Classical Mechanics
Phy 235, Lecture 15.

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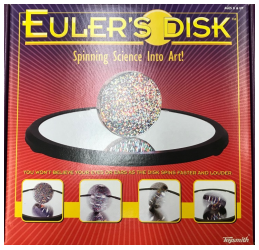
Comments on the PHY 235W Paper.

- Develop a strict schedule.
- For example:
  - First draft ready by Monday November 10.
  - Discuss with writing fellows during the week of November 10. **Schedule a meeting now!**
  - Modify paper during the week of November 17.
- Past mistakes:
  - Asking for an extension.
  - Unable to meet with writing fellows.
  - Too many topics (little depth).
  - Plagiarism.
- Paper due on 11/26/2025.



Topics were due on 10/24/2025.

2

So where are my KLM photos?

3

Comments on Exam 2

- Problem 1:
  - Similar, but simpler than Example problem 5.1.
  - Average score: 17.5/25
- Problem 2:
  - Homework problem (HW # 5, Problem # 2)
  - Average score: 21.6/25
- Problem 3:
  - Example problem 7.10.
  - Average score: 18.7/25
- Problem 4:
  - The KLM is 106 years old.
  - Average score: 17.9/25

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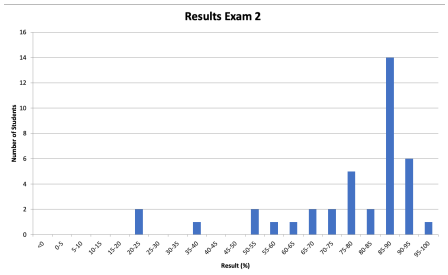
Results Exam 2



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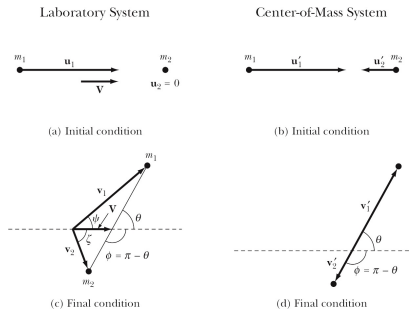
Collisions. Laboratory and Center-of-Mass Frames.



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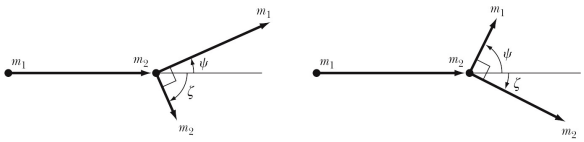
Outcome of collisions not uniquely defined.



If the mass of particle 1 is equal to the mass of particle 2, the two masses will always move at right angles with respect to each other after the scattering.

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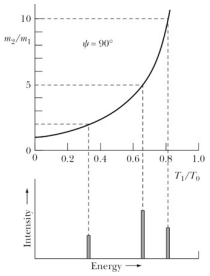
Using elastic collisions to probe targets.

Collisions can be used to probe targets.

$$T_{final} = \frac{m_1^2}{m_1^2 + m_2^2}\left[\left(\frac{m_2}{m_1}\right)^2 - 1\right]T_{initial}$$

If you know the projectile mass/kinetic energy and you measure its final kinetic energy, you can determine the mass of the target.



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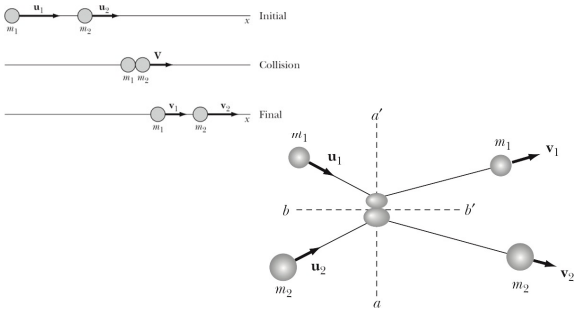
1D and 2D Collisions.



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2 Minute 37 Second Intermission.

- Since paying attention for 1 hour and 15 minutes is hard when the topic is physics, let's take a 2 minute 37 second intermission.
- You can:
  - Stretch out.
  - Talk to your neighbors.
  - Ask me a quick question.
  - Enjoy the fantastic music.

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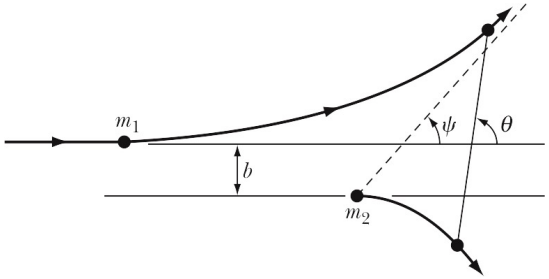
Impact parameter and scattering angle.



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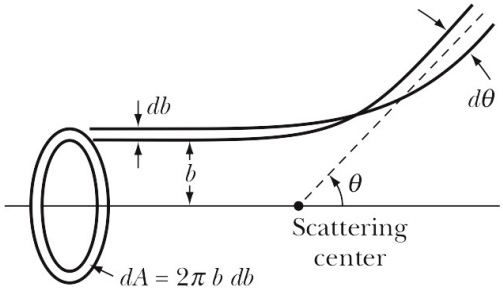
Impact parameter and scattering angle.



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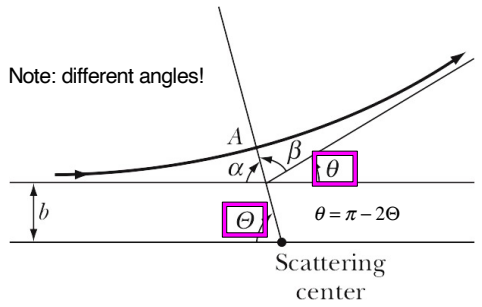
Connecting impact parameter and scattering angle: Coulomb repulsion.



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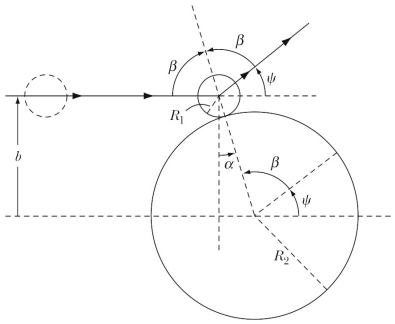
Connecting impact parameter and scattering angle: "hard" scattering.



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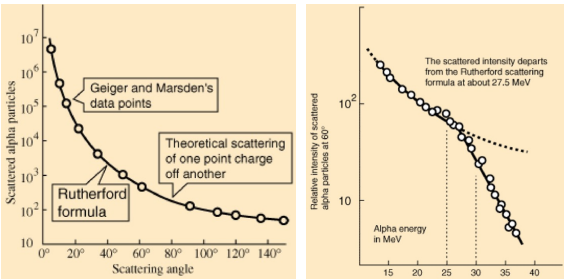
Rutherford Scattering



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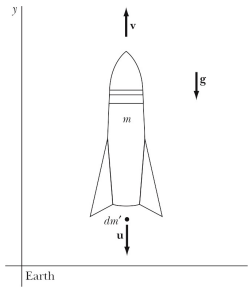
Rocket motion.

- Good example of a variable mass system.
- **First rocket equation**:

$$Ru = Ma$$

  - $R = dM/dt$ is the rate of fuel consumption.
  - u is the positive velocity of the exhaust gasses relative to the rocket.
  - a is the acceleration of the rocket.
- **Second rocket equation**:

$$v_f = v_i + u \ln\left(\frac{M_i}{M_f}\right)$$



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ENOUGH FOR TODAY?

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