Transactions IAU, Volume XXVIIIB
Proc. XXVIII IAU General Assembly, August 2012
Thierry Montmerle, ed.

doi:10.1017/S1743921315005426

CHAPTER I

TWENTY EIGHTH GENERAL ASSEMBLY

INAUGURAL CEREMONY

Tuesday, 31 August 2012, 14:00-16:00

China National Convention Centre, Beijing

1. Opening Event

The XXVIIIth General Assembly was opened by a Chinese Drum Performance.

2. Opening Address

Prof. Robert Williams, IAU President

Welcome to Beijing and IAU XXVIII General Assembly. Although the world economic situation continues to show stress, the science of astronomy is flourishing on many fronts. True, we are not immune to the negative effects of sharply reduced funding for projects and positions, yet our do-main sees increased international collaboration, pioneering facilities and techniques in development, and significant discoveries that are changing the way humanity thinks about the universe and our place in it. Programs that the IAU has undertaken such as the United Nations International Year of Astronomy 2009 and the creation of the Office of Astronomy for Development in Cape Town have been hugely successful.

The IAU is going through a period of transition from an organization that historically has maintained a largely internal focus emphasizing meetings and events for its members to one that is becoming more involved in education and outreach to the general public. We are also making efforts to foster international collaboration on large facility projects. Several changes to the Statutes are being proposed that will allow broader input and oversight from members on issues such as membership and finances. And most importantly we are proposing for the future that scientific resolutions be presented and discussed at the GA and on the IAU website but that voting be open to all members and conducted electronically following the GA. In addition, the Executive Committee is recommending a change to the divisional structure of the IAU that should organize the divisions more in line with current major research themes in astronomy. As the first large astronomical meeting of this nature to be held in China the present General As-sembly is a historic occasion for Chinese astronomy. It represents the tremendous growth in science in this country and increased funding that has enabled new projects and departments, and has attracted large numbers of students to undertake post-graduate studies in astrophysics.

We will see evidence of this activity in the talks and posters, of which many will be authored by young investigators.

The astronomical community in China has joined together to create an excellent venue and program of activities that make the General Assembly an ideal place to exchange ideas. There is the old and the new. The ancient traditions and scientific advances of past dynasties have provided a solid foundation for China?s innovative projects LAMOST, FAST, and AMiBA. You can experience excellent examples of both the old and the new in one place that you must visit while you are at the GA: the Beijing Planetarium. It combines the most modern facilities for astronomy education and outreach with a stunning collection of ancient instruments from the Han and Ming dynasties that long pre-date the instruments of Tycho Brahe on the island of Hven. Like many attractions in the Beijing area, it should not be missed. You should also take the opportunity to make the 10-minute walk over to the Chinese Academy of Sciences compound off Datun Road to visit the National Astronomical Observatories of China.

The "Inquiries of Heaven" daily newspaper will provide useful information for GA attendees. In addition to the daily schedule it will call attention to opportunities that you may find interesting, in addition to posting official information needed for official business meetings.

It is a pleasure to thank our Chinese colleagues who have worked to make the GA a success, and we look forward to a scientific program that will cause you to leave here full of ideas and enthusiasm.

3. Welcome Address by the Vice-President of the People's Republic of China

Mr. Xi Jinping,

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

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 worlds 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!

4. Presentation of Partners, Sponsors and Exhibitors

The IAU and Organising Committees acknowledge the invaluable support of the following institutions and organisations:

Partners
Air China
Beijing Science Video Network
H3C

https://doi.org/10.1017/S1743921315005426 Published online by Cambridge University Press

Microsoft Research
Star Alliance

Sponsors

Associated Universities, Inc.
Astronomy & Astrophysics
Chinese Association for Science and Technology
Chinese Academy of Sciences
National Astronomical Observatory of Japan (NAOJ)
National Natural Science Foundation of China
Wiley-Blackwell
World Wide Telescope Academy Program

Exhibitors

ALMA, the Atacama Large Millimeter/submillimeter Array
American Astronomical Society
Andor Technology
ASTRON Netherlands Institute for Radio Astronomy
Betop Multimedia
Cambridge University Press
Chinese Astronomical Society
Copernicus Meetings & Publications
CSIRO Astronomy and Space Science
Division for Particle Astrophysics, Institute of High Energy Physics, Chinese Academy of Sciences
European Southern Observatory (ESO)
European VLBI Network
Fulldome.pro
Finger Lakes Instrumentation
GREAT - Gaia Research for European Astronomy Training
Institute for the History of Natural Sciences, Chinese Academy of Sciences
Instituto de Astrofsica de Canarias
International Astronomical Union Office of Astronomy for Development
The International Centre for Radio Astronomy Research
Korea Astronomy and Space Science Institute
Cherenkov Telescope Array, HESS/MAGIC/VERITAS
Nanjing Institute of Astronomical Optics & Technology, NAOC
Nanjing iOptron Scientific, Inc.
National Astronomical Research Institute of Thailand (NARIT)
National Astronomical Observatories, Chinese Academy of Sciences
National Hellenic Research Foundation
National Radio Astronomy Observatory
National Time Service Center, Chinese Academy of Sciences
Oceanside Photo & Telescope
Officina Stellare SRL, Italy
Purple Mountain Observatory, Chinese Academy of Sciences
Santa Barbara Instrument Group
PlaneWave Instruments

School of Astronomy & Space Science, Nanjing University
School of Space Science and Physics, Shandong University at Weihai
Shanghai Astronomical Observatory, Chinese Academy of Sciences
SKA Organisation
Springer
The Kavli Institute for Astronomy and Astrophysics at Peking University
Thirty Meter Telescope (TMT)
Xinjiang Astronomical Observatory, NAOC
Yunnan Astronomical Observatory, NAOC

5. Ceremony Event

Classic Dance of Qin Dynasty
Ancient Traditional Musical Instrument Performance

6. The Gruber Foundation: Presentation of the Cosmology Prize 2012 and TGF Fellowship 2012

The President of the IAU, Robert Williams, opens the Ceremony, in the presence of

- Patricia Murphy Gruber, President Emeritus, The Gruber Foundation
- Charles Bennett, 2012 Cosmology Prize Recipient
- Wendy Freedman, Chair, Cosmology Selection Advisory Board
- Ian Corbett, General Secretary, IAU
- Anna Lisa Varri, recipient of the 2012 Gruber Fellowship

Robert Williams:

In year 2000 the Gruber Foundation created its International Prize Program with its inaugural prize in Cosmology. The intent of the Prizes is to call attention to the importance of accomplishments that benefit mankind in special, important areas of endeavor. The IAU is pleased to have been chosen by the Gruber Foundation to collaborate with them on the Cosmology Prize since its inception. The IAU has an advisory role in the constitution of the selection committee and as part of our collaboration we are very fortunate to receive an annual grant of $50,000 from the Gruber Foundation to be awarded to a postdoctoral fellow.

It goes without saying that the prestige and reputation of any award is determined by the quality of its awardees. By this criterion the Gruber Cosmology Prize has done superbly. During the past decade the Cosmology Prize recipients alone could write as authoritative a history of the universe as any group. The careers of the Gruber Fellows have also benefitted greatly from the resources made available to them by the Gruber Foundation stipend.

In the years of the IAU General Assembly the tradition has been for the Gruber Cosmology Prize to be presented in this Inaugural Ceremony. It is my great pleasure to present to you the President of The Peter & Patricia Gruber Foundation and co-Founder & President Emeritus of The Gruber Foundation, which will continue the Gruber Prize Program as part of Yale University, Patricia Gruber, who will introduce this year?s Cosmology Prize awards ceremony.

Patricia Gruber:

Welcome to the presentation of the 13th annual Cosmology Prize? honoring a leading cosmologist, astronomer, astrophysicist or scientific philosopher for theoretical, analytical, or conceptual discoveries leading to fundamental advances in our understanding of the universe. On behalf of my husband, Peter Gruber, myself, and all of us at the Foundation, we are pleased to be here in Beijing to present this Prize at the 28th General Assembly of the International Astronomical Union. Thank you, Bob Williams, for your warm welcome.

The Cosmology Prize was established in 2000 as the first Gruber international prize, and I would like to acknowledge the vision and leadership of Peter Gruber in establishing this and the other prizes. The Cosmology Prize is presented in conjunction with the International Astronomical Union. It is my pleasure to introduce Dr. Ian Corbett, Secretary General of the IAU, who will say a few words about this fruitful collaboration.

Ian Corbett:

The primary goal of the IAU is the development of astronomy world-wide. To this end, the IAU is pleased to collaborate with the Gruber Foundation on the Cosmology Prize.

The collaboration between the Gruber Foundation and the IAU consists not only of the Cosmology Prize, but also an annual $50,000 Fellowship. The fellowship is administered by the IAU and awarded competitively to a postdoctoral researcher—the stipend is to be used to further his or her research.

Awards are presented to promising young scientists of any nationality to pursue education and research at a center of excellence in their field; the IAU selects recipients from applications received from around the world. The fellowship has been awarded to scientists from Poland, India, Spain, Greece, the Russian Federation, Mexico, the UK, Colombia, and the United States.

The 2012 Gruber Fellow is Anna Lisa Varri, from the Universita' degli Studi di Milano (Italy). Her work focuses on the dynamics of globular clusters, with the aim of providing a more realistic dynamical paradigm for this class of stellar systems. I am happy to introduce her on this occasion and invite her to say a few words.

Anna Lisa Varri: expresses thanks and makes brief remarks.

Patricia Gruber:

Thank you Anna Lisa Varri.

We are here to honor the achievements of Charles Bennett and the Wilkinson Microwave Anisotropy Probe team. But first let me tell you a little about the company they are keeping.

The Foundation's prize program, established in 2000, now presents three annual $500,000 prizes in the fields of: Cosmology; Genetics; and Neuroscience.

Each prize recognizes achievements and discoveries that produce fundamental shifts in human knowledge and culture. Until 2011, the Foundation also awarded prizes in Justice and Women?s Rights. Under our newly enacted succession plan with Yale University, these two prizes are now part of an exciting new program at Yale Law School.

On October 14th, at the annual meeting of the Society for Neuroscience, the Neuroscience Prize will be presented to Lily and Yuh Nung Jan, and the Genetics Prize will be presented at the annual meeting of the American Society of Human Genetics on November 9th, to Douglas Wallace.

Returning to Cosmology, the 2012 Prize recipients were was selected by a distinguished Cosmology Prize advisory board:

- Wendy Freedman (Chair)
- Andrew Fabian
- Gerhard Huisken
- Helge Kragh
- Andrei Linde
- Julio Navarro
- Sadanori Okamura

Owen Gingerich and Martin Rees also serve as special Cosmology Prize advisors to the Foundation. Peter and I deeply appreciate the knowledge, commitment, and enthusiasm that the advisors bring to the judging process. Let me now invite the advisory board Chair, Wendy Freedman, to present the official citation and introduce the scientific accomplishments of our Cosmology Prize recipients.

Wendy Freedman:
The Recipients of the 2015 Prize are Charles L. Bennett and the WMAP Team.

The official citation reads:
The Gruber Foundation proudly presents the 2012 Cosmology Prize to Charles Bennett and the Wilkinson Microwave Anisotropy Probe team for their exquisite measurements of anisotropies in the relic radiation from the Big Bang—the Cosmic Microwave Background. These measurements have helped to secure rigorous constraints on the origin, content, age, and geometry of the Universe, transforming our current paradigm of structure formation from appealing scenario into precise science.

Charles Bennett: Expresses thanks, very brief remarks.

Patricia Gruber:
Please note that Charles Bennett will give a public lecture entitled "From Ancient Light to Modern Cosmology: The WMAP Mission" at 12:45 pm tomorrow in this room. Thank you for attending the 2012 Cosmology Prize ceremony. This concludes our presentation.

7. General Astronomy Talk

Dr. Jocelyn Bell-Burnell presented a talk entitled "Astronomy - Amazing Subject, Amazing Universe". See at the end of this Chapter.

8. Chinese Astronomy Talk

Prof. Ding-qiang Su, Past President of the Chinese Astronomical Society

Understanding Astronomy in China through recent major projects

Dear colleagues,
Good afternoon!

When I was President of the Chinese Astronomical Society, our application to host the IAU 28^{th} General Assembly in Beijing became successful. Today I am glad to be here to

https://doi.org/10.1017/S1743921315005426 Published online by Cambridge University Press

attend the opening ceremony of IAU 28^{th} GA. I wish this meeting a success and I wish all participants a happy and memorable time in China.

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. In the 20^{th} century, because of Japanese invasion, the Chinese civil wars, and various political campaigns, until 1976 Mainland China was poor and undeveloped. By now, however, much of this situation has changed. China′s GDP has risen to the second highest in the world. China is now one of the most advanced countries with respect to the supercomputer, steelmaking, hydraulic engineering, the high-speed train, the modern bridge, and so on. In addition, China has carried out manned space missions and lunar exploration, and has set up a space lab.

Please allow me to limit my talk to Mainland China′s projects since 2006.

I. The ground-based optical-infrared projects

1. LAMOST - Large Sky Area Multi-Object Fiber Spectroscopic Telescope

The Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST) is an innovative reflecting Schmidt telescope. LAMOST has a clear aperture of 4.3 meters and a field of view of 5°. It is the largest wide field-of-view telescope in the world. 4000 optical fibers are put on its focal surface. Such a large-scale slit spectroscopic survey is unprecedented. At present, several other projects around the world are being planned along this direction. LAMOST was completed in October 2008. LAMOST is an 8m-class telescope. Through the development of LAMOST China has proved the basic ability to develop a 30m-class telescope.

2. NEOST - Near-Earth Object Survey Telescope NEOST is a 1m Schmidt telescope.

3. NVST - New Vacuum Solar Telescope NVST, with a 1m aperture, is the largest vacuum solar telescope in the world.

4. ONSET - Optical and Near-Infrared Solar Eruption Tracer ONSET can obtain white light, Hα and 10830 $\dot{A}$ images at the same time. All these projects are completed.

II. The ground-based radio projects

1.21CMA - 21 Centimeter Array

Exploration of the neutral hydrogen reionization may be the last frontier in observational cosmology. 21CMA is a radio array for this goal. It was constructed in the Tianshan Mountains in west China. A total of 10287 antennas have been deployed along two perpendicular baselines of 10 km. 21 CMA was completed in 2007. It is the first facility of this kind in the world to start the search for the epoch of reionization.

2. CSRH - Chinese Spectral Radioheliograph

Images over centimeter and decimeter wavelengths are important for addressing fundamental problems in solar flares and coronal mass ejections. The Chinese Spectral Radioheliograph (CSRH) will be the first new-generation instrument of this kind in the world. It can obtain images with high temporal, spatial, and spectral resolutions simultaneously. It includes two arrays. The CSRH-I has been installed. The CSRH-II will be finished next year.

https://doi.org/10.1017/S1743921315005426 Published online by Cambridge University Press

3. Shanghai 65m radio telescope

This is Shanghai 65m radio telescope. It is also a bridge for China to develop larger steerable radio telescopes. It will be completed this year or next year.

4. FAST - Five-hundred-meter Aperture Spherical Radio Telescope

The Five-hundred-meter Aperture Spherical Radio Telescope (FAST) can be seen as a modified "Arecibo" type telescope, with an illuminated area of 300 meters in diameter, twice as large as the Arecibo. In FAST the main innovation is that the shape of the basic spherical reflector is changed to keep the illuminated area a paraboloid in real time. It will be completed in 2016. FAST will be the largest single-aperture radio telescope in the world.

III. The space projects

1. HXMT - Hard X-ray Modulation Telescope

The Hard X-ray Modulation Telescope (HXMT) works in 1-250 keV. It will obtain sky maps with high spatial resolution and sensitivity. HXMT also has a unique capability to study short time-scale variations with high spectral resolution.

2. DAMPE - Dark Matter Particle Explorer

A Chinese astronomer, through international cooperation by balloon observation, found "an excess of cosmic ray electrons at energies of 300-800 GeV." These electrons may arise from the annihilation of dark matter particles. This find has claimed worldwide attention, and China has decided to develop a satellite named Dark Matter Particle Explorer (DAMPE) to further detect the high energy electrons and gamma ray. In energy resolution (1.5% at 1TeV), energy detection range (5-10,000 GeV), and background level, DAMPE surpasses other similar projects.

3. DSO - Deep Space Solar Observatory

DSO includes a 1m telescope, mainly to study the solar magnetic field.

4. SVOM - Space Variable Object Monitor (China and France)

SVOM is a Chinese and French joint mission to study gamma-ray burst.

5. POLAR - Gamma-ray Burst Polarization Observation Experiment (an international collaboration project led by China)

All these projects will be launched between 2014 and 2016.

Dome A is the summit of the Antarctic icecap, where the Chinese Expedition Team made the first recorded human arrival in January 2005. Antarctica has the best astronomical sites on the ground.

A second-generation Chinese Antarctic Survey Telescope AST3-1 with an aperture of 50 cm was installed there in January this year. At present, it is the largest optical telescope in Antarctica.

The following projects are being planned or conceived:

1. Antarctic Astronomical Observatory

The third-generation Antarctic telescopes include a 2.5m optical-infrared telescope and a 5m THz telescope.

2. 20-30m Optical-Infrared Telescope

China has no large-aperture telescope for fine observation. So it is important to develop such a telescope.

3. 110m Steerable Radio Telescope

4. Large Solar Telescope (aperture $\geqslant$ 4m)

https://doi.org/10.1017/S1743921315005426 Published online by Cambridge University Press

5. LAMOST South
6. 2m Space Optical Survey Telescope
7. XTP - X-ray Timing and Polarization Mission

and others.

Other countries are welcome to participate in all Chinese projects and China will also be pleased to join the projects of other countries.

At present China is not yet one of the leading countries in astronomy, but it is approaching this goal. China has a brilliant ancient civilization, it has the largest population, and has recently made great economic achievements. China should make greater contributions to science and to humankind.

Thank you!

9. Ceremony Events

Chinese Long Ribbon Dance - Flying Apsaras
Tibet Dance
Chinese Silk Acrobatics - Butterfly Love, Winner of Italian Golden Circus Festival and China National Acrobatic Contest
Performance by NAOC staff - (Dream of Heaven)

10. Welcome Address by the President of the Chinese Astronomical Society

Prof. Xiangqun Cui

Respected Dr. Robert Williams,
Ladies and Gentlemen,

I am much honored to welcome you all to the IAU 28^{th} General Assembly in Beijing on behalf of the Chinese Astronomical Society.

The Society is very happy and encouraged to host this IAU General Assembly for the first time in China, especially in this festival year when we celebrate the 90^{th} anniversary of the establishment of the Chinese Astronomical Society.

As it is known, the Chinese Astronomical Society started to make preparations for the IAU 28^{th} General Assembly as early as August 2006 at the 26^{th} General Assembly in Prague when it succeeded in its bid for hosting this meeting. Early in 2007, the National Advisory Committee, the National Organizing Committee and the Local Organizing Committee were established to secure smooth planning and preparations for the meeting. Throughout the planning process, the close collaboration with IAU leadership and staff and the precious experiences from the 26^{th} and 27^{th} General Assembly meetings have been of great help to us.

I would like to take this opportunity to express our sincere gratitude to our counterparts from all around the world for their continuous guidance and support, in particular to Robert Williams, President of IAU, and Ian Corbett, General Secretary of IAU.

In addition, I would also like to express our sincere gratitude on behalf of the Chinese Astronomical Society to the many Chinese colleagues, scholars and students for their hard

https://doi.org/10.1017/S1743921315005426 Published online by Cambridge University Press

work and deep involvement in the preparation, to the Chinese public for their enthusiasm, and to the Chinese government for the serious concern and extensive support.

Chinese astronomy has a very long history. The recordings of the earliest astronomical observatory can be traced back to about 3000 years ago, with eminent ancient astronomers such as Zhang Heng and Guo Shoujing who are still being honored by the Chinese until present day. The Chinese Astronomical Society was initiated and established by Chinese astronomers in October 1922 during the very period of the anti-imperialist and anti-feudal "May 4th Movement". After the founding of the People′s Republic of China in 1949, and in particular over the last 30 years since China′s opening to the world, Chinese astronomy has experienced rapid development. At the same time, the Chinese Astronomical Society has grown extensively. Currently, the Chinese Astronomical Society consists of 17 Science Committees with branches scattered in different provinces around China. The Society has about 2000 individual members, and its member organizations come from relevant research institutions and universities all over the country. Up to now, the society has more than 400 IAU members since it joined the IAU in 1935.

Every year, the Chinese Astronomical Society holds a national Annual Meeting, as well as various kinds of seminars, workshops and activities. As such, the Chinese Astronomical Society has played a vital role in promoting scientific exchange and public awareness of astronomy.

Chinese astronomy is developing and we still have a long way to go to reach global levels. As such, the IAU 28^{th} General Assembly in Beijing will provide an opportune moment for Chinese astronomers to discuss and exchange views extensively with their international counterparts. It is my sincere wish that this meeting will give an impulse to the further development of Chinese astronomy, and provides a platform for international cooperation in astronomy.

I would like to extend once again a very warm welcome to all of you to the IAU 28^{th} General Assembly, and welcome to Beijing. We hope the meeting will be a great success for all of you, and we wish you a pleasant stay in Beijing.

Thank you.

https://doi.org/10.1017/S1743921315005426 Published online by Cambridge University Press

Astronomy: amazing subject, amazing universe

Jocelyn Bell Burnell
University of Oxford, UK

One hundred years ago

One hundred years ago our astronomical understanding was very different from today. We did not know about the Big Bang or the expansion of the Universe, nor about its age and scale. Inflation and dark energy were beyond our imagination, as was the Cosmic Microwave Background radiation. We barely knew of galaxies beyond the Milky Way and were ignorant of clusters of galaxies and dark matter. Active Galactic Nuclei, black holes and jets were unknown to us. We had not seen neutral hydrogen or Giant Molecular Clouds. Indeed the only astronomy done was in the visual band so the idea that one could observe at other wavelengths was alien to us. Cosmic rays were just being discovered; that we could study the universe through them or through other particles was also a foreign idea. We did not yet know what stars were made of, what their energy source was, or how they evolved. Things like exoplanets, space flight and the exploration of the solar system were only found in science fiction; Pluto had not yet been discovered and trans-Neptunian objects were unknown.

We have come a long way in one hundred years! This has been made possible by funding from our Governments, foundations and private individuals, and the support of industry. Also we have had amongst us some very smart people ? astrophysicists, engineers and ICT specialists ? and there have been brilliant technical innovations which have opened up the universe to us.

"Astronomical Treasures"

I was asked a few years ago to talk about the things that I felt were ?treasures of the universe? or astronomical treasures. Each of us will have our own list of astronomical treasures, but some of the remarkable developments that I believe deserve to be treasured are:

a) the COBE satellite data showing that the Cosmic Microwave Background radiation perfectly fits a blackbody spectrum (with temperature 2.74K);

b) the Ghez ? Genzel infrared observations over a number of years of the motions of stars within one parsec of the Galactic centre, showing that the stars move in curved tracks because they are diverted from straight lines by the gravity of a black hole at Sagittarius A*. The black hole has a mass of 4×10^6 solar masses; this looks large but actually is quite small for a black hole at the centre of a galaxy. You can see the movie at `http://www.astro.ucla.edu/ gehzgroup/gc/pictures/orbitsMovie.shtml`;

c) the staggering number of exoplanets now being found. The rate of discovery gets faster and faster! At the time of writing (August 2012) 786 are known, many of them in multiple systems, and when we look at the night sky we need to remind ourselves that there are as many planets up there as there are stars; and finally

d) the exquisite images now becoming available with wonderful clarity and detail.

Astronomy in our cultures

Astronomy is not and never has been the preserve of the professionals only; there is great public interest and considerable non-professional participation. Amateurs have helped find comets and observe variable stars, and now thousands of people participate in Cit-

https://doi.org/10.1017/S1743921315005426 Published online by Cambridge University Press

izen Science programmes helping us with the flood of data we now experience. So the public help search for pulsars, classify galaxies, identify small craters on the moon and scan Spitzer images (see for example, `https;//www.zooniverse.org`) The concept is being extended beyond astronomy to the identification of people or places in old photographs, and the scrutiny of old ships? log books to determine the weather in the past.

Chinese astronomers in previous centuries noted ?guest stars? (novae and supernovae) and their records have been invaluable in identifying historic supernovae.

Our ancestors were much more aware of the night sky and different cultures gave different names to the main objects in the night sky. Some alternative names for the Milky Way are: The Silver Street (Celtic); The Celestial River (China); River of Fire (ancient Hebrew); The Backbone of the Night (Kalahari); Silver River Water (Korean); The Long Fish (Maori); The Place where the Lightning Rests (Setswana); Silicon River (Siberia); The Winter Road (Sweden); and The Way of the White Elephant (Thai). Astronomy enters our culture in other ways too ? as inspiration for music, painting and poetry, and it is interesting to explore these portrayals of our subject and revealing to us to see what astronomical topics have caught the attention of poets, painters and musicians.

The next hundred years?

What of the future? The hectic pace will continue, not least because of the telescopes we have operating right now! New telescopes such as ALMA (Atacama Large Millimetre Array) in Chile and the X-ray astronomy satellite NuSTAR will come fully on line. We look forward to large optical telescopes such as LSST (Large Synoptic Survey Telescope), and at least one thirty metre telescope like E-ELT (European Extremely Large Telescope), both of which will probably also be built in Chile. There will be the large radio telescopes SKA (Square Kilometre Array) in Southern Africa and Australia, and the Chinese FAST (being built in Guizhou province). It is hard to imagine where we will be in terms of astrophysical understanding, but we will have a greater awareness of transient objects, pulsars will have tested Einstein?s theory of gravity to destruction (or not) and we will likely have found signs of life on an exoplanet. Understanding dark matter will have brought about a revolution in physics and understanding dark energy will probably have forced a change in the way we think about the universe ? a paradigm shift. In a hundred years? time people will look back and be amazed at our naivety!

https://doi.org/10.1017/S1743921315005426 Published online by Cambridge University Press