

Square Kilometer Array (SKA), but including both mm-wavelength spectral lines and radio continuum.

We also had a session on algorithms and the use of simulations to optimise these. M. Wright discussed the degradation in image fidelity due to deviations of antenna primary beams from their canonical shape and on the technique to correct this effect by deconvolution of the measured primary beam shape. N. Rodriguez Fernandez from IRAM presented the progress of the work being done under EU Framework Programme 6 (FP6) to develop on-the-fly interferometric observations for ALMA. The subject of combining interferometric and single dish data was analysed by Y. Kuroko from the University of Tokyo and he presented

simulations based on data from the Nobeyama Millimetre Array and the 45 m single dish telescope. Lastly, B. Nikolic presented some work done under FP6 at the University of Cambridge on simulations of atmospheric phase errors and their correction by a combination of fast-switching and water-vapour radiometry.

The final session at the workshop was on the configurations of ALMA and the impact of having 50 rather than 64 antennas in the main array. M. Holdaway (formerly at NRAO, and now running Kalimba Magic) discussed the effects of the antenna number reduction on calibration techniques (and also gave an impromptu kalimba performance). R. Reid of NRAO then presented his investigation of

proposed improvements to ALMA's intermediate configurations (those with baseline lengths about 4–10 km in length). This was followed by an open discussion on the scientific impact of the suggested configuration changes.

No proceedings of the workshop will be published, but all of the presentations are available at <http://www.mrao.cam.ac.uk>.

#### Links

Workshop webpage:  
<http://www.mrao.cam.ac.uk/~bn204/almasim08/>  
 CASA beta release:  
<http://casa.nrao.edu/betarelease.shtml>  
 Workshop presentations:  
<http://www.mrao.cam.ac.uk/~bn204/almasim08/presentations2008.html>

Report on the Conference

## 400 Years of Astronomical Telescopes

held at ESTEC, Noordwijk, the Netherlands, 29 September–2 October 2008

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Four hundred years ago, on 25 September 1608, the Dutch lens maker Hans Lipperhey from Middelburg traveled to The Hague to apply for a patent for his invention: the “spyglass”. The Commander in Chief of the Dutch armed forces, Prince Maurice of Nassau, was quite impressed. However, since the instrument could be easily copied, Lipperhey was not granted the patent. Nevertheless, he was generously rewarded and two more copies of his invention were ordered. Lipperhey's spyglass constitutes the basis for the development of astronomical telescopes.

To celebrate this event and the resulting developments, Leiden Observatory, in cooperation with ESTEC, recently organised an international meeting entitled “400 Years of Astronomical Telescopes”.

The meeting took place from 29 September–2 October 2008 at the ESTEC conference centre.

The goal of the meeting was to present a comprehensive coverage of the history, science and technology of 400 years of astronomical telescopes in a wider sense, provided exclusively as review talks by invited speakers. Although the classical telescope was an optical instrument, the topics covered the entire electromagnetic spectrum. The audience of about 130 participants — who were noticeably more senior than at most topical science meetings — included many key players in the creation of the current generation of telescopes (see Figure 1). Many of them contributed their own memories and perspectives to the meeting, frequently leading to very interesting coffee and dinner table discussions.

The meeting started with the historical development of optical telescopes, from the beginnings in Middelburg via Galilei,

Newton, Herschel and Lord Rosse to the great refractors of the 19th century, and the big reflectors of the 20th century. After a review of optical astronomical instruments the focus shifted to longer wavelengths, covering the history of infrared and radio telescopes.

The second day was — apart from an intermezzo on solar telescopes — dedicated to non-optical telescopes, from Riccardo Giacconi's talk on X-ray telescopes to reviews of gamma-ray and imaging TeV telescopes and neutrino detectors. Miscellaneous aspects, like the history of astronomical discoveries, the improvement of astrometric accuracy, the capabilities of amateur telescopes, and the history of the Hubble Space Telescope by Robert O'Dell, followed. The second day was concluded by Reinhard Genzel's talk, illustrating the feedback between technological developments and scientific discoveries relating to the Galactic Centre.

The third day started with the key enabling technologies for optical telescopes, from mirror casting and polishing, active optics and telescope design considerations to adaptive optics and interferometric techniques. The second part reviewed the technological developments that enabled submillimetre and radio astronomy, and the realisation of X-ray and gamma-ray telescopes. The session was complemented by a poster session and a visit to the Herschel Space Telescope. The interplay between technological developments, society and politics was highlighted in the next session, which included Lo Woltjer's talk on "ESO's Past and Future" and a stimulating plan to use telescopes to harvest solar energy by Roger Angel.

How embedded in, and dependent on, their surrounding infrastructure astronomical observatories really are became obvious on the last day of the conference, during the talks on the "Sacred Mountains", Mount Graham and Mauna Kea, on the increasing problem of light pollution, and on the role of observatories in underdeveloped countries. Talks on measures of the impact of publications, "very big science", the history of NASA's Great Observatories and perspectives for future technologies completed the programme of the last day. The meeting was concluded by Tim de Zeeuw's talk on "Challenges and Perspectives for Future Telescopes".

The social programme included three events: a welcome reception at ESA's Space Expo, a visit to the impressive collection of historical telescopes at the Museum Boerhaave in Leiden, and a dinner cruise along the Dutch canals. Certainly one of the most memorable and unique events was the get-together of five of the former and present ESO Directors General: Adriaan Blaauw, Lodewijk Woltjer, Harry van der Laan, Riccardo Giacconi and Tim de Zeeuw (see Figure 2). Being present throughout the meeting they contributed heavily to the discussion, in particular after Lo Woltjer's talk on the history of ESO.

The proceedings of the conference will be published in a hardcover book by



Credit: Carolina O'dman (Leiden Observatory)

Figure 1. Participants at the conference, 400 Years of Astronomical Telescopes.



Credit: Carolina O'dman (Leiden Observatory)

Springer in early 2009, and will be a great memory for those who attended the meeting, as well as a great resource for all those who missed this unique event. More details on the meeting can be found at <http://www.strw.leidenuniv.nl/400years/>.

Figure 2. Five ESO Directors General at the conference. From right to left: Tim de Zeeuw (2007–present); Adriaan Blaauw (1970–1974); Riccardo Giacconi (1993–1999); Lodewijk Woltjer (1975–1987); and Harry van der Laan (1988–1992). The VLT background was provided by Fred Kamphues (TNO).

The "International Year of Astronomy 2009" is celebrating the first astronomical use of the telescope by Galileo initiating an enormous wealth of astronomical discoveries over the past 400 years. As with many inventions, the astronomical telescope was probably the result of developments by numerous people. Around the end of the sixteenth century, the making and polishing of spectacle lenses had been gradually improved and magnifying optics and combinations of optical components had been developed. Significant progress was made by people like Juan Roget in Spain, Sacharias Janssen and Jacob Met