Story 4

# EuroLabCourse on Millimetre Observing

## Techniques and Applications in Astronomy: Observing the cold universe

*If our eyes were sensitive to electromagnetic radiation with a wavelength of one millimetre (instead of 500 nanometres) our perception of the night sky would be totally different. We could still see the moon and the planets. However, the stars would not be the most prominent features we see but it would be the Milky Way that dominates the sky. A closer inspection would reveal that the brightest spots coincide with clouds of dust and gas amidst the stars. These interstellar clouds are known to be the sites were stars and planets are still forming in our Milky Way and in similar galaxies.*

*The IRAM Interferometer in the French Alps combines six antennas to obtain a higher angular resolving power*

In the past decades astronomers have realized that we have to observe the sky in mm-waves in order to understand the origin of comets, planets stars and galaxies. In a German, French and Spanish effort, the Institute for Radioastronomy in the Millimetre Range (IRAM) therefore built an antenna with a diameter of 30 metres at a high mountain site in the Spanish Sierra Nevada. IRAM also operates a complementary telescope comprising of six 15 metre antennas on the Plateau de Bure in the French Alps. Both instruments are the world's leading telescopes for millimetre waves.

Every year more than 300 astronomers not only from the IRAM countries but also from all parts of the world are scientifically competing for observing time at these instruments. So big is the pressure from the astronomical community that it has been quite difficult for astronomers who are not coming from traditional mm-astronomy centres to have a chance to observe with this telescope.

*The IRAM30m Millimetre-wave Telescope in the Spanish Sierra Nevada could be used by participants of the 2001 IRAM observing school.*

Therefore the IRAM decided to offer a series of hands-on EuroLabCourses at the IRAM observatories to young European astronomers, in particular to those working normally in other fields of astronomy such as optical or theoretical astronomy. IRAM director Professor Michael Grewing even made available 25 hours of the precious observing time at the 30-m telescope in order to give the participants of the EuroLabCourse the opportunity to conduct their own small scientific projects. Financial support of the Course came mainly from the European Community.

The ski resort Pradollano, at a 30m drive from the 30m telescope, offered all the amenities to organise the first IRAM Millimetre Observing School in Spain. The participants of the school were still shocked by the events of September 11th 2001, which had happened just a few days before the school started, but soon everybody realized that the school was a true demonstration for fruitful international collaboration: 40 students from 14 nations met to listen to lectures by renowned scientists, to work in groups led by young scientists working in the field, to observe with the 30-m telescope, and finally to talk to each other and to learn about the Christian, Moorish and Jewish history of Andalucia and the city of Granada.

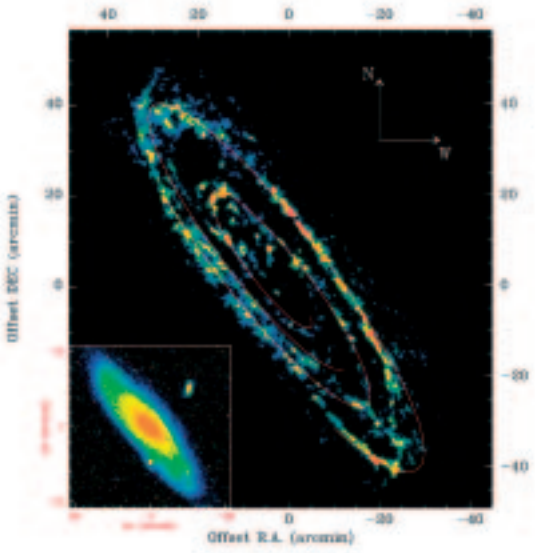
The scientific work done in the different working groups reflects nearly the total range of science that can be done with the 30-m telescope: One of the groups, guided by the dynamic Spanish professor José Chernicharo

investigated the chemical composition in the atmospheres of an old star: in the millimetre spectral range many of the chemical compounds which can be found in circumstellar gas radiate at characteristic frequencies, the so called spectral lines. From the line intensities and a comparison of spectra obtained in a laboratory one can predict the chemical composition and the physical parameters of the stellar atmosphere.

Another group around the German scientist Susanne Huettemeister determined the amount of molecular hydrogen in a galaxy in order to make predictions about the kinematics of the gas and to investigate whether it is going to form stars. The young German researcher Frank Bertoldi introduced his group to the secrets of observing with a new generation of mm-cameras the so-called bolometers. Such studies can reveal the properties in the interstellar dust and the properties of the most energetic events in the universe the enigmatic Gamma Ray Bursts.

Each group prepared and performed their own observations with the 30-m telescope and learned secrets and tricks not documented in any manual. The group members learned to analyse the data and to take into account the imperfections of the antenna, the mm-wave receivers and the atmosphere. Finally they presented their scientific conclusions in a mini workshop at the end of the course.

*Millimetre-wave observations reveal the sites of star formation in the nearby Andromeda galaxy (courtesy M. Guelin)*




*Contract HPCFCT 2001-00373*

After the intense 7 day course, the general consent among the young researchers was: they would come back to the 30-m telescope, but the next time with their own scientific project. In the meantime this turned out to be true. Numerous participants of the summer school have become regular observers at the IRAM telescopes. They are certainly well prepared when a new generation mm-telescope, the Atacama Large Millimetre Array (ALMA) will become operative in 2006. This telescope combines 64 antennas on a plateau at 5000m altitude in the Chilean Atacama desert as a joint project between many European countries and North America. Since there is an evident need to train young astronomers for present telescopes and for ALMA, IRAM has decided continues to host a yearly summer school at its observatories.



## Facts & Figures

Two EuroLabCourses "millimetre Observing School" (2001-373) were organised by the Institute for Radioastronomy in the mm-Range (IRAM). The first event took place in September 2001 in the Spanish Sierra Nevada and dealt mainly with mm-astronomical spectroscopy. The second school about "mm-astronomical interferometry" was held in October 2002 at IRAM's headquarters in Grenoble. In total there were 100 participants from 15 nationalities. The courses comprised lecture courses and lab courses. In the lab courses, participants used the IRAM telescopes to learn to prepare and perform observations and to interpret the obtained data.

**LINKS**

Name: **Rainer Mauersberger**
Institution: **Instituto de Radioastronomía Milimétrica**
e-mail: **mauers@iram.es**
Web site: **http://www.iram.es/IRAMES/events/summerSchool2001**