

## 6. NEWS FROM SPACE ORGANIZATIONS

### 6.1. Selection of ESA's Future Science Missions

[From ESA Release, 15 September]

The ESA Space Science Advisory Committee (SSAC) was impressed by the high quality of the Cornerstone (CS) and Flexi-mission candidate missions as presented by the science community in Paris on 12-13 September 2000. Having thoroughly reviewed the two candidates for ESA's Cornerstone 5 mission, BepiColombo (Mercury) and GAIA, which were unanimously supported by the Solar System Working Group (SSWG) and Astronomy Working Group (AWG), respectively, as well as the F2/F3 mission candidates recommended by the AWG, SSWG and FPAG (Fundamental Physics Working Group), the SSAC recommended that:

1. BepiColombo should be selected as CS5 and the GAIA mission as CS6;
2. LISA, the Fundamental Physics Cornerstone, should be implemented within a Flexi-mission envelope, in collaboration with NASA;
3. The European involvement in the Next Generation Space Telescope (NGST) should be pursued with the highest priority;
4. Solar Orbiter should be selected as a Flexi-mission, to be implemented after BepiColombo;
5. Eddington should be selected as a 'reserve mission', which could be implemented depending on the NGST and LISA schedules or provision of further resources.

The sequence of Cornerstones and this selection of Flexi-missions are based on their compelling scientific quality, technological maturity, extensive scientific support in and outside the core communities and the overall programme balance. European leadership in several key areas can only be assured through the timely implementation of these missions.

The SSAC identified two missions (NGST and LISA), the schedules of which are outside ESA's control. This consideration raised the opportunity to recommend to the Science Programme Committee (SPC) all the missions in items 1 to 5, as a package consistent with the recommendations expressed by the working/advisory groups, which is also in accordance with the scientific priorities set by the Survey Committee for Horizon 2000.

The SSAC noted that maintaining the purchasing power of the Scientific Programme at the 2002 level, as recommended by the SPC for planning purposes, would allow the implementation of all missions in the time frame 2008-2013 with a launch of BepiColombo in 2009 and GAIA not later than 2012 and gives the Executive the mandate to optimize the implementation of this package.

### 6.2. COROT: A Major Science Project

[From CNES Press Release, 6 October]

At its meeting on 5 October 2000, the Board of Administration of the Centre National d'Etudes Spatiales (CNES) gave the go-ahead for the COROT science mission.

COROT (CONvection, ROTation and planetary Transits) is a very-high-precision stellar photometry mission with two science objectives:

1. To study the internal structure and dynamics of stars by observing their natural oscillation modes (asteroseismology);
2. To search for extrasolar planets (exoplanets), i.e., planets circling stars other than our own Sun.

Searching for exoplanets is a major challenge for astronomers. Some 50 exoplanets have been discovered in the last two years, but until now only giant gaseous planets have been found.

COROT should give us the capability of detecting, by occultation, telluric planets, i.e., planets which have crusts composed of silicates. These are large Earth-like planets that could harbour liquid water and might therefore support biological activity.

The COROT instrument is a white light photometer with a reflector telescope, a dioptic imaging objective, and large defocused CCD sensors. COROT will offer pointing accuracy of the order of one hundredth of a degree, thus making a real step forward in this field. It will be placed into a circular, inertial orbit at an altitude of 850 kilometres. The mission is currently scheduled for launch in 2004 and expected to end in 2007 - long enough to observe at least five stellar fields.

COROT is the third mission of CNES's low-cost science mission programme built around the Proteus bus, after Jason and

Picasso-Cena. First proposed in 1993 by Annie Baglin of the Observatoire de Meudon and Claude Catala, now at the Observatoire de Midi-Pyrénées, this mission was recommended by CNES's Science Programmes Committee in March 2000.

The first studies for COROT got under way in January 1994. Today, many European partners are working together on the technical and science aspects of the project:

CNES is prime contractor for the system, ground segment and satellite, and is responsible for the launch contract. The COROT mission centre, located in Toulouse, south-west France, was developed in partnership with Spain. Alcatel Space Industries (ASPI) is supplying the Proteus bus, adapted to the mission's special requirements, and is responsible for satellite integration and the launch campaign. As instrument prime contractor, CNES is coordinating the work of French research laboratories (Observatoire de Paris, Laboratoire d'Astrophysique de Marseille, Institut d'Astrophysique Spatiale d'Orsay) and European institutions (University of Vienna, ESA-ESTEC, Astrophysics Institute of Andalusia (Spain), Astrophysics Institute of Liège (Belgium) and the Brera Observatory in Milan (Italy)).

For more information, visit the CNES Web site at [www.cnes.fr](http://www.cnes.fr)

### **6.3. Space Sciences in Costa Rica**

[A report by Walter Fernández (Laboratory for Atmospheric and Planetary Research, School of Physics, University of Costa Rica, San José, Costa Rica) and Jorge E. Páez (Laboratory for Astrophysical Research, School of Physics, University of Costa Rica, San José, Costa Rica)]

In 1992, the Second UN/ESA Workshop on Basic Space Science was held in Costa Rica and Colombia. The Workshop in Costa Rica dealt with the solar system and was instrumental in helping to strengthen space science activities in Costa Rica. The following provides a summary of such activities in Costa Rica since 1992.

### **1. Education and Training at the University of Costa Rica**

Postgraduate programmes related to space sciences leading to the MSc (Magister Scientiae) degrees are offered in Astrophysics, Atmospheric Sciences, and Physics.

The MSc programme in astrophysics started in the year 1999. The programme emphasizes the following areas: Radiative transfer in compact stellar entities, Astrometry and post-Newtonian approximations, Cosmology, Gravitational lenses, Quantum electrodynamics of strong fields, Astrophysical plasmas, Cosmic rays, and Sun-Earth interaction. A PhD programme may be started in 2001.

Some astronomy courses are offered in the Physics BSc programme. In addition, a course on Fundamentals of Astronomy is offered to students outside the areas of physical sciences and engineering.

The Department of Atmospheric, Oceanic, and Planetary Physics (DFAOP) offers curricula to obtain the degrees of Bachelor of Meteorology and Licenciante of Meteorology. It also offers, although not continuously, a Programme for Meteorological Technicians according to WMO personnel classification. In addition, the DFAOP collaborates with the University Postgraduate Study System (SEP) in two postgraduate programmes: (1) for the Master of Science programme (degree of Magister Scientiae) in Atmospheric Sciences and (2) in a postgraduate course specializing in Applied Meteorology. This Department is now one of the main centres in Latin America for education and training in the atmospheric sciences. Since 1968, the University of Costa Rica has been recognized by the WMO as a 'Regional Meteorological Training Centre' (RMTC). In parallel to the activities in Atmospheric Sciences, other teaching activities in several branches of the Geophysical Sciences have been developed, particularly in Planetary Science, Remote Sensing, and Physical Oceanography.

## **2. Research Laboratories at the University of Costa Rica**

Research laboratories have been created within the School of Physics of the University of Costa Rica. These are the Laboratory for Astrophysical Research and its Irazú Astronomical Observatory, and the Laboratory for Atmospheric and Planetary Research. In addition, there is an interdisciplinary centre named the Centre for Geophysical Research.

### **3. Laboratory for Astrophysical Research (LIA)**

The research areas dealt with in this laboratory are: Radiative transfer in compact stellar entities; astrometry and post-Newtonian approximations; cosmology; gravitational lenses; quantum electrodynamics of strong fields; astrophysical plasmas; cosmic rays; Sun-Earth interaction; parallel computing and visualization.

The research on radiative processes of strong magnetic fields of stellar atmospheres has been related mainly to: (a) calculation of pair annihilation in strong magnetic fields for any of the photon and fermion polarizations, (b) Compton effect calculations taking into account the polarization of photons and fermions, (c) self-energy calculations of the electron in a strong magnetic field. As already mentioned, other research includes: astrometry, gravitational lenses and their visualization, visualization of convective plasmas, and Sun-Earth relationships. The Laboratory collaborates with the Theoretical Astrophysical Institute of the University of Tübingen (Germany), the Institute of Astrophysics at the University of Bochum (Germany), the University of Calgary (Canada), and the Department of Physics of Universidad Nacional (Costa Rica).

### **4. Irazú Astronomical Observatory**

The University of Costa Rica, through its Laboratory for Astrophysical Research, is building a small astronomical observatory at Irazú Volcano, at 3432 m above sea level. A building of the National Park Service is being adapted for this observatory. A Meade 7 in. refractor telescope has been acquired for this purpose. It will be used mainly for solar activity observations, particularly in the  $H\alpha$  line to observe prominences and filaments, but also for other astronomical observations and teaching purposes.

## **5. Laboratory for Atmospheric and Planetary Research (LIAP)**

The goals of the Laboratory for Atmospheric and Planetary Research are to carry out research in the field of the atmospheric and planetary sciences, and to collaborate with national and international institutions which work in these same two fields. The current research topics of LIAP are: (a) Planetary science, (b) Applications of meteorological satellites, (c) Climatic variability and global change, (d) Solar radiation and planetary radiation, (e) Structure and dynamics of clouds and storms, (f) Mesoscale and synoptic scale processes, (g) Numerical modelling, (h) Atmospheric chemistry, (i) Atmosphere-ocean interaction, and (j) Micrometeorology.

In Planetary science, research has been carried out on the winds near the polar caps of Mars, on Martian dust storms, and some geophysical aspects associated with the occurrence of total solar eclipses. The data obtained from meteorological satellites are being used in the estimation of surface rainfall, in studies of surface global radiation, detection of forest fires, detection of volcanic eruptions and ash dispersion, and in the study of meteorological situations, such as the 'temporales' produced by hurricanes and other atmospheric conditions. Possible relationships between solar activity and climatic variability in Central America have been studied.

Although the topics already mentioned are the ones related to space sciences, some other research activities on atmospheric sciences should be mentioned. In climatic variability and global change, the seasonal and interannual variations of temperature, rainfall, and wind in Costa Rica and other countries are being studied (particularly in relation to El Niño-Southern Oscillation or ENSO), as well as the climatic conditions on the lee side of Costa Rica's main topographic features. Other topics are the variations of solar radiation (global and ultraviolet). Research is being carried out on rain-producing systems in the tropics and on the mesoscale effects which result from the interaction of air flow with orography. These effects are of great importance for the conditions of natural disasters, produced by 'temporales' which affect Central America, as well as the study of the dispersion of contaminants in the atmosphere. In Atmospheric chemistry, the reactions of isotopic interchange in the O<sub>x</sub> cycle and ozone formation mechanisms are being investigated. There is also a project to study different aspects related to environmental

radioactivity, in collaboration with the Applied Nuclear Physics Laboratory of the University of Costa Rica. Further fields of research are related to the incidence of plagues and diseases in crops, as well as climatic studies for agricultural and forest zoning.

### **6. Centre for Geophysical Research**

This Centre carries out research in all the Geophysical Sciences, including remote sensing. Among other activities are several short courses (of about one week's duration), workshops and occasional conferences on different aspects of astronomy, astrophysics, and the atmospheric sciences. For example, the Fifth Latin American Conference on Space Geophysics was held in Costa Rica in November 1998.

The use of the Internet and computer-aided learning (CAL) is being promoted in the University's programmes of study, not only as a valuable complement to the regular courses, but also as these will be valuable tools for acquiring information once graduates are incorporated into different institutions. Improvements in telecommunications will facilitate new and better teaching and learning schemes, as well as valuable data for research purposes.

Personnel from other universities and the National Meteorological Institute visit the University to carry out specific studies or research with the cooperation of the University's faculty.

There is a group in the School of Physics which provides popular education (short courses) and information to the public about astronomical events such as the occurrences of eclipses, solar activity, meteor showers, comets, space exploration activities, etc. In addition, it also provides educational material for teachers and students at primary and secondary school, including an astronomical calendar which provides information about astronomical events. It also provides information to the press.

There are plans to create a National Committee on Space Sciences (perhaps as part of the National Academy of Sciences) or a national association to promote activities in space sciences.

### **Reference**

Fernández, W. & Haubold, H.J. (ed.) Basic Space Science - Proceedings of the 2nd United Nations/European Space Agency Workshop on Basic Space Science, San José, 2-7 November 1992. In: ***Earth, Moon, and Planets***, 63, No.2, November 1993, pp. 93-170. Dordrecht: Kluwer Academic Publishers.

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