

# MAAPT Spring Meeting

Macalester College

Saturday, April 26, 2008

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## **1 (8:30 - 9:30) Session I**

### **1.1 (8:30) Sarah Anderson and Chad W. Hoyt, ”A LOW-COST WAVELENGTH METER WITH PICOMETER-LEVEL ACCURACY”**

Bethel University. We have demonstrated a low-cost Michelson interferometer-based wavemeter for use in high-resolution spectroscopy experiments. The wavemeter has a movable arm of length  $\sim 1.5$  m, composed of a common laboratory air track and cart. A commercial frequency stabilized Helium-Neon laser is used as a reference laser. The wavemeter was tested using an external cavity diode laser referenced to resonances in iodine at 636 nm and was demonstrated to have measurements that were within one picometer of the known values.

### **1.2 (8:50) Matthew Inman, “The Effect of the Use of Online Homework on Problem Solving Ability of Introductory Physics Students”**

MSU Mankato. Through the use of interviews, exam results, and surveys the effect of the use of online homework on the problem solving ability of introductory physics students is investigated. This information is compared with literature to determine if those using online homework differ significantly from those studied in literature. It is found that the students at Minnesota State University do not differ from the predictions made by literature. Students who are assigned online homework are given exam problems that are exactly the same as previously assigned homework problems. Students are not retaining information about problem solving as they struggle to solve exam problems that are exactly the same as previously assigned homework problems. A direct comparison of exam solutions of two sections, one using online homework and the other using traditional homework is made. No significant difference in exam solutions is seen between the section using online homework and the one using traditional homework; however, further study is needed.

### **1.3 (9:10) Ben VanHavermaet, Joshua Kranz, "Properties of Solid Nitrogen"**

Rochester Community and Technical College. The purpose of this experiment was to study the thermodynamic and optic properties of solid nitrogen formed in a vacuum. This was done by freezing liquid nitrogen with a known mass in a vacuum and taking the temperature of the solid nitrogen, then measuring the final mass of the nitrogen. The optics was done by firing a laser through the solid nitrogen and determining the angles of incidence and refraction.

## **2 (9:30-10:15) Plenary session: QuarkNet History: Nationally and at the University of Minnesota**

QuarkNet is a national program designed to involve high-school teachers and their students in real scientific research. Nationally, it began in 1999 and the University of Minnesota site was added in 2002. The program consists of an international collaboration of universities, high schools and research centers that include CERN in Switzerland, and Fermilab, LBNL, and SLAC in the United States. One of the program's goals is to involve students and teachers in authentic scientific research projects. By actually doing science, they gain first-hand knowledge of the process and engage in the inquiry method of learning. This talk will focus on the history of QuarkNet and the U of M's involvement in the program.

Additionally, an overview will be given of the Cosmic Ray Muon Detectors used by students in data-driven investigations. These cosmic ray data flow to an online e-Lab for input to analysis tools for student inquiry. The Cosmic Studies represent the first of several e-Labs for classroom use. Others to be shown include Ligo and CMS. Those with a wireless laptop may visit the demo sites during the presentation. These e-Labs represent the first time teachers and students run analysis code on the GRID. A presentation on the QuarkNet with opportunities for hands-on testing during the break afterwards.

## **3 (10:15 - 11:00) Poster session**

### **3.1 Ben Rislow, Gordon McIntosh, "Characteristic Lifetime of a Polarized Feature in the Ground State SiO Maser VY Canis Majoris"**

University of Minnesota, Morris. Silicon monoxide masers originate in the circumstellar environment of some red supergiant stars. A time series cross correlation analysis has been developed for calculating the characteristic lifetime of linearly polarized features. Our observations of VY CMa in the  $v=0, J=1 \rightarrow 0$  transition revealed a highly linearly polarized feature at  $V_{lsr}=18.5$  km s<sup>-1</sup>. Applying the cross correlation analysis to this feature gave a characteristic lifetime of 2800 days.

### **3.2 Brandon Lehner and Gordon McIntosh, "Correlation of R Cassiopeia's SiO Maser Properties"**

University of Minnesota, Morris. Theories suggest there may be a relationship between the kinematics of the circumstellar region and stellar phase of long period variables. To test this relation, the silicon monoxide maser spectra of R Cassiopeia from 1984 - 1995 were acquired and statistically

examined. The velocity centroids of the spectra have been determined and correlated with the flux densities. Results indicate a correlation between the integrated flux density and velocity centroid.

### **3.3 Jason Bonde and Gordon McIntosh, “The Characteristic Lifetime of Mira’s SiO Maser Features”**

,University of Minnesota, Morris. Silicon monoxide maser spectra of the long period variable star Mira have been observed for over five stellar periods in the  $v = 1, J = 1 - 0$  transition and a characteristic maser lifetime has been extracted. A characteristic lifetime of 470 days was determined. This lifetime is considerably longer than Mira’s optical variation period of 332 days and suggests that the masers are not reset at a particular stellar phase.

### **3.4 Shane Wood, “Using CERN Data with High School Students”**

Irondale High School. This poster will demonstrate how real data from high energy particle physics experiments can be used by high school students. The European Particle Physics Outreach Group (EPPOG) has organized particle physics Masterclasses in which students use data from CERN’s Large Electron-Positron Collider (LEP) experiments to better understand the world of quarks and leptons. Through the Internet, all teachers and students can access and utilize the LEP event display data housed on the Masterclass website.

### **3.5 Andrew Nguyen, Benjamin Stottrup, “Line Tension Measurements within Lipid Monolayers”**

Augsburg College. Preliminary measurements of line tension have been made for coexisting phases of lipid monolayers. We present several aspects of data collection and analysis for our non-invasive measurement technique. We also suggest a novel technique for determining monolayer transition pressures.

### **3.6 Benjamin Hoffmann, Benjamin Stottrup, “Using GFP to Find Protein Levels and Production Rates Over Cell Lifetimes”**

Augsburg Colleg. We have used manual and automated techniques to track and extract GFP fluorescence intensities throughout the lifetimes for hundreds of NIH-3T3 fibroblasts. GFP measurements provide information on protein levels as the cell develops. Cells were categorized into particular populations of GFP production patterns. Initial results will be presented.

### **3.7 Laura Steen and Keith Stein, “Types and refinement of finite elements for Finite Element Method in parachute modeling”**

Bethel University. This paper presents a study on a parachute model using Finite Element Method (FEM) structural analysis with specific focus on how the types and refinement of elements affects the outcome of numerical simulation. The data gained from these are taken as applied to computer simulations of a disk-gap-band parachute mesh as well as to a benchmark situation of the inflation of a quarter cylinder for analysis purposes. Two types of elements are used for the parachute model: quadrilateral elements, and triangular elements. Using these, three types of meshes will

be generated, using quadrilateral elements, triangular elements, and triangular elements utilizing adaptive refinement. Two types of elements are being used for the benchmark case of a quarter cylinder: quadrilateral elements and triangular elements.

## **4 (11:00-12:00) Session II**

### **4.1 (11:00) Tom Brenner, Pinshane Huang, Melissa Eblen-Zayas, “Hands-on Green Physics: Making your own biodegradable plastics and dye-sensitized solar cells”**

Carleton College. With the increasing interest in sustainability and environmental issues, we have developed two hands-on activities appropriate for introductory physics classes that highlight key physics concepts in the context of green technologies. We will describe the relevant physics concepts behind biodegradable plastics and dye-sensitized solar cells and how they can be made part of a classroom lab activity.

### **4.2 (11:40) Josh Perry, and Andrew Ferstl, “Simulation of an N-body system interacting via the gravitational force”**

Winona State University. This research project is a computer simulation of the formation of a solar system from a gas-like cloud. The gas particulates collide and combine to form increasingly larger celestial objects. The simulation incorporates conservation of linear momentum, conservation of energy, and the law of gravity. Further work could be done to incorporate conservation of angular momentum as well as magnetohydrodynamic effects.

### **4.3 (11:20) Andrew Haugen, “The influence of zwitterionic lipids on the electrostatic adsorption of macroions onto mixed lipid membranes”**

MSU Mankato. Charged lipid membranes commonly consist of a mixture of charged and zwitterionic lipids. We suggest a model that characterizes the influence of the dipolar nature of the zwitterionic lipid species on the electrostatic adsorption of macroions onto mixed membranes in the fluid state. The model is based on Poisson-Boltzmann theory which was modified to account for zwitterionic lipids. In addition the membrane lipids are allowed to adjust their lateral distribution upon macroion adsorption.

## **5 (12:00-1:00) Lunch and Business meeting**

## **6 (1:00 - 2:00) Session III**

### **6.1 (1:00) Linda Winkler, “Periodic Trends of the Halogens”**

MSU Moorhead. Here we demonstrate a nice set of experiments that show how properties change within a group in the Periodic Table. We look at the group VIIA, the halogens—specifically Chlorine, Bromine, and Iodine. Both solubility and reactivity of these elements can be demonstrated. This is an inexpensive, safe chemical or modern physics experiment that has an intriguing outcome.

## **6.2 (1:20) David DeMuth, Jr., Andrew Sheppard, “River Watch - A program to develop high school students interest in Science, Technology, Engineering, and Mathematics.”**

UofM Crookston. North America’s Red River Basin is a remnant of glacier activity that produced Lake Agassiz some 13,000 years ago. Communities such as Moorhead, MN, Fargo, and Grand Forks, ND became population centers after farming this Lake’s fertile residue, but frequently are challenged by flood, drought and water use. Preserving quality water is a signature characteristic of the River Watch Citizens Monitoring program which supplement efforts by the Minnesota Pollution Control Agency and various water management boards throughout the basin.

A web-based data acquisition and analysis system has been developed to ensure the highest quality data from an extended network of high school partners, where the development of leadership, sense of place, and basic research skills are objectives. Of particular interest is the program’s goal to facilitate an interest in the STEM disciplines and contributing to the Nation’s historic scientific prowess that is currently being challenged by globalization.

The River Watch program will be discussed and the <http://riverwatch.umn.edu> data system will be demonstrated.

References:

[http://en.wikipedia.org/wiki/Lake\\_Agassiz](http://en.wikipedia.org/wiki/Lake_Agassiz) <http://ray.crk.umn.edu/maapt/macalester/>

## **6.3 (1:40) Andy Rundquist, “Getting students to read the text”**

Hamline University. I will demonstrate my database-driven system to collect questions on the daily reading from my students and how I adjust my lectures based on them.