

# Norman M. Cao

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<https://maplenormandy.github.io/>

## EDUCATION

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### Ph.D. in Applied Plasma Physics from Nuclear Science and Engineering Dept

June 2020

- Massachusetts Institute of Technology, Cambridge, MA
- Thesis title: *Characterization of a turbulence bifurcation underlying L-mode confinement transitions on Alcator C-Mod*
- Graduate GPA of 4.9 out of 5.0

### Bachelor of Science in Aerospace Engineering and Physics, Minor in Mathematics

June 2015

- Massachusetts Institute of Technology, Cambridge, MA
- Undergraduate GPA of 4.9 out of 5.0

## APPOINTMENTS HELD

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### Assistant Professor (Non-Tenure Track) / Courant Instructor / Simons Faculty Fellow in the Mathematics Department of the Courant Institute at New York University

Sep. 2020 – Current

- Fellow in the Simons Collaboration on Wave Turbulence fostering interdisciplinary research on the wave kinetic equation and other wave turbulence problems
- Instructor for several undergraduate math courses

### Research Assistant at the MIT Plasma Science and Fusion Center

August 2016 – June 2020

- Member of the core transport group working to understand plasma turbulence at Alcator C-Mod and other magnetic confinement fusion experiments
- Maintained and developed software for HIREXSR, an x-ray imaging crystal spectrometer which provided ion temperature and rotation measurements critical to many publications

## TEACHING POSITIONS

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### Courses Taught:

- NYU MATH-UA 140 (Linear Algebra), 148 (Honors Linear Algebra), 325 (Analysis).
- Sample syllabi available at <https://maplenormandy.github.io/teaching/>

### Research Mentor for high school student Sander Miller

Oct 2020 – Nov 2021

- Met monthly, involving the student in plasma physics research on Alcator C-Mod
- Project Title: “The Effects of Core-Edge Temperature Gradients on Intrinsic Rotation during H-Mode in Tokamak Reactors”

### TA for MIT 22.63 (Engineering Principles for Fusion Reactors)

Sep – Dec 2018

## SELECTED PUBLICATIONS BY TOPIC

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Complete bibliography available online: <https://scholar.google.com/citations?user=WQRmB8MAAAAJ>

### Geophysical fluid dynamics / wave turbulence

- Cao N M Rossby waves past the breaking point in zonally-dominated turbulence (*submitted to J. Fluid Mech.*)

### Turbulence bifurcations / confinement transitions in tokamaks

- Cao N M, Rice J E, Diamond P H, White A E, Chilenski M A, Ennever P C, Hughes J W, Irby J, Reinke M L and Rodriguez-Fernandez P 2020 Evidence and modeling of turbulence bifurcation in L-mode confinement transitions on Alcator C-Mod *Phys. Plasmas* **27** 052303
- Cao N M, Rice J E, Diamond P H, White A E, Baek S G, Chilenski M A, Hughes J W, Irby J, Reinke M L and Rodriguez-Fernandez P 2019 Hysteresis as a probe of turbulent bifurcation in intrinsic rotation reversals on Alcator C-Mod *Nucl. Fusion* **59** 104001

### Computational statistics / spectroscopy

- Cao N M and Sciortino F 2020 Bayesian Spectral Moment Estimation and Uncertainty Quantification *IEEE Trans. Plasma Sci.* **48** 22–30

## Fusion Engineering

- Kuang A Q, Cao N M, Creely A J, Dennett C A, Hecla J, LaBombard B, Tinguely R A, Tolman E A, Hoffman H, Major M, Ruiz Ruiz J, Brunner D, Grover P, Laughman C, Sorbom B N and Whyte D G 2018 Conceptual design study for heat exhaust management in the ARC fusion pilot plant *Fusion Eng. Des.* **137** 221–42

(Note: This was a group paper from MIT 22.63 Engineering Principles for Fusion Reactors, Spring 2016)

## SELECTED CONFERENCE PRESENTATIONS

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*Invited Talk:* “Hysteresis as a Probe of Turbulent Bifurcation in Intrinsic Rotation Reversals on Alcator C-Mod”, 61<sup>st</sup> APS-DPP Meeting; October 21-25, 2019; Fort Lauderdale, Florida

*Best Student Poster Prize Winner:* “Observation and Quasilinear Modeling of Rotation Reversal Hysteresis in Alcator C-Mod Plasmas”, 24<sup>th</sup> Joint US-EU Transport Task Force Meeting; March 18-21, 2019; Austin, Texas

*Invited Talk:* “Observation and Quasilinear Modeling of Rotation Reversal Hysteresis in Alcator C-Mod Plasmas”, 2<sup>nd</sup> Asia-Pacific Conference on Plasma Physics; November 12-17, 2018; Kanazawa, Japan

## HONORS AND AWARDS

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| ▪ Promising Young Scientist Prize at 10 <sup>th</sup> Festival de Théorie in Aix-en-Provence | <i>Jul. 2019</i> |
| ▪ Best Student Poster Prize at 24 <sup>th</sup> Joint US-EU Transport Task Force Meeting     | <i>Mar. 2019</i> |
| ▪ Student Festival Fellow at 9 <sup>th</sup> Festival de Théorie in Aix-en-Provence          | <i>Jul. 2017</i> |
| ▪ U.S. NRC Nuclear Education Graduate Fellowship Recipient                                   | <i>Sep. 2016</i> |
| ▪ Inducted into Sigma Pi Sigma and Phi Beta Kappa Society                                    | <i>Jun. 2015</i> |

## COMMUNITY ACTIVITIES

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**MIT Mystery Hunt** *Jan. 2012 – Current*

- Help organize a team every January for MIT’s famously challenging mystery hunt

**MIT Plasma Science and Fusion Center Outreach** *Sep. 2015 – June 2020*

- Regularly lead tours and engage in other fusion energy outreach activities

**Teacher for MIT Educational Studies Program** *Jan. 2012 – Nov. 2019*

- Taught one- to two-hour courses on different topics in physics and math to middle and high schoolers

## ENGINEERING EXPERIENCE

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**Project Engineer for KitCube, MIT 16.83 Space Systems Engineering** *Feb. – May 2015*

- Acted as primary technical liaison between subsystems as project engineer for this capstone class
- Designed a \$2 million CubeSat capable of entering and sending transmissions from lunar orbit
- KitCube later won **2<sup>nd</sup> place out of 13 teams** at NASA CubeSat Challenge Ground Tournament 1  
<https://news.mit.edu/2016/aeroastro-student-project-could-go-to-the-moon-0205>

**Mission Assurance Intern at SpaceX** *June – Aug. 2014*

- Developed integrated probabilistic risk analyses (PRA) for Crew Dragon systems
- Assisted in investigations of major F9 anomalies
- Designed and implemented metrics for tracking component and system reliability