The Orion Spacecraft:
Future of Human Space Exploration
Jimmy Guerrero
Department of Physics and Astronomy
Ball State University

Abstract

The Multi-Purpose Crew Vehicle (MPCV) (above) is built by Lockheed Martin Corp. The MPCV is 16.5 feet wide at base, weighs 23 tons, has a volume of 660 cubic feet, 390 cubic feet for habitable space (Crew Module).

The SLS

The Space Launch System (SLS) will carry the MPCV equipment and important cargo into low Earth orbit (LEO) and beyond. SLS will encompass technologies from the space shuttle and Constellation program.

Service Module

The service module will provide the spacecraft with electricity derived from the sun using two solar arrays 19 feet in diameter. It will also cool the spacecraft using a radiator system.

Missions

First manned flight of Orion: 2021
Near-Earth Asteroid mission: 2025
President Obama unveiled an idea for a mission to Mars in 2010, and it is expected that the Orion Spacecraft will take Americans there.

Weight: 6.5 million pounds
Height: 400 feet
Payload: 130 metric tons (286,000 lbs)
Thrust: 9.2 million pounds

Jimmy Guerrero
The Effect of Fill Density on Rectal Balloon Dosimetry

Introduction
External beam radiation therapy for early-stage prostate cancer is a common and effective treatment option. The success of the treatment depends upon the geometric accuracy of targeting the prostate gland in each of typically 43 treatment fractions.

The prostate gland is attached by strong ligaments in the lower pelvic region. The gland is adjacent to the urinary bladder and rectum.

Variations in bladder and rectal filling as well as bowel gas distension may result in significant displacement of the gland relative to the planned position within one treatment period as well as between treatment fractions.

In order to maintain this position, commercial rectal balloons inserted into the rectum prior to each treatment have been used for several years.

The balloon is filled with approximately 90 cm³ of air.

The compression effect stabilizes the prostate gland during the treatment.

The balloon also serves to push the posterior rectal wall away from the radiation field.

The Key Questions
Does the density of the fill medium (air or water) significantly affect the dose to the posterior rectal wall?

Does the energy of the treatment beam (6 MV or 18 MV) in combination with the balloon medium significantly affect the dose to the posterior rectal wall?
Priscilla Asigbee and Dede Teye
Travis Everhart, Sadeq Malakooti, Priscilla Asigbee, and Zahrah Al Juzayri
Mammosite Brachytherapy Dosimetry – Effect of Contrast and Air Interface on Skin Dose

Imendra Ranatunga
Department of Physics and Astronomy
Boston University

Method
Monte Carlo simulations were used to calculate the dose distributions along the center of source at various distances of 1 cm to 5 cm from the surface of the balloon with different contrast (silicone) compositions, using a specially designed breast phantom made from tissue-equivalent material. Then the simulated volumes were compared with thermoluminescent dosimetry (TLD) measurements, which were placed at the same distance.

Results
Comparison of Monte Carlo simulations and TLD measurements are shown in Fig. 3.

Imendra Ranatunga

Reference

Method
The Monte Carlo simulations were used to calculate dose rates at the planning target volume (PTV) of a 24X radius Mammosite balloon dose delivery system. The simulations were carried out using an average female breast phantom. A 3D dose grid was used, and the dose rate was calculated for the PTV. The results were compared with clinical measurements.

Imendra Ranatunga
Andy Burks and Eric Hedin
The Forward GEM Tracker Data Analysis

Malorie Stowe
Thesis Advisor: Dr. David Grosnick

The Forward GEM Tracker (FGT) is a sector in STAR (Solenoidal Tracker at RHIC), which is located at the RHIC (Relativistic Heavy Ion Collider) collider at Brookhaven National Laboratory. The FGT is used to measure the position of forward charged particles, produced in proton-proton collisions. This information is critical in helping to determine the contribution of the quark and antiquark to the jet of the proton. It will also be important in identifying the decay of heavy mesons, such as N_G, created by the interaction of the quark and the antiquark of another proton-proton collision.

FGT Layout

Measure on the left is a view of half of the STAR detector with the side facing the FGT. The FGT is made of 6 disks, each divided into four sectors. Each quadrant contains 6 GEM (gas electron multiplier) foils. These GEM foils have holes that are double circular in shape and have an AlO$_3$ gas flowing in between them. When a charged particle passes through, it ionizes the gas and produces an electron avalanche in the holes when an electron reaches one. An avalanche of electrons is created.

Tracking

The avalanche detection system is used to track the charged particles. The GEM foils detect each event and allow the corresponding electron track. Each event is correlated with all other events, and the spatial correlation of the tracks is determined. The correlation between the tracks is then used to determine the path taken by the charged tracks after the collision.

STAR Data: Pedestals and Failure States

- SF 1: pedestal out of range (current range is 100-1200 ADU)
- SF 2: RMS out of range (current range is 0-100 ADU)
- SF 3: Fraction of integral near pedestal (i.e., 5% of the pedestal out of range (current range is 0-100 ADU))
- SF 4: Any one channel (threshold is currently 54.65 ADU)
- SF 5: Strip rate correlated
- SF 6: Strip rate not correlated
- SF 7: No signal on channel - cannot determine pedestals

Malorie Stowe
Weather Physics

Department of Physics and Astronomy

Andy Burks and Feng Jin
Mahfuza Khatun, Jeremy Christman, and Ron Cosby
The Effects of Toroid Geometry: Measuring Action Potentials in Nerves

W. Jay, C. Tipton, T. Tong, & R. Wijesinghe
Dept. of Physics & Astronomy, Ball State University

Mathematical Model:
We approximate solutions to Laplace's Equation in spherical coordinates using a standard finite difference method to form an electrical potential inside the tank.

The above equation is modified to incorporate the following boundary conditions:
- Nerve bundle - Dirichlet conditions
- Toroidal surface and peristaltic wall - Neumann conditions

Using numerical data similar to those that produced Figure 3, we calculate the return current. The return current is the extracellular current that flows between the toroid and the nerve bundle. The return current gives a measure for the effect of the toroid geometry on the measured signal.

The Experiment:
Components required to measure neural action potentials:
- Toroidal pick-up coil, wound with Cu wire (N turns) (See Figures 1 and 2)
- Current-voltage amplifier
- Control/recording electronics

The current in the nerve bundle generates an induced magnetic field. This magnetic field generates a current (called the copper winding's analog to Faraday's Law), which is amplified for precise and accurate measurement.

Results:
We are still in the process of analyzing the results from our experimental setup. Our goal is to understand how the geometry affects the signal. In the future, we plan to conduct more experiments to further explore these effects.

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2012 Society of Physics Student Inductees
Camrin Tipton, BSU SPS President and Sarah Thompson, Secretary-Treasurer
Camrin Tipton sharing the many activities of SPS from this academic year.
Tom Jordan
Tom Jordan with Sam McClellan, Miller Scholarship recipient
Malorie Stowe, Cooper Award recipient, with David Grosnick
Will Jay, Outstanding Senior award recipient, with Ranjith Wijesinghe