

## Personal information

Surname(s) / First name(s)

Address(es)

Email(s)

Nationality(-ies)

Date of birth

**Cooper, Patrick James**

New York University, 4 Washington Place, New York, NY 10003

pjc370@nyu.edu

USA

April 30, 1987 (Pittsburgh, Pennsylvania)

## Education

New York University

Sept 2010 - Dec 2015  
New York City, USA

**M.S., Ph.D.** in Theoretical Physics

- Research Topics: Effective String Theory, Supersymmetry, Integrability of p-branon scattering, Confinement and the Gribov ambiguity
- GPA - 3.911

University of Pittsburgh

Sept 2005 - June 2010  
Pittsburgh, Pennsylvania

**B.Sc** in Mathematics and Physics

- Completed additional honors component for degree in Physics
- Completed additional honors component for degree in Mathematics
- GPA - 3.95

University of Oxford

Sept 2008 - June 2009  
Oxford, England

- Studied the equivalent of Oxford's second year physics program, as well as courses in mathematics, philosophy and literature.

## Research & Projects

New York University

Spring 2016

**The Instantaneous Dynamics of Yang Mills Theory**

Standard Feynmann diagram perturbation theory is useless for understanding the details of Yang-Mills theory in the infrared due to strong coupling. This article attempts to use non-perturbative techniques (The Instantaneous Schwinger-Dyson equations) to gain some insight about confinement using the Gribov-Zwanziger action in Coulomb gauge. (*to be published summer 2016*)

New York University

Fall 2015

**Origin of Confining Force**

The topological obstruction to gauge fixing a non-abelian gauge theory has been lurking in the background as a serious concern for IR physics in the standard model. In this article, we show how restricting the measure of the path integral of Yang-Mills theory to the so-called "Gribov Region" enhances the long range color-Coulomb potential, thought to be responsible for the phenomenon of confinement. (P. Cooper and D. Zwanziger, Phys. Rev. **D93**, 105024 (2016), 1512.05725)

New York University

Fall 2015

**The Gribov Ambiguity at Finite Temperature**

This research shows the consistency of the Maggiore-Schaden shift with the temporal periodicity condition of finite-temperature field theory and suggests the connection between the Gribov mass and the magnetic mass of the spatial gluons in finite-temperature QCD. (P. Cooper and D. Zwanziger, Phys. Rev. **D93**, 105026 (2016), 1512.08858)

New York University

September 2013 - September 2014

**Searching For Integrability on the Flux Tube**

A study of the complete landscape of integrable theories whose light degrees of freedom are Goldstone particles of spontaneously broken superspace symmetries. (P. Cooper, S. Dubovsky, V. Gorbenko, A. Mohsen, and S. Storace, JHEP **04**, 127 (2015), 1411.0703)

## New York University

April 2013 - September 2013

## New York University

October 2012 - August 2013

## University of Pittsburgh

May 2010 - August 2010

## University of Hamburg

May 2008 - August 2008

### Superluminality on the worldsheet of an effective string.

Examination of a novel theory with macroscopically acausal but UV-complete and Lorentz Invariant scattering of p-brane excitations using the thermodynamic Bethe Ansatz. This provides a non-trivial example of a 'wrong sign', yet UV-healthy theory. (P. Cooper, S. Dubovsky, and A. Mohsen, Phys. Rev. **D89**, 084044 (2014), 1312.2021)

### Reintroducing reparameterization invariance into effective string theories

I prove an isomorphism between effective string theories derived from a derivative expansion of geometric invariants, and those that follow from a CCWZ coset construction of spontaneously broken spacetime symmetries. (P. Cooper, Phys. Rev. **D88**, 025047 (2013), 1303.0743)

### GRW Decoherence

As a Brackenridge Fellow, I attempted to understand and simulate various features of a proposed theory of quantum measurement and presented my results at a year-end conference for the Fellowship program.

### Molecules of Degenerate quantum gases

I conducted research in Professor Klaus Sengstock's laboratory at the Institute for Laser Physics in Hamburg, Germany. We used laser trapping and evaporative cooling to create bound states of Bose-Einstein condensates with ultracold fermions. My role was mainly engineering, designing lab equipment in CAD, and incorporating it into the experiment.

## Teaching

### New York University

Spring 2016  
New York University

### Cooper Union

Spring 2013  
Cooper Union for the Advancement of Science and Art

### New York University

October 2011 - Present  
New York University

### University of Pittsburgh

April 2006, April 2010  
University of Pittsburgh

### The Logan School for Creative Learning

July 2015  
Denver, USA

### Adjunct Professor (lecturer)

- o Professor for an advanced undergraduate course on General Relativity, aimed at physics majors with interest in attending graduate school.

### Adjunct Professor (lecturer)

- o Professor for an advanced undergraduate course on General Relativity to students of the engineering school

### Adjunct Professor (Teaching assistant)

- o Teaching assistant for Physics I under Kyle Cranmer
- o Teaching assistant for Physics I under David Grier
- o Teaching assistant for Physics II under Andrew MacFadyen
- o Teaching assistant for General Physics I under Burton Budick (X2)
- o Teaching assistant for General Physics II under Andre Adler
- o Lab instructor for Intermediate Physics Lab under Andy Haas
- o Teaching Assistant for Quantum Mechanics II for Aditi Mitra
- o Teaching Assistant for General Relativity (graduate level) for Andrei Gruzinov
- o Teaching Assistant for Dynamics (graduate level) for John Lowenstein
- o Lab instructor for the Advanced Physics Lab (graduate level) for Andy Haas

### Various Positions

- o Grader for several courses ranging from Calculus I through Differential equations
- o Worked as a tutor at the Mathematics Assistance Center for 3 years teaching the full undergraduate mathematics curriculum.
- o Undergraduate teaching assistant for the physics department, teaching the full undergraduate physics curriculum.
- o Worked for the Academic Resource Center (ARC) teaching various topics in mathematics, physics, economics and other sciences.

### Logan Camp

- o Designed and led two, week-long summer camps on Physics and Robotics for children between the ages of 7 and 12 at Logan Camp.

## Private Tutoring

- Conducted regular private tutoring sessions about a broad range of topics for the last 10 years, especially but not limited to STEM from primary level arithmetic to post-graduate physics and mathematics.

## Outreach and Conferences

### Outreach

Spring 2013-Current  
New York, NY

### CoLab

I'm cofounding a non-profit where my current project is to write content for an open source online science textbook/tool for teachers. A very strong emphasis is placed on hands on learning, creative thinking, as well as integration with other subjects and current events.

### Pittsburgh Learning Commons

Founder and executive director of a non-profit aimed at running informal after school and summer educational experiences with a focus on project and skills based learning in the Pittsburgh area.

### TopHonors

I volunteered as "games leader" weekly for an after school math assistance program through the non-profit TopHonors.

### US Science and Engineering Festival

I headed the theory team for the ATLAS detector at the LHC at the national STEM festival in Washington D.C. There I explained various topics on the frontiers of physics to thousands of participants of all age groups.

### Little, Brown Books for Young Readers

I'm the science editor for the Space Taxi series, a series of science novels for kids.

### Invited talk at the NYC Atheist Society

I gave a public talk about the theoretical motivation and implications of the Higgs Boson discovery at the Large Hadron Collider.

### Invited Talks for the Society for Physics Students (SPS)

The Society for Physics Students at NYU often reaches out to me to give talks on various advanced topics to precocious undergraduates. I've given several talks on topics ranging from technical aspects of quantum field theory, to more civic endeavors about the ethical responsibility of a scientist.

### Invited Talk at the Center for Cosmology and Particle Physics (CCPP)

I gave the CCPP "Brown Bag" talk to all the graduate students, post docs and faculty working for the CCPP. My talk was about gauge theories from a more geometrical perspective, leading up to a discussion about the current state of the Gribov ambiguity, pitched at the level of a first year graduate student.

Summer 2016-Current  
Pittsburgh, PA

Spring 2015-Summer 2016  
New York, NY

Spring 2014  
Washington, D.C.

Spring 2012-present  
New York, NY

Winter 2014  
New York, NY

2014-Present  
New York, USA

Fall 2015  
New York University

## Conferences

March 2014  
New York, NY

### Left Forum

Organizers and intellectuals gather from all over to discuss contemporary political struggles. With the cofounders of my non-profit, I ran 2 panels, one about building a general purpose online platform for political organizing and the second about financially sustaining a value based organization.

### Digital Labor (#DL14)

Culture and labor theorists as well as activists gather to construct a meaningful concept of labor in an increasingly abstract and digital age. The theory is used as a tool in fomenting activist sentiments as well as developing collective action strategies.

### Physics of the Universe Summit

General talks presenting the current status of theoretical high energy physics and cosmology.

### Back to the Future of Particle Physics

A small conference sharing research about the future of particle physics in the post LHC era.

### Annual Joint Mathematics Meeting

Enormous, general conference on various boundaries of our mathematical understanding.

Nov 14-16, 2014  
New York, NY

Sept 19-21, 2014  
New York, NY

Sept 28-29, 2013  
New York, NY

January 9-12, 2013  
San Diego, CA

## Languages

Proficient

L<sup>A</sup>T<sub>E</sub>X, German

Moderate

Python, C/C++

Beginner

JavaScript, HTML, CSS, American Sign Language (ASL), and Spanish