Riding The Rails To Space

New Mexico High School
Supercomputing Challenge
Final Report
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Team 041
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Executive Summary

In our project we want to find alternatives ways of putting payloads into space. The current methods of launching anything into space require rocket boosters, and the use of non-renewable resources. The cost of sending something to the International Space Station is approximately $10,000 per pound. We are going to research how rail gun technology of electromagnetism might be a time efficient way to put items into space.

Our project will use excel to calculate the maximum magnetic field. We then used the Biot savart law to calculate the magnetic field strength to tell us how long certain payloads need to be accelerated to reach escape velocity.

Introduction

In our project we want to find alternatives ways of putting payloads into space. The current methods of launching anything into space require rocket boosters, and the use of non-renewable resources. The cost of sending something to the International Space Station is approximately $10,000 per pound. We are going to research how rail gun technology of electromagnetism might be a time efficient way to put items into space. We will have to calculate to amount of power to move certain weight payloads to the speed need to enter orbit. We also need to calculate the amount of magnetic strength needed to reach the right acceleration. The initial cost of building a rail gun with the capacity and strength to put even a small satellite into orbit would be extremely high. After the rail gun has been built, many items can be put into space without having to wait for the propulsion system to be built. Even after having the rail gun built, the low power efficiency of the gun would add to the amount of money needed for each launch.

Description

We choose this project because man's dreams have always been on the star. We decided that the rail gun would be a good way to send payloads into space faster and more cost efficiently; allowing for cheaper and deeper space exploration. The only current method of getting to space is rocket boosters, which burn up natural resources. The rail gun would put objects into space with only using electricity as the source of projection. Although the traditional means of travel would have to be used ounce you reach space and to get people into space. The rail gun could be used for putting payloads into space.

Results

The results of our project so far is that we took the Biot Savart Law (Table 1) And plugged five different radiuses (r) , 0.042ft., 0.167ft., 0.67ft., 2.5ft., 10ft.,and five different distances (x), 0.5ft., 1.5ft., 3.375ft., 7.59375ft., 17.0859375ft., with a constant current (i) 450 Amp/Sec. The power of a nuclear power plant. Once we plugged all of these variables into the equation we came up with twenty-five different magnetic fields. (Table 2)

We then came up with five magnetic forces 1413.849, 19276.18, 77789.7, 38186.07, 10087.15, from these five forces we used five satellite masses 1kg., 100kg., 500kg., 1000kg., 2000kg., from these we were able to calculate the number of times each satellite would need to be accelerated by each magnet allowing that each object has to reach 734000 m/s to escape the earths atmosphere.(table 3)

Conclusion

In conclusion our results have shown that it would be possible to build a rail gun to shoot things into space, except that there is no known wire that could stand up to the amount of power needed to launch the satellites without being destroyed. Also it would need its own nuclear power plant to power it for each launch. Also you would need an incredibly fast computer just to switch the power from magnet to magnet which has to be somewhere near the speed of 7,340,000 times per second.

Acknowledgements

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Referencest

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2. http://hyperphysics.phy-astr.gsu.edu/hbase/magnetic/magfor.com
3. http://centaur.sstl.co.uk/sshp/nuno/nuno_future.html

Appendix

Table 1

$B=\mu_0 ir^2 / 2(r^2+x^2)^{3/2}$

μ_0= is the permeability constant (1.26×10^{-6} H/m)
i= is the current in the wire, in amperes
r= is the radius of the current loop, in meters
x= is the distance, on axis, from the center of the current loop, in meters

Table 2

Law of Biot Savart Magnetic field

3.14188767	0.117462	0.010322	0.000906	7.95721E-05
42.83595232	1.825226	0.16263	0.01432	0.001257873
172.865992	22.77991	2.479309	0.227988	0.020202947
84.85794309	56.74586	18.9798	2.75206	0.273115524
22.4158879	21.76144	19.13857	11.36526	2.899819636

Table 3

acc. 1kg	acc. 100kg	acc. 500kg	acc. 1000kg	acc. 2000kg
1413.849	14.1384945	2.8276989	1.413849452	0.70692473
19276.18	192.761785	38.5523571	19.27617854	9.63808927
77789.7	777.896964	155.579393	77.78969641	38.8948482
38186.07	381.860744	76.3721488	38.18607439	19.0930372
10087.15	100.871496	20.1742991	10.08714956	5.04357478