

# Dáibhid Ó Maoiléidigh

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## Research Experience

### Assistant Professor (January 2019–Present)

Dept. of Otolaryngology—Head & Neck Surgery, Stanford University School of Medicine

Information processing by hearing and balance organs.

### Instructor (May 2017–December 2018)

Dept. of Otolaryngology—Head & Neck Surgery, Stanford University School of Medicine

Cohesion of hair bundles, intrinsic noise in hearing, and active cochlear mechanics.

### Research Associate (May 2015–April 2017, Prof. AJ Hudspeth)

Lab. of Sensory Neuroscience, The Rockefeller University

Functional robustness of hearing and the effects of noise on signal detection by hair bundles.

### Postdoctoral Associate (May 2010–April 2015, Prof. AJ Hudspeth)

Lab. of Sensory Neuroscience, The Rockefeller University & Howard Hughes Medical Inst.

Control of hair-bundle function, cochlear mechanics, and frequency-tuning of hair-cell synapses.

### Guest Scientist (October 2006–December 2009, Prof. Frank Jülicher)

Max Planck Institute for the Physics of Complex Systems

Dynamics of cochlear mechanics in mammals.

### Doctoral Student (September 2000–September 2006, Prof. Andrei E Ruckenstein)

Dept. of Physics & Astronomy, Rutgers University

*The Kinetics of Transcription Elongation*, Pauses in transcription elongation.

### Masters Student (October 1999–October 2000, Prof. Sinéad Ryan)

School of Mathematics, Trinity College Dublin

*Comparison and Parallelisation of the Conjugate Gradient and Lanczos Algorithms Applied to the Kogut-Susskind Fermionic Interaction Matrix*, Lattice Quantum Chromodynamics.

### Research Assistant

Dublin Institute for Advanced Studies (June–September 1999, Prof. John T Lewis)

Dept. of Physics, Trinity College Dublin (June–September 1998, Prof. John F McGilp)

## Education

### Doctor of Philosophy in Physics (2006)

Dept. of Physics & Astronomy, Rutgers University, USA

### Master of Science in High-Performance Computing (2000)

School of Mathematics, Trinity College Dublin, Ireland

### Bachelor of Arts in Theoretical Physics (1999)

Dept. of Physics/School of Mathematics, Trinity College Dublin, Ireland

## Publications

### Peer-Reviewed Publications of Original Research (14)

1. Roongthumskul, Yuttana, **Ó Maoiléidigh, Dáibhid\***, and A. J. Hudspeth. “Bilateral Spontaneous Otoacoustic Emissions Show Coupling between Active Oscillators in the Two Ears.” *Biophysical Journal* doi.org/10.1016/j.bpj.2019.02.032 (2019): In press.  
\*Co-first author. Created mathematical model, analyzed data, and cowrote manuscript.
2. **Ó Maoiléidigh, Dáibhid**, and A. J. Hudspeth. “Sinusoidal-Signal Detection by Active, Noisy Oscillators on the Brink of Self-Oscillation.” *Physica D: Nonlinear Phenomena* 378–379 (2018): 33–45. Print.
3. **Ó Maoiléidigh, Dáibhid**. “Multiple Mechanisms for Stochastic Resonance Are Inherent to Sinusoidally Driven Noisy Hopf Oscillators.” *Physical Review E* 97.2 (2018): 022226. Print.
4. Milewski, Andrew R., **Dáibhid Ó Maoiléidigh\***, Joshua D. Salvi, and A. J. Hudspeth. “Homeostatic Enhancement of Sensory Transduction.” *Proceedings of the National Academy of Sciences of the United States of America* 114.33 (2017): E6794–E803. Print.  
\*Designed and directed all research. Performed initial research. Cowrote manuscript.
5. Salvi, Joshua D., **Dáibhid Ó Maoiléidigh\***, and A. J. Hudspeth. “Identification of Bifurcations from Observations of Noisy Biological Oscillators.” *Biophysical Journal* 111.4 (2016): 798–812. Print.  
\*Designed and directed all research. Wrote initial simulation code and performed analytical calculations. Cowrote manuscript.
6. Salvi, Joshua D., **Dáibhid Ó Maoiléidigh\***, Brian A. Fabella, Mélanie Tobin, and A. J. Hudspeth. “Control of a Hair Bundles Mechanosensory Function by Its Mechanical Load.” *Proceedings of the National Academy of Sciences of the United States of America* 112.9 (2015): E1000–E09. Print.  
\*Co-first author. Designed and directed all research. Performed simulations, data analysis, analytical calculations, and cowrote manuscript.

7. **Ó Maoiléidigh, Dáibhid**, and A. J. Hudspeth. “Effects of Cochlear Loading on the Motility of Active Outer Hair Cells.” *Proceedings of the National Academy of Sciences of the United States of America* 110.14 (2013): 5474–79. Print.
8. Szalai, Robert, Alan Champneys, Martin Homer, **Dáibhid Ó Maoiléidigh\***, Helen Kennedy, and Nigel Cooper. “Comparison of Nonlinear Mammalian Cochlear-Partition Models.” *The Journal of the Acoustical Society of America* 133.1 (2013): 323–36. Print.  
\*Advised research direction, checked calculations, and reviewed manuscript.
9. Patel, Suchit H., Joshua D. Salvi, **Dáibhid Ó Maoiléidigh\***, and A. J. Hudspeth. “Frequency-Selective Exocytosis by Ribbon Synapses of Hair Cells in the Bullfrog’s Amphibian Papilla.” *The Journal of Neuroscience* 32.39 (2012): 13433–38. Print.  
\*Analyzed data, designed model, performed simulations, and cowrote manuscript.
10. **Ó Maoiléidigh, Dáibhid**, Ernesto M. Nicola, and A. J. Hudspeth. “The Diverse Effects of Mechanical Loading on Active Hair Bundles.” *Proceedings of the National Academy of Sciences of the United States of America* 109.6 (2012): 1943–48. Print.
11. LeBoeuf, Adria C., **Dáibhid Ó Maoiléidigh\***, and A. J. Hudspeth. “Divalent Counterions Tether Membrane-Bound Carbohydrates to Promote the Cohesion of Auditory Hair Bundles.” *Biophysical Journal* 101.6 (2011): 1316–25. Print.  
\*Created data-analysis algorithm and cowrote manuscript.
12. **Ó Maoiléidigh, Dáibhid**, Vasisht R. Tadigotla, Evgeny Nudler, and Andrei E. Ruckenstein. “A Unified Model of Transcription Elongation: What Have We Learned from Single-Molecule Experiments?” *Biophysical Journal* 100.5 (2011): 1157–66. Print.
13. **†Ó Maoiléidigh, Dáibhid**, and Frank Jülicher. “The Interplay between Active Hair Bundle Motility and Electromotility in the Cochlea.” *The Journal of the Acoustical Society of America* 128.3 (2010): 1175–90. Print.  
†Highlighted as of outstanding interest by Barral, Jérémie, and Pascal Martin. “The Physical Basis of Active Mechanosensitivity by the Hair-Cell Bundle.” *Current Opinion in Otolaryngology & Head and Neck Surgery* 19.5 (2011): 369–75. Print.
14. Tadigotla, Vasisht R., **Dáibhid Ó Maoiléidigh\***, Anirvan M. Sengupta, Vitaly Epshtein, Richard H. Ebright, Evgeny Nudler, and Andrei E. Ruckenstein. “Thermodynamic and Kinetic Modeling of Transcriptional Pausing.” *Proceedings of the National Academy of Sciences of the United States of America* 103.12 (2006): 4439–44. Print.  
\*Co-first author. Performed simulations, data analysis, and cowrote manuscript.

## Book Chapters and Reviews

1. **Ó Maoiléidigh, Dáibhid** and A. J. Ricci. “A Bundle of Mechanisms: Inner-Ear Hair-Cell Mechanotransduction.” *Trends in Neurosciences* 42.3 (2019): 221–36. Print.
2. Corey, David P., **Dáibhid Ó Maoiléidigh**, and Johnathon F. Ashmore. “Mechanical Transduction Processes in the Hair Cell.” *Understanding the Cochlea. Springer Handbook of Auditory Research*, edited by Manley, Geoffrey A., Anthony W. Gummer, Arthur N. Popper, and Richard F. Fay, Springer, Cham, 2017, pp. 75–111.

## Peer-reviewed Proceedings (6)

1. **Ó Maoiléidigh, Dáibhid**, Joshua D. Salvi, and A. J. Hudspeth. “Signal Detection by Active, Noisy Hair Bundles.” *To the Ear and Back Again—Advances in Auditory Biophysics (Proceedings of the 13th International Mechanics of Hearing Workshop)*. *AIP Conference Proceedings* 1965.1, American Institute of Physics, 2018, pp. 060002.
2. Milewski, Andrew R., **Dáibhid Ó Maoiléidigh\***, and A. J. Hudspeth. “Homeostatic Enhancement of Active Mechanotransduction.” *To the Ear and Back Again—Advances in Auditory Biophysics (Proceedings of the 13th International Mechanics of Hearing Workshop)*. *AIP Conference Proceedings* 1965.1, American Institute of Physics, 2018, pp. 120007.  
\*Designed and directed all research. Performed initial research. Cowrote manuscript.
3. **Ó Maoiléidigh, Dáibhid**, and A. J. Hudspeth. “Vibrational Modes and Damping in the Cochlear Partition.” *Mechanics of Hearing: Protein to Perception (Proceedings of the 12th International Mechanics of Hearing Workshop)*. *AIP Conference Proceedings* 1703.1, American Institute of Physics, 2015, pp. 050003.
4. Salvi, Joshua D., **Dáibhid Ó Maoiléidigh\***, Brian A. Fabella, Mélanie Tobin, and A. J. Hudspeth. “Characterization of Active Hair-Bundle Motility by a Mechanical-Load Clamp.” *Mechanics of Hearing: Protein to Perception (Proceedings of the 12th International Mechanics of Hearing Workshop)*. *AIP Conference Proceedings* 1703.1, American Institute of Physics, 2015, pp. 030005.  
\*Designed and directed all research. Performed analytical calculations and cowrote manuscript.
5. **Ó Maoiléidigh, Dáibhid**, and A. J. Hudspeth. “High-Frequency Power Gain in the Mammalian Cochlea.” *What Fire is in Mine Ears: Progress in Auditory Biomechanics (Proceedings of the 11th International Mechanics of Hearing Workshop)*. *AIP Conference Proceedings* 1403.1, American Institute of Physics, 2011, pp. 645-51.
6. **Ó Maoiléidigh, Dáibhid**, and Frank Jülicher. “The Interplay between Active Hair Bundle Mechanics and Electromotility in the Cochlea.” *Concepts and Challenges in the Biophysics of Hearing (Proceedings of the 10th International Mechanics of Hearing Workshop)*, World Scientific, 2009, pp. 451-56.

**Presentations**  
**Invited Talks (16)**  
**Most Recent**

Amplification by noisy oscillators

42nd Annual MidWinter Meeting of the Association for Research in Otolaryngology (2019),  
Baltimore, Maryland, USA

Signal detection by active, noisy oscillators on the brink of self-oscillation

“Dynamics and Complexity in the Auditory Sensing System” Minisymposium  
SIAM Conference on Applications of Dynamical Systems (2017), Snowbird, Utah, USA

Sensory transduction by active, noisy oscillators on the brink of self-oscillation

Biomathematics/Computational Biology Colloquium  
Courant Institute of Mathematical Sciences, New York University, USA (2017), New York,  
New York, USA

Bifurcations of a noisy biological oscillator are associated with function

“Advances in Mathematical Models of Hearing” Minisymposium  
SIAM Conference on the Life Sciences (2016), Boston, Massachusetts, USA

**Contributed Talks (21)**  
**Most Recent**

The mechanosensory hair bundles of the inner ear distinguish sinusoidal forces from noise  
best when they oscillate spontaneously but remain on the verge of quiescence

American Physical Society March Meeting (2019), Boston, Massachusetts, USA

Amplification in the mammalian cochlea arises from active feedback to hair bundles

41st Annual MidWinter Meeting of the Association for Research in Otolaryngology (2018),  
San Diego, California, USA

Signal detection by active, noisy hair bundles

13th International Mechanics of Hearing Workshop (2017), St. Catharines, Ontario, Canada

Two effects increase the vibration energy of active auditory systems

40th Annual MidWinter Meeting of the Association for Research in Otolaryngology (2017),  
Baltimore, Maryland, USA

**Posters (10)**  
**Most Recent**

Motile hair cells distinguish mechanical signals from noise best when they operate on the  
brink of spontaneous oscillation

Biophysical Society 62nd Annual Meeting (2018), San Francisco, California, USA

## Grants

Co-investigator: *Molecules and Mechanisms of Mammalian Hair Cell Mechanotransduction* (NIH 2R01DC003896-21, 30 % effort, 3.6 Cal months, 01/01/18-12/31/22, PI: AJ Ricci)

## Service Conferences

Cofounded the annual *Sense to Synapse* meetings in 2012 with grant funding from the Biophysical Society. Keynote speakers from The Rockefeller University, Columbia University, New York University, Cold Spring Harbor Laboratory, Yale University, Harvard University, Monell Chemical Senses Center, Albert Einstein College of Medicine, the University at Buffalo, Hunter College, University of Pennsylvania, Rutgers University, and Princeton University.

Comoderated the *Middle Ear Mechanics* session and chaired an open discussion entitled *Progress in cochlear modeling* at the *12th International Mechanics of Hearing Workshop*.

Organizing committee member: *13th International Mechanics of Hearing Workshop* (2017).

Coorganizer of the symposium *Spontaneous otoacoustic emissions and active amplification in the inner ear* as part of the *42nd Annual MidWinter Meeting of the Association for Research in Otolaryngology* (2019).

Organizing committee member: *14th International Mechanics of Hearing Workshop* (2020).

## Manuscript Reviewer

*Nature*, the *Proceedings of the National Academy of Sciences USA*, *The Journal of Neuroscience*, *Journal of the Association for Research in Otolaryngology*, *Physical Review E*, the *Biophysical Journal*, *PLOS Computational Biology*, *PloS one*, the *SIAM Journal on Applied Mathematics*, *The Journal of the Acoustical Society of America*, and the *International Journal of Biological Macromolecules*.

## Editor

The *Proceedings of the National Academy of Sciences USA* (May 5–October 16, 2016)

## Grant Reviewer

The Israel Science Foundation (March 27–May 16, 2018)

## Science Outreach

Demonstrator for Science Saturday at The Rockefeller University in 2016. Science Saturday is an outreach program for elementary and middle school students.

## Honors

### Conference Award (2005)

Applications of Methods of Stochastic Systems and Statistical Physics in Biology  
Interdisciplinary Center for the Study of Biocomplexity, University of Notre Dame, USA

### Departmental Graduate Assistant Award (2005–2006)

Dept. of Physics and Astronomy, Rutgers University, USA

### Johnson & Johnson Summer Fellowship (2003)

### Richard J Plano Outstanding Teaching Assistant Award (2001)

Dept. of Physics and Astronomy, Rutgers University, USA

### Entrance Exhibition (1995)

Trinity College Dublin, Ireland

### Full Bachelor's and Advanced Degree Scholarship (1995–2000)

Dept. of Education, Ireland

## Teaching Experience

### Mentor

*Stanford University* (2017–Present)

I have a medical student, had a research assistant, and had a high-school summer student in my group. The medical student is analyzing the electrical response of the auditory system to sound. The research assistant is finishing work on the cohesion of hair bundles in the mammalian cochlea. The high-school student learned about computational approaches in hearing. I taught a T32 research fellow how to model the utricle and sit on her research committee and I provided a medical student with a reading course on auditory brainstem responses.

*The Rockefeller University* (2010–2017)

In the laboratory of Prof. Hudspeth, I guided two MD-PhD students throughout their graduate work. Based on the first student's work, we published in the *Proceedings of the National Academy of Sciences USA* and *Biophysical Journal*. The second student also published a manuscript in the *Proceedings of the National Academy of Sciences USA*. I have provided two students with year-long courses on dynamical systems and computational modeling.

### Invited Panel Member (2017)

*Mechanics of Hearing 101*

13th International Mechanics of Hearing Workshop

A panel discussion on the mechanics of hearing.

**Invited Panel Member (2005)**

*TAs in the Physical and Mathematical Sciences Answer Your Questions*

Teaching Assistant Project, Rutgers University, USA

A discussion on teaching for the benefit of new TAs.

**Teaching Assistant: Physics Recitation Instructor (2003–2005)**

Dept. of Physics and Astronomy, Rutgers University, USA

Recitations for 200-level spring and fall General Physics (2003–2004) for science majors and Honors Physics I & II (2004–2005) for physics majors courses. I prepared quizzes, illustrated how to solve physics problems, graded, invigilated exams, and lectured in the place of the Honors Physics course instructor when necessary.

**Teaching Assistant: Physics Laboratory Instructor (2000–2003)**

Dept. of Physics and Astronomy, Rutgers University, USA

At Rutgers I taught 200-level laboratory courses in physics to engineering and science majors including spring and fall Analytical Physics Lab (2000–2001) and General Physics Lab (2001). This involved creating quizzes, preparing experiments, assisting students with their experiments, and grading quizzes, homework, and lab reports. I received the *Richard J Plano Outstanding Teaching Assistant Award* in 2001 for teaching Analytical Physics Lab.

I ran one of the 100-level spring and fall Extended Analytical Physics workshops for engineering students (2001–2003). These courses involve more contact hours and smaller classes than usual. Workshops allow students to experimentally verify basic physical principles. I prepared experiments, assisted students, and graded quizzes, homework, lab reports and exams.

**Research in Physics Education Assistant (2002)**

Dept. of Physics and Astronomy, Rutgers University, USA

The 100-level Extended Analytical Physics courses are run by members of the *Physics and Astronomy Education Research* group. I provided detailed weekly reports on the syllabus during the Spring Semester and assisted in a revision of the final examinations' material.

**Observer and Evaluator of Teaching Assistants (2001)**

Dept. of Physics and Astronomy, Rutgers University, USA

Over the course of the Fall Semester I observed, evaluated, and interviewed all of the TAs for the 200-level Analytical Physics Lab and General Physics Lab.

**Master Class in Teaching Strategies and Skills (2001)**

Dept. of Physics and Astronomy, Rutgers University, USA

Presented a class for TAs on how to teach physics to undergraduates.



**Tutorial Instructor** (1999–2000)

School of Mathematics, Trinity College Dublin, Ireland

Tutorial instructor for a course on discrete mathematics for first-year science and second-year computer science students.

**Laboratory Instructor** (1999)

Blanchardstown Institute of Technology, Ireland

Laboratory instructor in computer applications and Visual BASIC for first-year computing and electronic engineering students. I assisted students with their assignments.

**Tutorial Instructor** (1997–1999)

School of Mathematics, Trinity College Dublin, Ireland

Tutorial instructor in classical mechanics for second-year engineers.