

SUPERCONDUCTORS

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Introduction

Superconductors are substances that are able to super conduct when at sufficiently low temperatures. To super conduct means to conduct electricity without any electrical resistance. As a result, superconductors are able to conduct electricity more efficiently and levitate when present with a strong magnet. Due to recent efforts made into superconductors in Japan, a new face of transport, specifically trains, have emerged. Initially, trains began with the standard wheels-on-track ‘technology’. Later on, electromagnets substituted wheels, whereas now Japan has stepped into the future and have begun manufacturing superconducting trains. Based on these high-tech trains, we are able to infer, the capacity of superconductors and understand what they are truly capable of. Our experiment was conducted to explore the mass and power aspect of superconductors. It can be hypothesised that the force of the magnet will not be directly proportional to the mass on it and if more magnetic field strength is applied, the height of the superconductor above the track will increase, as the magnetic force acting upon it is greater. Through this we hope to understand other implication of superconductors in our community.

Materials

- Superconductor set – 1
- Neodymium magnets – 64 pieces
- Magnetometer – 1
- Ruler – 1
- Sticky Tape – 1
- Liquid Nitrogen – 500ml
- Timer - 1

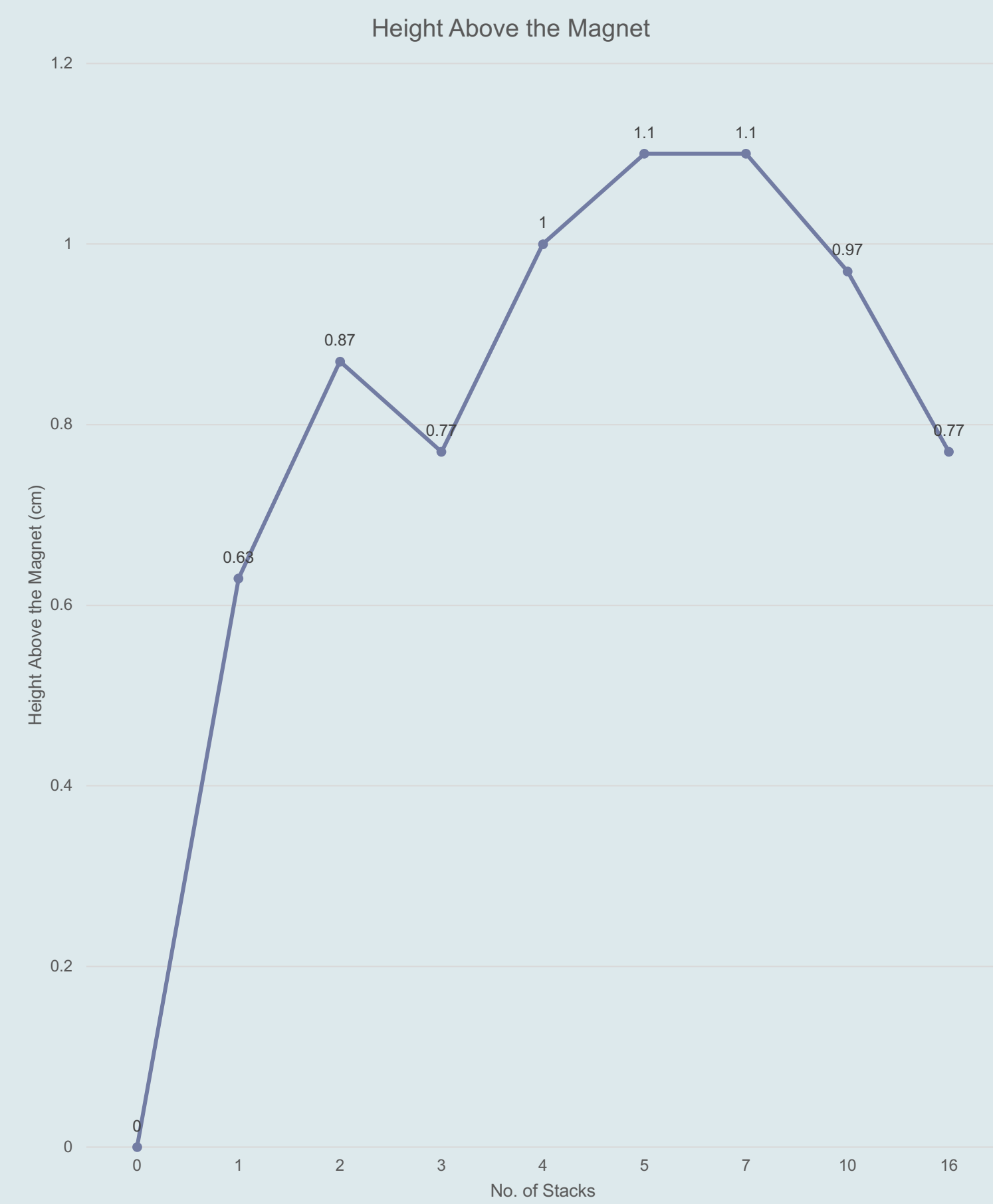
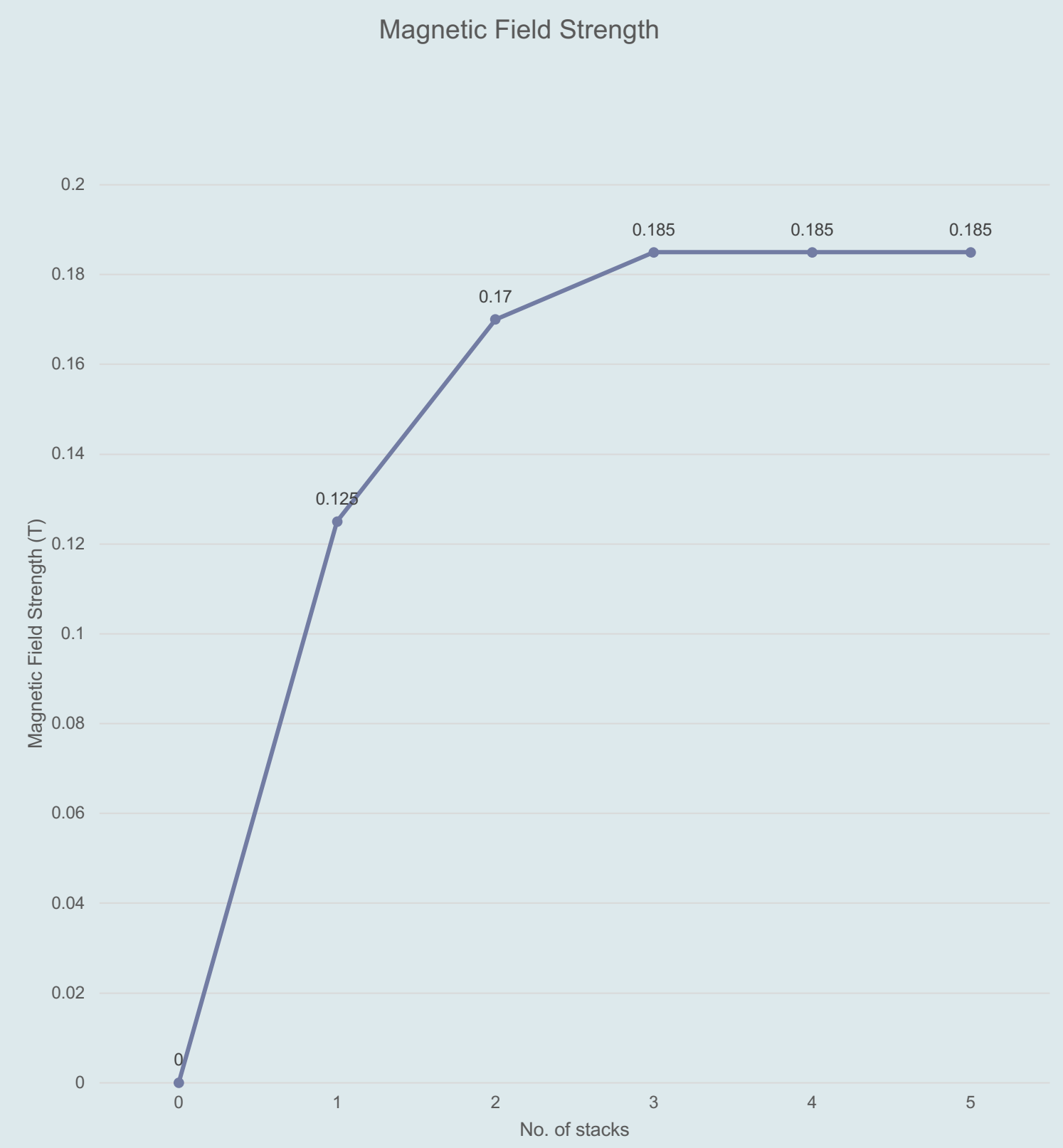
Methods

1 stack = 4 magnets

- 1) Use a magnetometer to measure the magnetism of the 1 stack in the SI units of tesla. Record the result.
- 2) Repeat step 1 with all stacks
- 3) If there is a difference in magnetic field strength, then set up the magnetic track.
- 4) Put superconductor into the liquid nitrogen until it can levitate.
- 5) Remove the superconductor from the liquid nitrogen and place it on the 1 stack.
- 6) Repeat steps 4-5 for all stacks.
- 7) Repeat steps 4-7 two more time.
- 8) Calculate the average of the results of each stack.

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Results



Discussion

When testing the magnetic field strength of the magnets, we found out as we increased the amount of magnets, the magnetic field strength increased to a point where the field strength remained stationary. And when testing the height the superconductor levitated above the magnet, the results showed that the height above the magnet increased, however, there were many errors. One reason that may have caused the magnetic field strength to stay stationary was that the magnetometer could only measure up to 3 stacks. This reason suggests that if another stack was to be applied to the 3 stack, the magnetometer would be unable to measure the 4th stack. This explains why when we measured the 4th and 5th stack, it had the same measurement as the 3 stack. One reason that can possibly explain why the height above the magnet increases as we increased the amount of magnets is that the more the magnetic field strength, the greater the strength of the superconductor that repels the magnet, hence it increasing in height. The results of this experiment refuted our hypothesis as it had too many errors to say for sure that the more we increased the magnets, the higher the superconductor levitated. One reason that may explain the errors is that we did not measure the time the superconductor stayed in the liquid nitrogen. Some trials may have shown results that have a bigger value than other trials because it stayed longer in the liquid nitrogen. So whenever there was an error, the superconductor may have not stayed in the liquid nitrogen long enough. Another error that could have affected the results is that we were measuring the results by hand, so the results written down may not be the actual results. To avoid these errors and improve the method of the experiment, we could have set a specific time in which the superconductor remained in the liquid nitrogen so that all trials was affected the same way by the liquid nitrogen as other trials. Another improvement we could have done to our experiment is recording the experiment on a 90 degree angle. By doing so, we could have measured the results by looking at the video of the experiment. This way, we could have measured the height above the magnet more accurately and avoided the parallax error.

Conclusion

With our investigation, we are getting one step closer to these new advanced technologies. To achieve our aim, we measured the field strength of the different stacks of magnet and also measured the height of the superconductor above the stack of magnets. Although, to obtain a more accurate range of results, more trails of the experiment is recommended. However, when compared to our hypothesis, it can be inferred that it has proved to be positive upto an extent since the number of stacks didn't impact the magnetic field strength after 3 stacks, although the 2 stack and 1 stack magnet did have an impact on its field strength. On the other hand, the results of the correlation between the height of the superconductor and the field strength has proved the hypothesis to be false. The results somewhat showed positive results, however, there are too many errors to say that our hypothesis was correct. Overall, this experiment showed us the impacts of magnetic mass to how high a superconductor levitates when present with a magnet which met out aim, however, it did not meet our hypothesis.

Acknowledgements can go here.