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Optimizing Maximum Ejecting Speed for a Gaussian Accelerator Cannon

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Abstract

This paper aims to find the maximum speed of an ejected steel ball from a magnetic cannon and determine its relation to other setup parameters. A magnet induces dipole moments in steel balls inside a magnetic cannon and makes them stick together along a straight line. At the moment of collision, this attraction reduces the motion of the balls in other directions. This creates a more efficient momentum transfer along the series of steel balls and consequently, a higher sped for the ejected ball. The striking ball was released from a height of 6 cm above the rail and and collided with two magnets, followed by three balls. The speed was calculated using the projectile range formula. The speed was found to be a damping non- monotonic function of the number of balls after the magnet. The effective parameters were studied and the maximum velocity obtained under experimental conditions was cm/s. Figures were made using Solidworks Software and data were analyzed using Microsoft Excel 2016 and Gnuplot software.

Key Words

Gauss rifle, neodymium magnets, Steel balls

Introduction

The magnetic cannon also known as gauss rifle is a series of steel balls connected to a strong magnet. The balls and magnets lie on a nonmagnetic rail. Another ball with a known initial momentum collides with the sequence of balls and magnets , causing the last ball to eject with a high velocity. This paper aims to determine the conditions under which the final speed of ejecting ball is maximized. When experimenting with magnetic cannons, it is important to ensure that the magnets are fixed in place to avoid any backward movement. Balls should be aligned along a straight line for optimized momentum transfer. It is preferable for better alignment to use magnet and balls with the same diameter.

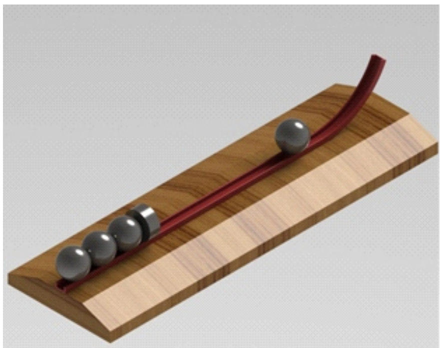

Figure 1 : Gauss rifle

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