



**COLORADO**SCHOOL OF **MINES**



# PHYSICS

Pathways to Distinction

Graduate Program

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# Who are we?

- app. 250 Undergraduate Majors (B.S. Engineering Physics)  
60-70 B.S. Graduates/year -> #5-8 Largest UG Physics Program USA
- app. 65 Graduate Students (M.S. and Ph.D. Applied Physics, Materials Science, Nuclear Engineering)
- 16 Research Focused Faculty and 7 Teaching Focused Faculty
- Research Volume app. \$5M/year
- Credit Hour Generation app. 13000/year (predominantly PHGN 100/200)
- Undergraduate Students follow slightly different, well defined tracks into graduate studies

# M.S. Level – Combined Program Tracks

B.S. Engineering Physics feeds into thesis/non-thesis M.S. at Mines:

In Physics Department:

- Applied Physics
- Materials
- Nuclear Engineering
- Space Resources

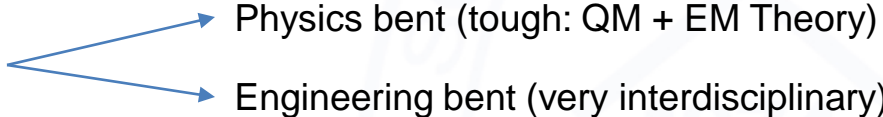
Other Departments:

- Mechanical Engineering
- Electrical Engineering
- Mathematics
- (– Technology Management)
- (– Computer Science)

Of our annual B.S. Eng. Phys. Graduates app. 40% stay at Mines for the above opportunities!

# M.S. Level – Applied Optics

Exploration for an interdisciplinary/disciplinary non-thesis M.S.  
Applied Optics:

- Evaluation of state industry needs in terms of graduates (conversations with optics industry ongoing);
- Teaching focused faculty member is spending an industry sponsored leave of one semester at a local company to explore needs, attitudes and approaches;
- Core course curricula 
  - Physics bent (tough: QM + EM Theory)
  - Engineering bent (very interdisciplinary)
- Existing physics electives  $\leftrightarrow$  Interdisciplinary electives
- Need for a strong laboratory/hands-on/project centered component to be useful to industry.

# Ph.D. Applied Physics → Physics

Typical PhD Graduate Program in Physics:

- 6 Core Classes (theory equalizer); poss. comprehensive exam
- A few electives
- Research and thesis

We at Mines Physics have held with that in order to keep our degree program (which has never been large due to relatively low faculty numbers) accepted nationally. However, since 20 years we have been improving our undergraduate program continuously and been reporting on our successes in physics education research (PER) journals (app. 30–40 publications in total) and received external funding for the developments and for outside implementations (e.g. UAE, Navy)

=====> It is time we improve our graduate program

# Ph.D. Applied Physics $\rightarrow$ Physics

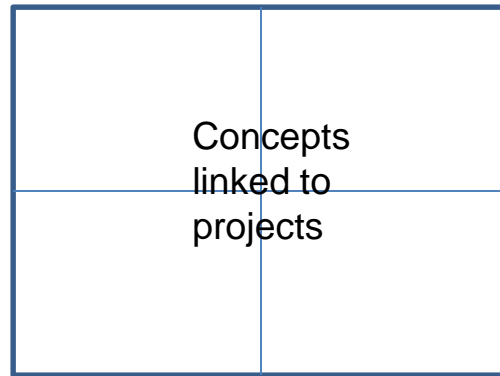
First steps (2 pilot core courses tested out and NSF Proposal submitted)

Educational part  $\leftrightarrow$  Research

(Theory  $\leftrightarrow$  Data Handling)

Connection through Projects in the Classes

Class content split in few modules aligned with fundamental concepts



Projects (hands-on, computational or data evaluation) runs through the length or a module with frequent reporting and discussion

Additional advantage: Meshing of teaching and research focused faculty interests and capabilities.

# Ph.D. Applied Physics → Physics

Next Steps: the other 4 Core Classes

- Challenges:
- Open Solution Brainstorming
  - Process Based Grading
  - Time to Allow for Failure Recovery
  - Assessment (How to Measure Creativity?)

The Electives: All Physics subfields have integrated hands-on parts in their electives (Radiation Detection, Laser Physics, Microprocessing) → combine into a Graduate Laboratory Enterprise.

- Challenges:
- Space

Potential Solution: Combine with Undergraduate Project Space and Design and Maker Space Development → would lead to better mixing of UG/G populations and better meshing of education/research.

# Ph.D. Applied Physics $\rightarrow$ Physics

Upcoming:

- Lots of Discussion
- Resource Definition
- Space Discussions
- Priorities UG  $\leftrightarrow$  G Programs  $\leftrightarrow$  Research/Other
- Resource Acquisition



Questions?