

# 10 YEARS EXPLORING THE UNIVERSE

ESO/Government of Chile Joint Committee  
for the development of astronomy





The clear clean skies of Chile have for several decades attracted the international scientific community. Various astronomy observatories especially established in the northern area of Chile constantly report discoveries which provide us with new knowledge about the origin of the universe and of life.

On September 5th 1996, this country and one of the main centres in this field -the European Organisation for Astronomical Research in the Southern Hemisphere (ESO) - signed an Agreement which may be considered historic due to its profound significance for our Astronomical Community, whereby ESO is committed to assign 10 percent of its telescope observing time to deserving projects by Chilean astronomers and to contribute an annual fund for development of this science in the country. The ESO-Government of Chile Joint Committee<sup>1</sup> for the development of astronomy was formed to manage this fund.

On the tenth anniversary of the Agreement which laid the grounds for the Joint Committee, the main beneficiary institutions were invited to submit a report on the impact of the resources assigned since the start of its activities in 1998. Their importance was such that only in 2005 -in addition to the 10 percent observing time- the funds assigned by the ESO-Government of Chile Joint Committee accounted for 8% of all resources received by Chilean astronomy, including contributions made by the Government and the universities.

The impact of this overall investment in astronomy in recent years has been major. According to a study performed in 2005 by the Chilean Academy of Science, in the last two decades the number of astronomers in the country has doubled, the number of scientific publications has increased eight-fold, and 100 percent of the observing time allocated by the international telescopes to Chilean astronomers is utilized.

The present document is an account of those eight years of activities of the Joint Committee formed by representatives of ESO and the Government of Chile -one of whom is the Director of Special Policies of the Ministry of Foreign Affairs- based on the opinions of the actual beneficiaries of this fund, which promotes the development of astronomy and scientific culture in Chile.

**Ambassador Luis Winter  
Director of Special Policies  
Ministry of Foreign Affairs of Chile**

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<sup>1</sup> The creation of an ESO-Government of Chile Joint Committee to manage an annual fund for the development of astronomy was set forth in Article 9 of the Interpretative, Supplementary and Modifying Agreement, ratified by the Senate of the Republic of Chile in 1996. This Committee met on March 13th 1998 with three representatives of the Government of Chile and three from ESO.

**T**he scientific achievements of the European Organisation for Astronomical Research in the Southern Hemisphere (ESO) have been possible thanks to the permanent support of the Government of Chile, which has granted us the privilege of operating under the transparent skies of that country.

Over 40 years ago ESO began working at La Silla (IV Region of Chile), and seven years ago began operation of the Very Large Telescope (VLT) at Cerro Paranal (II Region of Chile), one of the largest astronomical complexes in the world.

Furthermore, with the ongoing support of the Government of Chile and together with our colleagues of North America and Japan, we are currently constructing in the Llano de Chajnantor (II Region of Chile), the Atacama Large Millimeter Array (ALMA), which will be the first global observatory from the surface of the Earth.

The advanced technology and excellent observing conditions provided by ESO observatories have enabled European astronomy to play a key role in astrophysics, while Chile is becoming the world capital in observational astronomy.

In the past decade, ESO has contributed substantively to the development of Chilean astronomy through the ESO-Government of Chile Joint Committee. We see with gratification that this annual fund financed by ESO has helped to strengthen the training of young astronomers at the main Chilean Universities, and to implement dissemination programmes in astronomy addressed to society in general.

The commitment of ESO is, and will continue to be, the development of astronomy and scientific culture in the country hosting our observatories. Thus we celebrate with enthusiasm the 10th anniversary of the establishment of the ESO-Government of Chile Joint Committee, whose achievements are presented in this book by the beneficiaries themselves.

We sincerely hope that the close relationship between ESO and Chile will continue to strengthen, enabling Chile and Europe to continue to harvest great achievements in the joint adventure of peaceful exploration of the universe.

**Dr. Catherine Cesarsky**  
ESO Director General



# Origin of the ESO-Government of Chile Joint Committee

Ten years ago, the European Organisation for Astronomical Research in the Southern Observatory (ESO) and the Government of Chile signed an agreement whereby Chilean astronomy has access up to 10 percent of the total observing time at ESO telescopes in Chile.

This agreement guaranteed to Chilean astronomers privileged access to the state-of-the-art telescopes installed at La Silla (IV Region of Chile) and Cerro Paranal (II Region of Chile).

To make the most of this vast scientific wealth, the 1996 agreement established the creation of an annual fund financed by ESO, aimed at strengthening formation at Chilean Universities of young scientists and professionals in astronomy and related disciplines.

In this context, the ESO-Government of Chile Joint Committee was established for the development of astronomy, formed by three representatives of the Government of Chile and three from ESO.

Since 1998, this fund has financed postdoctoral fellowships and positions for astronomy professors at Chilean universities, infrastructure development, conferences, training for science teachers at primary and secondary level, and astronomy outreach programmes for the general public.

To the close on 400 thousand Euros (about CLP 255 million<sup>1</sup>) that ESO contributes annually to the ESO-Government of Chile Joint Committee, are added 550 thousand Euros (about CLP 350 million) distributed each year by ESO among various collaboration programmes in the regions where their observatories are located, doctoral fellowships for students at the main Chilean universities, and development of radio astronomy through the ALMA-Chile Committee.

In sum, aside from 10 percent observing time at their telescopes, ESO annually contributes close to 950 thousand Euros (about CLP 605 million) for the development of astronomy and scientific culture in Chile.

Through such contributions ESO expects to continue collaborating so that more and more Chilean scientists can take advantage of the tremendous wealth implied by observing and understanding the universe through the most advanced telescopes it has been possible to assemble in the north of Chile, one of the most privileged sites on Earth for research in astronomy.

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<sup>1</sup> Estimated at the current ESO official rate of exchange in May 2006.





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# Universidad de Chile



Image of the galaxy NGC 5128,  
Centaurus A, obtained by the  
National Astronomical Observatory,  
Universidad de Chile.



# Astronomy Department Universidad de Chile

Joint Committee Contributions 1998-2004

*"The ESO-Government of Chile Joint Committee is firmly linked to the present and future of the Astronomy Department at Universidad de Chile. It has supported five of the six faculty members hired since 2000, several postdocs have enlivened our scientific activity, and teaching and outreach activities have been strengthened by the acquisition of astronomical instrumentation".*

The role of the ESO-Government of Chile Joint Committee has been crucial for the growth of human resources for astronomy in Chile in recent years.

From 1998 to 2004, the Joint Committee has contributed a total of USD 489,500 to the Astronomy Department at Universidad de Chile, which have been basically allocated to creating teaching positions, funding postdoctoral studies, and improving scheduled visits to the Cerro Calán Observatory.

Through support for the first two years of senior lecturer positions and contributions to postdoctoral programmes, it has been possible to make better use of the astronomy instruments available to the Chilean scientific community and to improve the level of collaboration between ESO and local institutions. This has also stimulated and strengthened the commitment of our institutes to create positions for professors.

The greatest contribution to our Department has been the renewal of our professional corps. Three of the five new assistant professors: Paulina Lira, René Méndez, and Mario Hamuy, hired during this period, were funded through the Joint Committee.

A fourth assistant professor, Patricio Rojo, will soon join us, funded through a Joint Committee allocation in 2005.

I cannot sufficiently emphasize the significance of such contributions, given the regrettable losses suffered by our group from decease or retirement of some professors.

## **Postdoctoral Programme**

Similarly, the successful development of the new postdoctoral programme has been extremely important for the Department. This programme was a direct result of Joint Committee contributions.

The first postdoctoral graduate funded by the Joint Committee, Sebastián López, is currently staff of the Department, on the way to becoming associate professor.

Senior postdoctors like Fredrik Rantakyro and Kate Brooks developed close ties with our Department and continue to provide scientific cooperation. Indeed, Kate Brooks had been selected to be part of our Department, which was prevented only on account of external circumstances.

The first graduate of our doctoral programme was Dr Andrés Escala, who current-

ly works as postdoctor at our Department thanks to funds from the Joint Committee and has proved to be a major player in our scientific activities. More recently, we have been joined by Dr. Martin Altmann for two years -extended to three, given his excellent performance.

In sum, during its first years of existence the ESO-Government of Chile Joint Committee has been firmly linked to the present and future of our Department. One way or another, it has supported five of the six faculty members hired since 2000, decisively contributing to the renewal of our most important resource, our faculty.

Several postdocs have enlivened our scientific activity, and teaching and outreach activities have been strengthened by the acquisition of astronomical instrumentation.

This contribution has been outstanding and will certainly be recorded in the history of our Department.

**Astronomy Department  
Universidad de Chile**

Main building, Cerro Calán Observatory.



GOTO Telescope at Cerro Calán, donated by Japan.

## Visits to Cerro Calán Observatory

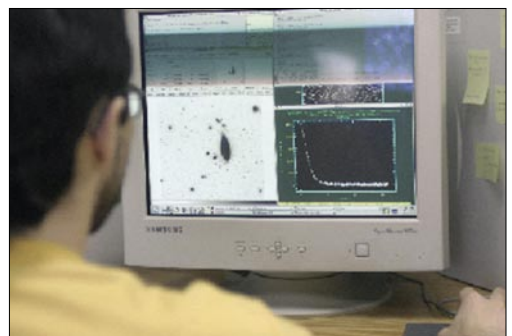
Instrumental teaching and dissemination have also progressed positively with the support by the Joint Committee.

With these funds it has been possible to implement an instrumentation laboratory for astronomy students, thanks to the purchase of an automatic spectrograph for the GOTO 45 telescope at Cerro Calán. This spectrograph has enabled secondary students and the general public to appreciate the importance of spectroscopy as a crucial tool for understanding astrophysical phenomena.

Scheduled visits to Cerro Calán have been enriched by the purchase of a 356-mm Celestron telescope. In addition, the capacity of the GOTO telescope was increased with the purchase of a high-speed CCD camera, 17 times faster than the original one, a cooled video camera, specially designed for astronomy applications, and a colour CCD camera for astrophotography. The purchase of computer equipment was also important for the early development of our image processing centre.



Heyde Telescope at Cerro Calán, built in 1910.



Computer for the analysis of astronomical data.



# Pontificia Universidad Católica de Chile



Image of a distant galaxy cluster  
obtained by Felipe Barrientos,  
associated professor of the  
Department of Astronomy and  
Astrophysics, PUC.



# Department of Astronomy and Astrophysics Pontificia Universidad Católica de Chile

Joint Committee Contributions 1998-2005

*"After eight years of sustained support by the ESO-Government of Chile Joint Committee, the Department of Astronomy and Astrophysics at PUC has obtained one tenured faculty position and thirteen fellow positions, all of excellent quality level. Similarly, production measured by number of publications has experienced remarkable growth".*

Through the establishment of a strong astronomy programme at Pontificia Universidad Católica de Chile (PUC), the Department of Astronomy and Astrophysics (DAA) expects to strengthen astronomy in Chile. This objective is being achieved by promoting the growth of the DAA at PUC and by increasing the number and enhancing quality level of professional researchers at this institution.

Having completed eight years of sustained support from the ESO-Government of Chile Joint Committee, the DAA has obtained one tenured faculty position and thirteen fellow positions, all of excellent quality level.

The funds allocated by the ESO-Government of Chile Joint Committee to the PUC Department of Astronomy and Astrophysics from 1998 to 2005 were distributed as follows: USD 422,500 for the DAA postdoctoral programme, USD 60,000 to hire one faculty member at DAA, and USD 35,000 to hire one faculty member at the PUC Department of Electrical Engineering, in the field of astronomy instrumentation.

As the number of professional as-

tronomers at PUC has increased steadily since 1998, production measured by the number of publications has shown remarkable growth.

In future, the objective is for this productivity to continue growing, to consolidate the recently created instrumental group, and to form a group devoted to millimetric and sub-millimetric astronomy at the DAA.

All this will require constant support from the ESO-Government of Chile Joint Committee.

## **Faculty position at the DAA**

In 2001 the ESO-Government of Chile Joint Committee granted funds (USD 60,000) to fund a new faculty position in the department. Thanks to this contribution, Dr. Márcio Catelan joined PUC in October 2001.

His salary was covered for two years by the Joint Committee; after this period PUC became responsible for payment of his salary.

Dr. Catelan is currently associate professor at PUC in charge of the undergraduate programme in Astronomy.

## **Postdoctoral Programme**

Since 1998 the Joint Committee has awarded funds to finance post doctors, which have served to support part of the Postdoctoral Programme.

Such funding has ranged between USD 17,500 and USD 15,000 per year per member, and includes payment of one salary (USD 15,000 per year) and, whenever possible, funds for research (USD 2,500 per year).

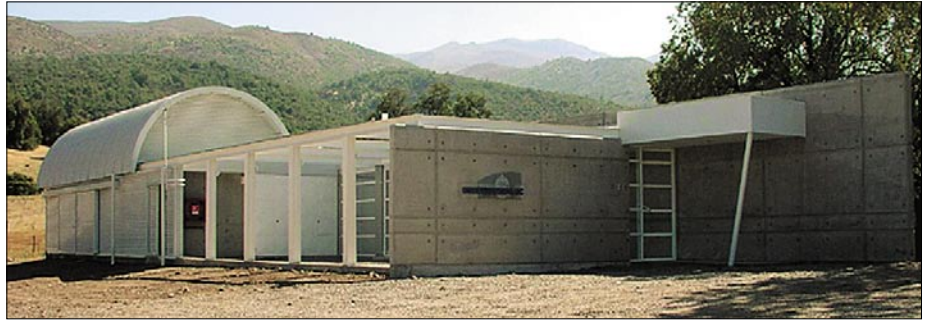
Ramana Athreya, Sarah Ellison, and Remi Cabanac were admitted as ESO exchange members. Their salaries were paid directly by ESO, thus no funds were transferred to PUC.

To assess the impact of the postdoctoral programme on astronomy development at PUC, we quantified the increase in the number of professional astronomers working at PUC and the increase in the number of publications during the 1997-2005 period.

As a way of graphically showing the impact of this programme, Table 1 contains the number of fellows and faculty members, and the number of publications in refereed journals from 1997 to 2005.



PUC Observatory, located in Santa Martina, Lo Barnechea.



Members of the Department of Astronomy and Astrophysics.



It is clear that there is a constant rise in the number of publications since 1997 and that the contribution made by fellows increased significantly since the beginning of the programme. In fact, in 2002 this contribution was at the same level as that of the faculty.

After 2002 there is a slight drop in the number of postdoctoral publications, owing to the fall in the amount of funds. However, in 2004 and 2005 the number of publications tended to level out at about 20 publications per year, which means between 2 and 3 publications per fellow per year.

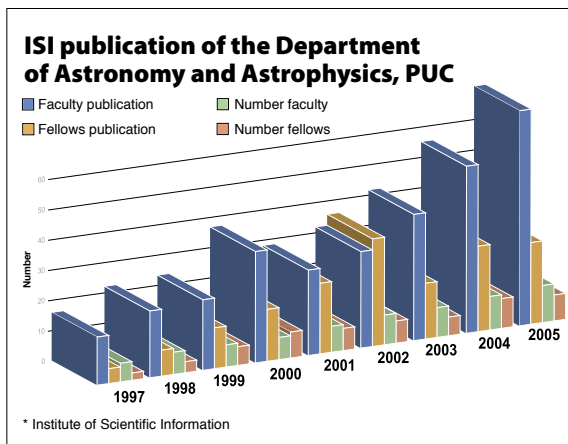
The rise in the number of publications by faculty is remarkable and it is tempting to attribute it to increased interaction among faculty and fellows. The objective is at least to maintain the present level of production in coming years.

**Department of Astronomy and Astrophysics  
Pontificia Universidad Católica de Chile**



## Electrical Engineering in Astronomy Instrumentation

A link with the Department of Electrical Engineering has been completed with considerable success, and a joint professorship in Astronomy Instrumentation has been established. The ESO-Government of Chile Joint Committee granted funds for one year (USD 35,000) and the university allocated additional funds for a permanent position after two years. In 2006 we will again apply for funds from the Joint Committee to cover the salary of this faculty member during the second year.



Evolution in the number of faculty and fellows, and ISI publications at the DAA.



# Universidad Católica del Norte



Eduardo Unda-Sanzana, Astronomy Institute UCN, 2006. Image under public domain by a Creative Commons License. Based on a technique originally suggested by Víctor Ramírez.



# Astronomy Institute Universidad Católica del Norte

Joint Committee Contributions 1998-2005

*“Support from the Joint Committee has proved decisive for the development of astronomy at Universidad Católica del Norte, thereby contributing to science in northern Chile. Proximity to the Paranal Observatory has also enabled us to receive important contributions by ESO for astronomy outreach in addition to joint protection of the area for astronomical purposes”.*

Creation in 1995 of the Cerro Armazones Observatory (OCA) and the Astronomy Institute (IA) at the Science Department of Universidad Católica del Norte (UCN) have been in line with the objectives of the university which carried out these initiatives with an innovative forward-looking vision.

The Astronomy Institute has conducted a number of research projects with the support of the ESO-Government of Chile Joint Committee for the development of astronomy, and their impact has been valuable to achieve the targets set.

The institute seeks to take advantage of the exceptional conditions for astronomy found in Region II, where the sky is deemed one of the best in the world. In addition, proximity to the Paranal Observatory has enabled it to receive important contributions from ESO through the Joint Committee for the development of astronomy in various forms, in addition to joint protection of the area for astronomical purposes.

## **New academics**

The Astronomy Institute at UCN currently has four academics, three of whom were hired thanks to funding from the ESO-Gov-

ernment of Chile Joint Committee for the development of astronomy:

- Prof. Dr Nikolaus Vogt, funded by the Joint Committee since March 2004
- Prof. Dr Marcus Albrecht, funded by the Joint Committee since September 2004
- Postdoctor Dr Eduardo Unda-Sanzana, funded by the Joint Committee since July 2005
- Prof. Dr Valeriy Kravtsov, funded by UCN since June 2004.

The faculty staff is expert in stellar astrophysics, especially variable stars, B stars and cataclysmic variable stars. Also in galactic astrophysics, with emphasis on globular clusters, Magellanic Cloud star groups, in addition to millimetric radio astronomy.

This academic group opens up excellent prospects of fostering high-level research at the Astronomy Institute, taking advantage of opportunities for observation offered by both OCA and the Paranal and La Silla Observatories.

To date, UCN professionals have contributed ten publications to scientific journals and seven proposals submitted have earned

observation time at international telescopes installed in Chile. This responds to the objectives of the University in terms of becoming the scientific-technological referent in northern Chile.

In this context, the UCN authorities plan to continue with the above positions after external funding finalizes, in order to strengthen research even further.

## **Major in Astronomy**

Furthermore, in 2002 Universidad Católica del Norte launched a Bachelor in Physics with a Major in Astronomy, which has aroused much interest among young people in the north and elsewhere in Chile.

From 2003 to date the curriculum of this career includes the following courses: Astrophysics I, II, and III; Advanced Astrophysics; Theory of Relativity; and Introduction to Physics and Astronomy. A voluntary course in Perl programming for Astronomy was also offered during August-October 2005.

Always in the area of teaching and as part of the UCN Education Project, changes are currently being made to the curriculum so as improve coordination with the Physics and Mathematics courses, and in order

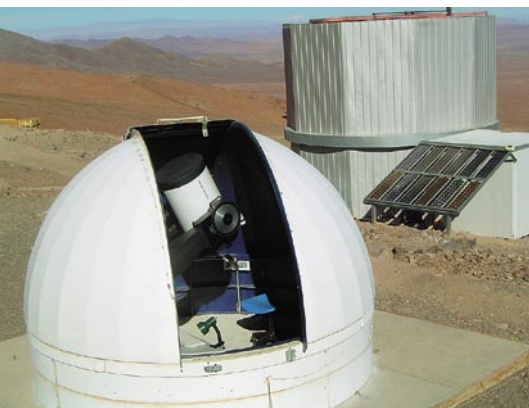
## Centre for Astronomy Outreach

The cooperation agreement between ESO and UCN for the creation and management of an Astronomy Outreach Centre was finalized in 1998 and since that date there is an annual programme of talks to the community, mainly for students of various schools in the II Region of Chile.

The main activities conducted in the framework of the UCN-ESO project "Astronomy Outreach in Region II of Chile" are as follows:

- Creating a working group with advanced students interested in astronomy outreach, under the guidance of Dr. Nikolaus Vogt, later with Dr. Eduardo Unda-Sanzana.
- Preparing 6 Power Point presentations describing the Solar System, size of the universe, stellar evolution, extrasolar planets, black holes, comets, and impact craters.
- Presenting a total of 25 talks from March to November 2005, mainly at schools in Region II of Chile, by Dr. Nikolaus Vogt and other members of the group.
- Cooperating with the public video conference over the Internet, organized by ESO on occasion of the Profound Impact campaign and the Tempel 1 Comet, on July 4th 2005 -presentations in Iquique and Antofagasta by Bernardita Donoso and Dr. Nikolaus Vogt respectively.
- Organizing a cultural and astronomical event in Taltal, consisting of two general talks on astronomy and various folklore performances by a local group and one UCN folklore group, on August 31st 2005 (Dr. Nikolaus Vogt and Dr. Eduardo Unda-Sanzana).
- Creating a new amateur astronomy group "Likancabur" in Antofagasta (Dr. Eduardo Unda-Sanzana).
- Preparing an observational astronomy competition for school children of Regions II, III, and IV of Chile, beginning on November 2005 and continuing until May 2006, in cooperation with PROED (Dr. Nikolaus Vogt and Dr. Eduardo Unda-Sanzana).

Cerro Armazones Observatory, Universidad Católica del Norte.



## ALMA Joint Committee

The ALMA-Government of Chile Joint Committee for the development of astronomy in Chile, formed by representatives of CONICYT, ALMA, ESO, NRAO, NAOJ and the Ministry of Foreign Affairs of Chile, granted funds for conducting the project "Observational Cosmology in view of ALMA - APEX Sunyaev-Zel'dovich Galaxy Cluster Survey", headed by Dr. Marcus Albrecht.

to make more effective use of the practical methods and observational techniques of current astrophysics.

Also, to make more efficient use of OCA and have our top students participate in research, in 2005 we launched observation campaigns applying differential CCD photometry to:

- Galactic open star clusters (search for variability)
- Quasars and active galactic nuclei (in cooperation with Dr Martin Haas, Bochum)
- Cataclysmic variable stars and other types of stars (partly in cooperation with Dr. Chris Sterken, Brussels)
- Extrasolar planets (search for transits)

The support of the ESO-Government of Chile Joint Committee has been decisive in the deployment of a number of efforts aimed at the development of astronomy at Universidad Católica del Norte, thereby contributing to science in northern Chile.

**Astronomy Institute  
Universidad Católica del Norte**



Yosselyn Bravo Barriga, Dr. Valeriy Kravtsov, Dr. Nikolaus Vogt, Dr. Marcus Albrecht, Dr. Eduardo Unda-Sanzana and Zoila Fernández Miranda.



# Universidad de Concepción

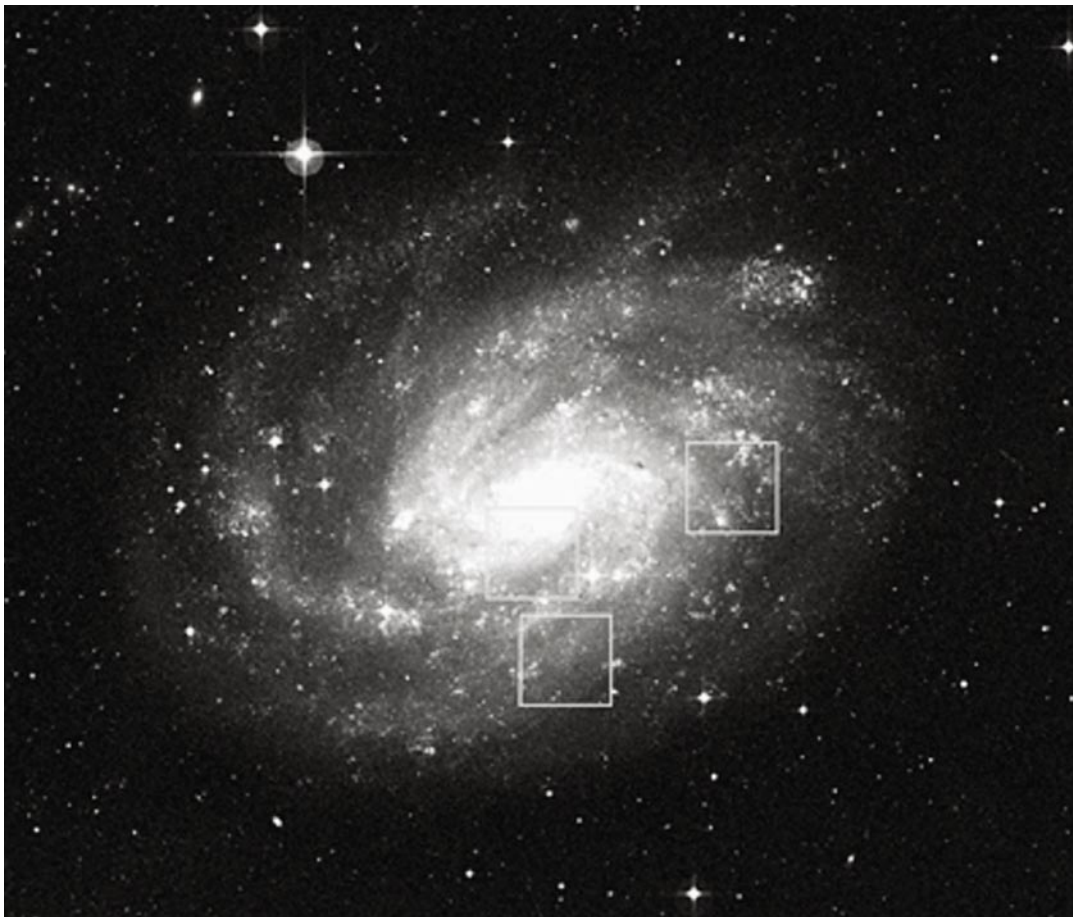


Image of the spiral galaxy NGC 300, obtained with the ESO VLT in Cerro Paranal (II Region of Chile), as part of the Araucaria Project of the Universidad de Concepción. This is the more accurate estimation so far of the distance for a galaxy outside the Local Group.



# Astronomy Group Universidad de Concepción

Joint Committee Contribution: 1998-2005

*"Joint Committee allocations over the past eight years have paved the way for sound scientific development at the Astronomy Group and have consolidated Universidad de Concepción as one of the major poles of astronomical research in Chile."*

Since 1998, when the ESO-Government of Chile Joint Committee first allocated funds for the development of astronomy in Chile, the Astronomy Group at Universidad de Concepción has greatly benefited from this programme.

Over the last eight years, the continuous flow of funds from the Joint Committee has been crucial for the development of scientific, academic, and outreach activities of the group and for reaching its sound present level, comparable to the activities developed in these fields by the main astronomy departments in the country.

Thanks to Joint Committee funds our group has been able very significantly to strengthen existing areas of research, besides introducing new ones by hiring new faculty.

With the first allocation by the Joint Committee for a three-year course in 1998, the Astronomy Group hired Dr. Tom Richtler (October 1999), who has furthered and considerably improved

the scientific activities of our group in the area of extragalactic globular cluster systems and their usefulness as identifiers of primordial galaxy halo dynamics.

In fact, the Universidad de Concepción organized the international conference on Globular Cluster Guides for Galaxies, held in March 2006 and attended by most leading researchers in the field.

## **Investment in infrastructure and postdoctoral training**

It is no exaggeration to say the allocations by the Joint Committee over the last eight years have paved the way for sound scientific development at the Astronomy Group and consolidated Universidad de Concepción as one of the major poles of astronomical research in Chile.

The allocations of the Joint Committee to the group have been by far the most important source of funding during this period, and the great impact they have had on Universidad de Concepción

may be easily analyzed by comparing the scientific status and performance of the group in 1998 and on the date of this report in 2005.

In 1998 the group had three full-time professors; at present there are six professor positions for the Astronomy Group.

In 1998 we had no postdoctoral graduates working with the group; today there are four and we are seeking one more. The Postdoctoral Programme of the Astronomy Group at Universidad de Concepción was established and has been maintained almost exclusively with Joint Committee funds and has been extremely successful.

In 1999 our group was allocated funds for infrastructure. With these funds (USD 65,000) the Astronomy Group was able to take a quantum leap in computer equipment by acquiring Sun work stations, Linux personal computers, and all necessary accessories (printers, plotters, DLT readers, etc.). This was the first truly modern and powerful computer



## Postdoctoral Programme

The Postdoctoral Programme at the Astronomy Group of Universidad de Concepción was created in 1999 with Joint Committee funds. To date, five postdoctoral positions have been financed with Committee funds.

One is filled by Dr. Pietrzynski, who together with Dr. Wolfgang Gieren, senior lecturer at the Astronomy Group, Universidad de Concepción, designed and co-directed Project Araucaria (see box).

Dr. Tappert has been working for two years (2001-2003) in the area of stellar evolution, directed by R. Mennickent. This area will be further strengthened by a new postdoctoral position financed from the latest allocation by the Joint Committee for this programme.

Dr. Aaron Romanowsky joined the group in October 2004. His experience in theoretical models with kinematic data of globular clusters and planetary nebulae is a very important complement to the experience of the other members of the group on galactic formation and evolution.

Dr. Matías Gómez was hired in a postdoctoral capacity in early 2004 to strengthen the group on galactic formation and evolution. Dr. Gómez has been involved in the study of globular cluster systems in various galaxies, mainly Centaurus A, the nearest giant elliptical galaxy. Dr. Igor Soszynski joined our group in July 2004 and worked with Dr. Gieren and Dr. Pietrzynski in the field of the extragalactic distance scale. Dr. Soszynski is at present a key member of Project Araucaria, focusing in particular on analysis of near-infrared Cepheid images in nearby galaxies, obtained by Project Araucaria with the ESO VLT.

infrastructure available to the group and it prepared the ground for the successful research activities conducted since 2000.

Joint Committee funding has also helped to set up an organized programme for astronomy outreach which includes guided night visits to our 12-inch telescope. As a result, the fame of our astronomy group has increased considerably in recent months among students and the public at large.

In conclusion, we wish once again to stress how crucial all the funds allocated to us so far by the Joint Committee have been. There is no doubt that the considerable development of the Astronomy Group at Universidad de Concepción in recent years has only been possible thanks to this. We wish to thank the Joint Committee for placing their trust in our group and hope to continue successfully using the funds allocated to us.

**Astronomy Group  
Universidad de Concepción**



10 YEARS JOINT COMMITTEE

ESO/Government of Chile

Telescope of the Astronomy Group, Universidad de Concepción.

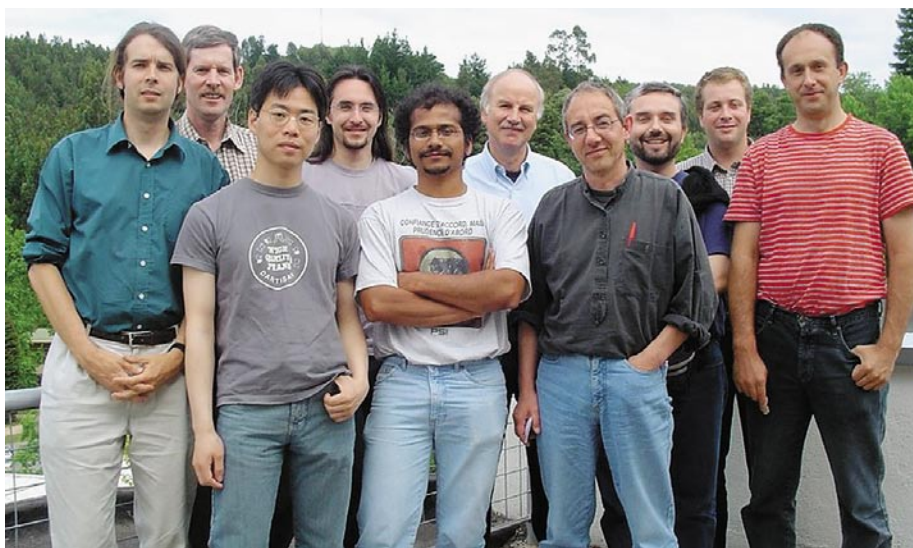
## In the forefront of extragalactic distances

Project Araucaria, directed by Professor Wolfgang Gieren, of the Astronomy Group, Universidad de Concepción, is one of the most significant Chilean scientific projects of recent years in the area of astrophysics. The aim of Project Araucaria is to determine the distances of relatively near galaxies with a less than 5-per-cent margin of error – a very difficult goal to achieve – by the comparative study of various indicators of stellar distance, such as Cepheid variables, red clump stars, and blue supergiant stars. On this basis, certain cosmological parameters such as the Hubble constant (which measures the current expansion of the Universe) may be determined more precisely.

In August 2005, a group of astronomers from Universidad de Concepción headed

by W. Gieren, together with colleagues from Europe, USA, and Pontificia Universidad Católica, were able to obtain the most precise distance known so far of a galaxy located beyond the neighbouring Magellanic Cloud. Using the ESO 2.2-metre telescope at La Silla (Region IV of Chile) and one of the giant 8.2-metre telescopes of the ESO VLT at Cerro Paranal (Region II of Chile), it was possible to determine with an error of only 3 per cent that the distance separating our Milky Way from the Spiral Galaxy NGC 300 is 6.13 million light-years.

This result was based on a photometric combination of the Cepheid variables in NGC 300 obtained in the optical and infrared range, which practically cancelled the effect of interstellar absorption, main source of error in distance measurements.



Members of the Astronomy Group.

## Radio Astronomy in Concepción

With the Joint Committee funds received in 2003, in October 2004 the group hired Dr. Neil Nagar, a radio astronomer with PhD from the University of Maryland, USA, who had held highly successful postdoctoral positions in Florence and Gröningen before joining the Astronomy Group in Concepción.

Dr. Nagar is currently developing radio astronomy in Concepción and works in close collaboration with groups at the Department of Electrical Engineering participating in the operations of the Caltech CBI instrument operations in northern Chile. He also collaborates with the University geodesic group which maintains an Observation Station (TIGO) as part of an international network, and whose facilities may be used for research programmes in radio astronomy. Neil Nagar also works actively in the study of black holes in active galactic nuclei and related objects, and in the analysis of residual infrared/optical luminescence of gamma-ray explosions as part of firm international collaboration.

Dr. Nagar will be given tenure at Universidad de Concepción after funding by the Joint Committee for this purpose expires and will lead the Astronomy Group in Concepción during the era of the Atacama Large Millimetre Array, ALMA.



# Universidad de La Serena



Very deep color image of the galactic HII region NGC 2467, obtained by Roberto Gamen of the Universidad de La Serena, using the Wide Field Imager (WFI) at the ESO 2.2-m Telescope in La Silla Observatory (IV Region of Chile).



# Astrophysics Group Universidad de La Serena

Joint Committee Contribution 2001-2005

*"Thanks to financial support from the ESO-Government of Chile Joint Committee, the group at Universidad de La Serena (ULS) has grown in five years from having no astronomers to the current group of four astronomers provided with full facilities for working on their research projects"*

The Strategic Development Plan for 1998-2002 of the Physics Department at ULS provides for the formation of an Astrophysics Group. Dr. Pedro Vega, Director of the Physics Department, began putting this initiative into effect by calling for two candidates with a PhD in Astronomy to fill as many new positions, also obtaining funds for the necessary computer equipment.

In 2000 Dr. Amelia Ramírez took charge of training the emerging group. Dr. Héctor Cuevas was hired the following year and, in addition to working as researcher, was also appointed Coordinator of the Physics Bachelor. Together with research, teaching, and management, initiatives were needed to support the community of Region IV, which was highly supportive of dissemination activities in astronomy. In this regard, the arrival of Professor David Orellana to the group was a key step; the School Astronomy Pilot Programme was organized, including with the Mobile Planetarium of Project Gemini (Explora-CONICYT project). Professor Orellana currently directs the ULS Support Centre for the Teaching of Astronomy (CADIAS).

In 2002 the group for the first time obtained funds from the ESO-Government of Chile Joint Committee, enabling it to hire Dr. Rodolfo Barbá for two years. On the third year, the University fulfilled its commitment to continue the training

programme for the emerging group taking over the cost of this contract. Further funding from the Joint Committee was obtained in 2003 and 2004 for purchasing necessary equipment to develop astronomy research and hiring Dr. Roberto Gamén in a postdoctoral capacity for two years; his position is currently being funded by the Committee for a further year.

The arrival of Dr. Barbá was most important owing to his extensive experience in research and teaching, while the addition of a postdoctoral position, besides increasing scientific production, has helped to create the initial mass enabling the group to receive foreign visitors, both astronomers and post doctoral graduates as well as graduate students from other institutions.

This rate of growth continues and for the second semester 2006 we expect to fill another postdoctoral position for two years and receive two visiting astronomers who will spend their sabbaticals with the group.

With respect to infrastructure, the group now has new facilities thanks to funds received for construction of a three-floor building (see photo).

## **Astrophysics as strength**

Universidad de La Serena is defining its policies for assessment and valuation of research work,

mainly in light of new scenarios for allocation of Government funds to State-owned Universities, substantially based on scientific productivity indexes.

The Astrophysics Group shows one of the highest scientific productivity indexes at the University and is highly regarded for its resource management capability, as shown by the analysis of funds acquired by the group from the ESO-Government of Chile Joint Committee and others.

In this context, the 2005-2009 Development Plan for the Physics Department at ULS states that astrophysics is the main strength of the Department and a priority area for academic development.

Basic Astronomy and Astronomy Teaching were added to the Education career in Mathematics and Physics, so that future teachers may benefit from all the astronomy resources intended for dissemination which have been set up in Region IV.

The support given by the Joint Committee to the Astrophysics Group has had an impact, not only on the Physics Department and the University, but also at the regional, national, and international levels.

## **Regional and international impact**

The Astrophysics Group supports efforts



CADIAS, Astronomy Teaching Support Centre. Upper right, ULS professor David Orellana.

## ALMA Joint Committee

Funds were obtained in 2005 from the ALMA-Government of Chile Joint Committee to finance a new postdoctoral position for two years.

This Project, which is conducted in collaboration with researchers at the Cerro Tololo Inter American Observatory and Universidad de Chile, is designed to generate astronomy databases to be utilized by the astronomy community for observation with the ALMA interferometer.

## Research Areas

The group research areas focus on stellar and extragalactic astronomy, specifically observation of massive stars and star formation, together with the constitution, dynamics and evolution of galaxies in clusters and superclusters.

The cumulative scientific production of the members of the Astrophysics Group totals 61 scientific papers cited in ISI, 12 of which lead to ULS as affiliation. In addition, 10 studies representing Universidad de La Serena have already been presented at international congresses.

At present, the astronomers of the Physics Department direct and participate in collaboration projects with researchers from major domestic and international astrophysics research centres. In addition

to Chilean institutions, this includes the Space Telescope Science Institute (USA.), Gemini Observatory, Carnegie Institution of Washington (USA), Ames Research Center NASA (USA), Observatorio de La Plata (Argentina), Instituto de Astrofísica y Geofísica-USP (Brazil).

Finally, group members assess projects for FONDEF, CNAP, CONICYT, CONICYT-Explora, Telescope Time Allocation Committee, and Astronomer Selection Committee for Cerro Tololo Observatory, and are judges for highly influential international scientific journals. Members have also been invited to join scientific committees at international meetings, and for 2006 have been asked to organize in La Serena the IV Annual Meeting of the Chilean Astronomy Society (SOCHIAS).

based on teaching science, e.g. the School Astronomy Programme, first started with REDLASER and currently under the aegis of the Physics Department.

The above programme focuses on disseminating Astronomy in the classroom, under the guidance of the teachers themselves, the latter enjoying reliable and serious backing from the ULS group.

As a result of the impact of the School Astronomy Programme, the Corporation which encompasses all municipal schools in La Serena included in their 2003-2008 Action Plan the mandatory delivery of two weekly hours in Astronomy within the curricular activities at each school.

At present the Astrophysics Group at Universidad de La Serena is considered the fourth group in Chile, following Universidad de Chile, Pontificia Universidad Católica de Chile, and Universidad de Concepción.

In addition, Universidad de La Serena is beginning to appear internationally, e.g. projects of the Space Telescope Astrophysics Institute.

**Astrophysics Group  
Universidad de La Serena**



**ULS  
Astrophysics  
Group. From  
left to right  
Héctor Cuevas,  
Amelia Ramírez,  
Roberto Gamén,  
Rodolfo Barbá,  
and Julia Arias.**

## Astronomy training in the Region

Four years ago, training for future astronomers was restricted to universities in Santiago.

At present Universidad de La Serena offers a Bachelor in Physics with a Major in Astronomy and five students from Region IV have already graduated. Thus there is now an option for students unable or unwilling to leave their home town.

Joining the course is indirect, that is, from the second semester students may transfer from another career, such as engineering or education. Student selection is based on academic achievement while keeping the total number of students down to not more than twenty. The Bachelor in Physics with a Major in Astronomy has achieved a good standard and students have obtained undergraduate internships at High Technology Centres operated by Fundación Andes; fellowships to attend the IAU School for Young Astronomers in Mexico. Others were selected for the Astronomy Research Programme (PIA) at the Cerro Tololo Observatory; some are co-researchers in Cerro Tololo Observatory projects and are also involved in research projects in collaboration with astronomers at the Gemini Observatory.



# Universidad Metropolitana de Ciencias de la Educación



Spiral galaxy NGC  
4565 obtained with  
the ESO VLT in Cerro  
Paranal (II Region of  
Chile).



# Astronomy Schools at UMCE

Joint Committee Contributions 2004-2005

*"Thanks to funding by the ESO-Government of Chile Joint Committee, two Astronomy Schools for Teachers were organized at UMCE designed to train and improve science teachers in the Chilean education system for efficient performance in the classroom. Implementation of these schools has brought to light the urgent need to provide systematic professional assistance for teachers."*

Universidad Metropolitana de Ciencias de la Educación (UMCE) is the main teacher-training centre for all areas and levels of the Chilean school system and has favoured the addition of astronomy to the training curriculum for science teachers. This view is based on the valuable motivational and educational contribution of astronomy and the speedy development of this science in Chile.

With the foregoing in mind, UMCE has defined other activities designed to support teacher training and improvement, both at undergraduate level and in continuing education, conducive to graduate and advanced degrees in the field of astronomy.

Interest in fostering astronomy had already taken root many years back at the UMCE Department of Physics, with emphasis on specific lines of action in the teaching field, i.e. general courses, preparing teaching material, exhibitions, astronomical observations in the field, and educational research on teaching astronomy. The experience

gained has provided significant support for the Astronomy Schools for Teachers.

## **Astronomy Schools for teachers**

The development of teaching and dissemination of astronomy at UMCE has been strengthened by favourable internal and external conditions to provide systematic support for training teachers working in the Chilean education system.

UMCE currently has a team of qualified professionals in the area of Teaching Astronomy and Physics:

- Luis Barrera Salas, PhD in Astronomy, MSc in Physics
- Juan Espinoza Gutiérrez, MSc in Education, Physics Teacher
- Luis Brahim Navarrete, MSc in Education and Multimedia, Physics Teacher

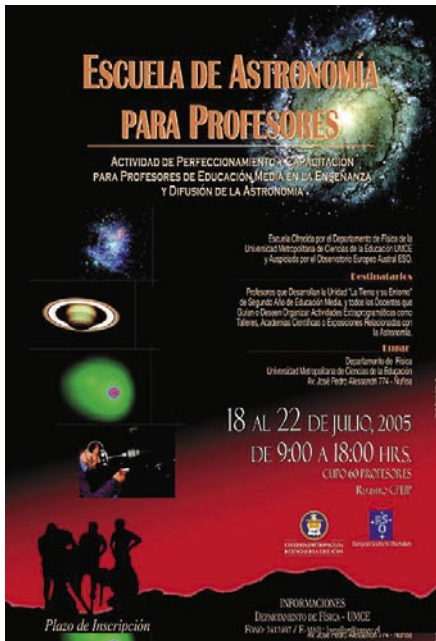
With the financial support of the ESO-Government of Chile Joint Committee, these professionals have organized two As-

tronomy Schools for Teachers designed to train and improve science teachers working in the Chilean education system and provide them with tools in astronomical science and methodology for efficient performance in the classroom. Implementation of these schools has brought to light the urgent need to provide systematic professional assistance for teachers.

The methodological structure of both schools emphasized active participation of teachers and students at laboratories, workshops, field observations, multimedia audiovisual sessions, and refresher talks on specific areas given by the teaching staff and with participation and collaboration of guest speakers.

The first Astronomy School for Teachers was held on July 18th to 22nd 2005 and the second School on January 2nd to 6th 2006. Both took place in the Physics Section of the UMCE Department of Basic Science, with a total enrolment of 100 teachers from various regions of Chile; almost one hundred pre-





## Higher level educational outlook

The current curriculum of the UMCE Department of Basic Science enables its students to choose among other options a Major in Astronomy. With this degree, graduates who are to work in the national education system will be capable of delivering the astronomy contents in the current curricula and promote the creation of workshops and extra-curricular activities. This Major will further enable graduates to work at other than formal educational institutions, e.g. museums, observatories, etc.

Moreover, the university observatory will assist the writing of dissertations and undergraduate theses, research papers, in addition to activities for disseminating astronomy to the whole community.

The development plan of the UMCE Physics Section contemplates the creation of graduate programmes and various stages of continuing education, such as graduate courses and advanced degrees in astronomy teaching.

It is to be hoped that the support for the improvement of professionals through advanced studies, specific courses, talks, etc. will have a significant impact on the quality of teaching by the teachers responsible for delivering astronomy-related topics, resulting in indirect benefit for the Chilean educational system.

enrolled participants could not be accommodated.

With the valuable contribution of the ESO-Government of Chile Joint Committee, it was possible to fund these Astronomy Schools and acquire a modern 16-inch automatic telescope which will be installed at the observatory in the new building of the Department of Basic Science. The equipment of this observatory will be supplemented by the existing minor telescopes in the UMCE Physics Section.

Based on the experience gained from the schools already held, the organizers intend these schools to become a permanent feature open to teachers during their refresher training periods in the winter or the summer holidays, and, as until now, under the valuable sponsorship of the university and the ESO-Government of Chile Joint Committee.

**Astronomy and Physics Group  
Universidad Metropolitana  
de Ciencias de la Educación**



From left to right, professors Juan Espinoza, Luis Barrera and Luis Brahim.



# Sociedad Chilena de Astronomía



Spiral galaxy NGC 1097 obtained with the ESO VLT in Cerro Paranal (II Region of Chile).



# Sociedad Chilena de Astronomía

Joint Committee Contributions 2002-2005

*"The annual meetings of SOCHIAS have become a permanent activity in the national scientific community, attracting increasingly greater attendance by Latin-American astronomers and students. Without support from the Joint Committee for holding these meetings, continuing with this important activity every year would not have been possible".*

The main mission of the Sociedad Chilena de Astronomía (SOCHIAS) is to encourage and conduct activities designed to develop national astronomy.

Its principal activity is holding the Annual Astronomy Meeting, a scientific event which summons astronomers and astronomy students to discuss their work and research, taking advantage of the occasion to promote collaboration among them.

The initiative started with the II Annual Meeting of SOCHIAS Members, held in 2002, and has successfully continued to take place since then.

SOCHIAS activities are mainly financed by members' dues and funds obtained by competition, like the funds from the ESO-Government of Chile Joint Committee.

To date three scientific meetings have been held: the II, III, and IV Annual Meetings of SOCHIAS. All received funding from the Joint Committee.

Attendance at these meetings increases each year including speakers wishing to

present papers and participants. It was thus decided to extend the meeting duration from two to three days, to give a greater number of participants a chance to make oral presentations. Contributions are also received for panel discussions, which have also steadily increased.

The IV Meeting was held outside Santiago for the first time: in Concepción, with over 100 attendants, mostly students and young astronomers. Also for the first time, there were several students from Argentina, who took the trouble of travelling by bus to attend.

## Public lectures

Together with scientific activities, during the meeting one or two lectures are given for the general public, taking advantage of the presence of experts in areas of general interest. The lectures attract large audiences.

Two such lectures were given during the IV Annual Meeting: Dr. Mario Hamuy, of Universidad de Chile, discussed "Acceleration

of the Universe in the light of Supernovas"; and Dr Duccio Macchetto, from the Hubble Space Telescope Science Institute, addressed the question "Is there life in the Universe?"

The SOCHIAS annual meetings have become an ongoing activity in the national scientific community and attract ever-increasing numbers of astronomers and students from Latin America.

The V Annual Meeting will be held in 2006 in La Serena. Although it is a fact that meeting costs are higher outside Santiago, we find it necessary to hold them in places where new astronomy groups are emerging.

SOCHIAS feels that support from the Joint Committee is essential to hold these annual meetings. Without this contribution it would not have been possible to hold this important activity each year.

**Sociedad Chilena de Astronomía  
SOCHIAS**

## First Latin American Astronomy School

Over 200 students and young researchers from 18 countries met in Santiago from the 8th to 10th December to participate in the first Latin American School of Astronomy organized by ESO, SOCHIAS and the City Council of Vitacura. This multi-theme meeting was held with funds from the Joint Committee and contributions from ESO, and enabled young scientists from the continent to update their knowledge in areas of leading-edge research in the field of astrophysics.

The talks were given by outstanding astronomers, among them Bob Williams, from the Space Telescope Science Institute (USA), who encouraged the young researchers to look at the primordial universe, and Professor Malcolm Longair, from Cambridge University (UK), who presented the history of cosmology in the 20th century.

Other speakers included Gloria Dubner (IAFE/CONICET, Argentina), Luis Felipe Rodríguez (UNAM, Mexico), Félix Mirabel (ESO, Chile), Dante Miniti (PUC,

Chile), and Pat Osmer (Ohio State University, USA). Mónica Rubio, Chairperson of SOCHIAS, discussed the development and current status of Chilean astronomy.

Considering the success of this first Latin American School of Astronomy and its impact on the formation of future astronomers in the continent, it has been proposed that this multi-theme school become one of the Regional Meetings of the International Astronomical Union (IAU).



## IAU XI Regional Astronomy Meeting

The eleventh meeting of the International Astronomical Union (IAU) LARIM 2005 was held in Pucón (Chile) from December 12th to 16th 2005, organized by SOCHIAS.

The meeting was attended by close to 300 astronomers from 20 countries, including Germany, Argentina, Australia, Brazil, Canada, Chile, Colombia, USA, France, Greece, Honduras, Japan, Mexico, The Netherlands, Peru, United Kingdom, Uruguay, and Venezuela. A remarkably large number of young astronomers and graduate students in astronomy accounted for 50% of the participants.

The programme included 24 top-level expert guest speakers and 60 oral presentations. One of the keynote speakers was Prof. Riccardo Giacconi, winner of the Nobel Prize for Physics in 2002. In addition, over 300 contributions in poster format were exhibited for 4 days. There were also two talks for the general public: one in Santiago by Professor Giacconi and another in Pucón by Dr. Luis Aguilar, from Mexico.

In the 2004 bid, the Joint Committee granted SOCHIAS the sum of USD 10,000 to support the organization of LARIM 2005. These funds were applied to grants for young astronomers and students.



# PROED



Horsehead nebula  
obtained with the ESO  
VLT in Cerro Paranal  
(II Region of Chile).



# PROED Teacher Training Programmes

Joint Committee Contribution 1999-2005

*"All contributions by the Joint Committee to PROED have focused on the UNIVERSUM programme, which has trained about 700 secondary school science teachers from six of the 13 regions of Chile, with special emphasis on astronomy in general and development of observation in Chile."*

Since 1999, the Joint Committee has continuously supported the PROED education projects in the area of furthering knowledge and dissemination of astronomy.

The fundamental justification for the existence of these programmes is that astronomy was included in the teaching of Physics in Chile 6 years ago and that the great majority of teachers lack information in this area.

The purpose of all these projects is to educate and update secondary school Physics teachers, regarding both information about astronomy and current teaching methods; connect teachers to their peers and to local universities in a working network; deliver teaching materials and instruments to the schools.

Our objective is that the sum of these different aspects should result in increased enthusiasm among students and the community about science, particularly astronomy.

All contributions by the Joint Committee have focused on the UNIVERSUM programme.

This programme has trained nearly 700 teachers from 6 of the 13 regions of the country. These teachers are in direct contact in the classroom with over 350,000 students. The programme has evolved in both methodologies and resources, until it has become a complete curricular supplement at all levels of secondary teaching, with special emphasis on astronomy in general and the development of observation in Chile.

During 2000, over 600 teachers from the Metropolitan Region and Regions V and VIII

participated in the Training Seminars included in the UNIVERSUM programme, focusing on the astronomy-related aspects of the Physics curriculum required by the Ministry of Education. The programme included provision of a toolkit with classroom teaching materials.

This programme was carried out in 1999 with ESO astronomers, jointly with the astronomy departments at Universidad de Chile and Universidad de Concepción.

In view of the success of the first year of the UNIVERSUM Project, the Exhibition and Teacher Training Seminars were extended to teachers from Regions II and IV, representing almost the whole universe of secondary school Physics teachers in those regions.

A total of 118 teachers were trained and the exhibition was set up at Universidad Católica del Norte (Region II) and Universidad de La Serena (Region IV) open to teachers and students. Two mobile teaching kits with materials (replicas of various parts of the exhibition) were given to the departments of astronomy and the local Ministry of Education, to be circulated among the regional schools.

At the end of the year, the UNIVERSUM Exhibition returned to Santiago to the Cerro Calán Observatory (Universidad de Chile), to become a permanent part of its future training centre.

## **Intensive training pilot Project**

The success of UNIVERSUM clearly evidenced the need to provide more complete training for "outstanding" physics teachers both

in physics and specifically in astronomy.

The new UNIVERSUM pilot project for the classroom was created and produced taking advantage of past experience and thanks to joint work with astronomers and Professor Nelson Mayorga, a member of the Physics Curricular Team for Secondary Teaching, Ministry of Education.

The programme included selection of 15 Physics teachers with proved interest in astronomy, who received a handbook with secondary teaching theory and activities, a kit of materials for each experiment, and a five-day seminar teaching by "immersion".

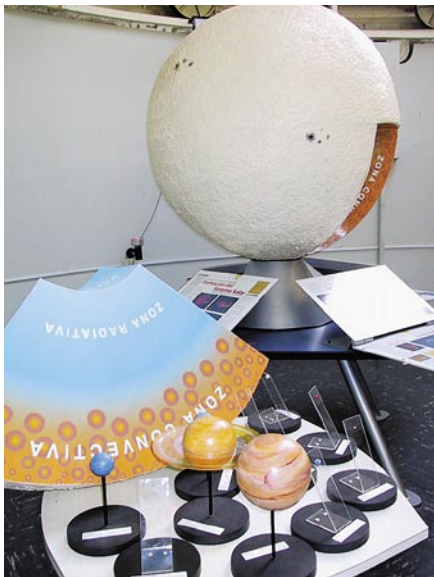
The teachers created the UNIVERSUM Teacher Network, which was later recognized by the regional office of the Ministry of Education and included in the Science Teacher Networks.

This programme, funded by contributions from the ESO-Government of Chile Joint Committee, surpassed all expectations in terms of teacher response; this was later made evident by enthusiastic and voluntary reproduction of the UNIVERSUM programme.

The UNIVERSUM programme has exceeded the expectations of PROED and of the teachers, and has helped to revive enthusiasm for learning and generating major progress in student understanding, leading to improved marks and expanded development of astronomy clubs and academies.

The programme has been acknowledged by the Ministry of Education as the agent of an





## UNIVERSUM 2004-2005 Regions II, III, and IV

Implementation of "UNIVERSUM in the classroom" began in 2004 as a result of the pilot project completed in 2003. The first year of implementation focused on 1st and 2nd Secondary Years, and in the second year it was extended to 3rd and 4th Secondary Years.

The 45 teachers trained encompass a universe of about 210,000 students. In addition, each teacher has reproduced parts of the UNIVERSUM programme to an average of 32 other teachers both at their own schools and through Science Teacher Networks, astronomy club, etc.

During 2004 the programme was included in an Impact Assessment which showed positive and significant results in student learning, who had improved fivefold in their skills, knowledge, and learning ability. This comprehensive programme is recognized as the best astronomy and physics programme for secondary teaching with an influence on teaching quality.

The programme was supported by the ESO-Government of Chile Joint Committee, Fundación Andes, ULS, and the Regional Ministerial Secretariat for Education.

important educational difference at the schools and in the regions where it has been adopted.

UNIVERSUM provides concrete answers to teacher needs continuing education and specialization, together with an innovative way of making an effective transfer of information in the classroom. With this programme, both teachers and students are able to discover and "rediscover" various phenomena, awakening positive interest in learning and research.

UNIVERSUM has caused a new and very interesting phenomenon which consists in the self-motivation of teachers to transmit the programme to colleagues at their own schools, holding seminars on weekends or through training networks. This propagation of the programme has reached the primary school teachers and even local universities, thus reaching an incalculable number of students.

In this way, knowledge of astronomy reaches the general public through science exhibitions, astronomy congresses, club activities, school events, relations with other local initiatives, etc.

Thanks to all the above the Project funded by the Joint Committee in 2006 aims to reinforce 25 selected astronomy clubs directed by UNIVERSUM teachers. These clubs are a concrete indicator of interest in astronomy together with enthusiasm for the project, and will undoubtedly drive for constant progress in the introduction of astronomy in Regions II and IV.



## UNIVERSUM 2006 Support for Astronomy Academies Regions II, III, and IV

During 2006, UNIVERSUM contemplates support for strengthening 25 Astronomy Academies in regions IV, III, and II. With this one-year programme, teachers will acquire knowledge, skills, and instruments for subsequent application at their academy by holding the intensive seminar on both optical astronomy and radio astronomy. Students will work with activities and techniques for observation with the naked eye, with binoculars, and with telescopes. They will also learn to find their way in the sky using stellar maps and will attend a special workshop to understand changes in the sky.



# Universidad de Santiago de Chile



Image of planet Saturn  
obtained with the ESO  
VLT in Cerro Paranal (II  
Region of Chile).



# Planetarium of USACH

Joint Committee Contribution 2000-2006

*"The funds granted by the ESO-Government of Chile Joint Committee since 2000 have allowed the USACH Planetarium access to a Mobile Planetarium and a Mobile Observatory, with which it has reached the remotest corners of the country delivering knowledge and entertainment to the whole school population".*

The Planetarium of Universidad de Santiago de Chile, in its effort to spread art, science, and technology -especially astronomy and related sciences- has prepared and submitted projects to the ESO-Government of Chile Joint Committee since 2000, as a result of which it has been able to access a Mobile Planetarium and a Mobile Observatory with which it has reached the remotest corners of the country delivering knowledge and entertainment to the whole school population.

In 2000, with a contribution of 17,500 US dollars, the Planetarium purchased the technical means to assemble a Starlab Deluxe Mobile Planetarium seating 80 students. That same year presentations were given to students in Arica, Putre, Chillán, Ancud, Coyhaique and other similar towns as part of the test and adjustment phase.

In 2001, another project was submitted to the Joint Committee and 28,500 US dollars were granted to the Planetarium. Part of the funds were used to purchase a lorry specially built and adapted for the Mobile Planetarium to move the equipment to the most distant locations in order to promote astronomy science. Another part of the funds granted that year was used to equip the Mobile Planetarium with a modern audio system, a computer, and a video system.

Two other special programmes were implemented: "Knowing the Universe" and "The Solar System", and panels and models were built for exhibition together with the public performances.

During the first year of formal operation, the Planetarium visited 16 towns between Arica and Puerto Aysén performing to close on 45,000 people.

**TOTAL VISITS IN 2001: 45,931**

In 2002, the Mobile Planetarium continued the dissemination performances and participated in major astronomy-related events such as the FIDAE International Air and Space Show and ÓRBITA 2000, reaching 37,000 people.

With an additional 44 thousand Euros granted by the Joint Committee, the Interactive Mobile Observatory (OMI) was acquired; it consists of a specially built vehicle, one main 14-inch telescope, two auxiliary 8-inch telescopes, an audiovisual projector system, an information system with astronomy software, and ancillary equipment. The purpose of the entire OMI system is to contribute to scientific dissemination throughout the country and extend the application of astronomy among primary and secondary students, and the public at large.

The project was implemented and put in motion that same year.

The normal activities of the Mobile Planetarium continued at the same time, 22 towns were visited and an audience of 48,382 people was reached.

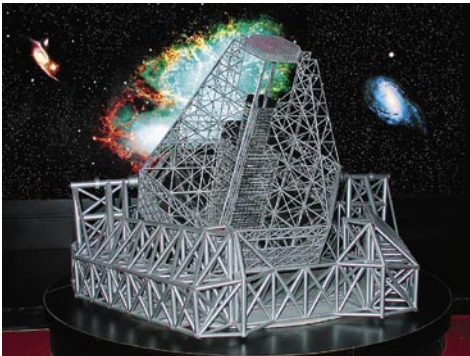
**TOTAL VISITS IN 2002: 85,382**

In 2003 the Mobile Planetarium visited over 30 communes in the country and the show was seen by 53,439 people including students and general public. Also that year investments were made in technical improvements, with a 28,000-US dollar contribution from the Joint Committee.

These funds were used to change the audio amplification system for a professional system; two multimedia projectors were replaced, the video reproduction system was changed from VHS to SVHS, and the stellar simulation projection system was upgraded. Also the third audiovisual production was created, "Lights in infinite space", and new models of the W. Herschel telescope were made, one replica of the telescope of Galileo Galilei and one astronaut.

Investments were also made in the maintenance area: monthly replacement of video tapes, quarterly replacement of carpeting, bulbs for the stellar projector, main-





## Planetarium and ESO at FIDAE 2006

In March 2006, the USACH Planetarium designed and built the FIDAE Space Pavilion. There were three exhibitors: Astrochile, Universidad de Santiago, and ESO, which organizations also played the role of sponsors and made contributions in money for the execution of the project. In particular, ESO funded the construction of three scale models of VLT, ALMA project and ELT in the appropriate settings (illuminated

photographs) and explanatory icons. During the week of the show, the Space Pavilion had more than 40 thousand visitors, including scientific delegations, exhibitors from the aeronautical area, businessmen, government officials, members of the Armed Forces, students, and general public. The greatest number visited on Saturday and Sunday, 1st and 2nd of April.

Mobile Planetarium.



tenance of the transport vehicle, repairs to models and panels, regular maintenance of the audiovisual system, dome repairs, insurance.

**TOTAL VISITS IN 2003: 53,439**

In 2004, with a 28,000-US Dollar contribution from the Joint Committee, the Mobile Planetarium and the OMI took active part in the FIDAE Air Show, at schools in the Metropolitan Region and elsewhere, totalling approximately 45,000 visits.

Also that year, further investments were

made in regular maintenance necessary for correct operation of the equipment: monthly replacement of video tapes, quarterly replacement of carpeting, bulbs for the stellar projector, maintenance of the transport vehicle, repairs to models and panels, regular maintenance of the audiovisual system, dome repairs, insurance, travelling costs (tolls, petrol) and operating costs.

In addition, to supplement the activities of the Mobile Planetarium, a multimedia room was constructed for the FIDAE Air Show, combining models, lighting, special digital effects, illuminated photographs, and audiovisual projection on screens showing the main milestones of astronautics.

**TOTAL VISITS IN 2004: 45,000**

In 2005 the Mobile Planetarium toured the north and centre of the country, including free performances at various town halls in peripheral communes of the Metropolitan Region. From June to August that year, close on 15,000 people visited the dome in the communes of Pudahuel, Lo Prado, La Granja, Lo Espejo, and Lampa.

In September the Mobile Planetarium took part in Expo Cobre 2006 at Estación Mapocho, presenting the audiovisual show "Deep Impact, Chilean copper in space". This perfor-

mance was attended by 7,000 people.

This same programme later travelled to various CODELCO divisions from October to December, totalling 12,923 visits (10,503 to the Mobile Planetarium, 2,420 to the Mobile Observatory).

Finally, for two weeks in November, the Mobile Planetarium visited Ovalle, where it welcomed 4,618 visitors, including 1,408 children from low-income schools in the area.

Also during 2005 the Mobile Observatory began operating at three important events: the first, "Combarbalá touches the stars", attracted about 3,000 people at this small town in Region IV; secondly, "Santiago touches the stars", held at Mt San Cristóbal before 500 people and attended by ESO astronomer Olivier Marco; finally, the tour of CODELCO divisions (described above) together with the Mobile Planetarium.

In total, during 2005, the Mobile Planetarium and the Mobile Observatory received 43,041 visitors.

Also this year, a new dome was acquired for the Mobile Planetarium, as the one previously in use showed natural wear and tear

**TOTAL VISITS IN 2005: 43,041**

**Planetarium of USACH  
Universidad de Santiago de Chile**





