AstroTalk: Behind the news headlines of August 2012

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Astronomy for a better world

I regularly travel by plane. Since most of my trips are work-related, I mostly spend those long flights alone. And because I like to connect with people, this means that I quite often strike up a conversation with my neighbour on those flights. The discussions usually focus on what each of us does for a living, and people are invariably interested in the science I do as an astronomer. By the way, I have learnt that there is an easy way to stop any conversation with an airplane neighbour from the moment I open my mouth: if I don’t feel like chatting, for whatever reason, I tell them I am an “astrophysicist”. This is usually followed by a comment like “Oh, that is interesting, but I don’t understand physics.” If, on the other hand, I tell my companion that I am an “astronomer”, I am almost guaranteed a discussion partner until at least the noise levels of the departing plane turn our conversation into a shouting match.

So far so good. However, once I have told them about what happens when galaxies collide (see my column in the August 2012 issue of this magazine), or even what we can learn from studying the evolution of so-called stellar populations in galaxies of different types, the question of the “use” of astronomy inevitably comes up. People wonder why “they” should invest in our pursuit of science for the sake of curiosity – and here they refer to themselves as the tax payer, so that they really wonder why society as a whole should fund our research. I have become quite good at defending doing science as a pursuit of satisfying one’s curiosity – after all, I have asked myself the same question many times.

Astronomy and astrophysics, as a physical and technical discipline, have contributed positively to many advances in our daily lives. Here are a few that you may not be aware of, and which I have borrowed from an essay by Dr. Jeremy Knapp (University of Leeds, UK):
- A precision camera developed for gamma-ray astronomy has been used to screen cargo containers for radioactive materials at airports, border crossings and other security-sensitive areas.
- Superconducting tunnel junctions, which are used on telescopes to measure low levels of radiation, are being developed to detect fluorescence from tagged DNA. This will improve DNA identification in medical and forensic techniques such as genetic profiling.
- One of the most successful imaging devices of recent decades has been the charge-coupled device or CCD, developed for astronomy and particle physics and now found in cameras everywhere (see my column of December 2011 in this magazine) and medical X-ray equipment.
- Adaptive optics is a technology to compensate for the blurring of starlight.
by the Earth’s atmosphere. It is now being applied in medical optics where there are two distinct uses. The first is to image the retina in unprecedented detail, opening up the possibility of early detection of disease and abnormalities. The second is to enhance vision.

- Imaging by micro-channel-plate camera, a standard technique in X-ray astronomy, has been developed into a sensitive camera for monitoring cancer treatment, and for imaging tumours in the body.

- Study of reactions between ions and molecules in the interstellar medium led to the development of a technique to measure trace gases. The same technique is now used as a non-invasive method for clinical diagnosis and therapeutic monitoring (breath testing). It is also finding applications in environmental science (pollution monitoring), health and safety (monitoring breath following exposure to hazardous chemicals) and animal husbandry.

- Mathematical techniques, designed for processing observations of the Universe as it was just after the Big Bang, are being applied in forensic and medical fields. Picture enhancement was first developed and applied to astronomical images, but is now used to reconstruct fuzzy police photos of car number plates, and to de-blur images of the human body taken by hospital scanners.

The question as to what we, and here I mean the scientific community in general, contribute to the development of our host nations by engaging in so-called ‘blue-skies research’ (research without immediate economic impact) has recently become rather a focus point. This is particularly so in Europe and the USA, where the ongoing economic crisis is putting significant strain on government-sponsored research budgets. Briefly before I moved from a senior position at a university in the UK to my current appointment at Peking University, I became aware of a number of documents that had been drawn up to address precisely this question. If you are comfortable reading English, I invite you to have a look at this summary: [http://www.ucu.org.uk/media/pdf/p/m/ucu_notsurvivingtheREF_r1.pdf](http://www.ucu.org.uk/media/pdf/p/m/ucu_notsurvivingtheREF_r1.pdf) – this document contains links for further background reading, and in the context of the current article, I suggest you have a look at the links under the ‘physics’ and ‘mathematics’ headings. Perhaps the best advocate of basic science whom I can quote today is Albert Einstein himself, who once said that “… [i]f we knew what it was we were doing, it would not be called research, would it?”

**The International Astronomical Union’s strategic plan and our role in China**

Let us now take a step back and consider the merits of pursuing research in astronomy in this context. When asked by parents why their children should study topics in astrophysics at university, I usually respond that our field educates students to become independent and critical thinkers who are well-equipped to tackle the scientific and societal issues of today using their highly prized problem-solving skills in any setting they choose to embrace. Academic researchers, on the other hand, are sometimes seen as out of touch with reality – despite their dedicated efforts to engage with the general public and offer outreach activities involving both primary and secondary schools. The International Astronomical Union (IAU), the world body of professional
astronomers and astrophysicists, has been making a major push in facilitating scientists to use their skills in support of the wider community they form a part of. Building on the resounding success of the 2009 International Year of Astronomy, the IAU set out to develop a visionary strategic plan (2010–2020), “Astronomy for the Developing World”. This plan aimed to use astronomy to stimulate development at all levels including primary, secondary and higher education, science research and the public understanding of science.
Because astronomy combines science and technology with inspiration and excitement, it can play a unique role in facilitating education and capacity building and in furthering sustainable development throughout the world. A challenging science in itself, astronomy provides an exciting gateway into physics, chemistry, biology and mathematics. In addition, the quest to explore the Universe satisfies the deepest cultural and philosophical yearnings of our species and can stimulate a sense of global citizenship. Astronomy is inspirational. It inspires teenagers to choose a career in science and technology and is a staple of adult education. Many large international telescope facilities are accessible to all astronomers throughout the world, providing an inexpensive entry to cutting-edge international research for developing countries.

The IAU regards access to knowledge about the Universe as a birthright of all people, and furthering the exploitation of astronomy for sustainable global development as an important part of its mission. The ambitious decadal strategic plan for stimulating astronomy in the developing world shows that astronomy can make an important contribution to global development and outlines a strategy for advancing this process. During the next decade, the IAU intends to expand its role in championing the use of astronomy at all levels in developing countries, working closely with relevant external organizations and using the International Year of Astronomy in 2009 as a springboard. The vast reservoir of talent presently active in astronomy and related technology throughout the world will be exploited and mobilised to work towards sustainable global development.

![Figure 4: Signing of the agreement between the IAU and the East Asian regional node representatives. From left to right: Zhanwen HAN (Director, Yunnan Astronomical Observatory), Jin ZHU (Director, Beijing Planetarium), Richard de Grijs (Director, East Asian regional node of the OAD; Kavli Institute for Astronomy and Astrophysics at Peking University), Ian Corbett (General Secretary, IAU), Kevin Govender (Director, OAD).](image-url)
Goals for the next decade are to raise the level of astronomy development in as many countries as possible, to maximise the size of the population reached, and to work to include aspects of astronomy as aids to the primary and secondary education of as many children as possible. Very importantly, we aim at enlarging the number of active volunteers. Present activities depend entirely on volunteers, both for their coordination and implementation. The IAU aims to enlarge the number of volunteer experts by recruiting more members and augmenting the pool of volunteers by doctoral and postdoctoral trainees and talented non-member experts on pre-higher education and outreach. An endowed lectureship program will provide semi-popular lectures on inspirational topics in modern astrophysics and astronomical technology for high-school students and the general public in developing countries. An institute twinning scheme will encourage developed astronomy institutes to provide long-term guidance and advice to university departments in developing countries interested in building up an astronomy research capability.

At the heart of the implementation of this plan was the creation of a central coordinating “Office of Astronomy for Development” (OAD). After a lengthy international selection process, the IAU chose South Africa as the host country for the OAD. On 16 April 2011 the OAD was officially launched by the South African Minister of Science and Technology. The OAD’s mission is to help advance the use of astronomy as a tool for development by mobilising the human and financial resources necessary to realise the field’s scientific, technological and cultural benefits to society.

Regional representation

An important component of the plan is the adoption of a “bottom-up” approach for astronomy development, with a substantial degree of decentralisation. This involves the appointment of regional development coordinators and the designation of regional institute nodes. At the 2012 General Assembly of the IAU, which was held in Beijing from 20 to 31 August, the OAD programme announced a number of exciting new partnerships that will assist with the IAU’s decadal strategic plan. These landmark decisions involve establishing two new coordinating centres that use astronomy as a tool for development in the East

Figure 1: As one of the first activities supported by the East Asian regional node of the OAD, I recently facilitated a teacher training workshop for secondary school teachers in physics and astronomy in Kazakhstan. I was sent out to the country’s capital, Astana, by Cambridge International Examinations (part of the University of Cambridge, UK) to help with curriculum development in physics and astronomy. With our expertise as astrophysicists, this is precisely the type of developmental activity we can have a major impact in!
and South East Asian regions, as well as launching an array of exciting programmes and events with different institutions across the world. The first of these pioneering agreements, concerning a coordinating centre to be established in the East Asian region (in China), was signed on Tuesday 21 August 2012. OAD Director Kevin Govender commented on the signing of this East Asian agreement:

“It is an essential part of the strategic plan to have regional coordination in place so as to ensure informed local participation in any IAU development activities. We really look forward to working closely with this group of institutions both to develop astronomy as a field and to use astronomy for development in the East Asian region.”

The agreement covers two important functions that the node will serve. One is known as a Regional Node, which entails the coordination of astronomy-for-development activities in countries within the general geographical region of East Asia (in first instance China, Mongolia and the DPRK, but without placing firm geographical limits on the region). The other is known as a Language Expertise Centre which will deal with all aspects relating to (mainly) the Chinese language and culture. The impact of the latter may obviously spread well beyond the geographical region to other parts of the world.
The main institutes involved in the consortium are the Kavli Institute for Astronomy and Astrophysics (KIAA, Peking University), Beijing Planetarium and Yunnan Astronomical Observatory. Our institutes are supported in our efforts by a number of important partners, including the National Astronomical Observatories of the Chinese Academy of Sciences (NAOC), the East Asian Core Observatories Association (EACOA), and Pyongyang Astronomical Observatory (PAO). For me personally, the fact that we signed the agreement with the IAU during its General Assembly in Beijing, left me with great satisfaction. I have been leading the efforts on behalf of the East Asian consortium, and the IAU has appointed me as the Founding Director of the East Asian OAD node. We are pleased to have been selected by the IAU to carry out this important mission. We are well placed, along with our many partners, to implement a wide variety of activities in the region that will contribute to the strategic plan. I look forward to working with the IAU as we set out to use astronomy to make the world a better place.

This agreement is the first of its kind to be signed anywhere in the world. A second regional node has been established in the South East Asian region (in Thailand) and coordinated by the National Astronomical Research Institute of Thailand (NARIT).

Finally, and most importantly, now that we have established the basic infrastructure for a regional OAD node in China and the more extended region, the hard work is about to begin. At the moment, we are represented by a small team of dedicated colleagues from the different institutions; both Beijing Planetarium and Yunnan Astronomical Observatory have pledged up to one salaried support staff member each to help our efforts reach fruition, but to
make this a success, we depend very heavily and crucially on the support of many volunteers. If you are an enthusiastic amateur astronomer, a science teacher, a professional researcher, a science student, or if you simply have skills or enthusiasm that you would like to offer towards us reaching the goals of the IAU’s strategic plan in China, Mongolia and the DPRK please get in touch! We have set up a dedicated email address for this purpose: eastasia@astro4dev.org (emails in Chinese or English are both welcome!). You can potentially get involved in any of the three strands of the OAD's strategic plan: Universities and research; Schools and children; and the general public. The opportunities are too numerous to mention; manpower is something we value highly and are currently severely short of!

We do depend on you, our community, and we hope that together we can work on developing “Astronomy for a better world.”

Figure 5: Summer schools for international students are among the activities that will be supported by the regional OAD node in the future. (Photo: the first international astronomical summer school in Mongolia, July 2008. Credit: Katrien Kolenberg.)