Laying Off Jargon: Pop Science Writing and Teaching High School

Dr. Karmela Padavic-Callaghan, Spring 2021

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Outline

1. My work at UIUC and what happened next
2. Teaching at Bard High School Early College (BHSEC) Manhattan
3. Freelance Science Writing
4. Some tips
A caveat: I’m going to try and be very honest here. I haven’t really figured anything out and this is just what the last year has been for me + small skills I picked up along the way. Make your own judgements, take your own paths etc.
My work at UIUC

- Defended in February 2020, advisor: Prof. S. Vishveshwara, CMT and AMO theory
- Three points of focus: novel geometries for BECs, SSH ladders and topology, generalized AAH and quasiperiodicity
My work at UIUC

- GPS and the Access Network
- WGMPA
- GEO
- Physics/Art
What to do after defending?

Applied to a lot of postdocs in the fall of 2020 and throughout the winter.
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Some personal nonsense

- A five year long two-body problem and my husband was about to graduate from his PhD program at Yale University too
- Unexpected illness that landed me in the ICU around Christmas 2019, after a week on a respirator and multiple surgeries I was really shaken and doing a fair amount of soul-searching
- Went to spend Spring Break 2020 in Brooklyn with my husband and his parents (they live there) when COVID-19 got really bad, basically didn’t manage to return to Urbana until August when my lease expired
- In summary: things were bad and I was too sad and too tired to try and fight my way into some surprise postdoc
How did I end up at BHSEC-Manhattan?

- In Spring 2020 me and my husband were living in my in-law’s basement in Brooklyn, waiting for the pandemic to be over, and applying to jobs
- My husband defended his PhD from the basement, via Zoom, and got a postdoc at CUNY Grad Center, also via Zoom
- I was applying to jobs in:
  - Education (private high schools, community colleges)
  - Science outreach (after school programs, science and math museums)
  - Science communication (science writing, public information work)
Wrote three or four versions of my CV highlighting different experiences for different jobs

Put a lot of time into having a few very good cover letter templates that also showcased different talents (at a suggestion of a career advisor at the grad college approached this as a writing project and tried to show a bit of individuality)
How did I end up at BHSEC-Manhattan?

- I was applying to jobs in:
  - Education (private high schools, community colleges)
    - Had a ton of experience TAing at UIUC (pretty much every semester) and from UChicago as an undergrad + completed a teaching course as a part of the Mavis Fellowship + mentoring and organizing experience helps Science outreach (after school programs, science and math museums)
    - GPS, GEO, WGMPA and Physics/Art experience helped here
  - Science communication (science writing, public information work)
    - Had some experience but not enough “clips” (more about this later)
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  - Science outreach (after school programs, science and math museums)
    - GPS, GEO, WGMPA and Physics/Art experience helped here
  - Science communication (science writing, public information work) - **I got one job offer along these lines**
    - Had some experience but not enough “clips” (more about this later) - **I had some very good interviews and am still doing a fair amount of this work freelance**
What is a High School Early College?

Essentially students at BHSEC complete high school by grade 10 then earn an AA degree or 2 years of college credits in 11th and 12th grade. Everything is free and the school is fairly diverse. Part of the NYC public school system and Bard college.

“The mission of BHSEC is to provide a rigorous course of study that emphasizes thinking through writing, discussion, and inquiry. This alternative to the traditional high school is founded on the belief that many young people are ready and eager to do serious college work at age sixteen. Based on the premise that these young adults’ ambition to learn must be taken seriously, BHSEC’s four-year program enables highly motivated students to earn a high school diploma and a tuition-free Bard College associate’s degree in four years.

Love of learning dominates the culture of BHSEC. Our rigorous curriculum allows students to fulfill all of the Newark Public Schools requirements through an engaging and demanding college-level education. Mastery of subjects at BHSEC is demonstrated by our students’ reasoned analyses and by their thoughtful and well-supported arguments for their views. Ninety-five percent of BHSEC graduates successfully move on to a four-year college.”
How did I end up at BHSEC-Manhattan?

Interview with the whole science department and the principal + demo class in the 9th grade (all over Zoom)
What do I do at BHSEC Manhattan?

- Since I’m not a department of education certified high school teacher, I am an employee of Bard College and my title is Assistant Professor. My current position is for three years, but were it to be extend and if I get certified I would also be eligible for tenure within Bard College.
- I teach a 9th grade Conceptual Physics Class and a 12th grade college-level elective (in the fall I taught Calculus II, now I have been given freedom to design and implement a Modern Physics class).
- We had blended in-person and remote learning for about 6 weeks in September and October and have been remote ever since, I teach … from my kitchen (luckily we moved out of my in-law’s basement right around when school started, but we still live in Brooklyn).
- The work is very different than TAing and much harder (but also more rewarding when you manage to catch your breath).
CONCEPTUAL PHYSICS II
SPRING 2023, Spring 2021, Dr. Kathy Gallagher

Welcome to CONCEPTUAL PHYSICS II. In this course, you will develop a deeper understanding of the principles of physics and how they apply to the world around us. We will focus on concepts rather than detailed mathematics, allowing you to see the big picture and understand the underlying principles of physics. This course is designed to be accessible to students with a variety of backgrounds and to help you build a strong foundation in physics.

**Who should you care about this course?**

Physics is a fundamental science that provides a comprehensive and accurate model of the physical universe. It is essential for understanding the physical world around us. Physics is applied in many fields, such as engineering, technology, medicine, and more. It is a crucial subject for anyone interested in pursuing a career in any field related to science and technology.

**What is this course about?**

This course provides an introduction to the fundamental principles of physics. The course covers topics such as mechanics, electromagnetism, waves, and thermodynamics. We will use real-world examples and applications to illustrate the concepts and help you understand how physics affects our daily lives.

**What will you get out of this course?**

- Enhance your critical thinking and problem-solving skills.
- Develop a deeper understanding of the world around you.
- Gain insights into the role of physics in modern technology and society.
- Improve your ability to communicate scientific ideas.

This course is suitable for anyone interested in physics, regardless of their background. Whether you are a current student or a lifelong learner, this course is designed to be accessible and engaging.

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**Modern Physics**

Stream: [Course Name]

- [Week 1: Intro + What is Quantum]
  - [Video 1: Intro to Quantum Mechanics]
  - [Video 2: Quantum Physics: Key Concepts]
  - [Quiz 1: Quantum Mechanics]

- [Week 2: Light and Mathematics of Waves]
  - [Video 1: Light and Waves]
  - [Video 2: Mathematics of Waves]
  - [Quiz 2: Waves and Light]
The rest of my talk will be about writing. Any questions so far?
How did I get around being a freelance science writer?
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- Defects may help scientists understand the exotic physics of topology, IQUIST News
- Ultracold Molecule Mystery Solved, Scientific American
- Identical Quantum Particle Pass Practicality Test, Scientific American
- Time's Arrow Flies Through 500 Tears of Classical Music, Physicists Say, Scientific American
- The Coolest Physics You've Ever Heard Of, Scientific American Observations/Opinion Blog
- Fast Quantum Random Number Generator Could Advance Cryptography on the Cheap, Physics World
- Ultracold Atoms Can Work Together To Shape Or Steer Light, New Scientist
- Deborah Jin Engineered New Quantum States of Matter - Twice, Massive Science
- Physicists plucked and collided two ultracold molecules with laser tweezers, Massive Science
- The International Space Station creates bigger, colder states of matter than are possible on Earth, Massive Science
- Hands-on at a distance: Making sense of physics with Jill, University of Illinois Urbana-Champaign Physics Department home page
- Physics learning for the future: Developing new ways of thinking with Eric, University of Illinois Urbana-Champaign Physics Department home page
- Creativity and authenticity are key ingredients for successful student-led DEI advocacy, Science on a Postcard Blog
- Amidst National Reckoning with Racial Injustice the Physics Community Reflects on Its Own Inequities, A Science Blog by Science Talk
- Quantum Physics is Easier to Understand as an Adventure, Lifeology Blog
- I'm Losing Count, The Xylom
How did I get around being a freelance science writer?

- The Xylom + newsletter (personal essay writing)
- ComSciCon-AIP + Science Talk
- Opinion piece in Scientific American that was workshopped at ComSciCon-AIP and where a mentor helped me with the pitch
- Two blog contributions (Lifeology and Science on a Postcard) based on what I learned and heard about at Science Talk
- Joined the NPR SciCommers Slack and Massive Science Consortium
- Debbie Jin piece on Massive Science (there is an internal pitching process where you get help and don’t have to search for editor’s emails by black magic)
- Started pitching to magazines: three pieces in Scientific American, one New Scientists, one Physics World (these are paid! SciAm pays ~1000$ for 800ish words).
- Public information work with IQUIST and IPaSS at UIUC
- Joined National Association of Science Writers
- Getting more freelance work by editors contacting me instead of me pitching them (but there is less and less money for freelance work at many magazines right now)
- Occasionally some company will reach out and ask for freelance work, I’m still testing the waters on this.
How did I get around being a freelance science writer?

- Hardest and most important part: pitching stories to editors
- Sometimes they don’t write back at all and sometimes you can’t find their email
  (generic emails that are pitches@publication.com instead of a name don’t get read by anyone + need to go through groups like NPR SciCommers etc and find someone who has contacted an editor before if the information is not listed anywhere public)
- Sometimes your pitch is just bad
- Mostly it takes a lot of time to do enough background research to write a really good pitch (a big challenge if you’re also, for example, teaching high school)
HI EDITOR,

I hope you have been doing well.

I am writing with two story ideas I think you and your readers would find fascinating. One is about a new platform for quantum computing that could lead to engineering of larger quantum computers without sacrificing the fidelity of information transfer within them and the other focuses on a recent study that used methods from nonequilibrium physics and statistics to quantify properties of over 8000 pieces of classical music. Below are more detailed pitches for both stories. I’d be happy to reach out to relevant experts when writing them.

I am a freelance science writer based in Brooklyn, NY and I hold a PhD in theoretical physics. The focus of my PhD research was in ultracold and quantum systems. I have recently written about quantum physics for Scientific American’s Opinion section here and Massive Science here. I am looking to take on more freelance work and would be very excited to write about this study for Wired.

ANALYZING FIVE CENTURIES OF CLASSICAL MUSIC SHOWS THAT ENTROPY-PRODUCING TUNES ARE MOST LIKEABLE

While the thought of playing songs in reverse might make you think of conspiracies and hidden messages, scientists are using ideas about time reversibility to quantify features of music we find pleasant as listeners. In a recent study published in Physical Review Research, a team of scientists used nonequilibrium physics and statistics tools to study over 8000 musical pieces originating across five centuries and consequently pinpoint how time-reversible and non-random music really is. Using novel statistical techniques, their work offers a mathematical foundation for our common experience of music being very different than noise. In other words, this study attaches measurable quantities to the notion that a musical composition is “going somewhere” rather than being generated at random.

The notion of statistical time reversibility is associated with an “arrow of time” or a clear direction in which time progresses, allowing us to define what it means to move forwards and backwards in time. Processes that are statistically time reversible are ignorant of the arrow of time and, under a quantitative analysis, seem the same when the arrow is flipped. White noise is one example. More surprisingly, so-called pink or 1/f noise, widely accepted as a valid description of composed music, is another example. The authors of this new study find the 1/f noise description of music to be imprecise – most compositions in their sample display time irreversibility. Irreversible processes are more ordered and less random, so one implication of this finding is that composing music is an out-of-equilibrium process. In equilibrium, all musical components would be evenly distributed rather than ordered. An equilibrium distribution would also have large entropy or disorder and look the same in all time directions. The ordering process i.e. composing can then be assigned a certain amount of lost energy and a change in entropy. The authors of this study even compare famous composers on how irreversible and how energy dissipating their work is. For instance, they find that Mahler’s compositional style on average produced more entropy than Paganini’s. Their work then not only challenges the so far accepted idea of music as 1/f noise, but also points towards a relation between time irreversibility and attractiveness of music to the listener.

I think this article could work well at 800-1000 words. In writing it, I would start with basic explanations of how music can be quantified, how thermodynamic equilibrium is related to randomness or disorder while more ordered systems are considered out-of-equilibrium, and how entropy is related to energy loss for a physical signal. The rest of the article would recount the Physical Review Research study, briefly touch on the fact that the authors used a new statistical method particularly well-suited to musical composition and outline their results. Since this study has made strides in quantifying the “musical narrative” we experience while listening, it could be interesting to close the article by noting that there have been musicians that have experimented with more random means of generating musical compositions in the past, but their music is less widely known and less commonly enjoyed than for instance Mozart. Looking through past writing about music and science in Scientific American, there seem to have been many interesting reports on how music affects our thinking and cognition, but not necessarily as many focusing on how music itself can be studied as a mathematical and physical object. I believe your readers may be interested in this perspective of why music is pleasant not just based on how our brains take it in, but also quantifiable properties of music itself.
Time’s Arrow Flies through 500 Years of Classical Music, Physicists Say

A statistical study of more than 8,000 compositions shows how the flow of time distinguishes music from noise

By Karmela Padavic-Callaghan on August 19, 2020

READ THIS NEXT

BEHAVIOR & SOCIETY
What Makes a Song? It’s the Same Recipe in Every Culture
November 21, 2019 — Jim Dalev
Things I learned about science writing

- You have to try a lot even though you will often not get assigned stories
- At the beginning it’s ok to write for free especially at places like Massive where you get training, but don’t get stuck there for too long
- Talk to people and use all the resources you can get, NPR SciCommers has a mentoring program where a real NPR editor helps edit and pitch your piece, The Open Notebook has a database of pitches
- Your pitches will be awful more often than not, other people need to look at them before you hit send (you are never as good of a writer as you think and editors are brutal)
- Interviewing scientists is really fun (and having a PhD means you speak insider language)
- You can’t use jargon and you have to be snappy, you have to be less jargony and more clever than even when you’re talking to a 9th grader
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Things I learned about science writing

- There’s a lot more public information work than there is freelance magazine work, these are more stable jobs and include some creativity, but you don’t choose your own stories as much and you’re working to market the university/lab you work for vs. just exploring and explaining cool science.
- As a freelancer you are running yourself as a business and have to send invoices, make sure you get paid, worry about taxes etc.
- Time management and being reliable is extremely important.
- Social media and LinkedIn are surprisingly important, as is word of mouth.
- There are master’s programs for science writing (that cost money) and the AAAS Media Fellowship which pays you and embeds you at a magazine.
- It’s probably possible to make a living as a freelancer but not in a year and maybe not in NYC.
Thanks for bearing with me!

Questions?