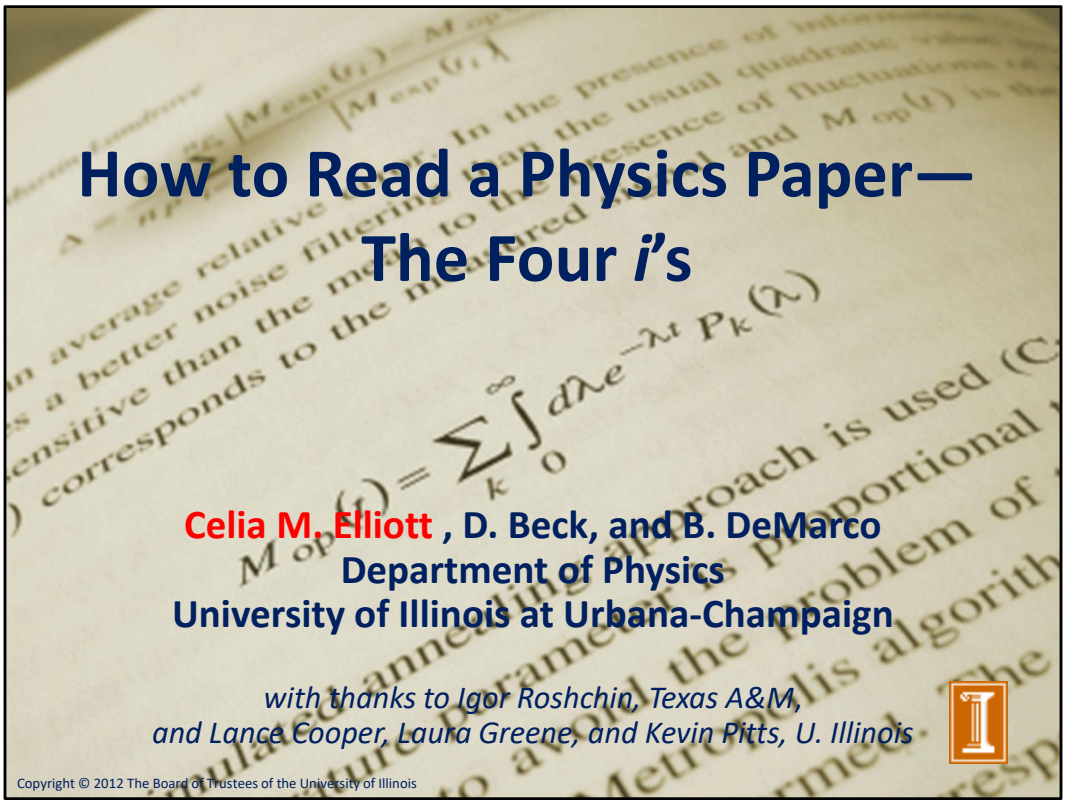
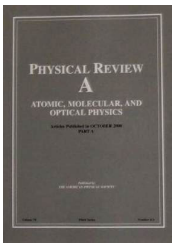
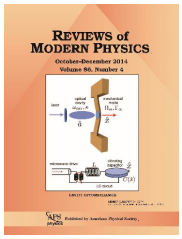


In this talk, we'll look at how scientists read journal articles—which generally is not to begin at the beginning and read every word through to the end. We'll consider why this unconventional, bouncing around reading style is advantageous and how you can use it to identify papers that are worth the time and effort to read thoroughly.

Introduction

- **Peer-reviewed papers are the primary means of communication in physics**
  - **Official record**
- **Three broad categories**
  - **high profile/"cutting-edge"**
  - **"bread & butter"**
  - **"review": synthesis**

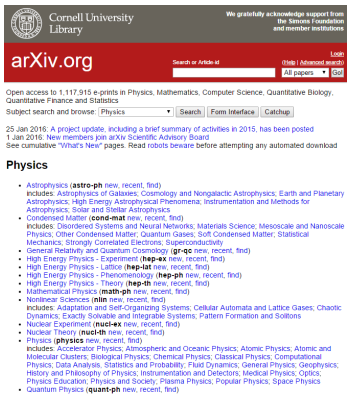




Depending on your field, there is discussion about "expert" peer-review vs "community" review (posting a paper and letting everyone comment) but at the end of the day people need to know the work has been vetted. This allows us to build on work without having to reproduce everything ourselves.

Philosophy

- **Read to learn about developments in your area**
  - **Most important use of what follows in this talk**
  - **Not a linear process, it will take a while**
- **Read to learn about something new or for interest**
  - **Scan the arXiv each week via RSS feed!**
  - **Physics ideas are interconnected**



-Learning about developments is something that is continuous in physics and often you have to start from ground zero on new topics.
-A lot of the newest science comes at the intersection between fields, cross-fertilizing ideas and techniques

A reading method

The four *i's*

Importance
Iteration
Interpretation
Integration

How do we read papers?

-As quickly as possible figure out the importance

-Read iteratively: quickly with notes, then more carefully

-Then interpret in your own words: write down a summary

-Finally, evaluate how the paper fits with your work, your knowledge, the field. Integrate with what you know.

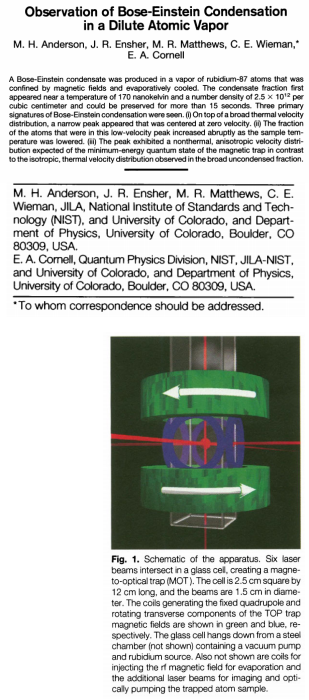
The first *i*: *importance*

Does the paper contain information (methods, results, conclusions) that has implications for your research?

- Read the title and the abstract
- Look at the author list and their affiliations
- Read the conclusions
- Look at the figures and captions

Is the paper worth reading?

- Study or go on?



Observation of Bose-Einstein Condensation in a Dilute Atomic Vapor

M. H. Anderson, J. R. Ensher, M. R. Matthews, C. E. Wieman,* E. A. Cornell

A Bose-Einstein condensate was produced in a vapor of rubidium-87 atoms that was confined by magnetic fields and evaporatively cooled. The condensate fraction first appeared near a temperature of 170 nanokelvin and a number density of 2.5×10^{12} per cubic centimeter and could be preserved for more than 15 seconds. Three primary signatures of Bose-Einstein condensation were seen. (i) On top of a broad thermal velocity distribution, a narrow peak appeared that was centered at zero velocity. (ii) The fraction of the atoms that were in this low-velocity peak increased abruptly as the sample temperature was lowered. (iii) The peak exhibited a nonthermal, anisotropic velocity distribution expected of the minimum-energy quantum state of the magnetic trap in contrast to the isotropic, thermal velocity distribution observed in the broad uncondensed fraction.

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Fig. 1. Schematic of the apparatus. Six laser beams intersect in a glass cell, creating a magneto-optical trap (MOT). The cell is 2.5 cm square by 12 cm long, and the beams are 1.5 cm in diameter. The coils generating the fixed quadrupole and rotating transverse components of the TOP trap magnetic fields are shown in green and blue, respectively. The glass cell hangs down from a steel chamber (not shown) containing a vacuum pump and rubidium source. Also not shown are coils for injecting the rf magnetic field for evaporation and the additional laser beams for imaging and optically pumping the trapped atom sample.

Scientists are busy, and far more papers are published every year than anyone could reasonably be expected to read.

The first step is to determine whether a paper is worth your time, i.e., determine its importance to your research.

Note that your purpose for reading a paper (and hence your focus) may vary from paper to paper. In some cases, you'll want to concentrate on the methods or techniques described, to determine if they could be adapted for your project, and you won't care about the authors' specific results or conclusions. Other times, you'll care just about where a point sits on a graph. How do you figure this out ...

Take author list with a grain of salt : Looking to see who wrote the paper is an important data point, but certainly not the only one. If someone whose affiliation is in a department of industrial engineering has written a paper announcing some world-shattering discovery in quantum measurement theory, you would rightly treat that paper with more skepticism than a paper written by Tony Leggett. However, young people and new people make important discoveries all the time, and some of the best work has been done in what might be considered unexpected places (e.g., Ernst Ising [Ising model] spent his whole career in the United States [after fleeing Nazi Germany] at Bradley University in Peoria, Illinois).

This whole process should take 20 min. Note that it's ok at any stage to put a paper aside and decide it's not even worth 30 min yet – based, for example, on just the title and

abstract. Eg. if you're looking for an experimental paper and you can tell you have one on theory, stop as soon as you can.

Second *i*: *iteration*

1. Skim the article and identify its structure
   Many (not all) papers:
   IMRD: Introduction, Methods, Results, Discussion
2. Find main points of each section
3. Generate questions: active reading
4. Read to answer questions
5. Iterate!

Take notes as you read!

Are answers in textbook or previous manuscripts?

Second *i*: *iteration*

Take the paper apart, section by section, and identify the key ideas

Highlight anything you don't understand

Cross-check the narrative with the figures and tables

Go back and re-read your highlighted sections; refer to the references or supplementary info

Repeat until you thoroughly understand the parts of interest to you

More specifics …

The third *i*: *interpretation*

Put the paper aside and write down the key ideas in your own words

Check what you've written against the paper; have you correctly represented the information and emphasis of the original paper?

Are there parts that you still don't understand? (go back to *iteration*)

Do you agree with what the authors have said? Have they provided sufficient detail and supporting evidence?

If I don't do this, I find I can't come back a week later and reconstruct my thoughts on the paper from my notes alone.

The final *i*: *integration*

Evaluate how the information presented in the paper fits with what you already know

Does it contradict something that you believe?

Does it raise new questions that you should investigate?

Does it describe a method that you could use?

Is it something that you should refer to in the future? (If so, how are you going to keep track of it?)

Evaluate the paper in the context of what you know or are interested in.

Decide what you want to do with your new knowledge. Maybe it goes into a file for current research maybe it goes into an “idea” file or a “general quantum” file.

QUIZ

How many hours does it usually take Prof. Mason to read a four-page paper and really understand it?

vs.

A. 30 minutes
B. 1 hours
C. 2 hours
D. 4 hours
E. 10 hours

4 hours (for a paper in our field!)