

Gravitational Device Model

Background and Objective

Gravity assist is one of the most significant developments in space travel. Gravity assist centers around using a celestial body's orbital energy to assist a spacecraft's trajectory and reduce fuel consumption. The energy can also be used to slow the spacecraft down. The idea uses Einstein's theory of general relativity which states every mass deforms the fabric of space and therefore affects all other objects in space. The more massive the object, the more deformation it will cause.

The team was tasked with creating a model to showcase gravitational assist in a way that is easily understood, specifically by middle schoolers and high schoolers.

The Gravity Device Models (GDM) created use a sheet of elastic material that is stretched and clamped to a circular frame. The flexible material represents space. Objects placed on it represent celestial bodies. Launchers are used to be able to recreate paths of the objects across the fabric. A small 4 x 4 diameter model can be set up in the classroom and a large 10 x 10 ft diameter model can be set up outside for demonstrations at schools.

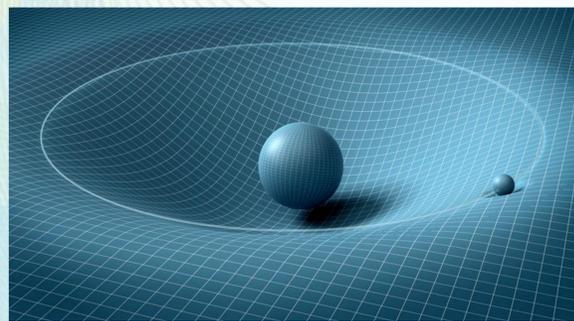


Figure 1. Theory of Relativity Model

Table Design Specifications

- Portable
- Max Load of 10kg
- 4:(2"x4') 1:(4' Diameter Ring)
- Kid friendly



Figure 2. 4x4 ft Prototype Model

Launcher Design

- The original Prototype Design is based on a Pinball Launcher.
- For testing purposes, we need a launcher that can fire at a consistent angle and speed. Several pre-made models were available online. We chose the PASCO mini launcher based on the variety of preset speeds, ability to measure between -45 to +90 degrees, consistently launch projectile 0.5, 1, or 2 m, and accompanying mount.



Figure 3. Pinball Launcher & Mini Launcher

Current Results

- Table is able to be quickly assembled and disassembled via four bolts.
- Table and fabric are capable of supporting two large and seven small bearings at 7.8 lbs total.
- Successfully completed launch simulations by hand with the bearings completing orbits before coming to a stop.



Figure 4. 10x10 ft Pool Frame Model

Progress Highlights

- Designed prototype table
- Designed prototype launcher
- Prototype table was constructed
- Began testing the prototype table

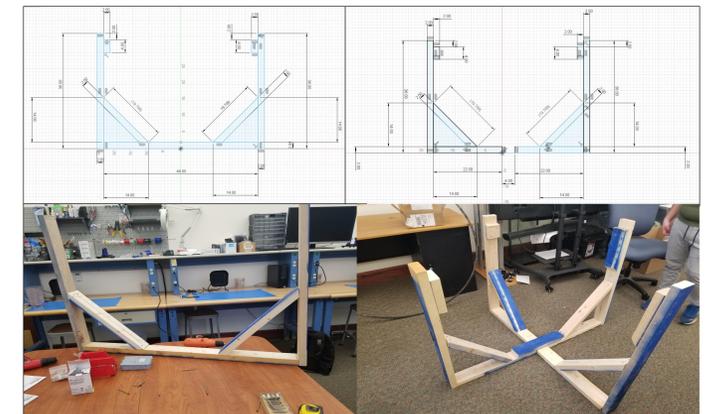


Figure 5. Design and production of prototype table

Future Work

- Construct pool frame to set up final GDM
- Mount to pool frame
- Test final GDM
- Order a track to mount the launcher on
- Fully automate the launcher



Figure 6. Automated track

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Figure 1 courtesy of Atleerner Science & Technology

Figure 2 & 4 courtesy of Amazon