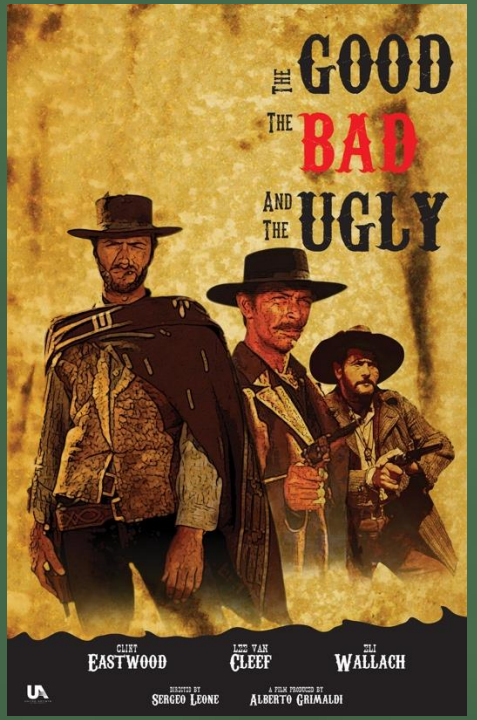
Introduction to Physics and Astronomy Research including Graduate School Research

Dr. Mike Strauss
(presented by Dr. Arne Schwettmann)
For the OU REU Program

Research:
The Good, the Bad, and the Ugly

- Many REU students are new to research.
- We hope that your summer research will be substantial, challenging, interesting, and even fun.
- This talk is meant to give you an accurate picture of what it takes to succeed at the highest levels of research.
- Undergraduate research expectations are commensurate with their experience. (Biggest concern from survey: Not being prepared, or able to understand, or able to contribute.)



Goal of Research

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- Discover something previously unknown about the natural world.
- To confirm aspects of current theories that have not been confirmed.
- To understand something more fully that is partially known.
- To measure something more precisely.

- Basic scientific research (scientist) is not the same as technological applications (engineer). Some fields of science are more easily applicable than others.

Research Demands

What is required to succeed in research?

- Dedication
  - Your research should be of highest priority. Spend time on the important things even if they are not urgent.
- Productivity
  - Productivity matters, not just putting in time. If you don't produce results, how much time you spent working is somewhat irrelevant.
- Self-Motivation
  - No required classes. Not just an 8-hour day.
- Creativity
  - What you are doing, by definition, has not been done before.

Research Demands

What is required to succeed in research?

- Perseverance
  - At some point you will hit a wall. Research is hard. You must be dedicated, or you will quit when this happens. People who simply try graduate school rarely succeed.
- Carefulness
  - In research, your final results shouldn't be wrong. Any mistakes in a publication is truly problematic. Be careful doing each step.
- Thoroughness
  - Good enough often isn't. Don't let anomalies go. Ask tough questions about the results.
- Others?

Graduate School Curriculum

Is graduate school simply 6 more years of classes?

- No
- The first two years or so of graduate school involve taking classes and maybe taking qualifying exams.
  - You will take mechanics, E&M, quantum mechanics, statistical thermodynamics, etc. at the graduate level, plus advanced classes.
- The next three years or so will consist of doing original research with the guidance of a research advisor.
  - Doing research is more like a job than like traditional classes.
- Most graduate students in physics and astronomy get stipends as teaching assistants or research assistants and do not incur any debt.

Graduate School and an REU

How might this REU relate to future graduate studies?

- Part of the selection criteria for our REU program was your interest in further studies in Physics and Astronomy.
- This summer may help you decide if you like doing research and want to pursue graduate studies.
- This summer research may help prepare you for the kind of research you would do in graduate school.
- Survey Results:
  - First summer REU? Yes: 10, No: 2 (For non-OU students: Yes 8, No: 0)
  - First research at all? Yes: 5, No: 7 (For non-OU students: Yes 4, No: 4)

Graduate School in Physics or Astronomy

Why go to graduate school?

Only go to graduate school if the job you want requires graduate education.

- A Ph.D. is a research degree which requires that you do original research.
- Careers involving research in physics and astronomy require a Ph.D.
- Almost all higher education jobs require a Ph.D.
- Many job opportunities outside of pure research are enhanced with a Ph.D.
- Almost all physics and astronomy graduate students apply for the Ph.D. program.

Graduate School in Physics or Astronomy

Is there any reason to get a Masters Degree?

- A masters degree does not usually provide new opportunities in pure science research fields.
- A masters degree may provide opportunities for teaching at a high school or 2-year college.
- A masters degree may help job prospects in the corporate world.
- Very few people apply to graduate school pursuing a terminal masters degree in Physics and Astronomy.

Research and Graduate School Challenges

- Imposter Syndrome
  - Everyone else is doing fine and they don't have any anxiety or problems. They are all succeeding and I'm not. I shouldn't be here.
- Time Management
  - I have way too much to do. I'll never accomplish it all.
- Stress Management
  - I can't handle all the challenges. I'm in way over my head.

These issues are common to all graduate students

- Despite the challenges, most students who give their best effort do succeed in graduate school.
- There are resources to help you succeed and face these challenges.
- Ultimately it is worth it and extremely rewarding.

Life at the OU REU

This summer is an introduction to research. You are not expected to start the summer with any experience or needed tools. You were selected from many qualified applicants. It's okay to feel overwhelmed at times.

We want you to:

- succeed.
- enjoy the summer.
- have a fulfilling research experience.
- learn something about what research is.
- experience a positive and supportive environment.

If the above things are not a part of your experience please talk with Dr. Schwettmann, Dr. Bumm, Mikey, your advisor, or someone who can help. There are lots of resources available.

Further comments/questions

Questions about:

- Research?
- Grad school?
- Careers in Physics?
- Summer Research?
- Other?