

**Workshop in Modern Physics**  
Summer 2009  
WMU Physics Department  
in Collaboration with the  
Mallinson Institute of Science Education

**Time:**

TBD

Monday – Friday 0800 – 1745.

**Place:**

TBD

**Instructors:**

Michael Famiano, Workshop director  
2229 Everett Tower  
387-4931  
[michael.famiano@wmich.edu](mailto:michael.famiano@wmich.edu)

Dean Halderson  
1135 Everett Tower  
387-4947  
[dean.halderson@wmich.edu](mailto:dean.halderson@wmich.edu)

Charles Henderson  
1129 Everett Tower  
387-4951  
[charles.henderson@wmich.edu](mailto:charles.henderson@wmich.edu)

**Office Hours:**

Instructors will make themselves available for a few hours for informal discussion after the dinner session. Participants should feel free to use this time to socialize, discuss, or ask questions of the instructors.

**Student Researchers:**

Two undergraduate students studying secondary education in physics have been working with the workshop director throughout the year and have been invited to participate in this workshop as your future colleagues. These students will also assist the director in the experimental portion of the workshop.

### **Objective:**

This course is designed to present materials in modern physics with an emphasis on nuclear physics. Many of the Michigan High School Content Expectations (HSCE) will be covered in this course. However, much enrichment material will also be covered. The goal of this workshop will be to better equip teachers to present some of the more advanced topics in the Michigan HSCE while preparing them to equip future scientists.

### **Summary of Topics Covered**

<b><u>Topic</u></b>	<b><u>Relationship to Michigan High School Content Expectations</u></b>
Newton and Einstein: Gravity, acceleration, and speed.	P2.x, 3.6
Plank: Light and waves.	4.6
Waves and Particles	4.7, 4.r9x
Matter and Energy	4.12x
Fundamental Forces	3.1x
Atoms and Nuclei	4.12
Radioactivity	4.12A
Nuclear Reactions	4.12, 4.12d
Stellar Burning	4.12d

### **Enrichment Topics Covered**

While not necessarily required by the Michigan HSCE, several exciting and timely topics will be covered each year to provide additional interest in physics. These include, but are not limited to:

- Nuclear Astrophysics
- Accelerators
- Detectors
- Supernovae and X-ray bursts
- Nucleosynthesis

### **Text:**

TBD.

Course notes will be provided. Notes can be accessed on the instructor web site: <http://homepages.wmich.edu/~mfamiano>

### **Participant Support:**

Support for participants will be provided in the form of a daily stipend to cover hotel and travel expenses. An evening dinner will also be provided.

Workspace and a computer account will be provided for teachers to develop experiments.

### **Laboratory Experience:**

Participants will spend a portion of each day in a real research environment constructing basic scientific apparatus for use in real experimentation and demonstration. This apparatus will then become available for participants to use in their own classrooms during the academic year.

### **Follow-Up**

At the end of this program, you will not only have an increased understanding of the content of modern physics, but a better understanding of how to present it at the high-school level. You will have also produced a series of in-class demonstrations suitable for the high-school level.

With the production of these demonstrations comes the availability of these demonstrations to you for use with your students. You will be given the opportunity during the school year to use these demonstrations in your classrooms.

The instructor will also take time during the school year to visit your classroom. This will serve three purposes. The first is to deliver the demonstrations to your class. The second is to visit your class and discuss careers in the sciences with you and your students. The third is to discuss any concerns with you in teaching modern physics to your students. Ultimately, this will create a stronger link between the university and the high-school in modern physics instruction.

In addition to this, you will be given the opportunity to present the workshop at a state chapter meeting of the American Association of Physics Teachers (AAPT). This will give you the chance to present the workshop and its effectiveness on a personal level. More importantly, you will be able to lead in the development of a state-wide network of high-school and university physics teachers.

## **Schedule of Activities:**

### **Day 1:**

#### **Introductions, development of program, syllabus**

#### **Session I: Modern Physics Review**

0830: “An Introduction to Modern Physics: Copernicus, Newton, Maxwell, Einstein” (Famiano)  
0900: Newton and Einstein: Gravity, acceleration, and speed. (HSCE P2.x, 3.6) (Henderson)  
1030: Break  
1045: Plank: Light and waves. (HSCE 4.6) (Halderson)  
1145: Summarize Morning Session. Questions.

#### **Lunch** (1200)

#### **Session II: In-Class Experimentation and Demonstration Construction**

1330: Introduction to experiments. Accelerator safety training. (Famiano, Kayani)  
1430: Development of experiments. Construction of scintillator detector. (Lead by Famiano and Undergraduate Researchers.)

#### **Session III: Teaching Techniques**

1645: Techniques Session. Teaching techniques for modern physics: misconceptions, content, approach (Henderson).

#### **Dinner, Office Hours, Discussion** (1800)

### **Day 2:**

#### **Session IV: Modern Physics**

0830: Heisenberg: Particles and Waves. (HSCE 4.7, 4.r9x) (Famiano)  
1030: Break  
1045: Feynman: Fundamental forces and the standard model. (HSCE 3.1x) (Halderson)  
1145: Summarize Morning Session. Questions and Discussion

#### **Lunch** (1200)

#### **Session V: Continue Experimental and Demonstration Development**

1330: Progress report. Questions.

1400: Development of Experiment. Finish Construction.

**Session VI: Teaching Techniques Session**

1645: Getting Students to Understand Modern Physics: Newtonian Analogs. Understanding the Non-Intuitive. Teaching Modern Physics with a Newtonian Background. (Henderson).

**Dinner, Office Hours, Discussion, Finish Experiment Construction if Necessary** (1800)

**Day 3:**

**Session VII: Modern Nuclear and Atomic Theory**

0800: Bohr, Rutherford, and Chadwick: Atoms and nuclei. (HSCE 4.12) (Halderson)  
0930: Curie and Bequerel: Radioactivity. (HSCE 4.12A) (Famiano)  
1030: Break  
1045: Oppenheimer: Introduction to nuclear reactions. (HSCE 4.12, 4.12d) (Halderson)  
1145: Summarize Morning Session. Questions.

**Lunch** (1200)

**Session VIII: Experiment**

1330: Radioactivity and Radioactive decay. Use experiment built during days 1&2 to study natural and artificial forms of radiation, including the accelerator, and cosmic rays. (Lead by Famiano & Undergraduate Researchers ).

**Session IX: Teaching Techniques Session**

1645: Tools for Teaching Modern Physics: Getting students to see the unseeable. (Henderson & Famiano).

**Dinner, Tour, Social Event** (1800)

**Day 4:**

**Session X: Special Topics in Modern Physics: Astrophysics**

0800: Top questions in science: The NSAC report. (Famiano)  
0830: Bethe: Stellar Burning. Nuclear Astrophysics. (HSCE 4.12d, 4.12A) (Famiano & Halderson)

1030: Break  
1045: Special Topic: Explosive burning. Supernova, X-Ray bursts, and nucleosynthesis, etc. (Famiano)  
1145: Summarize Morning Session: Questions and Comments.

**Lunch** (1200)

**Session XI: Experiment: Shielding and particle passage in matter.**

1330: Using the accelerator, some sources, and our detector, we will explore how different particles of different energies interact in matter and how this can be used to understand radiation shielding. (Lead by Famiano & Undergraduate Researchers)

**Session XII: Teaching Techniques Session**

1645: “The Gripe Session” How can the university help the high-school direct students to careers in science? (Famiano, Halderson, & Henderson)

**Dinner, Discussion, Office Hours** (1800)

**Day 5:**

**Session XIII: Laboratory tools in modern physics (Enrichment)**

0800: Introduction to Detection in Modern Physics. (Famiano)  
0830: Bethe: How particles interact in matter. Detectors. (Halderson)  
1030: Break  
1045: Experiments: Setting up a nuclear physics experiment. (Famiano & Possible Guest Speaker)  
1145: Summarize Morning Session: Questions and Discussion.

**Lunch** (1200)

**Session XIV: Experiment: Nuclear scattering**

1330: We will use the accelerator and our detector to understand how we can understand the nucleus through scattering of particles. (Lead by Famiano & Undergraduate Researchers)

**Session XV: Teaching Techniques Session**

1645: Resources for the high-school teacher. Follow-up plans. Workshop Evaluations. Presentation of results.

**End of Program** (1800)