ing ultra-deep ISAAC and FORS imaging, guided by Michael Schirmer (ING, La Palma); calculating the ionising flux of O-stars in dusty embedded star clusters using VLT/VISIR and HST images, introduced by Margrethe Wold (ESO); the search for ultra-compact dwarf galaxies in Abell 1689 with the help of HST images and spectroscopic confirmation with VLT/FORS, led by Steffen Mieske (ESO); and last but not least, the study of globular clusters and low-mass X-ray binaries in a Virgo elliptical by combining HST imaging with Chandra data, under the supervision of Andrés Jordan (ESO). Besides the usual series of lectures introducing basic photometric and spectroscopic techniques, special attention was given to the presentation of the available archives and archival research techniques. Taking advantage of ESO's strong involvement in instrumentation and telescope design, further lectures dealt with the diversity of instrumentation covering a large wavelength range and the history and future of telescope design.

The feedback from the school indicated a high satisfaction rate of the students and, what is more important, a notable increase in interest to make use of archival data and the need to learn more about the relevant research tools including Virtual Observatory developments. It is clear that the multi-wavelength approach is becoming the best way to do good research in astrophysics.

A common feature of both schools was the very positive impact of gathering students from various origins and nationalities, which is seen as a good start for future, pan-European collaborations. This was complemented by open discussions on the situation of jobs in astronomy and career strategies. Various job possibilities at individual universities and laboratories were presented as well as the more general exchange programmes offered by the European Union.

It is clear that the success of these schools calls for more such events in the future. We are pleased to announce the next NEON Observing School which will take place in Asiago Observatory (Italy), 4–18 September 2007. More detailed information on programme and registration will be announced later this year on the EAS web pages and through the usual communication channels. A further two NEON schools are planned for 2008: one will take place in La Palma using the ING and NOT telescopes, and the other one at ESO Headquarters, Garching, once more focusing on the use of Archival Data.

Report on the Meeting on

Science with ALMA: a New Era for Astrophysics

held in Madrid, Spain, 13–18 November 2006

Paola Andreani, Martin Zwaan, Robert Laing (ESO)

Three hundred scientists from all over the world met during a warm November week in Madrid to discuss the scientific revolution (or, according to one speaker, evolution) that we expect from ALMA. The large number of participants, the richness of the science and the wider community's increasing interest in ALMA made this meeting an optimistic and exciting one. The talks and posters covered almost all of the science areas relevant to ALMA including its main drivers: the formation and evolution of galaxies, the physics and chemistry of the interstellar medium, and the processes of star and planet formation. We heard about new results from the current generation of millimetre and sub-millimetre arrays such as the SMA and the recently upgraded Plateau de Bure Interferometer, as well as related observations at other wavelengths (especially from the Spitzer Space Telescope). The anticipated performance of ALMA and the current status of the project were both described, and many speakers presented ambitious plans for observing with the array once it becomes fully operational. It would be impossible even to list all of the contributors in a short article; instead, we briefly summarise some of the key topics, concentrating on star and galaxy formation.

Our present picture of low- and high-mass star formation is based on indirect evidence. Although the formation sites have been identified, the processes cannot be followed in detail. Stars form in the central cores of molecular clouds, mostly in multiple systems and coherent clusters. Observations show that the mass function of the molecular condensations is similar to the initial mass function for stars and that the fraction of the cloud in the condensed phase corresponds to the expected star-formation efficiency, but we do not know which physical processes govern the mass fragmentation of molecular clouds and hence shape the initial mass function. We do not understand in detail the kinematics and dynamics of accretion onto protostellar cores, the formation and collimation of outflows and the eventual evolution of circumstellar discs to form planetary systems, asteroids and comets. Still less do we comprehend the role of magnetic fields.

ALMA will be able to see the collapse of the central regions in pre-stellar cores and in young stellar objects, image the complex structures of infalling, outflowing and accreting material and follow the formation and evolution of discs. These processes will be studied not only with high-resolution continuum observations but also spectroscopically. Molecular abundances vary with evolutionary state, as different species appear and disappear, for example by depletion onto dust grains. A plethora of molecular species can be used as tracers of the complex physics and chemistry and the ability to model these processes with high spatial resolution was identified as an essential complement to ALMA observations.

Precision measurements of the spectral energy distributions of dust formation sites will give an indication of the grain size distribution in circumstellar discs. The evolution of dust can be followed as dusty particles around young stars collide and grow from sub-micron sizes to pebbles, boulders, planetesimals and eventually planets. The gaps predicted to occur in circumstellar discs as a result of planetary formation can be imaged directly by ALMA.

ALMA will enable a comparable series of advances in the field of galaxy formation and evolution, particularly at early epochs. Galaxy number counts will be extended to the faintest sources in every ALMA band. The spatial and redshift distribution of these sources, as well as their luminosity functions will become measurable, as ALMA will not be confusion limited in any of its bands. It will excel as a follow-up instrument for large-area surveys with bolometer arrays, both in resolving continuum emission and in measuring redshifts from molecular lines. Very deep, but narrow-field surveys will also be carried out with ALMA alone. CO will be the molecule of choice for redshift measurement except for the earliest galaxies ($z > 6$), for which singly ionised carbon may be more appropriate. The reason is that the energy output in this line is likely to be much higher than in the very high order CO transitions redshifted to ALMA frequencies. Continuum observations of the dust emission from the very first galaxies, as well as spectroscopy of their molecular and atomic lines, will allow us to probe the epoch of re-ionisation for the first time. The measurement of molecular absorption lines towards quasars will probe more tenuous regions along the line of sight as well as placing strong limits on the variation of fundamental physical constants, such the fine-structure constant α.

The dynamics of mass assembly in galaxies at $z \approx 3$ is just beginning to be resolved using ground-based near-infrared observations. ALMA will extend this to fainter, more typical and obscured objects. Indeed one of its top-level science requirements is to be able to resolve a galaxy like the Milky Way at $z = 3$ in CO or C II. On larger physical scales, imaging of the Sunyaev-Zel'dovich effect will provide a unique probe of substructure in the intracluster medium. The detailed chemistry of star formation in nearby galaxies will be a major topic for ALMA, as will the relationship between active galactic nuclei and starbursts.

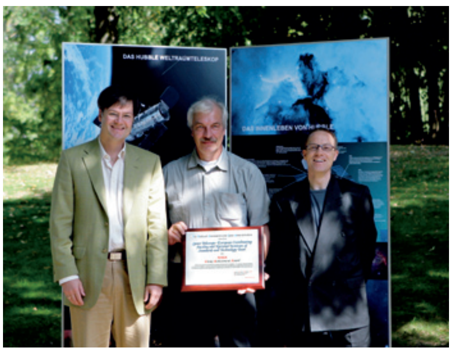
The meeting took place at the Consejo Superior de Investigaciones Científicas (CSIC) in Madrid and was financed by CSIC, Observatorio Astronómico Nacional, the ALMA project, ESO, NRAO, NAOJ, RadioNet and Astrocam. It was the second world-wide meeting on "Science with the Atacama Large Millimeter Array" (the first took place in Washington, D.C., in October 1999). The proceedings will be published in a special edition of Astrophysics and Space Science and the majority of presentations will be made available linked to *http://www.oan.es/alma2006*.

Prestigious NASA Award for ST-ECF (ESO/ESA) Scientists

A team of scientists from the Space Telescope European Coordinating Facility (ST-ECF) and the United States National Institute of Standards and Technology (NIST) has received one of the most prestigious honours issued by NASA: a Public Service Group Achievement Award: "In recognition of painstaking efforts to provide maximum scientific value to HST data using precision laboratory spectral measurements and physical instrument modelling techniques."

In this transatlantic cooperation which earned this recognition, the European group (Michael Rosa, Florian Kerber and Paul Bristow; Figure 1) joined forces with their US colleagues (Joseph Reader, Gillian Nave, Craig Sansonetti; Figure 2) with the aim of improving the calibration of Hubble Space Telescope (HST) spectrographs.

In their effort the team combined advanced modelling techniques, to describe the physical properties of a scientific instrument, with high-quality laboratory measurements of the spectral lines emitted by a Pt/Cr-Ne hollow cathode lamp used as calibration source onboard HST. The measurements performed in the laboratory of the NIST Atomic Spectroscopy Group filled a significant gap in our understanding of the output of such lamps and added about 5000 lines as wavelength standards now usable for calibration purposes. These enhanced line lists were used as input for the instru-



The European part of the NASA award winning team, the group at ST-ECF: Florian Kerber, Michael Rosa, Paul Bristow (left to right).