characteristic observables when direct observations of extrasolar planets become feasible, with future facilities such as the E-ELT.

The detailed scientific programme of the meeting is available at *http://www.arcetri.astro.it/elba2008/*. The scientific scope ranged from the detection of the tenuous sodium atmospheres of Mercury and our Moon to the bio-signatures of extrasolar planets. The proceedings will be published in a special edition of *Earth, Moon and Planets*, with a target publication date in the first half of 2009.

In the conference summary, provided by Hermann Boehnhard, the following main conclusions were reached and agreed:

– Even the most advanced and sophisticated space missions that provide for *in situ* data need the complement of remote sensing data to place the observations in their wider scientific context.

– The Solar System inventory is far from complete and there is a strong need for more surveys. For the faintest objects a serendipitous occultation mode (e.g., involving telescope acquisition cameras) shows great promise.

– For the inventory of asteroid and cometary nuclei, systematic statistical studies of shapes, sizes, albedos and rotation will depend critically on ground-based telescopes as well as the James Webb Space telescope (JWST). The same conclusion holds for the study of their surface chemistry.

– Paradigm-changing observations can, for example, be expected in the field of planetary atmospheres. Currently the long-term stability of planetary atmospheres against erosion by solar UV radiation and particle flux is not understood; high resolution spectral and spatial observations may provide for fundamentally improved insights into the relevant processes.

– In order to achieve a synthesis between the observations and theory of extrasolar protoplanetary discs and our Solar System, more mineralogical data (e.g., mid-infrared low resolution spectroscopy) for primitive bodies in our Solar System are mandatory.

– European astronomers will be in the front seat for these research programmes, thanks to participation in ALMA and the instrumentation suite under study for the E-ELT (D'Odorico et al., 2008). For Solar System studies, the METIS instrument (Mid-infrared Imager and Spectrograph with Adaptive Optics) and EPICS (the Planet Imager and Spectrograph with extreme adaptive optics) are most relevant.

In a splinter session, some 20 participants also convened to form the kernel of a working group to complement the Science Case of the E-ELT with a special Solar System section. Follow-up activities of this group are being planned soon[1].

References

D'Odorico, S. et al. 2008, SPIE, 7014, 70141
Käufl, H.U. & Sterken, C. 2006, The Messenger, 126, 48

[1] Anyone wishing to join this group can contact either of the authors by e-mail: *hukaufl@eso.org* or *tozzi@arcetri.astro.it*

Report on the ALMA Workshop

Simulations for ALMA

held at IRAM, Grenoble, France, 8–10 September 2008

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A workshop on Simulations for ALMA was held on 8–10 September 2008 at IRAM. About 40 participants from Europe, North America and Japan attended, and discussed many aspects of ALMA imaging: topics included detailed scientific simulations of astronomical observations together with more technical simulations of instrumental and atmospheric effects and the strategies for their correction. The workshop web page contains the presentations made at the meeting and is available from http://*www.mrao.cam.ac.uk*.

Construction of the Atacama Large Millimeter/submillimeter Array (ALMA) in northern Chile is proceeding rapidly. The majority of the hardware design is complete, and in many cases full production is underway. Eleven antennas have already been delivered to the mid-level site, the Operations Support Facility (OSF), near San Pedro de Atacama. With interferometric fringes expected next year, now is a good time to revisit in detail the plans for ALMA data analysis to ensure that ALMA scientists have the necessary tools both to develop their scientific observing programmes with ALMA and produce the best possible datasets for scientific analysis.

Extensive work is being done in many of the ALMA partner countries to develop

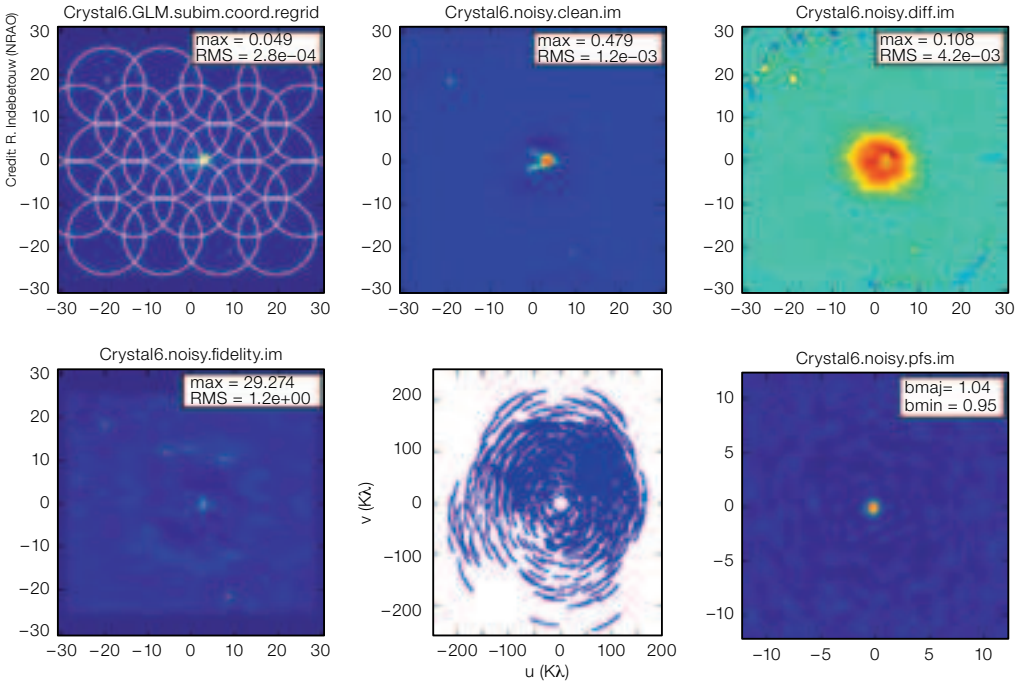

Figure 1. An example diagnostic output produced by *almasimmos* (the CASA simulator for ALMA) for a mosaic ALMA observation in one of the compact configurations at the frequency of 345 GHz.

the software required for data taking, data analysis and simulation. In the absence of a working ALMA interferometer, simulations play an important role in understanding how to optimise ALMA's performance. For example, simulations allow us to quantify the effects of errors caused by the atmosphere, by pointing errors or antenna surface errors. They also help us develop techniques for calibrating and imaging ALMA data. In addition, the realistic simulation of models of astrophysical objects — for example protoplanetary discs and high redshift galaxies — allows the scientific community to develop observing programmes for ALMA.

ALMA is an interferometer with many unique features. Its 66 antennas come in two sizes, 12 m or 7 m in diameter, and can be moved to any of the 200-plus pads on Chajnantor. They work at very high frequencies, so that the primary beams are imperfect, and the atmospheric phase errors are large. Pointing errors caused, for example, by wind shake can be significant at times. As expected, a great deal of effort has gone into simulations, especially in the early design years of the project, to ensure that the technical specifications of ALMA are good enough to meet the ambitious scientific goals.

The focus for this year's workshop, held at the headquarters of the Institut de Radio Astronomie Millimétrique (IRAM) in Grenoble was to bring together all the different groups worldwide working on different aspects of ALMA simulation software, to assess recent progress and help plan future software developments. The meeting was generously supported by Radionet and by IRAM.

Four of the major packages used for ALMA simulations were presented at the meeting. The CASA simulator for ALMA (*almasimmos*) was presented by R. Indebetouw of NRAO. The simulation capabilities of GILDAS were presented by F. Gueth of IRAM. F. Viallefond of LERMA presented the simulator that he has been designing in collaboration with J. Pardo; and M. Wright of Berkeley presented the simulation capabilities of the MIRIAD package.

Of the four, the package most targeted toward non-expert users is *almasimmos*, which also has the advantage of being a part of the official ALMA offline data reduction tool (CASA). A sample screenshot of *almasimmos* output is shown in Figure 1, illustrating the simulation of a mosaic ALMA observation. In common with CASA, *almasimmos* is still under active development and in a beta-testing stage only. With this *caveat* it is, however, available for use and testing by the entire community as part of the CASA beta release, which may be downloaded at *http://casa.nrao.edu*.

Also in the session on simulators, there were presentations by A. Richards from the University of Manchester on integration of simulations with the Virtual Observatory (VO) and by R. Lucas from the Joint ALMA Office, who presented the ALMA Shared Simulator, which is designed to simulate the detailed online operation of ALMA as a system.

In the session on science simulations, S. Takakuwa of ASIAA presented simulations of low mass star-forming regions and debris discs, illustrating the improvement in imaging fidelity provided by the ALMA Compact Array (ACA). M. Wyatt from the University of Cambridge presented exciting simulations based on physical models of debris discs as observed with ALMA at high resolution. E. van Kampen of the University of Innsbruck presented large-scale galaxy formation simulations and discussed their relevance to ALMA observations. I. Heywood from the University of Oxford also presented large-scale semi-empirical simulations designed primarily for the

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. Kurono 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 baselines 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

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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.