Astronomy in Arizona and Intelligent Outdoor Lighting

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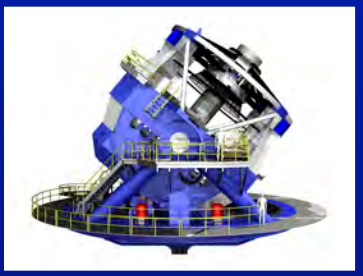


MAG Regional Council Meeting
December 3, 2008

Take Away Points

- Arizona is important to Astronomy and Astronomy is important to Arizona.
- Arizona governments and the astronomy industry in the state should work together to maintain and leverage our world class facilities for the mutual benefit of the communities of Arizona and Astronomy.
- Astronomers would like to work with you to further our common interests, which include the following:
  - Promoting intelligent outdoor lighting. This preserves the unique quality of Arizona as a site for observatories, saves energy (and money), and does not compromise safety and convenience.
  - Increasing the number and quality of partnerships between industry and research institutions located in Arizona. This requires continued investment in the state Universities and continued support for existing and new collaborations.

50th Anniversary of the National Observatory

Our mission is to support forefront astronomical research and education by and for everyone, based on the merit of their ideas.

IC342 Image by KPNO 4m +MOSAIC by Rector and Schweiker

Stakeholders:

(contributing to today's presentation)

Dan Brocious, **Fred Lawrence Whipple Observatory**, and Board member of International Dark Sky Association

Patrick Burkhart, President, **Arizona Arts, Sciences and Technology Academy**

Christopher Corbally, Vice Director, **Vatican Observatory**

Michael Drake, Director, **Lunar & Planetary Laboratory**, Univ. of Arizona

Richard Green, Director, **Large Binocular Telescope Obs.**, Univ. of Arizona

Buell Jannuzi, Director, **Kitt Peak National Observatory,** and Vice Chairman of the Board of Directors of the International Dark Sky Association

Christian Luginbuhl, **US Naval Observatory**, Flagstaff Station

Robert Millis, Director, **Lowell Observatory**

Paul Smith, **Steward Observatory**, U of A, ASU & NAU

Rogier Windhorst, **School of Earth & Space Exploration**, Arizona State University

And the students, employees, and suppliers of Arizona's astronomy industry.


Coconino
Mohave
Navajo
Apache
U.S. Naval Obs.
Lowell Obs.
Braeside Obs.
(ASU)
Discovery Channel
Tel.
Embry-Riddle Obs.
Yavapai
La Paz
Gila
Greenlee
Maricopa
Pinal
Desert Eagle Obs.
Graham
Mt. Graham
Intl. Obs.
Gov Aker
Obs.
Yuma
Mt. Lemmon
Kitt Peak Natl. Obs.
Natl. Solar Obs.
Mt. Bigelow
Pima
Desert Beaver Obs.
Vega-Bray Obs.
Smithsonian Astro. Obs.
Cochise
Arizona Sky Village
MMT Obs.
Winer Obs.
Tenagra Obs.
Fairborn Obs.
Santa Cruz

Kitt Peak, Ioligam Doag or Iolkam Duag, still a great site for astronomical research and education.

All the reasons it was picked after an extensive search for sites in the late 1950s are still true:

Clear (and Dark) Skies
Good Seeing
Near Necessary Support from major Universities and Industry
About 90 minutes from major Airport

Infrastructure Supports 26 Telescopes operated by
More than 30 Institutions

World’s Largest Telescope Achieves First Binocular Light

The Large Binocular Telescope on Mount Graham, Ariz., has taken celestial images using its twin side-by-side, 8.4-meter (27.6 foot) primary mirrors together, achieving first "binocular" light. March 6, 2008

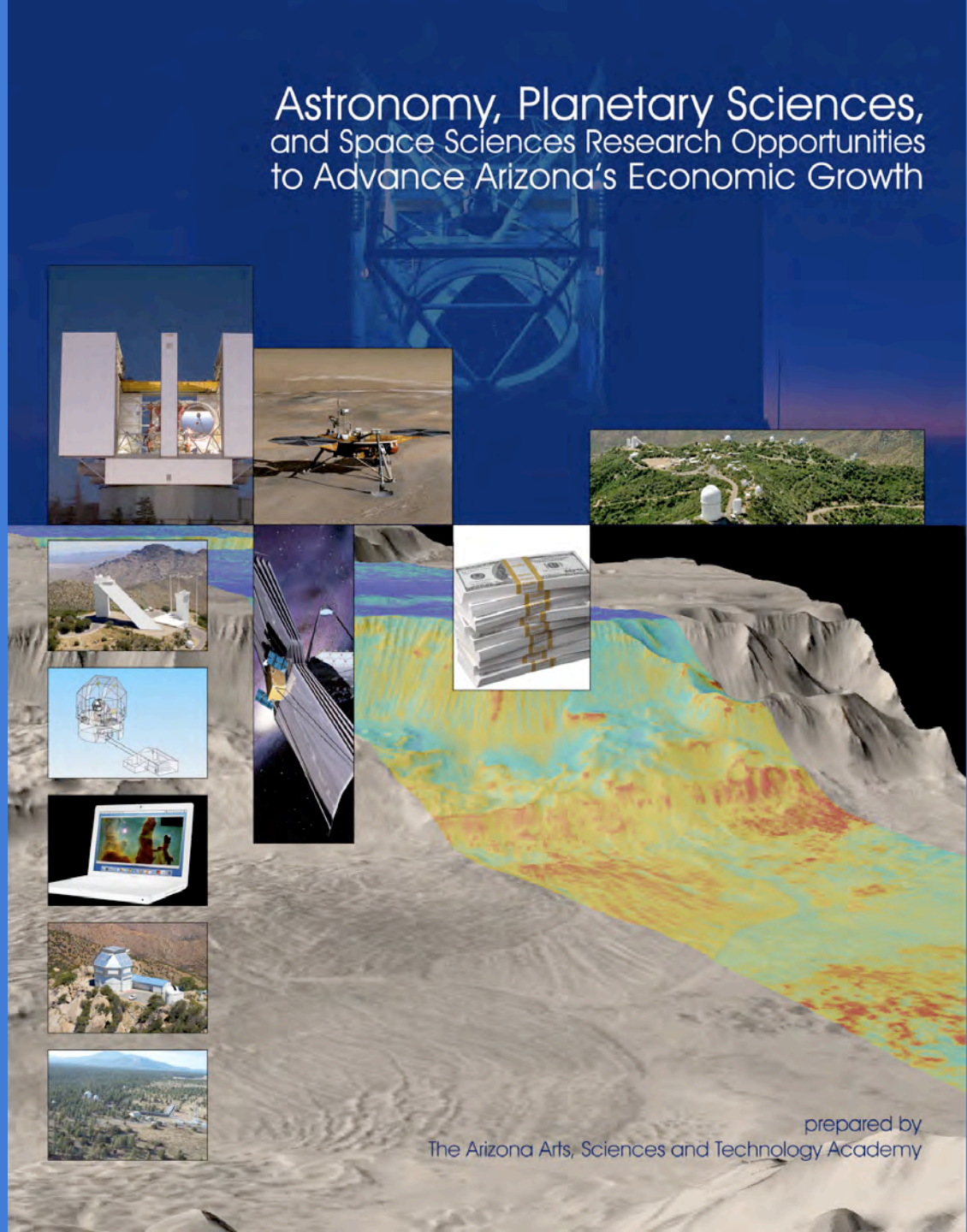
Spiral galaxy NGC 2770. This image is a composite of ultraviolet, green and deep red light and enhances the detailed structure of hot, moderate and cool stars in the galaxy.

(Credit: Large Binocular Camera team, Rome Observatory)

Stargazing nets $250 mil a year for Ariz. economy

The Arizona Republic
January 17, 2008.

Arizona Arts, Sciences, and Technology Academy commissioned the Eller College of Management to study the economic impact of astronom in Arizona.



Astronomy is worth billions to Arizona

This study found substantial capital investment (in excess of $1 billion) in, and economic return (nearly a quarter of a billion dollars annually) from APSS research in Arizona. The data also suggest the untapped potential of these research fields to expand the State's economic base. The study revealed levels of active research funding that well exceed other fields in the State, such as bioscience funding from the National Institutes of Health.

VERITAS -- High Energy Observatory

- VERITAS
  - 20 million dollar new observatory
  - International Partnership
  - Funded Primarily by Department of Energy and the National Science Foundation

4.2 meter Discovery Channel Telescope under construction in Northern Arizona

Rendering of the DCT facility and dome

Forty miles southeast of Flagstaff, atop a cinder cone at a site known as Happy Jack, the 4.2 meter Discovery Channel Telescope is under construction. Developed by Lowell Observatory in partnership with Discovery Communications, Inc., the DCT will be operational in 2010. It will be a powerful tool for research areas including the search for Near Earth Objects (NEOs), extrasolar planets, and exploration of the newly discovered Kuiper Belt. It will also expand opportunities for public outreach and education in the exciting world of science and technology.

GENERAL DYNAMICS
SPACE TECHNOLOGIES

GODDARD
SPACE FLIGHT CENTER

FERMI
Gamma-Ray Space Telescope

- Assembled in Gilbert, Arizona
- Most recent of NASA's Space Observatories
- $690 Million Dollar Observatory

This conceptual image of a eukaryote cell with a supernova exploding in its nucleus symbolizes the idea that the chemical elements that make up living things are produced in stars and stellar explosions, encapsulating the range of research in the project. Credit: Nahks Tr'Ehnl, School of Earth and Space Exploration

NASA picks ASU team to guide study of search for life

Humans have long pondered the possibility that life exists beyond Earth. The quest for habitable worlds has focused on searching for water, but "following the water" turns out to be too general a criterion. The list of planets and satellites that possess liquid water is growing faster than can be explored. As one of the new NASA Astrobiology Institute teams, Arizona State University researchers intend to boost extraterrestrial exploration to the next stage by refining the criteria that guide the search for life.

The multidisciplinary field of astrobiology explores the origin, evolution, distribution, and future of life on Earth and in the universe. The need for experts in areas as diverse as Earth and planetary science, astrophysics, microbiology, cosmochemistry, and evolutionary biology, gave rise to the NASA Astrobiology Institute (NAI). Established as part of NASA's Astrobiology Program, the NAI developed as a partnership between NASA and teams located at academic institutions, research laboratories, and NASA centers across the U.S. More than 700 scientists and educators are associated with the NAI.

Read More

- About ASU
- Colleges, Schools & Departments
- Tour ASU
- ASU President Michael Crow
- Apply to ASU
- School of Earth and Space Exploration
- Robert S. Dietz Museum of Geology
- Center for Meteorite Studies
- Mars Space Flight Facility
- Planetarium
- BEYOND: Center for Fundamental Concepts in Science

Additional Story Links

- Bioscience and Biotech
- Life Science
- Social Science

NASA announced Oct. 2 that ASU's School of Earth and Space Exploration is one of 10 research teams from across the country to be awarded five-year grants, averaging $7 million each. ASU previously operated as an NAI team and was a charter member of the NAI when the program was founded in 1998. The team is centered in the School of Earth and Space Exploration, an academic unit in ASU's College of Liberal Arts and Sciences, but also involves several faculty members from other college units including the School of Life Sciences, the Department of Chemistry

Recommendation 4

The Arizona Legislature, counties, municipalities and Tribal Nations should revisit the adequacy and enforcement of existing statutes and ordinances in a new effort to reduce light pollution associated with rapid industrial and population growth as well as old lighting installed before effective codes were in place.

Arizona Title 49, Chapter 7 calls for the elimination of mercury vapor lighting fixtures by 2011. All counties in the State and many municipalities have used the 1973 State law to enact light control ordinances. However the sheer rate of population growth, particularly in Maricopa County, and more recently in Pinal County ... threaten to undo that protection.

North America at Night

Southwestern United States, home of many of the large telescopes in the continental United States.

Lights as seen from above, as from the International Space Station, for example, looking down. Here the landscape outside of the cities looks dark. But this is misleading... it is not dark here.

... you can be 50 or 100 or 150 miles from the Phoenix metropolitan area and still see the effects of the city lights

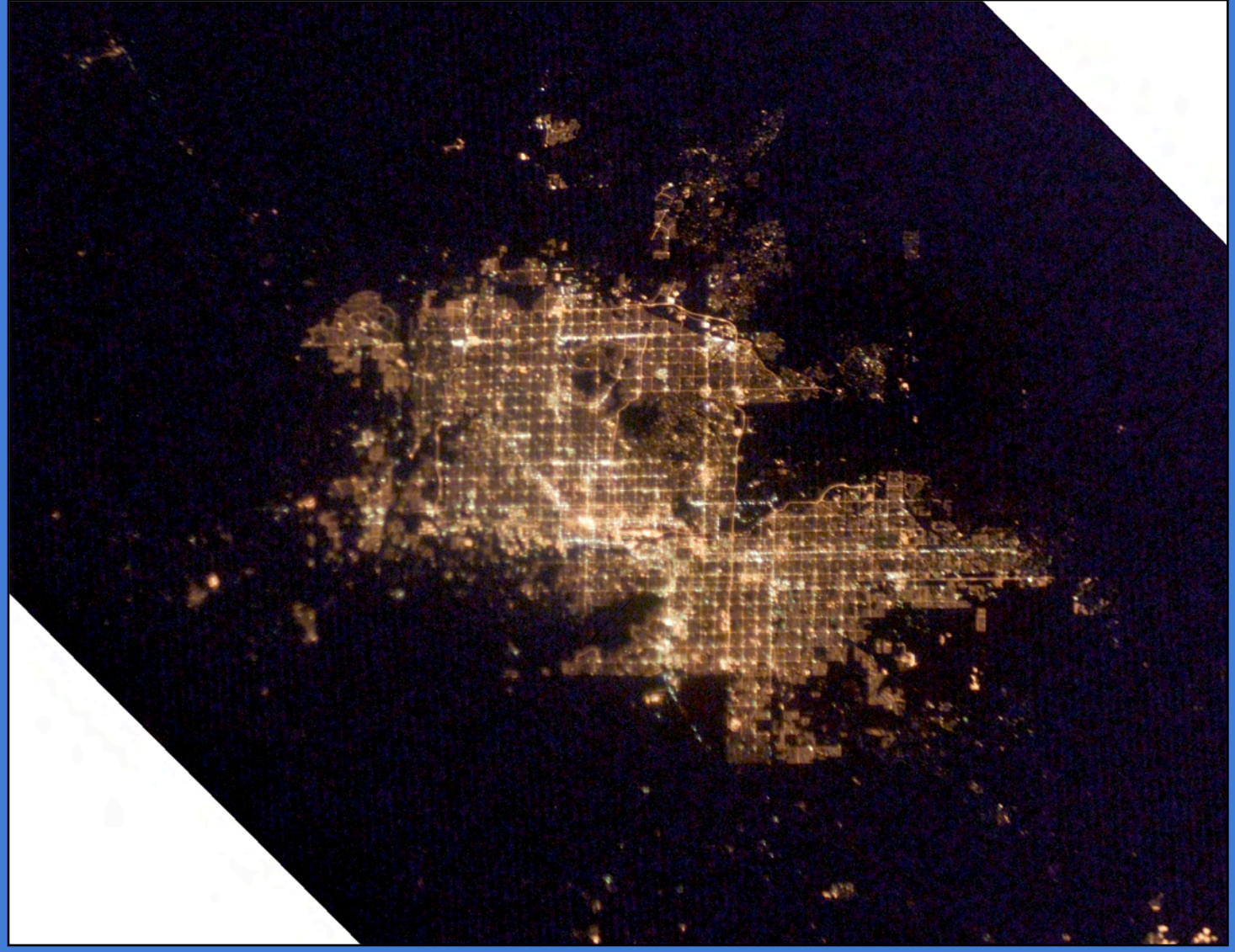


Image of Phoenix at night taken from the International Space Station

(~220 miles above) (NASA, ISS CEO project)

Phoenix/Casa Grande sky glow as seen from Kitt Peak National Obs.

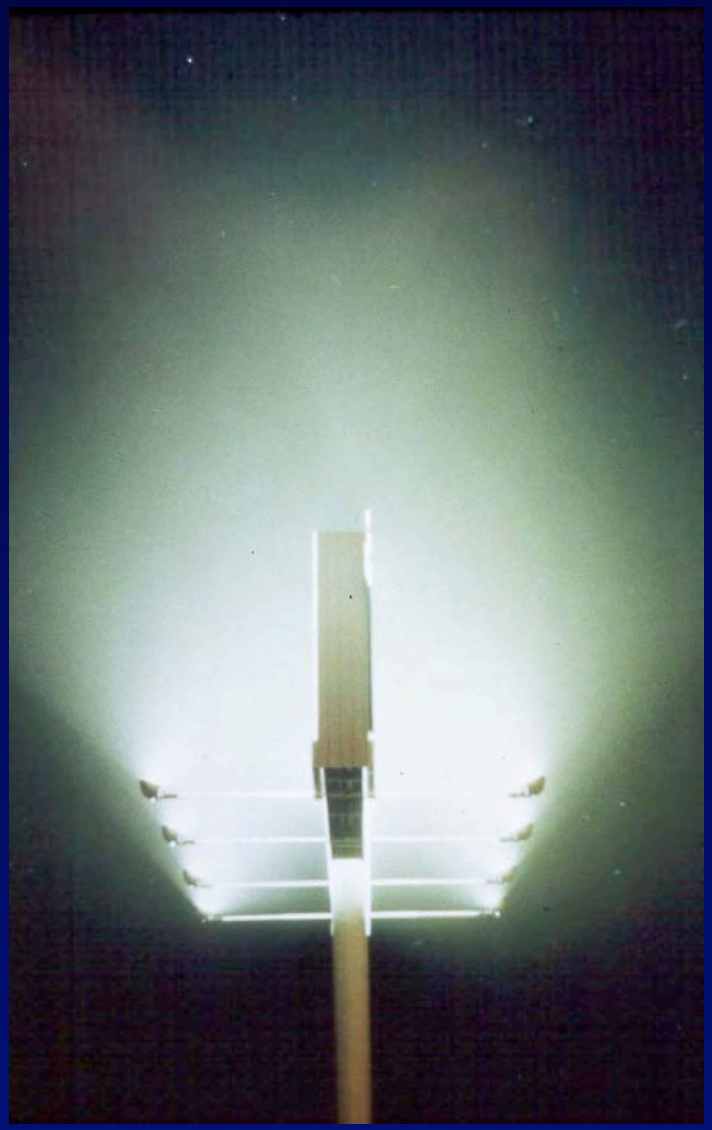
March 28, 2008. (KPNO photo by J. Glaspey)

Light Pollution at Mt. Graham as seen from LBT dome, March 10, 2008.

(Photo by Marco Pedani, LBTO)


Phoenix from Flagstaff, 125 miles away
$
(USNO)

A bottom lit billboard, seen from the side.



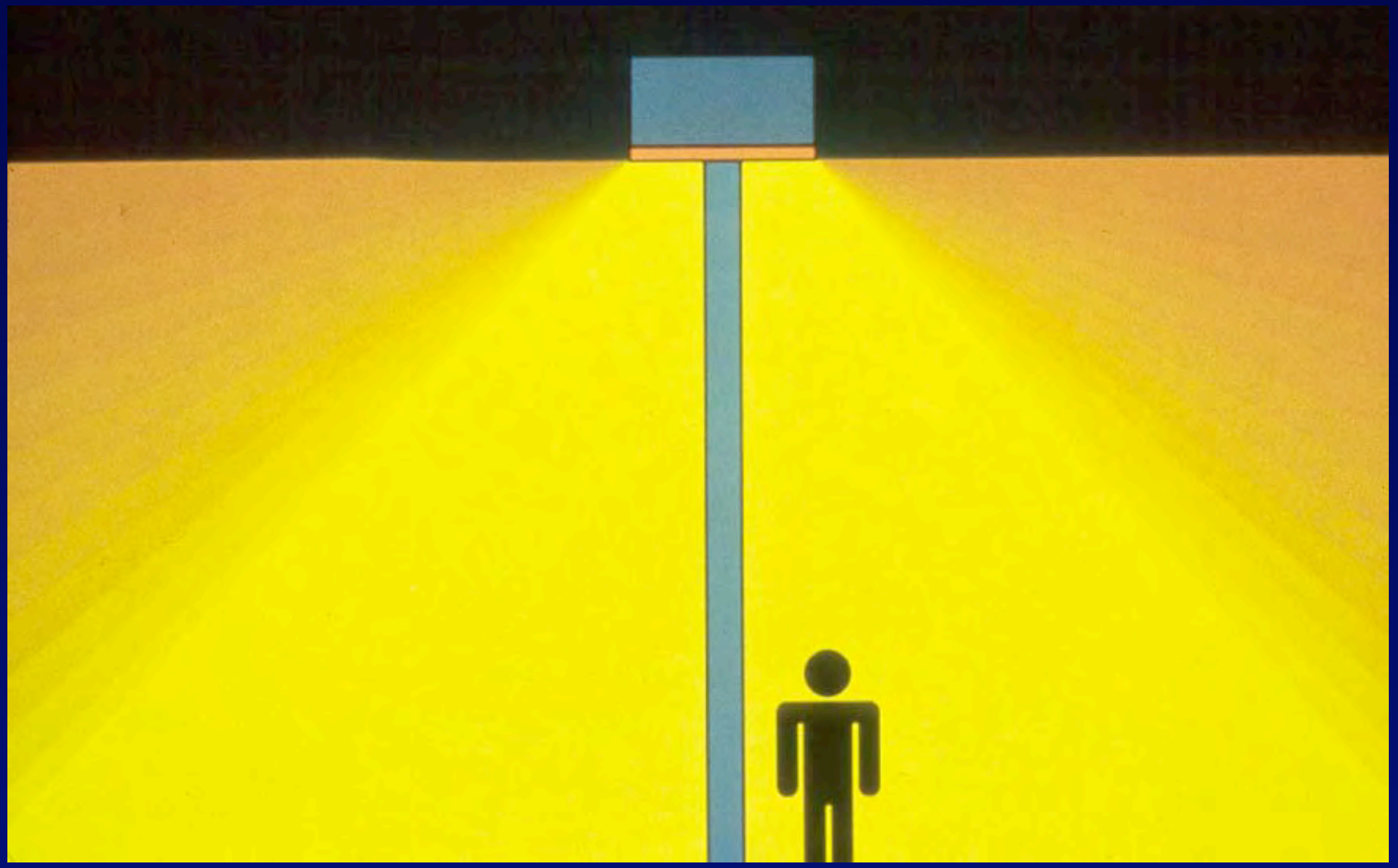
Note the student on the walkway.

She moved about four feet.

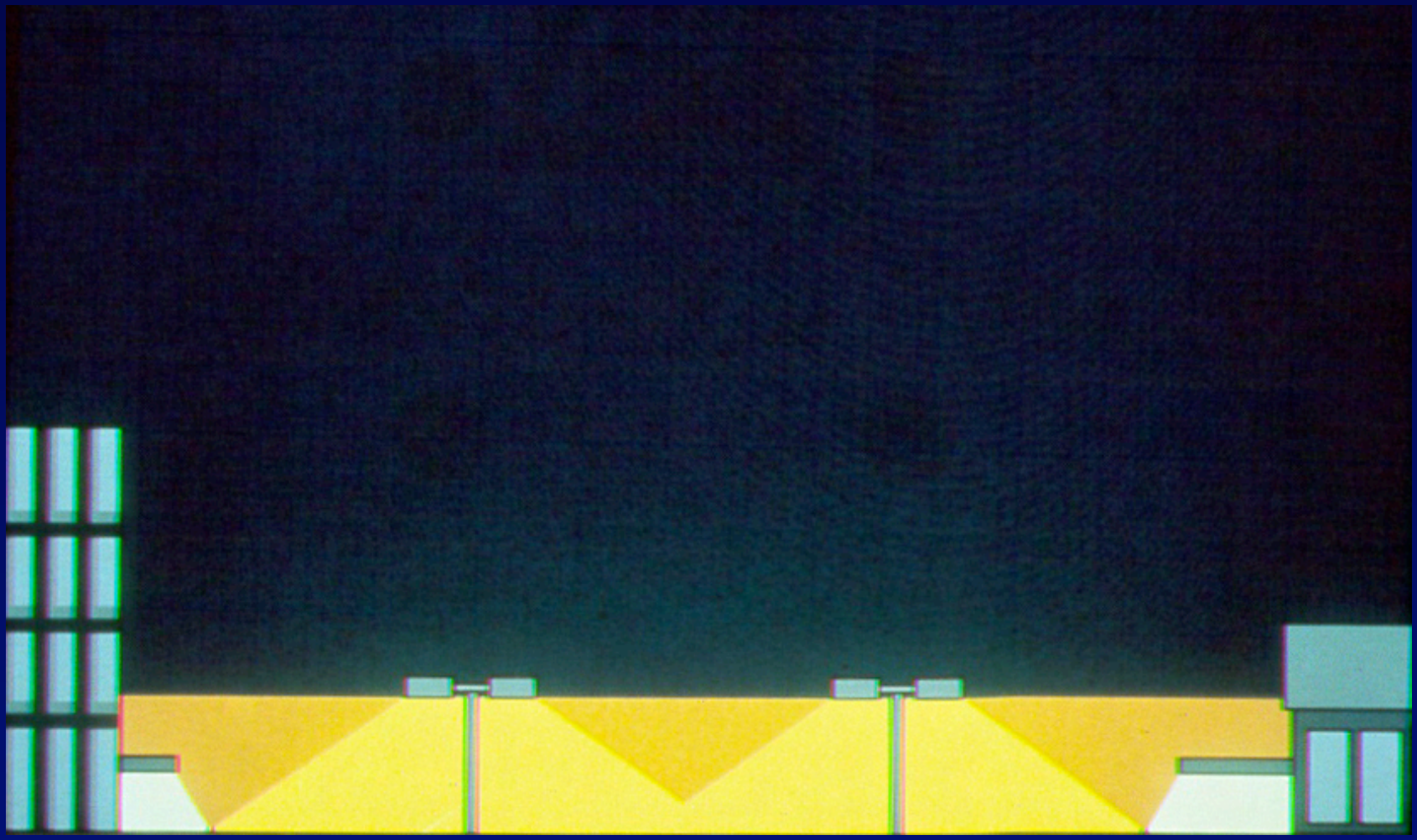
A view of a parking lot, one lit by glary lighting.

Same view, but with a flash photograph to show where he is.

A full cut-off lighting fixture with no direct up light and essentially no glare. All light is used, not wasted.



Optimal design! Note the added light near the entrances. The "task" there is greater than on the path where a lower lighting level is appropriate.

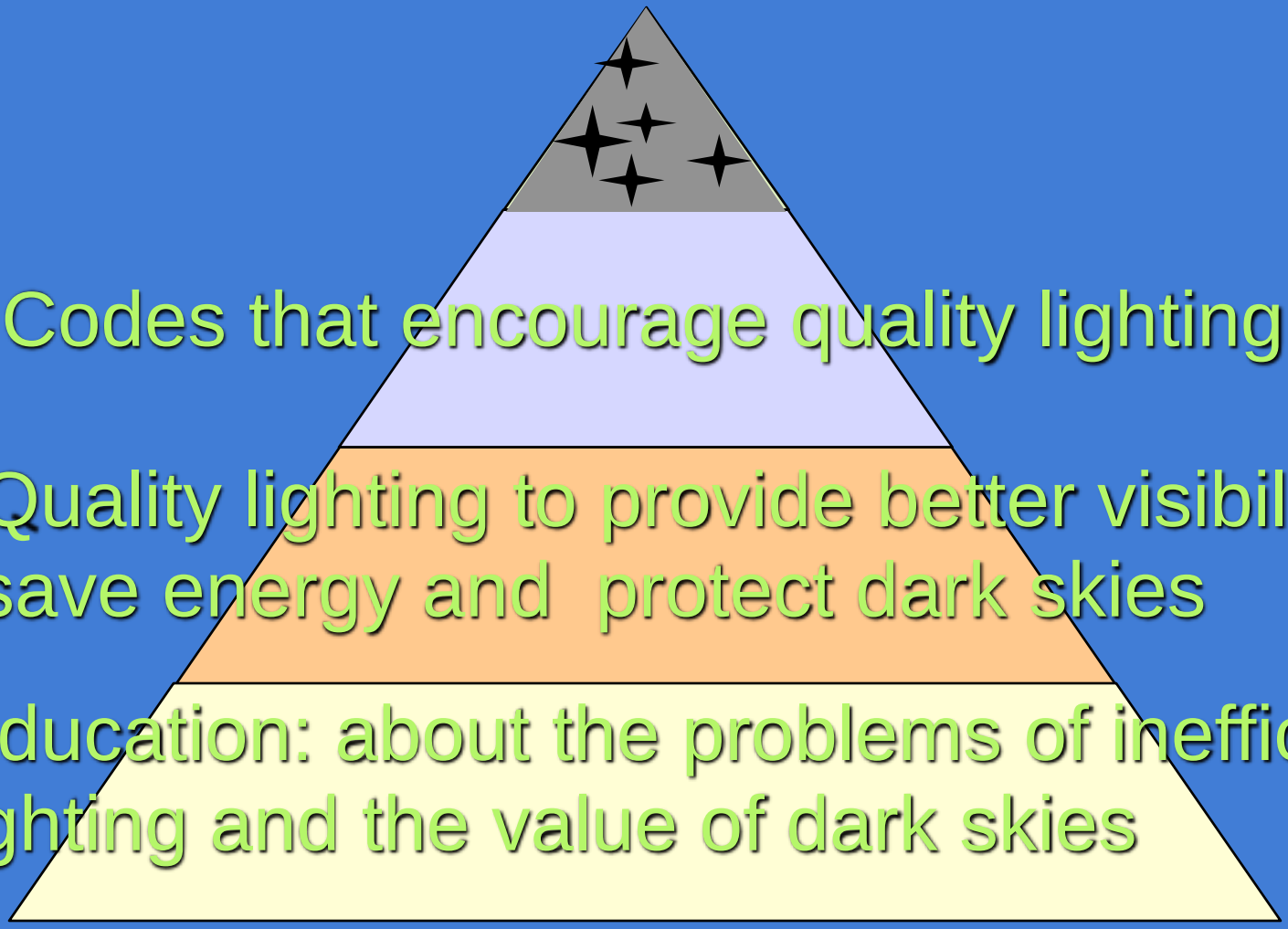


Thorpe Park, City of Flagstaff
1970’s vintage sport lighting
Note glare and spill lighting

Thorpe Park, City of Flagstaff
Modern sport lighting circa 2006

Benefits:
Light levels on playing field are twice previous.
Players and spectators can see better.
No light trespass into surrounding neighborhood.
Better energy efficiency.
Everyone wins.

What is the solution?



- Codes that encourage quality lighting
- Quality lighting to provide better visibility, save energy and protect dark skies
- Education: about the problems of inefficient lighting and the value of dark skies

Where do we go from here?

Form a working group of interested parties?

Is the Maricopa Association of Governments an efficient way to reach many jurisdictions?

The Astronomy Community stands ready to help.

The International Dark-Sky Association has a wealth of resources including a light fixture testing program.
www.darksky.org

Reduced Energy Use and Carbon Dioxide Emissions from Improved Outdoor Lighting Efficiency in Arizona

Christian B. Luginbuhl, US Naval Observatory Flagstaff Station
G. Wesley Lockwood, Lowell Observatory
10 January 2008

Summary

We estimate potential energy savings and carbon dioxide emission reductions if lighting standards similar to Flagstaff's could be applied to all commercial outdoor lighting within the state.

The results show that statewide energy use would be reduced by at least 360,000 MWh/yr. This figure corresponds to a reduction of 190 kilotons of CO_2 emissions per year with an energy cost savings of $30 million per year.

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A Protected Night Sky Over Flagstaff

(Credit and Copyright: Dan & Cindy Duriscoe, FDSC, Lowell Obs., USNO)