APPENDIX F

Windows Interpretive Content & Audiovisuals Development Plan

Windows on the Universe Center for Astronomy Outreach

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NOIRLab Reference Code

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Internal Use

Table of Contents

Document

This document is the second in the series of:

1. Kitt Peak Visitor Center Master Plan (the "DNA" of the Windows Center: mission, objectives, key performance indicators, target audience analysis, overall visitor experience, generic learning outcomes, IT planning, content production strategy during construction and operations, operations plan, staffing plan, and any visitor accessibility issues
2. **Windows Interpretive Exhibitions Content & Audiovisuals Plan (this document)**
3. Exhibition Implementation Plan
4. Windows Budget

Introduction

The Windows on the Universe Center for Astronomy Outreach (hereafter Windows Center) is a unique facility that is being designed around the existing footprint of the historic McMath-Pierce Solar Telescope (MMP). The experience will be one that combines a historical retrospective of the facility with an overview of modern astronomy. The use of the MMP facility will provide a unique environment, rich with a history of scientific discovery, to establish a context for visitors that bridges the history of astronomy research with humanity's current understanding of the cosmos. The MMP facility will be restored to original operational condition, especially the three heliostats which will allow live daytime solar disk viewing and interactive spectroscopy experiences for visitors as well as some nighttime viewing of bright objects.

An important context for the Windows Center is its location on lands of the Tohono O'odham Nation (TON). The Center will make it a high priority to foster partnerships with members of the Nation as guides and in the development of content sensitive to, and highlighting, the TON history and the relationship with KPNO.

A broader context for the center will focus on the tools of contemporary astronomy and the roles of NSF-supported astronomical research facilities including KPNO and all of the NOIRLab Programs. It is envisioned that many of the exhibits and displays will be available virtually to make the center accessible to audiences unable to visit the physical Center. Most, if not all, content will also be made available under a Creative Commons Attribution license to share with other visitor and science centers for adaptation or as virtual experiences.

Additional highlights include a modern digital planetarium and a *Science on a Sphere* which will feature programming on a wide array of topics ranging from general astronomy, the culture of

indigenous peoples to today's research from NOIRLab facilities on KPNO and beyond. The numbers in parentheses indicate the section numbers for the relevant exhibit.

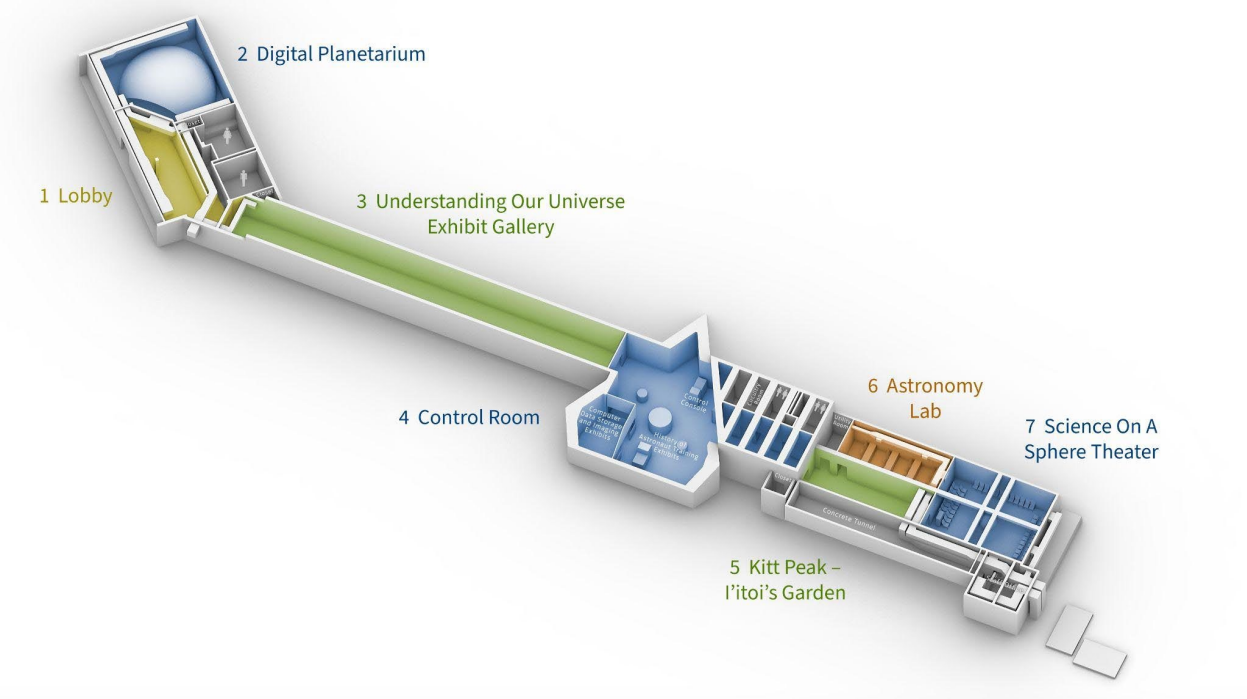


Figure 1: Locations of Exhibits on the Main Level. Credit: KPNO/NOIRLab/NSF/AURA

Visitor Flow and Exhibition Layout

The visitor experience begins at the original entrance to the MMP's main floor. The old glass storefront design has been completely replaced and developed into a more energy-efficient and secure façade. The shade structure will be constructed from colored glass, creating ever-evolving rainbow shadows that change depending on the Sun's location throughout the day. The placements and colors of the glass blocks are inspired by the spectrum of our Sun, created using the very spectrometer that still lives in the MMP's control room today. Benches near the entrance will allow for rest, interaction, and lunch breaks.

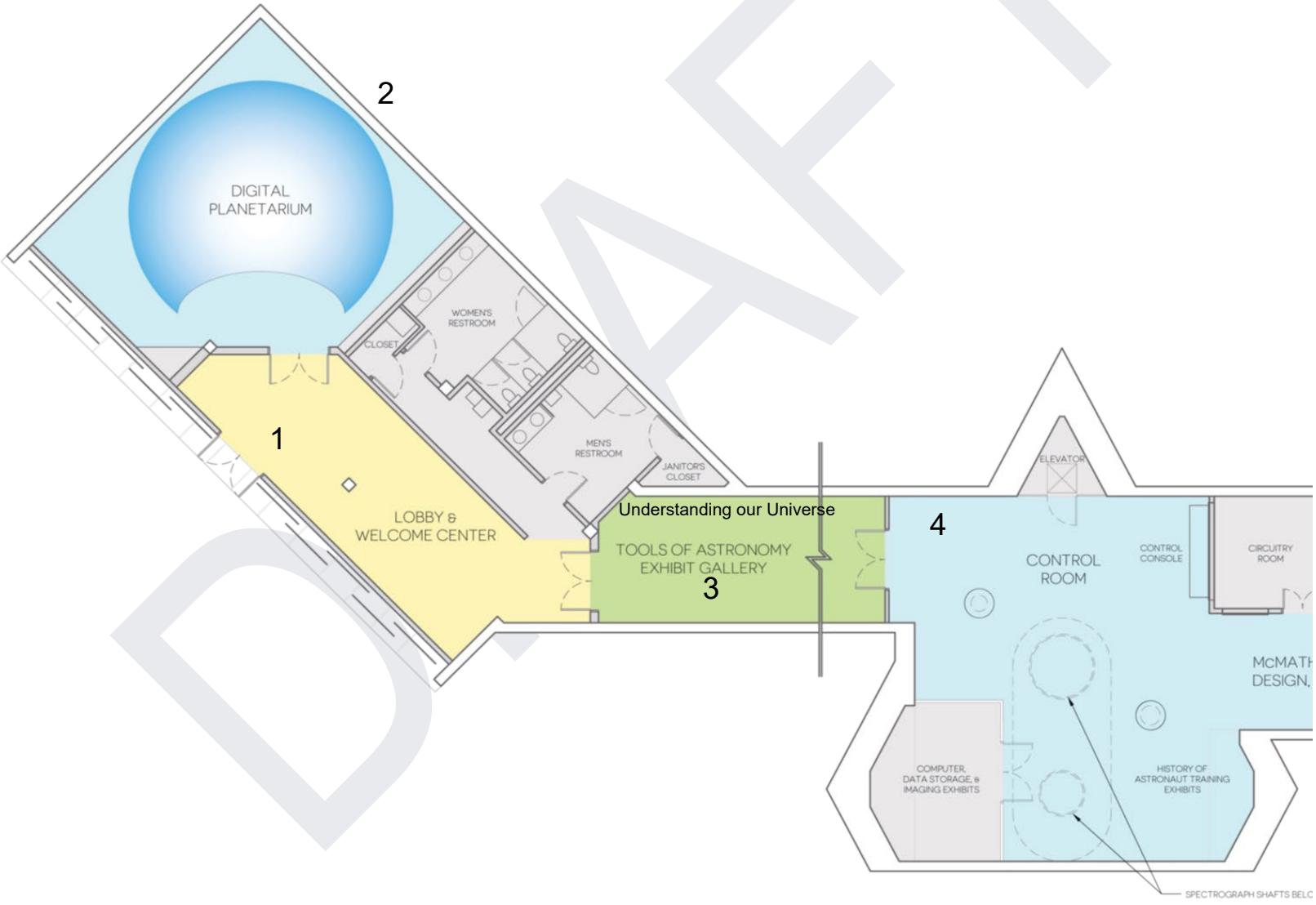


Figure 2: Architectural plan drawing of the Windows Center exhibition area and layout. Credit: Mei Starns/KPNO/NOIRLab/NSF/AURA

The Lobby (1) establishes a sense of place for visitors, orienting them to the MMP by providing an overview of some of the accomplishments of astronomers who have used the facility over the years. Displays describe the mission and priorities of the NSF and its role in astronomy research, in funding the construction and operation of the MMP as an observatory, and in funding the development of the Windows Center. The Lobby also serves as the gathering place for arriving groups or individuals and the location for volunteers or staff to welcome and orient visitors.

Adjacent to the Lobby is a modern, state-of-the-art digital fulldome planetarium (2) which will feature programming on modern astronomy, cultural aspects of skywatching in Arizona and around the world, as well as serve as a theater for a wide range of programming both live and pre-programmed.

Visitor flow naturally progresses from the Lobby into the Understanding our Universe hall (3) which provides a blend of static and interactive exhibits covering modern astronomy and physics, the electromagnetic spectrum, and the instruments astronomers use to probe the Universe. In this area, visitors can better understand our place in the Universe, how we know what we know about the cosmos, and why it's relevant.

Next, visitors enter the MMP Telescope Control Room (4). This room is where astronomers operated the MMP's heliostats and observed the Sun for decades, and several vintage aspects of the room have been preserved and incorporated into the experience. With its restored computers and analog control panel, the room evokes a sense of nostalgia. Here, during observing sessions with the three original MMP heliostats, visitors can witness first-hand what the Sun looks like through a large solar telescope and learn to identify features like sunspots and granulation. The room also features a large live solar spectrum on a touch screen interactive panel so visitors can explore the details of the spectrum and identify the elements behind its absorption lines.

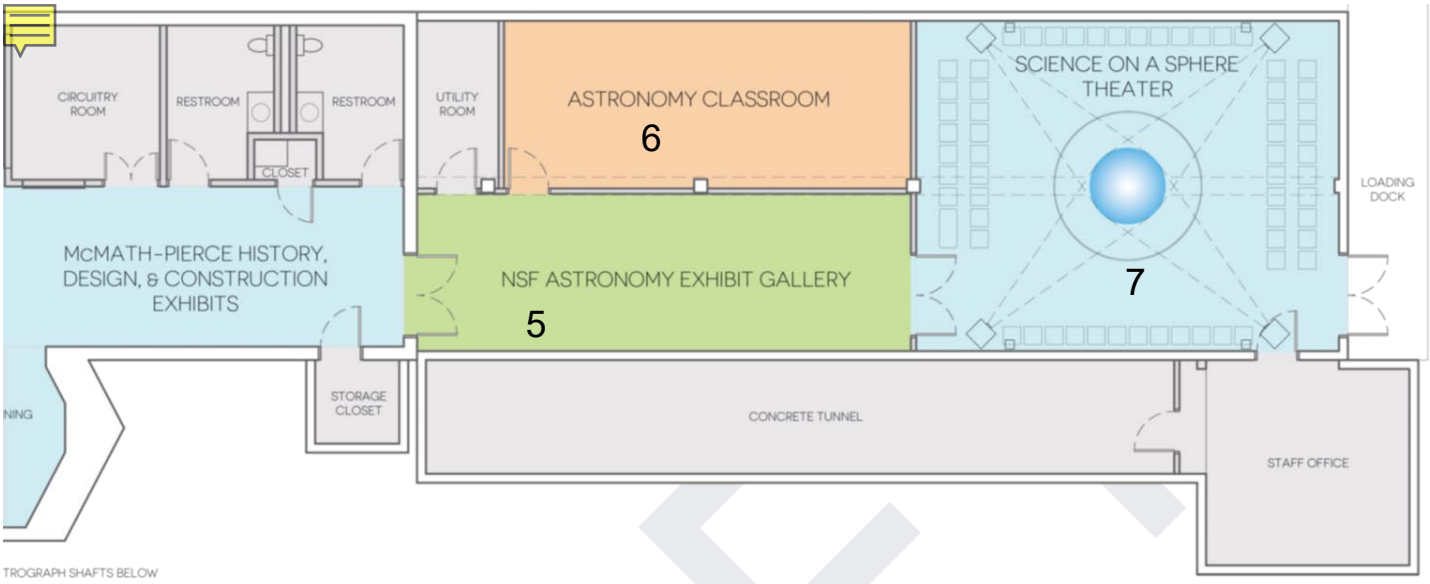


Figure 3: Architectural plan drawing of the Windows Center exhibition area and layout (cont'd). Credit: Mei Starns/KPNO/NOIRLab/NSF/AURA

As they exit the Control Room, visitors enter a gallery tentatively named Kitt Peak, I'itoi's Garden (5) which features images and information about nature on the sky island and the Tohono O'odham Tribe's culture and connection with the cosmos.

Adjoining this gallery is the Astronomy Lab (6) which will be used for scheduled special educational programs and multi-use events, especially those that engage students from the Tohono O'odham Nation.

At the far end of the exhibit area is the Science on a Sphere (7) exhibit which projects myriad videos and images on a spherical multimedia screen where visitors, together with a guide, can virtually explore planetary data from our Solar System and beyond. Global phenomena and issues such as climate change will also be shared by using compelling representations of real data and timely science. The focus of this exhibit is to provide visual context for understanding complex scientific concepts, to give visitors a better understanding of modern astronomy and climate science.

Upon leaving the Center, visitors will encounter what is being called the World's Largest Sundial (8). The sundial is formed by the structure of the MMP tower and is a dramatic illustration of the Earth's motions and an opportunity to teach visitors about timekeeping in the context of the Center.

The Optical Tunnel Viewing Gallery (10) can be accessed via a door on the exterior of the McMath-Pierce Solar Telescope tunnel. Visitors leave the Center and walk up to the optical tunnel. There is a

door on the east side of the optical tunnel near where the tunnel meets the ground. This door gives visitors access to the Optical Tunnel Viewing Gallery.

For both visitors to the Center, and virtual visitors on the Web a series of webcams (9) highlight the MMP as a sundial (see above), as well as live views of the solar image and spectrum in the control room.

Each exhibit element in the Center has specific educational and experiential goals (stated in each gallery section), following the overall Key Learning Outcomes from the Master Plan.

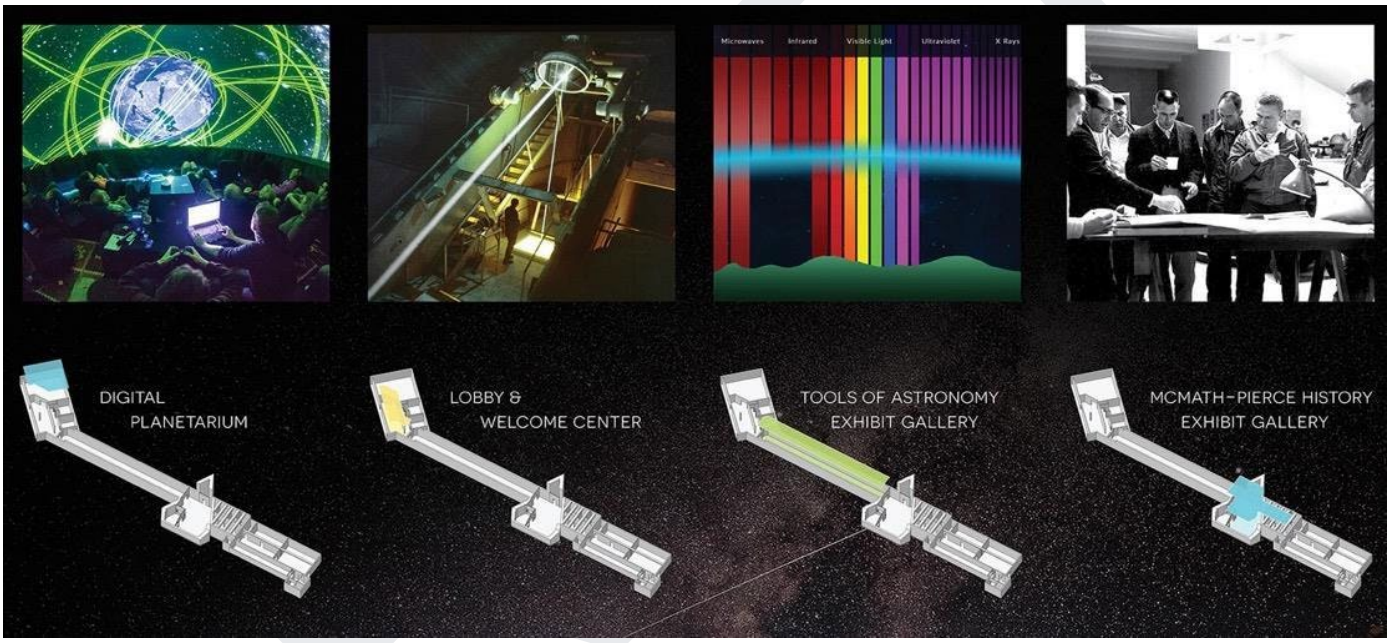


Figure 4: Windows Center areas and layout. Credit: Mei Starns/KPNO/NOIRLab/NSF/AURA

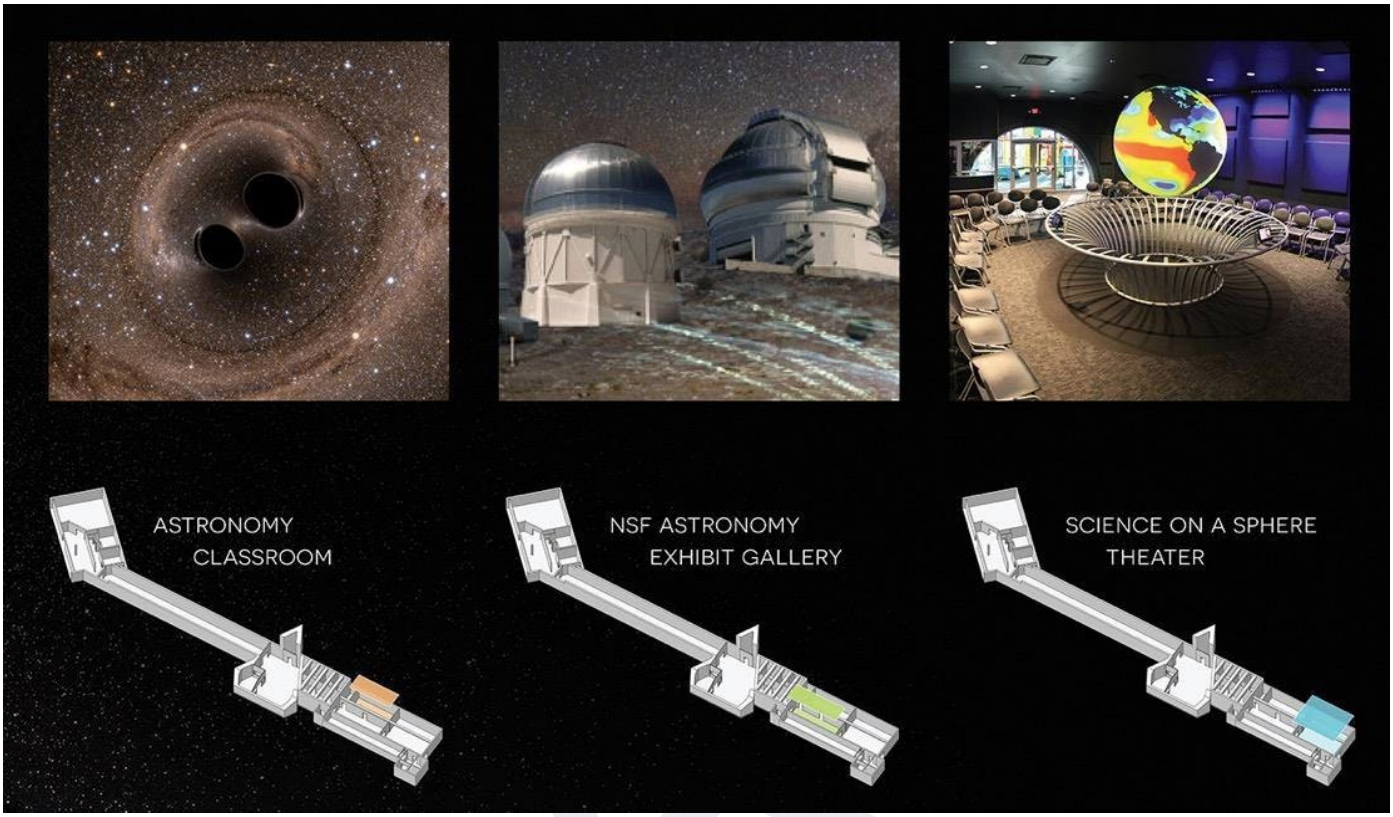


Figure 5: Windows Center areas and layout (cont'd). Credit: Mei Starns/KPNO/NOIRLab/NSF/AURA

1. Lobby Area

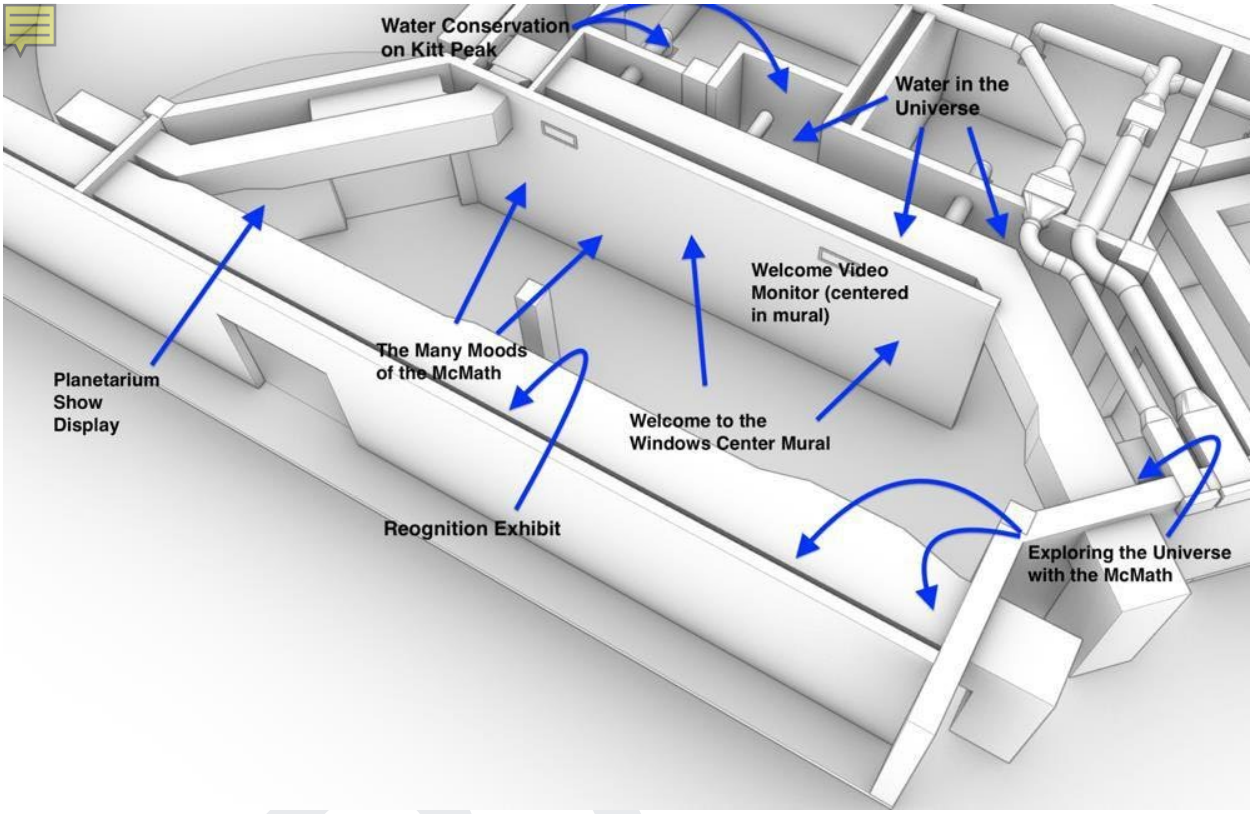


Figure 6: Layout of exhibits located in the Welcoming Area & Lobby. Credit: KPNO/NOIRLab/NSF/AURA

Working Title: Lobby Area
Size: About 570 square feet.
Location: Overlapping area between current lobby and some of the west corridor.
Visitor Experience Goals: Establish a sense of place, understanding of the TON history and culture, and scientific importance of the MMP Telescope. Visitors should feel oriented and know what to expect and have context as they explore the Windows facility.

Façade

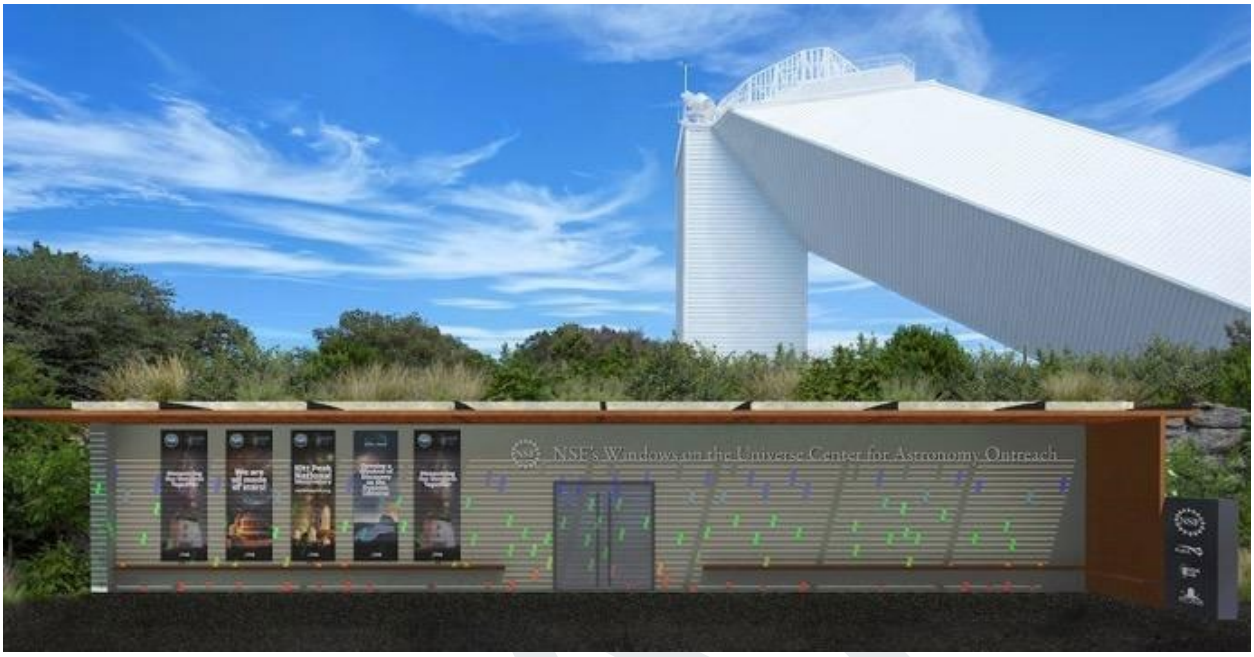


Figure 7: Architectural rendering of the new Windows Center façade. Credit: Mei Starns/KPNO/ NOIRLab/NSF/AURA

The existing front façade provides the public entrance to the main level of the MMP. This will serve as the public entrance for Windows on the Universe. The façade has been completely replaced and developed into a more energy efficient and secure façade than the old glass storefront design. The shade structure has colored glass in it, creating an ever-evolving rainbow-colored pattern that changes depending on the sun's location throughout the day. The placements and colors of the glass blocks are inspired by the spectrum of our Sun *(Fig. 8)*, created using the very spectrometer that still lives in the McMath-Pierce's control room today. Benches allow for rest, interaction and lunch breaks.

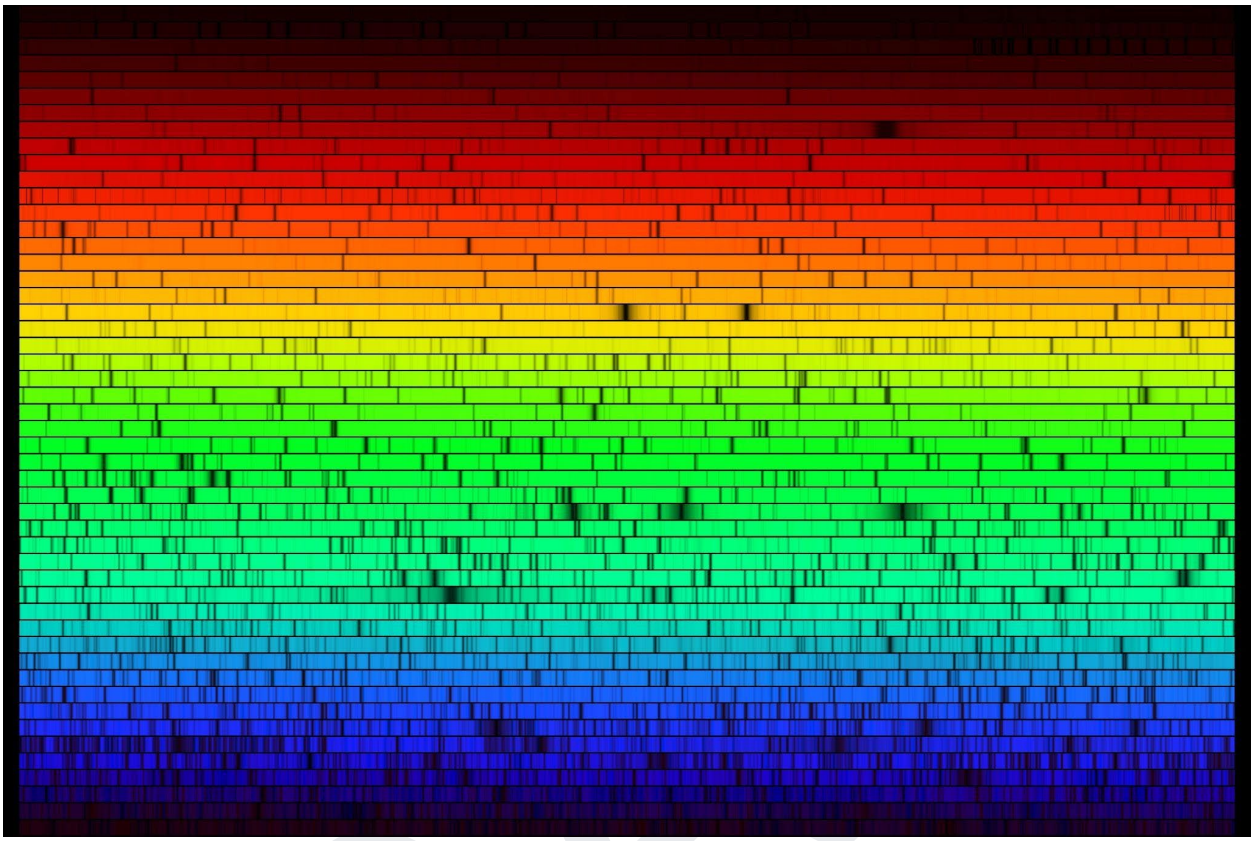


Figure 8: A high-resolution version of the spectrum of our Sun, this image was created from a digital atlas observed with the Fourier Transform Spectrometer at the McMath-Pierce Solar Facility at the National Solar Observatory on Kitt Peak, near Tucson, Arizona ('Solar Flux Atlas from 296 to 1300 nm' by Robert L. Kurucz, Ingemar Furenlid, James Brault, and Larry Testerman: National Solar Observatory Atlas No. 1, June 1984). Note: NSO/Kitt Peak FTS data used here were produced by NSF/NOAO. Credit: N.A. Sharp/KPNO/NOIRLab/NSO/NSF/AURA

Exhibits

The Lobby provides the context for the McMath-Pierce facility (MMP) and some of the accomplishments made by astronomers using the facility over the years. A primary focus of the Lobby area is KPNO's location on the lands of the Tohono O'odham Nation, specifically on Iolkam Du'ag (the original O'odham name for the mountain), as well as the relationship between the observatory and Nation members. By working with Tohono O'odham staff members and representatives from the Himdag Ki: Cultural Center, content is developed to provide visitors with an understanding of the O'odham culture and their important part in the history of KPNO. By implementing features such as a welcome message by a Tohono O'odham tribal member, architecture reflecting the O'odham building styles, and a garden showcasing culturally important plants, the Windows Center recognizes the Nation's history, their longstanding connection with the night sky, and the land they consider sacred. The Windows Center also makes it a high priority to foster partnerships with Nation members both in

the development of content and in O'odham staff working as interpretive guides to the space. Near the Lobby, large, aesthetically pleasing wall graphics serve as photo opportunities for visitors.

Content Themes

1. Why study the Sun, the Sun as a star, its immense size relative to Earth, and impacts on the habitability of Earth. **(Justine/Rob)**[1] Make connection to MMP
    a. Requirements:
2. Map of the MMP. **(Mei)**
    a. Requirements:
3. Logos acknowledging the federal funding of US astronomy and the NSF, NOIRLab, Kitt Peak, CTIO, Rubin, CSDC, Gemini, the Windows Center and AURA. Funder credits and various project acknowledgements. **(Lars)**
    a. Requirements:
4. TON welcome video: ~~Toh~~ono O'odham Nation history and relationship with KPNO, including cultural perspectives by TON members (as mentioned elsewhere in this document TON members will be an important part of the Center's staffing, especially as interpretive guides (docents). incl. the new Tohono O'odham land use statement. Constructed with the TO cultural center **(Rob, Jacelle)**
    a. Requirements:
5. ~~Hist~~ory: Early pioneers and visionaries of the MMP. What made the MMP unique and leading edge for 1962. Scientific discoveries.(contact Randy Johnson's family, operator for NSO for many years to feature his story in the control room/historical exhibits)
    a. Requirements:
6. Monitor: Planetarium theater showtimes & titles posters (on a monitor) and entrance queue. **(Lars)**
    a. Requirements:
7. Monitor: Science On a Sphere (SOS) show times and promo poster. **(Lars)**
    a. Requirements:
8. Very Large Wall Graphics & Photo Op for Visitors: The size of walls and the specified track light system in the lobby will support the use of very large graphics. Such panels will serve to help convey information to be presented by docents and staff, as well as serve as attractive photo-op:

[1] Some inspiration: https://supernova.eso.org/exhibition/0303/ https://supernova.eso.org/exhibition/0403/ https://supernova.eso.org/exhibition/0411/ https://supernova.eso.org/exhibition/1215/ https://www.eso.org/public/products/exhibitions/?search=sun

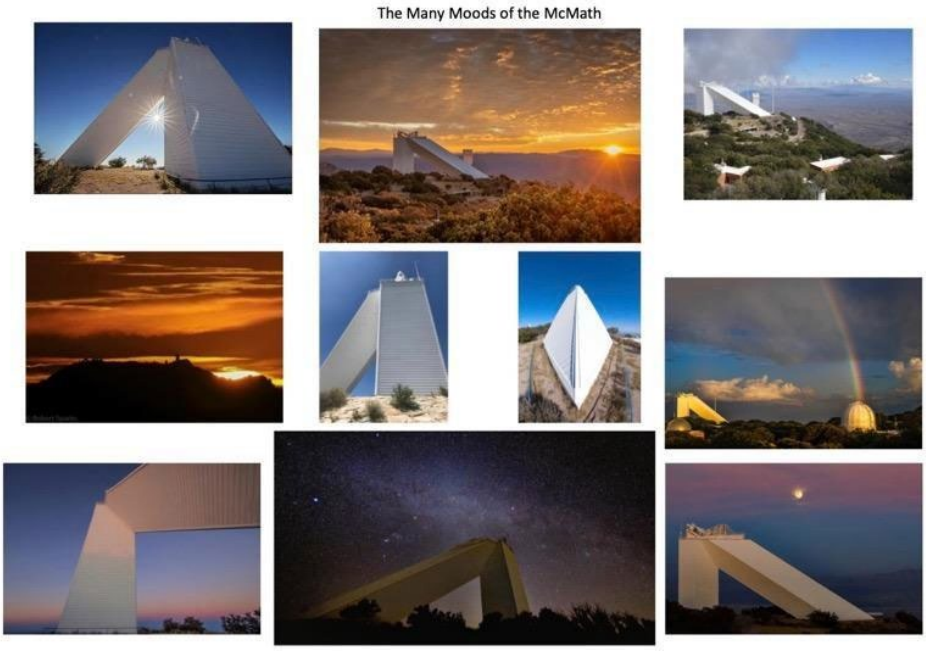
(Graphics Team)

One design approach would be to use the large mural as a visual frame surrounding the large welcome video monitor. The monitor would be installed in the center of the mural or off-center, depending upon the layout of the mural.

   a. Requirements:

9. Restrooms: Water in the Universe and water conservation at KPNO in context of restroom facilities, drinking fountains **(Justine/Rob)**
   a. Requirements: Posters/Infographics
10. If space allows:
   a. Artistic aspects of the MMP — ***The Many Moods of the McMath-Pierce Solar Telescope***

      This is intended to portray the artistic aspects of the architecture working in the unique mountaintop environment through the course of a year and diurnal cycle. Many striking photos have been taken by Visitor Center and other NOIRLab staff over the years that will be included in this ~~exh~~bit.



b. Exploring the Universe with the MMP: Photo mosaic of other objects studied with the MMP (large size color photos of Mercury, Moon, Mars, etc.). This large montage mural features images of the objects studied by the MMP over its scientific lifespan. Multiple images of the Sun are juxtapositioned with images of the Moon, Mercury, Io, and other objects that were targets of study using the McMath. Such a mural supports a smooth transition by the docent delivering the welcome presentation to begin discussing why the MMP was built. If budget allows, this mural should be designed as a 3-dimensional, raised relief mural featuring hemispheres of the smaller solar system bodies and large pie-shaped wedges of portions of the Sun. Such a design could utilize portions of ceiling space and could wrap around the corner to the two walls connecting to the gallery entrance. We introduce visitors to NSF and its mission and its decision to fund the construction of the McMath.
The location of this exhibit near the entrance to the Understanding our Universe exhibit gallery allows the conversation with the visitor to transition from what is studied to how we study the Universe.

Potential Items, Technology, Artifacts

- A large, detailed 3D wedge of the Sun placed high upon the wall, intersecting with the ceiling, with the Earth shown to scale.
- TON photos and illustrations
- Gray print giant size outline of the McMath facility on the entry wall
- Large size monitor with stereo speakers for playing orientation/history videos located on entry wall and framed by the large gray print of the MMP
- 2 monitors for showtimes.
- Letter from JFK
- Photos & plaques pertaining to Robert McMath and Keith Pierce incl. the original bronze plaques attached to the exterior and interior walls of the McMath prior to demolition
- Large color logos NSF, NOIRLab, Kitt Peak, CTIO, Rubin, CSDC, Gemini, and AURA printed large scale and laid out as a photo op for visitors.

2. Planetarium

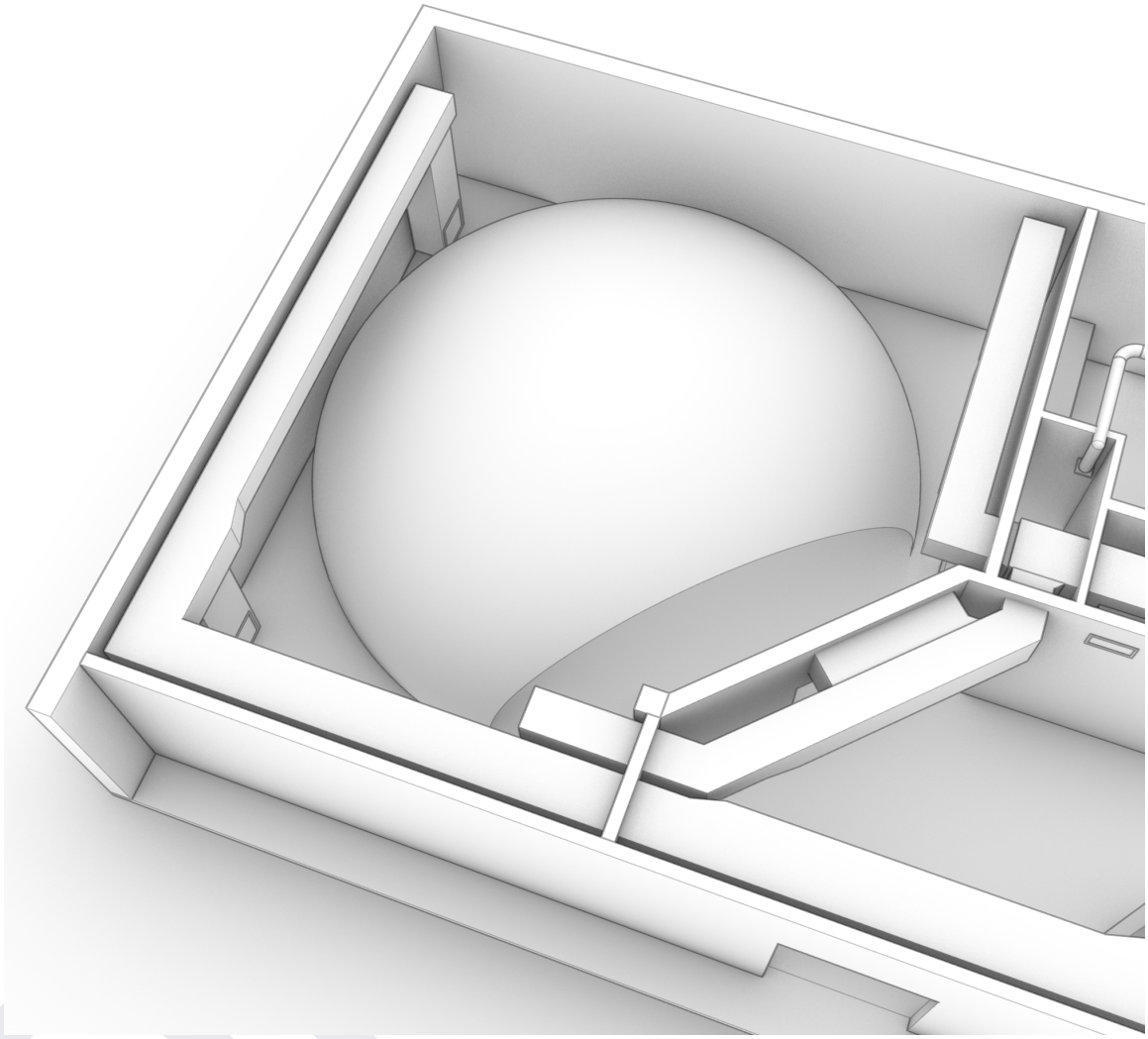


Figure 12: Digital rendering of the Planetarium Theater. Credit: Mei Starns/KPNO/NOIRLab/NSF/AURA. Max width: 28" 0' (8.53 m), Height: 3.20 m)

Working Title: Windows Planetarium Theater (Sponsorship opportunities/naming?)
Size: ~ XXX square feet
Location: Adjacent to Lobby Welcome Area at northeast end of the Center
Visitor Experience Goals: Visitors will leave with a better sense of the how contemporary astronomy, KPNO (and especially the MMP Telescope) and NOIRLab in general impact humanity's understanding of the Universe, an appreciation for the importance of the land for the Indigenous peoples (TON), and have an emotional connection to the cosmos as revealed by KPNO and NSF observatories around the world.

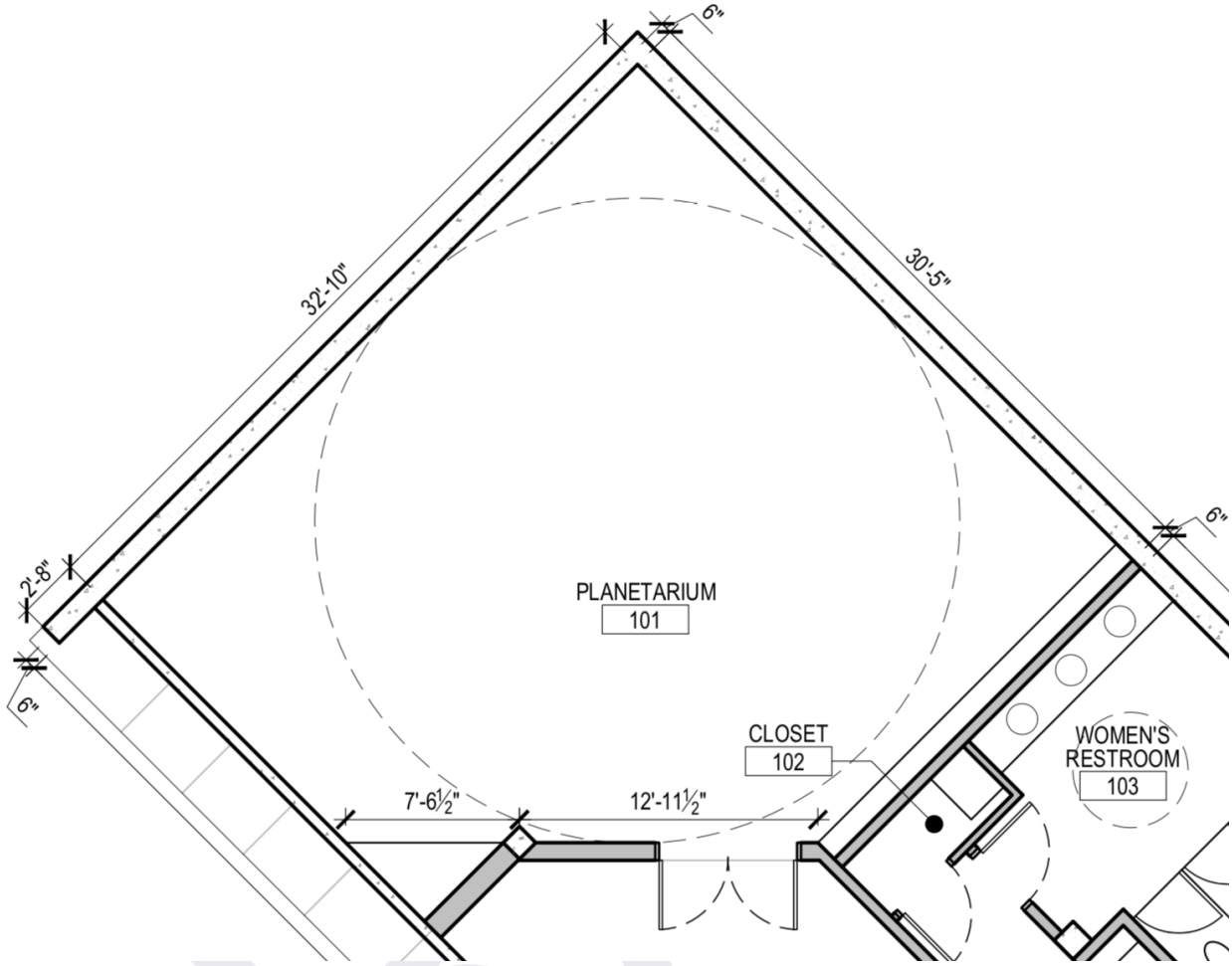


Figure 13: Architectural plan of the Planetarium (10.00 m W, 9.88 m L). 10'-6" ceiling height (3.20 m H). Credit: Mei Starns/KPNO/NOIRLab/NSF/AURA

Definition of System

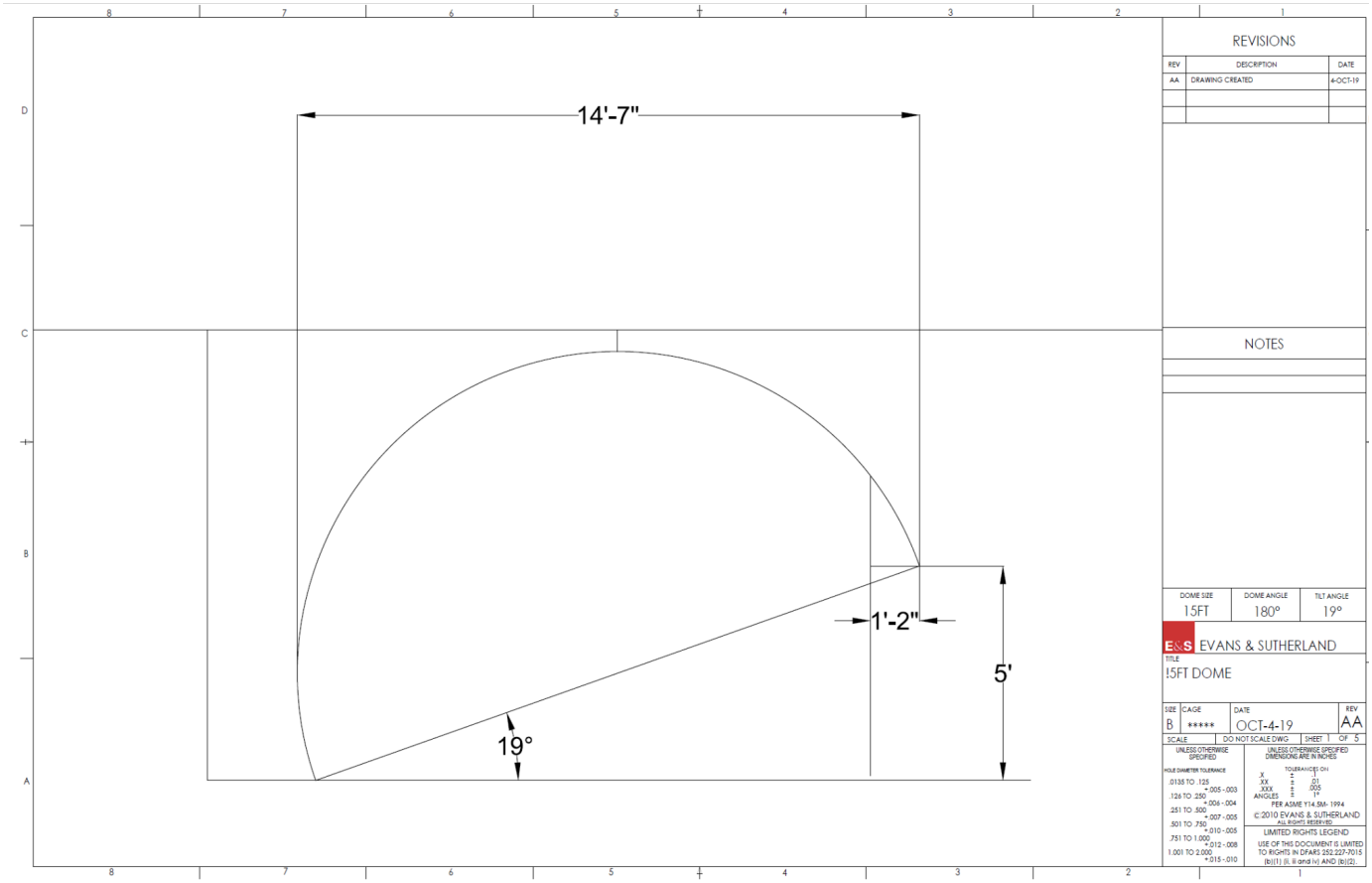
A planetarium will be installed in the NE part of the building. This is one of two astronomy data visualization systems in Windows (Science On A Sphere is the other). The digital planetarium comes with an extraordinary object database, video projection system, and well-designed user interface that enables travel in space and time, through a sophisticated 3D astronomical database.

The content developed for the planetarium will be shared with other established science center and museum user groups around the globe, creating international impact and visibility. The selected distribution license is Creative Commons Attribution. This will be only the second such planetarium with openly accessible, free materials in the world.

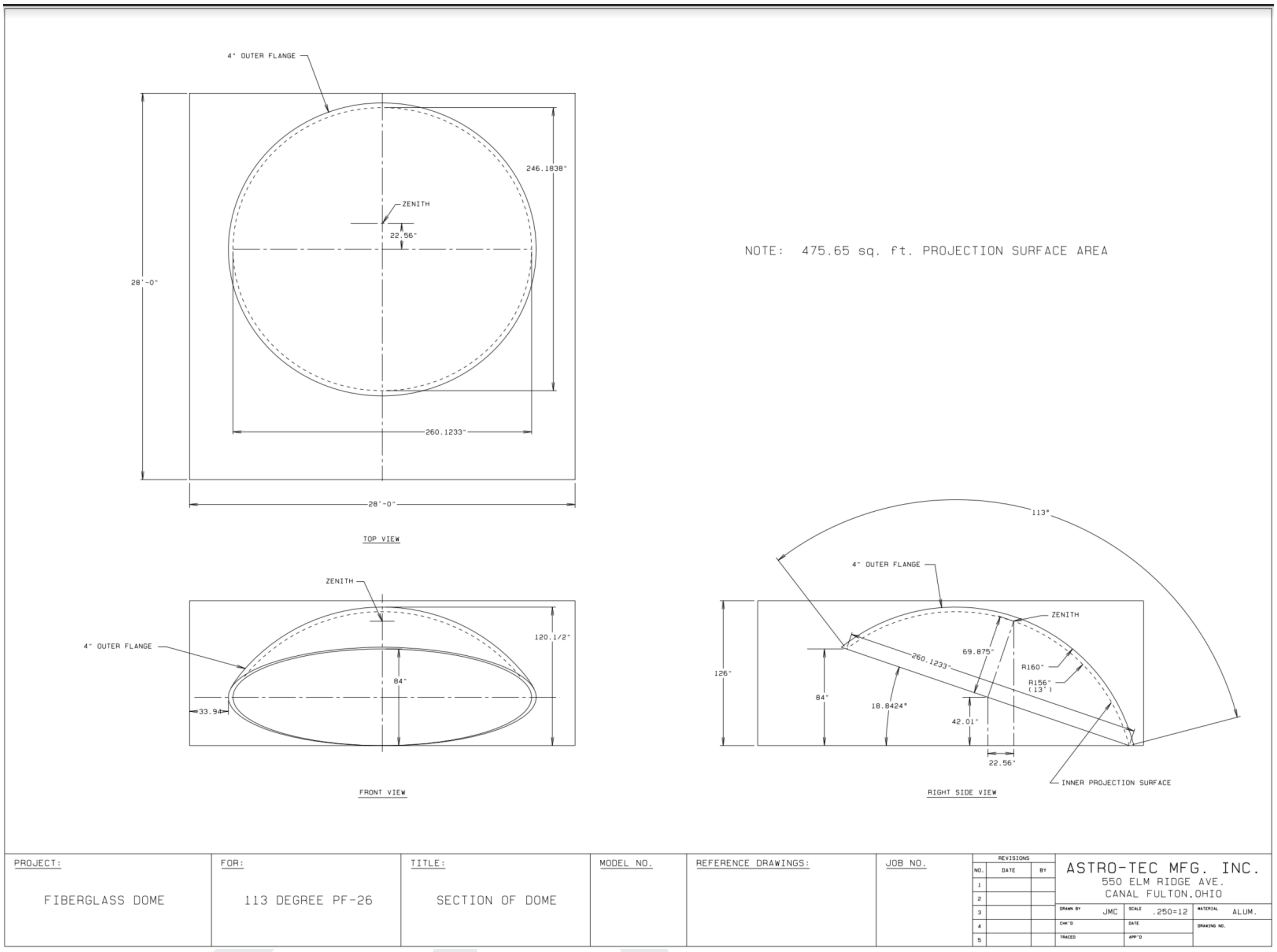
The available room is very unusual as it has an extremely low ceiling. Creative solutions are necessary to create an immersive experience transporting the spectators to the stars and galaxies.

Figure 14: Former Visitor Center Manager Bill Buckingham presents the newly-renovated Planetarium to a group of key NSF and NOIRLab officials, May 18, 2022. The current ceiling height is only 10'-6". Credit: KPNO/NOIRLab/NSF/AURA

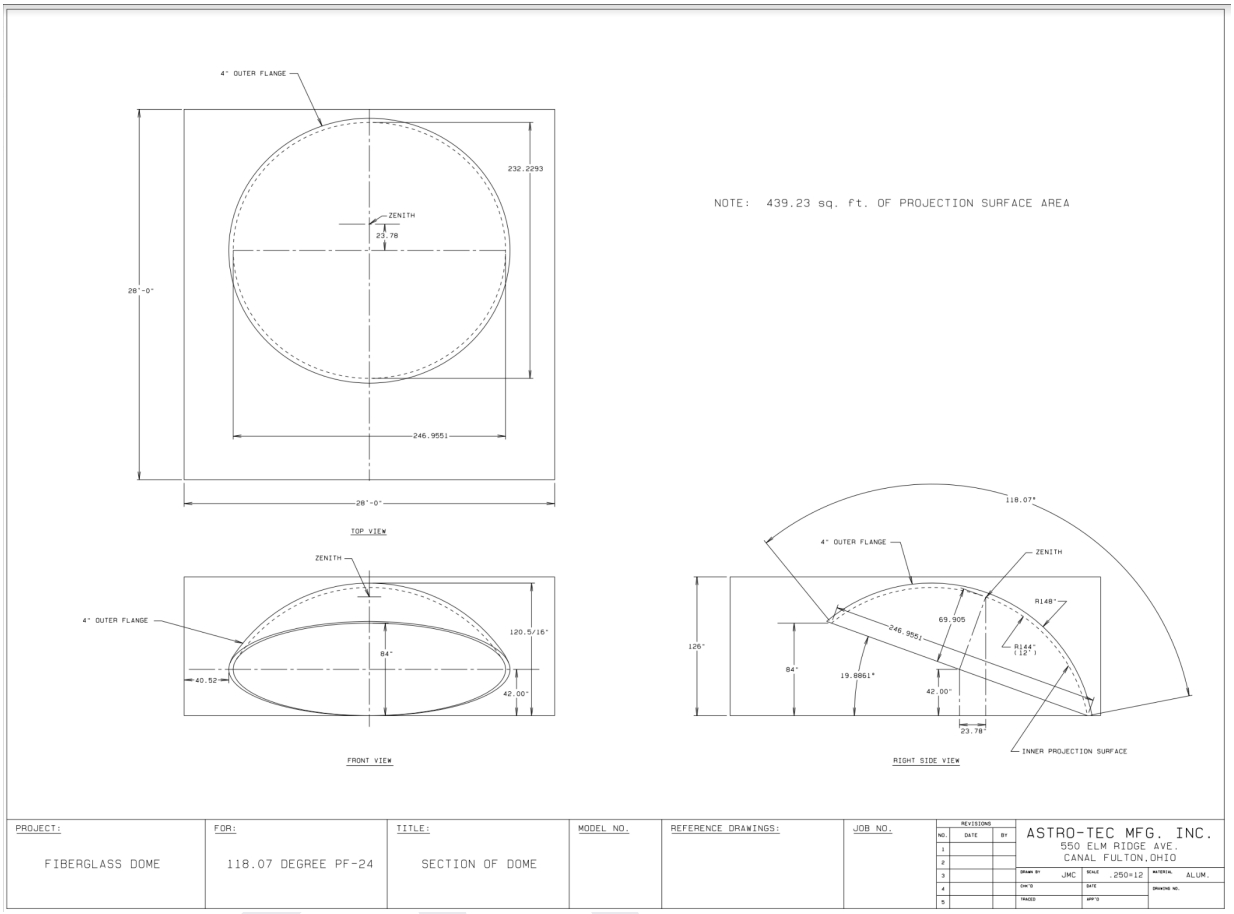
Option 1: A small dome with low tilt



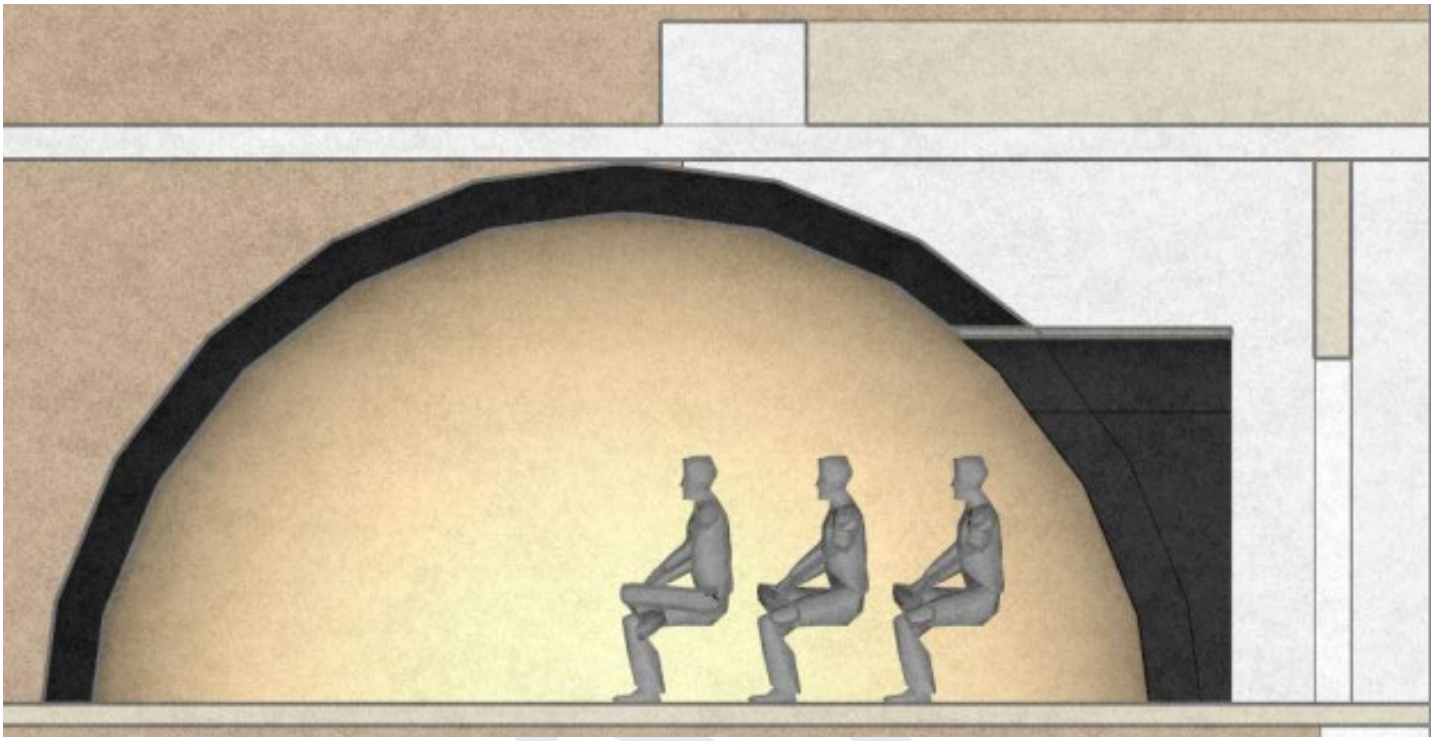
One option (E&S) for a 180-degree dome with 19 deg tilt.



Astro-Tec Option 1



Astro-Tec Option 2



Another option: Illuminati.

Option 2: a cylindrical segment

Due to the exceptionally low ceiling height projection would take place on a flat cylindrical surface, around the walls and perhaps the floor. In his admittedly unconventional concept is it still possible to run standardized astronomy software packages, such as Digistar.

Pros:

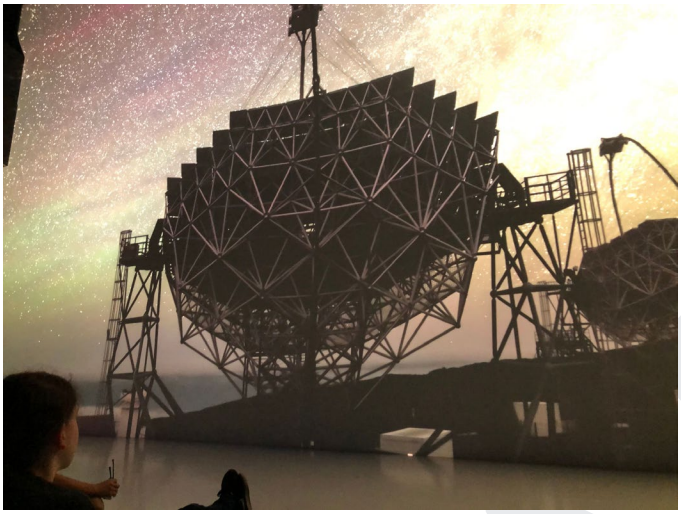
- The Visitor Experience Goals formulated above can still be met in a theater of this design.
- The room can hold more people than a very small dome “squeezed” into it.
- Rather than with the immersive experience of a planetarium dome, the concept presented here would impress with a projection of ultimate resolution, brightness and contrast, as cross-scattering is not an issue in the same way it is in a planetarium dome.
- A LED system would be a realistic option (Dome-X or similar)
- Live content would look good and relatively simple to set up
- Optionally, tracking devices (Kinect or the like) can be used to allow visitors to interact with the projection – something a typical planetarium dome cannot offer.
- Having one of the first LED installations in the US could be a unique selling point

Cons:

- The theater can not be called a “Planetarium” (as this would imply a dome), which arguably

could impact the ability to sell tickets.

- Standard planetarium shows can not be played back
- Any productions would be for this facility only



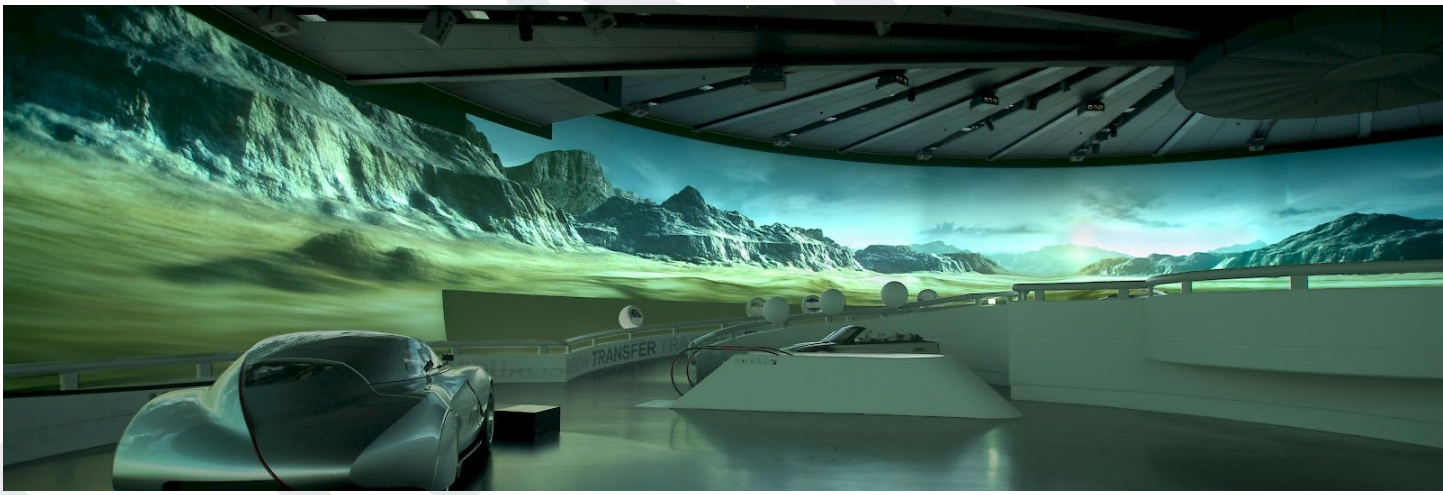
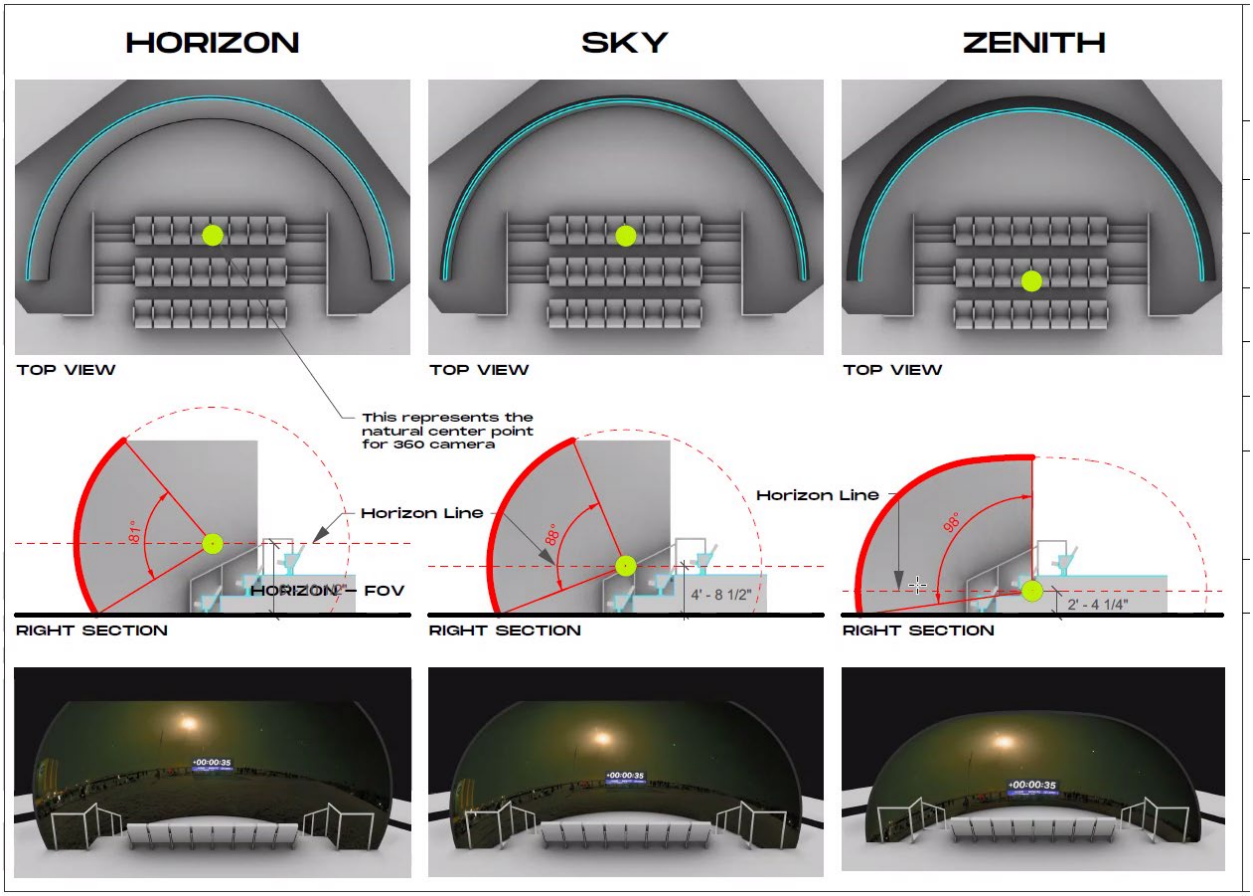
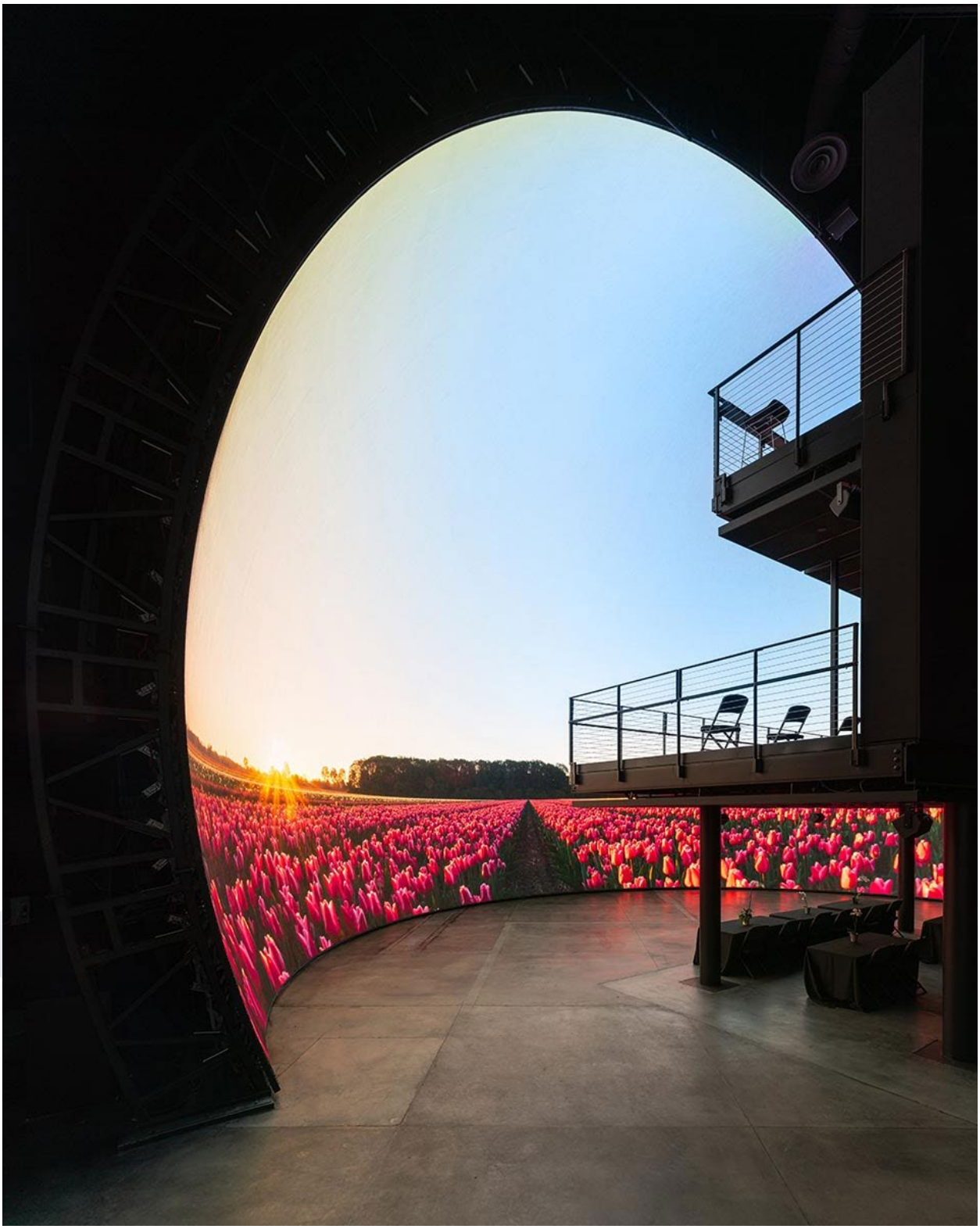


Figure 20: BMW Museum in Munich, Germany. This is a much larger room, but utilizes the same principle.


HORIZON
SKY
ZENITH
TOP VIEW
TOP VIEW
TOP VIEW
This represents the natural center point for 360 camera
Horizon Line
Horizon Line
81°
89°
98°
HORIZONTAL FOV
4' - 8 1/2"
2' - 4 1/4"
RIGHT SECTION
RIGHT SECTION
RIGHT SECTION



LED 8k demonstrator at COSM/E&S in SLC.

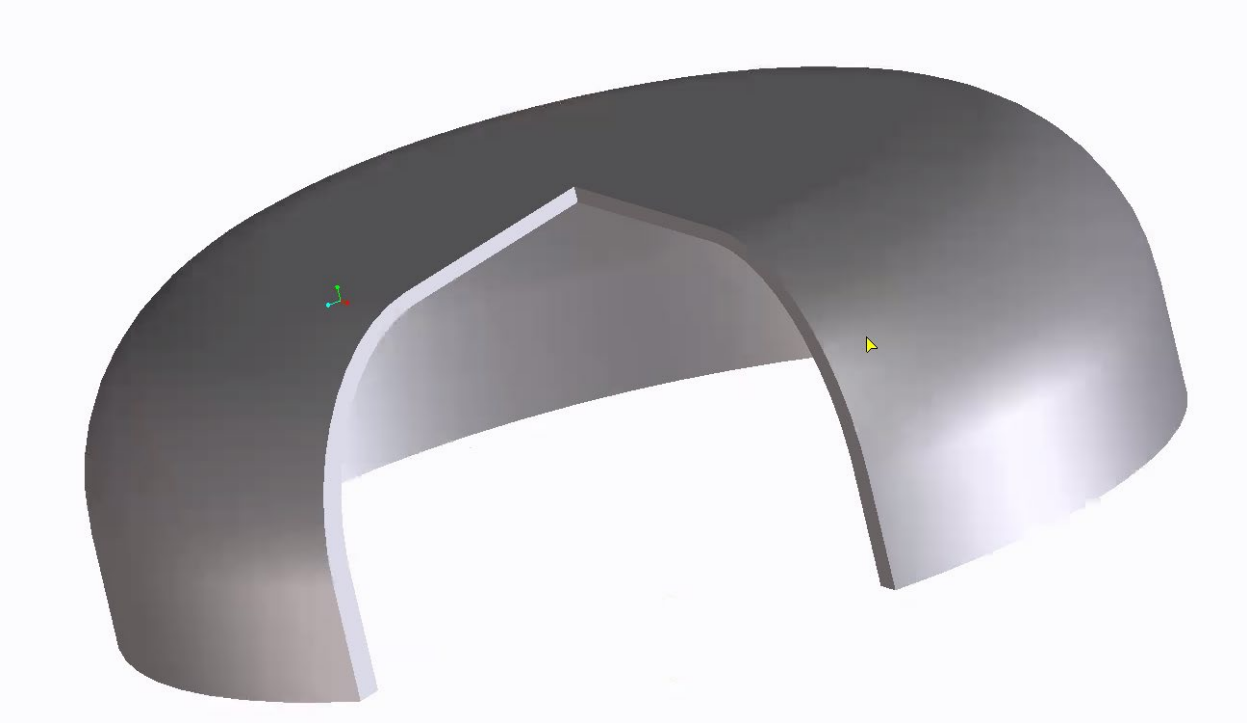
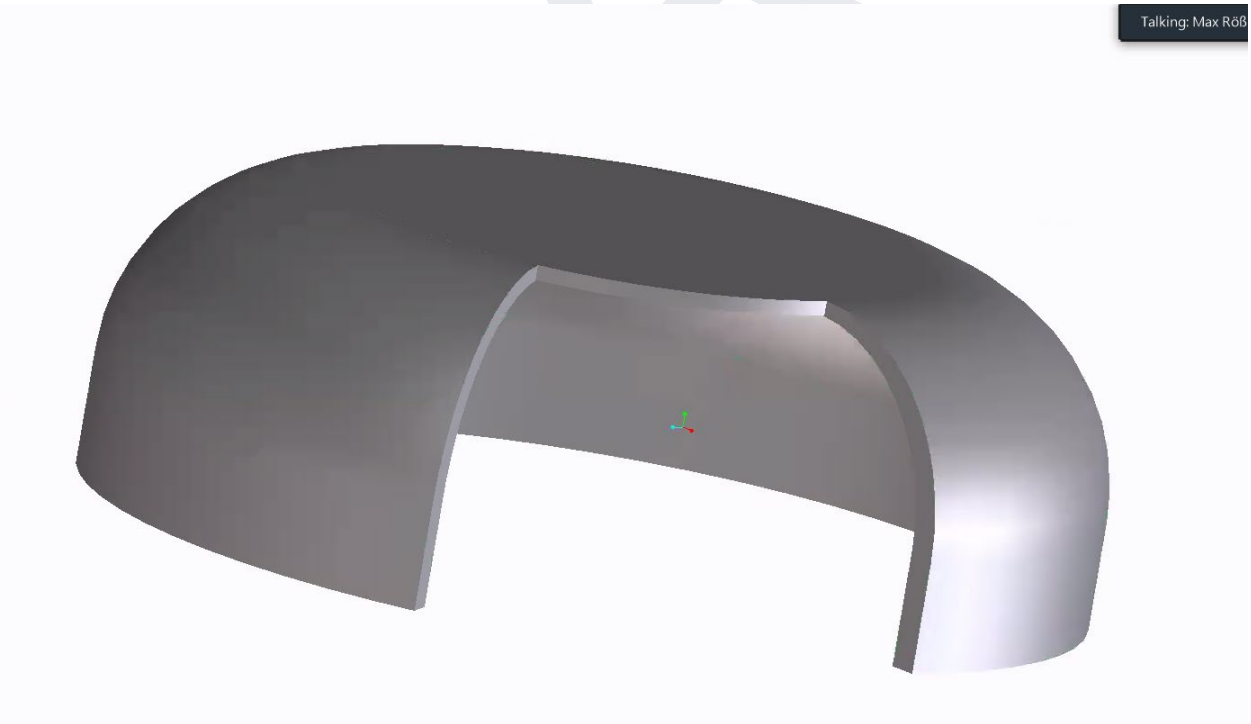
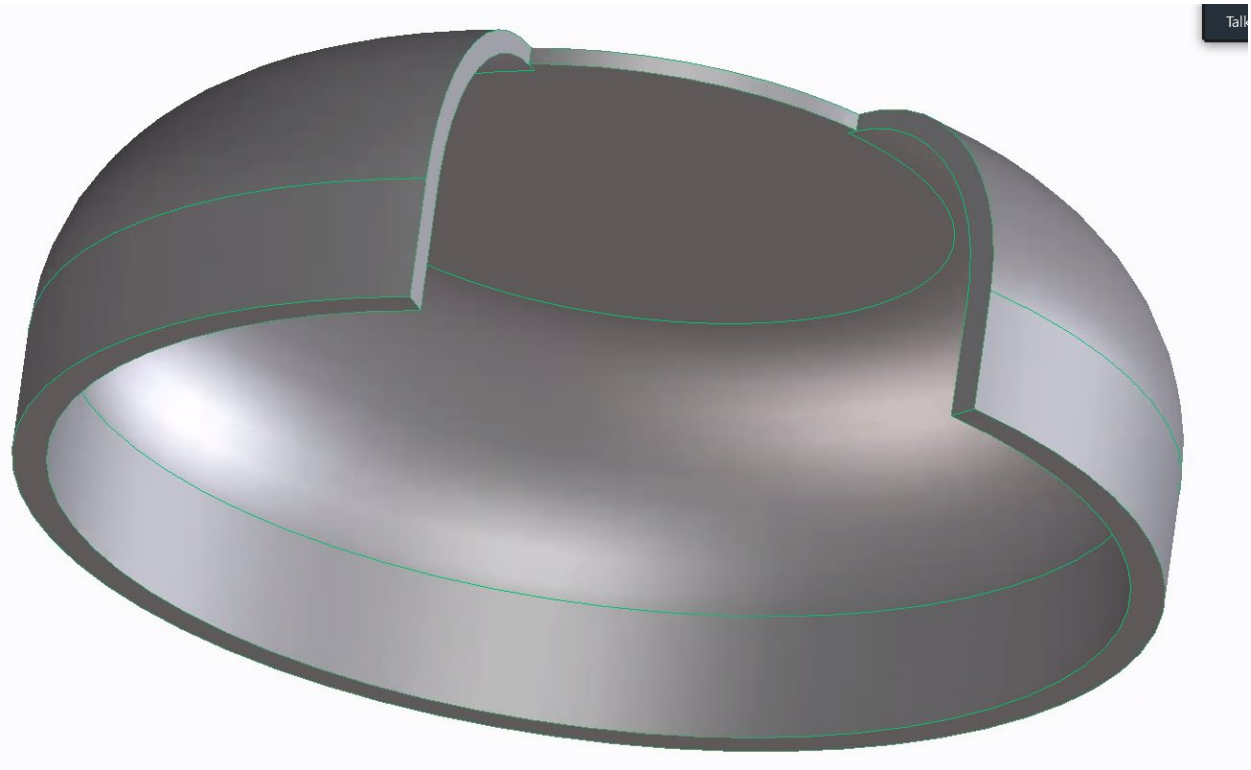


Figure 20x: A squashed dome





Content Model

It is envisioned that the planetarium will feature a signature program which will strengthen the sense of place for the Center, both culturally and scientifically. Options include the “Contemporary Astronomy” planetarium show already in production for NSF by CEE with GEMMA funding (multi-messenger, time-domain astronomy etc).

Around 20 fulldome shows have already been created or distributed by CEE members earlier. These

standard shows will be included in the daily schedule of programming as needed. The DESI planetarium show currently in production and Big Astronomy will also be included.

The NOIRLab Virtual Tours will also be included in the scheduling, ideally with a live narrated show by NOIRLab astronomers sharing their experiences about how astronomers and observatories work. This features snapshots of 70 locations on all 7 summits and bases.

Content distribution model

The chosen planetarium system will use NOIRLab's existing cloud distribution model. The system supports metadata standards like Data2Dome and AVM, and hence will from the get-go be delivering content to 100s of planetariums around the world.

All audiovisual content produced, including fulldome clips and shows, will be distributed under Creative Commons Attribution through NOIRLab's image and video archive. This will be only the second such "open-access" planetarium with openly accessible, free materials in the world.

Plan for domecasts

The chosen planetarium system will have a domecast module. Occasionally live domecasts will be broadcast from KPNO to audiences around the world, for instance for eclipses and other sky events. And domecasts from other planetariums in suitable time zones can be shown at the Windows planetarium.

Requirements for Vendor/System Selection

The vendor requirements are listed in this document. This system will be a standard fulldome system following International Planetarium Society (IPS) standards. The projector specifications are calculated in Fulldome Planetarium Resources.

Selection of Vendor

A vendor will be selected based on the criteria in the requirements document in an open, transparent and competitive process (in collaboration with CAS following standard procurement rules).

A full turn-key, fixed-price installation will be delivered that includes dome, seats, cove lighting, sound system, software, hardware, training and projection equipment.

3. Understanding Our Universe

Figure 21: Digital model of the Understanding Our Universe *exhibit hall. Credit: Mei Starns/KPNO/NOIRLab/NSF/AURA*

Working Title: Understanding our Universe
Size: ~ 1,600 square feet
Location: Main gallery, west wing
Visitor Experience Goals: In this area of the Center visitors will better understand our place in the Universe, how we know what we know about the cosmos, and why it is relevant. A range of technologies will be utilized due to limited space and vast content coverage. A dwell time goal is 20 minutes for adults visiting this gallery, with a minimum of 5 minutes on interactive kiosks (during unrushed, non-peak visitor periods).

Before renovation.

Description

Before showcasing leading edge astronomical research funded by NSF, visitors first gain an introduction to certain fundamentals in astronomy concepts and the tools of astronomy through self-guided experiences in this gallery, as well as guided tours and gallery demonstrations conducted by trained docents. Because this is such a large topic, it is expected that at least some of the exhibits will be interactive and computer-based to include broad and deeper content in a user exploration environment.

Big Idea:
How we reached our current understanding and how the KPNO contributed.

Themes

Three themes frame the *Understanding our Universe* exhibits:

You Are Here — This is Your Universe

We begin with a "you are here" theme to establish the size, scale, and age of the Universe. Beginning in southern Arizona, we move the visitor progressively from Earth, across the Solar System, through the Milky Way, and into the realm of the galaxies. The nature of planets, stars, nebulae, and other common and more exotic objects is introduced as they are encountered on the journey across the Universe.

How Do We Know? — How Do We Study the Universe?

Next, we address the theme "how do we know." The visitor is introduced to light and the electromagnetic spectrum. How nature transmits information across the vast distances of space through the electromagnetic spectrum, particles, and gravitational waves are presented. We provide

descriptions of the instruments and techniques used to capture and analyze these carriers of information.

Why Should I Care? — How Does This Relate to Me?

Woven into the messages in each exhibit is the answer to this question. This is an extremely common theme in questions we receive daily from visitors. We will show relevance, applications to daily life, or benefits gained by humanity having a clear, in-depth understanding of how the Universe works

Topics

It is in this gallery we introduce the following topics:

MISSING HUMAN STORY BELOW. the WHY. Leads to the How, then leads to below.

- From here to out there
    - Floor map showing high res satellite map of KPNO and Tucson
    - Powers of 10 scale of the Universe (ideally zooming out from KPNO)
- How does nature transmit information across the Universe?
    - EM Spectrum and the nature of light
    - Light that the eye cannot see, especially IR and UV
    - Earth's atmosphere and magnetosphere Windows and absorption
    - Gravitational Waves, Neutrinos, Gamma Waves — Multi-Messenger Astronomy (MMA)
- How do scientists capture this information
    - NSF Telescopes (including GW, Neutrino, Gamma & X-Ray) (see below*)
    - Spectrographs
    - Imagers
    - Adaptive Optics
- Time Domain Astronomy (TDA)
    - TDA through the ages, Solar System motions, Comets, Meteors, Supernovae (guest stars), variable stars
    - Rubin - TDA on steroids!
    - TDA follow-up Observations from NSF/NOIRLab facilities
- What's in it for me?
    - Exoplanets and life in the Universe
    - Star Power (solar and fusion energy to save our planet)
    - Fate of the Universe
    - Astronomy technology in daily life: Time and cycles, Detectors, AO and optometry, planetary climatology and the Earth's future etc.

* NSF astronomy and physics facilities globally and how they advance our understanding of the Universe. NOIRLab facilities will be a prime focus of the content, but other facilities, especially related

to Multi-Messenger Astronomy, will be featured and visitors will leave with a more complete understanding of the tools used to explore the Universe in diverse ways.
NSF-funded astronomy facilities and how each site captures information transmitted by different means across the Universe, building upon the basic astronomy concepts introduced in the Understanding our Universe exhibits.

Featured facilities include ICECube, CTIO, Gemini, KPNO, VLA, LIGO, ALMA, the new flagship Vera C. Rubin Observatory, US-ELTP (if approved) etc. The specific exhibitry to be developed for each facility remains to be developed in consultation with staff from each site.

Collaborate :

1. National Radio Astronomy Observatory (NRAO, VLA, ngVLA, VLBA)
2. Green Bank Observatory
3. Laser Interferometer Gravitational-wave Observatory (LIGO)
4. National Solar Observatory (DKIST, GONG, SOLIS)
5. IceCube Neutrino Observatory
6. Atacama Large Millimeter/submillimeter Array (ALMA)

7. NOIRLab: Rubin, KPNO, CSDC, Gemini, CTIO, US-ELTP

Potential split into sections

1) Astronomy — What is astronomy?
Astronomy is the study of the vast and wonderful Universe that we live in. It provides us with a humble look at ourselves and at our place in space and time.

2) Earth, Moon & Sun — Why is the Earth special?
The Earth is the only planet that we know to harbor life. Its large Moon and its motion around the Sun at just the right distance make the Earth the comfortable place for life that it is.

3) The Solar System — Is the Earth Unique?
The Earth is one of eight planets orbiting the Sun. But the Solar System also contains moons, asteroids, dwarf planets and comets. Is the Earth the only one among all these worlds that supports life?

4) Stars — How do stars form, live and die?
Stars don't live forever. They are born from cosmic gas clouds, and may live for billions of years. But in the end they die — as fading dwarfs, or in titanic supernova explosions. Astronomers have unraveled the stories of their lives.

5) Exoplanets — Are we alone?
The Earth is a living planet. Other stars have planets, too. Do they also harbor life? And how can we find out?

6) What is NOIRLab?
NOIRLab plays a leading role in ground-based astronomy. How did it develop? And what is so special about the sites in Arizona, Chile, and Hawaii?

7) Discovery machines — How do astronomers study starlight?
Ever since the invention of the telescope in 1608, astronomers have built larger instruments and improved the technology. The study of the Universe has become a high-tech endeavor.
Large telescopes and sophisticated instruments team up to unravel cosmic mysteries.

8) Galaxies — Is our Milky Way galaxy unique?
All the stars we see in the night sky are part of our home galaxy, the Milky Way. Trillions of other galaxies populate the Universe.

9) Cosmology — Where did we come from, and where are we going?
13.8 billion years ago, the Universe was born in the Big Bang. It has been expanding ever since, giving birth to galaxies, stars, planets, and life. While we know a lot of its past, its distant future is uncertain.

10) Cosmic mysteries and threats — What are the great unknowns?
We have learned a lot about the cosmos, but many mysteries remain unsolved. One of them is whether — and how — life on Earth will be able to cope with threats from space.

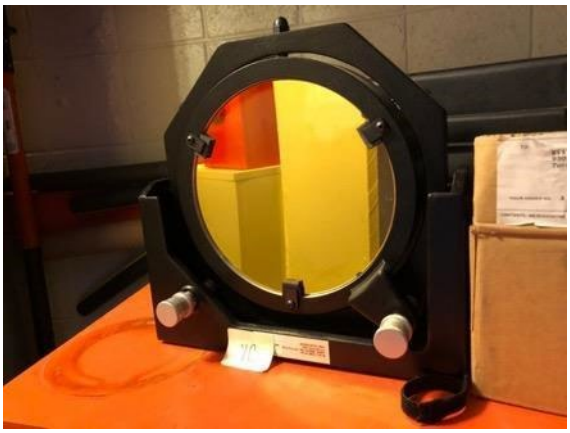
11) News — What are the hot topics in astronomy?

12) You can be an astronomer too – citizen science.

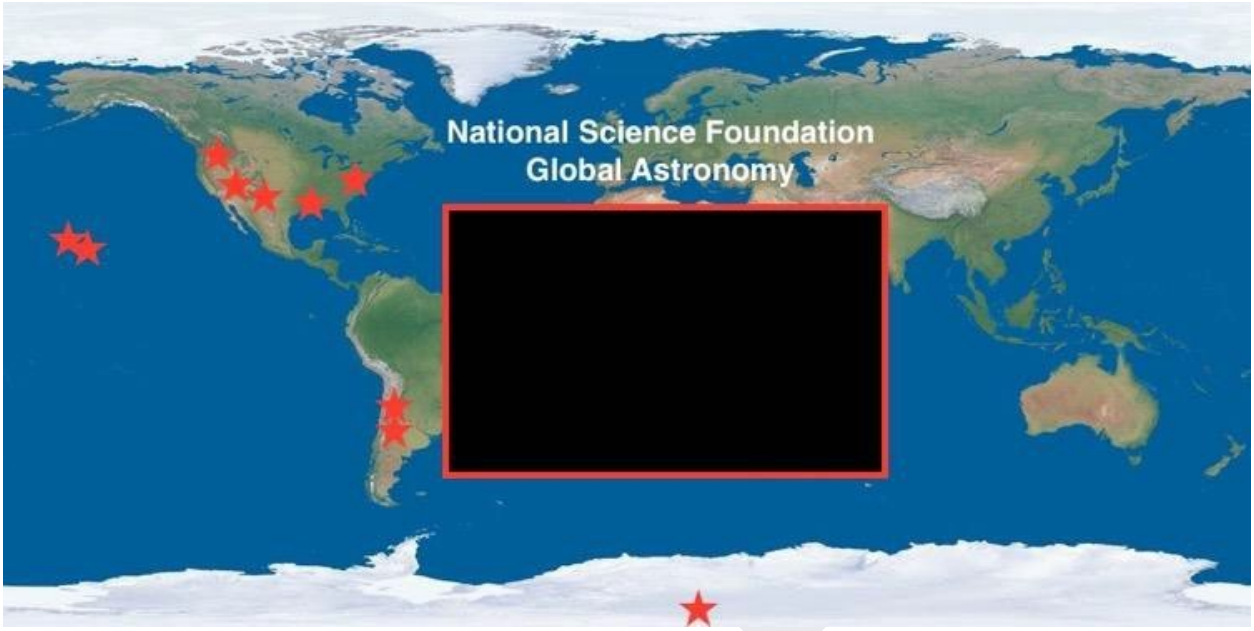
Potential Items, Technology, Artifacts

- “Here” floor map
- Large 3-D model of Sun
- Two or 3-D scale illustrations (size of Earth, Sun compared to other stars)
- Anatomy of the Sun mural
- A very large scale combo of existing “to scale” posters now in the hallway showing Earth on up to the largest known star.
- Very large map/rendering/mural of the Milky Way

- 3-D map of the local neighborhood of the Universe



- Small telescopes, some cut open. One or more can aim at a backlit starfield image much further down the gallery to allow visitors the experience of viewing through a telescope.
- IR camera, cut open
- Retired KPNO spectrograph, cut open and covered with glass for viewing without injury.
    - This will have additional exhibitry on spectroscopy in astronomy, expanding universe etc.
- Kiosk with access to online databases
- Exhibit with both 2-D and 3-D iron filings/magnetic fields; with projection or large monitor capabilities to allow group observation of the activity.
- Interactive magnets exhibit
- Recreation of Herschel's IR discovery set up (with movable thermometer)
- Views of familiar objects in different wavelengths
- NOIRLab Virtual Tour
- Interactive kiosk or image table with global map showing locations of each site with a mix of photos from each.
- Very large color graphic backdrop images
- Scale models of other observatories
- Exhibits previously developed at the showcased observatories, particularly LIGO.
- Augmented reality models to be used on mobile devices



A monitor displays a standard App playing a slide show and video clips of the latest and greatest images from other NSF sites. It is mounted within a large map showing locations of the other observatories. A standard touch screen monitor on a nearby reader rail mounting enables visitors to obtain more information about the observatory of their choice.

Figure 24: Example of an IR camera exhibit. Credit: KPNO/NOIRLab/NSF/AURA

Layout Notes

The gallery was rebuilt to include numerous electrical outlets and Internet jacks along the walls as well as the ceiling. This will support a wide variety of exhibit floor plans. The design of individual exhibits and their placement in the gallery should create meandering pathways for visitors. Visitors should not be able to see the end of the gallery from either the west or east entrances. As the visitor proceeds on his/her exploration, there is always something new encountered as they move through the gallery. The *example layout* below enables visitors to choose multiple pathways through the gallery while preventing a view from end to end.

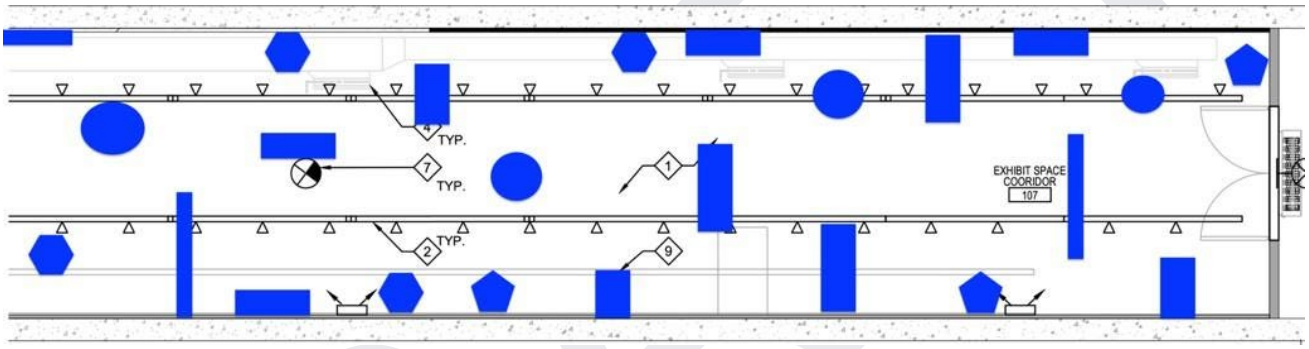


Figure 25: Example layout of exhibit hall. Credit: KPNO/NOIRLab/NSF/AURA

The individually controlled spotlights will enable tightly controlled lighting to emphasize exhibits or photographs, designated pedestrian pathways, and create artistic effects which combine to enhance the visitor experience in this gallery. From a functional perspective, staff will be spared excessive hours on very tall ladders as exhibits arrive or are rotated out. The steerable lights can be directed by remote control from floor level. The only time high ladder work will be necessary is when replacement or repair is needed on a particular lighting unit. The diagram below shows the lighting plan for the *Understanding Our Universe* gallery.

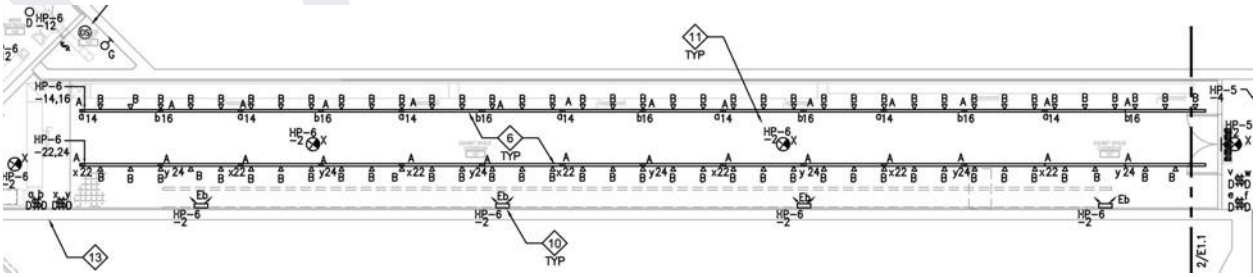


Figure 26: Diagram of the lighting plan for the Understanding Our Universe *gallery. Credit: Advantech A&E/KPNO/NOIRLab/NSF/AURA*

4. MMP Telescope Control Room

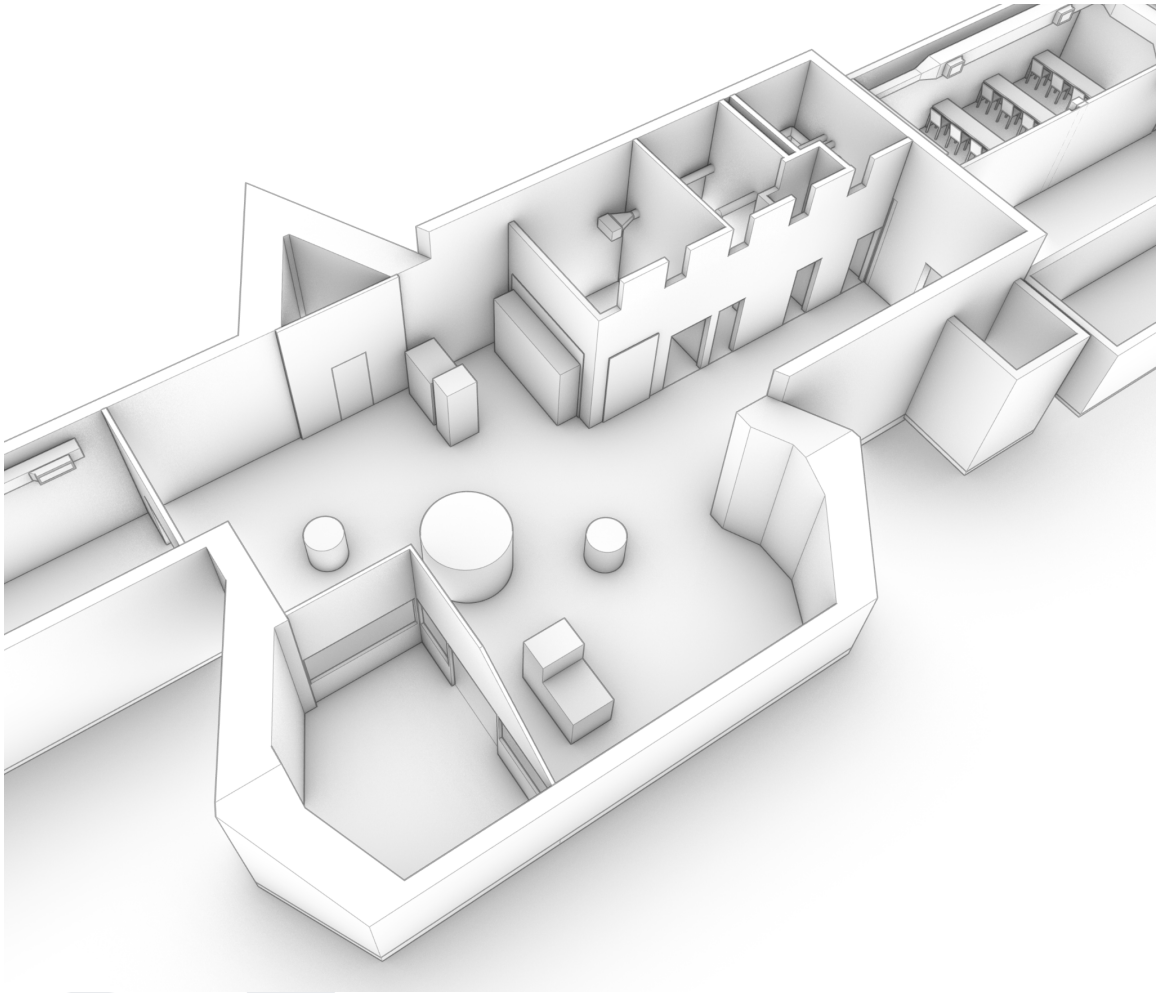


Figure 27: Digital model of the Control Room. Credit: Mei Starns/KPNO/NOIRLab/NSF/AURA

Working Title: MMP Telescope Control Room
Size: ~ About 1,417 square feet +195 sq. ft. in Computer Room
Location: At the end of the Understanding Our Universe Gallery
Visitor Experience Goals: Visitors to this area of the Center will depart with a visual memory of what the Sun looks like through a large solar telescope and the significance of features like sunspots and granulation and what causes them. Additionally, visitors will realize that the telescope was operated by vintage computers and feel a sense of nostalgia for the early technology that has been restored for this experience.

The control room provides a setting for guided tours, talks, demonstrations, and observing sessions

with the three heliostats. Staff or volunteers are always present in the room at times that the public is present to protect the heliostat control systems and related electronics.

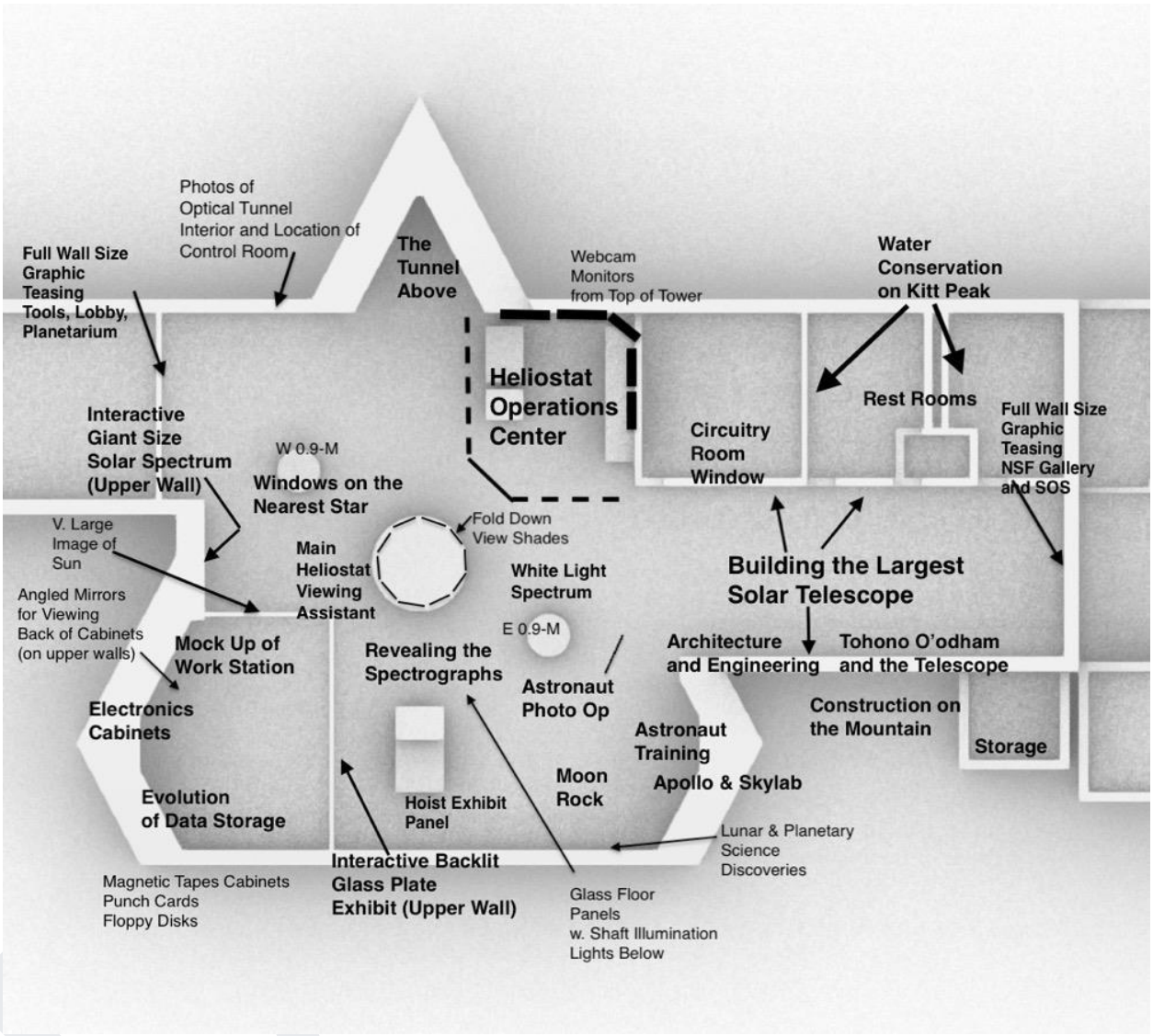


Figure 28: Layout of exhibits located in the Control Room. Credit: KPNO/NOIRLab/NSF/AURA

Several aspects of the retro look of the room have been retained, including the analog control panels and instrument racks — which remain crucial to the operation of the heliostats. The old white floor panels are retained in the computer room and an area closest to the control panel; others are carpeted to improve the hard acoustics of the room.

An organizing theme in this area is "reveal." We want to open and reveal as many aspects of the McMath construction and instrumentation as possible. The glass "storefront" built by the

demo/construction contractor around the elevator shaft is one expression of this theme. The floor panels in line with the storefront will be replaced with glass to showcase the spectrographs underneath. Above the glass floor panels, a blueprint of the optical tunnel as seen from below will be illustrated on the ceiling of the control room. Another way of revealing the inner workings of the control room would be to open the formerly-covered south wall of the electrical circuitry room by replacing the wood panels and doors with glass.

Potential Items, Technology, Artifacts

- All necessary control panels, computers, and electronics racks needed to operate the heliostats and spectrographs in one consolidated, protected area. Identifying labels and signage will be added.
- Variety of operating manuals and references on an enclosed bookcase, located near to control panels to create the operational look from the 1970s or 80s.
- Ceiling Photo Mural of Optical Tunnel
- Illuminated Optical Paths (illustrating light pathways between the ceiling mounted mirrors)
- Printed high resolution solar spectrum (with on/off identifications of many lines)
- Refurbished and enhanced large MMP model with augmentations: light path tracer, small grating, scale people inside control room
- Glass Floor Panels (near one of the spectrographs to show the 80-foot-deep pits)
- High quality diffraction grating with artificial light sources
- A large live solar spectrum
- Large photos of other solar system objects studied with the McMath
- Staff showcase exhibits (selected personal profiles of previous operators and scientists)
- Identifier Cards (labels with explanations of equipment around the room)
- Array of glass plates backlit and displayed photos taken by the McMath
- Large photo of the Moon
- Chairs or benches for group presentations/rest area for elderly guests
- Photos of different architectural models that were considered by Myron Goldsmith
- Large photos from its construction
- Panels featuring interviews of former construction workers and operators from Tohono O'odham Nation. May include interviews with family of deceased workers.

Building what was once the Largest Solar Telescope

This area tells the stories of the motivation for building the MMP, its planning, design, construction, and early operations. The roles of the architects, astronomers, NSF, and engineers who were most involved in conceiving and designing the facility are described. A comparison of other existing solar observatories in existence at the time is presented to demonstrate the quantum leap forward in

capability enabled by the new observatory. The congratulatory letter from President Kennedy is displayed here. Several oversized wall mounted photos depicting the enormous scale of effort involved in preparing for and constructing the MMP are accompanied by smaller photos and testimonials from workers who participated in the endeavor, particularly those from the Tohono O'odham Nation.

The construction exhibit previously displayed in the MMP (sample images above) was popular with visitors. Enlarged archival photos showing the earth work, tunneling, concrete, and beam work going up will be featured.

Heliostats Operations Center

A key attraction in this area will be the complex of control devices and electronics racks. The analog control panel has proven to be a very popular feature in this room. (Modification or modernization of the controls was not included in the project scope or budget.) The primary change will be to add large labels and signage identifying the components of the panel, making it easier for live interpretation talks presented by staff and docents. More in-depth explanatory panels will be located surrounding this area, on the outer perimeter of the glass wall, described next. The electronics racks, previously distributed around the room, will be moved close to the analog control panel. The larger unit, the Solar Crate, is used in the control of heliostats. We can more easily secure all the controls if they are in one location. The back of the Solar Crate is unprotected and as the middle photo below shows, heavily wired. The Spectrograph Control unit is more compact and better sealed from prying fingers.

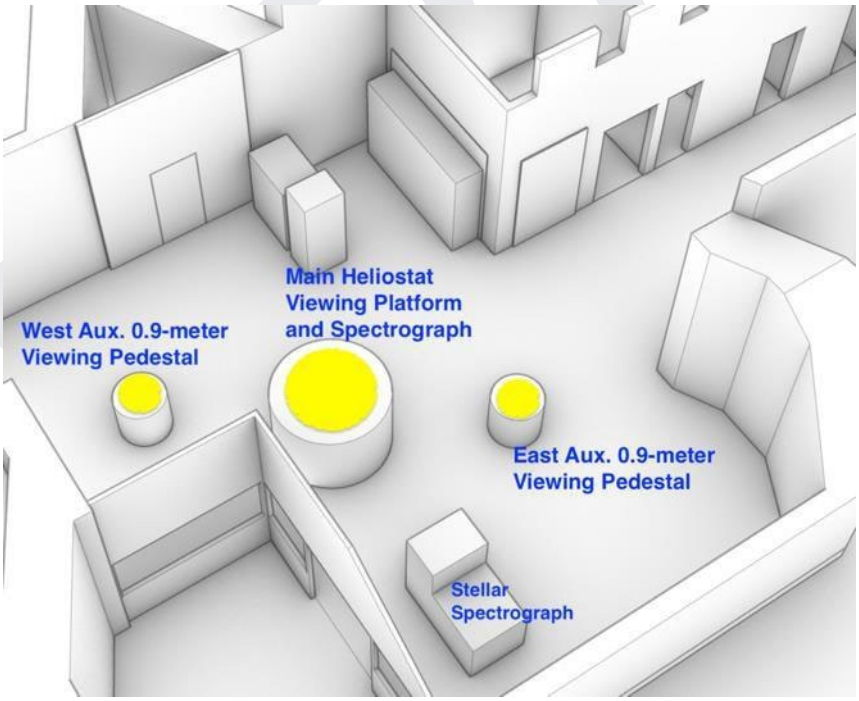
A glass barricade will surround the units to allow visitors views of the systems while preventing them from touching the equipment. The glass panel and a staff gate will be provided by the selected exhibit design/build firm and located as shown by the red line in the adjacent perspective drawing. Labels will be developed to identify the features on the analog control panel and the electronics racks. Reader rail will run the outer perimeter of the glass walls with the more in-depth descriptions of the equipment. The glass wall should be approximately 6 feet tall; there is no reason for it to connect to the ceiling. The enclosure will be built by the exhibits contractor.

Top of the Tower Viewing Monitors

A major new feature will be the addition of several webcams at the top of the optical tower showing the heliostats from a variety of angles. Large monitors will be installed on the walls above and to the side of the control panel displaying the live webcam views. The views will aid docents and staff in explaining the operation of the heliostats and provide exciting views when the mirrors are moved during start up, change of object, and shutdown. With the monitors above the analog control panel, visitors will be able to watch from several angles the motion of the heliostats every time they are slewed.

Windows on the Nearest Star

The most popular activity for visitors in the McMath has been the live projected viewing of the Sun, moon, and other objects. Also popular was a projection of a “live” solar spectrum, made possible by a high-quality grating.



The projection platforms for the west and east auxiliary heliostats had been tables; we will replace these with circular 30-inch tall specially made platforms that will be more functional, provide better access for visitors, and appear more attractive. The main platform will be repainted, and deteriorating side panels replaced. Other changes are described below.

Live Spectrum Exhibit & Demonstration

Long term, we plan to develop plans for a viable, built-in spectrum display and obtain the resources to construct it. A fine working solar spectrum display is featured in the McDonald Observatory Visitor Center. The subterranean nature of the McMath adds complications to such an exhibit for the Windows Center.

For our phase one operation, we will continue using the portable high-quality grating previously used for public demonstrations. The opportunity for visitors to examine the grating and for staff to interact with visitors, moving the grating and shifting the spectrum, has been an enjoyable experience for our guests. The photo shows the arrangement previously used with the west auxiliary. We will develop attractive exhibits and signage around this theme at either the east or west auxiliary viewing station.

Revealing the Spectrographs

Photographs, schematic drawings, and text will reveal how the stellar and solar spectrographs operate as well as the enormous volume occupied by each below the floors. A staff-control animation of the light pathways within the spectrographs will be displayed on a monitor placed near the stellar spectrograph.

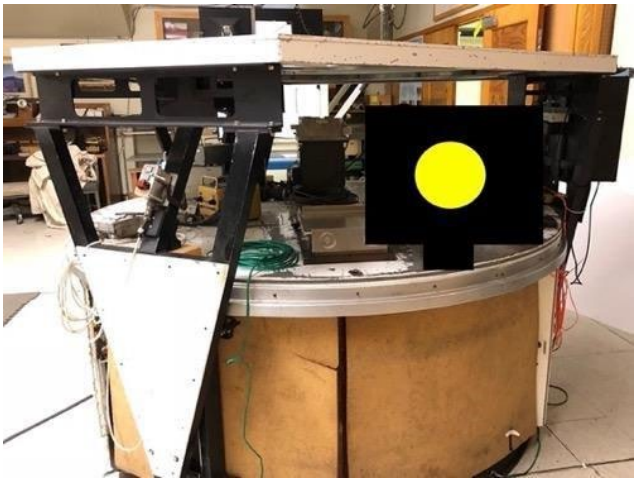
A modification was made by the Facilities team to the stellar spectrograph. The large protruding steel extension (yellow arrow) was removed. It was a serious threat for head injury to visitors and was not needed for operation of the spectrograph. The variety of small equipment, monitors, cables, and a computer aside and atop the spectrograph will require visitor proofing by enclosing in a glass and metal structure.

Photographs and details of instruments and modifications can be found in the Exhibits Implementation section.

Main Heliostat Viewing Assistant

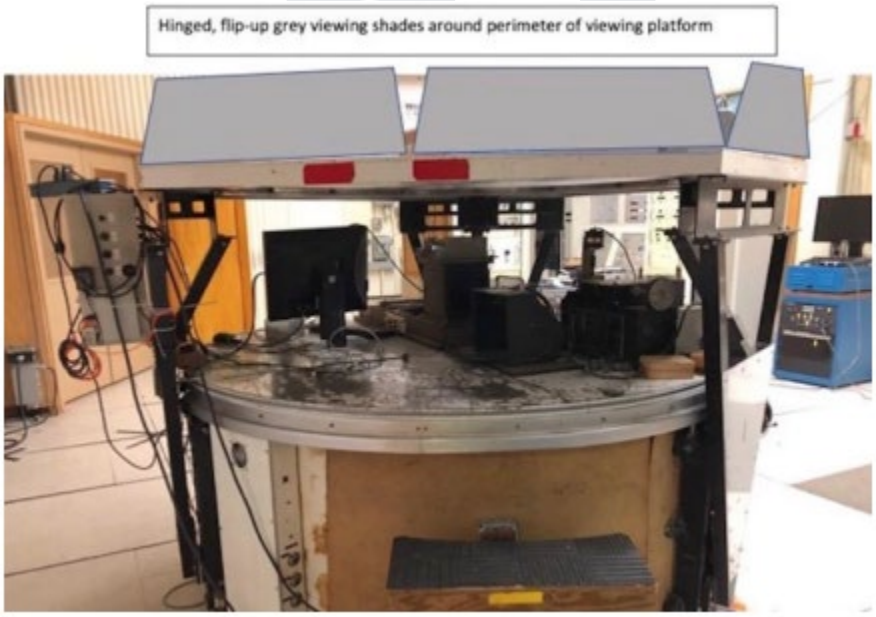
To enable live views of images on the platform for disabled guests and children, a webcam mounted on the ceiling near the main viewing portal will be pointed at the top of the main heliostat viewing platform and a monitor mounted to the side of the spectrograph will display the live image. We demonstrated the usefulness of this design during our heavily attended Transit of Mercury program (10 November, 2019) and it worked very well. Such a system will also enable better visitor experience during high attendance events.

The viewing stations for the two auxiliary heliostats are placed only 30 inches above the floor so they will not require cameras and monitors.



Solar Viewing Safety Shades

During public demonstrations of the main heliostat that were offered for years by National Solar Observatory staff, plastic sunglasses were distributed to and retrieved from visitors. To replace the use of individual sunglasses, a system of hinged dark gray glass panels will be mounted along the edges of the main viewing platform and enable visitors to safely view the Sun. During lunar and planetary viewings, the panels would be flipped up.



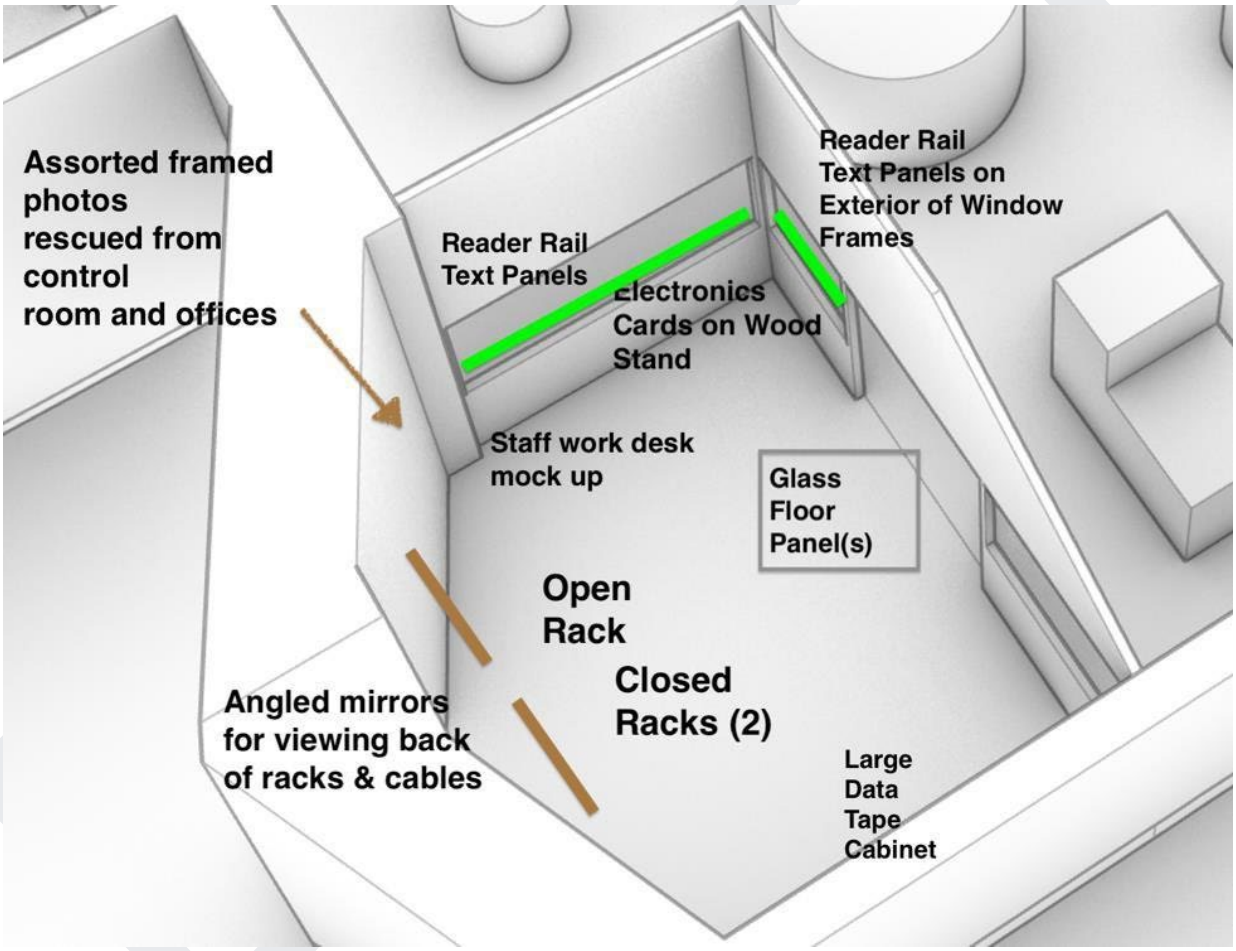
Eliminating the use of individual sunglasses will be more sanitary. The brightness of the projected solar image from the two auxiliary heliostats is not high enough to warrant replicating this feature at

those viewing stations. This will be constructed by the exhibits contractor.

Interactive Solar Spectrum

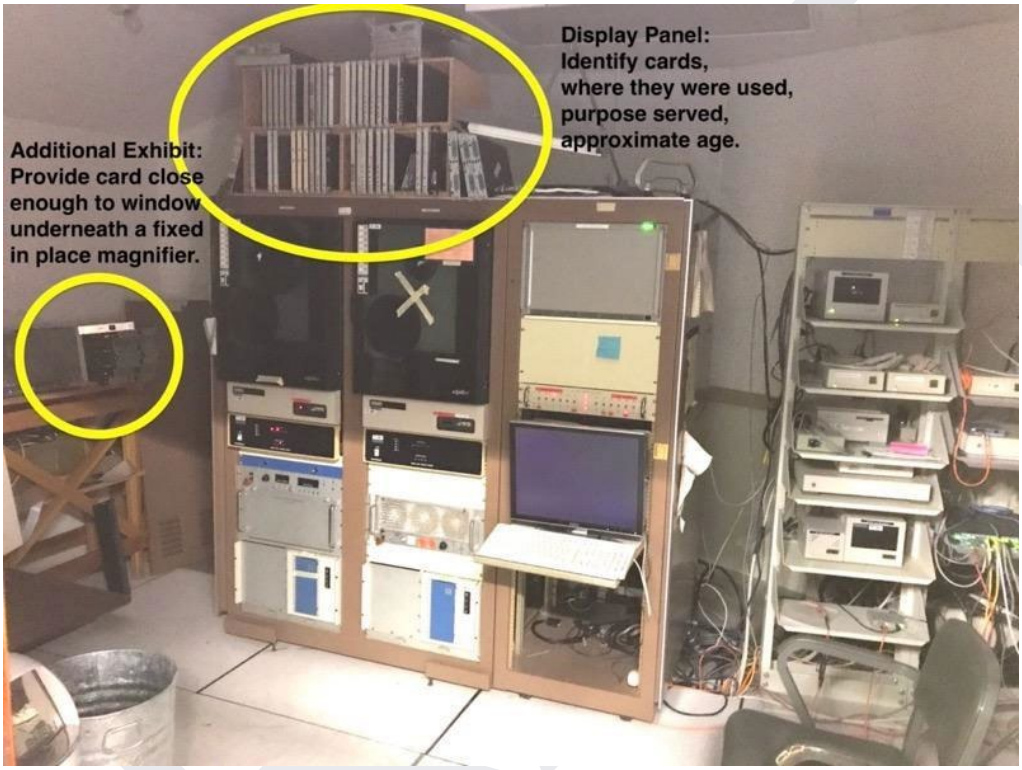
Located near to the West Auxiliary viewing station, a very large print of the solar spectrum will be mounted high up on this wall.Below it and mounted on a pedestal will be a touch screen interactive panel. This will enable visitors to explore the details of the spectrum and identify the elements behind some of the forest of absorption lines.

Computer Room



The Computer Room will be staged to reflect its look in the 1980's and 1990's with reel-to-reel tape readers, a cabinet of historic data tapes, and other equipment including the emulators-- which are still used to control the McMath's heliostats. Large viewing windows (without glass) in the doors and walls will enable visitors to view and photograph this room without touching the equipment.

This exhibit will describe how data management and storage has evolved during the lifespan of the McMath to the era of massive online, open databases in the 21st century. In the earliest days of the McMath, data was stored in the form of photographs on large glass panels, evolving to other types of film, then various forms of digital data. We preserved and stored many samples of these technologies before demolition began.



For more details on computer and control room artifacts see the Exhibit Implementation section.

Interactive Backlit Glass Plate Exhibit

Located on the outer wall of the Computer Room above the window and doors, this backlit display of multiple glass plates will have an interactive feature. A touchscreen control panel and monitor located near the stellar spectrograph will enable visitors to pull up detailed information and animations describing the event captured on each glass plate. We preserved a selection of hundreds of plates taken over several decades and capturing dramatic prominences, flares, and sunspots.

Alternatively, if this cannot be achieved due to budget constraints, the glass plates will be part of a static display.

The Tunnel Above

With the execution of subsequent phases, visitors will be able to enter the facility's optical viewing tunnel and learn how sunlight is collected by the telescope. A metal and glass "storefront" will provide visitors with views of the optical tunnel up through the elevator shaft. The purpose of the (retired) elevator will be explained. On the wall to the left will be large photographs of the optical tunnel.

5. Kitt Peak, I'itoi's Garden

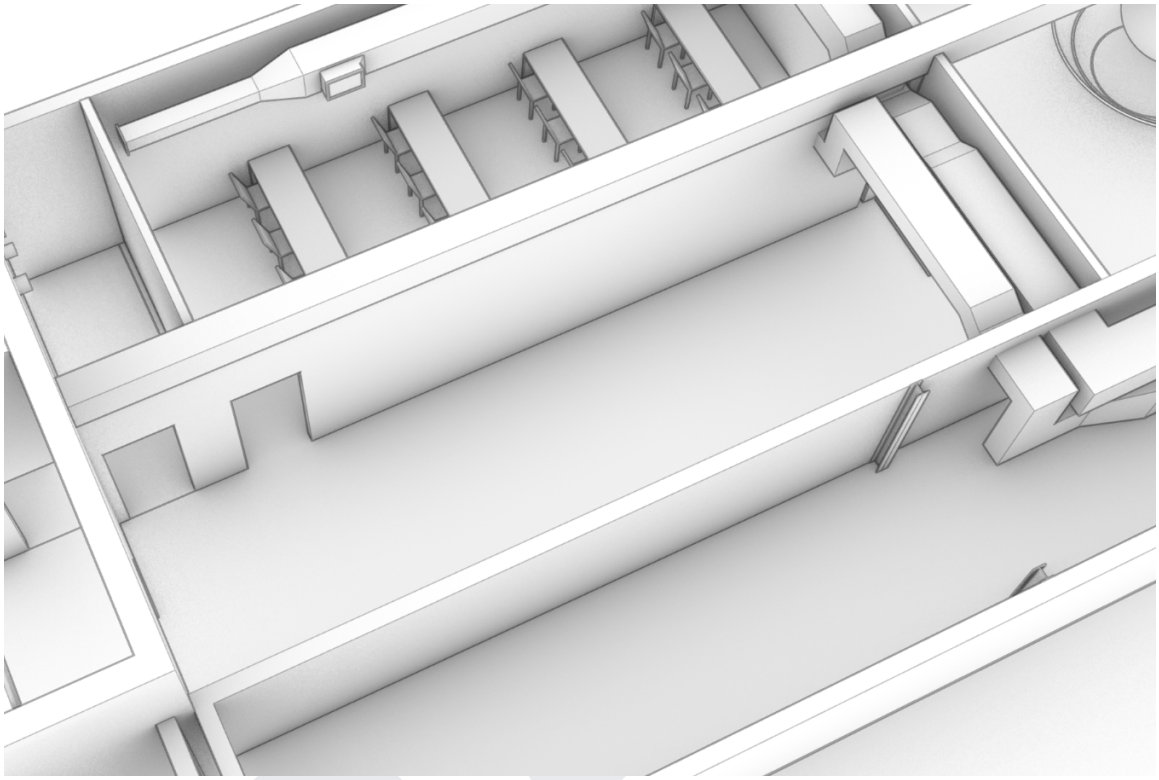


Figure 40: Digital model of the TON Gallery. Credit: Mei Starns/KPNO/NOIRLab/NSF/AURA

Working Title: Kitt Peak, I'itoi's Garden
Size: ~ 436 square feet
Location: East Gallery
Visitor Experience Goals: This gallery features images and information about nature on the sky island as well as the Tohono O'odham Tribe's culture and connection with the cosmos.

6. Astronomy Lab

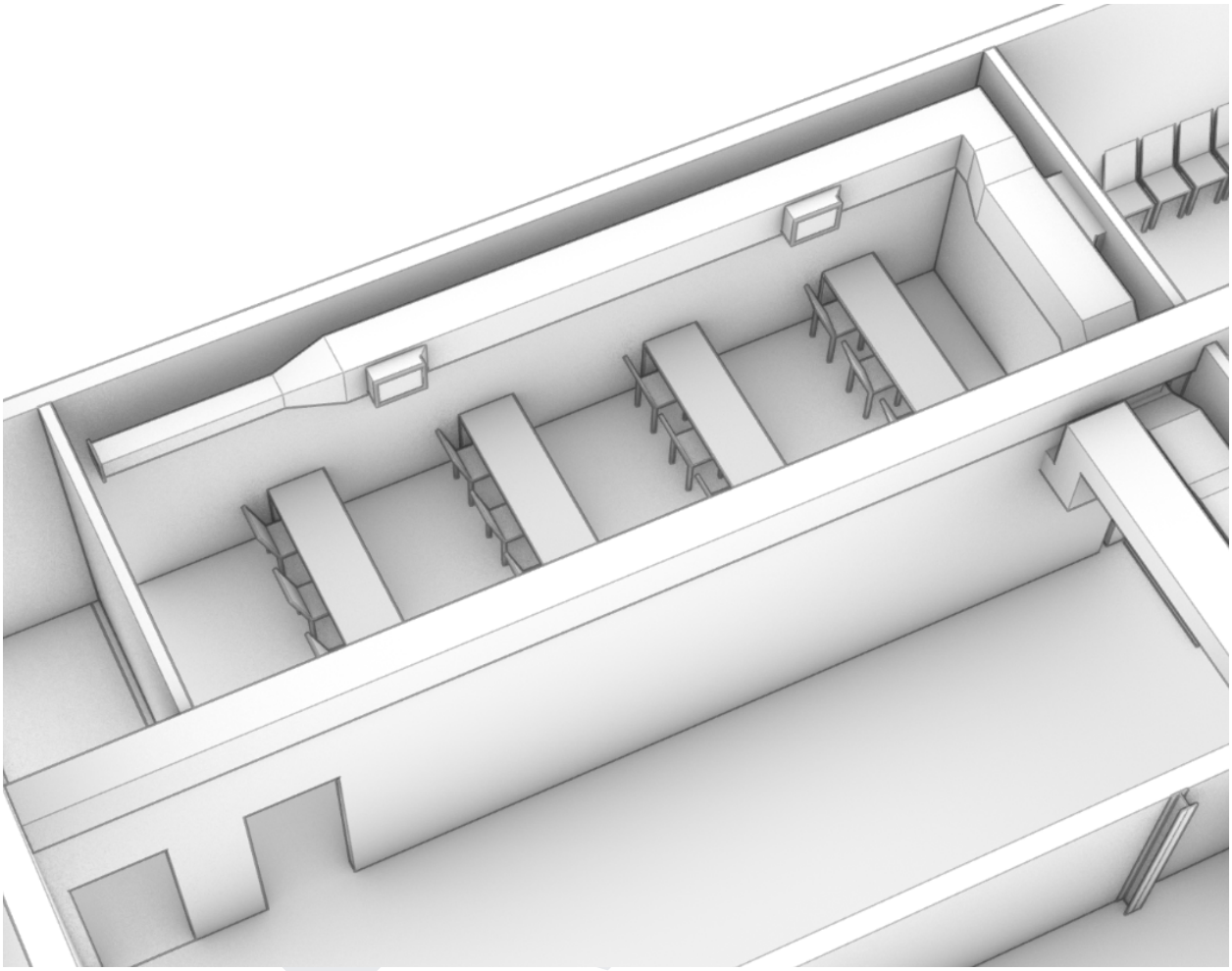


Figure 43: Digital model of the Astronomy Classroom. Credit: Mei Starns/KPNO/NOIRLab/NSF/AURA

Working Title: Astronomy Lab

Size: ~386 square feet (W: 12'-6 ¼", L: 30'-3 ¾")

Location: Back corridor, near Science on a Sphere

Visitor Experience Goals: The astronomy lab will be used for scheduled special educational programs and multi-use events, especially those that engage students from the Tohono O'odham Nation.

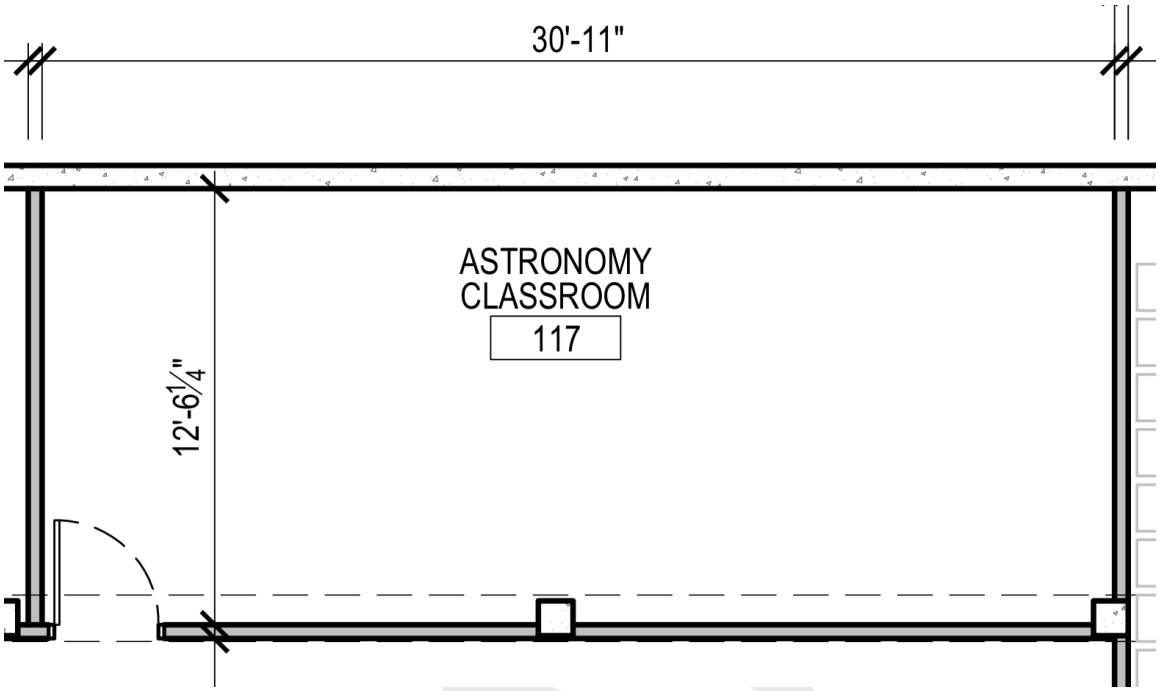


Figure 44: Architectural plan of the Astronomy Classroom. Credit: Mei Starns/KPNO/NOIRLab/NSF/AURA.

Description

This room will provide opportunities for small groups of students on field trips to have a deeper experience with NSF and NOIRLab Science and Astronomy. 12-15 people per group (inclusive of staff) is the target group size when using the classroom. Educators can sign up for specific activities, including activities tailored for TON students, *Teen Astronomy Cafe — To Go!* and Virtual Tours[2] of our facilities. This room can also be used for special events and lectures, including remote presenters via Zoom. Events such as Colors StudioLab, Project ASTRO workshops and other educator training will also take advantage of this space.

Flexibility of use of this room is important

We here describe three options for this classroom, depending on the availability of budget.

"Good"
Typical classroom setup with tables, chairs, whiteboard, basic presentation capabilities (screen and projector, with connected computer), cabinets for storage of equipment.

- Four heavy duty folding tables

[2] https://noirlab.edu/public/products/virtual-tours/

- 18 Stackable heavy duty, vinyl padded chairs
- Large screen monitor: (4K 85-inch — width 75' (200 cm))
- Input patch bay for several connector incl. HDMI
- Zoom Web Camera
- Steel lockable electronics cabinet for laptops, binoculars, AV controls, and easily moved program supplies items
- Two 60" x 40" Wall Mounted Steel Backed Dry Erase Board(s)
- 20 sets of 10 x 50 binoculars
- Discharge tubes, variety of light emitting devices
- Six large framed Lumabond astrophotography prints
- WiFi Router
- Printer
- Bean Bags or some other fun furniture to make it more cozy (Stored elsewhere and used for youth events)

"Better"
"Good" plus upgraded presentation capabilities to include being a proper Zoom room with dedicated camera and either a monitor or the screen/projector. Ability to interface with tablets to control presentations, including Virtual Tours.

- Standard computer equipment for ITOps to set up a standard Zoom room
- Room microphones for collaborative Zoom meetings (meeting room style)

"Best"
"Better" plus the Zoom room will include multiple cameras, capable of being controlled & switched remotely. Two monitors in the front of the room for videoconferencing and simultaneous screen sharing. These monitors will also be able to interface with tablets to enable making presentations (would have several ready to go) while moving around the room.

Polling interface for interaction with the speaker, Q&As, etc.

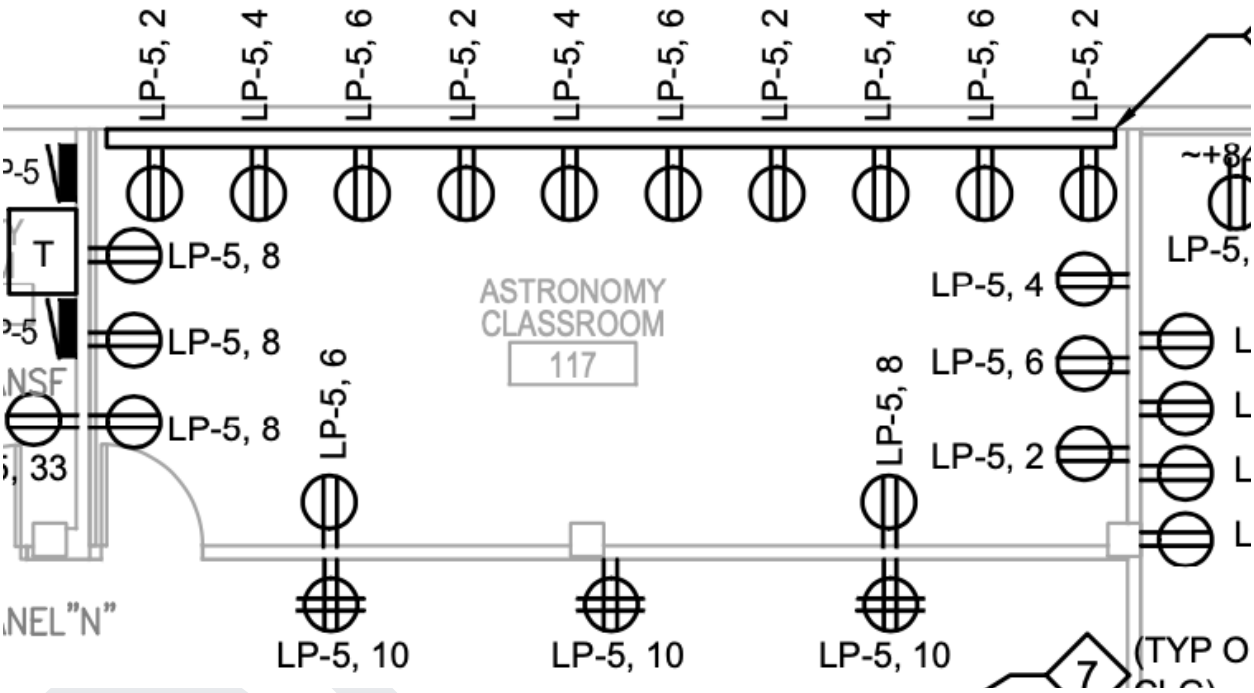
AR/VR areas for group interactions with Virtual Tours, AR experiences[3] with NOIRLab telescopes & instruments, AO, nebulae, galaxies, etc.

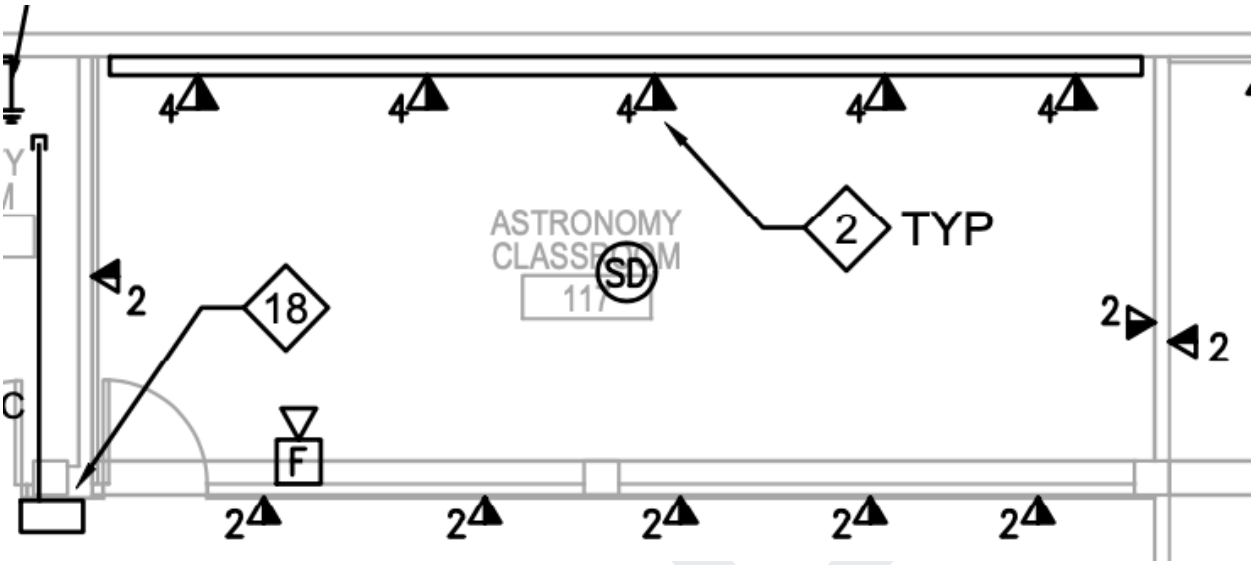
Multiple computers capable of doing Teen Astronomy Cafe — To Go! Activities (can do double duty with computers needed for AR/VR above).

[3] NOIRLab specific AR experiences would need to be developed.

Feeds from one or more of the heliostats, the solar spectra, remote telescope (SOLARIO) will enhance day and nighttime programs/instruction.

- 6 laptop computers for participants
- 7 mice and keyboards (?)
- 2 Tablet computer(s) for presentations
- External screen(s)
- Utra-smart Smartboard





7. Science on a Sphere Theater

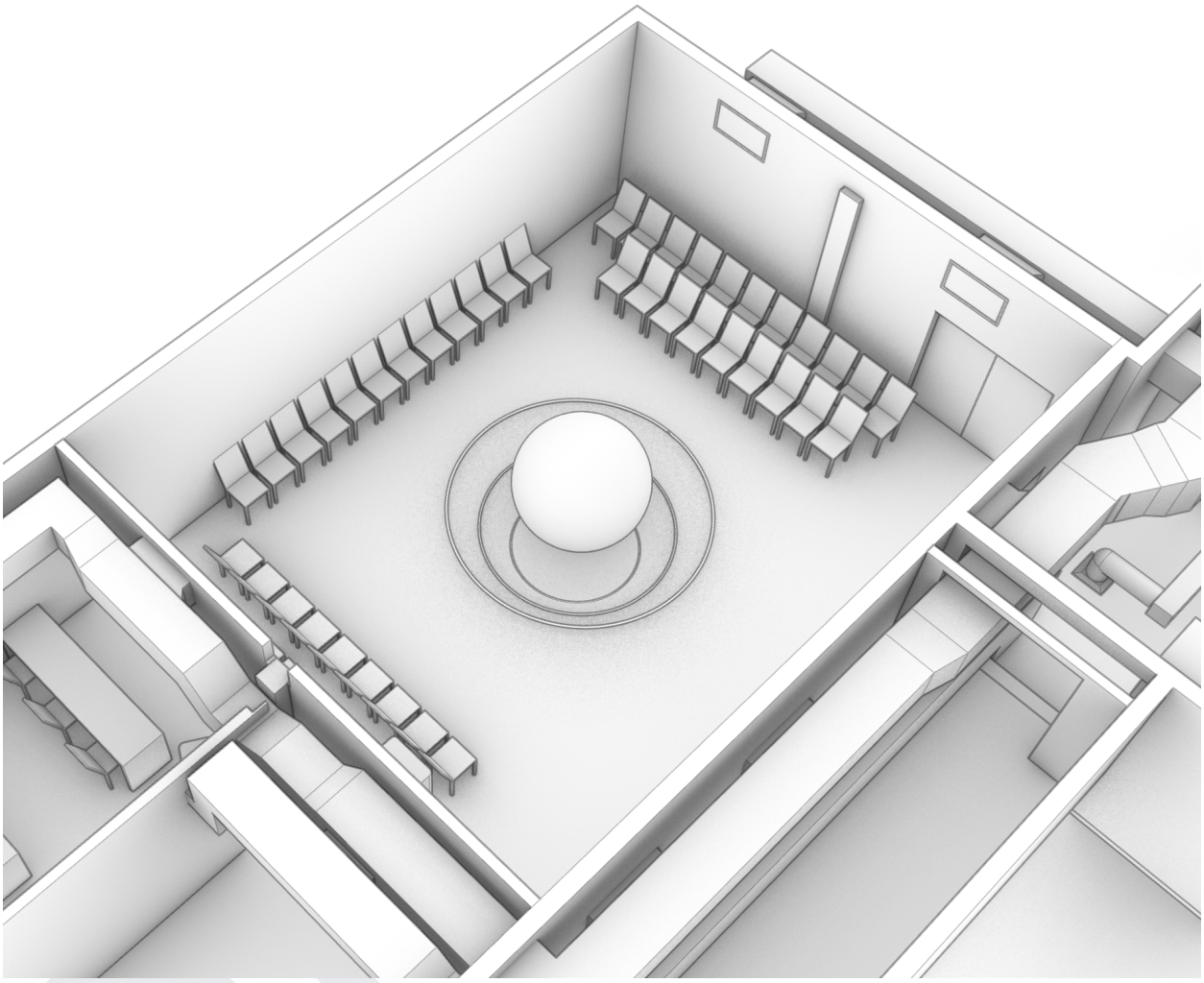


Figure 45: Digital model of the Science on a Sphere Theater. Credit: Mei Starns/KPNO/NOIRLab/NSF/AURA

Working Title: Science on a Sphere Theater
Size: ~ 777 square feet
Location: East wing, by loading dock
Visitor Experience Goals: The Science on a Sphere (SoS) features real data projected on a large spherical surface with content ranging from solar system (and exoplanet) science, to simulations on climatology and cosmology. Visitors will experience a visually compelling representation of real data and timely science as well as issues such as climate change. Upon leaving this exhibit, visitors will better understand at least one topic in modern astronomy and/or climate science and have a visual context for understanding complex scientific concepts.

The walls will feature the best possible, artistic astronomical imagery and potentially a donor wall. The lighting of the space will be managed when shows are not active. Possibly projection?

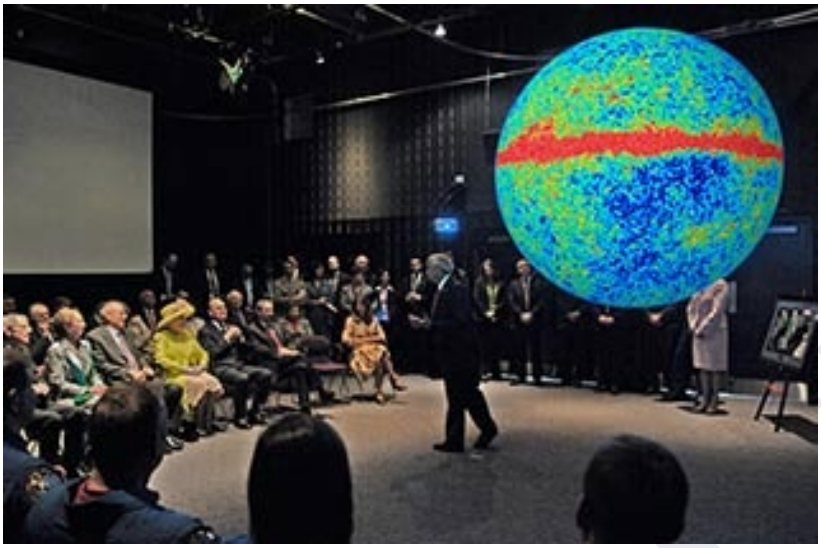
The SoS hardware has already been ordered and plans are under development regarding staffing and production/technical aspects of the SoS operations, which typically involve a balance of live presentations and more continuous “canned” programming.

Figure 46: Rendering of the Science on a Sphere Theater. Credit: Dean Salman/KPNO/NOIRLab/NSF/AURA

SOS Datasets Catalog: https://sos.noaa.gov/catalog/datasets/
SOS Live Programs Catalog: https://sos.noaa.gov/catalog/live-programs/

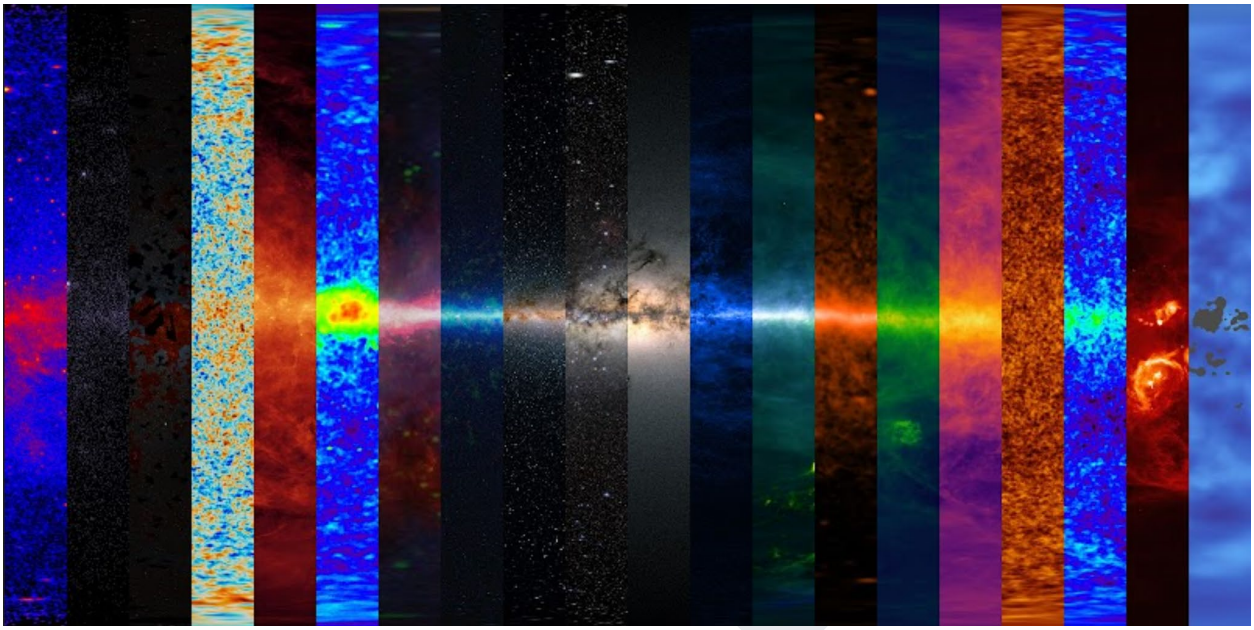
Figure 47: Science on a Sphere Theater at Science Central in Fort Wayne, IN. Credit: Science Central

Figure 48: Science on a Sphere Theater



Multiwavelength all-sky (10k x 5k):

- https://drive.google.com/drive/u/1/folders/13qU1jmgSTeEqKCVxB_3FHCEcWVBWjt4M (v5 - 1.76 GB)
  Preview:

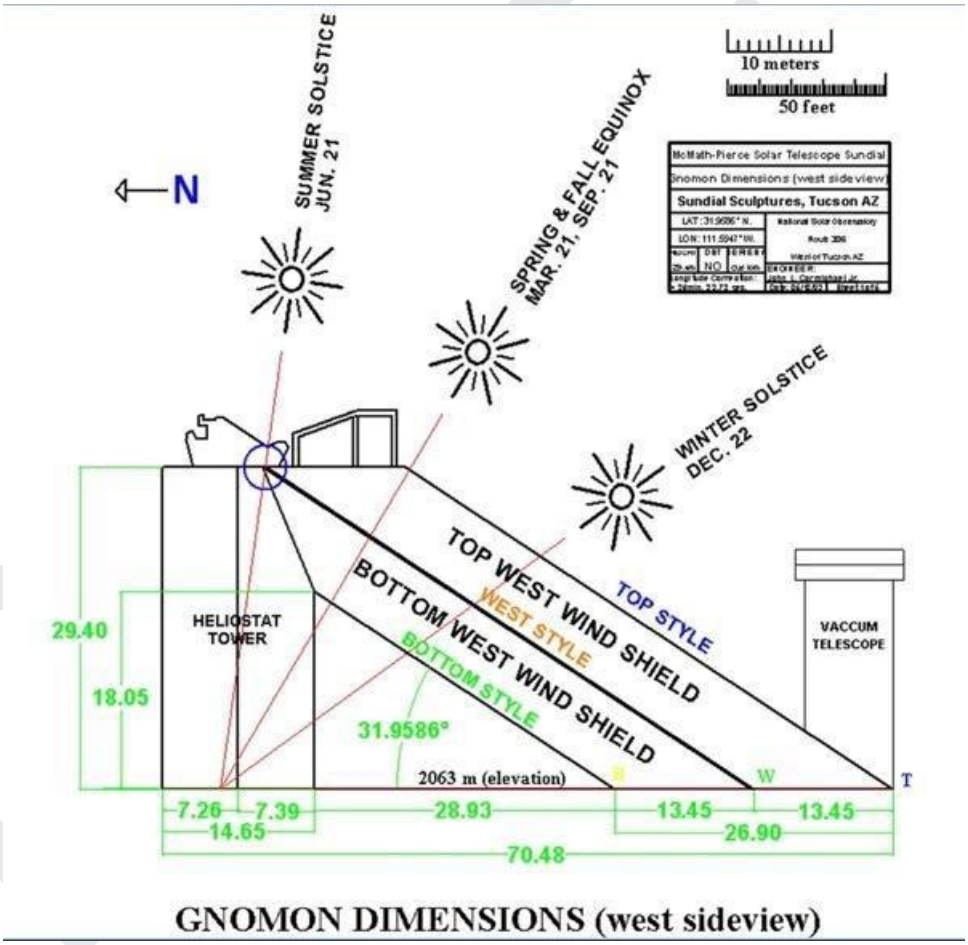


List of 360 images and videos:

- https://noirlab.edu/public/images/archive/category/360pano/
- https://noirlab.edu/public/videos/archive/category/virtual-reality/

8. Sundial

Working Title: World's Largest Sundial
Size: ~ 4000 square feet
Location: Above ground, across the area located underneath the optical tunnel span
Visitor Experience Goals: This large outdoor exhibit element will allow visitors to experience the motions of our planet in real time and gain an understanding of timekeeping and its importance to humanity throughout history and prehistory. An additional challenge to visitors will be to understand the equation of time and how the Earth's elliptical orbit impacts the measurement of time throughout the year. Finally, web visitors will be able to track the shadow of the MMP telescope remotely and via web cameras and build curiosity about the Windows Center which will lead to future visitors.

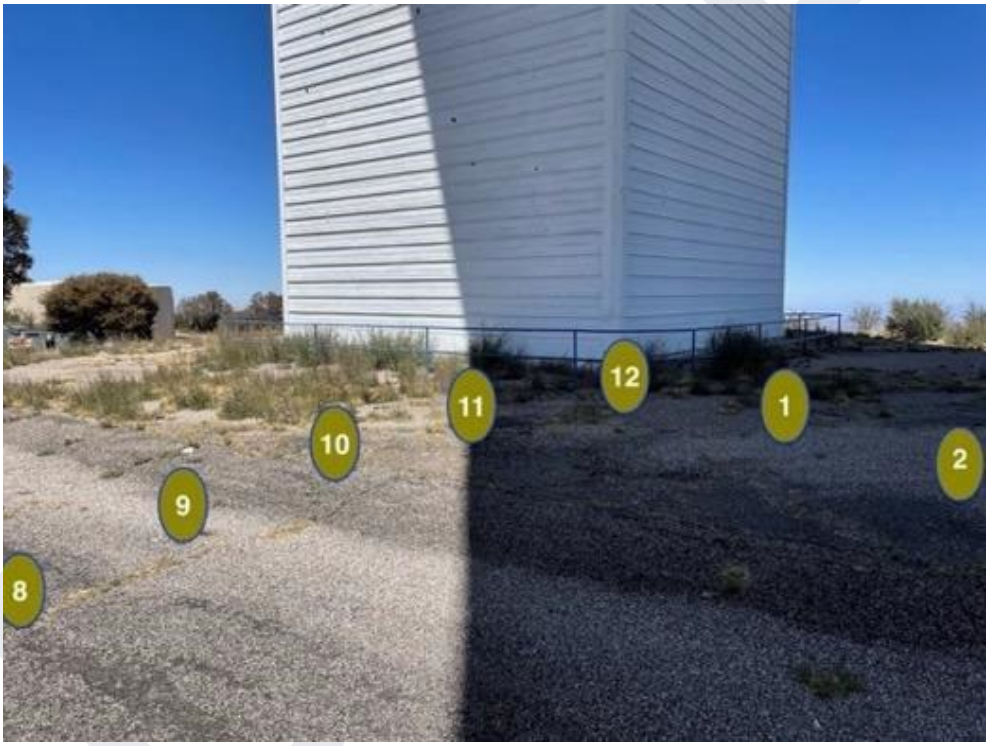


GNOMON DIMENSIONS (west sideview)

Description

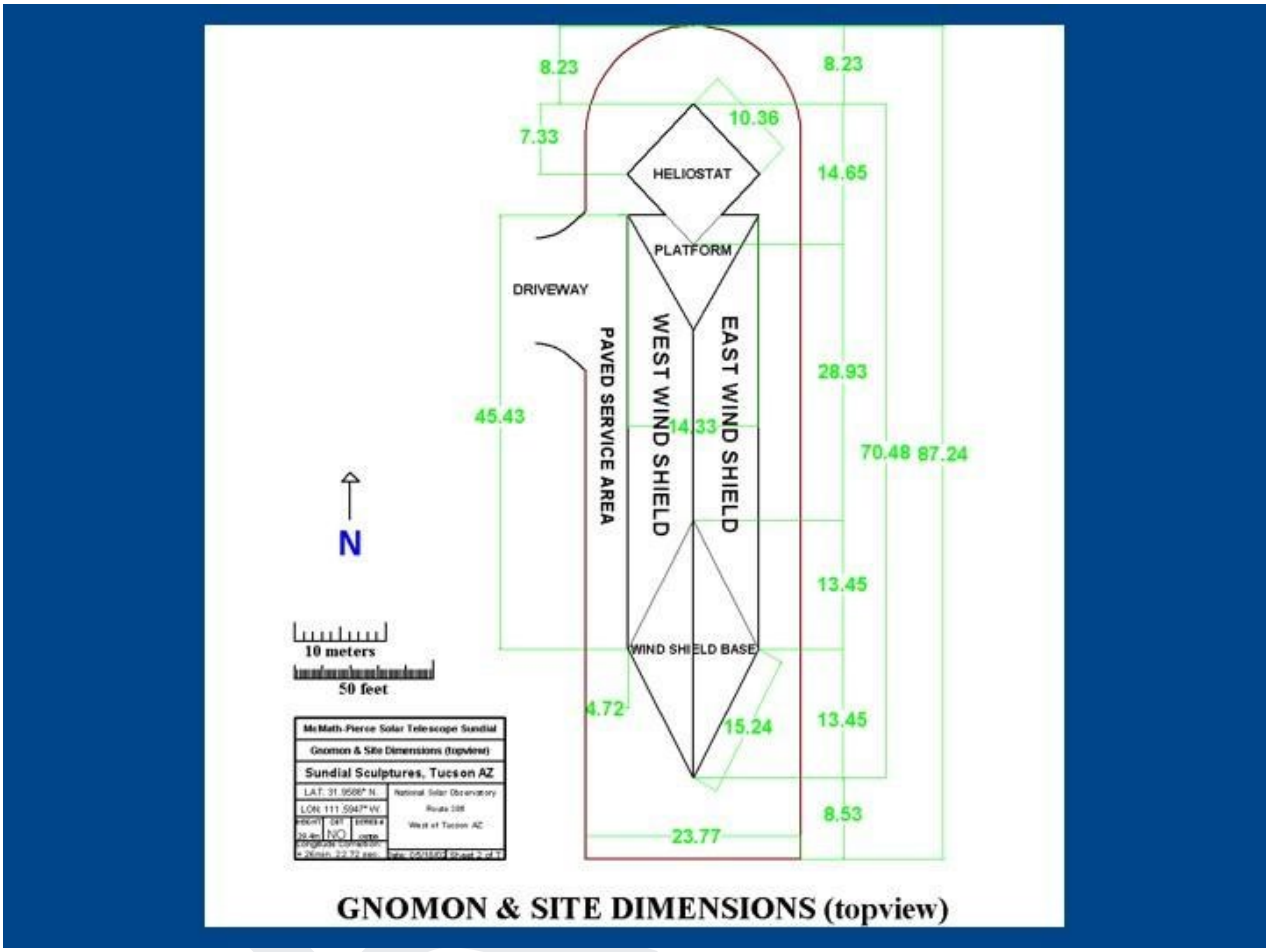
As visitors approach this area of the mountain, their view is dominated by the towering structure of the McMath. Before we introduce visitors to advanced observational astronomy or heliophysics, the network of NSF astronomy facilities around the globe, and the most recent discoveries in astronomy, we start with familiar concepts such as a sundial. The similarity between the gnomon of a garden variety sundial and the architecture of the observatory is intentional. This exhibit meets where most visitors have previous experience or familiarity at some level.

We will identify the observatory and provide a first introduction for visitors to its purpose as a day/night telescope facility. Very briefly describe the architecture (angle of the tunnel above and its match to the KP latitude) and its orientation toward true north. We then introduce the concept of a sundial using familiar examples. We will point out the hour markers on ground around the perimeter.



The exhibit will encourage visitors to determine the local solar time and compare that to what their watches or cell phones indicate. Briefly discuss seasons and changing azimuth of sunrise and sunset locations and direct their attention to horizon markers showing these points. We encourage visitors to explore the tunnel viewing gallery to learn more about the interior of the structure and to the main level below.
It is worth pointing out the detailed design work for this exhibit has already been completed and

provided to us by a local group with a particular interest in sundials around the world.



The hour signage should be large and durable and visible by the webcams on the top of the MMP. From time to time, this area has been used by Facilities staff as a parking area for oversized vehicles. *An agreement needs to be reached that their staff will stop using this area so that it can become an exhibition and educational program area.* Given the projected increase in pedestrian traffic in this area, this would be a wise change of practice regardless of the exhibit plan. There is space for oversized vehicles near the water tanks.

An online version of this exhibit could easily be developed by placing webcams at certain locations on the top of the tower and providing live views of the MMP shadow on the Visitor Center website. In addition, a wide-angle webcam can provide continuous live views of the KPNO campus to complement the two existing webcams at the 2.1- and 4-meter telescopes.
The existing cameras point north and south; this new webcam will point west providing online visitors a substantially different view.

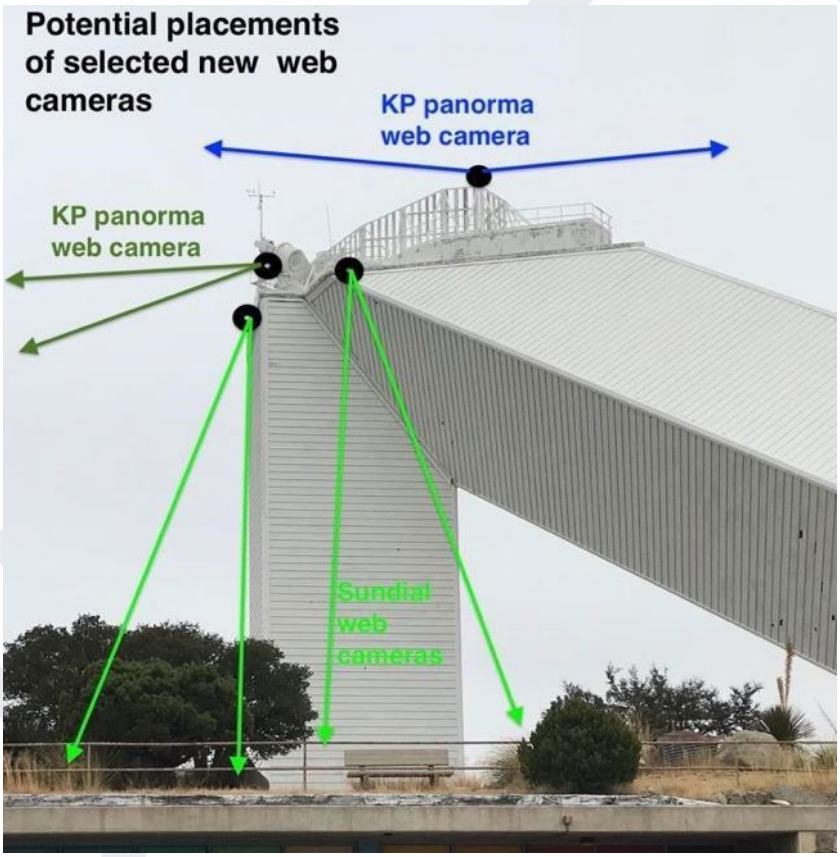
Potential Items, Technology, Artifacts

- Weatherproof outdoor color exhibit panels and hour marker panels staged underneath the above ground portion of the wind shields of the optical tunnel.
- Photo panel located at south point of optical tunnel showing star circles over the MP and explaining the rotation of Earth, motions in the sky.

9. Webcam(s)

Working Title: Webcams
Location: Cameras near heliostats, displays in Control Room
Visitor Experience Goals: Pending

At least one Webcam will be mounted atop the MMP tower allowing global audiences to view changing shadows throughout the day. As we acquire and archive these views, we can create fast-motion videos showing day and night at the observatory.



View to be provided by the new MMP webcam.

10. Optical Tunnel Viewing Gallery

Working Title: MMP Optical Tunnel Viewing Gallery
Size: ~60 square feet + all of tunnel
Location: Above ground, within optical tunnel
Visitor Experience Goals: While this viewing gallery is limited in space for interpretive panels and displays, visitors to this viewing gallery will experience the internal light path of sunlight in the MMP and leave with an understanding of how sunlight is directed to instruments and finally to the viewing stations in the control room. The experience will leave visitors with a sense of the scale of the MMP optics and precision necessary to study the Sun.

Description

This gallery, shown here to the right, provides visitors with their first views of the massive but mostly hollow structure comprising the top of the optical tower and tunnel. We will describe the purpose of all optical telescopes. The exhibit will provide some orientation and description of how the MMP functions and why this design was constructed. We will describe the function of the mirrors, the importance of the long tunnel, and identify some of the industrial-like hardware visible from the gallery. Point out the control room below and set of heliostats above. We will mention the Windows Center tours and programs available to visitors on the main level.

The view shows an external view of the tunnel viewing gallery as seen from across the optical tunnel. The tertiary mirror directing sunlight into the Control Room is in the foreground. Within the gallery or on the other side of the glass walls, etched or printed transparent panels will be placed to describe the light path. Reader rails provide more in- depth descriptions of the features within the tunnel.

You Are Here in the Tunnel!

This is a mini exhibit to be placed within the Viewing Gallery. A camera to be installed in the tunnel with this view angle will allow visitors to see themselves on a monitor in the viewing gallery while observing more of the structure, particularly their place within the structure, including the viewing portals into the Control Room. Exhibits that include the visitor directly into the exhibit are among some of the most popular in museums around the world.

Potential Items, Technology, Artifacts

- Button-activated monitor that plays animation illustrating the light path within the tunnel.
- Etched glass panels with labeled diagrams.
- Photos showing portions of the facility not easily seen (lower portion of tunnel, aluminization chamber, control room.
- Large print signage attached to various components within the tunnel identifying those components in the tunnel visible from the gallery. Signage within the viewing gallery further explains the purpose of the identified hardware.
- Large arrows within the tunnel denoting light path.
- A monitor with a live view of the gallery as seen from high up in the optical tower. This allows visitors to see themselves within the gallery box as well as portions of the tunnel blocked from view by nearby structures. See photo below.

11. Ideas from the 17 March 2023 Astronomers' Workshop

- Make use of the old instruments that are currently being stored at the 4-meter
- Incorporate the solar spectrum that comes from the NEID solar telescope
    - Sarah Logsdon
- look for stories, lots of stories out there we just need to talk to people
- People (organize based on the type of astronomy they do?)
    - highlight Vera Rubin by using testimonies of people who knew/worked with her
    - Roger Lynds
    - Tom Kinman
    - Detri Hunter at Lowell
    - Tod Lauer
    - John Glaspy
    - Leo Goldberg
    - Sydney Wolf
    - Helmut Abt - first identified the KPNO site
    - Arlo Landolt
- Should we include astronomy from space-based telescopes?
- How to incorporate climate change stories
    - we're bringing hundreds of people to the mountain, should we have a shuttle bus to reduce cars on the road?
    - make the bus a part of the experience
- Top ten discoveries webpage, who was involved?
- Highlighting some of the more obscure roles like engineers, safety, IT, etc.
    - journey through the universe career panels
    - *Unsung* with Mike Hawes
- most astronomers around the world have some sort of KPNO connection, everyone has a personal story
- tell the story of the scouting for and selection of the KPNO site
- feature grad students and postdocs to include current and relevant research
- give public an understanding of the emergence of remote observing
- show visitors the astronomy that will happen at kitt peak *that night*
- help public understand that projects like DESI and NEID are huge collaborations with lots of people involved even though no one actually goes to the telescopes
- bring in the holistic view of Earth and sky that the TON possess
- To what level does the project promote stewardship with the TON?
    - TON teacher training program
    - telescopes they have special access to

    - helping to transform/adapt to the nature of education for the TON
- How will we use the physical space to tell these stories?
- Educate the public on how they can observe off of the mountain too, local star parties
- Donors
    - hold a special event for donors to show them what their money is funding
    - naming opportunities for donors
    - establish a policy on different levels of donation and what each level gets you
    - rewarding donors for their contributions encourages continued donations and spreading the word to friends
- How can we educate teachers on how to carry the information from Windows Center to their classrooms?
    - possibility for an extensive program focused on teacher training
    - brings in a specific audience
    - extension of existing CEE teacher training programs
    - this has proven to be a very fundable thing
    - classes could be held at Tucson HQ and include a trip to KPNO and Windows Center