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SCIENCE OUTREACH

Friday, April 26, 1:00 - 4:15 p.m.
Learning Center 100E

1:00 SUMMER BIOLOGY WORKSHOPS FOR ELEMENTARY TEACHERS WITH SPECIAL OUTREACH PROGRAMS FOR TEACHERS OF UNDERSERVED STUDENTS

Mary A. Shimabukuro, Steve Zielinski**, and Nancy B. Walters***, *Department of Biology, Moorhead State University, Moorhead, MN 56563, **Washington School, Moorhead, MN, ***Minnesota Higher Education Services Office*

Moorhead State University has developed and implemented a series of two-week (four credit) summer biology workshops for area elementary teachers. These workshops have been offered for the past six years and have been supported by funds from the Eisenhower Mathematics and Science Education Act for five years. Shorter (1 credit) versions of these workshops have been prepared for teachers at schools near White Earth MN and for teachers in the Northern Region and Willmar Summer Migrant Schools. In 1994 this program was named a "Promising Practice" by the Eisenhower National Clearing House for Science and Mathematics. Areas of Biology which are particularly appropriate for elementary school students are emphasized, such as 1. Plants in the Classroom; 2. Human Biology; 3. Ecology and Environmental Science; and 4. Animals and Animal Behavior. The workshops feature hands-on experiences with inexpensive materials in an inquiry setting. Emphasis is placed on science process skills including observing, formulating and testing hypotheses, data collection and analysis, and drawing conclusions. Computer skills are is incorporated when appropriate. Through slides, handouts and an oral presentation, participants in this session will learn about the Eisenhower Program, the biology workshops and some of the resulting science classroom activities.

1:30 SIGMA DELTA EPSILON/GRADUATE WOMEN IN SCIENCE, INC.: SCIENCE OUTREACH PROGRAMS

Joy Frestedt, Chair, Xi chapter Science Outreach Programs, National President Elect, SDE/GWIS

SDE/GWIS was founded in 1921 and affiliated with AAAS in 1939 as an interdisciplinary society of scientists and mathematicians who encourage and support women and girls to enter and achieve success in science. Members participate in monthly meetings, local and national Newsletters, and an electronic discussion group specifically focused on the unique needs of women in science. The goal of this electronic outreach to professional women scientists is to connect women scientists who can mentor each other, share useful information, and discuss issues unique to women in science.

The local Xi chapter (Minnesota) science outreach activities include a speakers bureau, new e-mail bulletin board, job bank, and the science outreach program. Science outreach members often serve as a resource for groups needing volunteer scientists (e.g., Operation SMART, Girl Scouts, Project Link, Technically Speaking, Science By Mail, Kids and Chemistry, on-line discussions with individual schools in Minnesota, area principals meetings, school inventors fairs, and individual school classes and discussion groups). The science outreach committee in Minnesota is now 40 scientists strong and working to develop stronger collaborations and networks with existing organizations and events.

This year the GWIS science outreach committee has sponsored judges for the MAS science fairs, written a brochure describing how to write a science fair paper fore 4-8th grade students, commissioned a new award for science fair winners, worked to increase submissions to the MAS Journal, and agreed to sponsor a symposium on Women in Science at this meeting.

2:00 SUMMER SCIENCE WORKSHOPS FOR ELEMENTARY TEACHERS - WHAT WORKS? WHAT DOESN'T?

Dr. Lynn G. Hartshorn, University of St. Thomas, Chemistry Department, Mail #4051, 2115 Summit Avenue, Saint Paul, MN 55105

Successful science and mathematics workshops for elementary teachers have been held at St. Thomas during the summer for several years. The workshops include varied sessions in life science, earth science, and physical science in mathematics and in methods of teaching science. There is an emphasis on hands-on, minds-on activities, which are presented together with some content. Recently, the teachers have been introduced to the emerging National Science Standards. Some local resources are presented by means of field trips and outside speakers.

The workshop has been very well received by teachers. The workshop faculty includes grade school teachers, college faculty, and science education specialists. There will be a discussion as to the needs of practicing elementary teachers, as observed over several years, and how best to meet those needs. There will also be comments as to what works well in workshops of this kind and why.

2:30 - 2:40 BREAK

2:45 MATHEMATICS IN THE REAL WORLD: SAINT OLAF'S MATHEMATICS PRACTICUM

Steve McKelvey, Saint Olaf College

The Mathematics Practicum at Saint Olaf College is an educational outreach program involving the cooperation of the college and several outside businesses, government agencies and nonprofit organizations. The course is offered annually during our January interim session and is open to all upper class mathematics majors.

The primary goal of the course is to provide students with the experience of working on mathematical problems arising from real applications where no one knows the right answer. The best problems involve situations where even the best approach is not obvious.

A secondary goal is to provide the outside organization with information they may find directly or indirectly helpful to them in their work.

For the faculty the most difficult part of the course is finding good problems. The ideal problem is one of genuine importance to the sponsor and one which requires some creative problem solving. We routinely turn down problems involving textbook statistical analysis of data. We look for problems that possess an interesting non-standard twist. These problems generally involve some kind of modeling or intense numerical attacks.

We have worked with companies and agencies of all sizes. Our past partners include the St. Paul Companies, Cargill, CP Soo Line Railroad, the Mayo Clinic and Honeywell. We have also worked with both the Minnesota Pollution Control Agency and the United States Environmental Protection Agency. We have also worked with the Minnesota Department of Public Health and the Minnesota Department of Transportation. Smaller contacts are also quite valuable. In the past two years we have worked with a local manufacturer of flexible circuit boards and a one person firm designing medical supplies.

During this talk I will discuss the benefits of this experience for both students and the outside sponsors. I will also be happy to share the nuts and bolts of the administration of this course.

3:15 SHARING SCIENCE OUTREACH PROGRAM AND ITS IMPACT

Vijendra Agarwal, Gerald Hart, Walter Wesley, Department of Physics, Moorhead State University, Moorhead, MN 56563

The Physics and Astronomy Department at Moorhead State University has offered Sharing Science in-service workshops for teachers from the tri-state region since 1988. The workshops have focused on a wide spectrum of physics and physical science topics and have made a significant impact on classroom teaching of hundreds of grades 4-12 teachers. In addition, the Academic Alliance program has led to many informal but important partnerships between Schools and colleges throughout the region. We have also had several successful public science shows to attract large crowds including students of all ages, parents and teachers. This presentation will focus on the cumulative impact of our outreach efforts, problems encountered, teacher assessment of activities, and possibilities of maintaining momentum in coming years.

3:45 THE HAMLINE UNIVERSITY SCIENCE OUTREACH PROGRAM

Ronald G. Brisbois, Hamline University, 1536 Hewitt Ave., St. Paul, MN 55104

The Hamline University Science Outreach Program was initiated during the 1993-94 academic year. The focus of the program, to date, has been on 3rd and 4th grade students and their parents. A key goal of the program is to provide an experience through which parent(s) and child work together in learning aspects of fundamental physical science and develop a mutual appreciation for the important role technological understanding plays in the education. The presentation will address (1) how the program was started, (2) the role that Hamline undergraduates play in the program, (3) the specific physical science exercises offered, and (4) examples of parent/child response.

MINNESOTA ARCHEOLOGY

Friday, April 26, 1:00 - 4:00 p.m.

Drew Science 119

1:00 INTRODUCTION

1:10 THE SEARCH FOR "THE CORN OF THE NORTH": REEXAMINING THE EVIDENCE FOR WILD RICE

David Kluth, Leech Lake Heritage Sites Program

Wild rice has been well documented as an Important resource for historic American Indians in the Great Lakes region and beyond. However, direct evidence for the use of this annual grass in *prehistoric* periods has been scarce. More commonly, the prehistoric use of wild rice has been inferred based on the location of sites on lakes that contain historic or modern stands of rice, rather than on direct prehistoric evidence. Often the physical characteristics of a site have been the sole criteria for consideration as a *prehistoric* wild rice camp.

Direct evidence for the prehistoric use of wild rice is lacking, and more importantly, the theorized date of A.D. 800 for the beginning of intensive use of wild rice is not supported by the present data. The existing evidence for wild rice use in the Upper Midwest will be discussed, as well as the need for acceptable lines of direct evidence to suggest the use of wild rice prehistorically.

1:30 WILD RICE UTILIZATION ALONG THE WISCONSIN RIVER

Constance Arzigian, Mississippi Valley Archaeology Center, University of Wisconsin-La Crosse, 1725 State Street, La Crosse WI 54601

Wild rice was incorporated into the diet of many cultures in the upper Midwest. Middle and Late Woodland cultures along the Wisconsin River from northern to southwestern Wisconsin exploited wild rice, as did Oneota populations along the Mississippi River at La Crosse. In each of these cases, wild rice served as a complement to a hunting-fishing-gathering and sometimes agricultural diet. Suggestions are made about the availability of wild rice, its processing, and its nutritional value.

1:50 POLLEN EVIDENCE FOR WILD RICE (ZIZANIA AQUATICA) IN MINNESOTA AND ONTARIO: ARCHAEOLOGICAL IMPLICATIONS

James K. Huber, Archaeometry Laboratory, 214 Research Laboratory Building, University of Minnesota, Duluth, Duluth, Minnesota 55812

Ethnographic accounts indicate that wild rice *(Zizania aquatica)* has been utilized by Native Americans for subsistence for many centuries. Wild rice grains have been found in association with a Laurel feature dated at 1,670±45 yr B.P. at the Big Rice site, northeast Minnesota. The earliest record of wild rice macrofossils are from Wolf Creek in east central Minnesota dating between 9,000 and 10,000 yr B.P. Based on palynological evidence at Big Rice and other lakes in Minnesota and Ontario, wild rice was present in harvestable quantities for a considerable period of time before it was utilized as a major food source.

At Gegoka Lake, Lake County, Minnesota, a small Gramineae rise in the uppermost 15 cm of the core is attributed to the expansion of wild rice. The Gramineae rise is found in conjunction with the increase in ragweed (*Ambrosia*-type) pollen associated with Euro-American settlement and land clearance beginning about 1890. Based on the pollen evidence, the expansion of wild rice is a recent phenomenon in Gegoka Lake indicating that current stands of wild rice may have a relatively short history.

2:10 - 2:40 BREAK

2:40 THE CASS LAKE 1 SITE: DIRECT EVIDENCE FOR PREHISTORIC WILD RICE IN THE MISSISSIPPI HEADWATERS REGION

Rose Kluth, Leech Lake Heritage Sites Program; Bob Thompson, Woodward-Clyde, Inc.

In the summer of 1994, the Leech Lake Heritage Sites Program conducted a survey for the Chippewa National Forest, and during shovel testing located the *Cass Lake 1 Site.* The *Cass Lake 1 Site* is located on a cove near Strawberry Point, which extends into Cass Lake. Over 444 sherds were located in one shovel test, and appear to represent a single Brainerd vessel. Brainerd ceramics are thought to date to the Early Middle Woodland Period in northern Minnesota.

Because of the amount of charred residue on the interior of this Brainerd vessel, we asked Bob Thompson of Woodward-Clyde to complete an opal phytolith analysis on the encrusted sherds. His results indicate that wild rice was being cooked and/or processed in this vessel. Two AMS dates were obtained from the same charred residue that was analyzed by Mr. Thompson. Our data produced direct evidence of wild rice dating to the Early Middle Woodland Period. These studies at the *Cass Lake 1 Site* support the need for dated direct evidence of wild rice at prehistoric sites.

3:00 *CUCURBITA PEPO* FROM THE KING COULEE SITE

Bradley E Perkl, Interdisciplinary Archaeological Studies Program, University of Minnesota, 215 Ford Hall, Minneapolis, MN 55455

Domesticated *Cucurbita pepo* seeds were recovered at the King Coulee site (21 WB 56)in southeastern Minnesota from two contexts: Late Woodland and Late Archaic. During excavation of the site, high ground water levels interfered with stratigraphic control and may have re-deposited the seeds out of sequence from their original positions. To determine the contexts of the seeds, an AMS date is being assayed. Cucurbits are among the earliest cultivated plants in the Americas. In Minnesota the record of squash use, and early cultigens as a whole, is poorly understood. Squash first appears in the upper Midwest during the Middle Woodland period at sites in southwestern Wisconsin. By the Mississippian period and into historic times, squash use is well established with beans and corn. If the squash seeds are associated with the Late Archaic occupation, it would mark the earliest and most northern occurrence of tropical domesticates in the upper Midwest. If associated with the Late Woodland occupation, it would mark the first appearance of squash and one of the earliest occurrences of domestic plant use in the archaeological record of Minnesota. With the results of the AMS date, some knowledge of domestic plant use in Minnesota should be realized.

3:20 SANITATION PRACTICES AND DEPOSITIONAL PROCESSES IN THE URBAN ARCHAEOLOGY OF 19TH CENTURY MINNEAPOLIS

John P. McCarthy, IMA Consulting, Inc., 3300 University Avenue S.E., Suite 202, Minneapolis, MN 55414

Prior to the introduction, and later the mandated use, of indoor-plumbing, the rear yards of both residences and commercial establishments in urban areas included facilities dedicated to the supply and storage of water and the disposal and management of wastes. These may have included wells, cisterns, privies, and storage sheds. As municipal services were introduced to better serve these purposes and improve overall sanitation and public health, these facilities were abandoned and relegated to the archaeological record.

The manner in which these facilities were used, and filled when abandoned, is critical to understanding 19th-century sanitation practices and to defining the interpretive contexts of the artifact assemblages recovered from such features on urban sites. This paper will present an analysis of sanitation practices and depositional processes for features recently investigated at a 19th-century site in downtown Minneapolis. The specific processes resulting in the deposition of artifact assemblages will be identified, and the implications of these findings in developing sociocultural interpretations of urban artifact assemblages will be discussed. The general state of 19th-century sanitation practice in Minneapolis and the extent of compliance with public health regulations will also be reviewed.

3:40 PALEO-ENVIRONMENTAL RECONSTRUCTION OF THE SOUTHERN MILLE LACS LAKE AREA

Grant E Goltz, Soils Consulting, HC 74 Box 1380, Hackensack, MN 56452

The interpretation of Holocene environmental conditions has long been used in locating and interpreting traces of past human cultures. A variety of tools and research methods including maps, aerial photography, palynological studies, and a wide range of field investigative techniques have been utilized in these efforts. With the increasing sophistication of microcomputer hardware and software, and the availability of digital mapping products, a new format for manipulation and presentation of paleo-environmental data has become available. Computer generated photo-realistic landscape renderings depicting sets of geomorphic, hydrologic, vegetative, and seasonal conditions are presented. These renderings are derived from USGS Digital Elevation Model data in combination with traditional kinds of paleo-environmental data. Examples are presented with archaeological and other kinds of data added. The resulting product provides vivid graphic illustrations of environmental conditions, greatly facilitating both the interpretation of archaeological data and the presentation of such data to researchers, land managers, and the public.

Saturday, April 27 9:00 a.m. - noon
Drew Science 119

9:00 THE STATUS OF BIOARCHAEOLOGICAL RESEARCH IN MINNESOTA, WISCONSIN, AND IOWA: A VIEW FROM CNPO

Susan Myster and Barbara O'Connell, Hamline University, St. Paul, MN 55104

In 1991 the U.S. Army Corps of Engineers under contract with the Arkansas Archeological Survey commissioned an overview of the archaeological and bioarchaeological resources in the Central and Northern Plains Division (CNPO) covering all or portions of 11 states. This paper will report on the distribution of burial and cemetery sites in Region 1 (Minnesota, Wisconsin and Iowa) and the status of bioarchaeological research in this region. A total of 1,200 burial and cemetery sites representing 9,127 individuals were identified for this region. Distribution of sites are reported according to drainage system, vegetation zone, geological unit and adaptation type. The bioarchaeological resources are evaluated in terms of the substantive bioarchaeological literature and synthesized in terms of the current state of knowledge regarding the adaptation of people inhabiting this region over the past 10,000 years. Key topics include burial practices, demography, population affiliation, growth assessment, pathological indicators of nutritional deficiencies, infectious disease load, trauma and activity patterns. The current knowledge of the adaptation of American Indian, Euro-American and other groups in this region is summarized, hypotheses are proposed and suggestions for future research are discussed.

9:20 MINNESOTA MODEL: A REVIEW AND UPDATE

Guy Gibbon, Department of Anthropology, 215 Ford hall, University of Minnesota, Minneapolis, Minnesota 55455

9:40 AFTER THE HYPSITHERMAL: TRANSITIONS IN ARCHAIC PREDATION ON THE PRAIRIE PENINSULA

John R. F. Bower, Archaeometry Laboratory, University of Minnesota-Duluth, 10 University Drive, Duluth, MN 55812-2496

Archaeological evidence from the Prairie Peninsula indicates that the Hypsithermal, or Atlantic, period of climate history (approximately 8000-5000 years ago) witnessed the establishment of highly effective pedestrian bison hunting, perhaps spreading from west to east, as a major subsistence focus of regional, Archaic cultures. During the next three millennia, when climate evolved to modern conditions, prehistoric subsistence regimes experienced major changes. Although the transition is poorly represented in the archaeology of the northeastern part of the region, some interesting new data have been recovered. In this paper, information about post-Hypsithermal human predation in the northeastern Plains will be examined along temporal and geographic clines. The results, though tentative, suggest tenacious adherence to bison hunting despite deteriorating opportunities. This may have persisted virtually to the point of demographic and/or cultural collapse, followed by the introduction (from the east?) of radically different cultural

formations, perhaps after a time lapse. From an anthropological point of view, what is being argued is essentially a non-adaptationist perspective.

10:00 PALEOECOLOGICAL INVESTIGATIONS OF GRAND MOUND OXBOW LAKE AND THE HANNAFORD SITE, KOOCHICHING COUNTY, MINNESOTA

James K. Huber, Archaeometry Laboratory, 214 Research Laboratory Building, University of Minnesota, Duluth, Duluth, Minnesota 55812

As part of a multidisciplinary investigation of the Hannaford archaeological site, pollen, nonsiliceous algae, and macrofossils were recovered from a 148 cm core from Grand Mound Oxbow Lake, Koochiching County, Minnesota. The pollen, algae, and macrofossils from Grand Mound Oxbow Lake record changes in local and regional vegetation and lake productivity for the past 3,000 years. A mixed conifer-hardwood forest is indicated by the Grand Mound Oxbow Lake regional pollen spectra. Four periods of local vegetational change are indicated by the Cyperaceae and Chenopodiaceae/Amaranthaceae pollen curves and the macrofossil assemblage. An *Ambrosia* rise occurs in the upper 30 cm of the pollen sequence.

Two older periods of increased Chenopodiaceae/Amaranthaceae abundance are probably related to river dynamics. The two younger periods of high Chenopodiaceae/Amaranthaceae abundance may be related to human disturbance. The first may be related to occupation of the Hannaford site. The youngest Chenopodiaceae/Amaranthaceae maximum and the *Ambrosia* rise are attributed to deforestation and Euro-American settlement.

The algae recovered from the Grand Mound Oxbow Lake core indicate stagnant mesotrophic conditions have prevailed throughout most of its history. A *Gloeotrichia* maximum in the lower portion of the core suggests that more nutrient poor conditions may have occurred during the early stages of lake development. Sluggish water conditions are also indicated by the bryozoan statoblasts.

10:20 - 10:40 BREAK

10:40 OLD COPPER IN MINNESOTA: A REVIEW

Guy Gibbon, Department of Anthropology, 215 Ford hall, University of Minnesota, Minneapolis, Minnesota 55455

Old Copper refers to a complex of large utilitarian artifacts, such as spear heads, celts, and knives, that are made of nearly pure native copper. The complex is distinctive to the western Great Lakes area during the Middle to Late Archaic period (ca. 3000-1000 BC). This paper provides a (1) brief synopsis of the types, frequencies, and distributions of Old Copper artifacts in Minnesota, (2) a summary of what we think we know about the sources of copper used to make Old Copper artifacts in the state, and (3) a summary discussion of five key issues in Old Copper research.

11:00 CERAMICS FROM THE HANNAFORD SITE: KEYS TO UNDERSTANDING THE MIDDLE TO LATE WOODLAND TRANSITION

Dr. Christy A. Hobman-Caine, Hamline University, St. Paul, MN 55104

The ceramics from the Hannaford Site, in conjunction with a re-examination of woodland ceramics from northern Minnesota and the upper Great Lakes region, provide a framework for a new understanding of the middle to late woodland transition. Utilizing the extensive Lenius-Olinyk database, correspondences in motif occurrence and decorative changes are delineated. New tools for understanding ceramic changes, including charting of vessel form through the use of rim and mouth flare angles, orifice diameter, vessel height, and inflections points, are outlined. Transitional ceramic types between Laurel and Blackduck are defined based on data from Hannaford and other sites within the Rainy River region. Treating the data as vessels rather than rim sherds is emphasized, including the procedures for maximum restoration of all portions of vessels in order to determine the Minimum Number of Vessels (MNV) The importance of MNV is emphasized, with criteria set forth for their determination.

11:20 THE MCKINSTRY SITE DATA RECOVERY PROJECT: THE LATEST STEP IN A CENTURY OF RAINY RIVER RESEARCH

Matthew M. Thomas and David Mather, Loucks & Associates, Inc., 7200 Hemlock Lane, Suite 300, Maple Grove, MN 55369

The McKinstry Site (21 KC 2) is a multiple component American Indian habitation and cemetery site listed on the National Register of Historic Places. It is located at the confluence of the Little Fork and Rainy Rivers, in Koochiching County, Minnesota. A portion of the site within the Little Fork River floodplain is to be affected by a Trunk Highway 11 bridge replacement over the Little Fork River. Phase III archaeological mitigation of project impacts entailed excavation of a 5x5 meter block in the location of the proposed northeast bridge abutment. Stratified habitation components within the floodplain alluvium span the Initial through the Terminal Woodland Patterns. Earlier work also identified an underlying Late Archaic component. The history of the site occupation is defined through radiocarbon assays, geomorphological analysis, and the distribution of temporally diagnostic artifacts. These are primarily ceramic sherds including, but not limited to, Laurel, Blackduck and Selkirk wares. The site interpretation is also based on analyses of ceramic petrography; lithic tools and debitage; lithic use-wear; zooarchaeology; plant macrofossils; phytoliths/food residues; landscape history; and paleoenvironment. The findings are integrated into an overall site interpretation, inclusive of the earlier phases of investigation, presented in the context of a regional archaeological synthesis.

RESEARCH USE OF LASERS IN PHYSICAL SCIENCE

Friday, April 26 1:00 p.m. - 5:35 p.m.
Robbins Science 11

1:00 LASER COOLING: ATOMIC AND MOLECULAR PHYSICS AT MICROKELVIN TEMPERATURES

Dr. William Phillips, National Institute of Standards and Technology, Gaithersburg, Maryland

The radiation pressure exerted by laser light on atoms in a gas can cool and trap them, allowing new kinds of experiments to be performed. For example, cold atoms colliding in the presence of a laser bean can form unusual, giant diatomic molecules that are so weakly bound as to be nearly free atoms. This new kind of molecule has allowed us to see, for the first time, the change in the force between two atoms due to the finite speed of light. In other experiments, laser cooled atoms are held in a regular array of positions by an "optical lattice," creating a gas that has many of the properties of crystalline solids.

2:00 MEDICAL IMAGING WITH LIGHT

P. Saulnier, R. Corey, A. Schmidt, Gustavus Adolphus College, 800 West College Avenue, Saint Peter, MN 56082

Optical heterodyning is a powerful detection scheme that allows the preferential detection of ballistic photons transmitted through a random media, enabling the imaging of absorbing structures within. We introduce a normalized correlation function as a quantitative measure of image

quality and employ it to investigate the effect of source coherence length on the ability of optical heterodyning to detect these absorbing structures. The ability to image, in transmission, is found to be greatly enhanced using a reduced coherence length source. The effect on image quality of the transport mean-free-path length is quantified and found to depend on source coherence length. Work supported by Research Corporation and the Petroleum Research Fund, administered by the American Chemical Society.

2:20 - 2:40 Break

2:40 Laser Spectroscopic Techniques in the Far Infrared

Thomas D. Varberg, Department of Chemistry, Macalester College, 1600 Grand Ave., St. Paul, MN 55105

I will describe a high resolution spectroscopic technique called Tunable Far Infrared (TuFIR) spectroscopy which is suitable for recording molecular absorption spectra in the far infrared. In this method, tunable far infrared radiation is generated by mixing the output from two CO_2 lasers and a microwave synthesizer on a metal-insulator-metal (MIM) diode. By appropriate choice of the CO_2 laser lines, the experimenter can completely cover the 300 to 6000 GHz region, where many light molecules have pure rotational transitions. I will present some recent results on the diatomic molecules CO, OH and ZnH using TuFIR spectroscopy.

3:00 Modeling Laser Ablation

Theodore Hodapp, Hamline University, Physics Department, 1536 Hewitt Avenue, St. Paul, MN 55104

Micromachining high aspect-ratio structures can be accomplished through ablation of surfaces with high-powered lasers. Industrial manufacturers are now utilizing these methods to form complex and regular surfaces at the 10-1000 μm feature size range. Despite its increasingly wide acceptance on the manufacturing floor, the underlying photochemistry of the ablation mechanism, and hence the dynamics of the machining process, is still a question of considerable debate. We have constructed a computer model to investigate and predict the time-resolved formation of ablated structures. Qualitative as well as quantitative agreement with excimer-laser machined polyimide substrates has been demonstrated. Additional insights into the drilling process for high-aspect-ratio holes is leading us to consider different mechanisms for material removal.

3:20 Laser Optogalvanic Spectroscopy

Joseph M. Brom, Jr., Department of Chemistry, University of St. Thomas, 2115 Summit Ave., St. Paul, MN 55105

Laser optogalvanic spectroscopy is a versatile technique for measuring high resolution absorption spectra of atomic and molecular species in the gas phase. The technique is highly sensitive so it is particularly attractive for observing the spectra of free radical species or of species in excited electronic states. We will describe the details of using a single mode diode laser in an optogalvanic detection scheme to study the absorption spectra of atomic Na and molecular PCl. Atomic Na is studied using a hollow cathode lamp to produce a population of Na in the 3^2p state. The absorption of Na from 3^2p to 3^2D has been studied. Molecular PCl is produced in a radio-frequency discharge of PCl_3 in Ar. The $X^3\Sigma^-$ to $b1\Sigma^+$ transition of PCl is under investigation.

3:40 Holographic Real-Time Imaging of Standing Waves in Gases

Richard W. Peterson, Department of Physics, Bethel College, St. Paul, MN 55112.

Stroboscopic holographic interferometry allows real-time imaging of standing sound waves in gas filled, closed tube resonators. A heterodyne Mach-Zehnder interferometer was first built to show the feasibility of interferometric detection of sound waves in a small cell. In the subsequent holographic study, the laser irradiance is modulated by an acousto-optic cell at frequencies near that of the standing wave, and a video camera records the fringe motion due to sound pressure changes. Fractional fringe shifts are observed for an air filled cell, and multiple fringe shifts are imaged for the first three harmonics in the case of freon. Sound reflections from the cell ends are easily observed, with non-sinusoidal waveforms dominating at high intensities due to the superposition of resonator harmonics. Work supported in part by the MN NASA Space Grant Consortium.

4:00 - 4:15 Break

4:15 Laser Photofragmentation Studies of Gaseous Metal-Containing Molecules

William E. Hollingsworth, Department of Chemistry, Carleton College, Northfield, Minnesota 55057

An excimer-pumped dye laser is used to initiate multiphoton dissociation and ionization (MPD/MPI) processes in isolated metal-containing molecules in the gas phase. The mass-resolved ion fragments are dispersed in a time-of-flight mass spectrometer and the mass peaks are collected and then digitized in a fast storage oscilloscope and transferred to computer for storage and manipulation using Lab-View. The two main foci of this research are:

1) correlating fragmentation patterns observed at different wavelengths in the visible and near-ultraviolet with the nature of low-lying molecular electronic excited states in order to learn more about their fundamental photochemistry, and
2) monitoring changes in ion-peak intensities as the wavelength is scanned, using resonance effects in order to gather specific spectroscopic information on atomic and molecular fragments.

Several different avenues of work will be presented. In particular, results obtained for a novel metal-cluster molecular type – $Co_3(CO)_9CCH_3$ – will be presented with an emphasis on what is now known about energetic path- ways followed in the photodissociation, as well as tantalizing clues about novel bare metal clusters that are being produced along the way.

4:35 Far-Infrared Laser Spectroscopy of Semiconductor Quantum Wells

Professor James N. Heyman, Physics Department, Macalester College, 1600 Grand Ave., St. Paul, MN 55105

We are building an experiment to probe the dynamics of electrons in quantum wells using far-infrared laser spectroscopy. Quantum wells are semiconductor thin-film structures whose dimensions are comparable to the electron de Broglie wavelength. These wells can posses confined electronic states. It is possible to design the energy-level spectrum of such a well to optimize its linear and non-linear optical properties for different applications. Quantum wells have been used to produce novel semiconductor infrared detectors and lasers. Our initial experiments will study the rate at which electrons relax between confined subbands in quantum wells.

In a second experiment, we are using an Argon laser to perform Raman spectroscopy on amorphous carbon films grown by RF - driven plasma discharge by professor James Doyle at Macalester.

4:55 Optics Education and Research at St. Cloud State University

Richard Brundage, Department of Physics, Astronomy and Engineering Science, 720 Fourth Ave. S., St. Cloud State (University St. Cloud MN 56301-4498

Research using lasers at St. Cloud State University is part of a comprehensive program in optics leading to either a optics minor or concentration in electro-optics. Students choose among six different courses in optics to gain a broad knowledge of the field. They can participate in faculty research on interferometers or laser spectroscopy.

I will give a very brief overview of the optics program at SCSU and then discuss in more detail my research on the optical properties of rare-earth ions in glasses. I will summarize our studies of the coherence of an excited state of europium in a fluorophosphate glass that is a factor of ten greater than commonly observed. These results have important implications for optical data storage, laser operation, and basic studies of the dynamic structure of glasses.

5:15 Brillouin Light Scattering on Magnetic Thin Films

John Truedson, Bemidji State University

Magnetic thin films including multilayer and thin film sandwiches have been the subject of intensive study becuase of the antiferromagnetic interlayer coupling and the large magnetoresistance. Brillouin Light Scattering (BLS) has proved to be a very useful tool for the experimental investigation of microwave excitations in these materials.

In this presentation an introduction to the BLS technique will be given along with applications of this technique to Fe/Cr thin film sandwiches. The focus of the presentation will be to highlight the advantages of the BLS technique over convential microwave techniques to study microwave magnetic processes.

This work was conducted at the Magnetics Laboratory at Colorado State University.