

## Laser Interferometer Gravitational-wave Observatory (LIGO) public outreach videos

### Abilene Christian University

#### 1. Description of project

The Laser Interferometer Gravitational-wave Observatory (LIGO) is in need of public outreach projects to better inform the public of the collaboration's goals and mission. In an effort to fill this need, we began working on writing, filming, and producing short educational videos to communicate the ideas of both special and general relativity. Previously, six ACU students had created a video about special relativity for the LIGO collaboration as part of the Fall 2011 General Relativity class. This class project had originally been aimed at explaining concepts from General Relativity, but during the course of production, the students changed course to focus instead on Special Relativity. This change was made because the students felt that space-time and space-time diagrams deserved their own video in order to give them a proper treatment. Following the conclusion of the General Relativity course, the ACU-SPS picked up the project and set a goal to produce at least one video about General Relativity for the LIGO collaboration.

Planning for the next video began during the Fall 2012 semester. It was during this semester that we applied for the Marsh White award. Three SPS members, Spenser Lynn, Andrew Miller, and Elizabeth Carlisle collaborated with ACU Engineering and Physics professor Dr. Joshua Willis to develop the goals of the General Relativity video. Together, it was decided that the video should focus on two main ideas. The first is the differences between the Newtonian theory of gravity and General Relativity. The second idea is how objects begin to move along curved space-time after a geodesic had been created. These two ideas drove the production of the video and every effort was made to ensure that these ideas were emphasized and clearly communicated. In addition, special attention was paid to how successful Newtonian gravity is in order to prevent a Newton versus Einstein feel from developing and overshadowing the physics.

#### 2. Production (Script writing, filming, editing)

Script writing began in January 2013 as collaboration between the award proposers and continued into the Spring 2013 semester. Throughout the writing process, the writers met with Dr. Willis for quality checks and ideas on how to better communicate certain points. As the script was nearing completion, students began volunteering to narrate, and demonstrate parts of the film during the latter half of the semester; there were two days of filming. The first took place outdoors and students demonstrated Newton's realization that the moon's circular motion was caused by the force of gravity directed inwards toward the center of the earth. During this filming, a small demonstration was filmed for one of the segments in the video produced by the class last year. For the second day of filming, we partnered with our school's media lab in order to make use of their green screen. We needed to use the studio in order to allow for some of the actors to shown at different locations on the globe, but we also decided that it would be a good

idea to film the narrators, instead of simply recording voice-overs. In the first video, it seemed difficult to focus on what was being said without a face to go with the words, so for this one, the narration was filmed in front of a green screen so that the actors can be displayed over the graphs and animations demonstrating the principles they are introducing. This will allow the video to present information more clearly, and will also help to keep the audience engaged and alert. In addition to filming the narrators, several students even donned costumes to represent different geographic locations and show how straight lines on the globe are curved because the surface is not flat, just like world-lines are curved because space-time is not flat. One student even wore an Einstein wig while dancing, just to have some footage to keep the credits entertaining.

The addition of video footage of the narrators which requires green-screening does require much more work during editing however, but we believe that it will be well worth the effort. The scene shot to finish the first video has already been added, and it is ready for distribution. This year's video has been filmed and edited, however there are still several scenes that require diagrams and computer visualizations to be added. This work is planned to be finished early in the fall of this year.

### 3. Expenditures

Equipment fee: \$30.00

Costumes: \$24.50

Total: \$54.50

### 4. Pictures



Andrew Miller (Junior) adjusts the studio lighting as James Mallon (Freshman) watches on.



Adam Simpson (Junior) smiles for the camera after completing his scene.



Erik Forrister (Junior) shows off his relatively good dance skills while dressed as Albert Einstein.



Elizabeth Carlisle (Sophomore) and Andrew Miller (Junior) get advice on an upcoming scene from Dr. Willis (off screen).



Spenser Lynn (Senior) prepares for a scene while James Mallon (Freshman) looks over the script.