THE 2014 NORTH DAKOTA STATE UNIVERSITY UNDERGRADUATE PHYSICS RESEARCH SYMPOSIUM

April 11, 2014

South Engineering

Schedule Outline

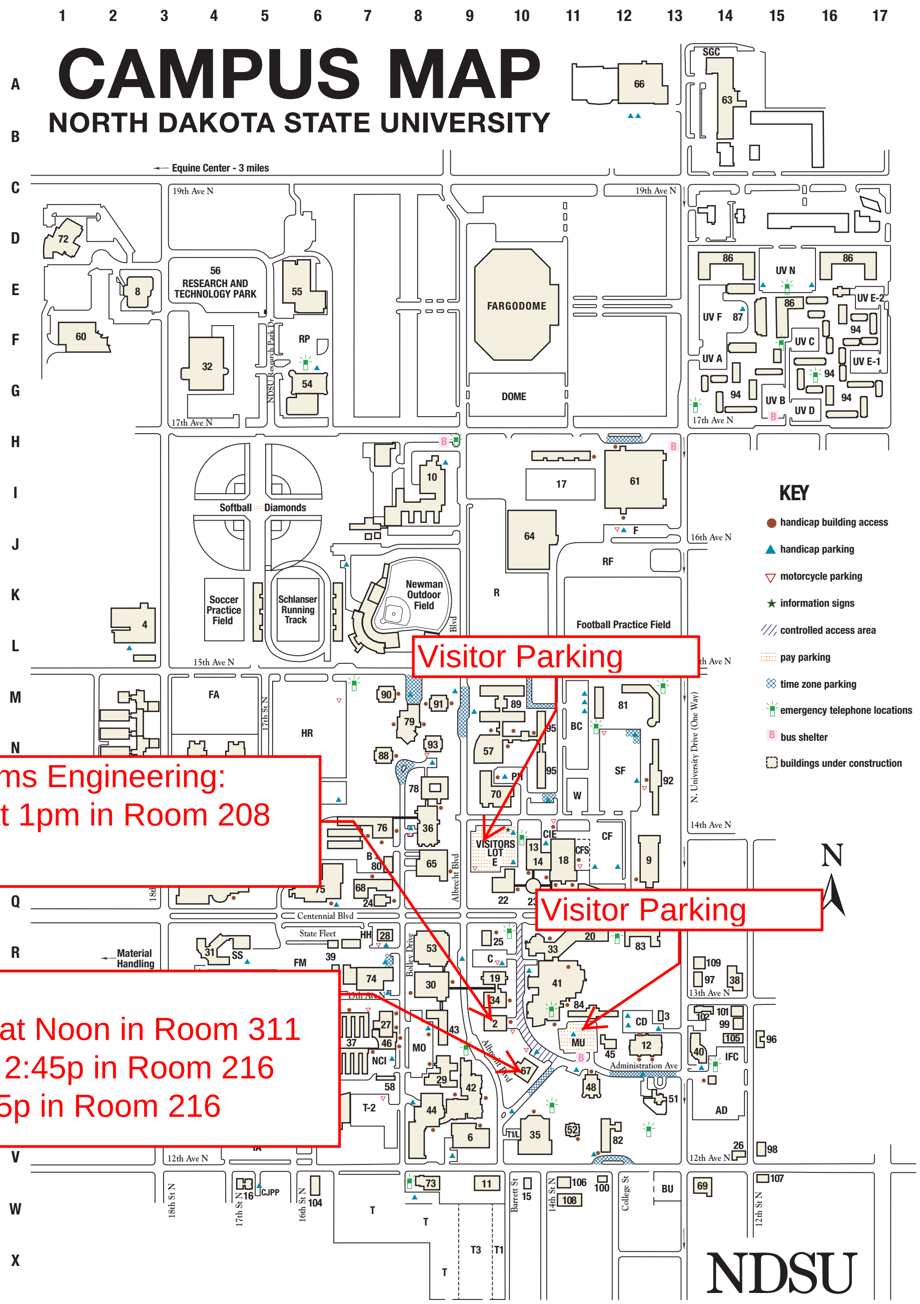
Noon-12:50pm Boxed Lunch for presenters in S. Engineering Room 311

1pm-1:05pm Welcome Announcement from College of Science and Mathematics Dean Scott Wood, Ag and Biosystems Eng Room 208

1:05pm-2:50pm Talks, Ag and Biosystems Eng Room 208

2:50-3:15pm Refreshments and Drinks, S. Engineering Room 216

3:15-5:00pm Poster Presentations, Conference Room S. Engineering Room 216



N2 1 AES Greenhouse
S9 2 Agricultural and Biosystems Engineering
S13 3 Alba Bales House (Equity and Diversity Center)
T13 40 Alumni Center *(McGovern Alumni Center)*
K2 4 Animal Nutrition and Physiology Center/Safety Office
Q11 5 Architecture and Landscape Architecture
V9 6 Askanase Hall (Theatre NDSU) (Reineke Fine Arts Center)
U6 7 Auxiliary Enterprises (University Police)
Barry, Richard H., Hall (811 2nd Ave N) (Business, Agribusiness and Applied Economics, Center for Global Initiatives, ND Trade Office, NDSU Bookstore[2])
E3 8 Batcheller Technology Center
P12 9 Bentson/Bunker Fieldhouse (Athletics, HNES, ROTC)
I8 10 Biosciences Research Laboratory
V9 11 Bison Block I
I12 61 Bison Sports Arena *(Sanford Health Athletic Complex)*
T13 12 Ceres Hall (Admission, Career Center, Cooperative Education, Counseling, Customer Account Services, Registration and Records, Student Financial Services, TRiO Programs)
P10 13 Civil and Industrial Engineering
P10 14 Construction Management Engineering
W10 15 Credit Union (Northland Educators)
W5 16 Criminal Justice and Public Policy
I11 17 Dacotah Field
P11 18 Dolve Hall (Mechanical Engineering)
R9 19 Dunbar Laboratories (Chemistry)
R11 20 E. Morrow Lebedeff Hall (Human Development and Education)
Q11 21 Ehly Hall (Architecture and Landscape Architecture)
Q10 22 Electrical and Computer Engineering
Q10 23 Engineering Center
Equine Center (3 miles west of campus on 19th Ave N)
Q7 24 Gate City Bank Auditorium
R9 25 Geosciences
V14 26 Graduate Center
S7 27 Harris Hall (Cereal Science, Food Science)
R7 28 Hastings Hall (Herbarium)
T8 29 Heating Plant
S8 30 Hultz Hall (Animal Science, Entomolog
R4 31 Johansen Hall (Seed Research, State
G4 32 John Deere Electronic Solutions
R11 33 Katherine Kilbourne Burgum Family Li
Klai Hall (711 2nd Ave N) (Architecture, Landscape Architecture)
S9 34 Ladd Hall (Chemistry)
V10 35 Library
P8 36 Loftsgard Hall (Biochemistry, Plant Sciences)
T7 37 Lord and Burnham Green
R14 38 Lutheran Student Center
R6 39 Maintenance Buildings
T13 40 McGovern, Harry D., Alun
S11 41 Memorial Union (Bison C
Programs, Multicultural Pr
U9 42 Minard Hall (Arts, Humani
S8 43 Morrill Hall (Ag Communic
Print and Copy Services)
U8 44 Music Education Building (Festival Concert Hall, Reineke Fine Arts Center)
T12 45 C.I. Nelson Building
T7 46 Northern Crops Institute
S5 47 Northern Crops Science Laboratory (sugar beets, sunflowers)
U11 48 Old Main (Administration, Student Affairs, University Relations)
T5 49 Plant Sciences Greenhouse
U6 50 Potato Research-Pesticide Storage
U13 51 President's House
U11 52 Putnam Hall
R8 53 Quentin Burdick Building (Computer Network, Computer Science, Industrial Agriculture, Information Technology Services, Upper Great Plains Transportation Institute)
Renaissance Hall (650 NP Ave) (Architecture and Landscape Architecture, Tri-College, Visual Arts)
G6 54 Research I
E6 55 Research II
E4 56 Research and Technology Park
N9 57 Residence Dining Center
T7 58 Residence Life Facility Services
P5 59 Robinson Hall (Veterinary Technology)
F1 60 Sanford
I12 61 Sanford Health Athletic Complex (Athletic Media Relations, Athletics)
O5 62 Service Center, Pilot Plant
A14 63 SGC Building (Distance and Continuing Education, Human Resources, Payroll, Family Studies Institute)
J10 64 Shelly Ellig Indoor Track and Field Facility
P8 65 Shepperd Arena
A12 66 Skills and Technology Training Center
T10 67 South Engineering (Physics)
Q7 68 Stevens Hall (Natural Sciences)
W14 69 St. Paul's Chapel (Newman Center)
O9 70 Sudro Hall (Pharmacy, Nursing, Allied Sciences)
T6 71 Sugar Beet Research
D1 72 Technology Incubator
V8 73 Thordarson Hall (Center for Distance Education)
R7 74 Thorson Maintenance Center (Parking Office, Facilities Management, Telecommunications)
Q6 75 Van Es Hall (Microbiological Sciences, Vet Science)
P7 76 Waldron Hall (Agriculture, Soil Testing Lab, Statistics)
Q4 77 Wallman Wellness Center (Campus Recreation/ Intramural, Disability Services, Student Health Service, YMCA of NDSU)
O8 78 Walster Hall (Agriculture)
M8 79 West Dining Center (Orientation and Student Success, ACE Tutoring)
P7 80 Wiidakas Laboratory (Corn Seed House, Plant Sciences)

HOUSING UNITS

M12 81 Bison Court
V12 82 Burgum Hall
R12 83 Churchill Hall
S11 84 Dinan Hall
N4 85 Living Learning Centers
D15 86 Niskanen Expansion
E14 87 Niskanen Hall
N7 88 Pavek Hall
M10 89 Reed-Johnson Halls
M7 90 Seim Hall
M8 91 Sevrinson Hall
N13 92 Stockbridge Hall
N8 93 Thompson Hall
F15 94 University Village
N10 95 Weible Halls (North and South)

FRATERNITY AND SORORITY HOUSES

T15 96 Alpha Gamma Delta
R13 97 Alpha Gamma Rho
V15 98 Alpha Tau Omega
S14 99 Delta Upsilon
V12 100 FarmHouse
S14 101 Kappa Alpha Theta
S14 102 Kappa Delta
Q14 103 Kappa Psi Pharmaceutical Fraternity
W6 104 Sigma Alpha Epsilon
T14 105 Sigma Chi
V11 106 Sigma Phi Delta
V15 107 Sigma Nu
W11 108 Tau Kappa Epsilon
R13 109 Theta Chi

SELECTED OFFICES

T13 12 Admission (Ceres Hall)
S11 41 Bison Connection (Memorial Union)
T13 12 Career Center (Ceres Hall)
T13 12 Counseling Center (Ceres Hall)
T13 12 Customer Account Services (Ceres Hall)
M12 81 Dining Services (West Bison Court)
Q4 77 Disability Services (Wallman Wellness Center)
A14 63 Human Resources (SGC Building)
S11 41 NDSU Bookstore (Memorial Union)
R7 74 Parking Office (Thorson Maintenance)
T13 12 Registration and Records (Ceres Hall)
M12 81 Residence Life (West Bison Court)
U11 48 Student Affairs (Old Main)
T13 12 Student Financial Services (Ceres Hall)
Q4 77 Student Health Service (Wallman Wellness Center)
M12 81 Student Loan Services (Bison Court)
U6 7 University Police (Auxiliary Enterprises)

Talk Abstracts

1:05-1:20p Influence of Crowding on Polymer Conformations in Polymer-Nanoparticle Mixtures: Monte Carlo Simulations
Wei Kang Lin, NDSU

Within the cytoplasm and nucleoplasm of eukaryotic cells, a complex mixture of macromolecules (biopolymers, such as proteins and RNA) and smaller molecules share a tightly restricted space. In this crowded environment, hard nanoparticles exclude volume to softer biopolymer coils, restricting protein and RNA conformations and folding pathways. At sufficiently high concentrations, nanoparticle crowding also can affect phase stability, inducing aggregation or separation into polymer-rich and polymer-poor phases. Through Monte Carlo simulations, we explore the impact of crowding on polymer conformations and phase behavior in a coarse-grained model of polymer-nanoparticle mixtures. Neglecting polymer self-interactions, we exploit the random-walk geometry of ideal coils to model the polymers as effective ellipsoids whose shapes fluctuate according to the probability distribution of the gyration tensor. Accounting for penetration of polymers by smaller nanoparticles, we calculate the crowding-induced shift in the polymer shape distribution. We compare our results with predictions of a free-volume theory and available experimental data.

1:20-1:35p Atlas TileCal Energy Mapping
Kyle Strand, Winona State University

The Atlas experiment is one of many experiments in high energy physics taking place at the Large Hadron Collider (LHC). The Atlas detector is one of two general purpose particle physics experiments at the LHC. The Atlas detector is contains a wide array of complex electronics to detect energies and acquire the data from proton-proton collision generated by the LHC. The Atlas detector contains two calorimeters designed to detect specific types of energies. The liquid argon calorimeter detects electromagnetic energy and the tile calorimeter (TileCal) is used to detect hadronic energies. The purpose of this talk is to briefly introduce experimental particle physics at the LHC, the hardware used in the Atlas detector, as well as discussing research performed to detect errors within Atlas TileCal.

1:35-1:50p Answer First: Examining Student Reasoning in Physics
Kyle Mueller, NDSU

This study was motivated by an emerging body of evidence that suggests that student conceptual and reasoning competence demonstrated on one task often fails to be exhibited on another. Indeed, even after instruction specifically designed to address student conceptual and reasoning difficulties identified by rigorous research, many undergraduate physics students fail to build reasoning chains from fundamental principles even though they possess the required knowledge and skills to do so. Instead, they often rely on a variety of intuitive reasoning strategies. In this study, we developed a methodology that allowed for the disentanglement of student conceptual understanding and reasoning approaches. We then applied the heuristic-analytic theory of reasoning in order to account for the observed inconsistencies in student responses.

1:50-2:05p Examining student reasoning in the context of physics: Intuitive vs. Formal thinking
Levi Remily, NDSU

One of the greatest challenges for students in introductory physics courses is the recognition that the intuitive approach to a problem may not be the most productive or even correct. Even after learning the correct approach, intuitive thinking can still dominate reasoning. In this study, students enrolled in introductory calculus-based mechanics course were asked to answer and provide explanation on two problems that required similar reasoning. Some students were able to answer both questions correctly and consistently, while others applied correct formal reasoning on the first question and "abandoned" this approach on the second question in favor of intuitive solution. Patterns in student reasoning will be presented. Implications for instruction will be discussed.

2:05-2:20p Dynamics of Water on Magnetite Surface
Evan Moen, University of North Dakota

We simulated magnetite using the molecular dynamics method which uses a Newtonian model of atomic level dynamics and allows for the dissociation of water. We ran simulations of pure magnetite with two sets of surface terminations in a vacuum and compared them to literature results to ensure the model's validity. We then simulated a monolayer of water on the magnetite in agreement with the results of previous simulations, some of which used more exact methods. We then took the results of that test and added a model of melted water on top of the magnetite/monolayer. At the current stage our results incorrectly indicate that the water is in an amorphous solid state. After this problem is resolved we plan to calculate the free energy cost of removing a proton from the surface in order to better understand recent experimental results of the generation of hydrogen by electrolysis using magnetite

2:20-2:35p Interning for SEEK(Summer Engineering Experience for Kids
Abel Tilahun, MSUM

In the summer of 2013 I was a mentor for the SEEK (Summer Engineering Experience for Kids) program of NSBE (National Society of Black Engineers). In the program I gave a practical demonstration of two engineering toys for middle school children with the purpose of inspiring them with STEM careers.

2:35-2:50p Influence of Electrostatic Interactions on the Immersion Depth of a Charged Nanoparticle at the Air-Water Interface
Joseph Roth, NDSU

We calculate the electrostatic contribution to the line tension of a nanoparticle at the air-water interface and use it to predict corresponding changes of the immersion depth. We observe differences for positively and negatively charged nanoparticles as a function of salt content and air-water surface potential.

Poster Abstracts

(Note: All talks previously listed have a poster)

Characterization of materials for proton-based fuel cells
Iwnetim Abate - MSUM

Developing efficient, sustainable, and economic alternative energy systems is currently of great political, technical, and scientific interest. Hydrogen-oxygen fuel cells are a possible solution for applications requiring a portable energy source. Central to proton-based fuel cell operation is the proton exchange membrane (PEM), which simultaneously provides electronic insulation between the fuel cell's anode and cathode, and allows proton conduction. Recently discovered candidate materials under consideration as proton conductors for PEM are alkali thio-hydroxogermanate system, (MS)xGe(OH)4-x yH2O, where M=Na, K, Rb, Cs, and x=1, 2, 3, 4. In this study, the correlation between conductivity, the type of alkali metal, and the amount of proton inside the system was examined in solid state. Nuclear magnetic resonance spectroscopy was used study the hydrogen local environment and mobility. Results will be presented.

Signal Enhancement in the Electrocardiogram and The study of Cardiac Activity Changes in Response to Stress in Zebra Fish
Loza Tadesse - MSUM

In the last decade the zebra fish has become a major model organism for various cardiovascular researches. ECG reading is one of the vital mechanisms used to assess changes in their cardiac activity. The purpose of this research to enhance the in-house ECG machine and develop a less invasive mechanism to study cardiac response in stressed zebra fish. Filters were added to the current ECG equipment in order to reduce the noise level. Several trials on human subjects were made by placing the electrodes on hands. While working with the fish, the electrode probes were placed in a small container filled with water. The first recording was taken with the fish swimming inside. A second recording was taken without the fish. The resulting signals were computed to isolate the signals from the fish ECG. The use of a faraday cage was also attempted, where by the fish inside the container was placed in a metal box. So far, it was found that the addition of filters further enhanced the required signals. Furthermore, various factors that influence the process were identified such as the motion of the water, the presence of an investigator and the type of container.

Hole Growth in a Thermally Stressed Lamellar Block Copolymer Film
Peggy Willenbring - NDSU

Block copolymers are interesting molecules that have found uses ranging from lithography to surface compatiblization. The usefulness of block copolymers is largely due to the nanoscopic internal structures that form due to microphase separation. The surface coverage of a polymer depends on the stability of film thickness to external perturbation. For example, if the film thickness changes, but its volume remains constant, holes must form in the film. Here we look at two different processes that occur when thin block copolymer films are subjected to different thermal histories. The first process we look at is the change of the area of pre-existing holes over time. We observe that a quench from hot to cold causes rapid growth initially, which eventually asymptotes to zero. We also examined the hole growth in a second solution in which the viscosity was increased and found that the hole growth process was slowed. The second process we examined was the formation of a hole "pattern". When initially flat films were quenched from hot to cold a pattern of smaller holes formed on the surface of the film. This "pattern" created a small rim around the larger holes on the film. The size of this rim was dependent on the quench depth and the thickness of the film. The "pattern" itself is also dependent on the quench depth. Initial examination of the "pattern" reveals no dominant wavelength.

An STM Study of Zn(II)-Phthalocyanine Physisorption Effects on Graphene

Ben Ware - UND

Semiconductors are used in nearly all modern electronic and solar technology. However, semiconductors are currently limited in their ability to transport electrons, an inability which generates unnecessary heat and limits applications in spintronics. Graphene could prove as a viable successor because its massless Dirac fermionic nature virtually erases heat generation, its long distance spin correlation is ideal for spintronics, and its chemically inert structure prevents degradation and the need for a protective coating that could adversely affect these properties. But, it's a metallic surface so it must be modified to have a band gap. In our study, we chose to modify graphene with the physisorption of Zn(II)-Phthalocyanine (Zn-pc) because it is capable of physisorbing on the chemically inert surface of graphene and it contributes both donor and acceptor atoms from within its structure. Scanning tunneling microscopy and spectroscopy showed partial surface coverage and localized doping effects from Zn-pc on graphene.

Dwarf Galaxy Alignment in Low-Redshift Abell Galaxy Clusters

Gregory Foote - UND

We investigate the alignment of dwarf galaxies selected from a sample of nearby ($z<0.2$) Abell galaxy clusters. Cluster galaxies are culled based on their location in the cluster color-magnitude diagram with respect to the host-cluster red-sequence. We explore the alignment of dwarf galaxies with the major axis of both the brightest cluster galaxy and the cluster as defined by the location of the red-sequence galaxies. In addition, we also look for an alignment between the major axis of cluster galaxies and a radius vector from the cluster center. We compare our results to predictions from N-body simulations of structure formation.