BROWN UNIVERSITY PHYSICS: UNDERGRADUATE JOURNAL CLUB

INTRODUCTIONS

Alex Jacoby

- Rising junior in Mathematical Physics and Pure Math.
- 2 years of research at Georgetown U. (Non-equilibrium quantum statistical dynamics) and 2 years with Professor Marston at Brown (quantum magnetism, information theory); both Condensed Matter Theory. I also worked for Professor Spradlin (High Energy Theory) for a summer. Generally, I am interested in the intersection of Condensed Matter and High Energy Theory.
- Current research project: reconstructing quantum spin chains from the entanglement of their ground states.

Lucas Brito

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OUTLINE

Flow of Today's Meeting:

- What are we trying to accomplish here?
  - We hope to foster an environment where students develop a skillset that will aid in physics research.
  - We are especially conscientious that you are all in different stages of your physics education and are committed to ensuring that programming events are highly accessible to younger students – particularly first years! We also feel strongly that full participation in journal club should not require an intensive background in physics.
- A first mini-programming event: getting to know the different subdisciplines of physics.
- A second programming event: how to search the physics literature (arXiv, Google Scholar, etc).
- Going forward and how you can help us improve.
- We'll keep the Zoom open for a while after the meeting, so feel free to hang out and share feedback.

GOALS OF THIS CLUB

The Central Mission:

- The goal of this program is to give you as many resources as we can to help you succeed in your physics research.

- Physics research can feel very formidable, but we strongly believe that there are some tools, skills, and central ideas that are useful in all branches of physics.
  - Oftentimes students pick up these tools as they go along (just like we did!) but this can leave you in the dark for long periods of time when you would have really benefited from some early exposure. Learning these tools on the front end can make the totality of your research career a lot easier.
- We also feel strongly about making this an inclusive environment.
  - We are especially interested in making the programming accessible to younger students, students with zero research experience, students who are just beginning their studies of physics.
  - All you need is an interest in physics research.

GOALS OF THIS CLUB

- Meetings 30 minutes – 60 minutes each. We'll end as appropriate.
- Tentatively, we're doing Wednesdays at 6pm EST for the most part.

- We hope to focus on the following three distinct types of programming events:
  1. Becoming familiar with engaging the literature (by way of a journal club).
  2. Developing concrete research skills.
  3. Guest lectures on contemporary research topics.

GOALS OF THIS CLUB

2. Developing research skills
   - Finding papers. Using the arXiv and Google Scholar. How to maneuver journal access (today!)
   - Reading papers. What's the difference between a theory paper and an experiment paper? What are general strategies to approaching papers?
   - The many programming languages used in physics. What are the most widely used ones? In what settings are each of them useful? Python workshop to learn the basics.
   - LaTeX (mathematical typesetting language). Why use LaTeX? LaTeX workshop to learn the basics. The various formats, packages, etc.
   - Finding research opportunities. How to find a lab group. How to introduce yourself to faculty? How to ask about a faculty's research? How to get funding? Should I stay with the same advisor for multiple years?
   - Literature reviews. How to write a literature review? How do you even know when you've found all the relevant literature?
   - Work-life balance. How to balance a healthy workload?
   - Communicating Physics. How to give a good poster session. How to give a good PowerPoint talk.

GOALS OF THIS CLUB

3. Guest lectures on contemporary research topics.
   - Predominantly from faculty, post-docs, and more experienced graduate students.
   - An introduction to their field of study as a whole and their research in particular.
   - Q&A

- Two final things to emphasize:
  1. We are trying to make these events as inclusive as possible especially to younger students with fewer years of formal physics training. If we do not live up to this, please tell us!
  2. There is no such thing as a stupid question. If you're wondering it, then others are too. You should generally feel free to interject with questions and not worry about being judged by your peers. The goal is to learn how to do physics research, and we're all working towards this together.

A FIRST MINI RESEARCH-SKILLS DEVELOPMENT
WHAT ARE THE DIFFERENT TYPES OF PHYSICS RESEARCH?

Name	Theory	Experiment
Condensed Matter	Phases of matter. Properties of crystals. Many-body Physics. Superconductors. Superfluids.	Experiment with 2d objects. Physics at low temperature. Electrical properties of materials
Astrophysics/Cosmology	Evolution of universe and Big Bang. Formation of galaxies, stars, etc. Dark matter and energy.	Observe space with huge telescopes. Data imaging. Dark matter detection.
High Energy Physics	Particles. String Theory. Quantum gravity. Black holes. Phenomenology. Origin of spacetime.	Detecting new particles. Data analysis and building new parts for LHC. Work at detectors.
Biophysics	Physics of biological systems. Cell dynamics. Enzymes. Proteins. Medical physics.	Hands on work with biological systems. Cultivating cells. Medical imaging.
Chemical Physics	Atomic and molecular physics. Chemical reactions and processes. Spectroscopy.	Study very small systems (individual atoms/ molecules)
Mathematical Physics	Develop novel math to make physics rigorous. Often study relativity and quantum mechanics.	-
Engineering	Mechanical. Electrical. Chemical. Aerospace. Environmental. Nuclear. Biomedical.	Hands on work to study and build materials and systems.
Geology/Geophysics	Physics of the earth. Weather. Oceans. Global warming. Tectonics. Volcanos.	Taking geological measurements. Examining mineral samples, etc.

RESEARCH-SKILLS DEVELOPMENT
HOW TO FIND PHYSICS PAPERS

First Tool: The arXiv

https://arxiv.org

What is the arXiv?

- The arXiv is a massive repository of scientific papers from many different fields (including physics).
- Note that the arXiv is merely a repository – not a journal. It is not peer reviewed. While the arXiv attempts to have moderators combing through submissions, it's impossible to check everything. Authors, however, must meet a minimum standard to posting something: they must receive an endorsement. That is to say, someone who has published multiple papers in this subfield and is named an endorser by the arXiv must give it the green light. Being an endorser is not a very stringent condition. I imagine all Brown professors can do it. The endorsement policy ensures that authors belong to the scientific community and can be a barrier to deceitful papers.
- The arXiv was created in the mid 1990s by Paul Ginsparg and adopted by the community shortly thereafter. Accordingly, you won't be able to find every physics paper ever published there. You'll only be able to reliably access the ones from 2000 onward, though some from before too. Nowadays, everyone posts all their papers on the arXiv (in addition to peer review), so the arXiv can reliably give you all* the recent literature.

RESEARCH-SKILLS DEVELOPMENT
HOW TO FIND PHYSICS PAPERS

First Tool: The arXiv

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Peer review

- To be peer reviewed means that other physicists have read through your work and believe it to be novel and of a reasonable quality and correctness. Having a peer reviewed paper lends credibility to the work. This is especially true if you're not an established name. When you submit a paper to reputable journals, they will peer review it before publishing it themselves.
- Often, papers aren't quite at the proverbial finish line on first submission, and the referees (peer-reviewers, mostly professors) will submit what is known as a "revise and resubmit." This means that they found your paper worthwhile but think some more development is needed before it's ready to be published; things like filling out sections and correcting errors. It is, however, a good thing to receive a revise and resubmit because it means it's something the journal would like to see published.
- Life cycle on peer review can vary wildly. Papers can spend years in process or be published in weeks.

RESEARCH-SKILLS DEVELOPMENT
HOW TO FIND PHYSICS PAPERS

First Tool: The arXiv

https://arxiv.org

Why use the arXiv?

- It's free.
- It is a single platform where you can see the entirety of the new body of physics work coming out in a particular day. That is, you can see all* of the physics papers submitted on any given day without having to search through the various physics journals.
- It can often take a while for a completed paper to appear in a journal . The arXiv is an immediate way to get your paper out to the community and to have the community thinking about your work without any delay time.
- Collogues can comment on your research and offer feedback (not very often).

RESEARCH-SKILLS DEVELOPMENT
HOW TO FIND PHYSICS PAPERS

First Tool: The arXiv

https://arxiv.org

A tour of the arXiv website…

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First Tool: The arXiv

https://arxiv.org

Subscribing to the arXiv

A final point about the arXiv

- A lot of time when you are in research settings (journal clubs, informal notes between you and your advisor, etc.) you're going to see people reference papers not by their name but by their arXiv serial number. Be on the lookout for them and don't get confused when people just drop a paper's arXiv number without giving you any further instructions.
- For example, you'll often hear people say "As discussed in 2006.08594…" Now you know what this means.

RESEARCH-SKILLS DEVELOPMENT
HOW TO FIND PHYSICS PAPERS

Second Tool: Brown's Software Catalog

https://www.brown.edu/information-technology/software/

How can you reliably find papers published earlier than 2000?

- These papers will have been published in one of the many physics journals. There will almost always be an online version of them (even important papers dating back from a century ago).
- The trouble is that having a subscription to these journals is not free. Some journals can even charge $20-$30 to "buy" a single paper.
- Fortunately, there is a workaround! Brown University has already paid the subscription fees, so you don't have to! The catch is that you need to be on Brown WiFi for the journals to recognize that you've already paid. This can sound particularly troubling especially in light of remote learning during COVID-19. Not all is lost though! Brown has a VPN service. This means that if you install a program on your machine, then it can "look" like you're actually on Brown's campus when you're remote. When you toggle the VPN on, you can get all the papers for free, no sweat!
- The above link will send you to Brown's software catalog where members of the community can download a whole swath of resources that Brown has paid for (all free of charge). It's a very good resource to know about.
- Some papers are available for free online, especially famous older ones. If you just look up the title, there are free pdfs available at university websites.

RESEARCH-SKILLS DEVELOPMENT
HOW TO FIND PHYSICS PAPERS

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What else can you use a VPN for?

- The computer algebra systems Mathematica and MATLAB are very useful tools to help you do symbolic math (computing very hard integrals for you for example).
- You can download these programs from the above software catalogue, but they typically require either a VPN or residency on Brown's campus.
- However, if you don't want to use a VPN, you can get permission to use them anywhere if you email Brown's software/IT people and ask for permission (it's usually approved no troubles).

RESEARCH-SKILLS DEVELOPMENT
HOW TO FIND PHYSICS PAPERS

Third Tool: Google Scholar

https://scholar.google.com/

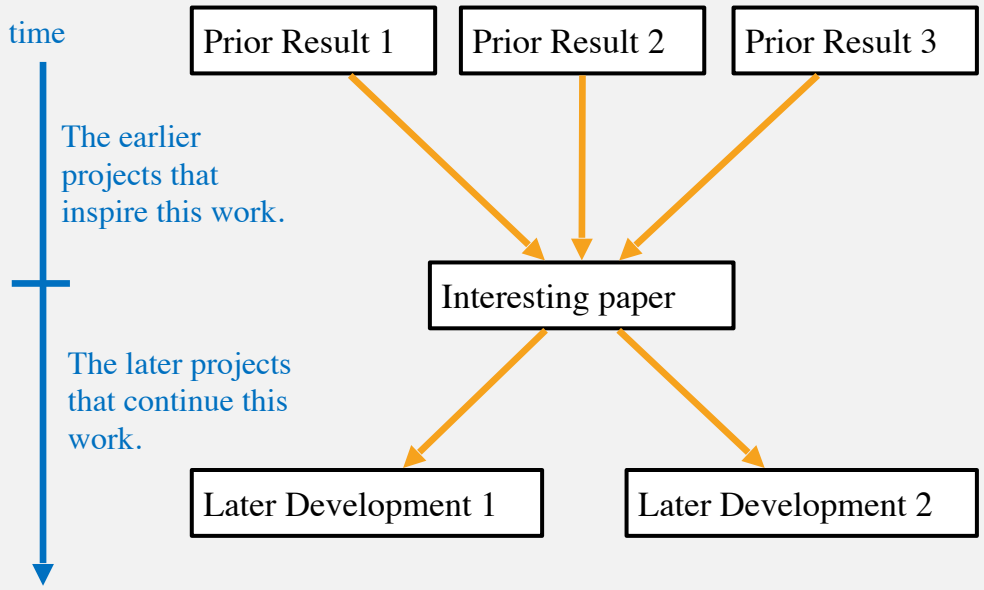
What is Google Scholar?

- Google Scholar is a search engine that gives you an easy way to access the full body of scholarly literature – and only scholarly literature.
- One can find any paper that has been published using this search engine as well as several other types of scholarly works (e.g. books, lecture notes, etc.)

Why use Google Scholar?

- Search the physics literature (including papers before 2000).
- Look at the body of work developed by a particular scholar.
- Can create citations.
- Find the 'network of related papers'

The Network of Related Papers:



RESEARCH-SKILLS DEVELOPMENT
HOW TO FIND PHYSICS PAPERS

Third Tool: Google Scholar

https://scholar.google.com/

A tour of the Google Scholar website…

MOVING FORWARD

- We are really interested in growing this group and want to put your needs first. The whole point of this is to develop research skills among undergraduates, so we cater to you! Let us know if there are things you want to see and things we could do better.

AGENDA FOR NEXT WEEK