The date you completed or expect to complete your Ph.D and a one-sentence summary of its subject matter:
I completed my PhD in 2017 on the theory of interferometry experiments in fractional quantum Hall effect states.

An explanation of any relevant background you have in category theory or any of the specific projects areas:
The theory of anyons in the fractional quantum Hall effect is described in terms of braided monoidal categories. I learned Haskell because it seemed like it might help me understand that topic, and fell in love with it. A significant fraction of my education in category theory comes from Dr. Milewski's course and functional programing lore. I do not consider myself an expert in category theory, but think it is very interesting and want to learn more.

Order of project preference:

- Traversal optics and profunctors
- Simplifying quantum circuits using the ZX-calculus

To what extent can you commit to coming to Oxford (availability of funding is uncertain at this time):
I can commit to coming.

How can this school contribute to your research goals?
I am hoping this school will give me an opportunity to learn more about category theory with excited people. I have a couple of projects that I've been working on that I would consider applications of category theory.

- I've been working on a series explaining how to implement an anyon vector space in Haskell. I've just gotten to the part where it seems pertinent to discuss the braided monoidal category interface. This work seems like it has aspects in common with the ZX-calculus.
  `http://www.philipzucker.com/a-touch-of-topological-quantum-computation-in-haskell-pt-ii-automating-drudgery/`
- Another project I've been playing with is Automatic Differentiation using a Lens-like pattern.
  `http://www.philipzucker.com/bidirectional-applicative-programming-and-automatic-differentation/`
- I've also been attempting to build a user land version of Conal Elliot's Compiling to Categories.
  `http://www.philipzucker.com/compiling-to-categories-3-a-bit-cuter/`
- At my current job, I've been learning about convex optimization for optimal control. I've been working to find a useful categorical way of talking about that subject.

Philip Zucker

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www.philipzucker.com

EDUCATION

2011 – 2017 **Doctor of Philosophy, Physics, Brown University**

- Doctoral advisor: Professor Dima Feldman
- Doctorate conferred May 28, 2017
- Dissertation: "Novel Probes of Topological Order in the Quantum Hall Effect"

2007 – 2011 **B.S. in Engr. Physics, University of Pittsburgh**

- Minors in Physics, Mathematics, Electrical Engineering, and Materials Science

EXPERIENCE

Nov 2017 – Present **Software Developer, MIT Lincoln Lab**

- Built test and evaluation framework for the DARPA BRASS program
- Run on the AWS Elastic Container Service cloud platform
- Robotic arm project using the control package Drake
- Wrote code in Haskell, Purescript, and Python

Spring 2017 **Visiting Assistant Professor, Brown University**

- Taught course on topological materials aimed at undergraduates
- Covered topological band theory, the quantum Hall effect, and anyons.

2015 **Co-founder, Sheepdog LLC**

- Built and sold web app based attendance system for after-school programs.
- MongoDB and Node.js backend
- Angular.js frontend

SKILLS

Programming Languages

- Python
- Haskell
- Javascript
- Mathematica

Software

- Numpy
- Scipy
- Pytorch
- Onshape
- OpenCV
- LaTeX
- Git
- Docker
- Linux
- Gurobi

Mathematical

- Linear Algebra
- Differential Equations
- Convex Optimization
- Discrete Optimization
- Mixed Integer Programming
- Dynamical Systems

PUBLICATIONS

Phys. Rev. Lett. 117, 096802 Stabilization of the Particle-Hole Pfaffian Order by Landau-Level Mixing and Impurities That Break Particle-Hole Symmetry
Authors: P. T. Zucker, D. E. Feldman

New J. Phys. 17 115003 Edge mode velocities in the quantum Hall effect from a dc measurement
Authors: P. T. Zucker, D. E. Feldman

ADDITIONAL INFORMATION

Interests Machine Learning · Quantum Information · Topological Matter · Dependent Types Numerical Methods · Robotics · Radio (KC1EVX) · 3D printing · Mathematical Logic FPGA · Electronics · Reinforcement Learning · Optimal Control