INQUIRIES OF HEAVEN

IAU 28TH GENERAL ASSEMBLY, BEIJING, CHINA , AUGUST 20 - 31, 2012 WEDNESDAY, AUGUST 22, 2012 DAY 3

Exploring the vast universe hand in hand, Working together toward a better future for humankind

– Speech at the opening ceremony of the 28th IAU General Assembly

Xi Jinping

Vice President, the People's Republic of China

Dear honored chairman, ladies, gentlemen, and friends,

Today, more than 2000 astronomers from all over the world gather together in Beijing to attend the 28th General Assembly of the International Astronomical Union. This is a grand event for astronomy. It is the first time for China to host an IAU General Assembly since China joined the IAU in 1935. On behalf of President HU Jintao, the Chinese Government, and the Chinese people, I am here to express our warm congratulations to this General Assembly, and express our sincere gratitude and cordial welcome to all attendants.

Astronomy, as the science to explore the universe, is one of the most important and the most active scientific frontiers that has pushed forward natural sciences and technology, and led to the advances of modern society. It has tremendously important influences on the progress of other branches of natural science and the development of technology. The vast expanse of space always stirs the curiosity of human beings on the earth, fascinates them, and has attracted generations after generations to devote themselves to the exploration of the universe. As the science to study the position, distribution, motion, morphology, structure, chemical composition, physical properties, origin, and evolution of the celestial bodies and matters in the universe, astronomy occupies an important position in the humans' activity of understanding and transforming the world. As we see, every major discovery in astronomy has deepened our understanding of the mysterious universe, every significant achievement in astronomy has enriched our knowledge repository, and every breakthrough in the cross-disciplinary research between astronomy and other sciences has exerted both immediate and far-reaching impacts on fundamental science and even human civilization.

As one of the ancient civilizations in the world, the ancient Chinese used to work after sunrise and rest after sunset, and started to gaze at the starry sky from very early on. At the end of the Warring States period more than 2300 years ago, the great romantic poet Qu Yuan in his "Inquiries of Heaven" queried "Whoever has conveyed to us, Stories of the remotest past? Who can verify the shapeless, Beginning time has overcast?" Our ancestors already built their astronomical observatories as early as 13th century BCE or even earlier, and we have kept the longest and most comprehensive records of astronomical phenomena in the world. Modern astronomy in China started 90 years ago, with the Chinese Astronomical Union being founded in 1922, the Chinese Astronomical Research Institute founded in 1928, and the Purple Mountain Observatory built in 1934. Since the founding of the People's Republic of China, especially since its reforming and opening up, Chinese Academy has established the systematic operating mechanism of modern astronomical observatories, after building the large sky area multi-object fiber spectroscopic survey telescope (LAMOST), now is constructing the five-hundred-meter spherical radio telescope (FAST), and is also making progress in space astronomy and Antarctic astronomy.

The advancement of astronomy is the result of the efforts of all humankind, and manifests the wisdom of humanity. The history of its development has offered us very valuable and profound enlightenment.

First, the development of science and technology is the driving force for humankind's exploration and transformation of the materialistic world. Science and technology are the most active, most revolutionary factor in eco-social development. Every grand advancement of human civilization is closely related to the revolutionary breakthrough in science and technology. The development of science and technology has profoundly changed the way people live and work, and science and technology are becoming the main driving forces for eco-social progress. To achieve sustainable eco-social development and wholesome development of human beings, it is critical to rely on scientific progress and technological innovation.

Secondly, the development of science and technology requires persistent exploration and long term accumulation. The exploration of the mysterious universe, just like the explorations of other science branches, should be endless. Science and technology, as the achievements of humankind in their exploration and transformation of the world, are the creative products of scientists only after their persistent exploration and long term accumulation. Only working in full devotion, exploring with never-ceasing steps, furthering continuously on the shoulders of giants, can one reach the pinnacles of science and drive the progress of humankind.

Thirdly, the development of science and technology requires to continuously emphasize and strengthen basic research. Astronomy as an observational science is a very crucial field of basic research. Such a field requires strategic plans for deployment in advance, with full respect to the internal logic of research activities and their long-term benefits. We will make larger and larger investments in such a field and ensure their execution, provide long-term and stable support to scientists, so that the scientists can discover, invent, create, and advance constantly, and make more and more achievements that will benefit humankind.

Fourthly, the development of science and technology requires broad and sound support from the public. Science and technology are a noble course that both benefit and rely on society, and the full development requires not only public understanding from all sides, but also the active participation of the public. Public outreach should be given equal emphasis as scientific research to educate the public, so as to create a positive atmosphere for the public to respect, love, learn and use science, and to inspire the creativity for science and technological innovation among the public.

Fifthly, the development of science and technology requires extensive international cooperation. Science and technology have no nationality! The vast expanse of space is the common home of all humankind; to explore this vast universe is the common goal of all humankind; astronomy in fast development is the shared fortune of all humankind. Nowadays the challenges for science and technology are more and more globalized, and all humankind are faced with the same problems in energy and resources, ecological environments, climate change, natural disasters, food security, public health, and so on. Both basic research such as astronomy and these common problems require scientific and technological exchanges and cooperation in various forms between different nations and districts, in order to push forward science and technological innovation, human civilization, sustainable development, and to benefit all humankind.

Today's world is an open world, and countries are depending on each other more and more heavily. In the past 30 years, China opened its gate not only for economic development, but also for exchanges and cooperation in science and technology. Especially since the advent of the 21st century, China has hosted a series of important international conferences in

natural sciences and engineering disciplines, such as the international congress of mathematicians and the World's Engineers' Convention and so on. This has greatly broadened the international horizon of the Chinese science and technology community, deepened the world's understanding of China, promoted mutual exchanges and cooperation between the Chinese and international science and technology communities, and created favorable conditions for the Chinese community to make their contributions to the world.

The convening of the 28th IAU General Assembly in China, I believe, will certainly promote the friendship between Chinese astronomers and astronomers from other countries, promote the exchanges and cooperation between the Chinese and international astronomy communities, and promote the development of China's astronomy and other related sciences. This convention, I believe, will inspire curious youngsters from all over the world including China to cast their attention and desire to the vast universe, and motivate them to devote themselves to the observations and studies in astronomy, and to science and technological innovations.

Finally, I wish this General Assembly a great success, and wish astronomers from all countries to explore the vast universe hand in hand, and to work together toward a better future for humankind.

Thank you, all! ■

Interview with the Nobel Prize Laureate Brian Schmidt

Q: How has the Nobel Prize changed you?
A: Well it certainly made my life very busy. I get to do all sorts of interesting things, but the fundamentals are the same. It's just the amount that I get to do is much larger.

Q: Your discovery opened up the field of dark energy. What is the future of this field?
A: It's unclear. It requires very large experiments. I think we see big experiments continuing on supernovae, but also things like baryon acoustic oscillations are very exciting. A somewhat unexpected thing for me was the weak lensing of the cosmic microwave background. Then there is weak lensing in general through optical galaxies. I was asked once if I could put all my money in one place, where would I put money to solve the questions of dark energy. I'd have to put it into theory, because the evidence is that dark energy is very similar to a cosmological constant. I suspect that's why we are doing experiments. Also, there's a big survey of the southern sky building on the success of the Sloan Digital Sky Survey.
Q: What advice do you have for young astronomers? What are the key skills to form a successful career in Astronomy?
A: You need to be very flexible, in all sorts of things. You do not need to worry about the future so much as to concentrate on what you want to do and learn how to work with other people to accomplish your scientific goals. I think it is very important to say this is what I want to achieve, this is the question I want to do, and go for it. Rather than trying to invent everything yourself, it's very collaborative. Bring the people you need along with you with your vision of where you want to go. That is more or less what I did, and it works very well. Ultimately worrying about the future and being very cutthroat about your science is not going to do you any good in the long term. I think the key is to make sure to do the best you can and accept the fact that there is a random part of what allows you to be a research scientist. Be positive and go for it or be negative and try to take out other people. I always believe in the positive bit. Realize that it is a privilege to do astronomy and our skills are such that we can use them for anything. Revel in the opportunity you have now and the future will take care of itself one way or another.
Q: Astronomy is becoming increasingly international. How do you see China's role in the international scene?
A: I'm familiar with China working in at least three areas in a very serious way. One is LAMOST. This big Galactic archeology project is technically challenging. It will be a new challenge for them. I think it was a bold project. Taking leadership in a project like that is good. I think it will be a challenging project because China has grown up around the site, but it was the right project to do, and that was good. I see China taking a leading role in the Thirty Meter Telescope (TMT). That is a piece of infrastructure in the future, and that is an international collaboration. I see China taking a very strong role in the SKA, and China is leading the way in optical astronomy in Antarctica. Boldly going with a vision where you lead by bringing others with you, I think this is what happens in all these things. Australia is involved with China in Antarctica and that's great! Maybe other countries can be involved as well. LAMOST has scientific input from lots of people. TMT is a massively international project. I see China having huge amounts of people developing technical expertise with amazing ability to do all sorts of manufacturing required in these new telescopes. In 10 or 15 years, you're going to have more astronomers than any other country and I see China being a real leader in astronomy. ■

Interview with the Gruber Prize winner Charles Bennett

Q: What are the scientific highlights of WMAP?
A: In the biggest picture, we now have, really for the first time, a standard model for cosmology. We have set tight limits on the shape of space and determined the expansion history of the universe. It's amazing that we can even rule out specific textbook models of inflation.
Q: What are you working on now?
A: There are still many unanswered questions by WMAP. The one I find most fundamental and fascinating is about inflation. We have from WMAP and some other experiments upper limits on the gravitational wave (B-modes) emitted during inflation. We really want to detect that because the amplitude of that polarisation pattern tells us the energy level of inflation. So I am leading a new experiment called CLASS, designed to detect B-modes from inflation. When completed, it will be deployed in the Atacama desert in Chile.
Q: Will there be future space experiments on polarisation?
A: If we start getting hints of detections on the ground, that will strengthen the call for doing this from space to measure the power spectrum more precisely. Space missions cost a lot and we would like to know there is going to be a signal there to measure. Working from the ground is a much better way to develop the technology and the approach to use later for space missions.
Q: You have worked at NASA for a long time, what are the lessons you have learned?

A: Space missions are very difficult to do, and it takes a lot of people to do them. No person is perfect. Everyone makes mistakes, and there has to be a systematic process to find mistakes. You have to put in various levels of reviewing, double checking, and testing the hardware.
Q: Another issue for any community is: how to reach consensus? You just had the decadal survey in the US?
A: It's a very difficult problem because there are many good things to do. One of the flaws of the decadal survey is that something really has to serve a lot of people for it to get recommended. But if you look at some of the things that have been most important – and I would count for example the Sloan Digital Sky Survey and WMAP – they were NOT recommended by decadal surveys. There was however a program that allowed for things like that to happen. And so these smaller, focused things that are for a smaller group of people – it's very difficult for them to get selected in a big consensus group of scientists. But the consensus group did recommend that there would be an explorer program. I think putting into place several programs that are competitive is a very good thing to do. Then we have a faster turnaround. If something exciting comes up you don't need to wait for another decadal survey or something. We already have a program that can handle it in principle. I'm a very big fan of the explorer program. Both COBE and WMAP were explorer missions. But in that program not everything has to be approved by the entire scientific community. It just has to have a proposal that beats other proposals that time around. I think that's a good thing to do. On the other hand, we would never do the big expensive things if it wasn't for the decadal survey. So I think that's the way to get a balance between the big and expensive things that appeal to lots of people and the smaller focused things that are very important by making sure that the community agrees that there should be these programs. ■

Interviewed by Prof. Shude Mao (NAOC & Manchester). Full transcripts of both interviews will be available online.

Welcome address

I am very honored to welcome you all to the IAU 28th General Assembly (GA) in Beijing on behalf of the Chinese Astronomical Society (CAS).

The Society is very happy to host this GA for the first time in China, especially in this festival year to celebrate the 90th anniversary of the establishment of the CAS.

CAS started to make preparations for the GA in August 2006 when it succeeded in its bid for this meeting. In 2007, associated committees were established to secure the preparation. The collaboration with IAU leadership and staff and experiences from two previous GA meetings have been of great help to us.

I would like to express our sincere gratitude to international counterparts for their continuous support, in particular to Robert Williams, President of IAU, and Ian Corbett, General Secretary of IAU.

I would also like to acknowledge many Chinese scholars and students for their hard work in the preparation, the public for their enthusiasm, and the government for the serious concern and extensive support.

CAS was established in October 1922 and has experienced rapid development, since the founding of the People's Republic of China, and China's opening to the world. At present, CAS consists of 17 Science Committees and has ~2000 members coming from relevant research institutions and universities all over China. Meanwhile, it has over 400 IAU members since it joined the IAU in 1935.

Every year, CAS holds a national Annual Meeting and various kinds of astronomical activities. It has played a vital role in promoting scientific exchange and public awareness of astronomy.

This IAU GA will provide us an opportunity to exchange views extensively with international counterparts. Hopefully, it will promote the development of Chinese astronomy, and provide a platform for international cooperation in astronomy.

Welcome to the IAU 28th General Assembly, and welcome to Beijing. We hope the meeting will be a great success for all of you, and wish you a pleasant stay in Beijing. ■

CUI Xiangqun
Academician of CAS, President of the Chinese Astronomical Society

Understanding Astronomy in China through Recent Major Projects

Dear colleagues,

When I was President of the Chinese Astronomical Society, our application to host the IAU 28th General Assembly in Beijing became successful. Today I am glad to attend the opening ceremony of this GA.

China learned its modern science and technology from the West. However, any nation with some self-respect is not satisfied with always following advanced countries. We hope that one day we can catch up with them, and even surpass them in some fields.

Today I will introduce major projects of Mainland China since 2006. These projects include the following: the Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST), the 21 Centimeter Array (21CMA), the Chinese Spectral Radioheliograph (CSRH), Shanghai 65m Steerable Radio Telescope, the Five-hundred-meter Aperture Spherical Radio Telescope (FAST), the Hard X-ray Modulation Telescope (HXMT), Dark Matter Particle Explorer (DAMPE), Chinese Antarctic Survey Telescope AST3-1, Near-Earth Object Survey Telescope (NEOST), New Vacuum Solar Telescope (NVST), Optical and Near-Infrared Solar Eruption Tracer (ONSET), Deep Space Solar Observatory (DSO), Space Variable Object Monitor (SVOM, a Chinese and French joint mission), and Gamma-ray Burst Polarization Observation Experiment (POLAR). Half of these projects are completed; the others are being developed. Most of these projects have one or more of the following characteristics: 1) they contain important innovations; 2) they are the first projects of their respective types in the world; 3) they give the best performances among projects of their respective types.

For the future, the following projects are being planned or conceived: Antarctic Astronomical Observatory (including a 2.5m optical-infrared telescope and a 5m THz telescope), 20-30m Optical-Infrared Telescope, 110m Steerable Radio Telescope, Large Solar Telescope, LAMOST South, 2m Space Optical Survey Telescope, X-ray Timing and Polarization Mission, etc.

At present China is not yet one of the leading countries in astronomy, but it is approaching this goal. ■

SU Dingqiang
Academician of CAS, Advisor and former president of the Chinese Astron. Society

National Astronomical Observatories, Chinese Academy of Sciences

The National Astronomical Observatories (NAOC) is headquartered in Beijing and has four subordinate units. NAOC operates several observing stations and a wide variety of instruments across the country. In addition, NAOC participates in operating an observation station in South America and is developing a station in Antarctica.

Distribution of NAOC, CAS

Here we will exclusively describe the headquarters (NAOC hereafter). Aiming to be at the forefront of astronomical science, NAOC conducts cutting-edge astronomical studies, operates major national facilities, and develops state-of-the-art technological innovations. Applying astronomical methods and knowledge to fulfill the national interests and needs is also an integral part of the mission of NAOC. In recent years, four National Awards have been granted to researchers at NAOC for excellence in astronomy research.

The Guo Shou Jing Telescope (Large Sky Area Multi-Object Fiber Spectroscopic Telescope, LAMOST) and the Five-hundred-meter Aperture Spherical Telescope (FAST) will be introduced separately in the series, and we will only pinpoint the highlights here. The technology development for LAMOST (active optics for both thin mirrors and segmented mirrors on the Schmidt corrector MA, with a parallel controllable positioning system for 4000 fibers) makes it feasible to fulfill the requirements of a large aperture and a wide FOV simultaneously. FAST uses the unique Karst depression at the site and will be the world's largest single-dish radio telescope when finished.

The Solar Multi-Channel Telescope (SMCT) is a unique video magnetograph that can simultaneously measure the solar 2-dimensional magnetic field and velocity field with different spectral lines.

The 21 Centimeter Array (21CMA) consisting of 80 pods with a baseline of 3 km, which allows us to reach high angular resolution and sensitivity, and provides a unique tool for study of reionization histories and 3D matter distribution at high redshifts. In addition, the 21CMA has also proved to be an efficient neutrino detector.

The Chinese Solar Radio heliograph (CSRH), a radio telescope dedicated to solar observations with high temporal, spatial and spectral resolution, will be implemented to study fundamental problems of energy release, particle acceleration and transportation associated with solar activities, such as solar flares, and coronal mass ejections.

NAOC is also involved with and plays an important role in China's Lunar Exploration Program. NAOC obtained China's first lunar image, the 7-meter resolution full-coverage images of the Moon's surface.

NAOC has also made steady progress in space mission programs. NAOC initiated the Chinese-French Space Variable Object Monitor (SVOM) mission, a multi-band Gamma-Ray Burst (GRB) project. It is designed to detect about 80 GRBs of all known types per year, including those at very high redshift. NAOC is advancing the deep-space Solar Observatory (DSO).

Equipped with a suite of instruments, NAOC participated in the project to quantitatively measure and evaluate astronomical observing conditions, and conduct astronomical research at Dome A.

During the last decade, NAOC has experienced enormous advances. Future large astronomical projects will put even more emphasis on international collaborations, and we are expecting invaluable perspective and advice from our international colleagues. ■

IAU-Gruber Foundation Fellowship 2012 Awarded to Anna Lisa Varri

During the Inaugural Ceremony of the XXVIII IAU General Assembly, the IAU-Gruber Foundation Fellowship 2012, a cash prize of USD 50,000 was awarded to Anna Lisa Varri for her work on stellar dynamics. The winner

was born and raised in Milan, Italy. Her interest in astrophysics sparkled during high school when she came across the subject almost by accident in a science textbook. She decided to drop humanities for what it was and enrolled in physics. She was introduced to astrophysics by her supervisor Giuseppe Bertin, working for her master thesis on non-spherical stellar dynamics.

She obtained her Ph.D. from the Universita' degli Studi di Milano (Italy) where she graduated a month ago. Her research focused on understanding the structure and dynamics of globular star clusters using analytical models and numerical simulations. As a Fulbright Visiting Student Researcher, she also spent time at Drexel University, under the supervision of Enrico Vesperini and Stephen McMillan, primarily performing numerical simulations designed to investigate the dynamical stability and the long-term evolution of rotating dense stellar systems.

After having met a previous Gruber Foundation Fellow at Northwestern University and noticing the announcement on the IAU website, Anna Lisa decided to apply for the Gruber Foundation Fellowship. After finding out that she was the winner of the 2012 round, she started her postdoctoral appointment as a Gruber Foundation Fellow at the Department of Astronomy at Indiana University, where the study of Galactic and extragalactic star clusters is a long-standing and prominent research theme, both from the theoretical and observational point of view. Together with Enrico Vesperini (Indiana) and Steve McMillan (Drexel) she will focus her attention on four open problems in this field: the effects of angular momentum in the early formation stages, the dynamical characterization of multiple stellar populations, the role of internal rotation in the kinematics of the central regions, and the interplay between internal rotation and external tidal fields. Congratulations, Anna Lisa! ■

Thijs Kouwenhoven
Professor, Kavli Institute for Astronomy and Astrophysics

Microsoft Research at the General Assembly of the International Astronomical Union in Beijing

Astrophysics is one of the oldest science disciplines and remains one of the most inspirational areas of scientific discovery. In the "big data" era, the IAU 2012 gathering includes researchers and educators not only in the traditional fields of astronomy and astrophysics, but also informatics, data science, and computer science.

Microsoft Research has a long history of working with the astronomical community. The data- and information-intensive problems presented by the All-Sky Surveys and the Virtual Observatory (VO) have stimulated many innovative software science and engineering ideas at Microsoft Research (MSR). One of the most successful outcomes of the collaboration between MSR and the astronomical community is the WorldWide Telescope, WWT.

WWT was originally created as an educational tool, but it has rapidly become the very best example of the all-sky "Virtual Observatory" research astronomers have been working toward since the advent of the Internet. Today, WWT is the single richest source of astronomical imagery and links online, and it is loved by educators and researchers alike. - Alyssa Goodman, Professor of Astronomy, Harvard University

WWT enables a computer to function as a virtual telescope and more. The WWT software aggregates the best data and imagery from all the main space- and ground-based telescopes in the world; connects seamlessly to the information behind the imagery; allows users to lay their own data on top of the common sky and the Earth imagery; and enables users to tell stories with data very easily. Since the first release in early 2008, WWT has gained millions of users worldwide. For many astronomical professionals, especially educators, WWT has made a fundamental difference in their career. With an exponentially growing community, WWT will continue to serve the users and contribute to the advance of computational astronomy research and science education.

At the IAU 2012, Microsoft Research is proudly presenting the WorldWide Telescope at exhibition booth #46. Together with the WWT Ambassadors from Harvard University, academic collaborators from the National Astronomical Observatory of Chinese Academy of Sciences and China Central Normal University, we are ready to impress and engage with IAU 2012 attendees and create more successful stories of WWT.

"I am immensely impressed with WWT as a teaching and outreach tool and what MR has done to make it both appealing and practical. The IAU has recently commenced a large global program to use astronomy as a tool for education and technology development and I believe that WWT should be a key element in that entire effort." - Bob Williams, President of the International Astronomical Union (IAU)

WWT has set forth a successful example for Microsoft to develop mutually beneficial collaborations with academia. In addition to WWT, we are looking forward to introducing visitors at our booth to other cutting-edge Microsoft technologies, including Layerscape, Microsoft Translator, and Kinect for Windows. ■

Yan Xu
Senior Research Program Manager, Earth, Energy, and Environment at Microsoft Research

JD5: From Meteors and Meteorites to their Parent Bodies:

Current Status and Future Developments

Joint Discussion 5 will be held from 22 to 24 August. The aim is to share the latest knowledge on the small Solar System bodies and also the possible parent bodies of meteors, meteorites and interplanetary dust from as wide a perspective as possible. Latest results will be presented from several international campaigns of ground-based observations, space missions to comets and asteroids (HAYABUSA, DAWN, EPOXI, Post-Stardust, Rosetta, etc.) and meteorite falls and recoveries. Together with dynamical studies, these new results will shed light on physical and chemical relationships between such small bodies. Intensive discussion will create effective strategies for future cooperative work, not only in meteor and meteorite studies, but also in related fields. The meteor showers, meteorite falls, and comet appearances recorded in the Far East over the centuries will also be revisited by modern researches. We expect twelve invited and sixteen contributed talks along with sixteen poster presentations. This JD will be dedicated to the late Brian Marsden, who served as a leader of the Central Bureau for Astronomical Telegrams of the IAU for a considerable time; an invited talk by D. Green on August 23 will review his important role in this field. This JD is coordinated mainly by Commission 22 "Meteors, Meteorites, and Interplanetary Dust" in Division III, and is supported by Commissions 4, 6, 8, and 15 in Divisions I and XII. ■

Leonid meteor storm appeared over Japan in 2001 (Credit: M. Tsumura). This storm provided new insight to the evolution of meteor showers.

Junichi Watanabe
President of Commission 22 IAU; Vice-director general of NAOJ

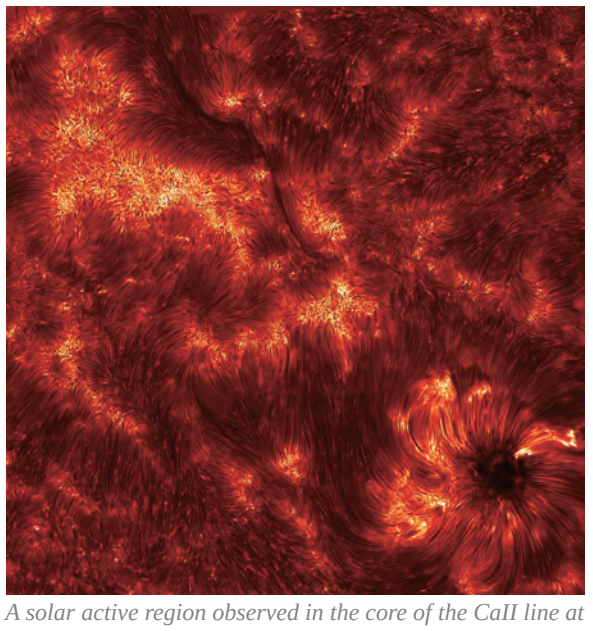
The Age of Large Solar Telescopes

In a drive comparable to that of night-time astronomy towards "Extremely Large Telescopes," several innovative solar telescopes have recently been proposed by the international community.

For many decades, solar telescopes have been built with evacuated optical paths in order to reduce the degrading effects of diurnal seeing, thus keeping their apertures around or below the 1 m limit. However, thanks to technological developments including the feasibility of air-cooled open telescopes for day-time astronomy, and advanced adaptive optic systems, times are now finally ripe for the operation of ground-based solar facilities with much larger apertures.

Newly commissioned telescopes of the 1.5 m class (e.g. NST at Big Bear; GREGOR at Tenerife) are paving the way for many other ambitious projects, including the 4 m US Advanced Technology Solar Telescope (ATST), now under construction in Hawaii and scheduled for first light in 2018, and the 4 m class European Solar Telescope (EST), currently in the design phase. The Chinese community is evaluating the feasibility of an annular solar telescope of 8 m diameter.

Such infrastructures hold promise of a quantum leap in our observational capabilities of the Sun. On the one hand, the increased resolving power of those new facilities will address spatial scales of the order of a few tens of



A solar active region observed in the core of the CaII line at 854.2nm with the IBIS imaging spectrometer.

km at the solar surface (less than 0.1" as seen from Earth), which are predicted by theory to be of fundamental relevance in the structuring of the solar atmosphere. Equally important, the much enhanced collecting power will allow both high cadence and highly accurate spectro-polarimetric measures, necessary to derive precise information about the atmospheric solar magnetic field, an important "player" even under quiet-Sun conditions. Finally, it is remarkable that most of these ongoing projects - from the ground but also from space - are planning to operate their instrumentation as a synergic "suite," capable of addressing the whole solar atmosphere as one seamless system, coupled through the presence of the magnetic field.

The Special Session 6 "Science with Large Solar Telescopes," taking place during this General Assembly, will present and discuss many of these projects and the science that they will enable. An important part of the discussion will be devoted to the new challenges that will accompany operation of these facilities. These challenges include the enormous data streams that the new telescopes will produce (pushing up to 100s of TB/day), as well as the new theoretical and interpretative tools that are needed, especially in the area of spectro-polarimetry, in order to properly interpret the new observations. We envision the Special Session as a starting point for a community-wide discussion on these and other critical issues, for the best exploitation of facilities that will be at the forefront of solar astrophysics for the next decades.

Special Session 6 will take place over 2.5 days starting from the afternoon of Wed. Aug 22, in Room 302A+B. ■

Gianna Cauzzi
Astronomer at the Arcetri Astrophysical Observatory (INAF). She is chairing SpS6 together with Alexandra Tritschler (NSO, USA) and Yuanyong Deng (NAOC).

Astronomy Libraries and You

Are you unsure what your librarians do for you? Would you like to make suggestions about services that could better serve your needs? Come to the sessions organized by the Working Group on Libraries of Commission 5 to find out and to make your ideas known! On Thursday and Friday, August 23. and 24., in Room 409, we are hosting a series of discussions and talks focusing on issues related to the challenges facing astronomy libraries and the role they play in supporting astronomical research. At 08:30 on the 23. we begin with a panel discussion, "Scientists' Need for Libraries in the Age of the Internet." Panelists include astronomers Paul T.-P. Ho (Taiwan), Ray Norris (Australia), and Pieter Degroote (Belgium), and librarians Christina Birdie (India), Eva Isaksson (Finland), and Sally Bosken (USA). Audience participation is encouraged! A particularly timely presentation on "Open Access Publishing in Astronomy" by Uta Grothkopf and Silvia Meakins (Germany) follows at 10:30. The afternoon sessions on Thursday include topics such as tracking publications and the H-index. On Friday at 08:30 Jill Lagerstrom (USA) will discuss bibliometrics, followed by presentations on document preservation and e-books vs. paper books. The Friday afternoon sessions begin at 13:00 and include the topics of digital scholarship and the value of historical books. The day concludes with an open discussion of best practices for institutional bibliographies. Please join us for these sessions, which will undoubtedly bring forward some thought-provoking ideas and should help you to appreciate the complex and rapidly changing environment of scholarly publishing that our astronomy librarians are helping us to navigate.We would like to thank our generous sponsors, IOP, IEEE, SPIE, and Elsevier as well as the IAU LOC, especially Katherine Chen, for outstanding support of the Working Group Libraries. ■

Marsha Bishop
Marsha Bishop (NRAO/USA), Robert Hanisch (STScI/USA), co-chairs, Commission 5 Working Group on Libraries

Commission 14 science meeting

Friday August 24, 14:00-18:00 hr, room 405

Following a brief business meeting, there will be a series of short talks on recent results in atomic and molecular spectroscopy relevant for astronomy as well as data needs from projects such as Herschel and ALMA. Speakers include Mashonkina, Zhao, van Dishoeck, Menten, Caselli and Kwok. The program also contains two guest speakers from the world-renowned Chinese Dalian Institute for Chemical Physics who will highlight state-of-the-art experimental techniques and theoretical methods to study astrophysically relevant reactions. For the full program, see http://home.strw.leidenuniv.nl/~sanjose/IAU_General_Assembly_Commission14. ■

Ewine van Dishoeck
Professor, Leiden Observatory

A Message from Division II

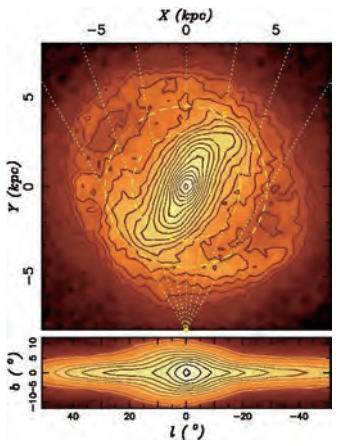
Division II, Solar and Heliosphere, of the International Astronomical Union hosts a Working Group on "International Collaboration on Space Weather" (ICSW). Analogous to the weather in Earth's lower atmosphere, Space Weather involves the changing environmental conditions in near-Earth space or the volume of space from the Sun's surface to the Earth. Space weather can also involve the interactions of solar activity with other planets or at deep-space spacecraft. Much of space weather is driven by energy carried through interplanetary space by the solar wind from solar activity such as flares and coronal mass ejections. The main goal of this WG is to provide a clearinghouse of information on space weather organizations and activities in countries around the world. There will be a meeting of this WG at the General Assembly on August 23 from 8:30 am until noon in Room 403 at the Conference Center. Please see the Chair, David Webb, of the ICSW working group if you wish to give a short presentation about your country's space weather activities. ■

David Webb *Chair, Working Group on "International Collaboration on Space Weather"*

The Milky Way in the age of large surveys

These are exciting times for Milky Way astronomy. Not only are we eagerly awaiting the launch of ESA's Gaia satellite next year, which will measure distances, velocities, and spectral properties for a billion stars, but also many on-going and planned surveys with telescopes all over the world are, and will be, giving us unprecedented new data. Together with the models needed for their interpretation, these data are already bringing about a new era of understanding of the structure and formation of our home galaxy.

The Milky Way, or also "the Galaxy", is one of numerous spiral galaxies, similar to many that can be observed in our local universe. Together with its neighbour, the Andromeda galaxy M31, and a number of smaller systems, it forms the Local Group, a sparse association of galaxies in the outer reaches of the Virgo cluster. Most of the stars in the Milky Way, including the Sun, are found in a rotating thin disk emitting about sixty billion solar luminosities. The central bulge, a three-dimensional system of old stars, contains about 20% of the total light. However, the dominant component by mass is the Milky Way's dark matter halo, reaching



Top: Face-on view of one simulation snapshot, scaled to the Milky Way. Bottom: edge-on view of the same snapshot.

a distance of at least 100 kpc and containing about ten times more mass than all the stars and gas put together.

In its motion around the Galactic centre and up and down in the disk, the Sun is currently inside the layer of gas and dust in the Galactic disk's mid-plane. Therefore much of the inner Galaxy is obscured by dust, and thus it has taken some time to understand that our Milky Way is a barred galaxy with a central box-peanut bulge. Recent sensitive near-infrared surveys penetrated the dust and have made it possible to observe the detailed structure of the bulge, including a characteristic X-structure predicted by galactic evolution models. In these models, such a boxy bulge forms through bar-buckling instabilities in the disk. It has a characteristic cylindrical rotation pattern, and is surrounded by a flatter elongated bar in the disk extending to about twice its radius. Large spectroscopic studies of bulge stars and star counts have verified these predictions and have also given us the first evidence for different evolutionary components in the bulge, characterized by their element abundance distributions and vertical scale-heights. The disk instability in the Milky Way must have occurred long ago. We know this because no young or intermediate-age stars are seen in Baade's Window. If the instability had occurred recently, it should have scattered younger stars up into the bulge.

As for the bulge, we are learning a lot about the Milky Way's stellar and dark matter halo, and about its main baryonic component, the disk. The stellar halo is a small part of the Milky Way, containing only about 2% of the stars. A number of small satellite galaxies and streams have been discovered recently, showing evidence that much of this component may have been accreted from outside as predicted by the hierarchical model of structure and galaxy formation. Recent large spectroscopic surveys of halo stars have also made it possible to measure the mass and extent of the dark matter halo much more accurately than previously possible, resulting in a relatively small total mass for the Milky Way compared with model predictions, about 10^{12} solar masses. A new large survey beginning next year will measure detailed element abundances for a million stars mostly in the disk, and will attempt to group these stars in abundance space in order to learn about their formation environments.

Only in our Milky Way can we obtain detailed information for many individual stars. The results will inspire us about what to look for in external galaxies. What we will learn about the formation of our Galaxy from Gaia and the ground-based surveys- will enlighten our quest to understand galaxy formation in general. ■

Ortwin Gerhard

Professor at the Max-Planck-Institute for extraterrestrial physics (MPE) in Garching, Germany

C41/ICHA Activities at GA

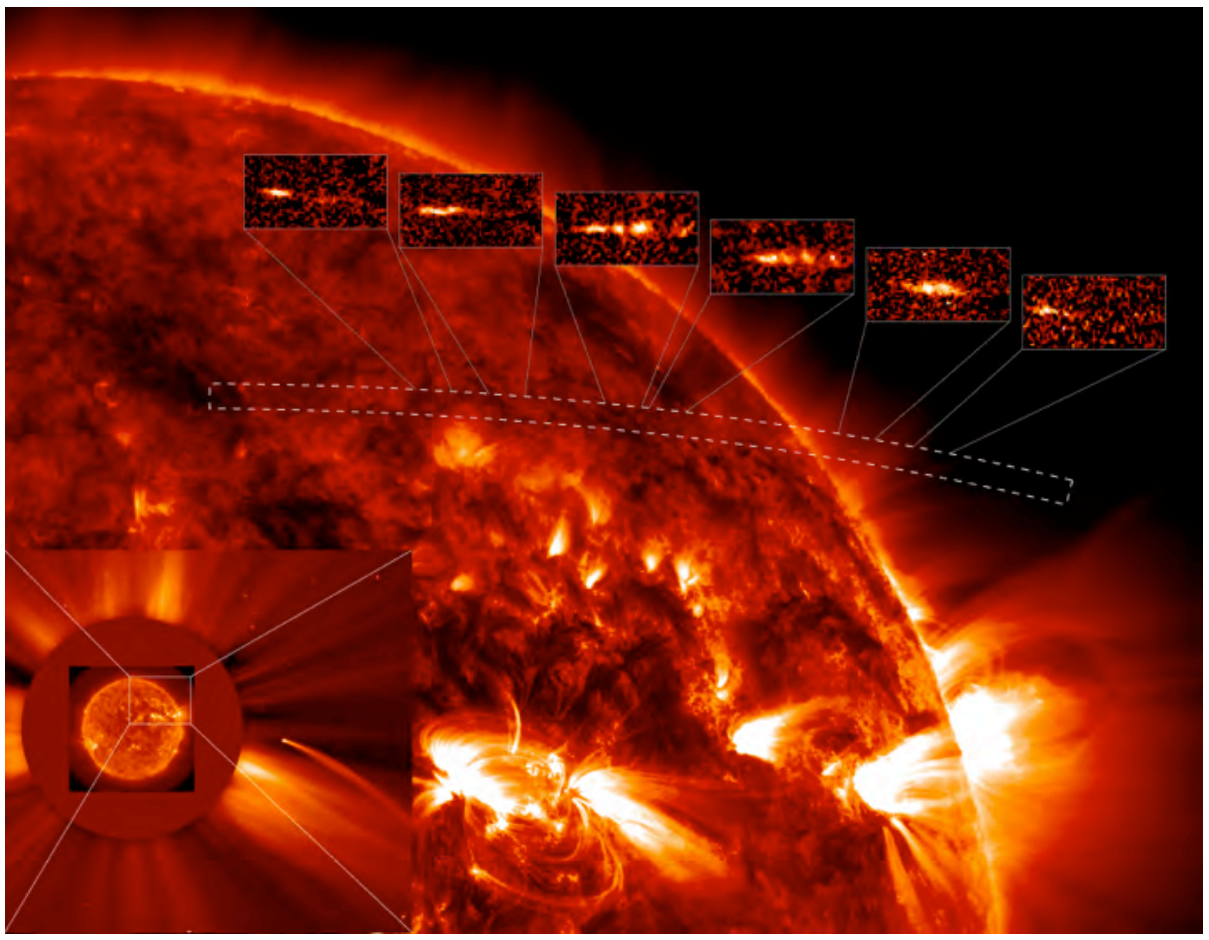
The Commission and its Working Groups have planned a number of business and science meetings at the 2012 IAU General Assembly. As these were not included in the scientific sessions program book, as a service to the general membership of the IAU, we include those for August 22 and 23 in this issue.

Wednesday, August 22 Room 402B
Session 3 (14:00 – 15:30) C41/ICHA Business Meeting
Session 4 (16:00 – 18:00) Invited keynote lecture: "When the Chinese met the West: A Review of the Dissemination and Influence of Indian, Arabic and European Astronomy and Astrology in the Imperial China," by Prof. Shi Yunli, Department of the History of Science, University of Science and Technology of China.followed by … C41/ICHA Science Meeting 1: Field Expeditions (organised by Rajesh Kochhar, Sara Schechner and Jay Pasachoff) Rajesh Kochhar, Chair
16:30 – 16:48 Vitor Bonifácio: The mid 19th and early 20th century pull of a nearby eclipse shadow path
16:48 – 17:06 Françoise Le Guet Tully and Santiago Paolantonio Observatories in South America: from astronomical expeditions to the foundation of national observatories
17:06 – 17:24 Ian Glass: La Caille's expedition to the Cape of Good Hope 1751–1753
17:24 – 17:42 Emanuel S. Mumpun and Bambang Hidayat: Social Impact of the Solar Eclipse in Indonesia: a comparative study
17:42 – 18:00 Discussion

Thursday, August 23 Room 402B
Session 1 (09:00 – 10:30): Sara Schechner, Chair
09:00 – 09:18 Ramesh Kapoor: Did Ibn Sina observe the Transit of Venus of 1032 CE?
09:18 – 09:36 Rajesh Kochhar: Transits of Venus and modern astronomy in India
09:36 – 09:54 Lu Lingfeng: Science news or astrological debating: Chinese records of the transit of Venus of 1874
09:54 – 10:12 J. McKim Malville and John Pearson: The eclipse expeditions of the Lick Observatory and the beginnings of astrophysics in the US
10:12 – 10:30 Jay Pasachoff: Expeditions to death and disaster: Chappe d'Auteroche and Charles Green at the 1769 transit of Venus
Session 2 (11:00 – 12:30): Jay Pasachoff, Chair
11:00 – 11:18 Gennadiy Pinigin and Zhanna Pozhalova: The value of the astronomical expeditions to West Spitsbergen, 40 years later
11:18 – 11:36 Sara Schechner: Astronomy behind enemy lines: Colonial American field expeditions, 1761–1780
11:36 – 11:54 Gudrun Wolfschmidt: Solar eclipse expeditions of Hamburg Observatory
11:54 – 12:12 Chris Sterken: Houzeau's visual magnitude estimates in Jamaica in 1868
12:12 – 12:30 Discussion

Discovery and Classification in Astronomy
Session 3 (14:00 – 15:30): Ken Kellermann, Chair
14:00 – 14:30 Ron Ekers: The Reclassification of Pluto as a Dwarf Planet
14:30 – 15:00 Steven Dick: A General Framework for Discovery and Classification in Astronomy
15:00 – 15:30 Martin Harwit: Discovery and the Search for the Design of the Universe

Session 4 (16:00 – 18:00): Steven Dick, Chair
16:00 – 16:30 Barry Madore: Cognitive Astrophysics
16:30 – 17:00 David DeVorkin: "A Desideratum in Spectrology": an Editor's Lament in the Great Correlation Era
17:00 – 17:30 Ken Kellermann: The Overdue Discovery of Quasars and AGN
17:30 – 18:00 Ray Norris: Mining the Observational Phase Space ■

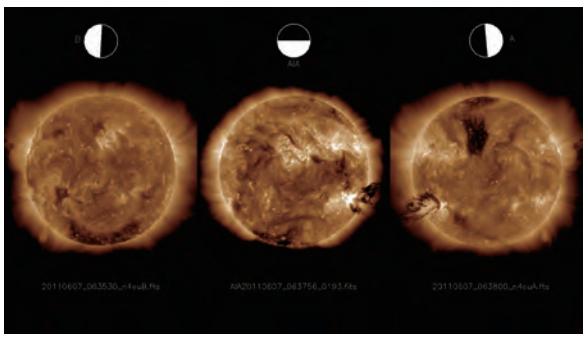


On 2011/07/06 AIA on the Solar Dynamics Observatory observed, for the very first time, the destruction of a Sun-grazing comet C/2011 N3 (SOHO) within the solar corona, by Wei Liu (Stanford Univ & Lockheed Martin Center).

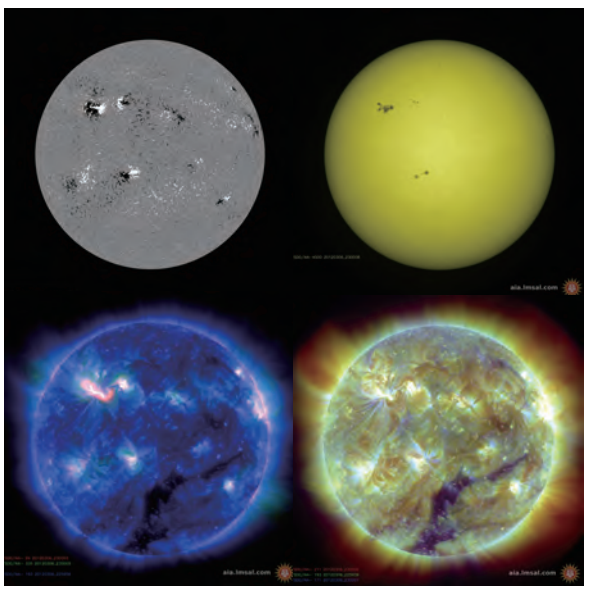
A NEW RENAISSANCE FOR SOLAR AND SOLAR AND HELIOSPHERIC PHYSICSS

In the three years since the last IAU General Assembly much has changed for solar and heliospheric physicists. They are being deluged with multiple terabytes of observational material each day. They achieved global coverage of the nearest star and can image ejections from the Sun to beyond the Earth (with STEREO perspectives since early 2011). They are receiving glimpses of the outermost reaches of the heliosphere (from the Voyagers, after 35 years in flight). They are seeing a revival of solar activity after an unusually low sunspot minimum and associated weak heliospheric field. The analysis of their data and the numerical experimentation throughout the vast and diverse solar-heliospheric realm are supported by computers that continue to grow in capacity in step with Moore's law. The Kepler spacecraft is providing information on tens of thousands of Sun-like stars and their planetary systems, thus complementing the observations of hundreds of similar stars being made by ground- and space-based spectroscopic observatories.

Solar physics continues to be strongly rooted in observations, but in some ways these developments enable it to approach experimental physics. The ever-growing archives of solar observations allow us to find other events occurring under similar yet distinct conditions. The growing stellar database allows us to look for dependencies of processes on surface gravity, rotation rate, chemical composition, or the effects of stellar and perhaps even close-in planetary companions. Virtual observatories in state-of-the-art computers facilitate studying the effects of physical processes from radiative transport to partial ionization, from environments with weak to those with strong magnetic fields, and even to learn about the internal magnetohydrodynamics of a star validated through helioseismic observations. These developments continue to make the Sun and the heliosphere important touchstones to test our emerging approximate physical descriptions prior to applying them to astrophysical conditions for which observations are much more limited.



Three perspectives of a massive solar ejection on 2011/06/07, captured by the AIA/SDO (center) and by the STEREO behind (left) and ahead (right) of the Earth, revealing long-range couplings between magnetically-driven phenomena. Image by Ralph Seguin (Lockheed Martin)



Views of the Sun obtained with the AIA and the Helioseismic and Magnetic Imager on SDO on 2012/03/07, hours before a major X5.4 flare. Clockwise from the top left: magnetogram, visible light image, and two EUV 3-channel composites: 211A/193A/171A (characteristic of 0.8MK-2.5MK) and 94A/335A/193A (2MK-5MK). Images for other dates can be found at http://sdowww.lmsal.com/suntoday/.

Seeing the Sun and inner heliosphere in action from all angles has made us realize that many of the explosive and eruptive events that we observe are influenced not only by local conditions, but also by distant processes, sometimes a full hemisphere away: flares and coronal mass ejections draw their energy from the local electromagnetic field, but the timing of their occurrences, and the details of their evolutions, are influenced both by the gradual change of the large-scale surrounding field and by the details of distant explosions that distort that field on short time scales. As a result, we see "sympathetic flaring" in a new light, aided by the interpretation of numerical experiments that show how sets of flux ropes can cascade into instability as the high field is pulled out of shape like sticky caramel.

The research community is learning how to deal with the rapid increase in data volumes: the growth in the research community of less than a factor of two is no match for the thousand-fold increase in data rates from our observatories over the past decade. Often, finding the data is no longer the primary problem, but rather processing or transportation is. Work is underway to automate feature finding and to enable data analysis tools to work at the archive rather than to move data to the analyst's environment.

As elsewhere in science, the questions are shifting as fast as the answers come in to the preceding set. With local dynamo action now viable in the computer, how do we tackle and validate full-sphere simulations from the Maunder minimum to the 2009 sunspot sabbatical? With transient and partial ionization coming in reach in chromospheric simulations, how do we deal with energetic particle populations escaping from the corona? With climate modeling confirming that global climate in recent decades is insensitive to solar variability, how do we understand regional resonances between weather patterns and the sunspot cycle? As we begin to form a comprehensive picture of space weather from its origins to geospace, how do we establish how to develop defenses for our ever-growing electrical and electronic infrastructure? As we uncover evidence that the most powerful flares seen on young stars no longer happen on the star we live with, how do we validate the tantalizing findings that the societal impact associated with the relatively modest solar events is much larger than we realized?

Solar and heliospheric physics are vibrant, relevant, and exciting fields. Join us in SpS6, SpS10, JD3, or IAUS 294 to see solar and heliospheric science in action. ■

Karel Schrijver
Incoming president of IAU Commission 10 (Solar Activity). He is a senior fellow at Lockheed Martin's Advanced Technology Center

The Opening Ceremony:
From High-Profile Guests to High-Flying Performances

There was a full house in Plenary Room B yesterday for the Opening Ceremony of the General Assembly (GA). While the programme promised fascinating scientific talks, a display of Chinese acrobatics and other entertainment, the main draw for GA delegates was the welcome address by a Senior Government Official. As the ceremony began, the delegates were asked to stand to welcome the arrival of Robert Williams, President of the IAU, and the highly anticipated VIP guest, who was revealed to be Xi Jinping, Vice President of the People's Republic of China.

In his welcome address, Williams spoke of the rich history of Chinese astronomy and the "perceptive studies of the cosmos that were being made 2,000 years ago [in China] that still remain valid today". Looking forward, Williams gave an overview of the many modern astronomical facilities constructed by Chinese institutes, such as LAMOST. These facilities were later discussed in greater detail by invited guest speaker Su Ding-qiang, an Academician of the Chinese Academy of Sciences.

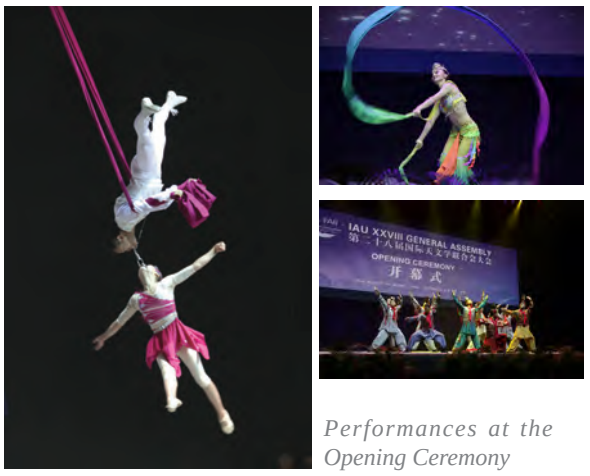
Before handing the podium over to Xi Jinping, Williams commented how the attendance of such a Senior Government Official at the Opening Ceremony demonstrates the high value that the country's government attaches to science.

Indeed, Xi Jinping, who studied chemical engineering at Tsinghua University in Beijing, spoke of the important role that astronomy plays in society. "Astronomy, as the science to explore the Universe, is one of the most important and the most active scientific frontiers that has pushed forward natural sciences and technology, and led to the advances of modern society," he said.

In his speech, Xi Jinping also discussed the importance of disseminating scientific research: "Public outreach should be given equal emphasis as scientific research to educate the public, so as to create a positive atmosphere for the public to respect, love, learn and use science." In closing, he discussed how convening the IAU GA in Beijing will promote international cooperation between astronomers in China and the rest of the world. Xi Jinping left the room to a standing applause of gratitude and appreciation for his inspiring welcome address.

The next order of business at the Opening Ceremony was the 2012 Gruber Prize presentations. Anna Lisa Varri, Università degli Studi di Milano, was announced as the 2012 Gruber Fellow, and Charles Bennett and the rest of the WMAP team were awarded with the 2012 Gruber Cosmology Prize. During his acceptance speech, Bennett thanked his family for their understanding for his "obsessive devotion to the WMAP mission" and added a lighthearted note that, despite his new honour and recognition, he will "continue to do [his] chores and take out the trash".

The magnitude of Bennett and the WMAP team's work in understanding our Universe was later highlighted by Jocelyn Bell-Burnell, during her presentation that looked at how astronomy has changed in the past 100 years, and where it may take us in the next 100.



Performances at the Opening Ceremony

Given this is likely to be the biggest ever GA, with 3,300 people already registered, it was only fitting that the finale of the Opening Ceremony had an Olympic feel to it. First on the line up was a Chinese drum performance, followed by several traditional dances and a musical instrument performance. And while in other instances the incredibly skilled silk acrobatics would have stolen the show, to an audience of astronomers, it was the mock-up of radio telescopes using silver umbrellas by staff and students from the NAOC that carried favour.

The final word went to Xiangqun Cui, President of the Chinese Astronomical Society, who commented that preparations for this GA started six years ago. Based on the first two days and the wonderful Opening Ceremony, it already promises to have been worth the hard work. ■

Sarah Reed *IAU Public Outreach Coordinator / NAOJ*

Chinese Classics

有物混成，先天地生。寂兮寥兮，独立而不改，周行而不殆，可以为天地母。吾不知其名，强字之曰道，强为之名曰大。

There is a thing integratedly formed and born earlier than heaven and earth. Silent and empty. It relies on nothing. Moving around for ever. We may regard it as the mother of all things. I do not know its name. So I name it as the "Tao", And further name it as the Great.

Lao Zi (c. 6th-5th century BCE)

Day 3: Program Summary

Plenary Talk by Andrew Fabian (8:30-10:00):
Probing General Relativity using accreting black holes

Gruber Lecture by Charles Bennett (12:45 -14:00)

Invited Discourse by Brian Schmidt (18:00-19:30):
Supernovae, the Accelerating Cosmos and Dark Energy

IAUS 288	Neutrinos & sub-mm observations
IAUS 290	Jets and outflows & Probing General Relativity
IAUS 291	Binary pulsars & Vibrations and emission & Pulsar timing and testing gravitational theories
IAUS 292	Gas in galaxies & Cooling flow, high-redshift and reionisation
SpS1	Sources of polluting gas & Formation and evolution of globular clusters
SpS2	Cooling Flows and AGN feedback & Cold gas and star formation
SpS3	Stellar populations & The Milky Way
SpS4	Micky way & Diverse galaxies
SpS 6 "Science with large solar telescopes"	Key scientific questions

JD2, JD3 and JD4 continue. JD5 "From meteors and meteorites to their parent bodies: Current status and future developments" starts.

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