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EDUCATION

Ph.D. in Physics, May 1996
University of Minnesota, Twin Cities
Thesis Advisor: Dr. Joseph I. Kapusta
Dissertation Title: *Correlated Density Matrices in Finite-Temperature Quantum Field Theory*
(Published in whole in *Physical Review D*)

B.A. in Biology, 1990
University of Minnesota, Twin Cities

AWARDS AND DISTINCTIONS

Itasca Directors' Scholarship for
field research in ecology, summer 1990

Department of Education Graduate Fellowship
January 1991-June 1994

Aneesur Rahman Dissertation Award for best thesis, May 1996

Burroughs-Wellcome Research Fellowship, August 1997-present
(Caltech initiative in Computation and Molecular Biology)

EXPERIENCE: current position

Member of the Engineering Staff, Jet Propulsion Laboratory
December 2000-present.

Currently Funded Projects as Principal Investigator

1. "Miniature Electronic Dynamic Ion Channel Sensor (MEDICS)," Biomolecular Systems Research Program, NASA Code U, July 2001-June 2004. Funding level: \$500 K/year for 3 years. Purpose: engineering of a stable millimeter-scale biosensor based upon ion channel proteins for detection of specific biosignatures. Work includes: MEMS design and processing; genetic engineering of ion channels; discovery of novel ion channels from extremophiles. Collaborators: Prof. Dennis Dougherty, Caltech.
2. "Researching Extraterrestrial Life with Ion Channel Sensors ("RELICS"), ASTID proposal, NASA Code S, 2002-2005. Funding level: \$300 K/year for 3 years. Purpose: theoretical investigation of membrane proteins of bacteria that may be developed into biosensors for ion channels. Examples include chirally-selective

amino acid binding proteins and ion-binding proteins such as siderophores.

Collaborators: Prof. Hagan Bayley, Texas AMU; Prof. Alexandra MacDermott, University of Houston Clear Lake.

3. "Astrobiology and Life Detection Institute for Informal Educators," ASTID Education and Public Outreach (E/PO) proposal. Purpose: to develop a display at the Minnesota Science Museum that presents JPL's Astrobiology efforts to the public. Funding level: \$50 K/year for 2 years.
4. "Quantum dots for *in situ* life detection technology," BioNanoTech, NASA Code R. Purpose: development of CdSe nanocrystallites as fluorescent sensors for space-flight and *in situ* life detection experiments. Funding level: \$200 K/year for 2-3 years (subject to annual review).
5. "Biofunctionalization of Nanoscale Cantilevers for Sensor Development," Director's Research and Development Fund (DRDF) (JPL/Caltech internal funding). Purpose: development of Bio-NEMS sensors. Funding level: \$100 K/year for 1 year.
6. "CHemistry and Imaging of Martian and Earth Soils (CHIMES)," Astrobiology Science and Technology for Exploring Planets (ASTEP), NASA Code S. Purpose: development of a flight-ready wet chemistry instrument suite for in situ detection of organic and inorganic biosignatures. Funding level: \$350 K/year for 2 years (chosen 10/02; to begin early 2003).

JOINT APPOINTMENT:

Visiting Associate in Mathematics and Physics, California Institute of Technology, May 2002- present. Project: "Bio-NEMS"; PIs: Prof. Michael Roukes and Prof. Scott Fraser. Purpose: biofunctionalization of nanometer-scale devices for sensing of bacteria, viruses, and organic molecules.

STUDENTS AND POSTDOCS SUPERVISED

Jeremiah Kloepfer, JPL Postdoc, April 2002-present. Quantum dot characterization and synthesis; ion channel sensors.

Martha-Helene Stapleton, Caltech senior undergraduate, July 2002-present. Biofunctionalization of gold surfaces.

PAST POSITIONS

Graduate Research Assistant, University of Minnesota

1992-1996. Projects involved computer simulation, numerical integration, and the development of analytic techniques for summation of finite-temperature Feynman diagrams.

Postdoctoral Research Associate, The Scripps Research Institute

1996-1997. Computer simulations and analytic approximations of water and ion flow through peptide nanotubes.

Postdoctoral Scholar, California Institute of Technology

Received a Burroughs-Wellcome physics/biology grant to inhibit neuronal signals in selective brain regions.

PROFESSIONAL SOCIETIES

American Physical Society
American Association for the Advancement of Science
American Chemical Society

LABORATORY SKILLS

Single-channel and whole-cell electrophysiology; immunocytochemistry; fluorescence, confocal, 2-photon, electron, and atomic force microscopy; ion channel cloning and mutagenesis; all modern techniques of molecular biology; bacteriology and virology, including Biosafety Level 3 containment; surface and linker biochemistry; electronics; quantum dot synthesis and characterization; some MEMS techniques.

SPECIAL SKILLS

Proficient in French and Russian.
Working knowledge of several computer languages and operating systems, including C, FORTRAN, Pascal, *Mathematica*, UNIX, and VMS.

PUBLICATIONS: BIOLOGY

“Quantum dots as species-specific and off-on microbiological sensors,” submitted 10/02 (preprint enclosed).

Kloepfer JA, Wong M, Nealson KH, Stucky G, **Nadeau JL**.

“Quantum dots for off-on biological labeling”

Nadeau JL, Wong M, Nealson KH, NASA New Technology Report NPO-30373.

Book chapter: “Transduction of ex vivo cell cultures through lentivirus vectors V: hippocampal neurons,” to appear in *Lentivirus Gene Engineering Protocols*, 2002 (accepted in final form September 2002).

“Quantum dots for species-specific labeling of microorganisms,” Gordon Research Conference abstract, 5/01.

“NRSF causes cAMP-dependent suppression of sodium channel type II in cultured hippocampal neurons,” **Nadeau H**, Lester HA, *The Journal of Neurophysiology* 88(1):409-21 (July 2002).

“Dominant negative Rab3a suppresses synaptic vesicle release in cultured hippocampal pyramidal and mossy fiber neurons,” Gordon Research Conference abstract, 3/00.

“Long-term, low-level expression of ROMK1 (Kir1.1) causes apoptosis and chronic silencing in hippocampal neurons,”

Nadeau H, McKinney S, Anderson DJ, Lester HA, *The Journal of Neurophysiology* 84(2):1062-75 (Aug. 2000).

“Two-compartment model for off-line artifact correction”

Nadeau H and Lester HA, *Journal of Neuroscience Methods* 30;99(1-2):25-35 (June 2000).

“ROMK1 (Kir1.1) silences central neurons *in vitro* and *in vivo*”

Society for Neuroscience Abstract, 11/99.

PHYSICS

“MEMS-based ion channel sensor with agarose supporting layer,” to be submitted after patent office clearance (preprint enclosed).

“Time resolved photoluminescence spectroscopy of biologically conjugated colloidal CdSe quantum dots”

Nadeau JL, Leon R, Neelson KH, in preparation.

“Fluorescent labels for in situ wet chemistry experiments”

Kloepfer JA, **Nadeau JL**, IEEE Proceedings 2003 (preprint enclosed).

“High-Q whispering gallery mode sensor in liquids”

Nadeau JL, Kossakovski D, Iltchenko V, Bearman G, Maleki L, *Proc SPIE* 2002.

“Relativistic generalization of the hypernetted chain approximation”

Nadeau H, *Physical Review D* 55: (2) 1109-1111 JAN 15 1997

“Variational density matrices in quantum field theory at finite temperature and chemical potential”

Nadeau H, *Physical Review D* 54: (2) 1696-1718 JUL 15 1996

“Photon emission from very-high-energy nuclear collisions”

Nadeau H, *Physical Review D* 48: (7) 3182-3189 OCT 1 1993

“Parametrization of thermal photon-emission rates from mesonic matter”

Nadeau H, Kapusta J, Lichard P, *Physical Review C* 45: (6) 3034-3036 JUN 1992

RECENT PRESENTATIONS

1. Oral presentation: “Bio Nano Molecular Systems,” First International Conference and School on Nanoscale and Molecular Mechanics (NMM-1), Maui, Hawaii, May 2002.
2. Poster: “Quantum dots for off-on biological labeling,” CLEO-QUELS, Long Beach, CA, May 2002.
3. Poster (invited): “Towards a fully enclosed ion channel sensor,” DARPA SymBioSys PI Meeting, Miami, Florida, February 2002.

4. Oral presentation: “High-Q whispering gallery mode sensor in liquids,” SPIE, San Jose, California, January 2002.
5. Invited talk: “Small-scale biosensors for life detection,” Rush University, January 2002 (also presented at the University of Minnesota and the Minnesota Science Museum, January 2002).

REFERENCES

(Direct supervisor)

Kenneth H. Nealson
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(Group supervisor)

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(Supervisor, Caltech joint appointment)

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(Program manager for funded work)

Darrell L. Jan, Ph. D.
Advanced Environmental Monitoring and Control Manager
Biomolecular Systems Research Program Deputy Manager
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(Thesis advisor)

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