A couple quick announcements

Colloquium Tomorrow: Nonthermal particle acceleration by magnetic pumping in pulsating plasmas

Giuseppe Arrò (U. of Wisconsin - Madison), 2:30 in G09

The origin of high-energy particles in astrophysical sources is still debated, especially in high-beta plasmas, where magnetic energy is insufficient to cause nonthermal particle acceleration. However, high-beta plasmas are often embedded in large-scale compressible flows that could accelerate particles via magnetic pumping (MP), a mechanism where the plasma is energized by instabilities driven through cyclic compression and expansion (pulsation). In this work, we investigate particle acceleration by MP in high-beta "pulsating" plasmas, showing for the first time that MP efficiently accelerates particles, producing nonthermal distributions with high-energy power-law tails. Our results are relevant for understanding particle acceleration in high-beta astrophysical plasmas, including planetary magnetosheaths, the intracluster medium of galaxy clusters, and accretion disks of compact objects.

While not every speaker does well at this, colloquium are supposed to be mostly understandable by freshmen.

STEM Career Fair Thursday
Consider going after class

- It ends at 3pm
- Located at the student rec center

Friday, September 25 at 10:00 AM

- **Mike Snodgrass, AI Specialist at Google, and Ola Adekunle, Senior Patent Counsel at Google**
- **The Future of AI at WVU: How Google Thinks About the Changing AI Landscape**
  45-minute presentation and live demos + Q&A
- A significant part of the session will consist of live demonstrations of AI applied to different tasks and applications.
- This is an opportunity to see what current AI tools can do, how they can be used, and where they may help. The speakers will also discuss AI literacy, data and intellectual property, governance, and the development of custom AI tools.
- **The talk is open to everyone, including students.**
  https://wvu.zoom.us/j/94180487824?pwd=8cklQgRFBgKraVhalQxgSgGcfQEhP0.1

Get in these late assignments if you haven't yet!

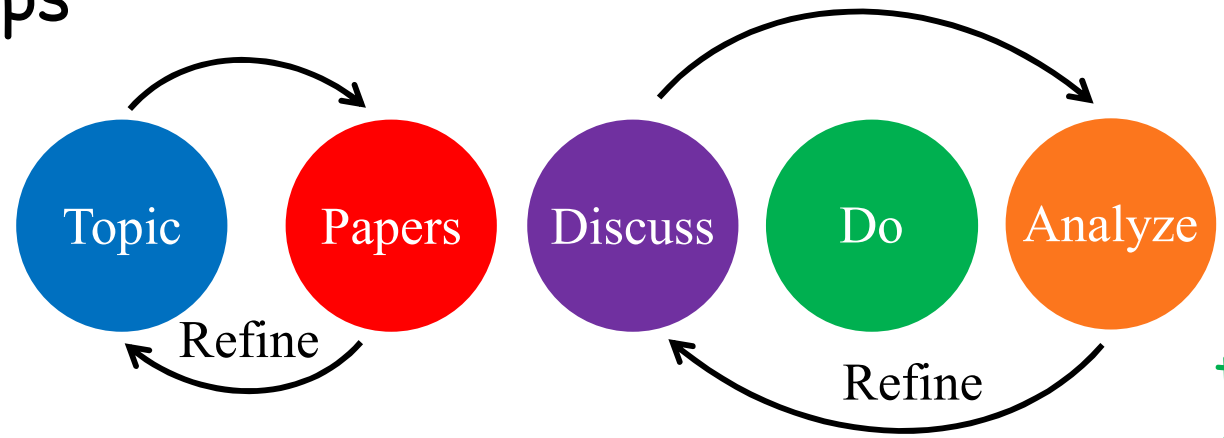
Important Papers (2-5) 1-2 sentence summary and why relevant to your work? (Disuss later)

Upcoming:
Thursday: Discussing your projects in class (not formally graded)
Next Tuesday: Reading on Perusall about other characterization methods
Following Thursday: Project Proposal!!!

Date	293 Topic	Homework (with goals color)
18-Aug	Pre-Surveys; What is this Class About?	Partner/Scheduling Info
20-Aug	Distinguishing Types of Magnetism	Reading 1 on Perusall
25-Aug	Holcomb Group Discovery	Reading 2 on Perusall
27-Aug	MOKE versus Other Magnetometry	Watch Video on Perusall
1-Sep	Project Planning: What Kinds of Magnetic Measurements	Syllabus Read/Agree
3-Sep	Finding Published Papers Relevant to Your Project	Bring a Related Paper to Class
8-Sep	Reading and Evaluating Papers	
10-Sep	Best Practices with Lab Notebooks	University Safety Requirement
15-Sep	MOKE Hands-On Demonstration	
17-Sep	VSM Hands-On Demonstration	Important Papers. Why? (2-5)
22-Sep	How to Give Peer Feedback and Group Project Planning	
24-Sep	Planning Group Oral Reports and Peer Grading	Mini Reports (in class)
29-Sep	Group Project Planning and Refinement	Quality Reading on Perusall
1-Oct	Assessing the Quality of Materials	Project Proposal
6-Oct	Best Practices with Graphing	Good/Bad Graphs
8-Oct	Fall Break (No Class)	
13-Oct	Introduction to Excel: Spreadsheets, Graphing and Fitting	
15-Oct	Understanding and Processing Your Data	Lab Notebook Check-In
20-Oct	Building a Story with Your Data When It Isn't Obvious	
22-Oct	Check-In and How Are Materials Grown	
27-Oct	How to Give a Good Talk	
29-Oct	Peer Evaluation of Lab Notebooks (Bring Notebooks)	
3-Nov	Election Day (Vote If You Can)	
5-Nov	Project Speed Dating: Share Your Project with Others	Graphs of Your Data
10-Nov	Time for groups to Discuss Presentation/Data Planning	
12-Nov	Eight Minute Group Presentations	Presentations
17-Nov	Eight Minute Group Presentations	Presentations
19-Nov	How to Write a Good Abstract	
1-Dec	Ask Your Final Questions of Instructor, Partners or Class	
3-Dec	Discussion of Research and Scholarship Opportunities	Abstract & Notebook

Phase 1: Me teaching you enough to start to work within groups

Phase 2: Working within your group to plan, do, analyze results and communicate them



Simplified course workflow

You are allowed to iterate on the experiments too if you have time, but don't have to.

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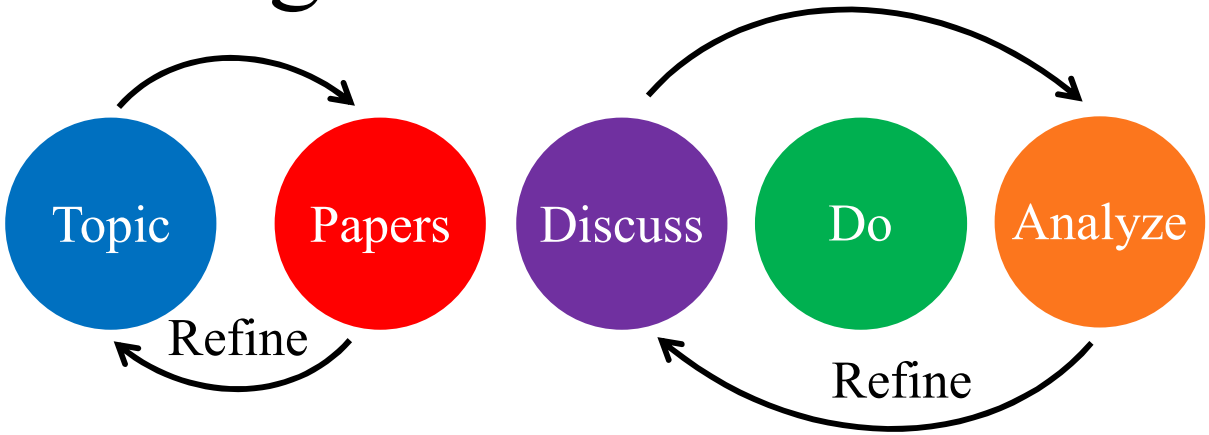
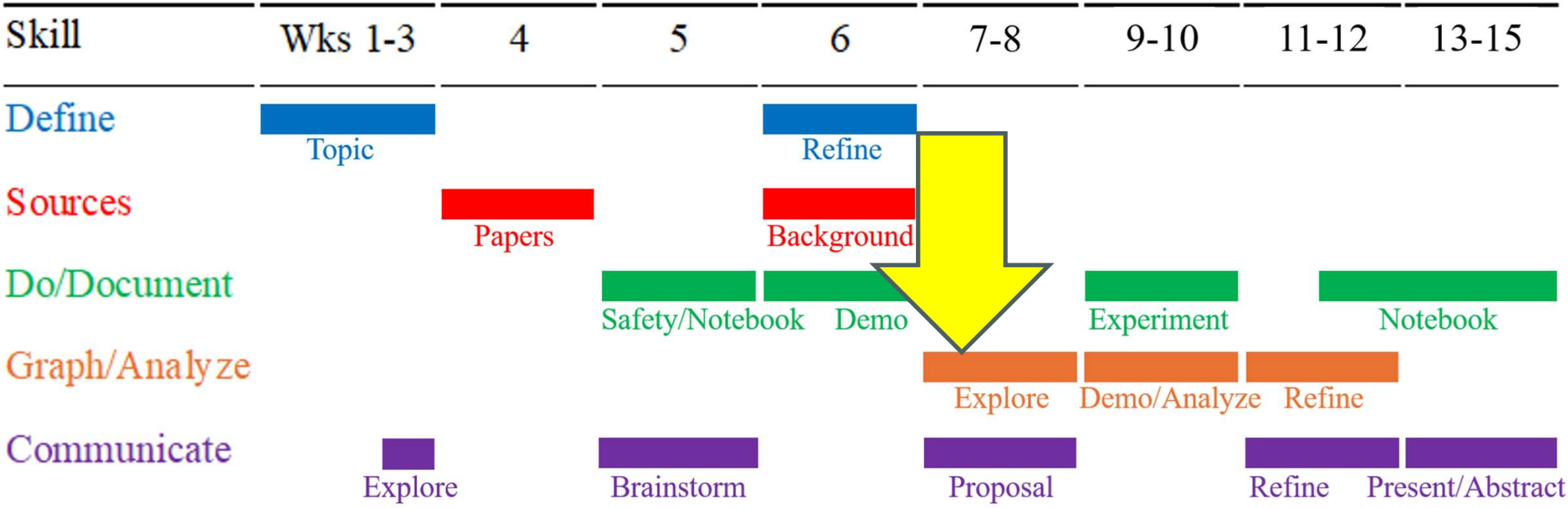
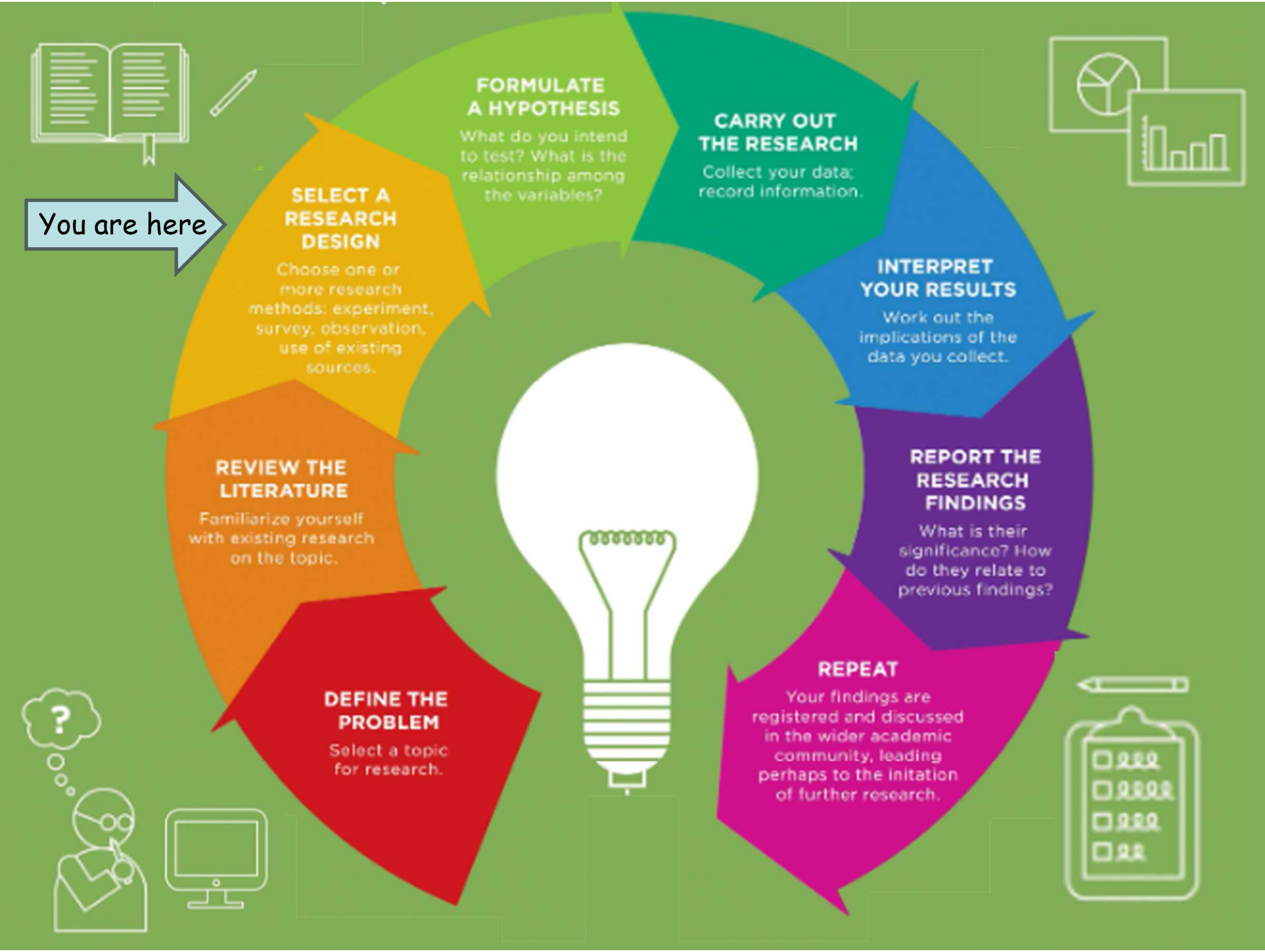
Today: The Class Focus Shifts

This class is based off of feedback. Your ideas right now probably still need work. That's what we are doing over the next two weeks.





Less simplified course workflow


You are here
DEFINE THE PROBLEM
Select a topic for research.
REVIEW THE LITERATURE
Familiarize yourself with existing research on the topic.
SELECT A RESEARCH DESIGN
Choose one or more research methods: experiment, survey, observation, use of existing sources.
FORMULATE A HYPOTHESIS
What do you intend to test? What is the relationship among the variables?
CARRY OUT THE RESEARCH
Collect your data; record information.
INTERPRET YOUR RESULTS
Work out the implications of the data you collect.
REPORT THE RESEARCH FINDINGS
What is their significance? How do they relate to previous findings?
REPEAT
Your findings are registered and discussed in the wider academic community, leading perhaps to the initation of further research.

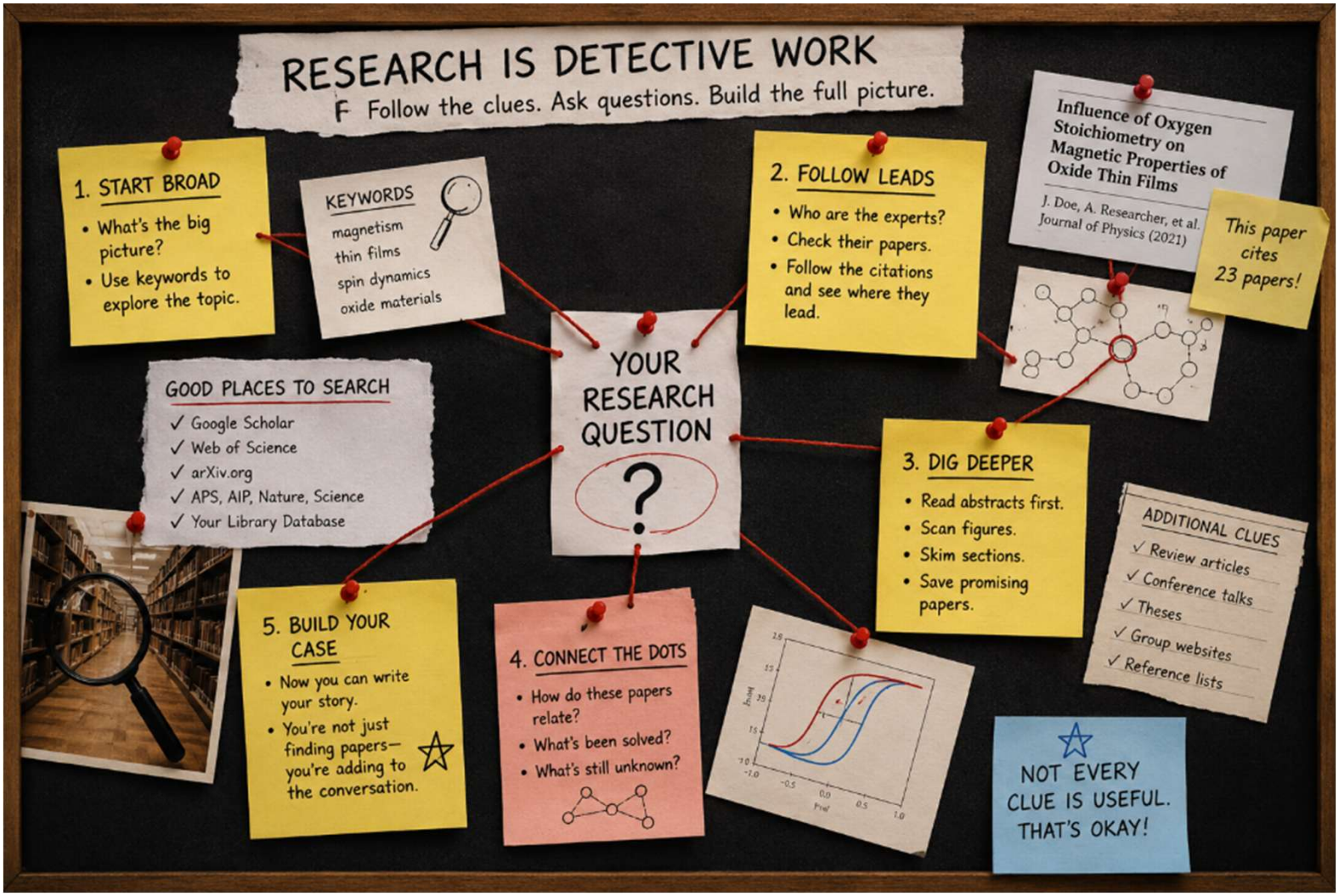
Training wheels are allowed

It's okay if you need help defining why a project matters or how to get started.

By the end of the semester, I want you to be confident talking about what you're studying, why it matters, and how you're investigating it.

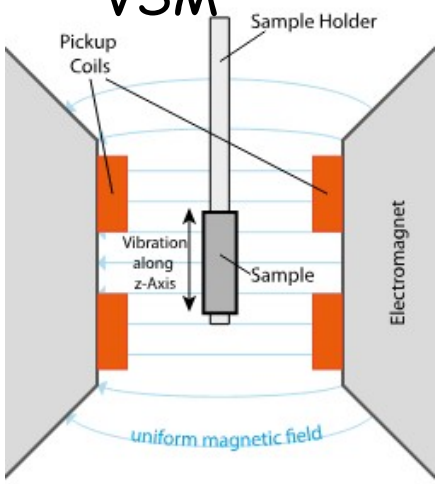
Brainstorm with your team. Learning how to work through ideas as a team is an important part of doing science. Explaining your ideas to others is one of the best ways to understand them better yourself.

Helpers: Professor, TAs, team, other peers, past 293 students, librarians

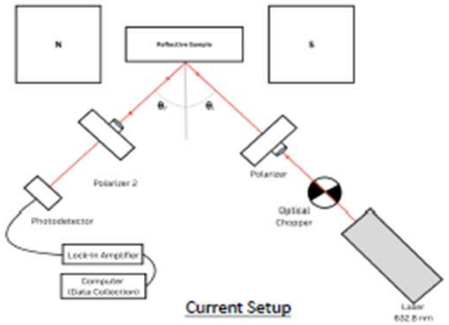


Except you get to pick your case (from a subset of case files)

VSM



Two measurement options

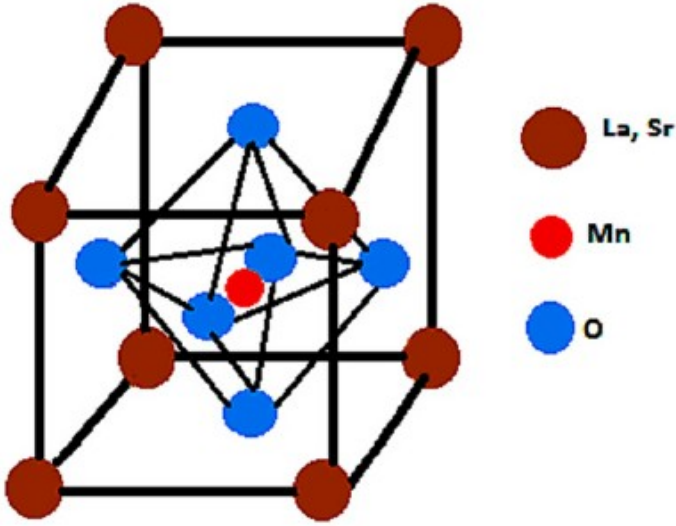


MOKE (not for powders)

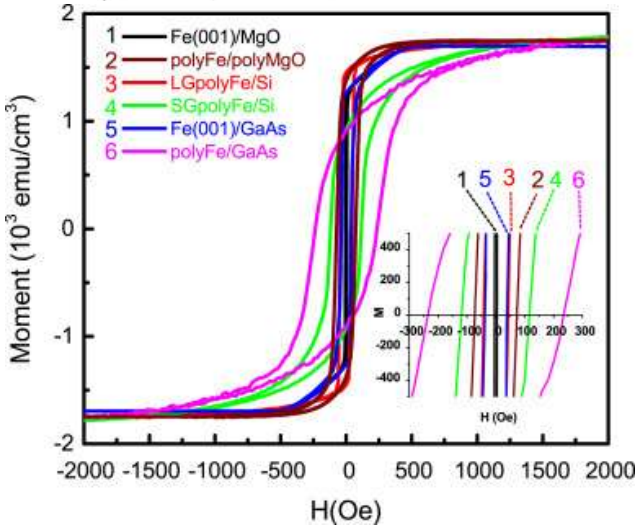
Fingerprint powders

Do magnetization affect print quality?

Reminder: Your Case File Selection

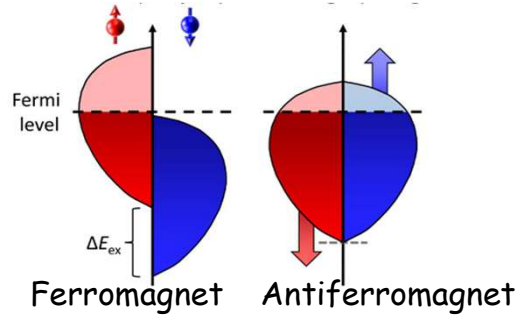


LSMO for PMA and/or spontaneous magnetization reversal



Fe thin film (good MOKE calibration, thickness dependence, cap layers, exchange bias with cycling)

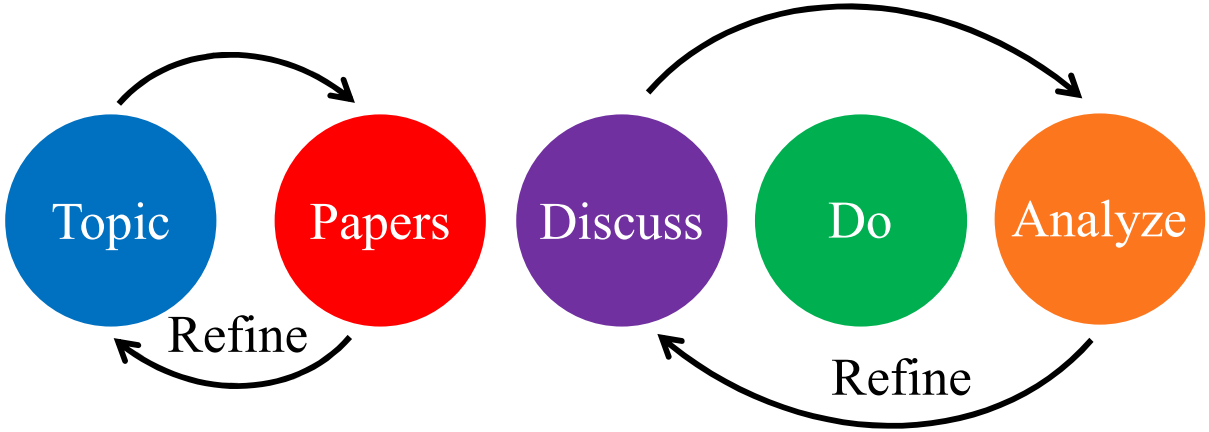
Matt Brahlek @ Oak Ridge: Old $MnBi_2Te_4$ with Te cap, MnTe-Bi_2(Te or Se)$_3$ interfaces, or YIG



Altermagnets

In a few minutes you will brainstorm with your groups.

- What material will you measure? Why scientifically is this material interesting?
- Why do you think this work could be important?
- What kinds of magnetic measurement planned? What temperatures or applied fields do you think make sense to look at? Why do you think that?
- What do you expect to observe? (~Hypothesis)



Next time you will discuss these questions with classmates not in your group to get feedback.

Thus, let's spend a few minutes on how to give good peer feedback.

Both sides important

THE BENEFITS OF PEER REVIEW

SELF-AWARENESS	• Fosters metacognition • Builds awareness of academic strengths, areas for improvement, and achievement goals
SELF-MANAGEMENT	• Managing impulses • Identifying their own positionality and competency
SOCIAL AWARENESS	• Considering another's perspective • Tailoring their message to the audience
RELATIONSHIP SKILLS	• Builds cultural competency • Developing emotional responsiveness • Builds perspective
RESPONSIBLE DECISION-MAKING	• Experiencing social consequences of how recipient receives feedback • Ownership of a role in building a writing community

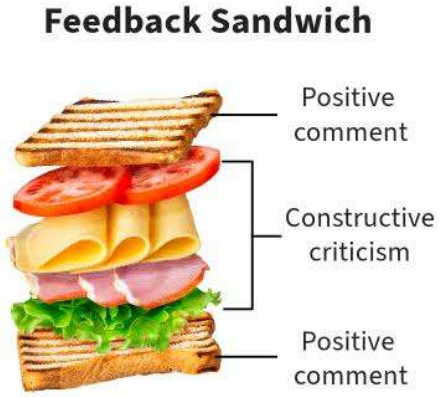
writetheworld.org

Science is full of peer review on posters, papers, proposals and teaching, so best to get practice!

Critiquing others helps you better critique yourself.

Giving Good Peer Feedback

- "It's terrible" *even if true* is not helpful.
- But neither is "it's great."



What works?
What is unclear?
What could make it better?

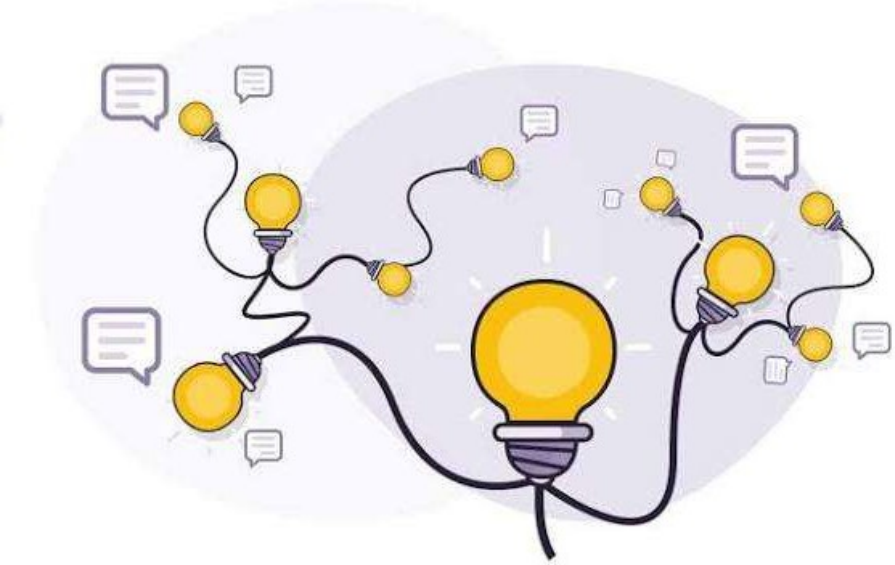
Useful feedback helps someone take the next step.

While these tips may be more helpful next time, you should still keep them in mind within your groups too.

Keep in mind

None of you knew any of this stuff 6 weeks ago.

Don’t be too harsh. You are still learning, but **how can you make the most of the next 10 weeks?**



Science is teamwork!

This Time: Brainstorm with Groupmates (Ask me questions!)
Next class: Discuss with Others

- What material will you measure? Why scientifically is this material interesting?
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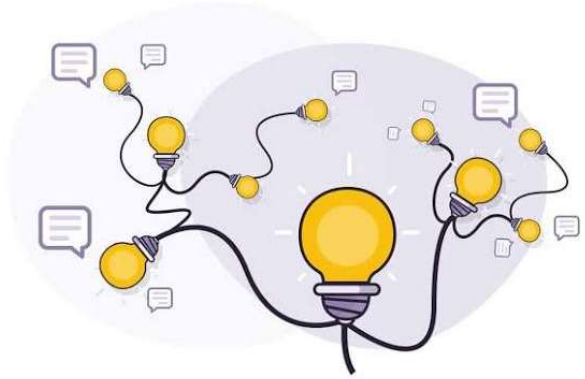

Idea Workshopping Let's Get Examples.

What material will you measure? Why scientifically is this material interesting?

Why do you think this work could be important?

What kinds of magnetic measurement planned? What temperatures or applied fields do you think make sense to look at? Why do you think that?

What do you expect to observe? (~Hypothesis)

It's ok not to have every answer yet, but we are trying to get most of the way there by Thursday!

More Brainstorming with Groupmates (Ask me questions!) Next time: Discuss with Others

- What material will you measure? Why scientifically is this material interesting?
- Why do you think this work could be important?
- What kinds of magnetic measurement planned? What temperatures or applied fields do you think make sense to look at? Why do you think that?
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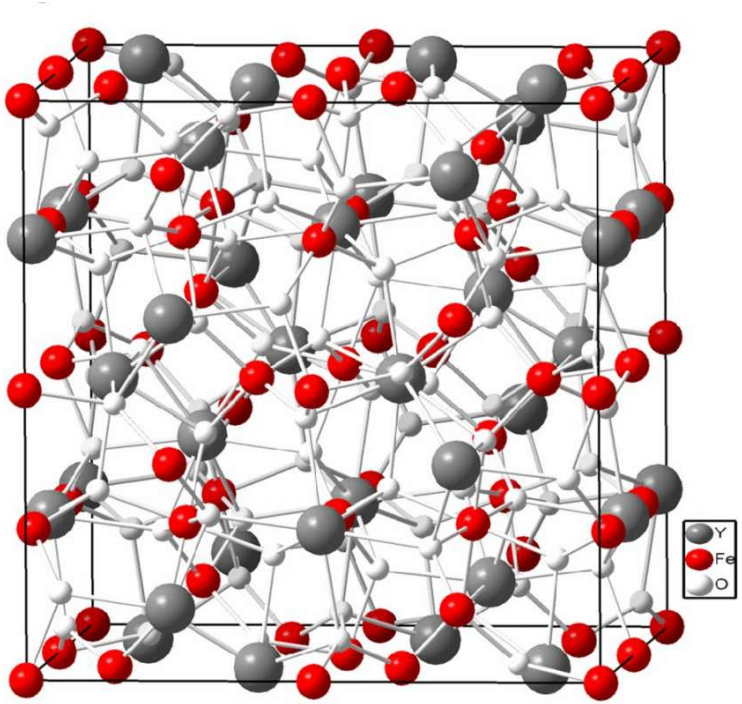
$MnTe\text{-}Bi_2(Te \text{ or } Se)_3$ Topological Insulators

- What happens when electricity flows through a normal copper wire. The wire gets warm because electrons bump into atoms—this is electrical resistance.
- **The Problem:** This is a waste of energy.
- **A Solution? Topological Insulators** are completely insulating on the inside, but they have a "perfect highway" on their outside surfaces where electrons can travel completely unimpeded, with zero resistance. Additional spin benefits!!!

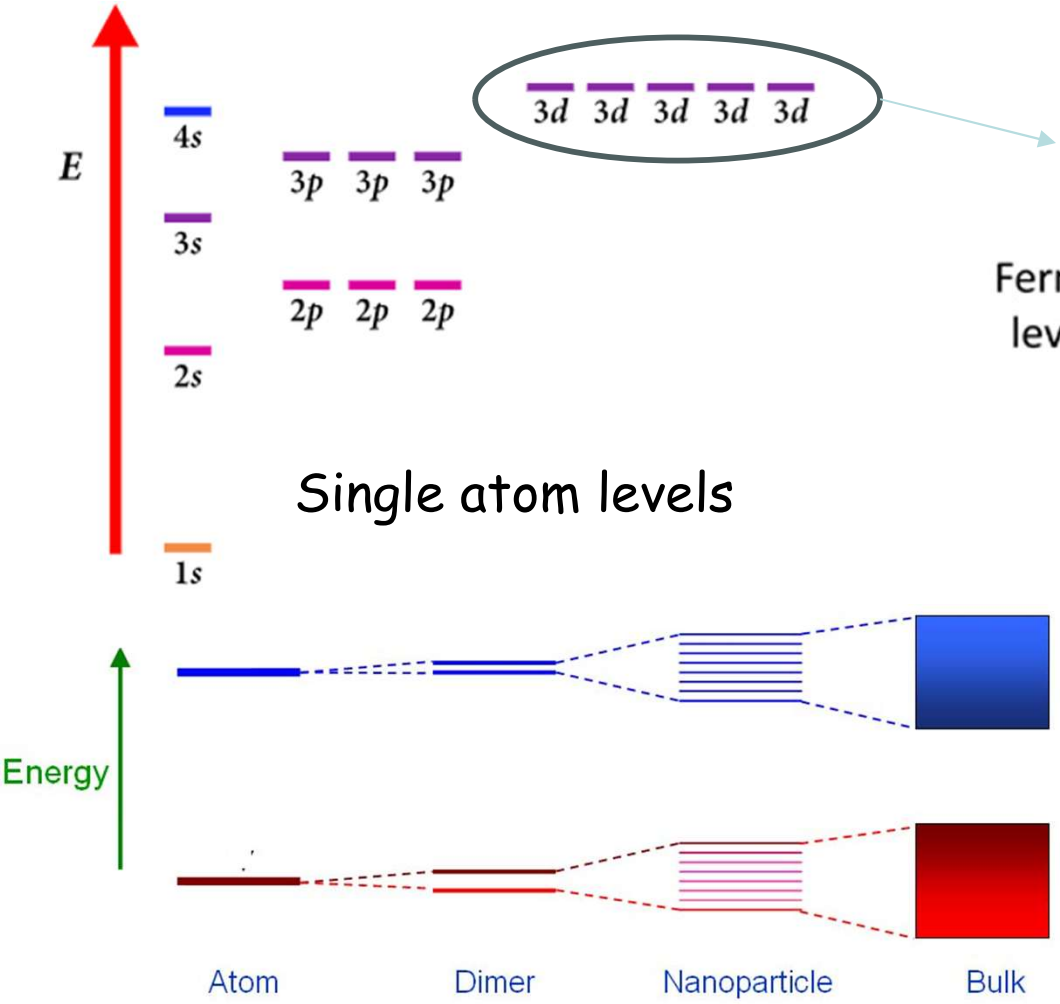
Yttrium iron garnet [YIG, $Y_3Fe_5O_{12}$]

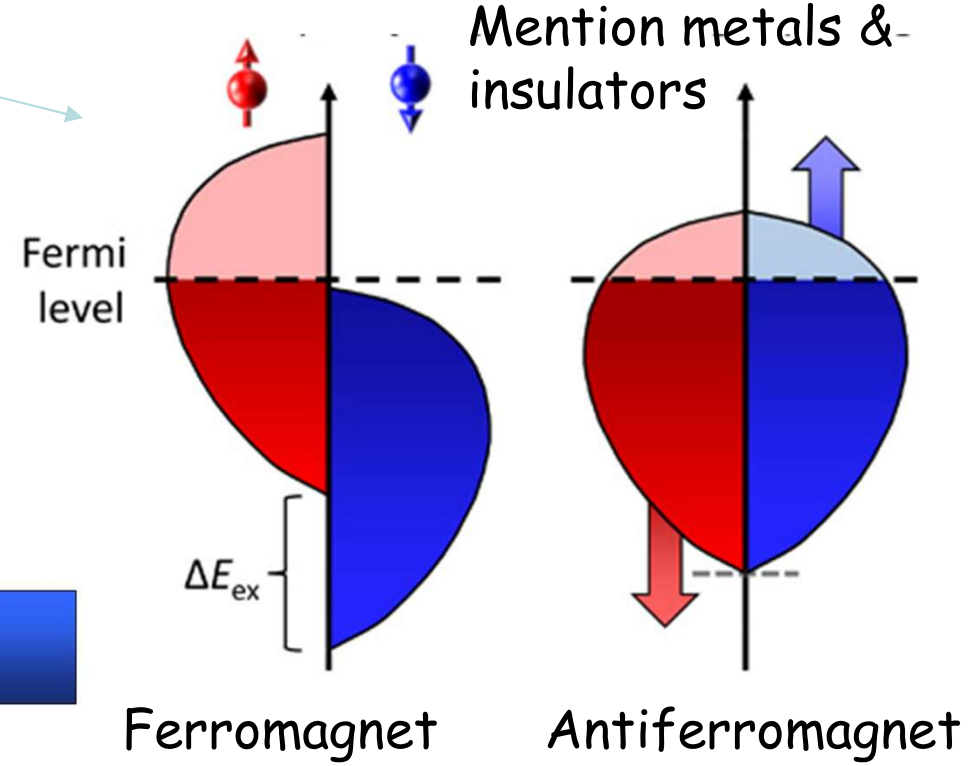
- Ferrimagnetic insulator famous for its ultra-low magnetic energy loss and coherent spin-wave propagation
- High Curie temperature of approximately 560 K to 600 K



In materials these levels become bands of potential energies.

And these bands can be different for spin up/down.





My imperfect understanding of altermagnets is that they look like ferromagnets, BUT which directions is more energetically favorable (lower) depends on which way they are moving. This could be important for advanced circuits!