Spencer D. Stirling, PhD

Postdoctoral Scientist, University of Utah

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SUMMARY

I am a research scientist seeking new opportunities in industry for entrepreneurship and innovation. My skillset includes scientific/quantitative expertise, software development, management experience, and excellent interpersonal relations.

In 2008 I earned a PhD in mathematics and quantum physics, and since then I have managed a research group at a large university. We specialize in modelling exotic cold materials called *topological phases*. These materials can be used to build powerful *quantum computers*. In my work I use advanced **mathematics** (category theory and topological quantum field theory) and **computational C++ models**.

Writing: Author of high-quality research publications, grant proposals, and technical documentation.

Speaking: Invited speaker to prestigious institutions worldwide.

Teaching: 14 years teaching at 2 large universities and a small college.

Management: 4 years managing research group of PhD students. Organized two professional seminars

Software: Experienced developer (mostly C++ on Linux platform). Exposure to many other languages and web technologies (Scala, Python, Java, CUDA, Matlab, Fortran, SQL, etc). Linux administration.

CURRENT

◇ **Postdoctoral Researcher, Physics** (under Yong-Shi Wu) **University of Utah**
Visiting Assistant Professor, Mathematics Utah USA
2008 - Present
Developed models of **topological phases** in cold materials using advanced mathematical tools and C++ models. **Teaching**.

EDUCATION

◇ **Ph.D. Mathematics (advisor Daniel S. Freed)** **University of Texas at Austin**
2001 - 2008 Texas USA
Studied topics in **topological quantum field theory (TQFT)** and **category theory**, with emphasis on applications to condensed matter physics.
Dissertation: *Abelian Chern-Simons theory with toral gauge group, modular tensor categories, and group categories*

◇ **Visitor, Institute for Theoretical Physics** **Utrecht University**
2002-2003 Netherlands
Quantum field theory, statistical field theory, general relativity

◇ **B.S. Physics and B.S. Mathematics** **University of Utah**
1996-2001 Utah USA
Magna cum laude in both degrees. Numerous awards and scholarships

◇ **Undergraduate researcher, Physics** **The Ohio State University**
Summer 2000, 2001 Ohio USA
Big Bang nucleosynthesis computational modelling

◇ **Valedictorian** **Taylorsville High School**
1996 Utah USA
Numerous awards, including Sterling scholar

Computer Skills

◇ **Software development, 7+ years** **many languages (esp. C++)**
1996-2001, 2010-2012
Experienced C++ developer, including *STL, Boost, C++11, design patterns, template metaprogramming.*
Various levels of exposure to Scala, Python (*NumPy/SciPy*), Java, CUDA, Matlab, Fortran, SQL, Bash, etc

◇ **Scientific/numerical computing, 4+ years** **C/C++, Fortran, Python**
Monte Carlo, Finite Element Method, CUDA GPGPU programming

◇ **Industry product development, 2 years** **C++**
1996-1998
Accounting software development. Major software releases, quality assurance

◇ **Technical writing, 15 years**
1996-Present
Corporate technical documentation. Informal Linux documentation
http://www.spencerstirling.com/computergeek/computernotes.html

◇ **Unix administration, 17 years** **Linux, FreeBSD/OpenBSD**
1995-Present
Dedicated web, email, and file servers for small organizations. Security, backup servers, firewalling. Networking and employee workstations. Mostly Debian

◇ **On-site technical consulting, 2+ years**
1996-1998
Excellent interpersonal skills in a corporate/client environment.

Prior Research

◇ **Big Bang nucleosynthesis** **Physics, The Ohio State University**
Summer 2000, 2001: Research Experience for Undergraduates (REU)
Advisor: Robert Scherrer

· **Computational modelling** of Big Bang nucleosynthesis. Research over two summers using **Monte Carlo method** to model the abundance of light elements created during the Big Bang. Modified legacy **Fortran** code, and extended with **C/C++, Perl, and Bash** code to take into account inhomogeneous neutrino concentration.
publication: see below

◇ **Scanning capacitance microscopy** **Physics, University of Utah**
1998-2000: Undergraduate Semiconductor research
Advisor: Clayton Williams

· **Computational modelling** of semiconductor imaging techniques. Used **finite element method** to create detailed models of electron/hole concentration and drift velocities in doped semiconductor samples. Developed code in **C++ and Bash** as well as a proprietary language.

· Designed and constructed an **experimental probe** to measure the dielectric constant of thin films on semiconductor surfaces. **Hardware programming in C**.
publication: see below

INDUSTRY EXPERIENCE

◇ **Linux administrator** **World Institute for Conservation and Environment**
2001-Present Shepherdstown, West Virginia USA

· Web and email servers, file servers, backup servers, firewalling, and security

◇ **C++ developer** **Create-A-Check, Inc.**
1996-1998 Salt Lake City, Utah USA

· Application development and custom programming (accounting software).

· Responsible for major software releases, designed and implemented product testing infrastructure.

· Author of large amount of internal technical documentation.

· On-site and remote technical consulting.

MANAGEMENT

◇ **Managed research group** of PhD students for 4 years at University of Utah.

◇ **Seminar** Ribbon Categories for Physicists **Physics, University of Utah**
Summer 2009 - Spring 2010 Utah, USA
Organized year-long intensive seminar with four physics graduate students. Several times per week, $2-3$ hours per session. Focused on collaborative learning and research related to applications of modular tensor categories to condensed matter physics. Students alternated speaking in highly-interactive environment. I organized and strongly guided the discussion. Seminar resulted in high-quality publications.

◇ **Seminar** TQFTTQC **Mathematics and Physics, University of Utah**
Fall 2008 - Spring 2010 Utah USA
Organized two-year interdisciplinary (math and physics) seminar called Topological Quantum Field Theory and Topological Quantum Computing. Hosted speakers from premier institutions worldwide in quantum computing and condensed matter physics. Speakers also included local faculty, postdocs, and grad students.

TEACHING EXPERIENCE

◇ **Visiting Assistant Professor** **Mathematics and Physics, University of Utah**
2008 - 2012 Utah USA
Partial differential equations, Quantum field theory, Statistical mechanics, Business algebra, Precalculus

◇ **Statistics Lecturer** **Western State College of Colorado**
2012 Colorado USA

◇ **Instructor** **Mathematics, University of Texas at Austin**
2005 - 2008 Texas USA
Calculus, Precalculus, Elementary educator math

◇ **Teaching Assistant** **Mathematics, University of Texas at Austin**
2004 - 2005 Texas USA
Differential equations, Vector calculus, Calculus

◇ **Teaching Assistant** **Physics, University of Utah**
1998 - 2001 Utah USA
Mechanics and waves, Electromagnetism

FEATURED SPEAKER

◇ **Western State College of Colorado** (January 2012)
Introduction to quantum computation using topological matter (public lecture)

◇ **SIAM-North Carolina State University** (October 2011)
Recent progress in exactly-soluble models of topological phases

◇ **University of Texas at Austin** (September 2010)
Levin-Wen models and Turaev-Viro TQFTs
Quantum Teleportation and Quantum Communication (public lecture)

- **Fudan University**, Shanghai, China (July 2010)
  Topological Phases and Emergent Phenomena in Physics
- **Macalester College**, St. Paul, Minnesota (April 2010)
  Quantum Invariants of 3-Manifolds and Modular Categories conference
- **Baylor University**, Waco, Texas (Oct. 2009)
  Fusion Categories and Applications conference
- **University of Queensland**, Quantum Information Science Initiative, Brisbane, Australia (Feb. 2008)
  2-week featured lecturer - mini-course about TQFTs and modular tensor categories
- **Texas A&M**, College Station, Texas (Apr. 2008)

Conference Presentations

- **Algebraic Aspects of Quantum Computation**, SIAM-North Carolina State U: Raleigh, NC (October 2011)
- **Topological Phases and Emergent Phenomena in Physics**, Fudan University: Shanghai, China (July 2010)
- **Strongly-Correlated Systems and Tensor Categories**
  Institute for Advanced Study, Tsinghua University
  Beijing, China (June 2010)
- **Quantum Invariants of 3-Manifolds and Modular Categories**, Macalester College: St. Paul, Minnesota (2010)
- **Fusion Categories and Applications**, Baylor University: Waco, Texas (2009)
- **Modular Categories and Applications**, Indiana University: Bloomington, Indiana (2009)
- **NSF-CBMS Conference on Knots and Topological Quantum Computing**, University of Central Oklahoma: Edmond, Oklahoma (2008)
- **Oporto Conference on Knot Homology and Physics**, University of the Algarve: Faro, Portugal (2007)
- **Texas Geometry and Topology Conference**, Rice University: Houston, Texas (2006)
- **Texas Geometry and Topology Conference**, University of Texas at Austin: Austin, Texas (2005)
- **Texas Geometry and Topology Conference**, Texas Tech: Lubbock, Texas (2005)
- **Loop Quantum Gravity in the Americas**, Perimeter Institute: Waterloo, Ontario (2004)

Publications

- *Ground state degeneracy in doubled topological phases*
  Yuting Hu, Spencer D. Stirling, Yong-Shi Wu
  Phys. Rev. B 85, 075107 (2012)
  free download at http://www.arXiv.org/abs/1105.5771
- *Counterexamples in the Levin-Wen model, group categories, and Turaev unimodality*
  Spencer D. Stirling
  free download at http://www.arXiv.org/abs/1004.1737.
- *Braided categorical quantum mechanics I*
  Spencer D. Stirling and Yong-Shi Wu
  free download at http://www.arXiv.org/abs/0909.0988
- *Abelian Chern-Simons theory with toral gauge group, modular tensor categories, and group categories*
  Spencer D. Stirling
  free download at http://www.arXiv.org/abs/0807.2857.

- *Big bang nucleosynthesis with gaussian inhomogenous neutrino degeneracy*
  Spencer D. Stirling and Robert J. Scherrer
  Phys. Rev. D66 (2002) 043531
  free download at http://www.arXiv.org/abs/astro-ph/0206173.
- *Two dimensional dopant and carrier profiles obtained by scanning capacitance microscopy on an actively biased cross-sectioned metal–oxide–semiconductor field-effect transistor*
  V.V. Zavyalov, J.S. McMurray, S.D. Stirling, C.C. Williams, and H. Smith
  J. Vac. Sci. Technol. B 18, 549 (2000).

Awards

- **Geometry Research Group Fellowship**, Department of Mathematics, University of Texas at Austin (2007)
- **NSF VIGRE Fellowship**, Department of Mathematics, University of Texas at Austin (2001, 2003)
- **Theoretical Physics (TPU) Fellowship**, Utrecht University, the Netherlands (2002)
- **International Study Abroad Scholarship**, University of Texas at Austin (2002)
- **NSF REU Research Scholarship**, Department of Physics, The Ohio State University (2000)
- **University of Utah, 1996-2001**
  - Honors at Entrance Scholarship
  - Kennecott Scholarship
  - Semiconductor Research Corporation Research Scholarship
  - Utah Mathematics Faculty Nominee Scholarship
  - Stephen E. Newman, Jr. Mathematics Scholarship
  - Physics Outstanding Junior Scholarship
  - Physics Outstanding Sophomore Scholarship
- **Taylorsville High School, 1996**
  - Valedictorian
  - Sterling Scholar

Interests

Hiking/mountaineering, camping, skiing. Music and movies. Open source software (esp. GNU/Linux)