Multidisciplinary Use of the Dome

Presenters:
Joe Eakin
Technical Director
Ho Tung Visualization Laboratory & Planetarium
Colgate University
13 Oak Drive, Hamilton, NY 13346
jeakin@colgate.edu

Ahmad Khazaee
Director of Engagement and Support
Information Technology
Colgate University

Dayna Thompson
Planetarium Director
Ball State University, Muncie, USA
dlthompson3@bsu.edu

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Abstract:

From drone data to 3d scanning, Colgate University brings in faculty from many disciplines to use the dome for research and teaching. Joining in the panel is Dayna Thompson from Ball State University and Ahmad Khazaee from Colgate University. This panel will discuss ways to bring faculty from all disciplines into the dome to create immersive co-curricular experiences for teaching and learning.

Introduction:

Many plantarians around the world engage audiences using mostly astronomical content. As technology advances in our field, the dome can now be used for a wide range of experiences from interacting with scientific datasets to immersing audiences in an artist's mindset. Both at Colgate University and Ball State, the planetarium expands into all disciplines to create immersive co-curricular experiences.

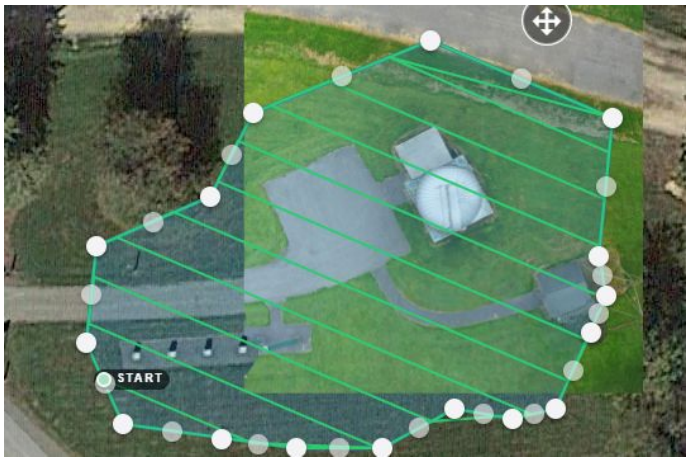
Colgate University

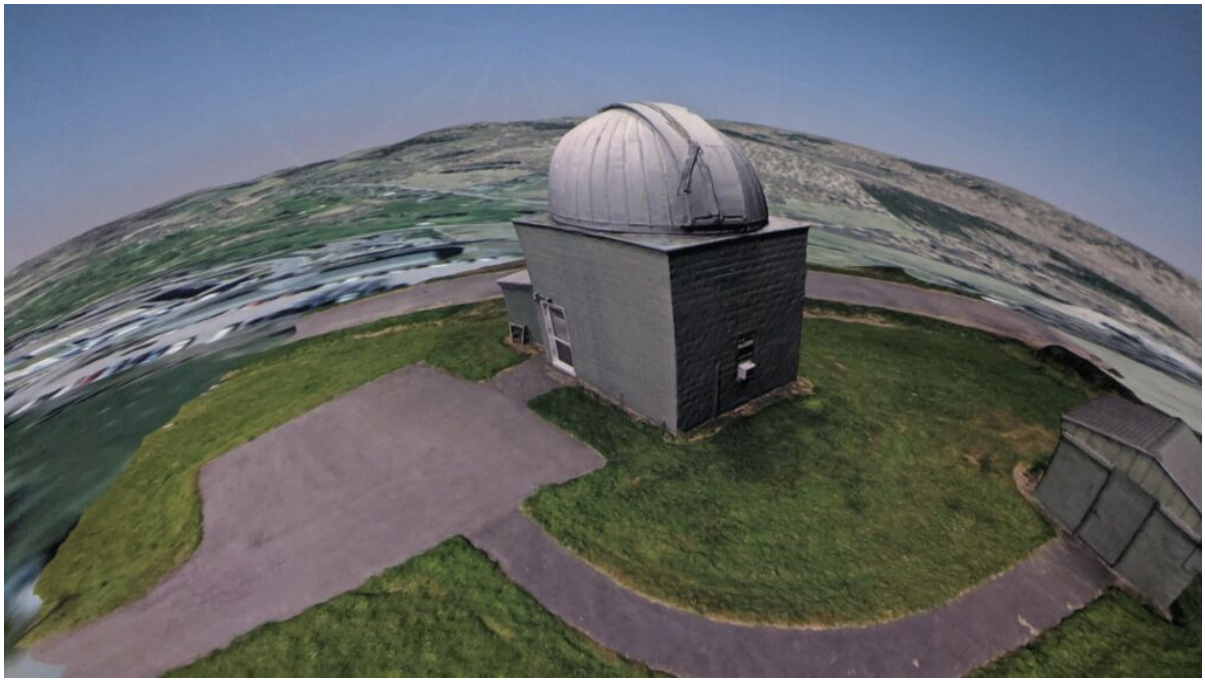
The Ho Tung Visualization Lab & Planetarium (Vis Lab) is located on the Colgate University campus and has become the center for co-curricular programming. The Vis Lab is known as "a dome for all disciplines" and helps that it is set in a liberal arts university in which cross disciplinary collaborations

are a norm. Not only do these collaborations bring in new patrons for our public shows but also expand the use of the dome in innovative ways. Armed with a Digistar 6 from Evans and Sutherland, we have been able to easily bring in a variety of data not only for teaching but also research. Three examples of this expanded use of the dome are just a small sampling of the larger collaborative work at Colgate University.

Drone Mapping and Collection

Drones provide a new way to view the world. This in conjunction with faster computers and better cameras provides an opportunity for additional ways of data acquisition and processing. You can see examples that go from Drone to Data to Model to Dome.



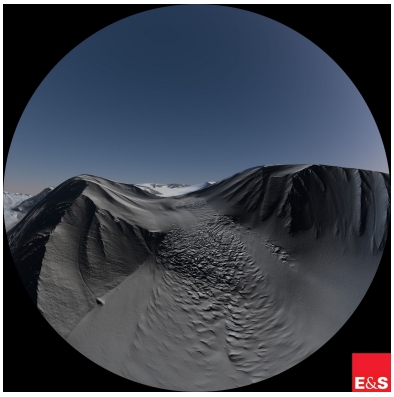


Remote Sensing and Drone Mapping

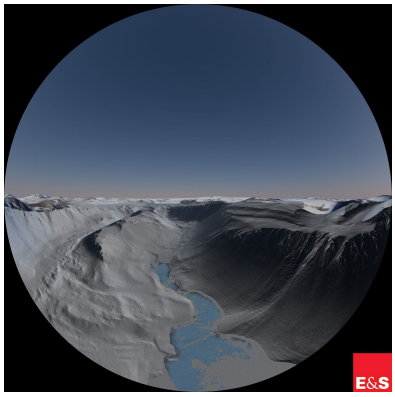
Geography professor, Mike Lorany, studies the arctic region in northern Siberia. He takes students regularly on location to look at differences of low density and high density forest growth in response to climate change. The dome comes into play after a region is mapped

using a drone and photogrammetry techniques. The dome provides Loranty and his students an unique perspective while looking for changes in these regions. Combined with fisheye imagery taken on site, students can gain a better understanding of the environment without having to actually travel which is especially important during pandemic times.

McMurdo Dry Valleys, Antarctica

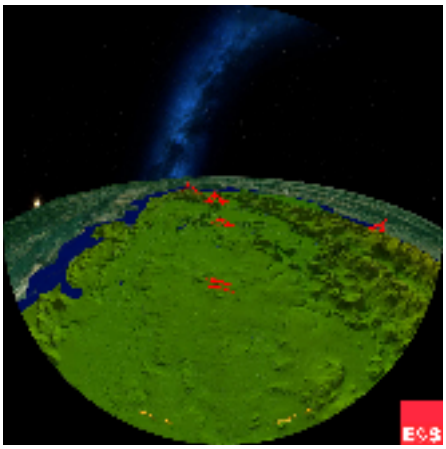


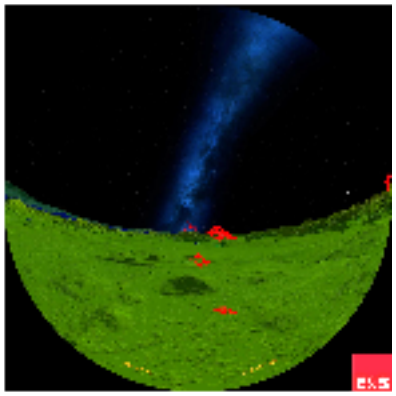
Another professor who uses the dome for mapping geologic data is Geology professor Joseph Levy. Dr. Joe Levy is a geomorphologist and planetary scientist, with interests in sedimentary geology, surface processes, and geological/ecological interactions. He focuses on permafrost landsystems around the world and around the solar system. Joseph travels to Antarctica and studies how climate change is affecting the McMurdo Dry Valleys region. He uses LIDAR to map features as small as pebbles to see how the melting of permafrost plays into climate change. In 2019, Levy received a $500,000 grant from NSF to continue his research and to create a new integrated education plan for training student research drone pilots. His plan involves a new innovative approach by attaching spectrometers to the drones where thousands of measurements can be made simultaneously instead of one at a time. The Vis Lab comes into play to help students visualize the area as a whole and allows students to pick up some details not normally seen on a flat surface. The McMurdo Dry Valleys dataset can be downloaded for free on the OpenTopography website: https://www.opentopography.org/news/mcmurdo-dry-valleys-antarctica-lidar-now-available



Archaeoastronomy

Assistant professor of Sociology and Anthropology, Santiago Juarez, studies the rise of urbanism during the Preclassic Period (2500 B.C.-A.D. 200) in the recently discovered site of Noh K'uh in Chiapas, Mexico. His research utilizes a multi-scalar analysis of Preclassic households, community, and landscape to reconstruct the role of commoners during the incipient phase of urban development in the Maya region. He focuses on the Maya community of Noh K'uh in order to reconstruct the commoner social networks that played a fundamental role in early urbanization. His latest project takes place in the Mensabak Biosphere Reserve of Chiapas Mexico. In this research, Juarez suggests that Preclassic Maya civilization based its political and economic systems around the cosmologically guided ritual activities that are visible in the site's architectural program. This project also continues the working collaboration with the local Lacandon Maya community of Mensabak. The success of previous and future projects is reliant on the support and assistance of the Lacandon people who actively protect the archaeological and cultural materials within this small region. For this site, Juarez and his team collected Lidar imagery and working with the Vis Lab mapped it to the dome to look for possible correlations with the sky. Preliminary results are interesting in the fact that the entire site's East-West axis is aligned with the center of the valley and the central plaza could be aligned with the heliacal rising of the milky way near the northern winter solstice. The dome became a vital part of this research and more study is required to further explorations of astronomical alignments in this area.





The expanded use of the dome across disciplines continues to be a part of the mission of the Ho Tung Visualization Laboratory at Colgate University. These collaborations all start with a conversation, typically in a coffee/break room, and lead to creative and innovative productions that involve students, faculty, and staff. It is vital to the planetarium community to keep expanding the use of the dome from art projects to data visualization.

Ball State University

Digital projection technology in the dome offers a medium in which people can see almost any spatial dataset – which has been a feature utilized for years in the planetarium and research communities. Researchers, who are used to experiencing their data on a computer

screen, are often astonished when seeing it projected all around them in the planetarium. By "flying" audiences over and through these projected datasets, we expand research possibilities, continuing to make the planetarium a location for inspiration and discovery.

Colleagues from Ball State University's (BSU) Department of Geography and the BSU Brown Planetarium collaborated to determine the capabilities of moving spatial datasets from the Geographic Information Science (GIScience) lab to the dome. Working with RSA Cosmos, a French company that develops the dome technology, they were able to transform spatial data generated using GIS mapping software to the dome. As GIS files are packed with information – from elevation, to location data – the data appears in the correct location, with the correct elevation and other important information. Once brought into the dome, the data lined up with and fit the curvature of the existing Earth model in the RSA Cosmos' Sky Explore. The planetarium operator can zoom and pan over this data, as well as change the date and time of the simulation in real-time, having shadows and other effects appear alongside the data.

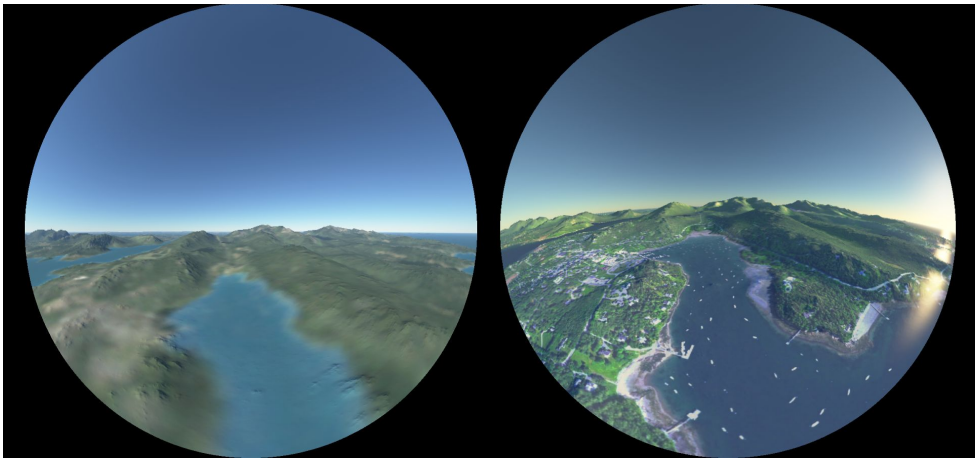


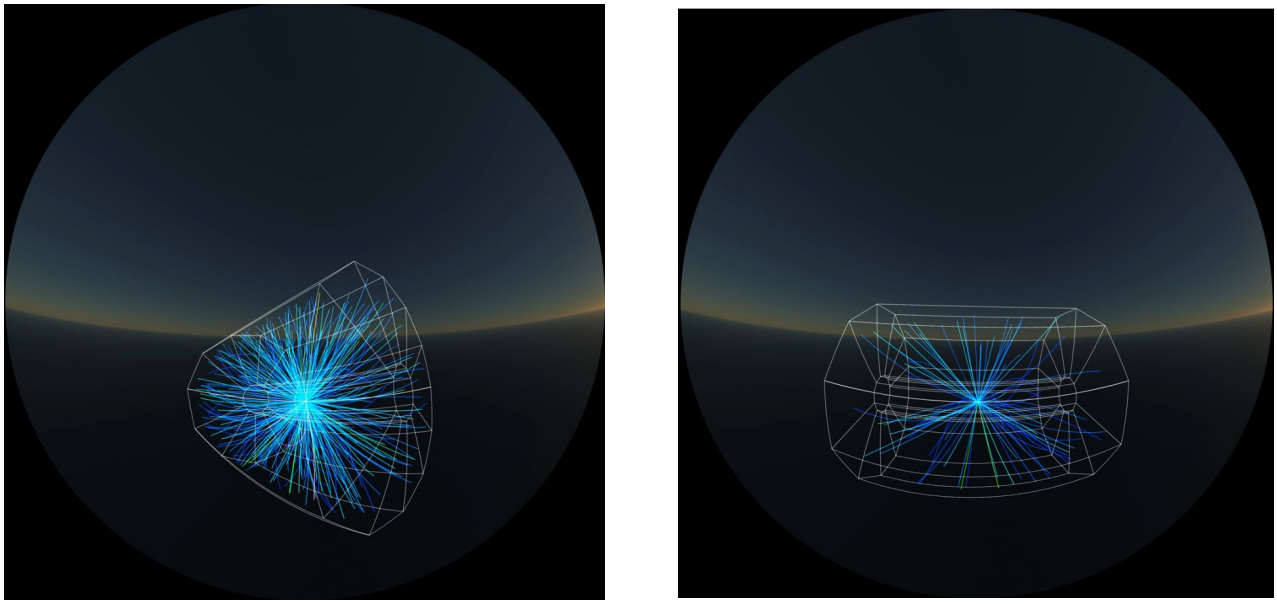
FIGURE XXX: Comparison of the default terrain in the planetarium software (on the left) versus an orthophotograph brought into the system (on the right). Note the planetarium software's sunset and atmosphere is present in the scene on the right.

The GIS project at BSU was initially funded by the Indiana Space Grant Consortium. As a part of that grant, three undergraduate students came aboard the project to gain experience working with the GIS data and the framework for bringing it into the dome. Two students were from the BSU Department of Geography and one was from the Department of Physics & Astronomy. As the planetarium is a part of the Department of Physics & Astronomy, this student focused her efforts on developing a program. As a result, she wrote and produced a 15-minute planetarium program that introduces GIS to students and the public. The program introduces topics such as the electromagnetic spectrum, spectral resolution, and imaging spectrometers.

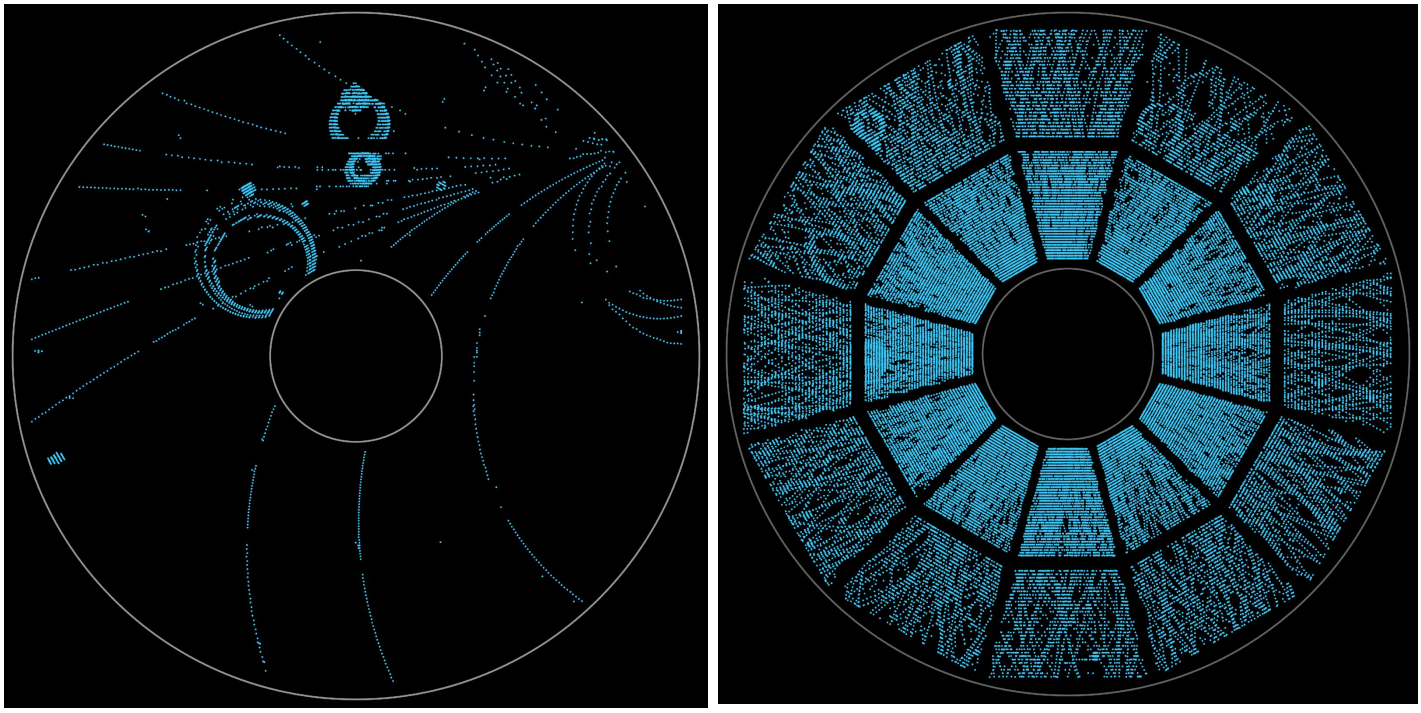
Since its construction in 2014, BSU's Brown Planetarium has built partnerships with many departments and units across campus. Beyond their work with the Department of Geography, they have also worked with architecture, anthropology, and physics – as well as less the data-driven fields of world languages, music, theater, and dance. Astronomy education is

the focus and main mission of the BSU Brown Planetarium, and as such, every partnership has included an astronomy component. From an education standpoint, these cross-departmental commonalities and collaborations only strengthen each individual program.

As with many collaborations, the projects being worked on at the BSU Brown Planetarium rely on the expertise of partners from outside the university. One such partner from Brookhaven National Lab's Relativistic Heavy Ion Collider (RHIC) team helped the planetarium staff show real particle physics data on the dome. This not only brought particle physics to the dome, but also a piece of the cosmic puzzle. This is because at Brookhaven's RHIC, heavy ions collide and create a quark-gluon plasma in an effort to understand the moments after the Big Bang. Visualizing the experimental aspects of astrophysics and cosmology can help learners better understand and appreciate the scientific process. The visualizations created for this project were used during a recent live Facebook event that explored the early universe as a part of the Brown Planetarium's online summer series, #YourUniverse (developed in the wake of the COVID-19 pandemic).



3D model of the Time Projection Chamber of the STAR Detector at RHIC displayed within the BSU Planetarium system.



(left): Cosmic ray hits detected by the STAR Detector at RHIC.

(right): Particle collision hits detected at STAR after a collision of heavy ions.