

Kai'aleleiaka ☀ THE MILKY WAY

Wally Pacholka / [AstroPics.com](#)

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Concordance Cosmology and Dark Matter

By JEREMIAH P. Ostriker

Cosmology is in a rather happy state at present. Due to a combination of observational advances made possible by rapidly advancing technology and the application of fundamental physical theory, we now have a model for the universe that has passed every test that we can set for it: the Lambda cold dark matter (Λ CDM) model.

The model states that cold dark matter (CDM) is the basic source of gravity holding the universe together, while dark energy (denoted by the Greek letter Lambda) is pushing it apart. For most of cosmic history gravity was winning, but now the dark energy seems to be the dominant force and is causing galaxies to accelerate away from one another.

Whenever there is a more powerful telescope or a new range of wavelengths utilized to study the cosmos, predictions are made on the basis of the Λ CDM model. It has been an amazing two decades since this model was proposed, and its parameters have since been refined to an ever higher degree of accuracy.

Dark matter was first proposed in the 1930s by the brilliant and eccentric Swiss astronomer Fritz Zwicky using studies of clusters of galaxies. Over the decades these measurements grew stronger and were supplemented by many other diagnostics based on galaxy rotation curves, gravitational lensing, the growth of structure and the microwave background, with all metrics giving essentially the same answer: Dark matter is between 20% and 25% of the critical density of the universe – more abundant than the ordinary baryonic chemical elements by a factor of four or five!

Despite decades of research, we still don't know what dark



energy and dark matter are. For dark energy, Einstein's much reviled cosmological constant does seem to be a perfect fit to the data. But for the dark matter, we have been looking for a fundamental particle and so far all efforts to detect it have failed.

However, there are tantalizing clues. On the smallest scales (kilo-parsecs and smaller) there are fewer galaxies and their dark matter densities are lower than expected. Warm dark matter, which would produce structures deviating from those made by cold dark matter on small scales in this fashion, is an example of a mild variant of the standard Λ CDM model that is currently being studied. But it is too soon to take any of the variants as either serious candidates for CDM or competitors to it. Stay tuned! ☺

JEREMIAH (JERRY) P. OSTRIKER is a theoretical astrophysicist who, after his Ph.D. with S. Chandrasekhar at the University of Chicago, has spent most of his career at Princeton University and is now teaching at Columbia University. He is one of the winners of this year's Gruber Cosmology Prize, which was awarded at the opening ceremony of the IAU General Assembly.

Kai'aleleiaaka THE MILKY WAY

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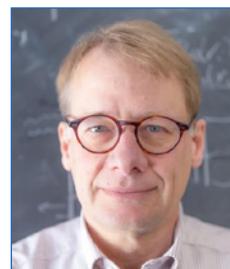
The Cosmic Microwave Background: Where We Are and Where We're Headed

By JOHN CARLSTROM & LYMAN A. PAGE Jr.

Since the discovery of the cosmic microwave background (CMB) 50 years ago, increasingly sensitive and accurate measurements of it have given us unique insights into the origin, composition and evolution of the universe. Measurements of the CMB provide evidence for a quantum mechanical origin of all the structure in the universe and are consistent with the theory of cosmic inflation, leading to a fertile connection between cosmology and the frontiers of physics, between the largest and smallest size scales, and between the lowest and highest energy scales.

Measurements of the CMB provide the precise foundation for the now standard Lambda cold dark matter (Λ CDM) model of cosmology, a model that accounts for all cosmological observations. (See Jeremiah P. Ostriker's article above for more information.)

There is much more to learn from the CMB. For example, CMB polarization measurements soon will be sufficiently advanced to provide precise independent checks of the results from the temperature anisotropy. Furthermore, both anisotropy spectra are sensitive to the number of neutrino species (as well as any unknown light relativistic species) and their masses. The impact of the cosmic neutrino background on the CMB spectra has been detected at high confidence. Future measurements will provide stringent tests of our understanding of particle physics. The CMB already provides the best limit on the sum of the neutrino masses and



should soon have sufficient sensitivity to determine the masses, providing critical information on the neutrino mass hierarchy.

There may be new significant component to the standard model that we have simply missed due to the lack of sensitivity. If the early universe produced gravitational waves through quantum fluctuations they would leave a distinctive imprint on the CMB, the so-called "primordial B-mode polarization," making it possible to image the quantum gravity fluctuations. While the level expected from some of the simplest models of the early universe has been ruled out, there are well-motivated models that suggest it may be within an order-of-magnitude in amplitude below the current upper limits.

On finer angular scales, the CMB is rapidly becoming a powerful tool for measuring evolution of structure in the universe. Hundreds of galaxy clusters have been discovered via the thermal Sunyaev-Zel'dovich (SZ) effect in the last few years and soon there will be many



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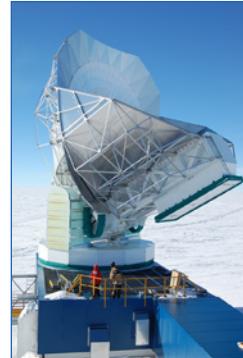
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thousands, providing a nearly redshift-independent, mass-limited sample. The initial detections of the kinematic SZ effect will eventually lead to mapping of the universe in momentum, as opposed to density. Measurements of the gravitational lensing of the CMB will be used to constrain the growth of structure, and by correlating with other surveys, such as galaxies, to assemble a 3D tomographic picture of the universe.

Page and Carlstrom lead the Atacama Cosmology Telescope (ACT) in the Chilean Atacama Desert, and the South Pole Telescope (SPT) projects, respectively. These are the two largest telescopes dedicated to observations of the CMB. They cover



The 10-meter South Pole Telescope at the NSF Amundsen Scott Research Station [John Carlstrom]



The Atacama Cosmology Telescope on Cerro Toco in the Atacama Desert, Chile. [Lyman Page]

over half the sky at arc minute resolution. Each has thousands of state-of-the-art polarization-sensitive cryogenic detectors. Combined, the teams comprise well over 100 exceptional faculty, researchers, postdocs, graduate students, and undergraduates from around the world. They do everything from developing the crucial detector systems to devising new algorithms for reducing multi-terabyte data sets to precise maps, to extracting the cosmological constraints. Currently both teams are working on major upgrades that will increase dramatically the sensitivity and speed of these telescopes for pushing the frontier of this exciting field over the next several years, while also pointing the way to an even more ambitious CMB program in the future. ♦

JOHN E. CARLSTROM is Professor of Astronomy and Physics at the University of Chicago, Illinois, where he is also the Deputy Director of the Kavli Institute for Cosmological Physics. **LYMAN A. PAGE Jr.** is the James S. McDonnell Distinguished University Professor of Physics and Department Chair at Princeton University. Carlstrom and Page are two of the winners of this year's Gruber Cosmology Prize, which was awarded at the opening ceremony of the IAU XXIX General Assembly.

FOCUS MEETING 4

Planetary Nebulae as Probes of Galactic Structure and Evolution

By ROBERTO MENDEZ, LETIZIA STANGHELLINI & MIRIAM PEÑA

Surprisingly, we have discovered more planetary nebulae (PNe) in other galaxies than we have found in our own. What are the reasons for this? Historically, the first motivation to target searches beyond our galaxy was related to their potential for distance determination. The planetary nebula luminosity function (PNLF) was empirically shown to have a constant bright end, which allows it to be used as a standard candle. Twenty-five years ago, the PNLF distances were among the first to point to a Hubble constant near 70 km/s/Mpc, subsequently confirmed with

Focus Meeting 4: Planetary Nebulae as Probes of Galactic Structure and Evolution

Start date	Wednesday, 5 August
End date	Thursday, 6 August
Oral sessions	Room 313B, Hawai'i Convention Center
Posters	Exhibit Hall 1, Hawai'i Convention Center
Coordinating Divisions	Division H: Interstellar Matter and Local Universe Division G: Stars and Stellar Physics Division J: Galaxies and Cosmology

For details on presenters, topics, and times see the [online program](#) or [mobile app](#).

other techniques. We are still trying to understand why the PNLF works so well as a distance indicator. This will eventually lead us to new knowledge of single- and double-star evolution.

PNe can be used as probes of the intermediate-age stellar population in our galaxy and beyond; their chemical abundances are relatively easy to measure, and they are formed during a definite stage of stellar evolution, which means they can be associated to a specific progenitor mass range. The populations of galactic and Magellanic Cloud PNe have been studied in detail by spectroscopic means to determine the metal distribution in our galaxy and in the Magellanic neighbors.

Moving now to harder observational goals, we have started measuring chemical abundances in more distant extragalactic PNe. What limits can we impose on galaxy formation by merging the observed metallicity gradients in galaxies with a variety of

morphologies? This kind of project will eventually need the light-collecting power of 30-meter-class telescopes, but it is time to discuss preliminary strategies, models, and observations.

It was clear from the very beginning that extragalactic PNe would be excellent kinematic probes of the stellar populations they represent. As soon as new, more efficient slitless methods for radial velocity measurement were implemented, this potential was exploited. We know of a few flattened elliptical galaxies that show a Keplerian decline of line-of-sight velocity dispersion

with projected distance from the galaxy center, opening a way to learn about dark matter distribution or the presence of radial anisotropy in the velocity dispersion. We need empirical ways to decide which of the two interpretations (or three, if we include Modified Newtonian Dynamics) is correct.

We also know of elliptical galaxies where PNe indicate a clear presence of dark matter, in agreement with other techniques (e.g., X-ray emitting gas, or globular clusters).

This indicates that PNe are indeed reliable kinematic probes.

As a forum to discuss and define the above topics, we are holding Focus Meeting 4: Planetary Nebulae as Probes of Galactic Structure and Evolution (FM 4) at this IAU General Assembly. FM 4 is chaired by Letizia Stanghellini, Miriam Peña, and Roberto Mendez, and is mostly about extragalactic PNe. However, some studies of the population of PNe in our galaxy are illuminating, so we will also have presentations about, for example, deep echelle spectrophotometry and Gaia astrometric observations. 



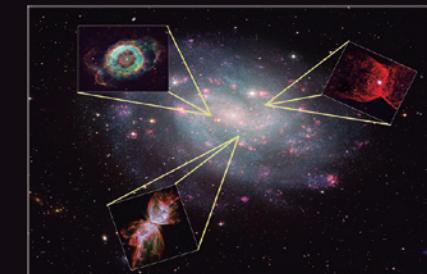
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International Astronomical Union (IAU) Focus Meeting FM4
"Planetary Nebulae as probes of galactic structure and evolution"

August 5 - 6, 2015 Honolulu Hawai'i



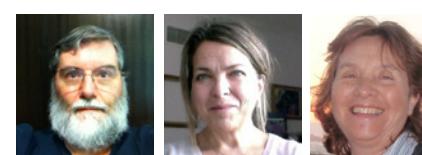
Topics:

Single and binary evolution of low- and intermediate-mass stars,
Stellar evolution with dust, PN populations in nearby galaxies,
Abundances in nearby galaxies, stellar populations and chemical evolution,
The PN luminosity function, PNe as dynamical probes, Intra-cluster PNe.

Invited Speakers:
Magda Arribalzaga (Germany), Bruce Balick (USA), Leticia Cariag (Mexico), Robi Curciu (USA),
Lodovico Decarli (Germany), Ana Bel Gómez-Hernández (Spain), Daniel Gonçalves (Brazil), Claudio Maraston (UK),
Jesse Nordin (USA), Werner Röhl (Australia), Michael Röder (Mexico), Paolo Ventura (Italy).

Scientific Organizing Committee (SOC):
Chair: Letizia Stanghellini (USA), Miriam Peña (Mexico), Roberto Méndez (USA)
and the IAU PN Working Group:

Yi-Hsia Chu (USA), Rosario Corradi (Spain), Osvaldo de Marco (Australia), Adam Frant (USA), Amanda Karakas (Australia), Karen Kwitter (USA), Xiaowei Liu (China), Alberto López (Mexico), Arturo Manchado (Spain), Quentin Parker (Australia), Albert Zijlstra (UK).



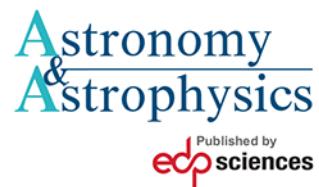
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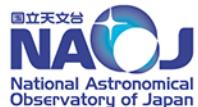
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X-ray Surveys of the Hot and Energetic Cosmos

By ANDREA COMASTRI

X-ray surveys are playing a key role in our understanding of the hot and energetic component of our universe. Since their launch in 1999, both the XMM-Newton and Chandra surveys have transformed our understanding of the sources of the cosmic X-ray background, shedding light on their cosmological evolution and the physical processes shaping their properties.

Detailed investigations of the physics and evolution of X-ray-selected sources were addressed with massive observations along the entire electromagnetic spectrum (such as the COSMOS, ECDFS, and AEGIS surveys). X-ray-survey science is still actively pursued by the scientific community and well received by the XMM and Chandra Time Allocation Committee, which has recently granted major programs (e.g., the Chandra Ultradeep 7Ms Survey in the Chandra Deep Field-South, the 3Ms COSMOS Legacy Survey, and the large-area surveys with XMM: XXL and Stripe 82X).

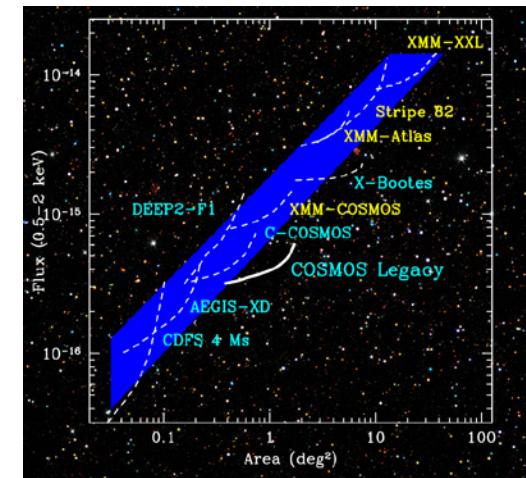
The 2012 launch of the Nuclear Spectroscopic Telescope Array (NuSTAR), with its advanced imaging capabilities, has provided access to even fainter sources than with previous surveys. The key goal of the NuSTAR surveys is to learn more about the hard-X-ray background and its sources. The Japanese mission ASTRO-H, due for launch in 2016, will also survey the hard-X-ray sky; its broad band coupled with high energy resolution will open an enormous discovery space for a wide variety of objects — particularly accreting black holes and clusters of galaxies.

Starting in 2017 the extended Röntgen Survey with an Imaging Telescope Array (eROSITA) will survey the entire sky, pushing into new energy regimes and revolutionizing our view of the high-energy sky. The detection of very large samples (roughly 100,000 objects) of galaxy clusters out to redshifts of $z > 1$ will

allow us to study the large-scale structure in the universe and test and characterize cosmological models including dark energy. eROSITA is also expected to yield a sample of around 3 million active galactic nuclei, providing a unique view of the evolution of supermassive black holes within the emerging cosmic structure.

The title of the IAU Focus Meeting 6 (FM 6), The Hot and Energetic Cosmos, is also the science theme of the European Space Agency's Advanced Telescope for High-Energy Astrophysics (ATHENA) mission, foreseen for a 2028 launch. The mission aims to explore how ordinary matter assembles into large-scale structure and how black holes grow.

The aim of FM 6 will be to review and discuss the recent observational advances obtained by X-ray surveys and complemented by multi-wavelength follow-up programs, alongside progress in theory and simulation. The scientific program, distributed over seven sessions, will touch on most of the “hot and energetic” questions about the physics of clusters of galaxies,



This figure plots the coverage of various X-ray surveys in area-flux space, with XMM surveys in yellow and Chandra surveys in cyan. The Chandra COSMOS Legacy survey is exploring a new regime outside of that covered by previous surveys (indicated by blue shading). The background is the three-color X-ray mosaic of the C-COSMOS survey. [Plot: Civano et al. 2015 (submitted). Background: Elvis et al. 2009]

the cosmic evolution of accreting black holes, and the high-energy phenomena in starbursts and normal galaxies. The final roundtable will be chaired by Günther Hasinger, Director of the Institute for Astronomy at the University of Hawai‘i, and attended by top-level researchers in the field. This discussion will address the way forward for future missions, including synergies with

multi-wavelength facilities.✿



ANDREA COMASTRI is Staff Astronomer at the Italian National Institute of Astrophysics (INAF) and Director of the Bologna Astronomical Observatory in Italy. He co-chairs the FM 6 Scientific Organizing Committee.

SOFIA: The View from the Stratosphere

By DANA BACKMAN, RAVI SANKRIT & JEONGHEE RHO

Flying at altitudes of 12 to 14 kilometers, above 99% of the water vapor in the Earth's atmosphere, the [Stratospheric Observatory for Infrared Astronomy \(SOFIA\)](#) — a modified Boeing 747SP jetliner carrying a 2.5-meter telescope — is able to observe at mid- and far-infrared wavelengths invisible to ground based observatories.

SOFIA has just returned to its home base in California after a six-week deployment to the Southern Hemisphere. Operating from Christchurch, New Zealand, SOFIA conducted a total of 14 science flights using FORCAST, a mid-infrared camera and grism spectrometer, and GREAT, a high-resolution far-infrared heterodyne spectrograph. An additional flight used the near-infrared camera FLITECAM, the fast optical photometer HIPO, and the FPI+ optical camera to successfully observe the occultation of a bright star by Pluto.

A SOFIA Splinter Session will be held at 6 pm this evening in Room 313B. Science Mission Operations Director Erick Young, Deputy Director Hans Zinnecker, and Deputy Project Scientist Tom Roellig will present the status of the program, describe some recent exciting scientific results, and describe the current 3rd-generation instrument call for proposals.

For more information about SOFIA, visit the [German SOFIA Institute \(DSI\)](#) display in Booth 325-327 in the main exhibit hall, and the SOFIA table within the NASA Science Mission



The SOFIA observatory in the air. [NASA/Jim Ross]

Direktorate's exhibit area. Also, members of the SOFIA Science Center staff will highlight SOFIA imaging and spectroscopic results at the NASA "Hyperwall" during both weeks of the IAU General Assembly.✿



DANA BACKMAN is the Director of SOFIA's education and public outreach efforts. **RAVI SANKRIT** is a user support scientist for SOFIA. **JEONGHEE RHO** is a research scientist at the SETI Institute.

EXPERIMENT IN BOOTH 329

Using Sound to See Better

By WANDA DIAZ MERCED

Late-onset diseases that affect the visual system, such as diabetes and glaucoma, are among the leading causes of blindness in adults in the United States. Unlike children who lose their sight while still young, adults who develop late-onset blindness are often already installed in successful careers. As a consequence they must be retrained to make use of technological accommodations if they are to retain quality of life. This is especially true for adults who have unique visual expertise prior to blindness, say, because they were engineers, scientists, or physicians.

So far, no data-analysis tool, processing tool, or algorithm is more powerful than the human brain for data analysis and pattern recognition. Astronomy searches for the unknown, for the invisible. Searching for cost-effective tools that may be used to bring everyone on board, the [IAU Office of Astronomy for Development \(OAD\)](#) has come across “multimodal perception,”

i.e., using multiple senses simultaneously. This could be used to improve data analysis, which will help to foster cutting-edge

Volunteer for the Experiment

Wanda Diaz Merced is conducting an experiment to test a tool that uses sound as an adjunct for visual processing, facilitating the identification of signal in noisy data. The tool is designed to enhance your ability to spot low-level features in data and to facilitate data analysis by scientists with impaired vision. This work is part of AOD AstroSense, a program to increase astronomy and science accessibility for individuals with different abilities and learning styles.

Do you work with astronomical data, such as time-series data or spectra that are typically represented as a two-dimensional graph? Are you interested in finding new ways to enhance your abilities to spot low-level features in your data? Then please volunteer for this experiment. Your contribution will help to develop ways to use your hearing capabilities to improve visual detections.



A volunteer tests the experimental tool for Wanda Diaz Merced. [Iris Nijman, Kai'aleleiaka]

Each iteration will take about 45 minutes of your time, and you will be contributing to a great endeavor. All you need to do is look at graphs on a screen while listening to sounds and press a button on a keyboard when you think you see or hear a pattern. It is like a video game, and people generally find it a lot of fun. Depending on your results, you might be asked to come back for a second iteration. Every day this week, 10 volunteers are needed for the experiments. [Please sign up!](#)

Honolulu Almanac 5 August 2015

Sunrise / set	6:06 am / 7:08 pm
Twilight ¹ start / end	4:46 am / 8:28 pm
Moonset / rise	11:34 am / 11:31 pm
Moon phase ²	● Waning gibbous (66% illum.)
Evening planets ³	Jupiter (W), Saturn (SSW)
Morning planet ³	Mars (E)

¹Astronomical twilight (Sun 18° below horizon). ²At meridian crossing ³Naked-eye planets. Source: [timeanddate.com](#)

research capabilities and augment the possibility of discoveries.

The OAD is currently developing ways to put complex astrophysics data into a more interpretable form. This will increase the sensitivity to detect events in space-physics numerical data. As part of the research we evidenced that sound increases sensitivity to visually ambiguous events embedded in different types of time series.

Another phase of the research is investigating the effects of plasticity using sonification (convert a data waveform into the audible domain) in a sample of normally sighted astronomers

who have career-related expertise in the visual interpretation of time-series data. Using a multimodal perceptualization and user-centered framework, we will develop training intervention for late-onset blind physicists. ♡



WANDA DIAZ MERCED is a postdoctoral fellow at the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts. Her research on multimodal perception involves collaboration with the IAU Office of Astronomy for Development and the University of Massachusetts, Boston.

Two Cultures, One Mountain

By INGE HEYER, *Kai'aleleiaaka*

At 10 am Tuesday, 4 August, about 50 local residents assembled in front of the Hawai'i Convention Center to raise awareness of cultural and environmental issues and to promote an “aloha ‘āina” march of solidarity and sharing scheduled for Sunday, 9 August, and going from Saratoga Road through Waikīkī to Kapi‘olani Park.

Reporters on the scene were addressed by two principal speakers: Jonathan Osorio and Joshua Lanakila Mangauil. Both stressed that the gathering was not in opposition to the IAU XXIX General Assembly nor to astronomy more generally. They stated that they object to the commercialization of their homeland and to intrusions into their sacred spaces. They feel that Mauna a Wākea, or Maunakea, is a poor choice for the location of telescopes.

Today marks the 133rd day of protesters’ vigil on the mountain. Osorio and Mangauil asserted that both the State of Hawai‘i and the University of Hawai‘i have failed to protect their sacred land. They said that the sanctity of Maunakea derives not only from cultural and religious values, but also from the fragile nature of its environment. “We all need to feel connected to this place; only then can we begin to take care of it, to serve



The scene outside the Hawai'i Convention Center on Tuesday morning. [IAU/B. Tafreshi, twanight.org]

and to honor it, and to protect and watch it,” they said. “The Hawaiian culture is science-minded; we do not see a divide between culture and science. However, both need to respect



The two principal speakers at Tuesday morning's rally, Jonathan Osorio (left) and Joshua Lanakila Mangauli, answer questions from the media. [Inge Heyer]

the land on which they exist."

Piero Benvenuti, the incoming General Secretary of the IAU, said, "We are deeply respectful of the views of all parties on this issue and hope that by engaging in open dialogue, this

General Assembly Resolutions Finalized

The four resolutions to be voted on at the Business Meeting of the General Assembly II on Thursday, 13 August, have now been finalized. Only a few minor changes were made to the drafts announced earlier (*Kai'aleleia* Issue 1). See [IAU Announcement 15023](#) for brief summaries of the resolutions, a link to a zip archive containing PDFs of the complete text, and two related documents. Note that although Announcement 15023 still refers to the resolutions as drafts, the link to the zip archive now points to the final versions. If you'd prefer a shortcut, here's a [direct link to the 175-kilobyte zip file](#). We encourage all IAU members to review the four resolutions carefully before coming to Ballroom B at 4:00 pm Thursday, 13 August, to cast your votes.

will encourage a collaborative, positive vision for the future of Maunakea. We support an open exchange of ideas on how science and culture intersect in Hawai'i and around the world."

Ka'iū Kimura, Executive Director of the 'Imiloa Astronomy Center of Hawai'i, offered her own statement: "To create a better, more cohesive and collective vision for the future of Maunakea, we have to listen and understand one another. It's all about relationships. We call on our community to join in having mindful, productive conversations about the future. Together we can find a way to bridge our desire to preserve the majesty of Maunakea with the scientific possibilities that only our mountain can provide." ❁

Workshop for Journal Authors & Referees

By JULIE STEFFEN

Here's an opportunity that you won't want to miss while you're in Honolulu for the IAU General Assembly: The editors, publishers, and staff of some of the leading journals in the astronomical sciences are offering a workshop for current and prospective authors and referees. It will be offered twice: on Wednesday, 5 August, and Monday, 10 August, from 10:00 am to 3:00 pm in

Room 323B of the Hawai'i Convention Center.

Hosting the workshop are the American Astronomical Society (AAS) and Institute of Physics (IOP) Publishing, partners in publication of the *Astronomical Journal* and the *Astrophysical Journal*, *ApJ Letters*, and *ApJ Supplements*; Oxford University Press, publisher of *Publications of the Astronomical Society of*

[Japan](#) and [Monthly Notices of the Royal Astronomical Society](#)

(the latter in partnership with the Royal Astronomical Society in the United Kingdom); and EDP Sciences, publisher of [Astronomy & Astrophysics](#).

Topics include writing a good paper for submission to a journal,

ORAL HISTORY PROJECT**Let Us Interview You!**

By JARITA C. HOLBROOK

The [AAS Historical Astronomy Division \(HAD\)](#) has been running an oral history project for two years, partially funded by the American Institute of Physics Niels Bohr Library, with ongoing funding coming from the AAS. Throughout the IAU General Assembly in Honolulu, we are conducting oral history interviews with U.S. and international attendees.

Our goal is to interview 60 people during the two weeks of the GA. Each interview lasts 1.5 hours, during which we will discuss your education, career moves and strategies, work-life balance, intellectual preferences, collaborations, reputation, leadership, and mentoring. We like to end with career advice to the next generation. We would like astronomers at all career stages, from graduate student to emeritus, to sign up to be interviewed.

We have a team of five people interviewing from 10:30 am to 9:30 pm, Monday through Friday, in the Ilima Boardroom and Tiare Suite at the Hilton Hawaiian Village. If you are interested in interviewing another astronomer for the project, we have training sessions each Wednesday from 10:30 am to 12 noon in Room 326B of the Hawai'i Convention Center. After training you are welcome to use our equipment and our interview rooms; you just need to

representing data, the peer-review process, and a Q&A (question-and-answer) session with journal editors. Lunch will be provided.

There is no cost to attend either workshop, but you must be registered to attend the General Assembly to participate. ☺



JULIE STEFFEN, the AAS Director of Publishing, is based in Tucson, Arizona. Formerly at the University of Chicago Press, she has many years of experience in scientific journal publishing.

schedule a time. It is easiest to interview someone you know, but you can use interviewing as a way to get to know someone new.

Meet the Mentors

The IAU Executive Committee [Working Group "Women in Astronomy"](#) and the AAS [Committee on the Status of Women in Astronomy](#) are pleased to announce the beginning of our Meet-the-Mentor events. These offer early-career members a chance to meet with leaders in the field to discuss work-life balance, networking strategies, and other issues of concern. Meet-the-Mentor sessions will occur twice daily, at 10:00 am and 2:00 pm, through Wednesday, 12 August. We invite students who haven't already signed up for one to visit the Student Pavilion in the Exhibit Hall to choose an available slot. See the conference website for a [PDF list](#) of participating mentors, their areas of career expertise, and which sessions they'll attend. Questions? Contact [Francesca Primas](#) or [Christina Richey](#).



To arrange to be interviewed, please fill out our [sign-up form](#).
To arrange a time to conduct an interview, please [email me](#).



JARITA HOLBROOK is Associate Professor of Physics and a member of the Astronomy Group at the University of the Western Cape, South Africa. She is also a past chair of the AAS Historical Astronomy Division.

Congratulations to

You have won dinner for two (value: \$110) at Kai Market at the Sheraton Waikiki 2255 Kalākaua Ave.

Prizes can be redeemed, and raffles can be entered, at Exhibit Hall Booth 336

Dyas Utomo!





How to Contribute to the Conference Newspaper

Kai'aleleiaka welcomes news, reviews, and opinions from attendees. Articles should be 300 to 500 words. Please also supply a relevant photo or illustration with a brief caption, as well as a photo and brief bio of you, the author. In case of multiple authors (no more than three, please), we'll need photos and bios of all of you.

We prefer receiving a Microsoft Word document, but a plain text file or even an email message will suffice. Graphics should be in TIFF, JPG, or PNG format; author photos can be 250 pixels wide by 300 pixels tall, but larger photos or illustrations should be at least 800 pixels wide and tall.

Please email your materials to newspaper@astronomy2015.org or bring them to our office, Room 302, in the Hawai'i Convention Center, Monday through Friday, 8 am to 6 pm. Note that if you want an article to appear on a particular day, you need to get it into our hands a day or two earlier.

We reserve the right to reject contributed materials for any reason and to edit all contributions for length, style, and clarity.

 Rick Fienberg, Editor in Chief

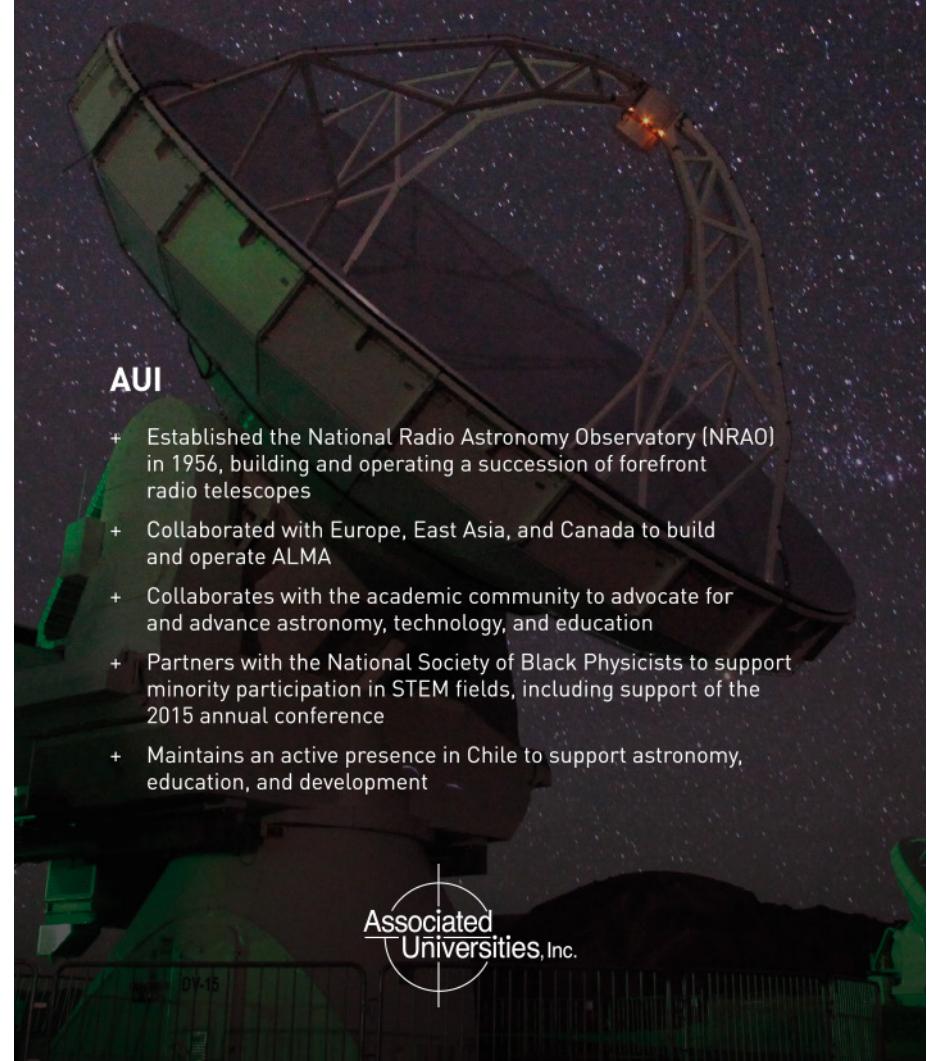
ASSOCIATED UNIVERSITIES, INC.

AUI collaborates with the scientific community and research sponsors to plan, build, and operate cutting-edge facilities. We cultivate excellence, deliver value, enhance education, and engage the public.



AUI

- + Established the National Radio Astronomy Observatory (NRAO) in 1956, building and operating a succession of forefront radio telescopes
- + Collaborated with Europe, East Asia, and Canada to build and operate ALMA
- + Collaborates with the academic community to advocate for and advance astronomy, technology, and education
- + Partners with the National Society of Black Physicists to support minority participation in STEM fields, including support of the 2015 annual conference
- + Maintains an active presence in Chile to support astronomy, education, and development



Australia's Got SPIRIT: Internet Telescopes for Students

By KIRSTEN GOTTSCHALK

Come by the Australian Astronomy booth (#236) in the Exhibit Hall and try your hand at imaging with a research-grade educational telescope located in Perth, Western Australia.

SPIRIT I (13 inches/35 cm) and SPIRIT II (16 inches/43 cm) are two fully automated telescopes designed for educational use by high-school students. They include accompanying curriculum resources and lesson plans, as well as a professional learning program for teachers conducted by the Perth branch of the curriculum support center [SPICE](#).

Both telescopes include multiple filters, and SPIRIT II also includes a low-resolution, web-enabled bright star spectroscope. Full technical details of both telescopes are available on the [project's website](#).

High-school students use SPIRIT to image and track minor planets, to investigate the solar system (including calculating the

mass of Jupiter by observing the Galilean satellites), and to get hands-on experience with astronomy research.

Weather permitting (it is winter in Perth), both [SPIRIT](#) telescopes will be operational each morning of the first week of the IAU General Assembly from 10:00 am at the Australian Astronomy booth (look for the giant inflatable SKA telescope to find us). There will also be a demonstration of the simple custom-built control system that allows high-school students to operate the telescope and image the sky with almost no learning curve. ♡



KIRSTEN GOTTSCHALK is the Astronomy Ambassador at the International Centre for Radio Astronomy Research in Perth, Western Australia. After completing her studies in astronomy in Australia, she realized her passion was in talking about it rather than doing it, and she hasn't looked back since!



Iranian photographer Babak Tafreshi found an ideal vantage from which to create this stunning panorama of Honolulu and [Diamond Head State Monument](#). Founder of [The World at Night](#), Tafreshi is internationally renowned for advancing the state of the art of landscape astrophotography and time-lapse video. [IAU/B. Tafreshi, [twanight.org](#)]

STAR PARTY ON THE BEACH

Spotting Saturn and Stars from the Shoreline

By IRIS NIJMAN, *Kai'aleleiaka*

A clear night sky, a few telescopes, dedicated volunteers, and an enthusiastic audience: All of the ingredients that you need for a successful stargazing party.

A few hundred people gathered on Monday evening, 3 August, in Ala Moana Beach Park for a stargazing party, organized by the Hawaiian Astronomical Society and the Institute for Astronomy at the University of Hawai'i. It was the first in a program of public events organized for the IAU General Assembly.

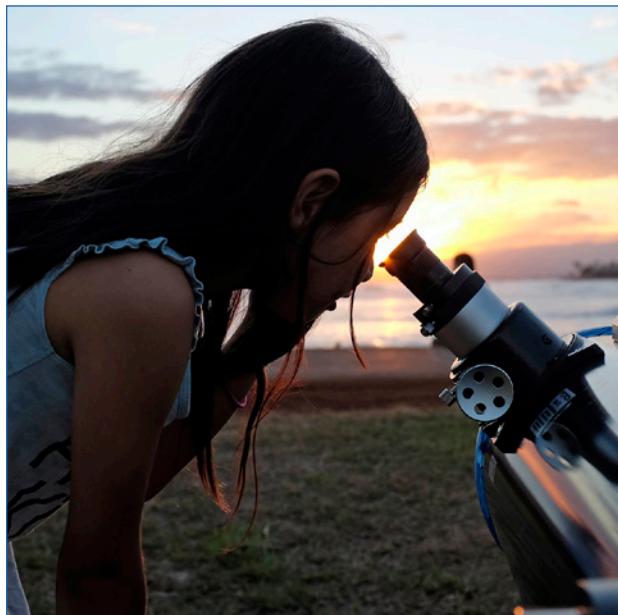
Stargazing parties are a fantastic way to introduce people to observational astronomy for the first time — and Monday night was no exception. Saturn's ring system is an enthralling sight for everyone, and the planet was high in the sky for the stargazing party-goers. "Wow! It's great that you do this, thank you!"

exclaimed one lady after she had seen Saturn for the first time.

Dyron Meck, a member of the Hawaiian Astronomical Society, aimed his telescope at the ringed planet. Being an enthusiastic amateur astronomer, he has bought his own telescope and takes pride in sharing his passion for astronomy with others. "Attending stargazing parties like this is something that I've been doing a lot with my family," he said.

Another volunteer at the park, Mike Lum, a Californian graduate student at the University of Hawai'i, aimed his telescope toward star cluster M21 and the Trifid Nebula. "Nebulae are space clouds," he explained to his audience. "Everything we see tonight is located within our galaxy, which is like a thin pizza."

The Institute for Astronomy organizes about 10 stargazing



[University of Hawai'i]



[IAU/B. Tafreshi, twanight.org]



[University of Hawai'i]

events every year. “I love to do this. I wish we did this more often,” said Lum, whose father is Hawaiian. “I moved back to Hawai‘i because of the good Ph.D. program here, and to be close

to my family.”

Did you miss this stargazing party? Join the next one on Thursday, 13 August, at sundown in Ala Moana Beach Park. ☀

The Women in Astronomy Luncheon

Finding ways to build on 15.9%.

By PAMELA L. GAY, *Kai‘aleleiaka*

If you look around the IAU General Assembly, you will see women in every arena. From the Executive Committee of the IAU to the youngest postdocs presenting, women are taking part in every scientific, educational, and communications aspect of this meeting. That said, only 15.9% of the IAU membership is female, and women make up only about 30%* of the registrants.

Recognizing the importance of creating a space for these women to gather, the IAU has been hosting a Women in Astronomy lunch for more than a decade. This year’s luncheon, held Tuesday, 4 August, brought together several hundred people (about 90% women) to listen to speakers and to openly discuss the problems that women face within academia.

The luncheon opened with remarks by AAS President Meg Urry, a woman who has over and over again been “the first woman to.” Over the 30 years of her career, she has seen remarkable change in not just astronomy, but in Western culture. How we view sex and gender has expanded, and the need to support diversity in all its forms is becoming embraced, if slowly. As she reflected on not just the hard road of her generation (and the harder road of the prior generation), she acknowledged that progress comes from recognizing that we don’t know everything, from listening, and from continually learning. As we meet here in Hawai‘i, we can take a page from the native Hawaiian people, who embrace individuals whose gender lies between traditional



AAS President Meg Urry (left) and NSF Director France Córdova. [Pamela L. Gay, *Kai‘aleleiaka*]

male and female gender roles with the word “mahu.”

Also speaking at the luncheon was the former IAU President Bob Williams and President-Elect Silvia Torres-Peimbert. With very different styles, they both addressed the lack of women in our field and the complexity of finding solutions. As Williams pointed out, some suggested solutions, like quotas, may increase participation of women, while also increasing the cultural issues that drive women out of astronomy. Torres-Peimbert noted the

*Of the 3,181 registered attendees, 2,616 answered the “gender” question, with 788 indicating female.

percent of women in the IAU, which represents the senior members of our field, has not substantially changed for six years, and we need to purposely work to change this. In the past, she pointed out bluntly, men were part of the problem, but today it is political correct to support women and this will help.

In addition to these speakers, the session also left 30 minutes for table discussions. As this reporter wandered the room, I heard voices that balanced hope and frustration. Table after table echoed the same problems. Women are told the field needs strong leaders, but when we are strong we are called aggressive. Women aren't listened to in meetings and are spoken over. Mentoring too often focuses on how to be appropriately feminine (how to dress and act) to be heard, and not on how to appropriately just do astronomy. Problem after problem was reiterated, but so were desired solutions: group mentoring, senior people

Women in Astronomy Scattered Lunch Talks

All talks are in room 318A from 12:30 to 2:00 pm

Friday, 7 August	CSWA Survey on Workplace Climate, by Christina Richey
Monday, 10 August	Inclusive Astronomy 2015, by Meredith Hughes
Wednesday, 13 August	Unconscious Bias, by Pat Knezek

to advocate for junior women, and acceptance within the field that astronomers are diverse in gender expression. Things can improve, but, everyone agreed, it will take effort.

The luncheon was organized on behalf of the IAU Executive Committee Working Group "Women in Astronomy," led by Francesca Primas, with help from Christina Richey of the [AAS Committee on the Status of Women in Astronomy](#). More information will be posted on the [Women in Astronomy Blog](#). ♀

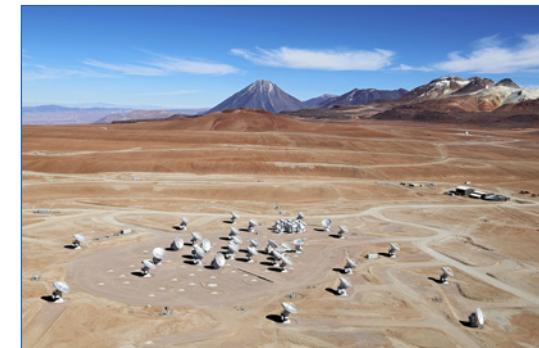
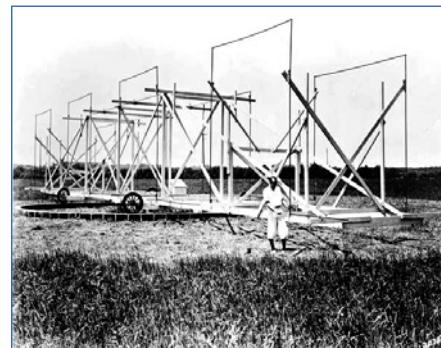
COMMISSION B4

From C40 to B4, It's All Radio Astronomy

By GABRIELE GIOVANNINI

We are now living in a golden renaissance of radio astronomy. The international community is making a phenomenal investment in the development of facilities at a scale that significantly benefits the global community. There are both major enhancements to existing facilities and the development of new facilities. The Atacama Large Millimeter/submillimeter Array (ALMA) represents one of the first truly international radio observatories, and will be followed by the similarly global Square Kilometre Array (SKA).

Radio astronomy observations provide the most sensitive, highest angular resolution, and broadest fractional wavelength coverage observations in modern astronomy. Moreover, we must not forget that from its beginning, radio astronomy has contributed to multiwavelength studies. The



Radio astronomy has come a long way since its primitive early days. In 1931 Karl Jansky used a 14.6-meter rotatable, directional antenna system (*left*) to make the first positive identification of extraterrestrial radio signals. [*NRAO*] Today, more than 80 years later, the 66 7- to 12-meter dish antennas of the sprawling Atacama Large Millimeter/submillimeter Array regularly acquire our most detailed and deep images of the radio sky. [*ALMA (ESO/NAOJ/NRAO)*]

importance of results only obtainable in the radio band (e.g., magnetic fields, radio spectral line emission) indicates that radio astronomy needs to be adequately represented in multi-wavelength astronomy.

The new IAU Commission B4, Radio Astronomy, builds upon the previous IAU Commission 40, which was established in 1948 and played an essential role in growing the radio astronomy community into a mature field. Now Commission B4 brings together scientists and engineers who carry out observational and theoretical research in radio astronomy, and who develop and operate the ground and space-based facilities that are used to explore the universe at radio wavelengths.

Key goals for B4 include the following:

1. Stimulate and support IAU Symposia and other international meetings, especially on cross-disciplinary themes where radio astronomy can play an important role and where work spans more than one facility (e.g., major surveys and science data processing).
2. Connect radio astronomy to the wider astronomy community by making data accessible to non-expert users and by providing tools to use archival radio data within general, multi-wavelength studies that address a broad range of science questions.
3. Place radio astronomy in the broader context of IAU Division B, Facilities, Technologies and Data Science. This includes, connecting radio astronomy to informatics and statistics.
4. Foster discussions and share information on topics of current interest to radio astronomers around the world and provide up to date information on radio science, data, facilities and techniques. Special attention will be devoted to the new radio astronomy bands at ultrahigh frequencies with ALMA and mm-VLBI, and low frequencies with LOFAR, ASKAP, MeerKAT, MWA, and the SKA.
5. Act as an interface between the large number of individuals and groups working in this field and other

Are IAU Members Getting Younger?

On Wednesday, 5 August, you may notice a sizable contingent of rather young people in Exhibit Hall 1. These are not IAU members, but we can hope that in time some of them will be inspired to become IAU members. Right now they are students at local primary and secondary schools, home schools, and camps. With generous support from [Associated Universities, Inc.](#), the IAU and AAS have invited these youngsters and their teachers, parents, and counselors to interact with scientists from some of the observatories, organizations, and institutions that have set up displays in the Exhibit Hall. The students will participate in hands-on educational activities and enjoy a unique opportunity to ask questions of astronomers from all corners of the globe. Please welcome them in the spirit of aloha!

The event will repeat on Wednesday, 12 August, with new groups of students. If you brought your family with you to Honolulu and would like your own school-age children to join next week's fun, please [email Debbie Kovalsky](#), the AAS's Exhibits and Sponsorships Coordinator.

— Rick Fienberg, Kai'aleiaka



Students who visited the 224th AAS meeting in Boston, Massachusetts, built millisecond pulsars and observed them spectroscopically using diffraction-grating glasses. [AAS photo © 2014 Jason Images]

- Commissions, Divisions, and the IAU in general.
6. Encourage membership, broaden participation, and support the development of younger astronomers working or interested in radio astronomy.
 7. Provide support to the Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science (IUCAF) for the protection of radio astronomy frequency bands, and to provide web information on these activities on the Commission website.
 8. Develop connections and partnerships with the IAU Commissions working in the areas of communication and

public outreach (C.C2) and education (C.C3).

The organizing committee of B4 includes: Gabriele Giovannini (President), Anthony Beasley (Vice-President), Wim van Driel, Xiaoyu Hong, Thijs van der Hulst, Joseph Lazio, Nicholas Seymour, and Tony H. Wong. 



GABRIELE GIOVANNINI is Vice-President of Division B Commission 40, Radio Astronomy, and a professor at the Institute of Radio Astronomy, Bologna, Italy. He studies the nuclear properties of nearby radio sources and nonthermal emission in clusters of galaxies.

COMMISSION B6

Astronomical Photometry and Polarimetry

By SAUL ADELMAN

Commission B6, Astronomical Photometry and Polarimetry, continues the distinguished history of Commission 25, which made profound and substantial contributions to the advance of astronomical research since 1922.

Photometric and polarimetric techniques and standardization are essential tools in the exploration and investigation of astronomical objects and quantities. A wide range of science requires calibrated photometry at or better than the 1% level: investigations of cosmology and the nature of dark energy from photometry of distant galaxies and supernovae; the formation and evolution of galaxies through the measurement of resolved stellar populations; characterizations of exoplanets around nearby stars; measuring stellar variability to map mottled stellar photospheres and to measure stellar pulsations, especially for asteroseismology; and precise luminosity calibration for stellar physics and the cosmological distance ladder. The analysis of polarization in the radiation produced by astronomical sources yields unique information on their geometric structure and the physical

Honolulu Weather Forecast 5-6 August 2015

WEDNESDAY, 5 AUGUST		High: 83°F/28°C Low 73°F/22°C
Morning	Afternoon	Evening
Partly cloudy	Partly cloudy	Partly cloudy
25% chance of rain	45% chance of rain	20% chance of rain
THURSDAY, 6 AUGUST		HIGH: 84°F/29°C Low 73°F/23°C
Morning	Afternoon	Evening
Partly cloudy	Mostly cloudy	Mostly cloudy
20% chance of rain	60% chance of rain	30% chance of rain

Extended forecast: Tropical Storm Guillermo is weakening and is forecast to pass north of O'ahu on Thursday. A high surf advisory with a warning of rip currents for the island's east-facing shores was issued on Sunday and will remain in effect through 12 noon on Thursday. Source: [Weather Underground](#).

Special Guests in the Exhibit Hall!

Among the programs highlighted by the IAU at Booth 329 in the Exhibit Hall are those being carried out under the Cosmic Light theme for IYL 2015. Please come by during the morning and afternoon coffee breaks to meet the leaders of these projects:



Wednesday, 5 August 10:00 am & 3:30 pm	Cosmic Light Project Coordinator Rick Fienberg, Galileoscope
Thursday, 6 August 10:00 am & 3:30 pm	Cosmic Light Project Coordinator Constance Walker, Quality Lighting Teaching Kit
Friday, 7 August 10:00 am & 3:30 pm	Cosmic Light Project Coordinator Constance Walker, Quality Lighting Teaching Kit
Monday, 10 August 10:00 am & 3:30 pm	Cosmic Light Project Coordinator Rosa Doran, Cosmic Light EDU Kit
Tuesday, 11 August 10:00 am & 3:30 pm	Cosmic Light Project Coordinator Pedro Russo, Dark Sky Meter App
Wednesday, 12 August 10:00 am & 3:30 pm	Cosmic Light Global Coordinator Sze-leung Cheung, IAU Office for Astronomy Outreach
Thursday, 13 August 10:00 am & 3:30 pm	Cosmic Light Project Coordinator Rosa Doran, Cosmic Light EDU Kit

processes occurring at and around the source and between the source and the observer.

Standardization is vital. Knowing that another observer measures in a standard system provides a lot of information, even if it is not clear what this information means in exact physical terms. Standardization means compatibility between different systems of measurement. It is inescapable for exchanging data or merging data from different sources. Photometry and polarimetry are extending in wavelength coverage, sky coverage, and to faint

magnitudes, now and in the next decades.

Although many of the new data sets available come from major surveys that are devoting considerable effort to photometric calibrations surveys (e.g., SDSS, PAN-STARRS, DES, VISTA, GAIA, and soon, LSST), there is need for guidance and discussion of topics, such as atmospheric extinction, the standardization of photometric passbands, the transformation between photometric (and spectrophotometric) systems, and absolute calibration in physical units. Likewise the whole sky has been mapped in polarization by the WMAP (radio) and Planck (radio and sub-mm) experiments, that are soon to be followed by optical surveys, such as SOUTHPOL. Understanding and minimizing calibration uncertainties are particularly crucial for polarization measurements. Being able to combine measurements made with all these (and other) major facilities, without losing the exquisite internal precision or introducing systematic errors, will be a major task for B6.

The Working Group on Infrared Photometry, formally established at the 1991 IAU GA, has been concerned with the improvement of IR photometry. The advantages of IR Working Group passbands that fit within and are not defined by the terrestrial atmospheric windows still need to be better promoted, as many IR systems do not properly transform to this system. Another important issue for infrared photometry is that there are many variations of the generally accepted systems (i.e., J, H, and K bands) from different surveys such as 2MASS and DENIS and from different telescopes throughout the world. These measurements generally do not have associated transformations between the competing systems. ♀



SAUL ADELMAN is the incoming President of the new Commission B6, Astronomical Photometry and Polarimetry. He is a professor in the physics department of The Citadel, Charleston, South Carolina, and received the 2011 Governor's Award for Excellence in Scientific Research at an Undergraduate Institution in recognition for his work on the chemical composition of stellar atmospheres.