Michigan Section of the American Association of Physics Teachers

Spring 2016 Meeting
Announcement and Program Schedule

Cranbrook, Bloomfield Hills, MI
April 9, 2016

Keynote Address

We are pleased to welcome Dr. Evgeniy Khain of Oakland University as our keynote speaker. Evgeniy received his PhD in Physics from the Hebrew University of Jerusalem, Israel, in 2005. He then came to the University of Michigan for a postdoctoral fellowship; in 2007, he joined Oakland University. Evgeniy's research interests lay in the fields of theoretical biological physics, nonlinear dynamics, condensed matter physics, and non-equilibrium statistical mechanics, from collective phenomena in biological systems to driven granular media.

Photo Contest!

We will be holding a high school physics photograph contest, based on the AAPT photo contest that is held at the Summer Meeting. Teachers can develop their own rules for the contest to fit their students and situation. Bring your top pictures to the meeting to be voted on by the attendees. It would be helpful if pictures were put onto large whiteboards or cardboard ahead of time. Some extra boards will be available if you just bring pictures. Prizes will be awarded.

Door Prizes!

We have some door prizes to be distributed during the afternoon business session. You will want to be there for the drawing!

Program Overview

Location: Cranbrook is located at 39221 Woodward Ave., Bloomfield Hills, MI 48304. General location: http://science.cranbrook.edu/visit/maps-directions . Campus map: http://cranbrookart.edu/wp-content/uploads/2014/09/CEC-Campus-map.pdf

Registration: Registration cost is $10 per meeting. Students and first-time attendees, though, may attend *free* of charge.

Parking: Please proceed through the main entrance off south-bound Woodward Avenue, just south of Long Lake Road, and follow the signs to the Science Institute. Park in the structure adjacent to the Science Institute, per the following link. Enter in the Instituteõs ñMain Public Entranceò shown in the link and proceed downstairs to the registration table and coffee setup.
http://science.cranbrook.edu/sites/default/files/uploads/CIS%20CEC.pdf

Lunch: Lunch (brunch) in the architecturally-splendid Cranbrook Dining Hall will be $10 per person, and includes a choice of brunch entrée or salad bar, or a combination thereof. A portion of the proceeds helps fund our complimentary breakfast. Please note, it is about a 10-minute walk to the dining hall from the Science Institute, and is not accessible by other means.

Program Schedule – Saturday, April 9th

7:30 – 8:00 am **Registration / Morning Refreshments**
Meeting fee: $10.00 (FREE for students and first-time attendees)
Location: Institute of Science, lower level (follow signs)

8:00 – 8:15 am **Call to Order and Welcome**
Les Latham, Port Huron Northern High School
Location: Auditorium, adjacent to registration

8:15 – 9:30 am **Contributed Presentations**
Location: Auditorium

8:15 - 8:30
Modeling Mechanics with Google Sheets
Don Pata, Grosse Point North High School

8:30 - 8:45
Counter-intuitive results from collisions involving rotation
Michael C. Faleski, Delta College

8:45 - 9:00
Creating a Mental Model of a Radian
James DeHaan, De La Salle Collegiate High School

9:00 ï 9:15
The Natural Human Electricity and Its Use to Operate Touchscreens
Wathiq Abdul-Razzaq, West Virginia University

9:15 - 9:30
Experimenting with Impacts
Michael C. LoPresto, Henry Ford College

9:30 – 9:45 **Break**

9:45 –11:15 **Contributed Presentations**
Location: Auditorium

9:45 - 10:00
Cheap Sensors Allow for Real Questions
Steve Dickie, Divine Child High School

10:00 - 10:15
Flipping a Class Without Flipping Out
Alan Grafe, University of Michigan - Flint

10:15 - 10:30
How Standards Based Grading Improved Student Achievement
Joanna DeMars, Grosse Ile High School

10:30 ï 10:45
Building a Culture for Learning Physics
Bryan Battaglia, Utica Academy for International Studies

10:45 - 11:00
Using Science Olympiad Events to Bring Engineering and Design Into the Classroom
James Gell, Plymouth High School

11:00 - 11:15
Why do we Teach Physics like it's 1899?
Vance J. Nannini, Divine Child High School

11:15 – 12:45 pm **Lunch**
Location: Cranbrook Dining Hall

12:45 – 1:45 pm **Keynote Address:**
Physics of clustering and invasion of living cells
Evgeniy Khain, Associate Professor of Physics, Oakland University
Location: Assembly Hall in Hooey Hall

Biological multicellular systems exhibit a variety of nonlinear phenomena, fascinating from the physics perspective. Brain tumor cells are able to migrate, proliferate (divide), and experience cell-cell adhesion. In this talk I will focus on clustering of cells on a surface (Figure 1). We formulated a stochastic model and identified two mechanisms of cell clustering. First, there is a critical value of the strength of cell-cell adhesion; above the threshold, large clusters grow from a homogeneous suspension of motile cells; below it, the system remains homogeneous, similarly to the ordinary phase separation. Second, when cells form a cluster, we have evidence that they increase their proliferation rate. We have successfully reproduced the experimental findings and found that both mechanisms are crucial for cluster formation and growth. We also analyzed cell invasion, a phenomenon that plays an important role in tumor growth and wound healing. When the strength of cell-cell adhesion exceeds a certain threshold (and proliferation is small), large isolated clusters are formed ahead of the cell invasion front.

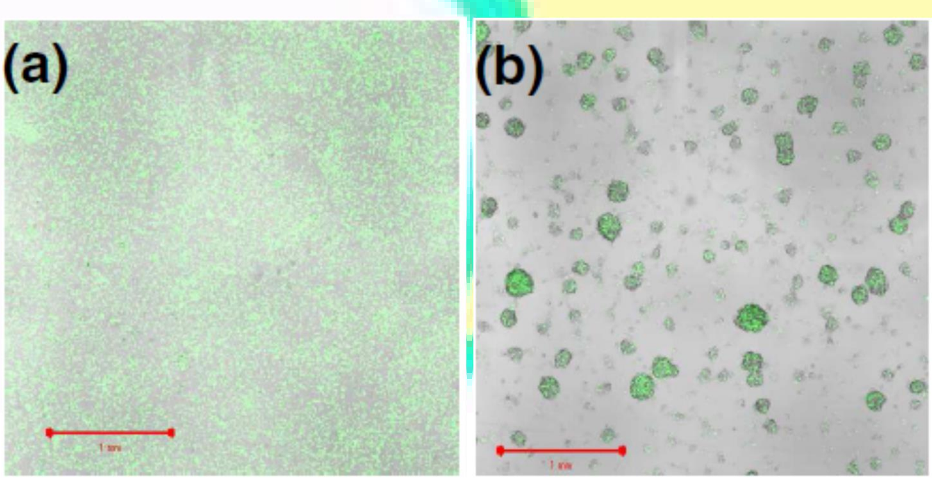

Figure 1: Snapshots of the system for the two cell lines five days after the beginning of the experiment. Mutant cells form clusters (b), while wild type cells are homogeneously distributed over the system (a). The typical cell diameter is 10-20 εm, so each cluster in (b) contains hundreds of cells.

1:45 – 2:15 pm **Puzzlers! And Door Prizes!**
Location: Assembly Hall

2:15 – 2:45 pm **MIAAPT Business Meeting**
Location: Assembly Hall

2:45 –4:15 pm **Contributed Presentations**
Location: Assembly Hall

2:45 - 3:00
EHW and Reflections in Physics Curriculum
Taoufik Nadji, Interlochen Arts Academy

3:00 - 3:15
Circular Motion – Lo-tech to Hi-Tech
Frank Norton and Dan Lorts, Cranbrook

3:15 ï 3:30
Principals for Smart-Teaching
Samanthi Wickramarachchi, Kalamazoo College

3:30 - 3:45
A Progress Report on the Physics Lab Curriculum Change at Lawrence Tech
Changgong Zhou, Lawrence Technological University

3:45 - 4:00
Integrating laboratory activities into an upper-division laser physics course
Christopher M. Nakamura, Saginaw Valley State University

4:00 - 4:15
A Case Study: Novel Group Interactions through Introductory Computational Physics
Michael J. Obsniuk, Michigan State University

4:15 –5:30 pm **<u>Afternoon Workshops Session</u>**

Workshop #1

A Game for Free Body Diagrams
Ron Schlaack, Delta College
Location: Rooms 45-48, TBA

Physics texts typically give a pictorial representation or a text description of a system and then ask the student to draw a free body diagram. Students understand that a system is described by a single free body diagram but rarely consider the concept that the same free body diagram can describe many different situations. A game has been developed, patterned after the children's game telephone, in which a group of students alternate between FBD's and drawings in order to see whether the group comes back to the original FBD. An incorrect final FBD leads the group to evaluate where the mistake or misconception occurred.

Workshop #2

Modeling in Electricity and Magnetism
Don Pata, Grosse Point North High School
Location: Rooms 45-48, TBA

Electricity and magnetism are traditional topics taught in introductory physics classes. The treatment of these topics is often confined to mathematical representations with little time spent on developing or using representational models. The Modeling Method describes the development and use of representational models that put students in a position to develop their own understanding of these complex topics. Participants in this workshop will participate first hand in exploring some of these models and comparing them to traditional treatments.

Workshop #3

Experimenting with Impacts
Michael C. LoPresto, Henry Ford College
Location: Rooms 45-48, TBA

This workshop will expand upon the talk of the same name (abstract below), with a focus on actually doing the experiment and analyzing the data. The workshop will also serve as a meeting of the NASA/JPL ï Center for Astronomy Education Great Lakes Teaching Exchange that also serves as the Astronomy Arm of the MiAAPT.

Abstracts for Contributed Presentations

Modeling Mechanics with Google Sheets
Don Pata, Grosse Point North High School

This year I have incorporated the use of google sheets in modeling of mechanics with my AP Physics students. I have found (anecdotally) that this allows them to apply the laws of physics in new and different ways and forces them to develop some skills that are commensurate with success in using spreadsheets. I will present some student examples and describe their struggles and successes.

Counter-intuitive results from collisions involving rotation
Michael C. Faleski, Delta College

In introductory classes, perfectly inelastic collisions of objects are the most straight-forward for students to solve. There are many examples in textbooks and also in the end-of-chapter problems. It seems that it becomes an easy problem for which students can memorize the necessary equation to achieve the desired result. Things become more problematic when the collision occurs for an object and a stick when rotation becomes involved. In this talk, we look at some potentially surprising results that arise when carefully considering these kinds of collision.

Creating a Mental Model of a Radian
James DeHaan, De La Salle Collegiate High School

What is a radian? Many people answer this question by relying on a formula or an irrational number. In order to have a deep understanding of rotational motion students need to develop a reliable mental model of a radian. Inquiry labs will be discussed that will help develop and deepen students' understanding of a radian.

The Natural Human Electricity and Its Use to Operate Touchscreens
Wathiq Abdul-Razzaq, West Virginia University

Many students are unaware of the fact that the natural electricity of the human body is sufficient to operate devices with touch screens such as smart phones. If the screen is touched by a finger, the bodyôs capacitance is connected to the sensor's circuit, causing a reaction and an operation. We developed a lab experiment to educate the student about the natural human electricity and its use to operate equipment. This is particularly important for the life-science students who want to see a bond between physics and their area of study.

Experimenting with Impacts
Michael C. LoPresto, Henry Ford College

A description of the procedure for and results of a simple experiment on the formation of impact craters designed for the laboratory portions of lower mathematical-level general education science courses such as conceptual physics or descriptive astronomy. The experiment provides necessary experience with data collection and analysis as well as practice with quantitative skills such as measurement and calculation in a manner that does not exceed the mathematical scope of the courses while, due to its hands-on nature and interesting topic, remaining engaging.

Cheap Sensors allow for Real Questions
Steve Dickie, Divine Child High School

I will share a student project made possible by the growth of the Maker Movement. Today there are a number of cheap, accessible sensors available that make it possible for students to investigate questions that would have once been impossible in a high school classroom.

Flipping a Class Without Flipping Out
Alan Grafe, University of Michigan - Flint

This presentation recounts the experience of transitioning UM-Flint's Classical Mechanics course to a flipped mode of presentation. Hardware, software, logistical, and curricular issues will be explored.

How Standards Based Grading Improved Student Achievement
Joanna DeMars, Grosse Ile High School

Standards Based Grading seems to be a hot topic in education right now. This talk will describe the transition from traditional grading to standards-based and show how one teacher's students' achievement on teacher-created summative assessments and on national standardized assessments improved. This presentation will also show how the process of standards-based grading changes as the classroom environment changes.

Building a Culture for Learning Physics
Bryan Battaglia, Utica Academy for International Studies

Amazing demo? Fantastic Lab? That's cool, but unless your students have the proper mindset you may not achieve maximum learning. I will share ways that I have used to help students trust themselves and each other in order to allow them to reach the sweet spot in learning.

Using Science Olympiad Events to Bring Engineering and Design Into the Classroom
James Gell, Plymouth High School

Science Olympiad offers K12 students the opportunity to compete in a variety of events that include science knowledge, technology, engineering, and problem solving. There are many ways in which these events can be used to engage students authentically in the learning process. This talk will focus on the use of one of these events, the Boomilever, in which students design, build, and test wood and glue structures to support a load. This activity will also be examined with respect to the new Michigan Science Standards.

Why do we Teach Physics like it's 1899?
Vance J. Nannini, Divine Child High School

Go through any introductory physics text (or curriculum) and we'd be hard-pressed to see much difference between the examples we use to teach the principles of physics now than in 1899. There may be a few "modern" examples thrown in, but for many of us teaching introductory physics involves the various movements of balls and blocks - not of much use in getting young adults excited about physics. Mastering the foundations is important, but there are multiple situations from actual events that not only integrate many fundamental physics concepts, but also tie what students learn to the world around them. Once such example is the gravitational assist - or gravitational slingshot - where a smaller body uses the gravity from a planetary body to gain velocity. Voyager 1 and 2, and the New Horizon's probe both used gravitational assist to accomplish their missions. Significantly, gravitational assist was also featured on the movie "The Martian" which has peaked many students' interests in space travel and physics. A study of gravitational assist integrates linear momentum, kinetic energy, and other fundamental physics principles in a situation where we can better capture student interest and demonstrate that physics isn't just about that darn ball's final velocity when it rolled down the inclined plane.

EHW and Reflections in Physics Curriculum
Taoufik Nadji, Interlochen Arts Academy

The presenter shares his experience with EHWs as assessment tools in his college Physics courses. In addition, the use of reflections in his curriculum is explained and samples of students' work are shared with the attendees.

Circular Motion – Lo-tech to Hi-tech
Frank Norton and Dan Lorts, Cranbrook

The presenters will demonstrate a series of observations designed to take students from the concrete to mathematical formalism. Using a 1.2 m diameter self-constructed turntable, motion and force concepts related to circular motion will be initially examined qualitatively using simple (lo-tech) measuring devices. Once students become familiar with the basic concepts, electronic sensors will be used to examine the quantitative aspects of circular motion. Discussion will culminate with a hi-tech demonstration of Vernierõs Centripetal Force Apparatus.

Principals for Smart Teaching
Samanthi Wickramarachchi, Kalamazoo College

We all teaching a course in our field of expertise but are we expert in how to teach others about our field? In fact, we need to create our own style of teaching that works for all and make students become self-directed learners. There are seven principles which provide instructors with an understanding of certain approaches to enhance learning. In this session, we will discuss the following principles: encourages contact between students and faculty, develops cooperation among students, encourages active learning, gives prompt feedback, respects diverse talents and ways of learning.

A progress report of physics lab curriculum change at Lawrence Technological University
Changgong Zhou, Lawrence Technological University

Starting in the Fall 2015 semester, Lawrence Technological University adopts a new pedagogy for introductory physics labs. The pedagogy is centered on the research finding that Immediate Feedback Assessment Technique improves student engagement and knowledge retention. A new lab curriculum is created based on the new pedagogy. This presentation will report the creation and implementation of the curriculum, students' and instructors' feedback, as well as improvements planned in the future.

Integrating laboratory activities into an upper-division laser physics course
Christopher M. Nakamura, Saginaw Valley State University

Physics requires an understanding of both theoretical and experimental techniques, and professionally, physicists must understand the interplay between these two aspects of the discipline. In the curriculum, however laboratory work and theory work are often separated in different courses, making the establishment of relevant connections more difficult. Special topics electives may give an opportunity to bring the two aspects together. In Fall of 2015 I taught an elective: Introduction to Lasers and Optoelectronics. The course has traditionally been a lecture-based theory course, however lasers and optoelectronics are an inherently experimental field. Therefore, I took the opportunity to implement a series of brief laboratory exercises designed to highlight experimental demonstrations of the theory, or applications of the theory. In this talk I will provide a brief overview of the lab exercises, the design intent, and discuss my experiences, both positive and negative, while working to implement the activities. Ultimately I found the approach to be useful, but with strong limitations. Opportunities for similar implementations beyond lasers and optoelectronics will be discussed, as will key caveats.
1This work is supported in part by a Herbert H. and Grace A. Dow Professor

A Case Study: Novel Group Interactions through Introductory Computational Physics
Michael J. Obsniuk, Michigan State University

With the advent of high-level programming languages capable of quickly rendering three-dimensional simulations, the inclusion of computers as a learning tool in the classroom has become more prevalent. Although work has begun to study the patterns seen in implementing and assessing computation in introductory physics, more insight is needed to understand the observed effects of blending computation with physics in a group setting. In a newly adopted format of introductory calculus-based mechanics, called Projects and Practices in Physics, groups of students work on short modeling projects -- which make use of a novel inquiry-based approach -- to develop their understanding of both physics content and practice. Preliminary analyses of observational data of groups engaging with computation, coupled with synchronized computer screencast, has revealed a unique group interaction afforded by the practices specific to computational physics -- problem debugging.

Abstracts for Contributed Posters

Perfectly inelastic collisions with a stick
Michael C. Faleski, Delta College

Students tend to find perfectly inelastic collisions about the easiest with which to deal in introductory physics. However, once the collision occurs with an uniform stick, e.g., rotation comes into play which greatly complicates matters. In this poster, we look at some of the more "surprising" results that are not necessarily intuitive upon first consideration of this class of problem.

Motivating Elementary Mechanics with Large Asteroid Datasets
Jordan Steckloff, Purdue University

Elementary Mechanics is typically motivated with examples on the Earth that are familiar to students. However, such examples are subject to non-ideal conditions (e.g. air drag, rolling friction, non-inertial reference frames), and their use may unintentionally reinforce incorrect schema that students have on their underlying physical processes (e.g. moving objects naturally come to rest without a driving force). Here we present a motivation for gravitation and circular motion using the Minor Planet Centerõs most recent published data set of asteroid spin periods and radii, which are obtained from asteroid light curve studies. Asteroid motion is not subject to friction, which complicates the understanding of Newtonõs laws on the Earth. Additionally, students are typically unfamiliar with asteroid mechanics and therefore possess fewer preconceived notions of how asteroids should behave.

Experimenting with Impacts

Michael C. LoPresto, Henry Ford College

This poster will report on student data and results from the experiment of the same name discussed in a contributed presentation, abstract above.

MIAAPT Mission Statement: The Michigan Section of the American Association of Physics Teachers is dedicated to promoting excellence in physics education in the state of Michigan and to supporting physics educators statewide. This organization shall endeavor to advance the knowledge of physics, to improve the teaching of physics, and to interest an increasing number of young people in making a career of physics.