Abstracts for the Physics & Astronomy Fall Summit 2023

Plenaries

"Our Place In Space!: Skynet-based Labs for Undergraduate Students" – Dan Reichart

For the past 15 years, UNC-Chapel Hill has been developing a unique, survey-level astronomy curriculum, primarily for undergraduate students. Called "Our Place In Space!", or OPIS!, this curriculum leverages "Skynet" – a global network of ≈20 fully automated, professional-grade telescopes that we have deployed at some of the world's best observing sites. The curriculum has now been adopted by over two dozen institutions, and we have recently received (1) $1.85M from NSF's IUSE program to expand it nationwide, and (2) $3M from DoD's NDEP program (a) to integrate a global network of 10m – 30m diameter radio telescopes into Skynet, and (b) to develop a follow-up curriculum to OPIS!. Both grants come with funding for new instructors.

"Repurposing Nebraska's Cold War Infrastructure for Warm War Climate Science" – David Harwood

Obtaining past records of Earth's climate history of temperature and ice sheet changes is vital to our ability to improve numerical models to predict the rate and scale of future changes as our world warms. Polar Regions preserve archives of past climate history within and beneath ice sheets in Greenland and Antarctica that have been accessed by UNL drillers, engineers, and scientists since the 1970s via ice coring, hot water drilling, and sediment drilling. An ambitious project is developing as part of UNL's Grand Challenges - the Ice Coring & Education (ICE) Silo – to repurpose an abandoned Atlas-F missile silo in the Lincoln area into an ice drill testing and design center where new tools and instruments can be tested before deployment to remote field sites. Science and Technology Literacy and Climate Resilience will be a parallel focus of the ICE Silo through innovative public education and outreach. This project's broad scope will enhance education in Nebraska and provide a one-of-a-kind research and testing facility for US and international polar scientists and engineers.

Breakout Sessions – 11:00 am

Teaching Star Trails with Simulations – Kent Reinhard
This breakout session is to learn how use computers and cell phones to explain and understand celestial rotation of the sky. Users will be able to place themselves on the earth at any latitude and see how the sky appears to move.

Neutrino Telescopes – Robert Tabb
In recent decades, a new way to observe the universe has emerged: neutrino astronomy. Neutrinos are subatomic particles that only interact weakly with ordinary matter making them difficult to detect. The detection of neutrinos offers a unique way of observing the cosmos. There are many experiments around the world that offer novel ways of detecting neutrinos. There are already some exciting results demonstrating the ability to view cosmic structures such as the Milky Way galaxy using only these illusive particles. Neutrino astronomy is an excellent avenue for fostering students' interest in science. The importance of neutrino detection in astronomy will be presented in this session, and several useful tools for students and teachers including apps, games, and other online resources will be demonstrated.

Modeling Instruction: A Physics Overview
(or Reforming Physics at Creighton Prep High School) – Todd Leif
During the summer of 2023, I attended an American Modeling Teaching Association, (AMTA) Professional Development course at University of Nebraska Omaha. As a nearly 40- year veteran physics teacher, I have tried, experienced, and field tested a plethora of physics education research-based curriculum models. After attending the course with my new physics teaching colleague Riley Geier at Creighton Prep High School, in Omaha, we decided to make some wholesale changes in our approach to teaching physics at C-Prep HS. This new course designed was made for those who wish to develop critical thinking and problem-solving skills through exploring various physical systems. Our students are expected to examine physical systems and develop reliable ways of thinking (basic models) that allow them to interpret physical systems. Students are expected to represent their thinking through graphs, maps, diagrams, mathematical relationships, and linguistic interpretations. Through consistent interpretation and reliable evaluation techniques, students develop a deep conceptual understanding of the basic concepts within introductory physics. During this presentation I will demonstrate methods of change that we have incorporated into our classroom atmosphere. Some “hands on” and “minds on” activities will be provided.

Cheap Physics Demos -- Adam Davis
Learn some new physics demonstrations that are inexpensive, oft simple, but effective. Some more suitable for presentation, others can be suitable for small lab activities. Will provide a list of some 100+ demonstrations (and variations) and a couple of resources where others can be found. You may know quite a few, but all but guaranteed to find something new.

Breakout Sessions – 11:30 am

Teaching Star Motions with the Planetarium – Todd Young

Dr. Todd Young, Director of the Fred G. Dale Planetarium at Wayne State College, will talk about how the planetarium can be used as an interactive astronomy classroom instead of just a passive environment for students to catch up on their sleep. He will discuss the equipment to be used by the students and guide you through an interactive lesson for the planetarium that should be general enough for all types of planetariums. This particular lesson will focus on understanding star motions at different latitudes of the Earth.

Teaching Plate Tectonics – Mindi Searls

Plate Tectonics drives most of the active geology on our planet. It explains much of our topography as well as volcanic and earthquake activity. In this workshop we will actively demonstrate a discovery-based approach to teaching the basics of the Theory of Plate Tectonics. In this data driven exercise the students analyze patterns in world maps containing earthquake, volcano, topography, and seafloor age data to discover, classify and describe the types of plate boundaries. This exercise aligns well with the science and engineering practices and the crosscutting concepts outlined in Nebraska's College and Career Ready Standards for Science.

The Psychology of Making Predictions – Manda Williamson

Dr. Manda Williamson's presentation will offer an interactive conversation on the psychological value of incorporating prediction into physics and astronomy lessons. The session begins with a brief theoretical justification for the value of prediction as a pedagogical tool to enhance student engagement and learning, followed up with a prediction activity that teachers will experience and can also incorporate directly into their physics or astronomy classrooms.

Breakout Sessions – Noon

Spectroscopic Binaries – Kevin Lee
Spectroscopic Binaries are one of the two really important types of binary stars in astronomy (eclipsing binaries being the other). Binary stars are one of the few ways for learning the masses of stars, but we can learn many other stellar parameters as well. Spectroscopic Binaries also have pedagogical value because of the large number of astronomy concepts that are at work in them: center of mass concepts, orbital motion concepts, doppler shifts and their correlation with radial velocity, and radial velocity curves which share many characteristics with light curves. This session will survey existing simulations related to binary stars and participants will work with a spectroscopic binary simulator recently developed and available on the https://astro.unl.edu web site.

Quantum Kits – Steve Wignall
https://yns.nebraska.edu/stem-tools-for-classrooms/mobile-labs, I will be showing some of the activities associated with the Plank's Constant lesson we are developing for teachers as part of the mobile Labs with the EPSCoR EQUATE grant. Participants will be able to try the activities associated with this kit, and have access to the Power Point with these lesson attached.

Acceleration of an Atwood Rocket – Tom Brestel
Participants will be shown how to model a rocket's motion using an Atwood machine. Participants will study accelerated motion using cell phone apps.

Electric Crystal -- Xiaoshan Xu
In this breakout session, we carry out group-based activities to understand the characteristics of crystals (like quartz), the role of symmetry, and how crystals produce electricity.

Breakout Sessions – 12:30 pm

Labeling Tasks in HTML5 – Chris Siedell
Recently the ability to create labeling tasks was added to the Interactives Editor at the astro.unl.edu website. The Interactives Editor is a free online tool for creating web-based, interactive formative assessment questions that can be used on student devices, including smartphones. In this section we will introduce the new features, cover best practices, and discuss the use of formative assessment in the classroom. With three question types now supported -- ranking, sorting, and labeling tasks -- the opportunities to engage and assess student learning continue to grow. Participants are highly encouraged to bring a laptop.

Physics for Life Science – Keith Foreman
Introductory Physics for the Life Science (IPLS) courses are uniquely challenged to not only engage students with much of the same, important fundamental physics found in other introductory courses, but do so in a biological context meaningful to life science students. This session will showcase some of the material and activities used in the IPLS courses offered at UNL, including but not limited to lecture content, clicker questions, demonstrations, recitation materials, and recently implemented laboratory activities. Also discussed are some of the pedagogical strategies employed and the reasoning behind decisions to include and exclude content that might be found in other, traditional intro physics courses. Participants will discuss and share ideas and experiences related to IPLS courses, and then will be able to perform the lab activities with the same equipment that UNL students use. The accompanying lab manuals and other course material will be available to participants.

Building a Refracting Telescope – Larry Browning
Next Saturday, Oct. 14, 2023, there will be a solar eclipse and Nebraska should be a great place to observe it. Get ready to watch it unfold from outside your school with a Safe Solar Viewer originally designed by T.R. Richardson of the College of Charleston. This construction will use laminate flooring and lenses from Surplus Shed to make a Galilean telescope which projects the sun's image on a screen. By looking down (instead of up) you will be able to safely watch the eclipse unfold and search for sunspots at other times. Materials for 12 telescopes will be provided.

Longer Sessions – 3:00 pm

Modeling Instruction: An Example from Astronomy – Ethan Van Winkle
Modeling Instruction is a pedagogy that uses student-driven authentic laboratory investigations to help students construct, refine, and apply the fundamental conceptual models that form the content core of the sciences. In 2017, the American Modeling Teaching Association with collaboration with Hands on Universe developed a new curriculum for astronomy. The attendees will get an overview of the types of activities that this new curriculum provides and experience one that is later in the curriculum regarding finding Jupiter's mass by studying the simple harmonic motion of Io in 10 recorded images. This is a great lesson for introductory astronomy courses or advanced physics courses when including SMH.

Putting Skynet to Work for You! – Dan Reichart
OPIS! consists of eight, and soon nine, labs in which students use the same research instrumentation as professionals to collect their own data. They then use this self-collected data (astronomical images and spectra) to reproduce some of the greatest astronomical discoveries of the past 400 years, and gain technical and research skills at the same time. Although students are not carrying out cutting-edge research, they are using cutting-edge research instrumentation, and consequently there is great overlap with the Course-based Undergraduate Research Experience (CURE) pathway model. Furthermore, these labs/observing experiences are specifically designed to pair with standard introductory astronomy curricula, facilitating widespread adoption. In this workshop, participants will learn how to queue observations on Skynet, and will carry out a few of the OPIS! experiences.

What should we do in STEM with Augmented Reality? – Herman Batelaan
Augmented Reality is gaining ground due to the progress of the technology that supports it. The next development is to create software content for this technology. In our session, there will be the opportunity to experience a bit of that technology, that is the Hololens and the Oculus headsets, through several pieces of software content we have developed. What is the place for such technology in training and education is unclear to us and this interactive session is a part of defining where the software development should go. Realizing that Virtual Reality as widely used for gaming, and that Virtual Reality is not Augmented Reality, limits the possible ideas for software development and leads to the central question. What STEM ideas are easier to explain with combined pieces of reality and virtual reality, or in other words with Augmented Reality? Answering that may tell us what to do in STEM with Augmented Reality.