611-1705 (40-165) Linear Accelerator

Caution: This product utilizes very powerful neodymium magnets. Use caution when handling and keep away from all electrical devices.
This device will shoot steel balls from the end of it. Always wear eye protection. Do not operate near breakable objects.

Introduction:

What happens when you align powerful neodymium magnets on a linear rail and arrange steel balls in a sequence? A fun and intriguing demonstration of Newtonian physics. When properly arranged, a slow moving steel ball will be accelerated to 3-4 times its original speed by the pull of magnets and Newton's Third Law of Motion. How is this possible? As a ball approaches the powerful magnet, it is accelerated into that magnet, but on the other side of the magnet there are two balls in a row. The impact of that ball kicks off the farthest ball on the other side just like Newton's Cradle. The released ball however has the energy of the magnetic acceleration propelling it faster than the original ball. This is possible because it begins its journey already a ball away from the original magnet. When this motion happens four times in a row, there is enough velocity built up to shoot a ball across a room!

The 40-165 comes with 4 neodymium magnets, 4 magnet holders which allow the user to move the magnets and reverse their polarity towards one another. Ten 3/4" steel balls, and a low friction track with an open end for launching the balls. This device can be used to teach magnetism, motion, Newton's Laws, and can be used as a fun ball launcher for other experiments and demonstrations.

How to use:

1) The 40-165 Linear Accelerator will launch steel balls several feet. Always wear safety glasses. Do not operate near breakable objects.
2) Begin by placing the track rail on a level desk or table. The end of the track should be even with the end of the surface with at least ten feet of open space in front of it.
3) Next, assemble the rail as in the picture at the top of the page. Each magnet will have two steel balls connected to one side of each magnet. They should be facing the open end of the track rail. The final magnet at the open end of the track should have the remaining balls attached to it in a row.
4) The accelerator is now loaded and ready to operate. .

How it works:

There are two principles at work which allow the balls to accelerate through the system. To realize this, let us follow the path of the balls down the track.

The first ball is released from the ramp at the end of the track. The ramp allows the acceleration due to gravity to impart a given velocity on the first ball. The

Warranty and Parts:

We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.

Visit us online at: www.sciencefirst.com

ramp allows for a reproducible initial velocity for performing experiments. As the first ball nears the first magnet, the magnetic force begins to pull the ball towards it and increases its velocity. The force that the magnet has on the ball increases exponentially as the ball gets closer and closer to it. This is because the strength of the magnet at a given point is equal to the inverse of the square of the distance to it.

The ball strikes the first magnet and transfers its energy to the farthest ball on the other side of the magnet. This demonstrates conservation of energy, and is the same principle which causes Newton's Cradle to swing its balls back and forth.

There are two balls on the far side of the magnet so that the ball that is released begins its motion a given distance from the magnet. As the magnetic field is exponentially reduced the farther away the ball is, it has enough energy from the initial impact to propel it towards the second magnet at a higher speed.

The accelerated motion of the released ball creates a chain reaction which propagates through each of the magnets until the final ball is shot from the end of the track.

Additional Experiments:

Caution: moving and removing the magnets must be done so carefully by an adult. The magnets in this device are very powerful and can pinch fingers or break.

By loosening the clips that hold the magnets in place, it is possible to alter the distances between magnets or remove the magnets all together.

Additional Experiment 1: use the accelerator as a ball launcher for gravity drop experiments. By using the launch ramp, the launch velocity becomes repeatable. Vary the height at which the ball is launched and calculate the landing point for different heights.

Additional experiment 2: Assemble the unit on a level table or desk. Remove the magnets from the accelerator one at a time and launch the ball in between each removal. Launch the ball without any magnets. Measure the distance of impact from each launch. By knowing the acceleration due to gravity, it is now possible to calculate how much energy is being added by each magnet.

Visit us online at: www.sciencefirst.com

Linear Accelerator teaching concepts

Physical Science:

Grades 5-8

Motions and forces

Transfer of energy

Grades 9-12

Motions and forces

Conservation of energy

Other products from Science First

611-0065Newtonian Demonstrator; The classic Newtonian demonstrator is designed with the utmost in Sturdiness and appearance. The wooden frame is 9" X 7" X 8" and can be seen from the back of a classroom.

611-1310 Dynamics Car Set; Demonstrate what an air track can, at one-tenth the price. This pair of heavy gauge stainless steel cars is ideal for demonstrations in momentum and elastic and inelastic collisions.

611-0103 Smart Photogate Timer; Why pay more when this accurate and versatile timer does far more for far less? You can measure the time interval between two photogates, measure the time it takes to pass through one photogate, measure acceleration of a released ball, determine the acceleration due to gravity (with a picket fence), determine elastic and inelastic collision times, calculate cycles, determine the frequency of a rotating object, determine the period of a pendulum, and count time with great accuracy.

P/N 24-4165