

Cratering (Part 1)

Lab Notebook

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|-------------------------------|-------------------|
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| Date: | 10/31/2025 |
| Course: | PHYS 13100 2 |
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Initial observations

As your group begins, what do you notice? What things will be important to keep in mind as you design and conduct the experiment? What (if anything) do you learn from the group discussion that informs how you will take data?

It is hard to maintain the surface of a sand completely flat during all trials in the experiment. Though we have efforts in smoothing it, there are inevitably fluctuations on the surface. This first may cause extra unconsidered uncertainty to the measurement of the height and the effect can be bigger at small height. Secondly, the interaction of the mass with a smooth or not smooth surface may have different mechanism that we are not able to explain and predict.



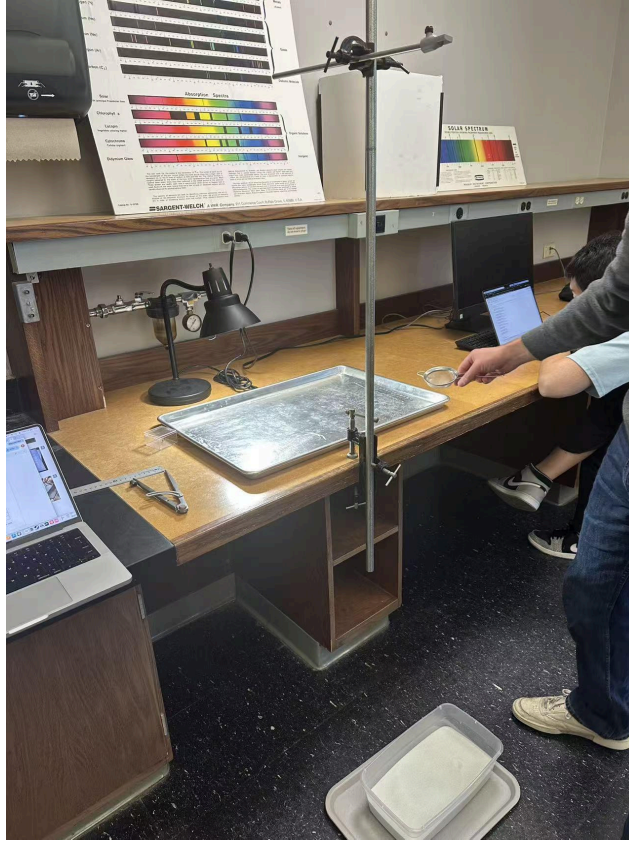
As shown in the graph, the edge of the circle trace due to the impact is not a clear border. Thus, during the measurement, there may be extra random uncertainty. It is also hard to locate where is the diameter too. 5.5

Collecting data and plotting

Record your data here, and make sure to plot as you go. Use this space also to record observations and thoughts, including details about your procedure (including pictures, if it would help) and how you are minimizing (and quantifying) your uncertainties.



We set the distance from the surface of the sand to the clip on the iron structure to the height we want to measure. We release the mass using the magnetic device shown in the image above. It will stick the iron ball and release it when taken away so that we avoid the force of our hand impacting the releasing of the iron ball. Afterwards, we measure the diameter of the circular trace due to the impact using a compass and a ruler. After each trial, we shake the sand and use the ruler to smooth the surface.



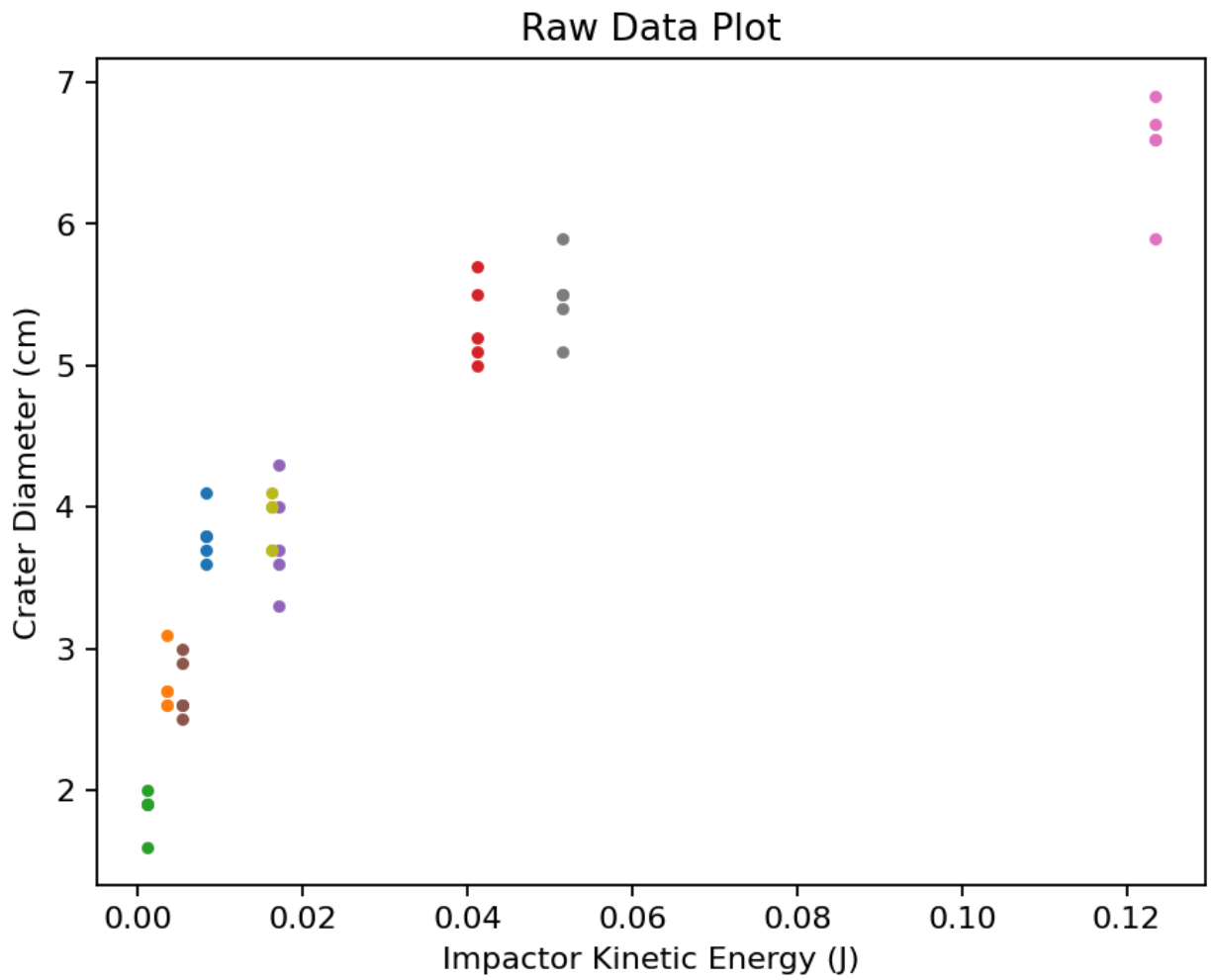
At the tallest height, we shift the sand to the ground. The mass sometimes fell to the side of the box. In such cases, we do the trial again.

| Height (cm \pm 0.05 cm) | Trials (#) | Diameter Measurement (cm \pm 0.05 cm) | | |
|---------------------------|------------|---|-----|-----|
| | | Mass (g \pm 0.1g) | | |
| | | 8.4 | 3.5 | 1.1 |
| 10.0 | 1 | 3.7 | 2.6 | 2.0 |
| | 2 | 3.8 | 2.7 | 1.9 |
| | 3 | 4.1 | 2.7 | 1.6 |
| | 4 | 3.6 | 3.1 | 1.9 |
| | 5 | 3.8 | 2.6 | 1.9 |
| 50.0 | 1 | 5.5 | 3.3 | 2.6 |
| | 2 | 5.7 | 3.6 | 2.5 |
| | 3 | 5.2 | 4.3 | 2.6 |

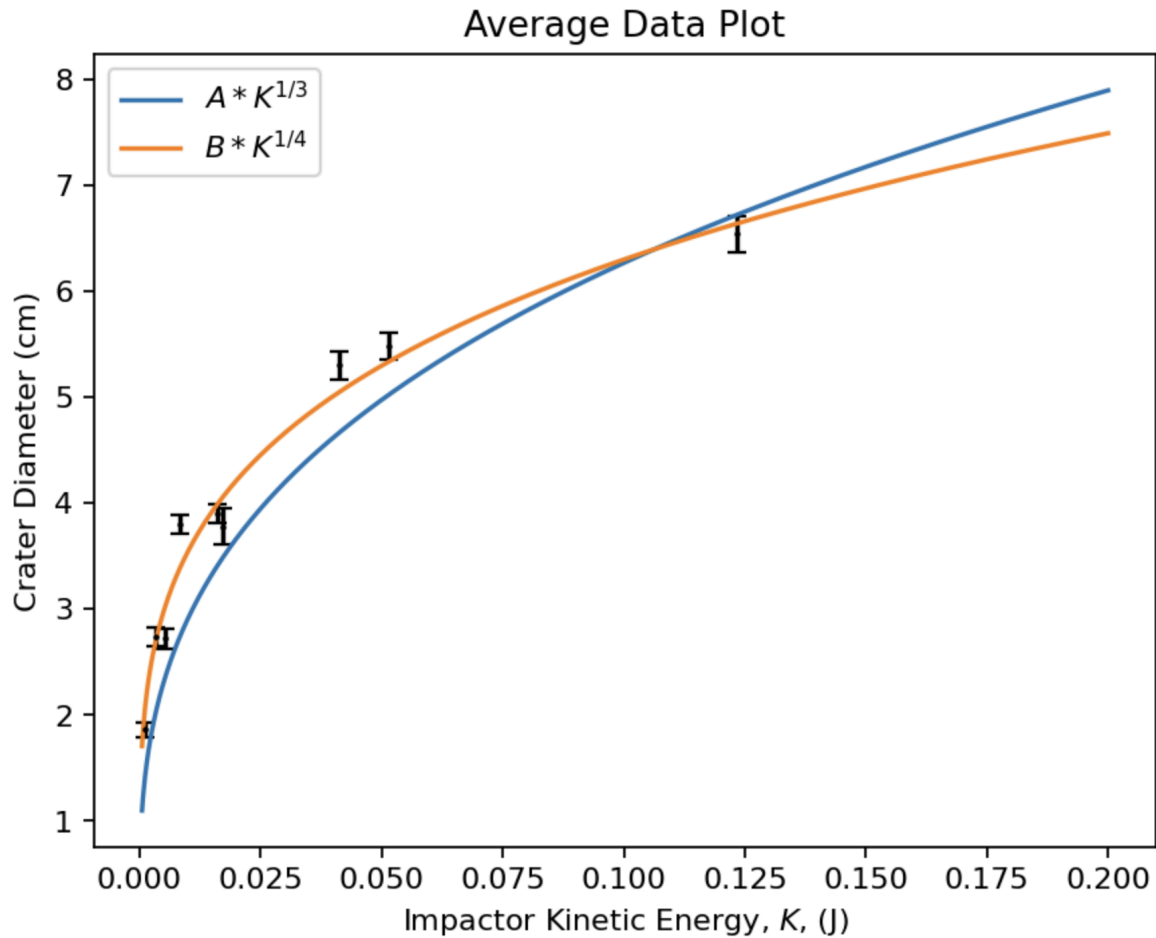
| | | | | |
|-------|---|-----|-----|-----|
| | 4 | 5.0 | 4.0 | 2.9 |
| | 5 | 5.1 | 3.7 | 3.0 |
| 150.0 | 1 | 5.9 | 5.5 | 4.0 |
| | 2 | 6.6 | 5.4 | 4.1 |
| | 3 | 6.6 | 5.9 | 4.0 |
| | 4 | 6.7 | 5.5 | 3.7 |
| | 5 | 6.9 | 5.1 | 3.7 |

Shared Google Colab:

<https://colab.research.google.com/gist/yaoshiiscool/92106dce1a4ee7666c245b5b75faf48d/crate-ring.ipynb>



A A13.50
 B B11.20
 maxK maxK0.20
☐ log-log plot?



Based on the two graphs, it appears that the 1st Model ($BK^{1/4}$) fits better with the data as for equal A and B, the orange line representing the Ejection model appears to intersect with more of our plotted bars to suggest that the results of the model are closer to the results of the experiment.