, Notre Dame.  
 International Workshop on Computational Electronics, IWCE-6, 1998, Osaka  
 International Workshop on Computational Electronics, IWCE-8, 2001, UIUC

International Workshop on Computational Electronics, IWCE-9, 2003, Roma, Italia  
 International Workshop on Computational Electronics, IWCE-11, 2006, Vienna, Austria  
 Jacobs University Bremen Germany  
 Johns Hopkins (Department of Biology)  
 Johns Hopkins (Department of Biomedical Engineering)  
 Kansas University (Mathematics, 2005, 2007)  
 Kavli Institute of Theoretical Physics, University of California Santa Barbara:  
     Evolutionary Perspectives on Mechanisms of Cellular Organization 2010  
 Laboratory of Molecular Biology, MRC, Cambridge England  
 Lancaster University (Department of Physics)  
 Lancaster University: Keynote Speaker at Conference on Fluctuations and Coherence.  
     (organizer Peter McClintock, 2011) see  
     [www.physics.lancs.ac.uk/FluctuationsConference2011/talks.htm](http://www.physics.lancs.ac.uk/FluctuationsConference2011/talks.htm)  
 Liblice Conference (5<sup>th</sup>) on Statistical Mechanics of Liquids, 1998  
 Los Alamos National Laboratory (Center for Nonlinear Studies)  
 Loyola University, Department of Physiology, Maywood, Illinois  
 Marquette University: Department of Biology  
 Marquette University: Department of Mathematics  
 Marine Biological Laboratory, Woods Hole  
 Mathematical Biosciences Institute, Ohio State University, Speaker at “Modeling and  
     computation of biomolecular structure and dynamics” April, 2011 [MBI 2011](http://beta.mbi.ohio-state.edu/video/player/?id=549&title=Lons+in+Channels%3A+important+biology+ready+for+mathematical+analysis), i.e.,  
<http://beta.mbi.ohio-state.edu/video/player/?id=549&title=Lons+in+Channels%3A+important+biology+ready+for+mathematical+analysis>  
 Max Planck Institute (Goettingen: Erwin Neher. Am Fessberg series) 2007  
 Max Planck Institute (Goettingen. MPI for Dynamics and Self-organization. Computational  
     Neuroscience 2009)  
 Max Planck Institute (Heidelberg: Ken Holmes)  
 Max Planck Institute (Heidelberg: Bert Sakmann)  
 Mayo Clinic, Pharmacology, John Blinks.  
 Mayo Clinic, Physiology, Stuart Taylor.  
 McMaster University: Department of Physics (Hamilton, Ontario)  
 McGill University: Department of Biomedical Engineering, Jay Nadeau (March 2010)  
 Medical College of Virginia  
 Medical College of Wisconsin  
 Medical Research Council, Mill Hill, England  
 Merck, Sharpe, and Dhome  
 Mesilla Conference on Physical Chemistry (2001), Las Cruces New Mexico  
 MIT Bio-Informatics Seminar (with the Whitehead Institute)  
 Monash University, Australia: Electrical Engineering  
 Monash University, Australia: Department of Physiology  
 NASA Ames: Biomolecular Systems  
 National Science Foundation (first MOBS Seminar: Modeling of Biological Systems)  
 NATO Advanced Research Workshop. Ionic Soft Matter, Lviv, Ukraine  
 National Taiwan University Taipei “Energetic Variational Approaches to Elastic Complex  
     Fluids and Molecular Biology” January, 2010  
 New Mexico Institute of Technology and Mining (Socorro)  
     Dept of Mathematics (host, Bxiang Wang), March 2011  
 New York University Medical School (Physiology)  
 New York University (Biology: Tamar Schlick’s Group)

NIH NINCDS  
 NIH Arthritis Institute  
 NIH GMS  
 NISTI-NIGMS Digital Biology Speaker (2003)  
 NIST Physical and Chemical Properties Division  
 NJIT (New Jersey Institute of Technology, Newark) Department of Mathematics, 2011  
 Northwestern University: Evanston, Applied Mathematics  
 Northwestern University Evanston Chemistry Colloquium  
 Northwestern University Evanston Chemistry  
     George Schatz & Mark Ratner Laboratory (2010)  
 Northwestern Univ Evanston, Mathematics “Conversations in Mathematics & Biology”  
 Northwestern University: Evanston, Neurosciences  
 Northwestern University Evanston, Physics and Engineering Sciences  
 Northwestern University: Chicago, Physiology  
 Notre Dame, Department of Electrical Engineering  
 Notre Dame, Department of Chemistry and Biochemistry  
 Novartis Foundation Symposium: Gramicidin and Related Peptides, 1998  
 Novartis Foundation Meeting: Physical Models of Ion Permeation, 2000  
 Oak Ridge National Laboratory and University of Tennessee, Knoxville. Summer School  
     on Biophysics: Computational and Theoretical Challenges (2010).  
 Oregon Health Sciences University (Vollum Institute)  
 Oxford University (England) Department of Physiology  
 Oxford University (England) Department of Biochemistry (2011)  
 Oxford University Biochemical Society (England)  
 Oxford University Seminar in Physical and Theoretical Chemistry (England)  
 Oxford University Seminar in Chemistry (Hagan Bayley)  
 Oxford University OCIAM Mathematics in Medicine 5<sup>th</sup> Study Group (October, 2005)  
 Oxford University OCIAM Mathematics in Medicine: Ion Channels (March, 2006)  
 Oxford University Occam Mathematical modelling of ion channels (September 2011)  
 PacifiChem (meeting of American Chemical Society, 2000)  
 PacifiChem (meeting of American Chemical Society, 2005)  
 Penn(sylvania) State University, Department of Mathematics,  
     IMA-PIP Workshop on Numerical Simulation of Complex Fluids and MHD  
 Polytechnic University (NY) Department of Chemical Engineering (2010)  
 Pierre & Marie Curie University (UPMC) Department of Physical Chemistry (Pierre Turq,  
     Jean-Pierre. Hansen) 2009  
 Princeton University Program in Applied Mathematics (October 2009)  
 Purdue University: Department of Biology  
 Purdue University: Department of Electrical Engineering: Solid State Physics,  
     Organizer: Mark Lundstrom  
 Purdue University Physical Chemistry Seminar Series, 2008, Organizer Dor Ben-Amotz  
 available at <http://www.nanohub.org/resources/4726/> [PDF]  
 Radon Institute (RICAM) EMS (European Mathematics Society) Linz, Austria (2006)  
     Minicourse (3 days) Lectures on Ion Channels  
 Radon Institute (RICAM), Linz, Austria, Special Semester on Quantitative Biology (2007)  
     Ionic Channels  
 Rensselaer Polytechnic Institute Department of Mathematics  
 Rice University Colloquium in Computational and Applied Mathematics (March 2010)

Rowland Institute (Cambridge MA)  
 Rush Medical College (Physiology, 1975)  
 Rush Medical College (Pharmacology, 2008)  
 Salk Institute (Host: Steven Kuffler)  
 Salk Institute (Host: C. Stevens)  
 Sandia National Laboratory (Laura Frink/Grant Heffelfinger)  
 Sandia National Laboratory Biophysical Discussion (Susan Rempe)  
 Satellite Meeting (Debrecen) of International Physiological Congress, 1980  
 Schlumberger Cambridge Research  
 Scripps Research Institute La Jolla  
 Simon Fraser University (Vancouver) Department of Physics  
 SISSA and ICTP Trieste, Italy Theoretical Biophysics and Structural Biology  
 SISSA and ICTP Trieste, Italy. Challenge: correcting Einstein's mistake  
 Society of Industrial and Applied Mathematics:  
     Invited lecture, Conference on Applied Probability in Science & Engineering Society  
     of Industrial and Applied Mathematics  
     Invited lecture, symposium on "Ionic Channels in Biological Membranes". Annual  
     meeting, 1993  
     Invited lecture, Symposium on Ionic Channels, 2001, Annual meeting  
     Invited lecture, Symposium Electrodifussion: Modeling, Analysis, Simulation, and  
     Applications, 2005, Annual Meeting. New Orleans  
     Invited lecture, Co-organizer Symposium Multiscale Modeling of Electrochemical  
     Systems, 2006, Annual Meeting, Boston.  
     Invited Lecture, Symposium, Multiscale Nonlinear Problems in Biology, 2007,  
     Conference on Dynamical Systems  
 SPIE Annual Meeting (1994) *in* Symposium "Mathematical Imaging: Wavelet  
     Applications" (presented by Amir Averbuch and Moshe Israeli)  
 Stanford University (Department of Electrical Engineering)  
 State University of New York (Albany)  
 State University of New York (Stony Brook)  
 Taft School Centennial Symposium  
 Technical University of Vienna (Mathematics)  
 Telluride Science Research Center Symposium on Biological Ion Channels (2003)  
 Telluride Science Research Center Symposium on Biophysical and Biochemical Properties  
     of Ion Channels in Epithelia (2004)  
 Telluride Science Research Center Symposium Biological Ion channels: Structure and  
     Function (2005)  
 Texas Instrument Corporation (1966)  
 Thomas Jefferson University: Daniel Baugh Institute  
 TIDS12 Transport in Disordered Systems 12<sup>th</sup> Annual Meeting, Marburg, 2007  
 TMR Meeting on Kinetics, Goteborg Sweden, 2000, Plenary Speaker  
 Tulane University (1967)  
 UCLA: Biology Department (1968)  
 UCLA: Jerry Lewis Muscle Disease Center  
 UCLA: Physiology Department  
 UCLA: Molecular Biology Institute  
 UCLA: Department of Anesthesiology  
 UCLA School of Engineering, Mechanics and Structures

UCLA Department of Bioengineering  
 University College (London): Biophysics  
 University College (London): Physiology  
 University of Buffalo (SUNY) Department of Physiology and Biophysics  
 University of Buffalo (SUNY) Department of Electrical Engineering  
 University of California (Berkeley) Chemical Engineering, Chakraborty Group  
 University of California (Berkeley) Colloquium in Physics Department (Marvin Cohen)  
 University of California (Irvine) Miledi Group  
 University of California (Irvine) Colloquium in Physics  
 University of California (San Diego) McCammon Group  
 University of California (San Diego) Department of Mathematics (Bo Li, Host).  
 University of California (San Francisco, Biochemistry, ~ 1970)  
 University of California (San Francisco, Biochemistry, 2007)  
 University of Chicago: Applied Mathematics. Organizer Victor Barcion  
 University of Chicago ‘Computations in Science Seminars’,  
     Organizers, L Kadanoff & Wendy Zhang  
 University of Chicago: Department of Biophysics. Organizer, George Eisenman  
 University of Chicago: Department of Physics (Franck Institute), Leo Kadanoff  
 University of Chicago: Department of Physiology Organizer, Harry Fozzard  
 University of Chicago: Department of Chemistry Organizer, Graham Fleming  
 University of Colorado (Boulder): Applied Mathematics  
 University of Colorado (Denver): Physiology  
 University of Florida Department of Chemistry, Charles Martin’s Nanogroup  
 University of Gröningen, Netherlands (Department of Chemistry)  
 University of Hawaii (von Bekesy Laboratory)  
 University of Heidelberg Bioquant-Vorlesung Seminar, 2007  
 University of Heidelberg: Bioms-Bioquant Lecture *in* the Workshop on Transport,  
     Signaling and Structure Formation in Cellular Systems: Mathematics Meets  
     Experiments  
 University of Illinois (Chicago): Department of Chemistry  
 University of Illinois (Chicago): Department of Physics  
 University of Illinois (Chicago): Department of Bioengineering, 2007, 2009  
 University of Illinois Medical School (Chicago): Department of Biochemistry  
 University of Illinois Medical School (Chicago): Department of Ophthalmology  
 University of Illinois Medical School (Chicago): Department of Physiology  
 University of Illinois (Champaign-Urbana): Physiology  
 University of Illinois (Champaign-Urbana): Biological Physics  
 University of Illinois (Champaign-Urbana): Physics, Beckman Institute  
 University of Illinois (Champaign-Urbana): Theoretical and Computational Biophysics  
     Group, Klaus Schulten  
 University of Illinois (Champaign-Urbana): Computational Electronics  
 University of Linz, Oesterreich (Austria). Johan Radon Institute of Applied Mathematics.  
 University of Maryland (Baltimore): Physiology  
 University of Maryland (Baltimore): Biochemistry  
 University of Maryland (College Park): Electrical Engineering, Electrophysics Series  
 University of Maryland (College Park): Institute for Physical Science and Technology  
 University of Maryland (College Park): CSCAMM  
 University of Massachusetts (Amherst) Department of Chemistry

University of Miami: Biophysics and Physiology  
 University of Michigan: Michigan Interdisciplinary Mathematics Meeting.  
 University of Michigan: Seminar in Applied and Interdisciplinary Mathematics  
 University of Münster, Westfälischen Wilhelms-Universität Germany,  
     Department of Applied Mathematics  
 University of New South Wales, Australia  
 University of Notre Dame (Department of Electrical Engineering)  
 University of North Carolina (Physiology) Host Gerry Oxford and Barry Palotta  
 University of North Carolina (Chapel Hill) Dept of Biochemistry Host Gerhard Meissner.  
 University of North Carolina (Charlotte) Joint Seminar Mathematics and Bioinformatics  
 University of Oklahoma, Department of Physiology 1968  
 University of Pannonia (Veszprém Hungary): Department of Physical Chemistry Dezső  
     Boda, 2009  
 University of Pennsylvania  
 University of Rochester (Physiology)  
 University of Rochester (Neurology)  
 University of Rochester (Neuromuscular Center)  
 University of Sydney, Australia  
 University of Texas (Austin), Physics and Mathematics Seminar (Irene Gamba, host)  
 University of Texas (Austin), Colloquium in Physics (Harry Swinney, host)  
 University of Texas (Austin) ICES/Computational Life Sciences and Biology Seminar:  
     “Ionic Selectivity: A Physical Analysis of Vital Chemistry” (Ron Elber, host)  
 University of Texas (Austin) Center for Nonlinear Dynamics (Harry Swinney, host)  
 University of Texas (Austin) Center for Nonlinear Dynamics (Mark Raizen, host)  
 University of Texas (Galveston)  
 University of Texas (Southwestern: Dallas)  
 University of Tokyo (Neuroscience)  
 University of Utah  
 University of Vermont  
 University of Vienna, Department of Mathematics  
 University of Washington  
 University of Wisconsin Madison (Electrical Engineering)  
 University of Wisconsin Madison (Contemporary Biochemistry)  
 University of Wisconsin Madison (Biochemistry, 2011, Julie Mitchell, host)  
 University of Wisconsin Milwaukee  
 USA-Japan Seminar Excitation-Contraction Coupling, Tokyo 1971  
 Vanderbilt University Colloquium on Physics  
 Washington University, St. Louis, Physiology  
 Washington University, St. Louis, Center for Computational Chemistry  
 Weizmann Institute, Rehovot: Bat Sheva (de Rothschild) Seminar.  
 Weizmann Institute, Rehovot: Chemistry Department  
 Western Nerve Net (San Diego)  
 Westfaelisch Wilhelms University Muenster Applied Mathematics  
 Westfaelische Wilhelms University Meunster  
     Multiscale Simulation for Ion Channels (2009)  
 Workshop on Wavelets: 16<sup>th</sup> International Conference of the IEEE Engineering in Biology  
     and Medicine Society.  
 World Congress on Medical Physics and Biomedical Engineering, 1994.

Yale University (Department of Physiology)  
 Yale University (Section of Neuroscience)  
 Yale University (Department of Mathematics and Computational Science)  
 Yangtze Conference on Fluids and Interfaces  
 Zhejiang University, Hangzhou. Symposium Department of Mathematics, 2011, organizer,  
 Fang-Hua Li of the Courant Institute, NYU

### *Symposia Organized*

- Chairman, Mini-symposium on **The Lens as a Syncytium**, Biophysical Society Meeting, 1980.
- Co-Chairman, with Brian Salzberg, **Symposium on Fine Processing in the Fine Processes of the Nervous System**, Biophysical Society Meeting, 1984.
- Chairman of Symposium and Luncheon **Calcium Signals in Muscle**, Biophysical Society Meeting, 1985
- Chairman of Symposium. **Nerve Impulse: From Conduction to Channels by way of Conductance** at the 100<sup>th</sup> Anniversary Meeting of the American Physiological Society, 1987.
- Chairman of Symposium. **Skeletal Muscle Physiology: an Update** at the 100<sup>th</sup> Anniversary Meeting of the American Physiological Society, 1987.
- Chairman of Minisymposium. **Moving through (Biological) Channels**, Society of Industrial and Applied Mathematics Conference on Applied Probability in Science and Engineering, New Orleans, 1990.
- Chairman of Minisymposium. **Ionic Movement through Biological Channels**. Society of Industrial and Applied Mathematics, Annual Meeting. Chicago, 1990.
- Organizer of Workshop: **From Structure to Permeation in Open Ionic Channels**. Biophysical Society Annual Meeting, Washington D.C., 1993
- Chairman of Symposium: **Ionic Channels: Natural Nanotubes**. American Physical Society Annual Meeting, 2000.
- Chairman and Organizer of **Novartis Foundation Meeting: Physical Models of Ion Permeation**, 2000
- Chairman and Organizer of **Symposium at International Conference on Computational Nanoscience, 2001: Nanostructure Simulation from thin oxides to biological ion channels**.
- Co-organizer of **Yangtze Conference on Fluids and Interfaces** (Chief Organizers Kwong-Yu Chan and D Henderson). Chairman, Ion Channels Session, 2001. see *J. Colloid Interface Sci.* 2002 246: p.222.
- Organizer and Chairman of **Nanostructures: biological ion channels to thin oxides**. Nanotech 2003, San Francisco.
- Co-organizer and Chairman (with Dirk Gillespie) of **Physical Models of Ion/Protein Interactions**, American Physical Society (Division of Biological Physics) March, 2003. Austin, TX.



- Chairman (Organizer Maria Kurnikova) **Physics of Ion Interactions with Proteins**, March, 2004, American Physical Society, Montreal Quebec Canada.
- Member, Organizing Committee, NATO Advanced Research Workshop. **Ionic Soft Matter** Lviv Ukraine, 2004.
- Helper to Andrij Trokhymchuk and David Busath, **Festschrift for Doug Henderson**, Brigham Young University, 2004.
- Co-organizer, with Heinz Engl, **RICAM Seminar on Ion Channels**, Johan Radon Institute of Applied Mathematics, University of Linz (Austria), 2004.
- Organizer and Chair, **Multiscale Analysis in Biology: Computation**, American Physical Society, March, 2005, Los Angeles.
- Organizer and Chair: **MultiScale Analysis of Ions in Solutions, Proteins, and Channels: Analysis**, American Physical Society, March, 2005, Los Angeles.
- Problem Presenter: **Mathematics in Medicine Study Group**, Mathematics Institute, Oxford University, Sept. 2005, March 2006
- Organizer and Chair: **Physical Models of Ion Channels**, American Physical Society, March 2006, Baltimore.
- Helper to Chris Breward: Oxford University OCIAM **Mathematics in Medicine: Ion Channels**, March, 2006.
- Member, Organizing Committee for **Special Semester on Quantitative Biology analyzed by Mathematical Methods**: RICAM (Radon Institute for Computational and Applied Math); (Oct 2007- Jan 2008: Johannes Kepler Univ of Linz, Austria) <http://www.ricam.oeaw.ac.at/ssqbm/>
- Co-organizer (with Martin Burger, Peter Pohl, Heinz Engl) of Workshop on Ion Channels, Oct 8-12, 2007
- Co-organizer, with Martin Bazant of Symposium, **Multiscale Modeling of Electrochemical Systems** SIAM (Society of Industrial and Applied Mathematics), 2006.
- Organizer of ARO Sponsored Meeting, **Calibrating Simulations**, at Rush University Medical Center, January 2007.
- Facilitator of Annual Reciprocal Symposia between Biophysical Society and Division of Biological Physics of the American Physical Society, commencing 2007. Planned to be the first in a continuing series.
- Organizer of Symposium (Sponsored by American Physical Society Division of Biological Physics) **Modeling as a Tool in Biophysics**, at Biophysical Society Annual Meeting, 2007. Planned to be the first in a continuing series.
- Co-organizer: **Direct and inverse problems in channels and membranes**, ICIAM 6<sup>th</sup> International Congress on Industrial & Applied Mathematics Zurich 2007, Organizer Heinz Engl; co-organizer Martin Burger, pair of minisymposia.
- Lecturer Short course on **Channel Biophysics**, 10 hours, ICTP and SISSA Theoretical Biophysics and Structural Biology, Trieste, Italy, Organizer Paolo Carloni.

Co-organizer: Symposium on **Inhomogeneous Electrolytes** Northwest and Rocky Mountain Regional Meeting American Chemical Society Co-organizer Douglas Henderson, June 2008.

Organizer and Speaker: Workshop “Biophysics of Membrane Bound Channels” American Physical Society, Division of Biological Physics, March 2009.

Co-organizer: National Taiwan University “Energetic Variational Approaches to Elastic Complex Fluids and Molecular Biology” January, 2010, Organizer Tai-Chia Lin

### ***Equipment and Software Designed***

Wide band amplifiers for microelectrode recording (with several collaborators, see publications 3, 9, 11, 16, 22, and 24).

Software for computing and analyzing impedance measurements with wide band amplifiers (*ibid.*)

**Axopatch Amplifier** for patch clamp recording, with R. Levis, J. Rae, and A. Finkel, sold by Axon Instruments, Burlingame CA, now part of Molecular Devices Sunnyvale CA.

**Perfusing Pipettes**, a hardware kit available from ALA Scientific, for perfusing patch pipettes.

**PNP Online** <http://www.pnponline.org/> Interactive software for running Poisson Nernst Planck theory, with Brice Burgess

**Patent Application**, PCT/NL2003/000013 Liquid Based Electronic Device (from BioMade, Groningen, Netherlands.) Patent Application was subsequently withdrawn, but it is an interesting idea, nonetheless, in my biased view, PCT/NL2003/000013 Liquid Based Electronic Device (from BioMade, Groningen, Netherlands.) [[PDF](#)]

**Patent Application**, Mathematical Design of Ion Channel Selectivity via Inverse Problems Technology (with Heinz Engl and Martin Burger, from Rush University) [[PDF](#)]

### ***Professional Societies***

American Association for Advancement of Science

American Mathematical Society

American Physiological Society

American Physical Society, Fellow

American Society of Cell Biologists

Biophysical Society

Institute of Electrical and Electronic Engineering, Senior Member

Mathematical Association of America

New York Academy of Sciences

Physiological Society, England (Associate Member)

Royal Society of Chemistry (UK)

Society of General Physiologists

Society for Industrial and Applied Mathematics  
 Society of Neuroscience  
 Institute for Strategic Studies (London: 1963-1992)

## ***Research Interests***

### **1960's-1980's:**

Electrical properties of cells and tissues. The relationship between the structure of biological tissues and the pathways for current flow: measurements of linear electrical properties to determine equivalent circuits of skeletal and cardiac muscle, nerve, the lens of the eye, and epithelia.

The modeling of tissues of complex geometry and the solution—in physically meaningful form—of the differential (or difference) equations which describe such tissues. Thus, models of the three dimensional spread of current in spherical and cylindrical cells; models of the spread of current in the random network of transverse tubules in skeletal muscle; models of current flow in the clefts of cardiac muscle; models of current flow in epithelia; models of current flow in dendritic trees.

The use of mathematics (ranging from singular perturbation theory to numerical simulation) to provide insight into the physical meaning of complex theory.

### **1960's-1990's:**

Excitation-contraction coupling in skeletal and cardiac muscle; particularly, the junction between the tubular system and the sarcoplasmic reticulum and the mechanism of calcium release from the sarcoplasmic reticulum.

The electrical properties of the sarcoplasmic reticulum and its ionic channels as seen in patch clamp measurements from skinned muscle fibers.

### **1980's – 2000's:**

Analysis of ionic channels, experimental and theoretical: properties of single channels in epithelia, particularly “pressure activated” channels. Single channels in sarcoplasmic reticulum of skinned muscle fibers.

Design of patch clamp amplifiers, headstage, holders with “zero excess” noise.

Optimal detection of single channel events using signal detection theory.

Measurement of open channel noise.

Theoretical analysis of ion movement through channels using an hierarchy of models from molecular dynamics to continuum electrostatics.

Simulations of the molecular dynamics of channel proteins.

Stochastic analysis of flux over barriers: first passage times, concentration boundary conditions and ionic fluxes.

PNP model of the open channel. Poisson-Nernst-Planck model of open channels, in which the potential distribution through the channel is calculated not assumed. PH model of the open channel, the Poisson Hydrodynamic model including temperature changes.

Coupling of fluxes, active transport, gating, and gating currents in a permanently open channel of one conformation as predicted by the PNP model in complex geometries and the PH model.

The stochastic generalization of the PNP model.

Simulations of the molecular dynamics of the entry process models of gramicidin.

## 2000's -... :

Design and construction of ion channels as useful devices.

Thus, building design tools for understanding current flow in bulk solution, ion channels, and proteins in general.

Computation of macroscopic properties of ionic solutions and channels from higher resolution models, using Langevin-Poisson, Monte Carlo Poisson, or Molecular Dynamics Poisson methods.

Mathematical analysis of macroscopic properties of ionic solutions and channels starting from higher resolution models, using Langevin-Poisson, Monte Carlo Poisson, or Molecular Dynamics Poisson methods.

Simulations and theories of gating and conformational change.

Construction of nonequilibrium statistical mechanics starting from the properties of chaotic trajectories computed with Poisson and molecular dynamics. Statistical mechanics as stochastic processes.

Crowded Charge model of protein function, specifically, ion selectivity and permeation in ion channels.

Variational Principles (built on the energetic variational approach of Chun Liu) applied to ions in channels, ions and water in solutions, cells, and macroscopic tissues, and to vesicles and viruses fusing with membranes.

Role of Crowded Charge in Enzyme Function. The density of acid and base side chains is so large at active sites that it appears to be a 'universal' feature that is a biological adaptation with an unknown function. Searching for that function, I ask a speculative question: *what is the role of the high charge density and crowded conditions of at active sites? Does it significantly constrain solutions of the Schroedinger equation?*

## ***Administrative Work***

### **UCLA**

Member of Committee for Graduate Students.

First Year Advisor for Graduate Students.

Member of numerous review committees for promotions: received commendation from Vice Chancellor Saxon for work on review committees.

Member of Advisory Committee for the Jerry Lewis Muscular Dystrophy Center.

### **Rush Medical College**

**Chairman**, Department of Physiology, then Department of Molecular Biophysics and Physiology. First holder of "The Francis and Catherine Bard Chair of Physiology"

Department has approximately 15 tenure track faculty since 1976 and approximately 9,000 sq ft of usable research space. All faculty with research space (i.e., 4 laboratories) have had NIH or equivalent funding without interruption, thanks to their significant personal productivity. Key members (alphabetical order) in research: Lothar Blatter, Fred Cohen (viral fusion); Tom DeCoursey (H<sup>+</sup> ion channels); Mike Fill (Ryanodine Receptor); Dirk Gillespie (selectivity); Josefina Ramos-Franco (IP<sub>3</sub> receptor); Eduardo Rios (Ca<sup>++</sup> movement). Key members in Medical School Teaching, Joel Michael, Tom Shannon, and Dirk Gillespie; in Nursing Teaching Joe Zbilut (deceased).

### **Academic Administration.**

Member of College Councils.

Chairman of Promotions and Appointments Committee.

Member, Vice Chair, then Chair of Search Committee for Microbiology Chair.

Vice Chairman of Search Committee for Dean of the Medical College.

Member, Search Committee for Dean of the Graduate College.

Member, Search Committee for Pediatrics Chair.

Member, Search Committee for Microbiology Chair

### **Teaching**

General responsibility for all teaching activities of the Department at Rush, including course and curriculum reorganization. Physiology Lectures for medical and nursing students.

### **Graduate students:**

J. Leung, R. Mathias, E. Engel, R. Levis, R. Milton (with R. Mathias), J. Tang, P. Gates, J. Wang, A. Hainsworth (with R. Levis), P. Dull (summer student), Dirk Gillespie, Amy Del Medico (summer student), Boaz Nadler (in significant part: Zeev Schuss, supervisor); Amit Singer (in significant part: Zeev Schuss, supervisor), Janhavi Giri (Bioengineering, University of Illinois, Chicago).

### **Post-doctoral fellows:**

John Howell, Peter Vaughan, Bert Mobley, Art Peskoff, Richard Mathias, Eli Engel, Richard Levis, Richard Milton (with Rick Mathias), Kim Cooper, Peter Gates, Dunapin Chen, John Tang, Danuta Rojewska, Dirk Gillespie,; Trudy van der Straaten (with Umberto Ravaioli), Sheila Wigger-Aboud (with Marco Saraniti), Jim Fonseca.

### **Community Activity**

AVENUE BANK OF OAK PARK: Director, Member, then Chairman of Audit Committee, Executive Committee, and Marketing Committee (1987-1992).

AMERICAN HEART ASSOCIATION OF METROPOLITAN CHICAGO: Member, Board of Governors, Executive Committee, and President's Cabinet (1984-1986). Member Research Council (1989-1990) and Chairman, Committee on Human Experimentation.

TAFT SCHOOL (Connecticut): Speaker at Centennial Symposium, and Seminar/Discussion Group.

PRESIDENT 7320 Condo Association. (1997– 2003; 2007; 2009-2011)

TOWN TALK Telluride Science Research Center (part of Pinhead Lecture Series) 2003.

ARMY RESEARCH OFFICE talk to North Carolina Ventures Program for High Schools 2005

**ROBERT S. EISENBERG****PUBLICATIONS**

[Reprints](#) available on this [hyperlink](#) or by clicking [\[PDF\]](#)

(Last update: September 19, 2011)

[\[Laboratory of Robert S. Eisenberg\]](#)

***Papers: Electrical properties of tissues, mostly experimental:***

1. Eisenberg, R.S. and Hamilton, D. Action of  $\gamma$ -aminobutyric acid on *Cancer borealis* muscle. Nature 198: 1002-1003 (1963). [\[PDF\]](#)
2. Eisenberg, R.S. Impedance of single crab muscle fibers. Ph.D. Thesis, University of London (1965). [\[PDF\]](#)
3. Eisenberg, R.S. Equivalent circuit of single crab muscle fibers as determined by impedance measurement with intracellular electrodes. J. Gen. Physiol. 50: 1785-1806 (1967). [\[PDF\]](#)
4. Eisenberg, R.S. and Gage, P.W. Frog skeletal muscle fibers: change in the electrical properties of frog skeletal muscle fibers after disruption of the transverse tubular system. Science 158: 1700-1701 (1967). [\[PDF\]](#)
5. Gage, P.W. and Eisenberg, R.S. Action potentials without contraction in frog skeletal muscle fibers with disrupted transverse tubules. Science 158: 1702-1703 (1967). [\[PDF\]](#)
6. Horowicz, P., Gage, P.W. and Eisenberg, R.S. The role of the electrochemical gradient in determining potassium fluxes in frog striated muscle. J. Gen. Physiol. 51: 193s-203s (1968). [\[PDF\]](#)
7. Eisenberg, B. and Eisenberg, R.S. The transverse tubular system in glycerol treated muscle. Science 160: 1243-1244 (1968). [\[PDF\]](#)
8. Eisenberg, B. and Eisenberg, R.S. Selective disruption of the sarcotubular muscle: A quantitative study with exogenous peroxidase as a marker. J. Cell Biol. 39: 451-467 (1968). [\[PDF\]](#)
9. Gage, P.W. and Eisenberg, R.S. Capacitance of the surface and transverse tubular membrane of frog sartorius muscle fibers. J. Gen. Physiol. 53: 265-278 (1969). [\[PDF\]](#)
10. Eisenberg, R.S. and Gage, P.W. Ionic conductance of the surface and transverse tubular membrane of frog sartorius fibers. J. Gen. Physiol. 53: 279-297 (1969). [\[PDF\]](#)
11. Gage, P.W. and Eisenberg, R.S. Action potentials, after potentials, and excitation-contraction coupling in frog sartorius fibers without transverse tubules. J. Gen. Physiol. 53: 298-310 (1969). [\[PDF\]](#)
12. Eisenberg, R.S., Howell, J. and Vaughan, P. The maintenance of resting potentials in glycerol treated muscle fibers. J. Physiol. 215: 95-102 (1971). [\[PDF\]](#)
13. Vaughan, P., Howell, J. and Eisenberg, R.S. The capacitance of skeletal muscle fibers in solutions of low ionic strength. J. Gen. Physiol. 59: 347-359 (1972). [\[PDF\]](#)

14. Eisenberg, R.S., Vaughan, P. and Howell, J. A theoretical analysis of the capacitance of muscle fibers using a distributed model of the tubular system. *J. Gen. Physiol.* 59: 360-373 (1972). [[PDF](#)]
15. Leung, J. and Eisenberg, R.S. The effects of the antibiotics gramicidin-A, amphotericin-B, and nystatin on the electrical properties of frog skeletal muscle. *Biochem. Biophys. Acta. Amsterdam* 298: 718-723 (1973). [[PDF](#)]
16. Valdiosera, R., Clausen, C. and Eisenberg, R.S. Measurement of the impedance of frog skeletal muscle fibers. *Biophys. J.* 14: 295-315 (1974). [[PDF](#)]
17. Valdiosera, R., Clausen, C. and Eisenberg, R.S. Circuit models of the passive electrical properties of frog skeletal muscle fibers. *J. Gen. Physiol.* 63: 432-459 (1974). [[PDF](#)]
18. Valdiosera, R., Clausen, C. and Eisenberg, R.S. Impedance of frog skeletal muscle fibers in various solutions. *J. Gen. Physiol.* 63: 460-491 (1974). [[PDF](#)]
19. Mobley, B.A., Leung, J. and Eisenberg, R.S. Longitudinal impedance of skinned frog muscle fibers. *J. Gen. Physiol.* 63: 615-637 (1974). [[PDF](#)]
20. Mobley, B.A., Leung, J. and Eisenberg, R.S. Longitudinal impedance of single frog muscle fibers. *J. Gen. Physiol.* 65: 97-113 (1975). [[PDF](#)]
21. Eisenberg, R.S. and Rae, J.L. Current-voltage relationships in the crystalline lens. *J. Physiol.* 262: 285-300 (1976). [[PDF](#)]
22. Mathias, R.T., Eisenberg, R.S. and Valdiosera, R. Electrical properties of frog skeletal muscle fibers interpreted with a mesh model of the tubular system. *Biophys. J.* 17: 57-93 (1977). [[PDF](#)]
23. Eisenberg, R.S., Mathias, R.T. and Rae, J.L. Measurement, modeling and analysis of the linear electrical properties of cells. *Ann. N.Y. Acad. Sci.* 303: 343-354 (1977). [[PDF](#)]
24. Mathias, R.T., Rae, J.L. and Eisenberg, R.S. Electrical properties of structural components of the crystalline lens. *Biophys. J.* 25: 181-201 (1979). [[PDF](#)]
25. Rae, J.L., Eisenberg, R.S. and Mathias, R.T. The lens as a spherical syncytium. Ed. Satish K. Srivastava. Elsevier North Holland Inc. **Red Blood Cell and Lens Metabolism**. pp. 277-292 (1980). [[PDF](#)]
26. Mathias, R.T., Rae, J.L. and Eisenberg, R.S. The lens as a nonuniform spherical syncytium. *Biophys. J.* 34: 61-85 (1981). [[PDF](#)]
27. Eisenberg, B. and Eisenberg, R.S. The *T-SR* junction in contracting single skeletal muscle fibers. *J. Gen. Physiol.* 79: 1-20 (1982). [[PDF](#)]
28. Rae, J.L., Thomson, R.D. and Eisenberg, R.S. The effect of 2-4 dinitrophenol on cell to cell communication in the frog lens. *Exp. Eye Res.* 35: 597-610 (1982). [[PDF](#)]
29. Rae, J.L., Mathias, R.T. and Eisenberg, R.S. Physiological role of the membranes and extracellular space within the ocular lens. *Exp. Eye Res.* 35: 471-490 (1982). [[PDF](#)]
30. Eisenberg, R.S., McCarthy, R.T., and Milton, R.L. Paralysis of frog skeletal muscle fibres by the calcium antagonist D-600. *J. Physiol.* 341: 495-505 (1983). [[PDF](#)]



31. Levis, R.A., Mathias, R.T., and Eisenberg, R.S. Electrical properties of sheep Purkinje strands. Electrical and chemical potentials in the clefts. *Biophys. J.* 44: 225-248 (1983). [[PDF](#)]
32. Hui, C.S., Milton, R.L. and Eisenberg, R.S. Charge movement in skeletal muscle fibers paralyzed by the calcium entry blocker D600. *Proc. Natl. Acad. Sci.* 81: 2582-2585 (1984). [[PDF](#)]
33. Curtis, B.A. and Eisenberg, R.S. Calcium influx in contracting and paralyzed frog twitch muscle fibers. *J. Gen. Physiol.* 85: 383-408 (1985). [[PDF](#)]
34. Milton, R.L., Mathias, R.T., and Eisenberg, R.S. Electrical properties of the myotendon region of frog twitch muscle fibers measured in the frequency domain. *Biophys. J.* 48: 253-267 (1985). [[PDF](#)]
35. Eisenberg, R.S. Membranes, calcium, and coupling. *Can. J. Physiol. and Pharmacol.* 65: 686-690 (1987). [[PDF](#)]

***Papers: Theoretical Analysis and Modeling of Spread of Current:***

36. Eisenberg, R.S. and Johnson, E.A. Three dimensional electrical field problem in physiology. *Prog. Biophys. Mol. Biol.* 20: 1-65 (1970). [[PDF](#)]
37. Eisenberg, R.S. and Engel, E. The spatial variation of membrane potential near a small source of current in a spherical cell. *J. Gen. Physiol.* 55: 736-757 (1970). [[PDF](#)]
38. Barcilon, V., Cole, J. and Eisenberg, R.S. A singular perturbation analysis of induced electric fields in nerve cells. *SIAM J. Appl. Math.* 21: No. 2, 339-354 (1971). [[PDF](#)]
39. Eisenberg, R.S. and Costantin, L.L. The radial variation of potential in the transverse tubular system of skeletal muscle. *J. Gen. Physiol.* 58:700-701 (1971). [[PDF](#)]
40. Engel, E., Barcilon, V. and Eisenberg, R.S. The interpretation of current-voltage relationships from a spherical cell recorded with a single microelectrode. *Biophys. J.* 12: 384-403 (1972). [[PDF](#)]
41. Peskoff, A., Eisenberg, R.S. and Cole, J.D. Potential induced by a point source of current in the interior of a spherical cell. UCLA Engineering Report #7259, 62pp. (1972). [[PDF](#)]
42. Peskoff, A., Eisenberg, R.S. and Cole, J.D. Potential induced by a point source of current inside an infinite cylindrical cell. UCLA Engineering Report #7303, 70pp. (1973). [[PDF](#)]
43. Peskoff, A. and Eisenberg, R.S. Interpretation of some microelectrode measurements of electrical properties of cells. *Ann. Rev. Biophysics. and Bioeng.* 2: 65-79 (1973). [[PDF](#)]
44. Peskoff, A. and Eisenberg, R.S. A point source in a cylindrical cell: potential for a step-function of current inside an infinite cylindrical cell in a medium of finite conductivity. UCLA Engineering Report #7421, 73pp. (1974). [[PDF](#)]
45. Peskoff, A. and Eisenberg, R.S. The time-dependent potential in a spherical cell using matched asymptotic expansions. *Journal of Math. Biol.* 2: 277-300 (1975). [[PDF](#)]

46. Peskoff, A., Eisenberg, R.S. and Cole, J.D. Matched asymptotic expansions of the Green's function for the electric potential in an infinite cylindrical cell. *SIAM J. Appl. Math.* 30: 222-239, No. 2 (1976). [[PDF](#)]
47. Eisenberg, R.S., Barcilon, V., and Mathias, R.T. Electrical properties of spherical syncytia. *Biophys. J.* 25: 151-180 (1979). [[PDF](#)]
48. Mathias, R.T., Levis, R.A. and Eisenberg, R.S. Electrical models of excitation contraction coupling and charge movement in skeletal muscle. *J. Gen. Physiol.* 76: 1-31, (1980). [[PDF](#)]

***Papers: Electrical Properties of Ionic Channels:***

49. K.E. Cooper, Tang, J.M., Rae, J.L., and Eisenberg, R.S. A Cation Channel in Frog Lens Epithelia Responsive to pressure and Calcium. *J. Membrane Biology.* 93: 259-269 (1986). [[PDF](#)]
50. K.E. Cooper, P.Y. Gates, and Eisenberg, R.S. Surmounting barriers in ionic channels. *Quart. Rev. Biophysics.* 21: 331-364 (1988). [[PDF](#)]
51. K.E. Cooper, P.Y. Gates, and Eisenberg, R.S. Diffusion theory and discrete rate constants in ion permeation. *J. Membrane Biol.* 106: 95-105 (1988). [[PDF](#)]
52. J.M. Tang, J. Wang, and Eisenberg, R.S. K<sup>+</sup> selective channel from sarcoplasmic reticulum of split lobster muscle fibers. *J. Gen. Physiol.* 94:261-278 (1989). [[PDF](#)]
53. P.Y. Gates, K.E. Cooper, J. Rae, and Eisenberg, R.S. Predictions of diffusion models for one ion membrane channels. in *Progress in Biophysics and Molecular Biology.* 53: 153-196 (1989). [[PDF](#)]
54. P.Y. Gates, K.E. Cooper, and Eisenberg, R.S. Analytical diffusion models for membrane channels. in **Ion Channels, Volume 2** (editor. T. Narahashi), Plenum Press (1990). [[PDF](#)]
55. D. Junge and R.S. Eisenberg. Uniqueness and interconvertibility among membrane potassium channels. *Comments on Theoret. Biology.* 11: 45-55 (1990). [[PDF](#)]
56. Tang, J.M., Wang, J., F.N. Quandt, and R.S. Eisenberg. Perfusing pipettes. *Pflügers Arch.* 416:347-350 (1990). [[PDF](#)]
57. Chen, D.P., Barcilon, V., and R.S. Eisenberg. Constant fields and constant gradients in open ionic channels. *Biophysical J.* 61:1372-1393 (1992). [[PDF](#)]
58. Barcilon, V., D.P. Chen, and R.S. Eisenberg. Ion flow through narrow membrane channels. Part II. *SIAM Journal of Applied Mathematics* 52:1405-1425 (1992). [[PDF](#)]
59. Wang, J., Tang, J.M., and R.S. Eisenberg. A calcium conducting channel akin to a calcium pump. *J. Membrane Biology* 130:163-181 (1992). [[PDF](#)]
60. Barcilon, V., D.P. Chen, R. Eisenberg, and M. Ratner. Barrier crossing with concentration boundary conditions in biological channels and chemical reactions. *J. Chem. Phys.* 98(2) 1193-1211 (1993). [[PDF](#)]

61. Chen, D.P. and R.S. Eisenberg. Charges, currents, and potentials in ionic channels of one conformation. *Biophysical Journal*. 64:1405-1421 (1993a). [\[PDF\]](#)
62. Chen, D.P. and R.S. Eisenberg. Flux, coupling, and selectivity in ionic channels of one conformation. *Biophysical Journal* 65:727-746 (1993b). [\[PDF\]](#)
63. Hainsworth, A.H., Levis, R.A., and R.S. Eisenberg. Origins of open-channel noise in the large potassium channel of sarcoplasmic reticulum. *J. Gen. Physiol.* 104:857-884 (1994). [\[PDF\]](#)
64. Eisenberg, R.S., Klosek, M.M., and Schuss, Z. Diffusion as a chemical reaction: stochastic trajectories between fixed concentrations. *J. Chem. Phys.*, 102(4): 1767-1780 (1995). [\[PDF\]](#) and Revised Version [\[PDF\]](#)
65. Elber, R., Chen, D., Rojewska, D., and Eisenberg, R.S. Sodium in gramicidin: an example of a permion. *Biophysical Journal*, 68: 906-924, (1995). [\[PDF\]](#)
66. Chen, D., Eisenberg, R., Jerome, J., and Shu, C. Hydrodynamic model of temperature change in open ionic channels. *Biophysical J.* 69: 2304-2322. (1995). [\[PDF\]](#)
67. Barkai, E., Eisenberg, R.S., and Schuss, Z. (1996). A bidirectional shot noise in a singly occupied channel. (*Physical Review E*(2), 54 1161-1175). [\[PDF\]](#)
68. Chen, D., Lear, J., and Eisenberg, Bob. (1997) Permeation through an Open channel. Poisson-Nernst-Planck Theory of a Synthetic Ionic Channel. (*Biophysical Journal*, 72 97-116). [\[PDF\]](#)
69. Barcion, V., Chen, D.-P., Eisenberg, R.S., and J.W. Jerome. (1997) Qualitative properties of steady-state Poisson-Nernst-Planck systems: perturbation and simulation study. *SIAM J. Appl. Math.* 57(3) 631-648. [\[PDF\]](#)
70. Chen, D.; Xu, L.; Tripathy, A.; Meissner, G.; Eisenberg, B. (1997) Permeation through the Calcium Release Channel of Cardiac Muscle. *with an appendix Rate Constants in Channology*. *Biophys. J.* 73(3) 1337-1354. [\[PDF\]](#)
71. Nonner, W.; Chen, D.; Eisenberg, B. (1998) Anomalous Mole Fraction Effect, Electrostatics, and Binding. *Biophys. J.* 74 2327-2334. [\[PDF\]](#)
72. Nonner, W. and Eisenberg, B. (1998) Ion Permeation and Glutamate Residues Linked by Poisson-Nernst-Planck Theory in L-type Calcium Channels. *Biophys. J.* 75:1287-1305. [\[PDF\]](#)
73. Chen, D.; Xu, L.; Tripathy, A.; Meissner, G.; and Eisenberg, B. (1999) Selectivity and Permeation in Calcium Release Channel of Cardiac Muscle: Alkali Metal Ions. *Biophysical Journal* 76:1346-1366. [\[PDF\]](#)
74. Hollerbach, U., Chen, D.P., Busath, D. D., and Eisenberg, B. (2000) Predicting function from structure using the Poisson-Nernst-Planck equations: sodium current in the gramicidin A channel. *Langmuir* 16:5509-5514. [\[PDF\]](#)
75. Gardner, C., Jerome, J. and R.S. Eisenberg (2000) Electrodiffusion Model of Rectangular Current Pulses in Ionic Channels of Cellular Membranes. *SIAM J Applied Math* 61 792-802. [\[PDF\]](#)

76. Nonner, W., L. Catacuzzeno, and Eisenberg, B. (2000). Binding and Selectivity in L-type Ca Channels: a Mean Spherical Approximation. *Biophysical Journal* 79: 1976-1992. [[PDF](#)]
77. Hollerbach, U., Chen, D.P., and Eisenberg, B. (2001) Two and Three Dimensional Poisson-Nernst-Planck Simulations of Current Through Gramicidin-A. *J. Scientific Computing* 16 (4) 373-409. [[PDF](#)]
78. Gillespie, D. and Eisenberg, R.S. (2001) Modified Donnan potentials for ion transport through biological ion channels. *Phys Rev E*, 63 061902 1-8. [[PDF](#)]
79. Nonner, W., Gillespie, D., Henderson, D., and Eisenberg, Bob. (2001) Ion accumulation in a biological calcium channel: effects of solvent and confining pressure. *J Physical Chemistry B* 105: 6427-6436. [[PDF](#)]
80. Schuss, Zeev, Nadler, Boaz, and Eisenberg, R.S. (2001) Derivation of PNP Equations in Bath and Channel from a Molecular Model, *Phys Rev E* 64: 036116 1-14. [[PDF](#)]
81. Hess, K., Ravaioli, U., Gupta, M., Aluru, N., van der Straaten, T., and R.S. Eisenberg (2001) Simulation of Biological Ionic Channels by Technology Computer-Aided Design. *VLSI Design* 13: pp.179-187. [[PDF](#)]
82. Gillespie, Dirk, Nonner, W., Henderson, Douglas and Eisenberg, Robert S. (2002) A physical mechanism for large-ion selectivity of ion channels. *Physical Chemistry Chemical Physics*. 4, 4763-4769. [[PDF](#)]
83. Gillespie, Dirk, and Eisenberg, Robert S. (2002). Physical descriptions of experimental selectivity measurements in ion channels. *European Biophysics Journal* 31: 454-466). [[PDF](#)]
84. Gillespie, Dirk, Nonner, W., and Eisenberg, Robert S. (2002) Coupling Poisson-Nernst-Planck and Density Functional Theory to Calculate Ion Flux. *Journal of Physics (Condensed Matter)* 14: 12129–12145. [[PDF](#)]
85. Gardner, Carl L., Jerome, Joseph W., and Eisenberg. R.S. (2002) Electrodiffusion Model Simulation of Rectangular Current Pulses in a Voltage Biased Biological Channel. *Journal of Theoretical Biology* 219 291-299. [[PDF](#)]
86. Gardner, Carl L., Jerome, Joseph W., and Eisenberg. R.S. (2002) Electrodiffusion Model Simulation of Rectangular Current Pulses in a Biological Channel. *J Computational Electronics*, 1 347-351. [[PDF](#)]
87. van der Straaten, T.A., Tang, J., Eisenberg, R.S., Ravaioli, U., and Aluru, N.R. (2002) Three-dimensional continuum simulations of ion transport through biological ion channels: effects of charge distribution in the constriction region of porin. *J. Computational Electronics* 1 335-340 [[PDF](#)]
88. Boda, D., Busath, D., Eisenberg, B., Henderson, D., and Nonner, W. (2002) Monte Carlo Simulations of ion selectivity in a biological Na channel: charge-space competition. *Physical Chemistry Chemical Physics* 4 5154-5160. [[PDF](#)]
89. Hollerbach, Uwe and Robert Eisenberg. (2002) Concentration-Dependent Shielding of Electrostatic Potentials Inside the Gramicidin A Channel. *Langmuir* 18 3262-3631. [[PDF](#)]

90. Gillespie, D., Nonner, W. and RS Eisenberg. (2003) Crowded Charge in Biological Ion Channels *Nanotech* 3: 435-438. [[PDF](#)]
91. Nadler, B., Schuss, Z., Singer, A., Eisenberg, B. (2003) Diffusion through protein channels: from molecular description to continuum equations. *Nanotech* 3: 439-442. [[PDF](#)]
92. Wigger-Aboud, S., Saraniti, M. and R. Eisenberg. (2003) Self-consistent particle based simulations of three dimensional ionic solutions. *Nanotech* 3: 443-446. [[PDF](#)]
93. Aboud, S., Saraniti, M. and R. Eisenberg. (2003) Computational issues in modeling ion transport in biological channels: Self-consistent particle-based simulations. *Journal of Computational Electronics* 2: 239-243. [[PDF](#)]
94. van der Straaten, T., Kathawala, G., Kuang, Z., Boda, D., Chen, D.P., Ravaioli, U., Eisenberg, R.S., and Henderson, D. (2003) Equilibrium structure of electrolyte calculated using equilibrium Monte Carlo, Molecular Dynamics, and Transport Monte Carlo simulation. *Nanotech* 3: 447-451. [[PDF](#)]
95. Chen, D.; Xu, L.; Eisenberg, B; and Meissner, G. (2003) Calcium Ion Permeation through the Calcium Release Channel (Ryanodine Receptor) of Cardiac Muscle. *J Phys Chem* 107 9139-9145. [[PDF](#)]
96. Nadler, Boaz, Hollerbach, Uwe, Eisenberg, Bob. (2003) The Dielectric Boundary Force and its Crucial Role in Gramicidin. *Phys. Rev. E* 68 021905 p1-9. [[PDF](#)]
97. Gillespie, Dirk, Nonner, Wolfgang, and Eisenberg, Robert S. (2003) Density functional theory of charged, hard-sphere fluids. *Phys Rev E* 68 0313503 1-10. [[PDF](#)]
98. van der Straaten, T. A., Tang, J. M., Ravaioli, U., Eisenberg, R. S. and Aluru, N. (2003) Simulating Ion Permeation Through the OmpF Porin Ion channel Using Three-Dimensional Drift-Diffusion Theory. *Journal of Computational Electronics* 2: 29-47. [[PDF](#)]
99. Boda, Dezso, Varga, Tibor, Henderson, Douglas, Busath, David, Nonner, Wolfgang, Gillespie, Dirk, and Bob Eisenberg. (2004) Monte Carlo simulation study of a system with a dielectric boundary: application to calcium channel selectivity. *Molecular Simulation* 30: 89-96. [[PDF](#)]
100. Gardner, Carl, Nonner, Wolfgang, and Eisenberg, Robert S. (2004) Electrodiffusion Model Simulation of Ionic Channels: 1D Simulations *Journal of Computational Electronics* 3: 25–31. [[PDF](#)]
101. Boda, Dezso, Gillespie, Dirk, Nonner, Wolfgang, Henderson, Douglas and Bob Eisenberg. (2004) Computing induced charges in inhomogeneous dielectric media: application in a Monte Carlo simulation of complex ionic systems *Phys Rev E* 69, 046702. [[PDF](#)]
102. Goryll, M., Wilk, S., Laws, G. M., Thornton, T. J., Goodnick, S. M., Saraniti, M., Tang, J. M. and R. S. Eisenberg (2003) Silicon-based ion channel sensor Superlattices & Microstructures 34(3-6), 451-457. [[PDF](#)]
103. Goryll, M., Wilk, S., Laws, G.M., Thornton, T. J., Goodnick, S. M., Saraniti, M., Tang, J. M. and R. S. Eisenberg (2004) Ion Channel Sensor on a Silicon Support Mat. *Res.*

- Soc. Symp. Proc. Vol. 820, O7.2.1-5. Proceedings Title: Nanoengineered Assemblies and Advanced Micro/Nanosystems Editors (Symposium O): Jun Liu, Jeffrey T. Borenstein, Piotr Grodzinski, Luke P. Lee, Zhong Lin Wang. [[PDF](#)]
104. Nadler, Boaz, Schuss, Zeev, Singer, Amit, and RS Eisenberg. (2004) Ionic diffusion through confined geometries: from Langevin equations to partial differential equations. *J. Physics: Condensed Matter* 16: S2153-S2165. [[PDF](#)]
  105. Schuss, Zeev, B. Nadler, A. Singer, and R.S. Eisenberg, Models of boundary behavior of particles diffusing between two concentrations in *Fluctuations and Noise in Biological, Biophysical, and Biomedical Systems II* editors: D. Abbot, S. M. Bezrukov, A. Der, A. Sanchez, 26-28 May 2004 Maspalomas, Gran Canaria, Spain, Spie proceedings series Volume 5467, pp. 345-358. [[PDF](#)]
  106. Miedema, Henk, Anita Meter-Arkema, Jenny Wierenga, John Tang, Bob Eisenberg, Wolfgang Nonner, Hans Hektor, Dirk Gillespie and Wim Meijberg (2004) Permeation properties of an engineered bacterial OmpF porin containing the EEEE-locus of Ca<sup>2+</sup> channels. *Biophysical Journal* Volume 87 3137–3147. [[PDF](#)]
  107. Aboud, S., Marreiro, D., Saraniti, M., and R. Eisenberg. (2004) A Poisson P3M Force Field Scheme for Particle-Based Simulations of Ionic Liquids. *J. Computational Electronics*, 3: 117–133. [[PDF](#)]
  108. Wilk, Seth, Goryll, Michael, Laws, Gerard M., Goodnick, Stephen M., Thornton, Trevor J., Saraniti, Marco, Tang, John M. and Eisenberg, Robert S. (2004) Teflon coated silicon aperture for lipid bilayer attachment. *Applied Physics Letters*, 85, 3307-3309 [[PDF](#)]
  109. Nadler, Boaz, Schuss, Zeev, Hollerbach, Uwe, R.S. Eisenberg. (2004) Saturation of conductance in single ion channels: the blocking effect of the near reaction field. *Phys Rev E* 70, 051912. [[PDF](#)]
  110. Nonner, Wolfgang, Peyser, Alexander, Gillespie, Dirk, and Bob Eisenberg. (2004) Relating microscopic charge movement to macroscopic currents: the Ramo-Shockley theorem applied to ion channels. *Biophysical Journal*, 87: 3716-22. [[PDF](#)]
  111. Singer, A., Schuss, Z., Nadler, B., and RS Eisenberg (2004) Memoryless control of boundary concentrations of diffusing particles *Phys Rev E* 70, 061106. [[PDF](#)]
  112. van der Straaten, Trudy A., Kathawala, G. Trellakis, A., Eisenberg, R.S., Ravaioli, U. (2005) BioMOCA — a Boltzmann transport Monte Carlo model for ion channel simulation. *Molecular Simulation*, 31: 151-171. [[PDF](#)]
  113. Aguilera-Arzo, Marcel, Aguilera, Vicente and R. S. Eisenberg (2005) Computing numerically the access resistance of a pore *European Biophysics Journal*, 34: 314-322. [[PDF](#)]
  114. Aboud, Shela, Marreiro, David, Saraniti, Marco, and Robert Eisenberg. (2005) The Role of Long-Range Forces in Porin Channel Conduction. *Journal of Computational Electronics* 4: 175–178. [[PDF](#)]



115. Marreiro, David, Aboud, Shela, Saraniti, Marco, and Robert Eisenberg.(2005) Error Analysis of the Poisson P3MForce Field Scheme for Particle-Based Simulations of Biological Systems *Journal of Computational Electronics* 4: 179–183. [[PDF](#)]
116. Singer, Amit, Schuss, Zeev, and R. S. Eisenberg. (2005) Attenuation of the electric potential and field in disordered systems *J. Stat. Phys.* 119 (5/6) 1397-1418. [[PDF](#)] Posted on arXiv.org with Paper ID [arXiv:0501048](#)
117. Boda, D., Gillespie, D., Eisenberg, B., Nonner, W., Henderson, D. (2005) Induced Charge Computation Method: Application in Monte Carlo simulations of inhomogeneous dielectric systems p. 19–43.in D. Henderson et al. (eds.), Ionic Soft Matter: Modern Trends in Theory and Applications, Springer NY. [[PDF](#)]
118. Singer, Amit, Schuss, Zeev, Holcman, David and R. S. Eisenberg. (2006) Narrow Escape. Part I, *J. Stat. Phys.* 122, 437-463. [[PDF](#)] Posted on arXiv.org with Paper ID [arXiv:0412048](#)
119. Siwy, Zuzanna, Powell, Matthew R., Kalman, Eric, Astumian, R. Dean, Eisenberg, Robert S. (2006) Negative Incremental Resistance Induced by Calcium in Asymmetric Nanopores. *Nano Letters* 6, 473-477. [[PDF](#)]
120. Miedema, Henk, Vrouenraets, Maarten, Wierenga, Jenny, Eisenberg, Bob, Schirmer, Tilman, Baslé, Arnaud and Wim Meijberg. (2006) Conductance and selectivity fluctuations in D127 mutants of the bacterial porin OmpF. *European Journal of Biophysics*, 36 13-22. [[PDF](#)]
121. Siwy, Zuzanna, Powell, Matthew R., Petrov, Alexander, Kalman, Eric, Trautmann, Christina, and Eisenberg, Robert S. (2006) Calcium-Induced Voltage Gating in Single Conical Nanopores. *Nano Letters* 6, 1729 -1734. [[PDF](#)]
122. Boda, Dezsó, Valisko, Monika, Eisenberg, Bob, Nonner, Wolfgang, Henderson, Douglas, and Dirk Gillespie (2006) The Effect of Protein Dielectric Coefficient on the Ionic Selectivity of a Calcium Channel. *Journal of Chemical Physics* 125, 034901 1-11. [[PDF](#)]
123. Miedema, Henk, Vrouenraets, Maarten, Wierenga, Jenny, Gillespie, Dirk, Eisenberg, Bob, Meijberg, Wim and Wolfgang Nonner. (2006)  $\text{Ca}^{2+}$  selectivity of a chemically modified OmpF with reduced pore volume. *Biophysical J.* 91 4392-4400. [[PDF](#)]
124. Eisenberg, Bob, Nonner, Wolfgang (2007) Shockley-Ramo Theorem Measures Conformation Changes of Ion Channels and Proteins. *J Computational Electronics* 6:363-345. [[PDF](#)]
125. Eisenberg, Bob, Liu, Weishi (2007) Poisson-Nernst-Planck systems for ion channels with permanent charges. *SIAM Journal on Mathematical Analysis* 38, No. 6, pp. 1932–1966. [[PDF](#)]
126. Burger, Martin, Eisenberg, Robert S. and Heinz Engl (2007) Inverse Problems Related to Ion Channel Selectivity. *SIAM J Applied Math* Vol. 67, No. 4, pp. 960–989. [[PDF](#)]

127. Boda, Dezso, Valisko, Monika, Eisenberg, Bob, Nonner, Wolfgang, Henderson, Douglas, and Dirk Gillespie (2007). The combined effect of pore radius and protein dielectric coefficient on the selectivity of a calcium channel. *Phys Rev. Letters* 98 168102 p.1-4 [[PDF](#)]
128. Boda, Dezső, Nonner, Wolfgang, Valisko, Mónica, Henderson, Douglas, Eisenberg, Bob, and Dirk Gillespie (2007) Steric Selectivity in Na Channels Arising from Protein Polarization and Mobile Side Chains. *Biophysical Journal* 93:1960-1980. [[PDF](#)]
129. Wilk, S.J., Petrossian, L., Goryll M., Thornton, T.J., Goodnick, S.M., Tang, J.M., Eisenberg R.S. (2007) Integrated Electrodes on a Silicon Based Ion Channel Measurement Biosensors and Bioelectronics [Volume 23, Issue 2](#), 30 September 2007, Pages 183-190. [doi:10.1016/j.bios.2007.03.030](https://doi.org/10.1016/j.bios.2007.03.030) [[PDF](#)]
130. Miedema, Henk Vrouenraets, Maarten Wierenga, Jenny Meijberg, Wim, Robillard, George and Bob Eisenberg (2007) A biological porin engineered into a molecular, nanofluidic diode. *Nanoletters* 7: 2886-2891. [[PDF](#)]
131. Boda, Dezső, Nonner, Wolfgang, Henderson, Douglas, Eisenberg, Bob, and Dirk Gillespie. (2008) Volume exclusion in calcium selective channels. *Biophys. J.*, 94: 3486–3496 *BioFAST*: January 16, 2008. [doi:10.1529/biophysj.107.122796](https://doi.org/10.1529/biophysj.107.122796). [[PDF](#)]
132. Roth, Roland, Gillespie, Dirk, Nonner, Wolfgang, Eisenberg, Bob. (2008) Bubbles, gating and anesthetics in ion channels. *Biophysical Journal* Volume 94 4282–4298 published online as January 30, 2008 as *BioFAST*, [doi:10.1529/biophysj.107.120493](https://doi.org/10.1529/biophysj.107.120493) [[PDF](#)] *note misprint in middle initial of RSE in print edition.*
133. Powell, Matthew; Sullivan, Michael; Vlassiounk, Ivan; Constantin, Dragos; Sudre, Olivier; Martens, Craig, Eisenberg, Robert; and Siwy, Zuzanna (2008) Nanoprecipitation Assisted Ion Current Oscillations. *Nature Nanotechnology* 3, 51 - 57 (01 Jan 2008), [doi: 10.1038/nnano.2007.420](https://doi.org/10.1038/nnano.2007.420). [[PDF](#)]
134. Eisenberg, Bob. (2008). Bubble Gating Currents in Ionic Channels. Posted on arXiv.org with Paper ID [arXiv:0802.0308v1](https://arxiv.org/abs/0802.0308v1). [[PDF](#)]
135. Singer, A. Gillespie, D., Norbury J., and Eisenberg, R.S. (2008) Singular perturbation analysis of the steady state Poisson-Nernst-Planck system: applications to ion channels. *European Journal of Applied Mathematics* vol. 19, pp. 541–560. [[PDF](#)]
136. Abaid, Nicole, Eisenberg, R.S., Liu, Weishi. (2008) Asymptotic expansions of I-V relations via a Poisson-Nernst-Planck system. *SIAM Journal of Applied Dynamical Systems*. 7 1507-1526. [[PDF](#)]
137. Boda, Dezső, Valisko, Monika, Henderson, Douglas, Eisenberg, Robert, Gilson, Michael. (2009) Ions and Inhibitors in the Binding Site of HIV-Protease: Comparison of Monte Carlo Simulations and the Linearized Poisson-Boltzmann Theory. *Biophysical Journal* 96 1293–1306. [[PDF](#)]
138. Boda, Dezső, Valisko, Monika, Henderson, Douglas, Eisenberg, Bob, Gillespie, Dirk, and Wolfgang Nonner. (2009) Ionic selectivity in L-type calcium channels by electrostatics and hard-core repulsion. Cover of *Journal of General Physiology* [[COVER](#)] and 133 p. 497-509. [[PDF](#)]



139. He, Yan, Gillespie, Dirk, Boda, Dezső, Vlasiouk Ivan, Eisenberg, Robert S., and Zuzanna S. Siwy. (2009) Tuning transport properties of nanofluidic diodes with local charge inversion *Journal of the American Chemical Society* 131 (14), pp 5194–5202. [[PDF](#)]
140. Bardhan, Jaydeep P., Eisenberg, Robert S., and Dirk Gillespie. (2009) Discretization of the Induced-Charge Boundary Integral Equation. *Physical Review E*. 80, 011906. [[PDF](#)]
141. Luchinsky, D. G., Tindjong, R., Kaufman, I., McClintock, P.V.E., and R.S. Eisenberg. (2009) Self-consistent analytic solution for the current and the access resistance in open ion channels. *Physical Review E* 80, 021925. [[PDF](#)]
142. Malasics, Attila, Gillespie, Dirk, Nonner, Wolfgang, Henderson, Douglas, Eisenberg, Bob, Boda, Dezső. (2009) Protein structure and ionic selectivity in calcium channels: Selectivity filter size, not shape, matters. *Biophysica and Biochimica Acta: Biomembranes Biochimica et Biophysica Acta* 1788, 2471–2480. [[PDF](#)]
143. Luchinsky, D. G., Tindjong, R., Kaufman, I., McClintock, P.V.E., and R.S. Eisenberg. (2009) Charge fluctuations and their effect on conduction in biological ion channels. *Journal of Statistical Mechanics: Theory and Experiment*. P01010. [doi:10.1088/1742-5468/2009/01/P01010](https://doi.org/10.1088/1742-5468/2009/01/P01010). [[PDF](#)]
144. Knepley, Matthew G., Karpeev, Dmitry A., Davidovits, Seth, Eisenberg, Robert S., and Dirk Gillespie. (2010) An efficient algorithm for classical density functional theory in three dimensions. *Journal of Chemical Physics* 132, 124101-1 to 124101-11. [[PDF](#)] Posted on arXiv.org with Paper ID [arXiv:0910.1531](https://arxiv.org/abs/0910.1531).
145. Zhang, Chao; Raugei, Simone, Eisenberg, Robert, and Paolo Carloni. (2010) Molecular Dynamics in Physiological Solutions: Force-fields, Alkali Metal Ions, and Ionic Strength. *Journal of Chemical Theory and Computation*. 6:2167-2175. [[PDF](#)]
146. Eisenberg, Bob, Hyon, YunKyong, and Chun Liu. (2010) Energy Variational Analysis EnVarA of Ions in Water and Channels: Field Theory for Primitive Models of Complex Ionic Fluids. *Journal of Chemical Physics*. 133, 104104 [[PDF](#)]
147. Hyon, YunKyong, Eisenberg, Bob and Chun Liu. (2010). A mathematical model of the hard sphere repulsion in ionic solutions. *Communications in Mathematical Sciences* **9**, pp. 459–475 [[PDF](#)]
148. Eisenberg, B., Multiple Scales in the Simulation of Ion Channels and Proteins. (2010) *The Journal of Physical Chemistry C*, 2010. **114** (48): p. 20719-20733. [[PDF](#)]
149. Giri, Janhavi, Fonseca, James. E., Boda, Dezső, Henderson, Douglas, and Eisenberg, Bob. (2011) Self-organized Models of Selectivity in Calcium Channels. *Physical Biology Phys. Biol.* **8** 026004 [[PDF](#)]
150. Boda, Dezső, Giri, Janhavi, Henderson, Douglas Eisenberg, Robert and Gillespie, Dirk. (2011) Analyzing the components of the free energy landscape in a calcium selective ion channel by Widom's particle insertion method. *Journal of Chemical Physics*. **134**, 055102 [[PDF](#)]
151. Krauss, Daniel, Eisenberg, Bob and Gillespie, Dirk. (2011) Selectivity sequences in a model calcium channel: Role of electrostatic field strength. *European Journal of Biophysics*, **40**(6): p. 775-782. [[PDF](#)]

152. Boda, Dezsó , Henderson, Douglas, Eisenberg, Bob and Dirk Gillespie. (2011) A method for treating the passage of a charged hard sphere ion as it passes through a sharp dielectric boundary. *Journal of Chemical Physics*, 135(6): 64105. [[PDF](#)]
153. Mori, Yoichiro, Liu, Chun, and RS Eisenberg (2011) A model of electrodiffusion and osmotic water flow and its energetic structure. *Physica D (in the press)*. [[PDF](#)] See early version [Everything Else, 34. Mori]
154. Hyon, YunKyong, Fonseca, James E., Eisenberg, Bob, and Chun Liu. (2011) Energy variational approach to study charge inversion (layering) near charged walls. *Discrete and Continuous Dynamical Systems - Series B (DCDS-B) (in the press)*. [[PDF](#)]

**Reviews, mostly invited:**

1. † Eisenberg, R.S. The equivalent circuit of frog skeletal muscle. (1971) In: *Contractility of Muscle Cells* (Ed. R. Podolsky) Prentice Hall, p. 73-88. [[PDF](#)]
2. † Eisenberg, R.S. and Mathias, R.T. (1980) Structural analysis of electrical properties. *Critical Reviews in Bioengineering* 4: 203-232. [[PDF](#)]
3. Eisenberg, R.S. Structural Complexity, Circuit Models, and Ion Accumulation. (1980) *Fed. Proc.* 39: 1540-1543. [[PDF](#)]
4. Mathias, R.T., R.A. Levis, and R.S. Eisenberg. (1981) An alternative interpretation of charge movement in muscle. In: **The Regulation of Muscle Contraction: Excitation-Contraction Coupling**. Ed. A. D. Grinnell & M.A.B. Brazier, Academic Press, New York, pp 39-52. [[PDF](#)]
5. Eisenberg, R.S. (1983) Impedance Measurement of the Electrical Structure of Skeletal Muscle. In: **Handbook of Physiology, Section 10: Skeletal Muscle**, Ed. L.D. Peachey American Physiological Society, pp 301-323. [[PDF](#)]
6. † Eisenberg, R.S. (1984) Membranes and Channels. *Physiology and Molecular Biology*, pp. 235-283. In: **Membranes, Channels, and Noise**, Eds. R.S. Eisenberg, M. Frank, and C.F. Stevens, Plenum Press, NY. [[PDF](#)]
7. Eisenberg, R.S. (1986) Electrical field problems in muscle and their meaning to mathematicians, physiologists, and muscle. *in: Some Mathematical Questions in Biology - Muscle Physiology. Lectures on Mathematics in the Life Sciences, Vol. 16*. Ed., Robert M. Miura, American Mathematical Society, Providence, Rhode Island, 16: 223-234. [[PDF](#)]
8. † Eisenberg, R.S. (1987) Impedance measurements as estimators of the properties of the extracellular space. *Ann. NY Acad. Sci.* 481: 116-122. [[PDF](#)]
9. † Rae, J.L., Levis, R.A., and Eisenberg, R.S. (1988) Ionic channels in ocular epithelia. Ch. 8, p. 283-327 *in Ion Channels* (ed. T. Narahashi), Plenum Press. [[PDF](#)]
10. † Eisenberg, R.S. Channels as Enzymes. *J. Memb. Biol.*, 115, 1-12 (1990). [[PDF](#)] Published August 1, 2008, posted on arXiv.org with Paper ID as [arXiv:0808.0130](#) [[PDF](#)]

11. † Tang, J.M., Wang, J., and Eisenberg, R.S. (1992) Studies on intact sarcoplasmic reticulum: patch clamp recording and tension measurement in lobster split muscle fibers. *in* **Ion Channels** (ed.'s B. Rudy and L.E. Iverson), a volume of **Methods in Enzymology**. [\[PDF\]](#)
12. † Tang, J.M., Wang, J., and Eisenberg, R.S. (1992) Perfusing patch pipettes, easily and quietly. *in* **Ion Channels** (ed.'s B. Rudy and L.E. Iverson), 207: 176-180 **Methods in Enzymology**. [\[PDF\]](#)
13. † Tang, J.M., F.N. Quandt, and R.S. Eisenberg. Perfusion of Patch Pipettes. (1995) *in* **Patch Clamp Techniques and Protocols**. (p.123-140) ed.'s: A.A. Boulton, hG.B. Baker, and W. Walz. Humana Press. [\[PDF\]](#)
14. † Eisenberg, R.S. (1996a) Atomic Biology, Electrostatics and Ionic Channels. Ch. 5, p. 269-357, in: *New Developments and Theoretical Studies of Proteins*. Edited by Ron Elber in the *Advanced Series in Physical Chemistry*, Vol. 7. World Scientific, Philadelphia. [\[PDF\]](#) Published July 5, 2008 in arXiv.org with Paper ID [arXiv:0807.0715](#). [\[PDF\]](#)
15. Eisenberg, R.S. (1996b). Computing the field in proteins and channels. *J. Membrane Biol.* 150:1-25. [\[PDF\]](#) Posted on arXiv.org with Paper ID [arXiv:1009.2857](#), September 15, 2010.
16. Eisenberg, Bob (1998). Ionic channels in biological membranes. *Natural nanotubes. Accounts of Chemical Research* 31:117-125. [\[PDF\]](#)
17. Eisenberg, Bob (1998). Ionic Channels in Biological Membranes: Natural Nanotubes described by the Drift-Diffusion Equations. (Invited by and accepted by VLSI Design) *Proceedings of the Fifth International Workshop on Computational Electronics*. 8:75-78. [\[PDF\]](#)
18. Eisenberg, Bob (1998). Ionic channels in biological membranes. *Electrostatic analysis of a natural nanotube. Contemporary Physics*, 39 (6) 447-466. [\[PDF\]](#)
19. Nonner, Wolfgang, Chen, Duan, and Bob Eisenberg. (1999). Progress and prospects in permeation. *Journal of General Physiology* 113: 773-782. [\[PDF\]](#)
20. Eisenberg, R.S. (1999). From Structure to Function in Open Ionic Channels. *Journal of Membrane Biology* 171 1-24. [\[PDF\]](#) Posted on arXiv.org with Paper ID [arXiv 1011.2939](#)
21. Nonner, Wolfgang, and Bob Eisenberg. (2000) *Electrodiffusion in Ionic Channels of Biological Membranes. Journal of Molecular Liquids* 87:149-162. [\[PDF\]](#)
22. Eisenberg, Bob. (2000). Permeation as a Diffusion Process. Chapter 4 in **Biophysics Textbook On Line “Channels, Receptors, and Transporters”** Louis J. DeFelice, Volume Editor. Location Updated on November 18, 2005 [\[PDF\]](#) Published July 5, 2008 in arXiv.org with Paper ID [arXiv:0807.0721](#). [\[PDF\]](#) Original Biophysical Society publication is found at [Original](#) and [Original 2](#).
23. Eisenberg, R. (2000) Ionic channels: natural nanotubes described by the drift diffusion equations. *Superlattices and Microstructures*. 27 (5/6) 545-549. [\[PDF\]](#)

24. Eisenberg, Bob (2003) Proteins, Channels, and Crowded Ions *Biophysical Chemistry* 100: 507 - 517. [Edsall Memorial Volume] [[PDF](#)]
- 24a. Eisenberg, Bob (2003) Erratum to "Proteins, channels and crowded ions", *Biophysical Chemistry* 106 p.93. [*N.B., note misprint in title of Erratum in initial, i.e., left quotation marks!*] [[PDF](#)]
25. Schuss, Zeev, Nadler, Boaz, Singer, Amit, and Eisenberg, Robert S. Eisenberg. (2002) A PDE formulation of non-equilibrium statistical mechanics for ionic permeation, AIP Conference Proceedings 665, Washington, DC, 3-6 September 2002: *Unsolved Problems Of Noise And Fluctuations*, UPoN 2002, 3rd International Conference on Unsolved Problems of Noise and Fluctuations in Physics, Biology, and High Technology (S.M. Bezrukov, ed.), p.312, Washington, DC. [[PDF](#)]
26. Eisenberg, Bob. (2002) Ionic channels as natural nanodevices. *J. Computational Electronics* 1 331-334. [[PDF](#)]
27. Eisenberg, Bob (2003) Ion channels as devices. *J. Computational Electronics* 2 245-249. [[PDF](#)]
28. Eisenberg, Bob (2005) Living Transistors: a Physicist's View of Ion Channels. Posted on arXiv.org with Paper ID [arXiv:q-bio/0506016v2](#), June 14, 2005. version 2 Aug 25, 2005, posted Feb 3 2008. [[PDF](#)]
29. Saraniti, Marco, Aboud, Shela, and Robert Eisenberg (2006). The Simulation of Ionic Charge Transport in Biological Ion Channels: an Introduction to Numerical Methods. *Reviews in Computational Chemistry Vol 22*, pp 229-294. [[PDF](#)]
30. Eisenberg, Bob. (2008) Ion channels allow atomic control of macroscopic transport. *Physica Status Solidi (c)* 5, 708–713 (2008) /DOI 10.1002/pssc.200777556. [[PDF](#)]
31. Eisenberg, Bob. (2010). Crowded Charges in Ion Channels. *Advances in Chemical Physics* (Stuart Rice, Editor), *in the press*. Posted on arXiv.org with Paper ID [arXiv:1009.1786v1](#) September 9, 2010. [[PDF](#)]
32. Eisenberg, Bob (2011). Life's Solutions are Not Ideal. Posted on arXiv.org with Paper ID [arXiv:1105.0184v1](#), May 3, 2011. [[PDF](#)]
33. Eisenberg, Bob (2011) Mass Action in Ionic Solutions. *Frontiers Article*, and cover of *Chemical Physics Letters*, 511 p. 1-6; DOI: [10.1016/j.cplett.2011.05.037](#). *Note misprint in address. should be Rush University.* [[PDF](#)]

### ***Everything Else:***

1. Eisenberg, R.S. (1975) *Electrophysiology. A review of Electric Current Flow in Excitable Cells*. J.B. Jack, D. Noble and R.W. Tsien. Clarendon (Oxford University Press), New York, 1975, xvi, 502pp. *Science*, 190, p. 1087.
2. Eisenberg, R.S. (1973) *Studies of Biomembranes*. Book review of **Perspective in Membranes. A Tribute to Kenneth S. Cole**, D.P. Agin (Ed.) Gordon & Breach, New York 319 pp. 1972, *Science* 181: 539. [[PDF](#)]

3. Eisenberg, R.S. (1982) Book review of **The Biophysical Approach to Excitable Systems**. Eds. W.J. Adelman, Jr. and D.E. Goldman, Plenum, New York, Science, 46: 1102-1103.
4. Eisenberg, R.S. (1987) Gating Current. **Encyclopedia of Neuroscience**, Birkhauser, Boston, MA, p. 449-450.
5. Eisenberg, R.S. (1987) Ionic Channels in Membranes. **Encyclopedia of Neurosciences**. Birkhauser, Boston, MA p. 627-628.
6. Eisenberg, R.S. (1987) Structural Complexity in Nerve Cells. **Encyclopedia of Neuroscience**, Birkhauser, Boston, MA, p. 741-742.
7. Eisenberg, R.S. (1987) Volumes apart. Nature. Scientific Correspondence on a paper of Zimmerberg and Parsegian. 325: 114. [[PDF](#)]
8. Eisenberg, R.S. (1990) Complexities in solution. Trends in Biochemical Sciences, 15:51, A Letter concerning a paper of Payne and Rudnick. [[PDF](#)]
9. Eisenberg, RS. (1992) A unified theory of membrane transport. *in* **Harvard Class of 1962. Thirtieth Anniversary Report**. Harvard University: Office of the University Publisher, Cambridge, MA. [[PDF](#)]
10. Eisenberg, R.S. (1993) Popper, Wolpert, and Critics. Nature 361 292. [[PDF](#)]
11. Bertl, A., Blumwald, E., Coronado, R., Eisenberg, R., Findlay, G., Gradmann, D., Hille, B., Köhler, K., Kolb, H., MacRobbie, E., Meissner, G., Miller, C. Neher, E., Palade, P. Pantoja, O., Sanders, D., Schroeder, J., Slayman, C., Spanswick, R., Walker, A., and Williams, A. (1992) Electrical measurements on endomembranes. Science 258: 873-874. [[PDF](#)]
12. Chen, D.; Xu, L.; Tripathy, A.; Meissner, G.; Eisenberg, B. (1997) Rate Constants in Channology. *Appendix to* Permeation through the Calcium Release Channel of Cardiac Muscle. Biophys. J. 73 1337-1354. [original paper is also cited in this CV] [[PDF](#)]
13. Eisenberg, Bob (2000) Vignette Applications of Physical Chemistry, a Biological Example. in Berry, Rice, and Ross **Physical Chemistry** (2<sup>nd</sup> Edition, Oxford University Press, p. 1011-1017). [[PDF](#)]
14. Eisenberg, Bob (2003) Why can't protons move through ion channels? Biophysical Journal 85 3427-3428. [[PDF](#)]
15. Tindjong, R., Applegate, A., Eisenberg, R.S. Kaufman, I., Luchinski, D.G., and PVE McClintock. (2004) Ionic current through an open channel: a low-dimensional model of coupling with vibrations of the wall.† In D Abbott, SM Bezrukov, A Der, and A Sanchez, Eds. Fluctuations and Noise in biological, Biophysical, and Biomedical systems II Proc of SPIE 5467, 2004 338-344. (Proceedings of Conference in Maspalomas, May 2004). [[PDF](#)]
16. **Patent Application**, PCT/NL2003/000013 Liquid Based Electronic Device (from BioMade, Groningen, Netherlands.) Patent Application was subsequently withdrawn, but it is an interesting idea, nonetheless, in my biased view, PCT/NL2003/000013 Liquid Based Electronic Device (from BioMade, Groningen, Netherlands.) [[PDF](#)]



17. Tindjong, R, Eisenberg, R.S. Kaufman, I., Luchinski, D.G., and PVE McClintock. (2005). Brownian dynamics simulation of ionic current through an open channel.<sup>†</sup> In T Gonzalez, J. Mateo, and D. Pardo, Eds Proc of AIP Conference 780 p. 563-566. (Proceedings of the 18<sup>th</sup> International Conference on Noise and Fluctuations Salamanca, Spain Sept, 2005). [[PDF](#)]
18. Eisenberg, Bob (2005). Validating the need to validate code. Physics Today (Letter to the Editor) 58 (8) p. 13. [[PDF](#)]
19. Eisenberg, Bob (2006). The value of Einstein's mistakes. "Einstein should be allowed his mistakes ..." Physics Today (Letter to the Editor) 59 (4) p.12. [[PDF](#)]
20. Eisenberg, Bob (2007). New and Notable: Mechanical Spikes from Nerve Terminals. Biophysical Journal 92 p. 2983. [[PDF](#)]
21. Eisenberg, R.S. (2007) Look at biological systems through an engineer's eyes. Nature Vol 447, p. 376. [[PDF](#)]
22. **Patent Application**, Mathematical Design of Ion Channel Selectivity via Inverse Problems Technology (with Heinz Engl and Martin Burger, from Rush University Medical Center.) [[PDF](#)]
23. Eisenberg, Bob. (2008) Understanding Life with Molecular Dynamics and Thermodynamics: Comment on Nature 451, 240-243 (2008). Posted on arXiv.org with Paper ID [arXiv:0802.2244v2](http://arxiv.org/abs/0802.2244v2) [[PDF](#)]
24. Eisenberg, B. (2008) Engineering channels: Atomic biology Proc. Natl. Acad. Sci. U. S. A. 2008 105: p. 6211-6212. [[PDF](#)]
25. Eisenberg, B. (2008) Letter to the Editor. New York Times, May 15, p. A30. [[PDF](#)]
26. Luchinsky, D.G., Tindjong, R., Kaufman, I. McClintock, P.V.E., R.S. Eisenberg. (2008) Charge fluctuations and their effect on conduction in biological ion channels.<sup>†</sup> Posted on arXiv.org with Paper ID [arXiv.org:0807.0838v1](http://arxiv.org/abs/0807.0838v1) [[PDF](#)]
27. Eisenberg, B. (2008) Ionic Selectivity in Channels: complex biology created by the balance of simple physics. Nanotechnology 501 Lecture Series: Purdue University.: Nanohub Purdue University. <http://www.nanohub.org/resources/4726/> [[PDF](#)]
28. Eisenberg, B. (2009). Self organized model of selectivity. Available online from Institute for Mathematics and its Applications (IMA) University of Minnesota at [Self-Organized IMA link](#) and posted on arXiv.org with Paper ID <http://arxiv.org/abs/0906.5173> [[PDF](#)]
29. Eisenberg, B. (2010). Ion Channels and Selectivity. Kavli Institute of Theoretical Physics. University of California Santa Barbara. Seminar Slides on-line at <http://online.kitp.ucsb.edu/online/evocell10/eisenberg>
30. Bardhan, Jaydeep P., Leaf, Gary K. and Bob Eisenberg. (2010) Reproducible Estimation of Osmotic Coefficients Using the Inverse Monte Carlo Method. Argonne National Laboratory Mathematics and Computer Science Preprint ANL-MCS P1764-0610 [[PDF](#)]

31. Eisenberg, Bob. (2010) CSO Deserves Immense Credit. Letter to the Editor, Chicago Tribune, June 4. [[PDF](#)]
32. Eisenberg, Bob, Hyon, YunKyong, and Chun Liu. (2010) Energy variational analysis EnVarA of ions in water and channels: Field theory for primitive models of complex ionic fluids, Preprint# 2317 of the reprint series of the Institute for Mathematics and its Applications (IMA, University of Minnesota, Minneapolis) <http://www.ima.umn.edu/preprints/jun2010/jun2010.html> [[PDF](#)] *Nearly identical to paper 146.*
33. Hyon, YunKyong, Eisenberg, Bob, and Chun Liu. (2010) A mathematical model for the hard sphere repulsion in ionic solutions Preprint# 2318 of the reprint series of the Institute for Mathematics and its Applications (IMA, University of Minnesota, Minneapolis) <http://www.ima.umn.edu/preprints/jun2010/jun2010.html> [[PDF](#)]
34. Mori, Yoichiro, Liu, Chun, and RS Eisenberg (2010) A Model of Electrodifusion and Osmotic Water Flow and its Energetic Structure. Posted on arXiv.org with Paper ID <http://arxiv.org/abs/1101.5193v1> [[PDF](#)], See final version: Papers, No. 153. Mori

**Books:**

1. Eisenberg, R.S., M. Frank, and C.F. Stevens (eds.) (1984) **Membranes, Channels, and Noise.** Plenum Press, NY, pp. 1-54.

**Abstracts:**

1. Eisenberg, R.S. and Gage, P.W. (1968) Electrical properties of frog skeletal muscle fibers with disrupted transverse tubules. *Biophys. J.* 8: A-188.
2. Eisenberg, R.S. and Eisenberg, B. (1968) The extent of disruption of the transverse tubular system in glycerol treated skeletal muscle. *Federation Proceedings* 27: 247.
3. Eisenberg, R.S. and Gage, P.W. (1968) The surface and tubular membranes of frog sartorius muscle fibers. *J. Cell Biol.* 39: 39a .
4. Eisenberg, R.S. and Gage, P.W. (1969) The conductance of the surface and tubular membranes of frog sartorius muscle. *Biophys. J.* 9: A99.
5. Eisenberg, R.S. and Johnson, E.A. (1969) The interpretation of potentials recorded with double-barrel microelectrodes or with a single electrode bridge. *Federation Proceedings* 28: 397.
6. Howell, J., Vaughan, P. and Eisenberg, R.S. (1970) Maintenance of resting potentials in glycerol treated muscle fibers. *Biophys. J.* 10: 75a.
7. Howell, J., Vaughan, P. and Eisenberg, R.S. (1970) Changes in the capacitance of frog skeletal muscle. *Federation Proceedings* 29: 656.
8. Eisenberg, R.S. (1972) The electrical properties of the internal membrane structures of skeletal muscle. *J. Physiol. Soc. Japan.* 34:90.
9. Valdiosera, R., Clausen, C. and Eisenberg, R.S. Impedance of frog skeletal muscle fibers. (1973) *Biophys. Soc. Abst.* 195a.

10. Mobley, B.A., Leung, J. and Eisenberg, R.S. (1974) Longitudinal Impedance of skinned frog muscle fibers. *Federation Proceedings* 33: 401.
11. Peskoff, A. and Eisenberg, R.S. (1974) Influence of extracellular resistance on membrane potential of cells. *Federation Proceeding* 33: 1266.
12. Mathias, R.T., Clausen, C. and Eisenberg, R.S. (1975) Mesh model of the electrical properties of the tubular system of skeletal muscle. *The Physiologist*, 18: August.
13. Clausen, C., Lewis, S.A., Diamond, J.M. and Eisenberg, R.S. (1976) Electrical circuit analysis of tight epithelia by alternating current techniques. *Biophys. J.* 16: 131a.
14. Eisenberg, R.S., Barcilon, V. and Mathias, R.T. (1978) Electrical properties of a spherical syncytium. *Biophys. J.* 21: 48a.
15. Mathias, R.T., Rae, J. and Eisenberg, R.S. (1978) Linear electrical properties of the lens of the eye. *Biophys. J.* 21: 48a.
16. Eisenberg, B.R. and Eisenberg, R.S. (1980) *T-SR* Junction in activated muscle. *J. Cell. Biol.* 87: 264a.
17. Eisenberg, R.S. Structural analysis of electrical properties. (1981) *Biophys. J.* 33: 267a.
18. Eisenberg, R.S., Mathias, R.T., and J.L. Rae. (1982) Series resistance measured by integrals of transients. *Biophys. J.* 37: 63a.
19. Milton, R.L., Mathias, R.T. and R.S. Eisenberg. (1982) Impedance measurements at the pelvic end of frog sartorius muscle fibers. *Biophys. J.* 37: 356a.
20. Hui, C.S., Milton, R.L., and Eisenberg, R.S. (1983) Elimination of charge movement in skeletal muscle by a calcium antagonist. *Biophys. J.* 41: 178a.
21. McCarthy, R.T., Milton, R.L., and Eisenberg, R.S. (1983) Paralysis of skeletal muscle fibers by a calcium antagonist. *Biophys. J.* 41: 178a.
22. Levis, R.A., Mathias, R.T. and Eisenberg, R.S. (1983) Electrical properties of sheep Purkinje strands: Impedance measurements and voltage clamp simulations including electrodiffusion. *Biophys. J.* 41: 308a.
23. Curtis, B.A. and Eisenberg, R.S. A delayed calcium influx related to contraction in frog twitch fibers. (1984) *J. Gen. Physiol.* 84: 36a.
24. Cooper, K.E., McCarthy, R.T., Milton, R.L. and Eisenberg, R.S. (1984) Calcium antagonists modify contraction of skeletal muscle fibers. *Biophys. J.* 45: 232a.
25. Eisenberg, R.S., Curtis, B.A. and McCarthy, R.T. (1984) Calcium uptake and  $K^+$  contractures in paralyzed and contracting muscle fibers. *Biophys. J.* 45: 234a.
26. Eisenberg, R.S. Structural analysis of neuronal integration. (1984) *Biophys. J.* 45: 153a.
27. Curtis, B.A. and Eisenberg, R.S. (1984) A delayed influx related to contraction in frog twitch fibers. *J. Gen. Physiol.* 84: 36a.
28. Curtis, B.A. and Eisenberg, R.S. (1985) Calcium entry and the repriming period of frog twitch fibers. *Biophys. J.* 47: 132a.
29. Eisenberg, R.S. Calcium Signals in Muscle. (1985) *Biophys. J.* 47: 194a.



30. Curtis, B.A. and Eisenberg, R.S. (1985) Calcium ions: The link between t depolarization and SR Ca release. *Biophys. J.* 47: 195a.
31. Cooper, K.E., J.M. Tang, J.L. Rae and R.S. Eisenberg. (1985) Cation selective channel in the epithelium of frog lens. *Biophys. J.* 86: 9a.
32. Cooper, K.E., J.M. Tang, J.L. Rae and R.S. Eisenberg. (1985) Cation-selective channel in the epithelium of frog lens. *J. Gen. Physiol.* 86: 9a-10a.
33. Cooper, K.E., J.M. Tang, J.L. Rae and R.S. Eisenberg. (1986) A cation-selective channel from frog lens epithelium. *Biophys. J.* 49: 6a.
34. Cooper, K.E., Gates, P.Y., and R.S. Eisenberg. (1987) Rate constants for ionic diffusion over barriers. *Biophys. J.* 51: 48a.
35. Gates, P.Y., Cooper, K.E., and R.S. Eisenberg. (1987) Diffusive flux through ionic channels. *Biophys. J.* 51: 48a.
36. Tang, J. M., Wang, J., and R.S. Eisenberg. (1987) Patch clamp of sarcoplasmic reticulum within muscle fibers. *Biophys. J.* 51: 106a.
37. Eisenberg, R.S., Hainsworth, A.H., and R.A. Levis. (1987). Open-channel noise in a cation channel of the frog lens epithelium. *J. Physiol. (London)* 396: 84P.
38. Hainsworth, A., Tang, J.M., Wang, J., Levis, R.A., and R.S. Eisenberg. (1988) Open channel noise in the K<sup>+</sup> channel of the sarcoplasmic reticulum. *Biophys. J.* 53: 151a.
39. Cooper, K.E., Gates, P.Y., and R.S. Eisenberg. (1988) Diffusion theory and discrete rate constants in ion permeation. *Biophys. J.* 152a.
40. Moghaddamjoo, A., Levis, R.A., and R.S. Eisenberg. (1988). Automatic detection of channel currents. *Biophys. J.* 153a.
41. R.S. Eisenberg. Channels as Enzymes (*title only*). (1988) *Medical Physics* 15: No. 4, p. 440.
42. J. Wang, J.M. Tang, and R.S. Eisenberg. (1989) Ca<sup>++</sup> channels in the sarcoplasmic reticulum (SR) of skinned lobster muscle fibers: patch clamp measurements. *J. Cell Biology* 107:144a.
43. R.S. Eisenberg, A.H. Hainsworth, and R.A. Levis. Open-channel noise in the potassium channel of lobster sarcoplasmic reticulum. (1988) *J. Physiol. (Cambridge Meeting, July)*: 107P).
44. J. Wang, J.M. Tang, and R.S. Eisenberg. Ca<sup>++</sup> channels from sarcoplasmic reticulum of split lobster muscle fibers. (1989) *Biophysical J.* 55: 207a.
45. A. Hainsworth, R.A. Levis, and R.S. Eisenberg. (1989) Excess open-channel noise in the SR K<sup>+</sup> channel. *Biophysical J.* 55: 200a.
46. R.S. Eisenberg, A.H. Hainsworth, R.A. Levis. (1989) The effect of temperature on open-channel noise in the potassium channel of the lobster sarcoplasmic reticulum. *J. Physiol.* 410: 18P.
47. J.M. Tang, J. Wang, F.N. Quandt, and Eisenberg, R.S. (1990) Perfusing patch pipettes quietly and easily. *Biophys. J.* 57: 171a.

48. J.M. Tang, J. Wang, T. Lea and Eisenberg, R.S. (1990) Contractures and reloading in skinned lobster muscle fibers. *Biophys. J.* 57: 171a.
49. R.S. Eisenberg, J.M. Tang, and J. Wang. (1991) Ionic channels of the sarcoplasmic reticulum of lobster remotor muscle. *Biophys. J.* 59: 177a.
50. D.P. Chen and R.S. Eisenberg. (1991) Constant fields and constant gradients in open ionic channels. *Biophys. J.* 59: 404a.
51. R.S. Eisenberg, D.P. Chen, and V. Barcilon. (1991) Constant fields and constant gradients in open ionic channels. *Physiologist.* 34: 102.
52. Wang, J., Tang, J.M., and RS Eisenberg. (1992) Calcium conducting channel in SR: calcium pump without occlusion? *Biophys. J.* 61. A433.
53. Chen, DP, Barcilon, V. and RS Eisenberg. (1992) Induced and permanent charge in open ionic channels. *Biophys. J.* 61. A11.
54. Chen, DP, and R Eisenberg. (1992) Exchange diffusion, single filing, and gating in macroscopic channels of one conformation. *J. Gen. Physiol.* 100: 9a.
55. Eisenberg, Robert From Structure to Permeation in Open Ionic Channels. (1993) *Biophys. J.* 64:A22.
56. Eisenberg, Robert and Duanpin Chen. (1993) Poisson-Nernst-Planck (*PNP*) theory of an open ionic channel. *Biophys. J.* 64:A22. [\[PDF\]](#)
57. Chen, Duanpin and Robert Eisenberg. (1993) Poisson-Nernst-Planck (*PNP*) theory of open ionic channels. *Biophys. J.* 64:A22. [\[PDF\]](#)
58. Chen, Duan P. and Robert S. Eisenberg. (1994) Divalent effects on mono-valent cation channels, an extension of Poisson-Nernst-Planck theory. *Biophys. J.* 66(2) A292.
59. Elber, Ron, Duan Chen, Danuta Rojewska, and Bob Eisenberg. (1994) Na<sup>+</sup> in Gramicidin: the prototype permion. *Biophys. J.* 66(2) A354.
60. Eisenberg, Bob, Malgorzata Klosek, and Zeev Schuss. (1994) Stochastic theory of the open channel. *Biophys. J.* 66(2) A354.
61. Chen, Duan, Paul Kienker, Jim Lear and Bob Eisenberg. (1995) PNP Theory fits current-voltage (*IV*) relations of a synthetic channel in 7 solutions. *Biophys. J.* 68:A370.
62. Chen, Duan, Wolfgang Nonner, and Bob Eisenberg. PNP (1995) Theory fits current-voltage (*IV*) relations of a neuronal anion channel in 13 solutions. *Biophys. J.* 68:A370
63. Chen, D., Eisenberg, R., Jerome, J., and Shu, C. (1995) PH (Poisson-Hydrodynamic) Theory of an open channel. *Biophys. J.*, 68:A371.
64. Tang, John, Rick Levis, Kelvin Lynn, and Bob Eisenberg. (1995) Opening and closing transitions of a large mitochondrial channel with microsecond time resolution. *Biophys. J.*, 68:A145, 1995.
65. Janovic, Slobidan, Kelvin Lynn, Xaioye Wu, Bob Eisenberg, and Rick Levis. (1995) Real-time analysis of single channel currents. *Biophys. J.*, 68:A42.

66. Eisenberg, Robert S., Chen, P. Solutions to Fields in Biological Channels. (1996) American Chemical Society, Division of Physical Chemistry, 212<sup>th</sup> Meeting. *Printed but perhaps not published Abstract.*
67. Chen, D., Xu, L., Tripathy, A., Meissner, G., and R. Eisenberg (1997) Permeation through the calcium release channel (CRC) of cardiac muscle. *Biophys. J.*, 72:A108.
68. Tang, J., Chen, D., Saint, N., Rosenbusch, J., and R. Eisenberg (1997). Permeation through porin and its mutant G119D. *Biophys. J.*, 72:A108, 1997.
69. Tang, J., Saint, N., Rosenbusch, J., and R. Eisenberg (1997). Currents through single channels of maltoporin. *Biophys. J.*, 72:A108, 1997.
70. Gardner, Carl, Eisenberg, B., and Joe Jerome. (1998) Numerical simulation of rectangular channel currents. *Biophys. J.*, 74 A342.
71. Schuss, Zeev and Eisenberg, B. (1998) Stochastic and continuum models of unidirectional fluxes in open ionic channels. *Biophys. J.*, 74 A342.
72. Elber, R. and Eisenberg, B. (1998) Molecular dynamics simulations of solvated ions between a membrane and metal electrodes at various electric potentials. *Biophys. J.*, 74 A342.
73. Chen, D., Tripathy, A., Xu, L., Meissner, G. and Bob Eisenberg. (1998) Permeation in the calcium release channel (CRC) of skeletal muscle. *Biophys. J.*, 74 A342.
74. Chen, D., Tripathy, A., Xu, L., Meissner, G. and Bob Eisenberg. (1998) Selectivity of calcium release channel (CRC) of cardiac muscle. *Biophys. J.*, 74 A342.
75. Nonner, W., Chen, D. and Bob Eisenberg. (1998) Anomalous mole fraction effects: an electrostatic interpretation. *Biophys. J.*, 74 A342.
76. Nonner, W. and Bob Eisenberg. (1998) Calcium channel permeability and glutamate residues linked by PNP Theory. *Biophys. J.*, 74 A342.
77. Catacuzzeno, L., W. Nonner, and B. Eisenberg. (1999) PNP2 Links Crystallographic Structure and Conduction in K Channels. *Biophysical Journal*. 76:A79.
78. Gillespie, D, and Bob Eisenberg. (1999) An analytic formula for the reversal potential derived from *PNP* theory. . *Biophysical Journal*. 76:A192.
79. Hollerbach, U., Chen, D., Nonner, W., and Bob Eisenberg. (1999) Three-dimensional Poisson-Nernst-Planck Theory of Open Channels. *Biophysical J. Biophysical J.* 76:A205.
80. Catacuzzeno, L., W. Nonner, L. Blum, and B. Eisenberg. Ca Selectivity in the 'EEEE' Locus of L-type Ca Channels. (1999) *Biophysical Journal*. 76:A259.
81. Nonner, W, L. Catacuzzeno, and B. Eisenberg. (2000) Ionic selectivity in K channels. *Biophysical Journal*. 78:A96.
82. Nonner, W, L. Catacuzzeno, and B. Eisenberg. (2000) Ionic selectivity in calcium channels. *Biophysical Journal*. 78:A455.
83. Chen, Duan, Le Xu, Bob Eisenberg, and Gerhard Meissner. (2000) Calcium and potassium ion selectivity of skeletal muscle ryanodine receptor. *Biophysical Journal*. 78:A462.

84. van der Straaten, T.A., RS Eisenberg, JM Tang, U Ravaioli, and N Aluru. (2001) Three dimensional Poisson Nernst Planck Simulation of ompF porin. *Biophysical Journal*. 80: 115a.
85. Chen, Duan, L Xu, B Eisenberg, and G Meissner. (2001) Ca ion permeation through the calcium release channel (ryanodine receptor) of cardiac muscle *Biophysical Journal*. 50: 115a.
84. Nonner, W., B Eisenberg, and D Henderson (2001) Ca channel selectivity: the role of solvent *Biophysical Journal*. 80:453a.
85. Nonner, W., Gillespie, D., and B Eisenberg. (2002) Flux and selectivity in the Ca channel: a density functional approach. *Biophysical Journal*. 82: 340a.
86. Gillespie, D. and RS Eisenberg. (2002) Measurements of selectivity: physical interpretation. *Biophysical Journal*. 82:206a.
87. Van der Straaten, T.A., Tang, J.M., Eisenberg, RS, Ravaioli, U., Aluru, N., Varma, S., and E. Jakobsson. (2002) A study of mutations of ompf porin using Poisson-Nernst-Planck theory. *Biophys. J.* 82: 207a.
88. Chiu, See-Wing, Varma, S., Jakobsson, E., Tang, J.M., van der Straaten, T., Eisenberg, and R.S. (2002) Molecular dynamics of permeation in porin and its mutant G119D. *Biophysical Journal*. 82:208a.
89. Gillespie, D., Nonner, W., and Bob Eisenberg. (2002) Physical model of selectivity and flux in Na channels. *Biophysical Journal* 84 (Number 2) p. 67a.
90. Nonner, Wolfgang, Gillespie, Dirk, Eisenberg, Bob, and Douglas Henderson. (2002) A physical basis for large-ion selectivity. *Biophysical Journal* 84 (Number 2) 93a.
91. Chen, Duan, Kuang, Zhifeng, Boda, Deszo, Eisenberg, Bob, Busath, David and Douglas Henderson. (2003) Ion channel permeation simulated by non-equilibrium molecular dynamics calibrated by equilibrium Monte Carlo. *Biophysical Journal* 84 (Number 2) 94a.
92. Boda, Deszo, Gillespie, Dirk, Nonner, Wolfgang, Henderson, Douglas, Busath, David, and Bob Eisenberg. (2004) Effects of dielectrics on selectivity: computing induced charge in Monte Carlo simulations. *Biophysical Journal* 86 6a.
93. Miedema, Henk, Meter-Arkema, Anita, Wierenga, Jenny, Hektor, Hans, Tang, John, Eisenberg, Bob, and Wim Meijberg. (2004) Permeation properties of an engineered OmpF containing the EEEE locus of Ca-channels. *Biophysical Journal* 86 260a.
94. Nonner, Wolfgang, Gillespie, Dirk, and Bob Eisenberg. (2004) Moving gating charges: comparing electrostatic energetics of the S4 motion of different models. *Biophysical Journal* 86 436a.
95. Aguilera-Arzo, Marcel, Garcia-Celma, Juan, Aguilera, Vicente, and Robert Eisenberg. (2004) Computing numerically access resistance of a channel. *Biophysical Journal* 86 629a.
96. Peyser, Alexander, Nonner, Wolfgang R., Gillespie, Dirk, and Eisenberg Bob. (2005) Electrostrictive Forces in S4 Models. *Biophysical Journal* 88 458a.

97. Henderson, D., Boda, D., Valisko, M., Gillespie, D, Eisenberg, B., and Nonner, W. (2005) New constant voltage method of simulating ions in a dielectric near a metallic electrode PacifiChem 2005, Honolulu HI.
98. Eisenberg, R. S. (2005) Ions in channels: Life's transistors PacifiChem 2005, Honolulu HI.
99. Wilk, S.J., Petrossian, L., Goryll, M., Thornton, T.J., Goodnick, S.M., Tang, J.M., and Eisenberg, R.S. (2005) Integrated Platform for Ion Channel Sensing. IEEE SENSORS 2005: the 4th IEEE conference on sensors.
100. Siwy, Z, Powell, M., Kalman, E., Heins, E., Martin, C.R., and Eisenberg, R.S.. (2006). Pores in plastic can be calcium sensitive and gate. Biophysical Journal 90 314a.
101. Boda, Dezso, Valisko, Monika, Gillespie, Dirk, Nonner, Wolfgang, Henderson, Douglas and Eisenberg, Bob. (2006) Dielectrics Enhance the Selectivity of Calcium Channels. Biophysical Journal 90 404a.
102. Nonner, Wolfgang, Gillespie, Dirk, and Eisenberg, Bob. (2006) How Do Long Pores Make Better K Channels? Biophysical Journal 90 239a.
103. Eisenberg, Bob. (2007) . How can a channel tell  $\text{Ca}^{2+}$  from  $\text{Na}^{+}$  ? Biophysical Journal 92 342a; Symposium 14: Modeling as a Tool in Biophysics.
104. Siwy, Zuzanna S., Powell, Matthew R., Kalman, Eric, and Eisenberg Robert S. (2007) Gating, Modulation, and Rectification in a Large Diameter Abiotic Nanopore. Biophysical Journal 92 342a Symposium 14: Modeling as a Tool in Biophysics.
105. Boda, Dezso, Valisko, Monika, Eisenberg, Bob, Nonner, Wolfgang, Henderson, Douglas, and Gillespie, Dirk. (2007) The effect of the protein dielectric coefficient and pore radius on the Na affinity of a model sodium channel. Biophysical Journal 92 p. 609a. Poster [[PDF](#)]
106. Powell, Matthew R., Sullivan, Michael, Siwy, Zuzanna S., and Eisenberg. Robert S. (2007) Stochastic Sensing of Analytes by a Synthetic Nanopore with Adaptor. Biophysical Journal 92 p. 649a.
107. Arning, Katrin, Burger, Martin, Engl, Heinz, Eisenberg, Robert, He, Lin, and Marie Wolfram. (2007) Simulation of ion transport through nanopores. International Conference on Simulation of Semiconductor Processes and Devices (SISPAD).
108. Powell, Matthew R., Sullivan, Michael, Vlassioux, Ivan, Constantin, Dragos, Sudre, Olivier, Martens, Craig, Eisenberg, Robert S., and Siwy, Zuzanna. (2008) Ion Current Oscillations Caused by Femtoliter Volume Precipitation in a Nanopore. Biophysical Journal 94 p. 333a. Poster [[PDF](#)]
109. Boda, Dezsó, Nonner, Wolfgang, Valisko, Monika, Henderson, Douglas, Eisenberg, Bob, and Gillespie, Dirk. (2008) Competition of Steric repulsion and Electrostatic Attraction in the Selectivity Filter of Model Calcium Channels. Biophysical Journal 94 p. 447a. Poster [[PDF](#)]
110. Eisenberg, Bob, Roth, Roland, Gillespie, Dirk, and Nonner, Wolfgang. (2008) Bubbles, Gating, and Anesthetics in Ion Channels. Biophysical Journal 94 p. 1040a. Abstract [[PDF](#)]

111. Eisenberg, Bob, Boda, Dezsó, Giri, Janhavi, Fonseca, James, Gillespie, Dirk, Henderson, Doug, and Nonner, Wolfgang. (2009) Self-organized Models of Selectivity in Ca and Na Channels. *Biophysical Journal*, Volume 96, Issue 3, 253a. Abstract [[PDF](#)] and Poster [[PDF](#)] Other versions available at Institute of Mathematics and its Applications IMA, University of Minnesota, [Self-Organized IMA link](#) and on the arXiv.org with Paper ID [arXiv:0906.5173](#) [[PDF](#)]
112. Knepley, Matthew G., Karpeev, Dmitry A., Eisenberg, Robert S., and Gillespie, Dirk. (2009) Energetics of Calcium Selectivity: A Three-Dimensional Classical Density Functional Theory Approach. *Biophysical Journal*, Volume 96, Issue 3, 661a. Abstract [[PDF](#)] and Poster [[PDF](#)]
113. Mori, Yoichiro, Liu, Chun, and RS Eisenberg (2010) A multidomain model for electrodiffusion and water flow Volume 98 pp. 96a Abstract [[PDF](#)] and Poster 511 [[PDF](#)]
114. Fonseca, James E. Boda, Dezsó, Nonner, Wolfgang, and Bob Eisenberg (2010) Conductance and concentration relationship in a reduced model of the K<sup>+</sup> channel. Volume 98 pp. 117a Abstract [[PDF](#)] and Poster 613 [[PDF](#)]
115. Zhang, Chao, Raugei, Simone, Eisenberg, Bob, and Paolo Carloni. (2010) On the domain of applicability of currently used force fields for the calculation of the activity of alkali ions at physiological ionic strength. *Biophysical Journal*. Volume 98 pp. 330a - 331a. Abstract [[PDF](#)] and Poster 1718 [[PDF](#)]
116. Giri, Janhavi, Eisenberg, Bob, Gillespie, Henderson, Douglas, and Dezsó Boda. (2010) Monte Carlo simulation of free energy components. Energetics of selective binding in a reduced model of L-type Ca<sup>2+</sup> channels. *Biophysical Journal*. Volume 98 pp. 514a – 515a Abstract [[PDF](#)] and Poster 2665 [[PDF](#)]
117. Eisenberg, Robert S., Hyon, YunKyong, and Chun Liu. (2010) Energetic Variational Analysis *EnVarA* of ions in calcium and sodium channels. *Biophysical Journal*. Volume 98 pp. 515a. Abstract [[PDF](#)] and Poster 2666 [[PDF](#)]
118. Mori, Y., C. Liu, and R.S. Eisenberg, (2011) Electrodiffusion and Osmotic Water Flow and its Variational Structure. *Biophysical Journal*. 100(3): p. 86a-87a. Abstract 466-Pos [[PDF](#)] and Poster Board B266 [[PDF](#)]
119. Berti, C., D. Gillespie, B. Eisenberg, S. Furini, and C. Fiegna, (2011) A novel Brownian-Dynamics Algorithm for the Simulation of Ion Conduction Through Membrane Pores. *Biophysical Journal*. 100(3): p. 158a. Abstract 867-Pos [[PDF](#)] and Poster Board B667 [[PDF](#)]
120. Ryham, R., R. Eisenberg, C. Liu, and F. Cohen, (2011) A Continuum Variational Approach to Vesicle Membrane Modeling. *Biophysical Journal*. Volume 100(3): p. 187a. Abstract [[PDF](#)] and 1025-Plat [[PDF](#)]
121. Jimenez-Morales, D., J. Liang, and B. Eisenberg, (2011) Active Sites of Enzymes are Crowded with Charge. *Biophysical Journal*. 100(3): p. 218a. Abstract 1191-Pos [[PDF](#)] and Poster Board B101 [[PDF](#)]

122. Hyon, Y., J.E. Fonseca, B. Eisenberg, and C. Liu, (2011) A new Poisson-Nernst-Planck Equation (PNP-FS-IF) for charge inversion near walls. *Biophysical Journal*. 100(3): p. 578a. Abstract 3130-Pos [[PDF](#)] and Poster Board B235 [[PDF](#)]
123. Giri, J., J.M. Tang, C. Wirth, C.M. Peneff, T. Schirmer, and B. Eisenberg, (2011) Single Channel Measurements of N-Acetylneuraminic Acid-Inducible Channel (NANC) in *E. coli*. *Biophysical Journal*. Volume 100(3): p. 579a. Abstract 3136-Pos [[PDF](#)] and Poster Board B241 [[PDF](#)]
124. Giri, J., J.M. Tang, C. Wirth, C.M. Peneff, T. Schirmer, and B. Eisenberg, (2011) Sialic Acid Transport in *E. coli*: Role of Outer Membrane Porin NanC. *Biophysical Journal*. 100(3): p. 577a. Abstract 3123-Pos [[PDF](#)] and Poster Board B228 [[PDF](#)]
125. Jimenez-Morales, D., J. Liang, and B. Eisenberg, (2011) Active Sites of Enzymes are Crowded with Charge. 6<sup>th</sup> Annual Midwest Conference on Protein Folding, Assembly, and Molecular Motions. University of Notre Dame. (*not published*) [[PDF](#)]

[\[Laboratory of Robert S. Eisenberg\]](#)