22nd Annual Natural Sciences Academic Festival
Physics Department
Capstone Presentations
***Friday,* 6 May 2016, Morken 132**

12:30 PM - 12:45 PM **Noel Oteng-Mensah**

How the Surface Roughness of a Tennis Ball Affects the Magnus Force
The Magnus Effect quantifies the force, on a spinning object, that points perpendicular to both its spin axis and its velocity. This experiment uses tennis balls spinning at 9000 rpm, in a stream of ~100 m/s air, to study the effects of surface roughness. The Magnus forces range from 1.91-2.22N.

12:45 PM - 1:00 PM **Conor O'Bryan**

Determination of Static Oil Film Thickness using Optical Geometry
A proposed technique for measuring oil film thickness on water was investigated. 633nm laser light was reflected off a 5.0 mm oleic acid layer. The method determined a film thickness of 5.50 ± 0.45 mm. Uncertainties and systematic errors will be discussed. The technique appears viable and possibly scalable.

1:00 PM - 1:15 PM **Michael Goodman**

Ballistics Comparison
Ballistic testing has been a useful tool in confirming if a weapon has fired a particular bullet. Part of the testing involves measuring the width of the lands and grooves, which is a class characteristic of the firearms make and model. Higher pressured (extra gunpowder) rounds were thought to have a different effect on the bullets, which could lead to misidentification of the gun make/model. However, higher pressured rounds were shown to have little to no effect on the bullet's land and groove width/depth measurements.

1:15 PM - 1:30 PM **Ignacio Ibarra**

Biomechanical Model of the Takeoff Phase in the Pole Vault
An analysis is made of Nicholas Lithorne's mathematical model of the takeoff phase in the pole vault, for a rigid pole. Theory predicts an optimum takeoff angle of ~ 32 degrees to maximize the vaulter's grip height on the pole. The maximum grip height depends on the takeoff velocity, takeoff angle, the athlete's vertical reach, and the depth of the plant box. This project uses a more accurate model to calculate the vaulter's moment of inertia, which results in a lower maximum grip height compared to the point-mass calculation made by Lithorne.

1:30 PM - 1:45 PM **Hannah Walton**

Using meteor trails to find the distance to the sun
Surprisingly, observing meteors in the night sky yields a method to estimate the distance between the Earth and the sun, known as an astronomical unit (AU). In this project, meteor trails (obtained through video study) are plotted on a star map and analyzed to calculate a lower limit on the AU.

1:45 PM - 2:00 PM **Alex Orlowski**

Analysis of Physical Alterations of Bassoon Reeds Affecting Tone
Specific notes were played on a bassoon with an artificial embouchure that applied steady airflow to 3 reeds. The reeds were altered to produce "flatter" or "sharper" tones, and Fourier analysis of each note revealed how the alterations affected its frequency spectrum.

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2:00 PM - 2:15 PM **Mackenzie Cameron**

A Study of Chladni's Law Using Driven Vibrating Plates
The driven vibrations of rectangular, square, and circular plates with unbounded edges are examined. This experiment correlates the modal frequencies to those predicted by Chladni's Law and the 2-D wave equation. Insufficiencies of the model, sources of error, and possible future research are discussed.

2:15 PM - 2:30 PM **Seth Anderson**

Flame Table: A Two-Dimensional Ruben's Tube
This is the classic Ruben's tube experiment, but in two dimensions. Nodal analysis and partial differential equations are used to model the standing wave patterns that occur at the flame table's resonant frequencies. Solutions are compared to actual flame patterns.

2:30 PM - 3:30 PM Poster Presentation Session
Snack Buffet
Morken Center Atrium/Hallway

3:30 PM - 3:45 PM **Brian Ruggles**

Accounting for friction and air drag on a roller coaster
This project explores the complications faced by roller coaster engineers in launching trains of different masses such that they reach the same height. A mathematical model involving friction and air drag was created to test data collected from a rubber band-launched K'nex roller coaster model.

3:45 PM - 4:00 PM **Dylan Lasher**

A Study into Minimizing the Dribbling Phenomena of Teapots
The "Teapot Effect" is a phenomenon where a liquid poured from a spout clings to the underside and dribbles downward. This experiment uses video analysis to quantify the effects of liquid viscosity and spout geometry, and compares the data to theoretical predictions.

4:00 PM - 4:15 PM **Mike Traner**

Pointy Leaves Shed More Water
Many plants in the tropics have evolved more elongated leaf tips compared to plants in temperate climates. Why? The hypothesis is that the more rapid shedding of water by leaves with elongated tips leads to advantages, e.g., increased photosynthesis and reduced epiphyte growth. This project seeks to quantify the drainage rates, in a controlled environment.

4:15 PM - 4:30 PM **Ryan Page**

Single Crystal Germanium Optical Fibers for Mid-Infrared Waveguides
Long, highly crystalline germanium optical fibers were made with high-pressure chemical vapor deposition and a laser anneal technique. Parameters such as optical loss at IR wavelengths and crystal length were improved by nearly 3 and 4 orders of magnitude, respectively, compared to competing fibers.