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List of publications (2001)
Catania Astrophysical Observatory

1. Introduction
The Catania Astrophysical Observatory develops in two separate settlements. The main seat in Catania is inside the Catania University Campus, where research offices, Laboratories, workshop, the solar observing station are located, and the mountain observing station, *Mario Girolamo Fracastoro*, located on the south west side of ETNA at 1750 m a.s.l.

The Catania Astrophysical Observatory operates and strictly cooperates with the Astrophysical Section of the Physics and Astronomy Department of the Catania University, which is hosted in the same building of the Observatory, where teaching activities for University degree and P.h.D. are currently done. Lecture halls and laboratory for student training are available.

The aim of this report is to present the main results achieved during the year 2001, on the management, technological and scientific aspects of Catania Astrophysical Observatory.

Acknowledgements: I would like to thank very much mrs Daniela Recupero and Gina Santagati from our scientific secretariat office, Piero Massimino from the computing center, Rita Ventura, Giuseppe Leto, and Daniele Spadaro for their invaluable help in preparing this Report.

The Director
*Santo Catalano*
Figure 1. The lecture hall in new annex building at Catania (Città Universitaria) seat.
2. Summary of results

The management of the annual 2001 financial balance, as in the previous years, has been marked by the saving on functional expenses and by the acquisition of new facilities necessary for reaching the institutional aims of the OACt.

This activity is confirmed by the acquisition of noteworthy facilities also using the saving of expenses realized in the previous years and in the enhancement of the OACt services. The good results obtained are also confirmed by the 70 papers published in international refereed journals including the invited papers and 76 oral contributions presented at specific meetings and internal reports (see List of Publications 2001).

The main technological activities concerned the development of:

- instruments for optical and ultraviolet observations, carried out also in the framework of national and international coordinated projects,
- acquisition systems concerning in particular the CCD characterization techniques and the development of new photon counting detectors (IAPS)
- realization of Peltier-cooled CCD cameras

The implementation of new in situ analysis of UV and ion irradiated ices has been carried out at the Experimental Astrophysics Laboratory.

The scientific activities have continued with high standard levels even if the lack of funds allotted by MURST has limited the mobility of researchers. Nevertheless, the funds assigned by the European Community and by the National government, the availability of modern high-performance computing facilities and the high professional capability of the researchers have allowed the OACt to efficiently compete in the international context.

2.1 Acquisition of new instrumentation and facilities

The enhancement and the renewal of the scientific facilities have gone on in 2001 according to the annual programme. Moreover, using the saving on expenses obtained in the previous balances, it has been possible to get new facilities. The most important ones acquired in the course of 2001 are:

- **A new Automated Photometric Telescope (APT/80):** the mechanics and the optics have been completed by the Marcon firm.
- **The expansion to 200 KeV of the Ion Implanter** of the Experimental Astrophysical Laboratory: committed to Danfysik
- A Compaq Alpha Server DS10
- A Linux cluster based on 5 PCs AMD 1.4 GHz
- 8 PCs AMD 1.4GHz as workstation for researchers
- 8 PCs AMD 900 MHz used as workstations for the administration staff
- A Sonicwall (firewall) with protection software
- A Lexmark T622N printer
- A PPP Perle 833 server with 4 asynchronous modems
- 2 3Com data switches with 12 ports 10/100
- 10 portable PCs
- 2 HP 4400 scanners
3. Scientific facilities and services

3.1 Library

Scientific supervisor: R. Ventura
Library staff: A. Mangano, M. Calì, G. Caripoli, D. Domina, D. Recupero, L. Santagati

The library collection of Catania Astrophysical Observatory includes 10650 volumes, 397 journal titles, 234 antique (figure 2) volumes and a certain number of audio-video material. The library content is mainly specialized for Astronomy and Astrophysics, but two significant sections are also devoted to General Physics and Mathematics. Moreover, a special section, dedicated to education is continuously updated with cd-roms and videotapes.

The library is open to astronomers, technicians and staff of the Catania Astrophysical Observatory and to teachers and students of the Physical and Astronomy Department of the Catania University as well as to researchers and University students of several institutions and faculties, and to all interested visitors (by permission).

Opening hours: from Monday to Saturday, from 8:15 to 13:45 and on Monday, Wednesday and Thursday from 14:30 to 17:30.

Services: Loan; interlibrary-loan; document delivery service

Routine maintenance (M. Calì). Call numbers of books and labels of the different sections of the library have been revised and maintained. The area in front of the library has been enlarged and transformed into a studying room, with 8 study places where students can look books and journals up and have access to a PC. In the studying room the catalogues collection is available for consultation.

Acquisitions and inventory (G. Caripoli, D. Domina, M. Calì) During 2001, the total budget of 190 million lire has allowed us to purchase 102 books for a cost of 15 MLit and to subscribe to 115 periodicals for a cost of 175 MLit.

Besides the traditional print periodicals, many electronic subscriptions have been taken out in order to get the full-text of on line journals: these have provided an indubitable advantage for users, but have increased the cost of the library acquisitions as well. The reduction of costs for every single acquisition has been made possible by the comparison of on-line offers and by the services offered by the library consortiums (ESO, CNR-Bologna, CILEA; CBD- Catania, INAF) which provided free journals in a mutual exchange regime.

Cataloguing (D. Domina, A. Mangano) New books acquired in 2001 (about 115) have been catalogued according to descriptive and semantic rules, with the UNIBIBLIO software. The relative bibliographic control has been made when the records have been exported to built the web catalogue. The semantic cataloguing has been made using an Italian Subject Index (edited in 1999) which refers to that of the Library of Congress and to the IAU Thesaurus.

Journals catalogue (L. Santagati, A. Mangano) The update of the journals list has been performed following the on-line procedure of the Archivio Collettivo Nazionale Periodici (ACNP), adopted by the library. In 2001 the on-line service of document delivery has increased (more than 120 articles required both by the Italian Observatories and other
Figure 2. - Library historical section, cover of the book: *Opere di Galileo Galilei Nobile Fiorentino Accademico Linceo-Primario Filosofo. e Matematico del Serenissimo Granduca di Toscana: Tomo Primo*, by Franciscus Agelli
libraries joining the ACNP). The library has also joined the ACNP ASTRONOMICO, an OPAC constituted by the journals owned by the libraries of the Italian Observatories. The requests made on behalf of the internal researchers and users to external libraries have increased as well.

**Historical Archive and Catalogue** (D. Recupero and A. Mangano) In the framework of the national project "Specola 2000" which gathers all the Italian Observatories with the aim of developing and making the historical collections accessible, the Sovraintendenza Archivistica per la Sicilia has committed the inventory of the historical archive to an external collaborator. The bibliographic part and the correspondence had been previously sorted by the librarians. The series of letters has been requested for consultation by various users, both internal and external.

**Scientific secretariat and Preprints** (D. Recupero and L. Santagati) Fourteen preprints have been printed and distributed to 47 Italian and foreign Astronomical Institutes and Observatories. Numerous papers have been linguistically reviewed. The organisation of the Conference "Piazzi 2001: from Piazzi to the 3rd millennium" has been accomplished and the conference proceedings have been edited and published. The exhibition *Envisat: Occhio alla Terra* has been organized in July 2001.

**Loan, reference service, electronic information service** (D. Domina, A. Mangano, D. Recupero, L. Santagati, G. Caripoli) The reference service for students and researchers consists in the search in the local catalogues, both printed and on-line, and other external catalogues using internet facilities. The intense collaboration between the libraries of the other Italian Observatories has enhanced thanks to the CUBAI (Catalogo Unico Biblioteche Astronomiche Italiane) and ACNP Astronomico projects. Other collaborative links has been established (CIBD Centro di Coordinamento delle Biblioteche dell'Università di Catania and other foreign institutions) in the framework of a more and more intense inter-library cooperation.

### 3.2 Computing center and local network

**Supervisor**: P. Massimino  
**Staff**: A. Costa, C. Lo Presti, A. Giuffrida

**Catania site**: The computing center consists of central machines and distributed workstations, running various operating systems:  

- **Central machines (computing servers)**
  - SUN Sparc 20 (UNIX) Server and Sun cluster  
  - Compaq DS10 (Open VMS)  
  - SG Origin 200 with two processors (UNIX)  
  - LINUX Cluster based on 5 PCs AMD 1.4 GHz  
  - IBM 9076-550 SP3 with 24 parallel processors  

- **Network server**
  - PC Linux Suse 7.2 (astrct: DNS, SSH….FTP, WEB and the solar image archives)  
  - PC MS-WindowsNT (netserver, interactive Web services for astronomy and library)  
  - 4 Laser printers
During 2001 the implementation and reconfiguration of the components which must guarantee the security of information systems have continued. New facilities have been implemented. The problem of security has been the main issue of this year.

The principal specific activities are as follows:

1. The new firewall Sonicwall Pro 200, supplied with the "High Availability" software, has been installed. It allows to obtain high performances, keeping low "failure" possibilities (if one of the two firewall crashes, the other one automatically takes its place).

2. The Sonicwall view Point environment has been configured. It allows a detailed analysis, through both graphics and tables, of all the networked activities generated in the OAC LAN, and of those generated in the external Wan. It also monitors in detail the possible activity generated by any hacker attack.

3. A Linux cluster, composed of 5 PCs replacing the Sun cluster, has been set up. One node is exclusively dedicated to the mass memory share and to the management of the printer queues.

4. The Linux software has been installed in many PCs assigned to researchers.

5. Additional 12-ports 10/100Mbs Data-switches, which make the connection of the workstations to the LAN very fast, have been installed.

6. A new PPP(ISP) server, which allows many users to simultaneously access the server using 4 telephone analogical lines operated by the OACt PBX (switchboard), has been installed.

7. The new Compaq DS10 Open VMS computing system, replacing the old Alpha400 server has been installed and configured. All the users moved to the new system.

OA Catania Web page: The observatory web page is continuously updated. The web-based monitoring system has been implemented. It generates alert messages (via e-mail and SMS) in case any crucial component does not properly operate.

CNAA Roma web page: The "Consiglio Nazionale per l'Astronomia e l'Astrofisica" web page, initially located on the Origin 200, has been moved to the Linux server. During 2001, the section dedicated to the board meeting reports (accessible through password), public notices, projects and courses managed by the CNAA, has been periodically updated.

Solar images on the Web: The images of the Sun acquired during 2000 and 2001 at Catania Observatory have been put on the Web and catalogued in "web access" mode, thus updating the archive started in the past. All the images daily collected on the web page are stored in the archive and are accessible at any moment.

M.G. Fracastoro station (Serra la nave, Etna): A feasibility study for the realization of the direct wireless connection with Catania was performed. This connection will replace the present telephone link.

Tests for the compatibility with the ENEL-WIND transmitter have been made in order to install the antenna on the ENEL tower. The test result is positive, allowing a connection up to 5Mbit/sec. A plan for connecting by optical fibers the lodge and the ENEL tower has been made. The necessary authorizations have been requested to Parco dell'Etna for the underground cabling, to Enel for the installation of the antenna, and to Ministero delle Telecomunicazioni for the frequency allocation.

3.3 Opto-mechanical workshop and telescopes' automation

<table>
<thead>
<tr>
<th>OACt staff</th>
<th>: G. Carbonaro, G. Gentile, M.P. Puleo, E. Martinetti, M. Miraglia, S. Sardone, P. Bruno</th>
</tr>
</thead>
<tbody>
<tr>
<td>External collaborator</td>
<td>: S. Massaro</td>
</tr>
</tbody>
</table>
a) Telescope automation

91-cm Cassegrain telescope: The new software "Asterix 2000" has been tested. It includes the following utilities:
- on-line catalogue of stars with magnitudes >2, used for the calibration of the telescope
- on-line NGC, IC, UGC, SAO, Messier and GCVS catalogues
- view of the selected field through the images of the DDS catalogue accessible via internet
- on-line processing of the image acquired from the DSS catalogue
- calculation of the ephemerides of the solar system objects

The software converting the telescope coordinates into the azimuthal system will allow to interface the control system to the electronic encoder providing the position of the dome. Therefore it will be easier to realize the complete automation of the telescope.

The cloche has been modified to allow the interface with the tracking electronic system. A tracking software has been developed within the Lab-view environment, using its graphic libraries.

The image acquisition card has been replaced with an updated one which performs the processing through a 10bit A/D converter. Preliminary tests for computing the centroid of the reference star and for keeping the telescope position carried out on a single digitized frame, starting from the images of the intensified camera, have produced encouraging results.

The automatic pointing command "GO TO" has been activated, after completing the mapping of the allowed positions and of the forbidden paths imposed by the telescope's German mounting.

61-cm Schmidt telescope: The project of the mechanical revision has been updated before starting the operative phase. In particular, a careful study on the performances of the brake, inserted in the ADS drawing, has been carried out, since it has been questioned whether it was suitable for the axis block without producing angular clearance. Since this condition has not been guaranteed by the manufacturer, therefore the block of the axis has been conceived by closing the brakes on a couple of discs, one of them fixed with respect to the fork.

The possibility of eliminating the axis braking has been considered, substituting the double pinion system with electric pre-loading, with a mechanic pre-loading one. This solution, which simplifies the control system, since only one engine must be managed, is under consideration, as well as the devices to be used.

APT-80/2: The manufacturer Marcon has completed the mechanics and the mirrors (figure 3). The motion of the telescope, based on brushless engines and on the Galil controller has been implemented by the staff, following the standard procedure applied for every telescope at the Observatory. The pointing and tracking operations have been successfully tested at Marcon by the Asterix 2000 software, thus confirming its reliability and portability. Pointing and repeatability accuracy, tested with a laser beam, matches the constraints requested to the manufacturer.

The requirements of the domes, whose aperture must be compatible with the automatic movement of the telescopes, have been set and the Halfmann Teleskopetechnik GmbH in Hamburg, which will realize the cover with folding material, has been contacted. This kind of cover has been already installed at ESO at Mt. Paranal. The building will also host a telescope for educational activities.
Figure 3. - The new automatic telescope APT80/2 at Marcon factory, during mechanical and pointing tests.
b) Opto-mechanical laboratory

**Aluminization:** The aluminum coating of the primary mirror of the APT/80 telescope has been carried out after having built an appropriate structure to hold the mirror in the revised evaporation chamber. The secondary mirror and all the optics have also been cleaned. The overall efficiency of the telescope has been improved: the good reflectivity of the primary mirror (comparable to that of previous sessions) and - above all - the reconfiguration and re-alignment of all the system have produced a significant improvement of the telescope efficiency.

**Spectro-polarimetric module:** The spectro-polarimetric module for the REOSC echelle spectrograph mounted at the 91-cm telescope has been successfully tested and the precision of positioning and alignment of the polarizing plate have been checked. An analogue module, which makes use of super achromatic plate, realized for the high resolution spectrograph (SARG) has been installed at the Telescopio Nazionale Galileo. Since the first tests we could notice the high quality standards of the system which in agreement with the characteristics required, has an efficiency of 92% and 85% for the linear and circular polarization respectively.

**New off-set guider:** The project of the new offset to be mounted at the 91cm telescope has been completed, the support structure has been built and the software for the movement of the probe mirror has been installed.

**Focal reducer and CCD camera:** The mechanical design of the supporting structure for the optics and of the filter wheels for the CCD camera of the 91 cm telescope has been completed.

The optical system has been designed by dr. Pernechele of Padua Observatory and manufactured by *Ottica Colombo*. The construction of mechanical part is well in progress.

The CCD camera, with a new conceived cooling system, is being projected by the detector group. The camera uses a 1024x1024 CCD with 24micron pixels; it will have a 10 arcmin field of view and will reach a magnitude 18 with a ratio S/N=100 in 10 min.

**Technical installations:** The LAN network has been installed in the new building of the Catania Observatory: new access points have been activated in all offices and working desks for Ph D students.

The same network has been installed in the two offices at M.G. Fracastoro Observatory on Mt. Etna, and the connection with the dome of the 61-cm telescope has been activated.

### 3.4 CCD image acquisitions

<table>
<thead>
<tr>
<th>Supervisor</th>
<th>G. Bonanno</th>
</tr>
</thead>
<tbody>
<tr>
<td>Researchers</td>
<td>R. Cosentino, S. Scuderi</td>
</tr>
<tr>
<td>Technical staff</td>
<td>M. Belluso, P. Bruno, A. Cali, M.C. Timpanaro</td>
</tr>
</tbody>
</table>

The activity of the image acquisition devices is managed by the detector staff, who performs the maintenance and implementation of new cameras and control systems. The activity carried out in 2001 consists in the following:
• **Solar CCD Camera:** After the breakdown of the CCD camera for solar observations, the original control system has been replaced with a TNG standard controller. All the acquisition system has been substituted with the implemented acquisition software COLD-WIN, which stores the images in the standard FITS. The group has also designed a mechanical device for positioning and controlling the focus of the lens on the solar spar, adopting a standard device control system. Such device has been manufactured and installed by an external factory.

• **Spectrograph CCD Camera:** The CCD controller of the REOSC spectrograph of the 91-cm telescope has been replaced with the last version of the standard TNG controller and the updated version of the software COLD-WIN had been implemented, with the acquisition of the images in FITS format. Moreover, the PC used for the acquisitions has been linked with the computer which drives the telescope (ASTERIX). The names and coordinates of the objects are automatically stored in the header of the FITS file of the image.

• **Imaging CCD camera for the 61-cm telescope:** A new camera, cooled by Peltier effect cell, has been designed and manufactured by the group. It is now under testing. The mechanical interface with the filter wheel has been designed by the group and committed to an external manufacturer. Its control system is based on a standard set up built by the staff. The system, including the controller, is under testing.

• **Imaging CCD camera for the 91-cm telescope:** The staff has designed and manufactured a prototype of a new camera for the 91-cm telescope coupled to the focus reducer. This camera will be cooled by a three stages Peltier effect cell able to reach temperatures of -70°C. The prototype is under testing as far as the vacuum and the limit temperature are concerned.

### 3.5 Photometric data acquisition

**Supervisor:** E. Marilli  
**Technical Staff:** V. Greco, C. Lo Presti, P. Massimino

The photometric laboratory deals with:  
The setup and testing of the single channel photometer for the acquisition of photometric data at the focal plane of the 91-cm telescope at Serra La Nave.  
The development of hardware and software for acquisition, reduction and storage of data.  
The large-band photometry with U B V filters and with interferential filters u v b y Hβ W HβN g1 g2 (Stromgren photometric system) is performed by the photon-counting single channel photometer cooled by a Peltier effect system at about -15°C and equipped with a photometric head characterized by low dark current (about 1cts/sec at -15°C). The filters are mounted on the filter wheels operated through a step engine, managed by the acquisition software OBELIX. The optimization of times to move from one filter to the next one has been carried out.  
This system activates two different acquisition modes: a standard acquisition, which allows observations with one or more filters with maximum time resolution between two measures of 0.2 sec, and a fast acquisition mode with a maximum time resolution with one filter up to 0.01s, implemented in the last version of OBELIX written in Visual Basic (Win Obelix). Besides the photometric acquisition program OBELIX, two new programs have been developed in 2001: OBPRINT and OBGRAPH. The first one generates a PDF file of data acquired during the observational run and displays the content on the monitor. The PDF file can be stored on a disk to be printed later on.
The OBGRAX program reads the data acquired during the ongoing observations or from a file of previous observations and generates a graphics of the data of the object and of the filter selected in a pop-up menu window. Moreover, it has been introduced the option which allows the FFT of an interval of the selected graphics. This option is very useful for programs dealing with short period pulsating variables.

The group goes on maintaining and updating the software "PHOT" for the data reduction, which allows the rapid reduction of data in magnitude differential, standard UBV and Stromgrend system. The package runs in DOS and VMS environment. It is characterized by a high degree of flexibility to adapt to the different requirements of observation and data reduction.

A study has been started to develop a program which, using the WEB and the computing resources accessible via internet, performs:
- automatic cataloguing of acquired photometric data
- photometric archive consultation
- input of new photometric data
- automatic processing of photometric data with display of graphics and tables

3.6 The "Mario G. Fracastoro " station (Mt. Etna)

Supervisor : S. Catalano
Technical staff : G. Carbonaro, A. Di Stefano, A. Miccichè, M. Miraglia, G. Occhipinti, M. G. Puleo,
Mentenance staff : G. Corsaro, C. Scuderi, A. Ventimiglia

The observing station is located at Serra La Nave (SLN), on Mt. Etna, at an altitude of about 1700 mt a.s.l. It has been dedicated to Prof Mario G. Fracastoro, who promoted its building during the period of his directorship (1954-1967). This site is about 40 km far from Catania and 20 Km from Nicolosi, the nearest village.

Four telescopes are installed in three different domes:
- The 91-cm Cassegrain reflector (figure)
- The 61/41-cm Schmidt-Cassegrain Universal Telescope (figure)
- The automatic Ritchey-Chretien photometric telescope (APT/1-80cm)
- A 30-cm Cassegrain reflector, hosted in the APT/1-80cm's building.

The last telescope is used for educational purposes, such as student training and visitors’ visual observations. Two additional buildings are used as guardian and guest house, respectively.

The 91-cm Cassegrain reflector mechanical part was manufactured by Marchiori and the optics by Tinsley. It has been operating since 1965. The optics have a classic design. They allow the use of the telescope at its prime focus and at the newtonian focus, with a relative aperture f/4.68, or in a Cassegrain configuration having a f/15 relative aperture.

The pointing and tracking system, originally operated by the observer and equipped with fixed frequency engines, has been replaced with brushless engines and digitized reading of coordinates. A Pentium PC with Asterix 2000 drives the telescope in semi-automatic mode.
Figure 4. - Dome of the 91 cm telescope (upper) and of the 61 cm telescope (lower)
The 91-cm telescope is usually used with the Cassegrain configuration, with the following instruments:

- **REOSC Echelle spectrograph** (F/15 collimator and CANON camera f=300 mm., F/2.8) with the possibility of observing in single dispersion (resolution of 0.9 Å/pxl) or cross dispersion (resolution of 0.15 Å/pxl). The spectrograph is connected to the telescope by means of an optical fibre and during 2000 it has been equipped with a polarimetric module for the measurement of the linear and circular polarization, allowing the determination of the four Stokes parameters. The acquisition system consists of a CCD camera (1024x1024, 224 µm), managed by the same software used for the TNG cameras.

- **Single head photometer** for UBV photometry, ubvy-Hγ and cometary bands (IHW): the photometer can perform rapid photometry with maximum time resolution of 0.1 and 0.5 sec., using a single filter or different filters sequentially inserted, respectively.

- **Double-channel photometer URSULA** for simultaneous UBV photometry of two near objects.

- **Near IR photometer** (JHKLM bands) with InSb sensor, cooled with liquid nitrogen, which is normally used up to K band (2.2 micron).

- **CCD Camera**. Some tests have been carried out with the controller developed for the TNG telescope and a focal reducer with a field of view of about 10' is under construction as above explained.

The 61/41 cm Universal Schmidt-Cassegrain telescope, built by "Meccanica Sarti of Bologna" (1966) is completely manually operated. The Schmidt configuration has a relative aperture of f/3.5 and a field of view of 4.2x4.2 degrees in the photographic mode. It is equipped with a secondary mirror which allows a quasi-Cassegrain focus, with a nearly null field of view, used only for photoelectric photometry. The photometer contains standard UBV filters mounted on a rapidly rotating wheel (0.1 Hz), which performs quasi simultaneous measurements in the three filters (maximum time resolution of 1 sec) and is particularly suitable for the study of rapidly evolving events, such as stellar flares. The telescope is presently being restored in order to implement the automatic control of the pointing and tracking system, also for objects with large proper motion. It will be equipped with a CCD camera for the monitoring of Near Earth Orbit (NEO) asteroids in the framework of the ITANET project.

The APT/1-80cm (Automated Photoelectric Telescope) built by AutoScope Co. (Tucson AZ, USA) was installed at the end of 1991. The optical configuration is a Ritchey-Chretien type with absolute aperture of 80 cm and equivalent focal of about 6 mt. Both the telescope and the photometer (UBV) are automatically operated by a PC-AT/386. The observational efficiency (duty-cycle), over 10 year operation period, has been estimated to be of about 70%, while the traditional telescopes seldom get 30-40%. The system is completely automated, including the opening and closing of the sliding roofs of the rectangular block (4x8 mt) hosting it. The opening command of the roof is activated after meteorological test is passed, on the basis of fixed meteorological limits (absence of rain, fog, strong wind and so on).

The telescopes of the M.G. Fracastoro stellar station are effective about 350 nights in a year. Six technicians in turn guarantee the night technical assistance. The 91-cm and the APT/1-80 cm are full time allocated, while the 61-cm Schmidt telescope is presently under revision.
Figure 5. - The REOSC echelle spectrograph placed on its fixed carrier on the floor below the telescope level. The blue wire hosts the fibres coming from the spectropolarimeter.
The statistics relative to the use of the telescopes nights/year are listed in the following table:

<table>
<thead>
<tr>
<th>Telescope ----&gt;</th>
<th>Cassegrain 91-cm</th>
<th>APT/1-80cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nightly use &gt;50%</td>
<td>120</td>
<td>167</td>
</tr>
<tr>
<td>Nightly use &lt;50%</td>
<td>20</td>
<td>32</td>
</tr>
<tr>
<td>Maintenance, test</td>
<td>22</td>
<td>36</td>
</tr>
<tr>
<td>Not used (meteo)</td>
<td>129</td>
<td>112</td>
</tr>
<tr>
<td>Not used (failures)</td>
<td>73 a</td>
<td>18</td>
</tr>
</tbody>
</table>

*Notes:* (a) Including the period of inactivity (60 days) spent for the aluminization of the mirrors and the revision of the bearing of the primary mirror
(b) Including the time spent for the aluminization of the primary mirror (20 g days)
(e) Including 30 nights of inactivity due to the eruption of Mt. Etna

**Visiting astronomers:** During 2001 the following researchers have visited the M.G. Fracastoro station to carry out observations in the framework of individual or collaborative research programs:
Rosita Paladino Università degli Studi "Federico II" from Naples (23 nights at the 91 cm photometer).
Refereed and invited papers as well as papers presented at meetings totally or partially based on observations carried out at M.G. Fracastoro Station, Serra la Nave (numbers refer to the List of publications 2001) are as follows: 6, 18, 20, 24, 27, 28, 29, 32, 33, 38, 39, 40, 46, 48, 53, 65, 71, 74, 90, 94, 95, 98, 104, 106, 107, 122, 126.

### 3.7 Solar observation facilities

**Supervisor:** M. Ternullo, F. Zuccarello  
**Technical staff:** E. Catinoto, S. Sciuto, G. Sapienza  

**Equatorial spar.** The equatorial spar consists of 6 optical benches, three of which are devoted to the daily observing program:
- The bench for the white light observations, sunspot shape and sunspot group drawing;
- The bench for Hα observations, chromosphere and photosphere with Zeiss filter (CCD camera);
- The bench for Hα visual observations, Halle filter.

The data acquired in the framework of this program deal with: groups of sunspot, faculae, quiescent and active prominences on the disk and at the limb, flares. The standard sequence of observations consists in:
- one image every 15 min at the center of the Hα line (chromosphere),
- one image every 15 min in the Hα line wing (+5Å, photosphere),
- rapid sequences of images during flares or eruptive prominences.
Figure 6. - The equatorial spar and an Hα image of the Sun taken with the Zeiss filter
The works and improvement of services in 2001 include:

- Adjustments and enhancement of performances of the CCD camera (carried out by the detector laboratory);
- Duplication of the commands to report the telescope control in the room below the dome (carried out by the staff of the laboratory for telescope automation);
- Installation of a movable lens holder for the focusing and the collimation of various instruments (provided by the manufacturer TMA);
- Installation of a TV camera enabling the remote pointing of the Sun (carried out by the staff of the laboratory for telescope automation);
- Recording of solar images using the standard international FITS format (carried out by the staff of the Detector laboratory);
- Implementation of a new method for data archiving (carried out by P. Massimino);
- Implementation of IDL routines for the preliminary data analysis.
4. Research Programs

4.1 Solar Physics

Solar physics studies carried out in Catania have covered nearly all the regions of the Sun, from its interior, to the surface and corona, and out to the solar wind.

In addition to the traditional activities concerning the systematic patrol of solar activity, the structure and the dynamics of the solar interior, the theoretical investigation about the generation and evolution of magnetic fields, the study of the rotational characteristics have been carried out.

Recently, there has been a significant involvement in space missions devoted to the observations of the solar atmosphere, in particular the ESA/NASA Solar and Heliospheric Observatory (SOHO) and the NASA Transition Region and Coronal Explorer (TRACE). This has allowed the development of activities concerning the spectroscopic diagnostics and modelling of coronal magnetic structures and of the solar wind source regions.

More specifically, research activities have been conducted according to the following scheme.

A. Systematic patrol of photospheric and chromospheric activity

The systematic observations of the Sun in integral light and \( H\alpha \) have been carried on in the framework of an international collaboration aimed at performing the patrol of solar activity. The data acquired within this project refer to: sunspots, faculae, quiescent and active prominences on the disk and on limb, flares. These data are daily sent to the various international collecting centers and put on the web page of the Catania Astrophysical Observatory, thus contributing to the study of the so-called Space Weather [67, 113, 114, 137, 139, 140].

B. Spectroscopic diagnostics and modeling of coronal magnetic structures

D. Spadaro has discussed the importance of observation and analysis of EUV emission lines for determining the physical structure and dynamics of the solar transition region and corona [70].

A.F. Lanza, D. Spadaro, A.C. Lanzafame, in cooperation with researchers of the Naval Research Observatory of Washington and Goddard Space Flight Center (NASA) have developed models of ultraviolet emission during the formation of solar prominences and the development of thermal instabilities in coronal structures. The study takes into account the ionization and recombination in a plasma subject to rapid and nonhomogeneous variations of temperature, density and velocity and uses the most recent atomic parameters deduced from the ADAS database (originally developed at the Joint European Torus and presently managed by a consortium which the Observatory has joined) the results obtained are very interesting for the analysis of the observations made with the instruments CDS and SUMER on board of the SOHO satellite [25, 111, 112, 130, 134].

R. Ventura and D. Spadaro have carried out the analysis of the data acquired with the UVCS/SOHO spectrocoronagraph and relevant to the two coronal mass ejection (CME)
observed on 2 and 3 Nov. 2000 during the simultaneous observational campaign with various SOHO instruments (MEDOC campaign) at the Institut d’Astrophysique Spatiale of Orsay-Paris.

This analysis has determined the intensity distribution of some EUV emission lines and the velocity fields which are typical of the plasma emitted during the observed CME. The simultaneous observations of the two phenomena with EIT/SOHO and LASCO/SOHO have been taken into account. The results show that the distribution of the plasma ejected in the interplanetary medium is extremely complex and irregular and they provide some guidelines for the development of magnetohydrodynamical models which describe the CME [60].

F. Zuccarello, L. Contarino, P. Romano have analyzed the images obtained from the TRACE satellite to study the flares characterized by the increase of EUV emission in loops and in areas full of moss (a material observed for the first time by TRACE at 171 Å and coinciding with the chromospheric faculae). The results show that many flares are activated by the interaction with loops through a process of magnetic reconnection and that the increase in luminosity observed in the moss can be explained by the heating of big arcs of loops whose footpoints coincide with the moss itself. Moreover, some indications on the characteristics of the velocity fields which cause the distortion of magnetic arcs have been obtained. [51, 61, 80, 117, 118].

A.C. Lanzafame and D. Spadaro have carried out a study on the active solar regions observed with SOHO/SUMER and have identified some stationary loops with different maximum temperatures (from 0.1 to 1.0 MK) and slight quasi-stationary fluxes (from 3 to 15 Km/s), probably due either to pressure differences at the foot-points or to asymmetric heating of the plasma confined on the magnetic structure. The part of loops whose plasma is down-flowing, producing a shift of the spectral lines toward longer wavelengths, generally has a stronger emission. This could be a concurrent cause of the formation of the redshift observed on average on wide atmospheric regions whose origin has not been exactly determined. The study on the opacities of EUV solar lines observed by SOHO/CDS and SOHO/SUMER has been done in the framework of the escape probability theory, and the characteristics of opacity for carbon, oxygen and nitrogen multiplets have been set. The lines are classified on the basis of their optical depth at the center of the solar disc and on the limb.[100].

D. Spadaro has collaborated to the study of the solar wind interaction with the interstellar medium at the boundary of the heliosphere with observations made with UVCS-SOHO [59].

C. Dynamo theory of solar activity

A. Bonanno and G. Belvedere have developed a dynamo model of the solar cycle in the presence of meridian circulation. They have investigated the dependence of the symmetric and antisymmetric dynamo modes on the velocity of meridian circulation, on the magnetic viscosity and on the extension of the area where the alpha effect is active [68, 114, 120]. The study has also dealt with the correlation between the alpha effect and the kinematic and magnetic helicity, in connection with the angular momentum in the solar convective zone [41, 75].

Further studies have concerned the dynamo models in asymptotic approximation [74, 119].
D. Structure and dynamics of the Sun's interior

L. Paternò has investigated, on the basis of the most recent data, the standard solar model and the neutrinos' problem. In addition, L. Paternò, A. Bonanno and M.P. Di Mauro have studied the influence of uncertainties on the determination of cross sections in the nuclear reactions responsible for the production of neutrinos. In particular, it has been estimated the effect of these uncertainties on the solar oscillations in the framework of a two-flavor neutrino model.

A new method based on helio-seismology, aiming at determining the zero energy astrophysical factor for the pp reaction cross section has been developed [84]. The effects produced on the oscillation frequencies by the inclusion of the relativistic corrections in the solar equation of state has been accomplished by a helioseismic analysis [10].

M. P. Di Mauro, in collaboration with the helioseismic group of Aarhus (DK) has dealt with the inversion problems of oscillation frequencies of high degree p-modes (l<1000) observed by the MDI instrument on board SOHO satellite, obtaining new results on the properties of the convection zone near the photosphere, on the EOS of solar plasma and on helium abundances [56, 69, 81, 91, 96].

4.2.1 Stellar Physics: magnetic activity and variability

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<tr>
<td>University researchers</td>
<td>G. Belvedere, C. Lanzafame, M. Rodonò</td>
</tr>
<tr>
<td>IRA-CNR Noto Researchers</td>
<td>C. Buemi, P. Leto, C. Trigilio, G. Umana</td>
</tr>
<tr>
<td>CNAA fellowship, TNG, La Palma</td>
<td>G. Marino</td>
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Magnetic processes just like those seen in the space environment of the Earth and of course, on the Sun have moved in wider areas of the astrophysical research. This is a recent cultural achievement of high relevance for the understanding of cosmic powerful processes as the pulsar emission, the formation of powerful relativistic jets in accreting black holes and the QUASAR jets. It is fair to say that virtually all the physics of magnetic fields exploited in these and other fields of astrophysics is based on our understanding of the Sun's and star's magnetic fields.

The surface magnetic field of a star can either be the relict of interstellar field frozen during the contraction of the pre-stellar cloud, as in Ap and Cp stars, or a dynamo-generated field within the star that somehow made it up to the stellar surface where it is observed, just like in the Sun. The application of solar-like magnetic field studies to stars, other than Ap and Cp stars, opened up a new very effective field of research that became widely known as the 'solar-stellar connection'.

The study of magnetic activity phenomena on the Sun and stars has a long-standing tradition at Catania Astrophysical Observatory. Specifically, our research activity has been devoted to the connection between atmospheric phenomena and physical processes in the stellar interiors, pursuing a unified scheme with the purpose of interpreting the generation of magnetic fields and magnetic-related phenomena as a result of the interaction between stellar turbulent convection and rotation. While the solar activity studies provide us with detailed investigations on the interaction between magnetic fields and plasma in active
regions, stellar phenomena provide us with information on the dependence of physical processes on the global stellar parameters, such as rotation speed, mass, radius and age.

Studies of the different aspects of stellar magnetic activity, connected with the properties of turbulent convection and stellar rotation, as well as the stellar interiors probed by asteroseismology experiments have been continued at Catania Observatory as follows:

**A. Structure and atmospheric models of the chromosphere and corona**

A.C. Lanzafame, I. Busà and M. Rodonò have presented a new chromospheric NLTE modelling of the active binary system RS CVn V711Tau. Models have been obtained by means of detailed fits of hydrogen and magnesium line profiles of the transition region between the chromosphere and the corona. From this analysis the physical conditions of active regions and the origin of the broad component of the chromospheric lines have been deduced [86].

E. Busà, in collaboration with Andretta, Gomez and Terranegra (INAF-OAN) has worked on the modelling of the lines of the Ca II infrared triplet, defining a new diagnostic tool for chromospheric activity [54, 121]. The study of this new indicator demands a homogeneous sample of spectroscopic data, for which observational time has been assigned at the TNG with SARG. Busà has also worked on the development of a method for the correction of excess of UV continuum due to the influence of line-blanketing on NLTE radiative transfer calculation [15].

I. Pagano and M. Rodonò, in collaboration with other researchers, have investigated the properties of the corona of the binary system AR Lac by means of radio and X-ray observations [35, 49]. Moreover, they have carried on new researches on the chromosphere and transition regions of late-type stars [97, 102, 103, 108, 109, 110, 131, 138].

The collaboration of A.F. Lanza and S. Messina with the Villanova University for the study of starspots by means of photometric observations of TiO bands is producing the first results [116].

**B. Photospheric and chromospheric magnetic structures in single stars and binary systems**

S. Catalano, A. Frasca and E. Marilli have carried on the study of Hα line emissions of numerous active binary systems (among which AR Lac [95]) to investigate the long-term evolution of chromospheric emission. In particular, accurate physical parameters of the components of the long orbital/rotational period (108 days) binary system HR 7428 (K2III+A2V) have been derived. Moreover, evidences of an extend cloud, connected with the system, indicative of mass exchange within the components have been obtained [28, 104].

S. Catalano, A. Frasca and E. Marilli have investigated the system RS CVn MM Her from a photometric and spectroscopic point of view in collaboration with a group of researchers of the Ege University (Turkey). The photometric study of this active system has revealed that a cycle of activity with a period of about 6 years is possible. The determination of physical parameters of the components and their spectral classification has been improved [46].

Chromospheric and photospheric activity on the single solar type star HD2068660 has been studied from Hα spectroscopy and uvby photometry [94].

G. Cutispoto, S. Messina, and M. Rodonò have presented the UBV(RI)c photometric observations of 31 active stars observed at ESO and with the APT at the Catania Astrophysical Observatory in 1993, pointing out for many stars the variations of the
photometric period and of the surface fraction covered by photospheric spots. Many spectral classifications of the observed stars have been revised and improved. The study of active stars discovered in the X images of EXOSAT has continued [18], and activity characteristics have been deduced.

G. Cutispoto, S. Messina and M. Rodonò have performed the multi-band analysis of the X G1355 (LQ Hya) stellar source, while the photometric and spectroscopic observations of HD52452 have revealed that it is a triple system with an eclipsing component[105].

P.J. Amado, G. Cutispoto, A.F. Lanza and M. Rodonò have investigated the photospheric activity of the single star AB Dor, analyzing the photometric data available in the literature and deducing an activity cycle of about 20 years [71].

Preliminary results of an intense flare observed in the active binary star UX Ari, during simultaneous H α and radio observations at Serra La Nave and with the VLBI antenna at Noto have been presented by S. Catalano et al. [122].

C. Systematic observations and activity cycles

M. Rodonò, G. Cutispoto, A.F. Lanza and S. Messina have described the systematic monitoring of active single stars and binary systems conducted since 1992 by means of the APT of the Catania Astrophysical Observatory. The most important results include the singling out of activity cycles and active longitudes in different objects and the relation between the orbital period variations and the magnetic activity in close binaries [39, 65].

S. Messina, M. Rodonò and E. Guinan [33], have applied the well known rotation-activity connection to the photospheric indicators of magnetic activity and have found new correlations between magnetic activity in the photosphere and global stellar parameters.

A. Lanza, M. Rodonò, L. Mazzola [contract researcher at OACt] and S. Messina have analyzed a sequence of lightcurves of the active binary system SZ Piscium, pointing out the long-term variation of the spotted area and a probable activity cycle in the secondary star. Results have been obtained on the connection between the orbital period variation and the magnetic activity [24].

M. Rodonò, A. Lanza and U. Becciani have investigated the possibilities offered by a new parallel code for modelling the light curves sequences of active binaries. It has been applied to a sequence of the binary system RS Canum Venaticorum exploring the geometric and photometric parameter space with the Cray-TT3E of CINECA. Results have underlined the effect produced by the activity on the determination of physical and evolutionary parameters of the system components [40].

A. Lanza and M. Rodonò have examined the principal characteristics of the solar-type magnetic activity in close binary systems and have discussed in particular the model recently proposed for the connection between the orbital period variation and the activity cycles [62, 98].

D. Magnetic activity evolution

The study of pre-main sequence binary systems (PMS), whose principal aim is the determination of their fundamental parameters, has led to the discovery of RXJ 0529.4+0041, the first eclipsing binary whose components are PMS low-mass stars. The photometric observations were made at the 91-cm telescope.

Further observations of this binary system have been obtained by the Adaptive Optics Near-Infrared System ADONIS at the ESO 3.6-mt telescope and by the OIG Camera at TNG (UBVRI). The J, H K filters ADONIS observations have allowed the depth of the secondary minimum of the eclipsing binary to be defined, without the contribution of the
third component of the visual system. The preliminary results have been presented in an ESO Press Release [89].

The spectroscopic study of 6 pre-main sequence binary stars, with periods ranging from 3 to 47 days, has been carried on in collaboration with a research group of Naples [17]. The radial velocity curves of these double-spectrum systems, together with their relevant orbital solutions, have been published. This research has yielded fundamental results for testing the pre-main sequence evolutionary models and for studying the evolution of stellar rotation, chromospheric activity and Lithium abundances [90].

A.C. Lanzafame, with other researchers, has applied the advanced techniques of spectroscopic diagnostics to UV data to determine the atmospheric structure of T Tauri stars, contracting towards the main sequence [88].

S. Messina has started a new monitoring program of young stars in the Pleiades and Alpha Persei clusters to investigate the age dependence of stellar activity [32]. Moreover, a collaboration with the Observatory of Strasbourg has began in order to select the pre-main sequence stellar candidates on the basis of their flaring activity and to classify them by means of photometric and spectroscopic observations [20]. Messina and Guinan have continued the study of activity cycles and differential rotation included in the The Sun in Time project.

E. Marilli, S. Catalano and A. Frasca have carried on photometric observations for the study of stellar rotation of low mass stars in the young clusters alpha Per, Hyades, Pleiades, Praesepe and Coma Berenices [89].

### 4.2.2 Stellar Physics: stellar oscillations

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<tr>
<th>OACT Researchers</th>
<th>A. Bonanno, M.P. Di Mauro, R. Ventura</th>
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<td>Univ. Researchers</td>
<td>L. Paternò</td>
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The success of helioseismology, both from ground and space, has spurred investigators to search for similar oscillations and apply its methods to other stars which show multi-mode pulsations. Unfortunately, the seismological approach to these pulsating stars, known as Asteroseismology, is currently hindered by the problem of mode identification since the oscillation amplitudes observed on the Sun (a few parts per million in flux) are too small to be detected in other stars with ground-based telescopes. In order to reach the required sensitivity and frequency resolutions, several space experiments (MOST, COROT, MONS, Eddington) will be soon devoted to the measurements of oscillations of stars. In anticipation of oscillation data that the satellites will be able to provide, it is necessary to prepare the theoretical background and optimize the selection of the targets. With this aim, M.P. Di Mauro and L. Paterno' in collaboration with J. Christensen-Dalsgaard and the group of asteroseismology of the University of Aarhus (DK) have investigated the theoretical prediction of power spectrum and amplitudes of oscillations of stars which show pulsational instability. In particular, they have been able to develop structure models and to calculate adiabatic oscillations of stars with external convective region (solar-type stars) and of delta Scuti stars. Results have been obtained for Procyon A and eta Bootis, and for the rapidly rotating delta Scuti star V480 Tau. This is of crucial importance to test stellar evolution theory and to get information about the properties of stellar interiors [92, 93]

A. Bonanno and R. Ventura have observed Procyon A by means of SARG spectrograph at TNG, obtaining 900 spectra, whose reduction is still in progress, in order to detect solar type oscillation modes. The observations of the hot pulsating sub-dwarf PG1338-018 have
been carried on with the photoelectric photometer mounted on the 91-cm telescope at the M.G. Fracastoro stellar station. This star is part of a close binary system and can give interesting information on the physical characteristics of the variables of the type EC144026, non-radial pulsators characterized by p and g modes with amplitudes of few hundredth of magnitudes.

### 4.2.3 Stellar Physics: chemical composition and chemically peculiar stars

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<th>OACt Researchers</th>
<th>: I. Busà, G. Catanzaro, F. Leone</th>
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<td>Univ. Researchers</td>
<td>: F. A. Catalano</td>
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It is widely accepted that the surface magnetic field of Ap and Cp stars can be the relic of the interstellar field frozen during the contraction of the pre-stellar cloud, however the suggestion for a dynamo-generated field cannot be completely excluded. Magnetic chemically peculiar (CP) stars have spectral types between late B and early F and are characterised by: overabundances of some chemical elements by up to $10^6$ times and/or underabundances by a factor of 100, strong magnetic fields inferred from the integrated Zeeman effect (typical fields are 0.1 - 1 Tesla, the strongest known being 3.5 Tesla). The study of CP stars is particularly important for understanding those phenomena that in normal stars appear on a reduced scale or in a much complex form. For example, large-scale organised magnetic fields, that are relatively difficult to be modelled, represent a possible test for methods and strategies devoted to the study of magnetic fields in solar-like stars.

At the Catania Astrophysical Observatory in 2001, we have studied various aspects of CP and AP problems. F. Catalano and G. Catanzaro have continued their research on main sequence chemically peculiar stars exhibiting complex characteristics: slow rotation, variable and intense magnetic fields, over- and under-abundances of different elements, spectral and photometric variability.

The behaviour of the HeI line at 5876 Å in 16 chemically peculiar stars of early spectral types has been studied and its variation in intensity pointed out. An extensive bibliographic research carried out during the last two years has resulted in the publication of the Fifth supplement to the catalogue of Ap stars, in cooperation with P. Renson, from Liège University, Belgium. The huge amount of data collected in order to study the distribution of periods of the above-mentioned stars, as well as to assess the validity of interpretative models [37], is being worked out.

F. Leone has studied the characteristics of polarized radiation of CP stars from both an observational and interpretative point of view [1, 27]. F. Leone and G. Catanzaro have observed various CP stars with the “Telescopio Nazionale Galileo”, using the SARG high-resolution spectrograph equipped with a polarimetric module. Data analysis is in progress, some spectra have already been reduced and analysed in order to infer the possible surface structure non-homogeneity of the magnetic field.

F. Leone and G. Catanzaro have extended the spectroscopic analysis of chemically peculiar stars to the far ultraviolet. Time with the FUSE satellite, for simultaneous observations in the far-UV and in the optical at high-resolution in the visible, has been already obtained [87].
G. Catanzaro and F. Leone have also carried on observational programmes at “M.G. Fracastoro” stellar station. They concern the HeI 5876 Å line spectral variability and the determination of orbital parameters of a sample of CP stars belonging to spectroscopic binary systems.

In cooperation with Prof. Reimers’s group (Hamburger Sternwarte), I. Busà has worked on the reduction and analysis of spectroscopic data for metallicity determination in halo metal-poor stars within the Hamburg/ESO objective-prism Survey (HES). Within this project I. Busà was involved in the development of a database for managing both high and low resolution spectroscopic data; she has also carried out spectroscopic observations with the MSSO 2.3-m telescope (Australia), whose analysis is in progress.

4.2.4 Stellar physics: stellar formation and evolution

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<tr>
<th>OACt Researchers</th>
<th>G. Catanzaro, A. F. Lanza, G. Lanzafame, A. Magazzù, S. Scuderi</th>
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<td>Univ. Researchers</td>
<td>G. Belvedere, M. Rodono', R. A. Zappala'</td>
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<td>Ph. D. students</td>
<td>V. Costa, G. Palazzo, R. G. Pizzone</td>
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A. Star formation

S. Scuderi and N. Panagia, in collaboration with colleagues at the HST Science Institute, have studied the nucleus’ inner regions of the interacting galaxy M51, using six-band photometric data obtained with the HST and characterizing massive stellar populations, in particular with regard to young objects in HII regions [57].

G. Catanzaro and S. Scuderi, in cooperation with L. Bianchi (John Hopkins University), have examined a few, galactic and extragalactic, massive stars specifically with regard to the Hα line profile’s variations due to strong stellar winds. The project is being carried out and foresees spectroscopic analysis of high sequence stars by using both ground based spectra, partly obtained at the “M.G. Fracastoro” stellar station, and spectra obtained from orbiting instruments such as the FUSE satellite and the HST space telescope [3, 4, 5, 29].

A. Magazzù, in collaboration with colleagues at IAC, has conducted research campaigns on brown dwarfs in the Taurus star-forming region and has carried on the study of their spectral properties [30, 47].

B. Evolution of binary systems with a compact-component

A.F. Lanza and M. Rodonò have developed a theory for describing fluctuations of the gravitational quadrupole moment in stars with convective zones, and applied it to evolution models of binary systems containing very fast pulsars (millisecond pulsars), in order to investigate the origin of orbital eccentricity in these systems and verify models themselves [23].

G. Belvedere and G. Lanzafame have carried out bi-dimensional simulations of accretion discs in binary systems interacting with a compact object consisting of a neutron star, intended to study the formation and position of radial shock waves with spiral structure depending on the mass relationship between secondary and primary and on the initial
angular momentum of the stream injected through the L1 Lagrangian point. Specifically, the role of the initial angular momentum has been examined [26, 76, 77, 101].

C. Nuclear astrophysics

The group of nuclear astrophysics (R. A. Zappalà, A. Lattuada, C. Spitaleri, G. Palazzo, V. Costa, R.G. Pizzo) has investigated the possible synthesis of p-nuclei in high-mass stars (M > 10-15 solar masses), during type II supernova explosion. Nucleosynthesis codes employing stellar evolution models have been used and negative results obtained by comparing the abundances of Mo and Ru p-isotopes (and other less abundant isotopes), calculated in previous models with standard abundances in the solar system, have been emphasized as being connected with the uncertainties in the “weak” s-process model. The latter is the synthesis model of s-nuclei in the He burning phase in high-mass stars [36].

4.3 Extragalactic astrophysics and cosmology

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<th>Univ. Researchers</th>
<th>Post-Doc.</th>
<th>IRA-CNR Noto Researchers</th>
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<tr>
<td>V. Antonuccio, A. Bonanno, U. Becciani, S. Catalano, A. Frasca, A. Magazzù, E. Marilli</td>
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<td>R. A. Zappalà</td>
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<td>M. Bonamente, A. Pagliaro</td>
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<td>P. Cassaro</td>
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The world scientific community has devoted most attention to the study of the origin and evolution of the large-scale structure of the universe and of active galactic nuclei. Last year, research activity at the OACt was focused on fundamental aspects of these fields.

M. Bonamente, in collaboration with other researchers, has studied the EUV and X emission of the intergalactic medium, in order to investigate the composition and properties of some clusters of galaxies [7, 8, 9, 58].

V. Antonuccio, U. Becciani, A. Pagliaro and other researchers have carried out high-resolution simulations on the formation of galaxy clusters. They permitted to study in detail the environmental dependence of galaxy dynamical properties. It has been found that the relationship between mass and velocity dispersion has a weak dependence on the environment; moreover this is better understood in the hypothesis that dark matter halos have a sharp boundary.

This result, allowed by the high dynamical range of simulations, suggests that the role of environmental tidal fields could be significant in determining the stability structure of halos [52].

In collaboration with colleagues of “La Sapienza” Rome University and Torino Observatory, A. Frasca, E. Marilli and S. Catalano have carried on photometric U B V observations of BL Lac objects, within international programmes of short- and long-term multiband monitoring. In particular, preliminary results of simultaneous optical and X–ray observations of BL Lac, the prototype of blazars, have been published. The Catania group has given a significant contribution to the determination of spectral indices of energy distribution of the source, because U-band observations have been carried out only at Catania Observatory. During this campaign “intraday” variations have been revealed. While the soft X-ray flux appears well-correlated with the optical UBV variations, the hard X-ray flux does not [106].
P. Cassaro and R. A. Zappalà have cooperated in VLBI observations of seven BL Lac objects with the radio-interferometric system EVN+MERLIN. They have detected the presence of an helicoidal jet in at least two sources, (Cassaro et al. 2001, in press). These sources will be thus reobserved in order to trace out the jet at different scales and determine the distance of saturation [55].

A. Magazzù has taken part in international observational campaigns aimed at the detection and study of Gamma Ray Burst (GRB) afterglows, using the TNG [16, 21, 31].

In collaboration, among others, with Prof. M. Reuter, Institut fuer Physik, Universitaet Mainz, Germany, A. Bonanno has proposed a model of primordial universe able to describe the Planck time physics, applying quantum effects to the gravitational field. It has been shown that the evolution of the Universe immediately after the Big-Bang can be described, and that the problems of horizon and flatness of standard cosmology are thus solved. It has been shown that similar quantum mechanisms, but operating on a large-scale structure, can solve the "cosmic coincidence problem" (see N. Straumann *astro-ph/0009386*) occurred in recent data obtained by the SnIa supernovae [11, 12].

### 4.4 Laboratory of Experimental Astrophysics and Solar System Physics

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<tr>
<th>OACt Researchers</th>
<th>G. A. Baratta, G. Leto, M. E. Palumbo, G. Strazzulla</th>
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<tr>
<td>Univ Researchers</td>
<td>C. Blanco</td>
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<tr>
<td>Technical Staff</td>
<td>F. Spinella, G. Carbonaro</td>
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“Laboratorio di Astrofisica Sperimentale” (Catania-LASp for short) has been active in Catania starting from the eighties. Thanks to several funding agencies (Consiglio Nazionale delle Ricerche, CNR; Ministero dell'Istruzione, dell'Universita' e della Ricerca, MIUR; Agenzia Spaziale Italiana, ASI, etc.) to the Observatory, and to the Catania University the LASp has grown. Today Catania-LASp means a group of 6 people with permanent position plus students and guests, a laboratory building equipped with high vacuum chambers, facilities for the deposition of ice films, ion and Lyman-alpha irradiation experiments, many spectrometers in the range from 190 nm up to 200 micron, and also Raman spectrographs.

Fast ions passing through a solid target release energy to the target material, as a consequence many molecular bonds are broken along the ion-track and, in a very short time (one picosec or less), the radicals and molecular fragments recombine giving rise to a rearrangement in the chemical structure. As a consequence, in addition to the alteration of the chemical and lattice structure of the target material, new molecular species (not present before irradiation) are formed. The LASp group is mainly involved in the experimental study of the effects induced by fast ions and, recently, UV Lyman-alpha photons in solids (frozen gases, carbonaceous and organic materials, silicates etc.) of astrophysical interest and not. The "in situ" techniques used to analyze the effects of irradiation are Infrared, Raman and UV-Vis-NIR spectroscopy.

The main results obtained during the year 2001 are:

1. The results of an experimental study, obtained by IR spectroscopy in the 1.75-25 μm (5700-400 cm⁻¹) range, on ice mixtures containing nitrogen as dominant species and a different amount of water and methane have been presented. Some of the studied mixtures
Figure 7.- The ion implantation system and the in-situ spectral analyser of the LASP
have also been irradiated with energetic ions and their spectra collected at different temperatures. Irradiation produces molecules not present in the original mixture and leaves a complex refractory residue whose color, because of progressive carbonization, is darker and darker as the irradiation dose increases. The results have been discussed with a view of their relevance to the chemistry of the surfaces of Pluto and Triton. It has been suggested that isolated water molecules should be searched for; many not yet detected molecular species (in particular some containing CN groups) should be present. A hypothesis to explain the observation of CO2 on Triton (but not on Pluto) has been also proposed (Satorre et al. [43]).

2. Infrared spectra of many protostars show an absorption feature at 4.62 µm. Although a nitrogen-bearing species has been implicated through a comparison with laboratory data, the feature has not yet been unambiguously identified. In a review paper (Strazzulla et al. [44]) irradiation experiments have been reported, the experiments were carried out on mixtures containing nitrogen-bearing compounds and have shown that N2, which is a more likely interstellar ice component than NH3, can be the molecular progenitor of the carrier of the interstellar XCN band. In fact this feature does not appear after UV photolysis of mixtures containing N2; hence UV laboratory experiments have exclusively considered NH3 as the molecular precursor of nitrogen to form the XCN feature. A study is in progress in the laboratory on the properties of the organic residues formed after irradiation of ice mixtures made of H-, C-, N-, and O-containing species.

3. Solid objects in space (interstellar grains, comets, interplanetary dust particles), are continuously exposed to energetic processes such as cosmic rays and UV photons. Although the effects induced by such physical agents have been studied in laboratory for several years, up to now no experimental study of the combined effects induced by fast ions and UV photons on frozen gases of astrophysical interest has been carried out. The effects induced by ions or UV photons could be enhanced or depleted and new effects could appear if the frozen gases are simultaneously irradiated (or has been already irradiated) with UV photons or ions respectively. Recently it has been added a Lyman-alpha microwave powered lamp to the experimental apparatus. This gives the capability to study (by using 'in situ' Infrared and Raman spectroscopy) the effects induced by fast ions and UV photons on frozen gases and solids. The experimental apparatus has been designed for a continuous monitoring of the ions and UV flux, thus allowing a reliable comparison and quantification of the effects induced by these agents. By using this apparatus it has been found that the chemical evolution of UV and ion-irradiated molecular ices can be very different.

C. Blanco has continued the processing of the photometric data collected at M. G. Fracastoro stellar station of Catania Astrophysical Observatory, during several observational campaigns of main-belt asteroids, Near Earth Objects and Trojans. New values of the rotation period for 40 asteroids have been published. The coordinates of the rotation axis direction (pole), and the value of the axes relationship (shape), have been determined for about twenty objects [38, 53, 143]. The analysis of data collected during the observational campaigns of mutual events of Saturn (PHESAT 95) [48] and Jupiter satellites (PHEMU 97) [6] was concluded.
4.5 Image detectors for Astronomy

OACt Researchers  : G. Bonanno, R. Cosentino, S. Scuderi
Technical staff  : M. Belluso, P. Bruno, A. Calì, M.C. Timpanaro
External collaborator  : G. Poma

The principal activity of this research group consists in the study and realization of image acquisition systems based on two-dimension detectors and optical instrumentation for astronomical applications. Typical products of this activity are "Front-End electronics" for CCD detectors, photon counting systems, acquisition, analysis and reduction of images, electro-optical characterization of detectors for ground and space telescopes. The optimization of the CCD controller is centered both on the use of new technology circuits such as DSP and FPGA and on the attenuation of the readout noise to obtain high signal-to-noise ratios, thus allowing the detection of weak "features", e. g. smaller than 1% of the continuum, in the case of spectrophotometry.

Since 1998 the group has begun a search program dedicated to select new detectors useful for astronomical observations, both from Earth and space. In addition to CCDs three detectors in particular are under investigation: one based on diamond (Cofin. MURST), one based on MCP coupled to CMOS-APS sensors to obtain photon counting with the highest dynamical count rate (CNAA funding), and one based on avalanche photodiodes (SPAD).

Last frontier of CCD technology is the production of "high resistivity deep depletion" CCDs with higher quantum efficiency and better uniformity in the Near-Infrared than currently available. The group has already made contacts with Marconi Advanced Technology (an English factory) in order to cooperate in a complete characterization of this kind of CCD for astronomical use, i.e. in terms of spectral response, dark current and readout noise. For this purpose the group is equipping the laboratory with a new instrument (entirely designed by the group) enabling "charge diffusion measurements" on the single pixel at different wavelengths (CNAA funding).

The semiconductor technology is producing new and alternative detectors with respect to CCDs called Complementary Metal Oxide Semiconductor - Active Pixel Sensor (CMOS-APS). These detectors, at present, show a noise higher than CCDs and a quantum efficiency lower than CCDs, but they have very important characteristics for space applications such as: very high integration of electronic circuits "on chip" (compactness), low power consumption and easy "space qualification". For such detectors the group is progressing to carrying on the project already started with the Istituto di Fisica Cosmica of Milan-CNR with the aim of producing a photon count imaging system using CMOS-APS coupled with MCP intensifiers.

Another interesting activity dedicated to the study of new detectors is the characterization of individual and array of "Single Photon Avalanche Diodes" (SPAD) recently undertaken within a special agreement with the ST Microelectronics (R&D of Catania).
Figure 8. - A view of the characterization facility for optical and UV detectors.
The main facilities and instruments available to the group include:

- a characterization system in the 130-1100 nm spectral range
- two optical benches with several optical components
- a 20" integrating sphere for uniformity measurements of very large detectors as CCD mosaics
- cryogenic systems with Liquid Nitrogen cooling and thermoelectric cells (Peltier) and chillers
- a class 100 clean room (12 squared meters)
- various electronic benches equipped with oscilloscopes and several multi-meters
- a software development kit (Xilinx) for programming of electronic FPGA

The group activities in 2001 have been divided into three main areas: local, national and international areas, depending on whether the project is carried out in cooperation with other groups or national and international institutions.

A. Local projects

CCD cameras for SLN instruments. The imaging camera for the 61-cm telescope has been now completed with the delivery of the filter wheel and shutter units, manufactured according to the design provided by the group. An improved version of the 61-cm CCD camera to be used for photometric applications at the 91-cm telescope has been designed and is under construction. This new version will be able to reach lower temperature (about -70 C) thus allowing to have a lower dark signal.

Solar observations. The group has been involved for two years in the development and improvement of the performance of the instrumentation used for solar observation of the photosphere and the chromosphere. Specifically, the CCD camera controller has been replaced with the TNG type, the image acquisition software has been modified as well as the camera cooling system. In addition a lens holder has been designed for the focusing and collimation of instruments on the solar spar.

CCD characterization laboratory. The electro-optical characterization system of detectors has been developed and completely automated as regards the movements, measurement acquisition and implementation of a number of procedures for routine calibration. The system has been used for quantum efficiency measurements of four photomultipliers employed by the IFCAI group of Palermo CNR for the EUSO project. Furthermore, the CCD of the Schmidt 67/90 telescope operating at Padua Observatory, has been characterized. The system is also used by the students of the Astronomy and Physics Department of Catania University for the Laboratory Training course [135].

B. National projects

SARG (TNG). After the end of the commissioning phase [13, 34, 128, 129, 133, 144, 145] and the delivery of the spectrograph to the astronomical community, the group has been involved in two main activities. From a technological standpoint, the group has worked on the spectropolarimeter commissioning (person responsible for the instrument realization: F. Leone) and on the optimisation of the user interface of the spectrograph. Among its main applications, the spectropolarimeter measures stellar magnetic fields. Moreover, in cooperation with Padua Astronomical Observatory, the group is involved in a scientific project employing the SARG spectrograph, regarding observations, data reduction and analysis for detecting extrasolar planets in binary stars [22].
UVISS. The UVISS project, regarding the construction and the launch into orbit of an ultraviolet telescope on the International Space Station (ISS), has been funded by ASI and should start the B phase after its approval. In collaboration with Brera-Merate Astronomical Observatory and the Institute of Cosmic Physics of Milano CNR, the group is involved in the realization of a UV camera for large-field images [79, 136].

CMOS-IAPS. The project, carried out in collaboration with the Institute of Cosmic Physics of Milano CNR, aims to build a photon-counting system based on a microchannel plate (MCP) using a CMOS-APS device as reading system. The project feasibility has been shown by the realization of a device prototype [83, 115].

Diamond detectors. This research programme is conducted in cooperation with the Department of Astronomy and Space Science of Florence University, the Department of Materials and Mechanics of Reggio Calabria University and the Department of Sciences and Energetic and Physical Technologies of "Tor Vergata" Rome University. The objective of the programme is to realize a matrix UV detector based on synetetic diamonds [19].

SPAD. The purpose of the project, in cooperation with ST Microelectronics, is to develop a Single Photon Avalanche Diodes (SPAD) matrix. The construction of a circuit for the detector readout (quenching circuit), to characterize the performance (dark, QE, acquisition rate) of the SPAD is in progress.

CCD controller. The project, in collaboration with Padua Astronomical Observatory and the "Elettromare" Firm of La Spezia, consists in the implementation of a new-generation CCD controller. Compared to the previously developed controller, now used at the TNG and various Italian Observatories, the improvements regard the transmission speed, conversion speed, and the application of more modern electronic technologies to communicate with the host computer [123, 124].

Figure 9. - The CCD camera for 61 cm telescope with the Peltier cooling system during test at the Detector Lab.
4.6 Computational technologies for astrophysics

<table>
<thead>
<tr>
<th>OACt Researchers</th>
<th>: V. Antonuccio, U. Becciani</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-doc</td>
<td>: M. Bonamente, A. Germanà, A. Pagliaro</td>
</tr>
<tr>
<td>Doc. Students</td>
<td>: D. Ferro, A. Romeo</td>
</tr>
<tr>
<td>Technical Staff</td>
<td>: E. Martinetti</td>
</tr>
</tbody>
</table>

The development of high performance computing gives a fundamental improvement to the study of the origin and the evolution of the Universe. This leads to the study of complex scientific problems, generally using parallel algorithms on massively parallel systems MPP and SMP systems. However, the availability of these resources produces a large amount of data that the research needs to manage and analyze.

At present, computational resources needed to run large simulations are available only either in high performance computing sites or using distributed resources. Catania Astrophysical Observatory has an SMP system, the IBM SP 9076, with 24 processors and 48 Gbyte RAM memory principally used for cosmological simulations. This system enables to run very large parallel programs and some parallel codes have been developed by researchers.

The problem of the data analysis is also a fundamental task of this group, that is involved in a European project for data analysis using the scientific visualization. The tools AstroMD is a public domain code that the OACt is developing together with the CINECA VISit Laboratory, using the Virtual Theatre at the Cineca. AstroMD manages multidimensional data from cosmological simulations, but it can also manage data from observational surveys.

The study and the development of gravitational N-body codes using parallel computing techniques is in progress. The tree code has been implemented on three platforms (T3A, Origin and SP) using the IBM SP system acquired by Catania Astrophysical Observatory. Its final version FLY (Fast Leveled tree n-bodyY code) (http://www.ct.astro.it/fly/) has been made accessible to the public (open source) and till now is used by more than 50 researchers all over the world [2, 141].

The parallelization of a procedure which allows high-level modelling of photometric and spectroscopic observations of active binary stars, with non-homogeneous distribution of superficial brightness has been performed in collaboration with M. Rodonò and A.F. Lanza [c8]. This method has been tested and has been used to identify the photometric parameters of the binary system RS Canum Venaticorum [40].

The project of data analysis proposed by the Catania Astrophysical Observatory and by CINECA for the years 2001 and 2002 is financed by CNAA. It will consist in testing some useful techniques and in developing a package of scientific visualization AstroMD (http://www.cineca.it/astromd) whose first open source version is already available[142].

The package is based on the Visualization Toolkit (Kitware), which is a software object-oriented to 3D graphics. AstroMD performs the multi-dimensional and multi-varied analysis, contains some tools that can visualize clusters, computes specific quantities (i.e. Correlation functions, Minkowski functionals etc..), analyzes vector fields and uses the IVR (Immersive Virtual Reality) techniques. The first results have been recently presented at the Europhysics Conference on Computational Physics [72, 73, 85]. The development of AstroMD has been further financed (Sept. 2001) by the European Community which has approved the Cosmo.Lab project (http://cosmolab.cineca.it/index.html).
U. Becciani, in collaboration with other researchers, has investigated the inference rules for the Fuzzy processor used for the project of an intelligent-based readout system of Silicon drift detectors (SDD) of the Image tracking system (ITS) within the ALICE experiment. ALICE is a high energy physics experiment performed at CERN to explore the "quark gluon plasma using LHC (Large Hadron Collider) beams. This innovative technique, which employs the processing and control of information in real time through a Fuzzy processor can be used in the front-end electronics of detectors commonly used in Astronomy [42].

Figure 10. - The IBM 9076-SP3 parallel computer
5. Projects and collaborations

5.1 Approved proposals on international facilities
Participants from the OACt are in bold

**Title:** Asteroseismology in solar-type stars  
PI and CoI: **A. Bonanno, R. Ventura, R. Gratton** et al.  
Observatory and instrument: TNG; SARG  
Allotted time: 7 nights

**Title:** Study of a new index of chromospheric activity in late-type stars, R_IRT, from the CaII infrared triplet.  
Observatory and instrument: TNG-SARG  
Allotted time: 2 nights

**Title:** Nucleo-chronometric age dating of the oldest stars in the Galaxy  
PI and CoI: **N. Kristlev, I. Busa'** et al.  
Observatory and instrument: ESO-UT2 Instrument: UVES  
Allotted time: 20 hours

**Title:** Measurements of magnetic fields in young open cluster late-type stars  
PI and CoI: **S. Catalano, M. Rodonò, A. Frasca, E. Marilli, A.F. Lanza, A.C. Lanzafame, R. Cosentino**  
Observatory and instrument: TNG - SARG  
Allotted time: 3 nights

**Title:** The first low-mass Pre-Main Sequence Eclipsing Binary: an Adaptive Optics Near Infrared Imaging  
PI and CoI: **E. Covino, J. Alcalà, A. Frasca, E. Marilli, S. Catalano** et al.  
Observatory and instrument: ESO, 3.6m - ADONIS-SH  
Allotted time: 2 nights

**Title:** Pre-Mains-equence spectroscopic binaries: direct mass determination and observational tests of PMS evolution  
Observatory and instrument: ESO - 1.5 m Telescope + FEROS  
Allotted time: 12 nights

**Title:** Rotation and magnetic activity signatures at the end of the main sequence and beyond'  
Observatory and instrument: ESO 2.2 m + WFI  
Allotted time: 21 h service

**Title:** Shearing velocity fields and filament activation in highly erupting active regions  
PI and CoI: **F. Zuccarello, L. Contarino, P. Romano** (Dipart. Fis. e Astron.)  
Observatory and instrument: THEMIS – IPM  
Allotted time: 4 days
**Title:** Magnetic field polarity inactive late type stars  
PI and CoI.: I. Tuominen, M. Rodonò, S. Catalano, F. Leone, S. Berdyugina, I. Ilyin  
Observatory and instrument: TNG; SARG  
Allotted time: 4×1/2 nights

**Title:** Probing the inner regions of the Beta Lyrae radio nebulae.  
PI and CoI.: G. Umana, C. Trigilio, F. Leone  
Observatory and instrument: VLA  
Allotted time: 7 nights

**Title:** The inner core of the bipolar nebula  
PI and CoI.: G. Umana, C. Trigilio, F. Leone  
Observatory and instrument: VLA  
Allotted time: 1 nights

**Title:** VLBI observations of the magnetic CP star CU Virginis  
PI and CoI.: C. Trigilio, C. Buemi, F. Leone, P. Leto, G. Umana  
Observatory and instrument: VLBI  
Allotted time: 1 nights

**Title:** Can diffusion be at the origin of the CP anomalous abundances  
PI and CoI.: F. Leone, M. Stift  
Observatory and instrument: TNG - SARG  
Allotted time: 2 nights

**Title:** Vertical abundance stratification in the atmospheres of chemically peculiar stars.  
Observatory and instrument: FUSE spectrograph R=16.000  
Allotted time: 13 ksec

**Title:** "FUSE Observations of Cool Stars: Transition Region Structure, Magnetic Activity and Mass Flows"  
Observatory and instrument: FUSE spectrograph  
Allotted time: 42 ksec

**Title:** Coronal Structure in the RS CVn binary AR Lacertae  
PI and Co-I: Siegmund Oswald H.W., Griffiths, M. Rodono', I. Pagano  
Observatory and instrument: Rossi XTE  
Allotted time: 177 ksec

**Title:** Wind-momentum - Luminosity relation for the early type supergiants. Spectral class dependence.  
PI and CoI: S. Scuderi, R. Casentino et al.  
Observatory and instrument: TNG - SARG  
Allotted time: 2 nights

**Title:** Search for extrasolar planets around stars in wide binaries: II  
PI and CoI: R. Gratton, R. Claudi, et al. G. Bonanno, R. Cosentino, S. Scuderi
Observatory and instrument: TNG - SARG  
Allotted time: 8 nights

**Title:** AdOpt imaging of the fields of the targets of the COROT space mission  
PI and CoI: E. Antonello, A. Baglin, A. Buzzoni, C. Catala, A. Ghedina, E. Poretti, L. Mantegazza, D. Fugazza, R. Ragazzoni, M. Rodonò, I. Pagano, G. Cutispoto  
Observatory and instrument: TNG - AdOpt  
Allotted time: 4 nights

**Title:** Ground-based Characterization of the target selection for the COROT space mission  
PI and CoI: E. Poretti, C. Catala, E. Antonello, E. Bertone, A. Buzzoni, L. Mantegazza, D. Katz, C. Van't et al., G. Cutispoto, I. Pagano  
Observatory and instrument: ESO - FEROS  
Allotted time: 2 nights

### 5.2 National and international projects

The research activity at Catania Astrophysical Observatory is going on in the framework of a number of national and international projects and collaborations, the most important of which are:

**REM.** M. Rodonò, G. Cutispoto, E: Martinetti, S. Messina and S. Sardone have collaborated on the design of the REM automatic telescope for near-infrared spectroscopy, devoted to the observations of Gamma Ray Bursts, detected by the SWIFT satellite. One of the most important characteristics of this instrument is the fast pointing system which will enable the detection of the GRBs [50].

**WSO/UV.** The World Space Observatory is an international project which involves several countries in the realization of a space telescope optimized for ultraviolet observations. The project is in the feasibility study phase and the group is involved in the realization of an imaging camera and detectors. I. Pagano, coordinator of the Italian Working Group, has represented the Italian community at the WSO/UV Implementation Committee [63].

**COROT.** I. Pagano has also worked on the COROT project, coordinating the Italian group involved in stellar activity programs [107]. A.F. Lanza and M. Rodonò have discussed the role of magnetic activity in the detection of oscillations in solar type stars by COROT [99].

Further participation in projects:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Project Title</th>
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<tbody>
<tr>
<td>APT/2-80cm</td>
<td>Automatic Photometric Telescope with CCD camera</td>
</tr>
<tr>
<td>AVES</td>
<td>Adaptive optics Visual Echelle Spectrograph: intermediate dispersion spectrograph for VLT (ESO) / LBT, with adaptive optics. Phase A</td>
</tr>
<tr>
<td>COROT</td>
<td>COnvection ROtation and planetary Transits, CNRS-ASI-ESA</td>
</tr>
<tr>
<td>COSIMA</td>
<td>COmetary Secondary Ion Mass Analyzer for ROSETTA, ESA</td>
</tr>
<tr>
<td>EUSO (ex AirWatch)</td>
<td>Space-born telescope for EECR study (Extreme Energy Cosmic Ray), ASI-NASA</td>
</tr>
</tbody>
</table>
REM Robotic telescope (Rapid Eye Mount) GRB detection in the NIR band

PEPSI Potsdam echelle Polarimeter Spectrograph instrument

SOHO SOlar and Heliospheric Obs., UVCS Spectrograph, NASA-ESA

SPAD Single Photon Avalanche Diode

TNG Telescopio Nazionale Galileo (technical plant, detectors imaging systems, polarimetric module on SARG)

UVISS UV telescope for the International Space Station

WSO World Space Observatory, a large UV space mission

_Diamante Project_ Development of detectors based on CVD diamonds

### 5.3 Staff involved in projects

- **Becciani U.** - TNG (archiving software group)
- **Bonanno A.** - COROT (WG Seismology)
- **Bonanno G.** - TNG (Imaging and SARG group)
  - UVISS (Detector for the imaging camera)
  - AVES (CCD camera, controller)
  - PEPSI (Control electronics and CCD)
  - SPAD (Electro-optic characterization)
  - WSO (Detector coordination)
- **Belluso M.** - AVES (CCD camera, controller)
  - PEPSI (Control electronics and CCD)
  - SPAD (Electro-optic characterization)
- **Bruno P.** - TNG (Imaging group, SARG, polarimetric module)
  - UVISS (Detector for the imaging camera)
  - AVES (CCD camera, controller)
  - PEPSI (Controls software)
- **Busà I.** - COROT (WG Stellar activity, and Ground Support)
  - APT/2-80cm (Data archiving and reduction)
- **Cali A.** - TNG (Imaging group and SARG)
- **Catalano S.** - TNG (SARG polarimetric module)
  - UVISS (Science team, imaging camera)
  - AVES (Science team)
  - COROT (WG Stellar activity, and Ground Support)
- PEPSI (OACt chair person)

Cosentino R.  - TNG (Imaging group, SARG)
- AVES (CCD camera, controller)
- PEPSI (Control electronics and CCD)
- SPAD (Electro-optic characterization)

Cutispoto G.  - REM (OACt chair person)
- COROT (WG Stellar activity, and Ground Support)

Di Benedetto R. - EUSO (Calibration)

Di Mauro M. - COROT (Seismology WG)
- GONG (

Gentile G. - TNG (Polarimetric module)
- APT/2-80cm (Focal plane mechanics)

Frasca A. - COROT (WG Stellar activity, and Ground Support)
- APT/2-80cm (Archive and data reduction)

Lanza A. F. - COROT (WG Stellar activity, and Ground Support)

Leone F. - TNG (Polarimetric module project)
- PEPSI (Polarimetry, data reduction)

Martinetti E. - REM (Mechanics, electronics and test)
- APT/2-80cm (Software e installation)

Pagano I. - UVISS (Science team)
- COROT (WG Stellar activity, and Ground Support)
- WSO (Italian PI, Science team)

Sardone S. - REM (Mechanics, electronics and test)
- APT/2-80cm (Mechanics, optics supervisor)

Scuderi S. - TNG (Imaging group SARG)
- UVISS (Imaging camera, mirrors, filters)
- AVES (CCD camera)
- Diamante Project (Detector)

Spadaro D. - SOHO (UVCS, Co-I)

Spinella F. - COSIMA (Technical)

Strazzulla G. - COSIMA (Co-I)

Ventura R. - SOHO (UVCS, Co-I)
- COROT (WG Seismology)
5.4 Collaborations

In the scientific context of the researches carried out at Catania Observatory several collaborations with single scientists and Institutions are going on as listed below:

**Solar Physics**
- Dip. Astronomia Univ. Firenze, Firenze: G. Noci
- Dip. Scienze Fisiche e Astronomiche, Univ. di Palermo, Palermo: G. Peres
- Institut d'Astrophysique Spatiale, Parigi (Francia): J.C. Vial, P. Lemaire
- Osservatorio Astronomico di Palermo, Palermo: S. Orlando
- Osservatorio Astronomico di Torino, Pino Torinese (TO): E. Antonucci

**Stellar Physics**
- Armagh Observatory, Armagh (North Ireland): C.J. Butler, J.G. Doyle
- Astron. Institute, Potsdam (Germany): K. Strassmeier, et al.
- Complejo Astronómico El Leoncito (Argentina): S. Malaroda
- Catholic University of America (IACS), Washington (DC, USA): R.D. Robinson
- Dept. of Physics and Astron., College of Charleston (NC, USA): J.E. Neff
- Dept. of Physics and Astronomy, Rutgers University, (NJ, USA): M. Gagnè
- Dip. Scienze Fisiche e Astronomiche, Univ. di Palermo, Palermo: G. Peres
- Goddard Space Flight Center, Greenbelt (MD, USA): HST/STIS Team
- Ege University Observatory, Bornova, Izmir, Turchia: C. Ibanoglu, S. Evren
- European Southern Observarory, Garching bei Munchen (Germania): L. Pasquini
- European Southern Observatory, Santiago del Cile (Cile): M. Kurster, S., Bagnuolo
- Istit. di Radioastronomia del CNR, Noto (SR): C. Trigilio, G. Umana
- Joint Institute for Laboratory Astrophysics, Boulder (CO, USA): J.L. Linsky, A. Krishnamurthi
- Johns Hopkins University, Baltimora (MD, USA): L. Bianchi
- Lockheed Palo Alto Research Co., Palo Alto (CA, USA): B.M. Haisch
- National Astronomical Observatory, Sofia (Bulgaria): N. Markova
- National Optical Astronomical Observatory, Tucson (AZ, USA): J. Valenti
- Observatoire Midi-Pyrénées (Francia): J. F. Donati
- Obs. Astronomique, Univ. Strasbourg (France): R. Freire-Ferrero, A. Fresnau, J. Guillot
- Osservatorio Astronomico di Brera, Merate (MI): G. Chincarini, G. Tagliaferri, L.Pastori, E. Antonello, L. Mantegazza, + REM Group
- Osservatorio Astronomico di Capodimonte, Napoli: E. Covino, J Alcalà
- Osservatorio Astronomico di Palermo, Palermo: R. Pallavicini, A. Maggio
- Osservatorio Astronomico di Roma: F. D’Antona, C. Maceroni
- Osservatorio Astronomico di Torino: M. Villata, C. M. Raiteri
- Observatoire de Paris: A. Baglin, et al.
- Space Telescope Science Institute, Baltimora (MD, USA): N. Panagia
- Special Astrophysical Observatory of the Russian (Russia): D.N. Monin
- Theoretical Astrophysics Center, Aarhus (Danimarca): J. Christiansen-Dalsgaard, F. Pijpers, H. Kjeldsen
- Univ. Federale del Rio Grande du Norte, Natal (RN, Brasil): R. de Medeiros
- University of Chicago, Chicago (IL, USA): R. Rosner
- University of Southampton (UK): P. Maxted
Chemically Peculiar Stars
- Complejo Astronomico El Leoncito, San Juan (Argentina): S. Malaroda
- Istit. di Radioastronomia del CNR, Noto (SR): C. Trigilio, G. Umana
- NASA InfraRed Telescope Facility, Honolulu (HI, USA): W. Vacca
- South African Astronomical Observatory, Cape Town (Sud Africa): P. Martinez
- University of Cape Town, Cape Town (Sud Africa): D. Kurtz
- University of Toronto, Toronto (Canada): G. Wade
- University of Wien, Vienna (Austria): S. Bagnulo, M. Stift

Experimental Astrophysics and Solar System
- Center for Astrophys. and Space Astron., Boulder (CO, USA): T. Snow
- Dept. of Astronomy, Ohio State Univ., Columbus (OH, USA): D. M. Terndrup
- Dept. of Astronomy, Univ. of Virginia (VA, USA): R.E. Johnson, R. Baragiola
- Earth and Space Sci. Dept., NY State Univ., Stony Brook (NY, USA): F. Walter
- Istituto di Fisica, Univ. di Lecce, Lecce: A. Blanco
- Istituto Universitario Navale, Napoli: E. Bussoletti
- Max-Plank Inst. fur Kernphysik, Heidelberg (Germania): J. Kissel
- Osservatorio Astrofisico di Arcetri, Firenze: P. Caselli, M. Walmsley
- Osservatorio Astronomico di Capodimonte, Napoli: L. Colangeli, V. Mennella
- Osservatorio Astronomico di Cagliari, Cagliari: G. Mulas
- Osservatorio Astronomico di Roma, Roma: B. Nisini
- Università di Valencia, Valencia (Spagna): M.A. Satorre

Galaxies and Cosmology
- Inst. of Astron., Univ. of Edinburgh (UK): E. van Kampen
- Lebedev Inst. for Theoretical Physics, Mosca (Russia): V. Lukash et al.
- Università di Copenhagen (TAC), Copenhagen (Danimarca): J. Sommer-Larsen
- Università dell' Insubria, Como: A. Treves
- Università "La Sapienza", Roma: E. Massaro, R. Nesci
- Osservatorio Astronomico di Torino, M. Villata,

Image Detectors and image Processing
- CARS0 (Center for Advanced Research in Space Optics), Trieste: R. Stalio
- Dipartimento di Fisica, Università di Firenze, Firenze: P. Spillantini
- English Electric Valve, Chelmsford (UK): P. Jorden
- European Southern Observarory, Garching bei Munchen (Germania): J. Beletic
- Istituto di Fisica Cosmica del CNR, Millano: M. Uslenghi
- Osservatorio Astrofisico di Arcetri, Arcetri (FL): E. Pace
- Osservatorio Astronomico di Brera, Merate (MI): R. Citterio
- Osservatorio Astronomico di Padova, Padova: R. Gratton, F. Bortoletto
- Osservatorio Astronomico di Palermo, Palermo: R. Pallavicini
Others
- CINECA, Casalecchio di Reno (Bo): G. Erbacci e R. Ansaloni (Calcolo ad Alte Prestazioni), C. Gheller e L. Calori (Visualizzazione Scientifica)
- Ottica Marcon, S. Donà di Piave (VE): progetto APT/2-80cm

6. Socio-cultural activities

In addition to the institutional scientific activity, various educational and popular activities have been carried out during 2001. These activities are spontaneously promoted by the OACt and respond to pressing requests from high schools and local cultural organizations. Within the programme, funded by the MURST, to promote scientific culture: “Use of astronomy as a universal and basic cultural heritage”, they include:

- guided visits of Catania Astrophysical Observatory, for high-school students (about 150 classes per year), involving about 8,000 students: the visit includes a visual observation of the Sun;
- guided visits of the Mario G. Fracastoro stellar station at Serra La Nave (Mt. Etna), for high-school students from Sicily (about 50 classes per year), involving about 3,000 students also from other Italian regions and from abroad;
- public guided visits of Mario G. Fracastoro stellar station at Serra La Nave (Mt. Etna), during the summer, including observations of the Moon and main planets with the use of telescopes (about 2,000 visitors per year);
- lectures on specific astronomical topics of great interest for schools, public institutions and cultural organizations;
- popular scientific articles on the local and national press;
- publication and spread of popular and educational material, such the CD-ROMs describing the OACt activities;

Moreover, during the 19-28 July 2001 period, the travelling ESA “ENVISAT occhio sulla terra” exhibition, promoted by “IDIS-Città della Scienza”, was held at the OACt.

7. Staff members

New permanent positions covered in 2001 after completion of public examinations are as follows:

Astronomo Straordinario: G. Bonanno (since 1 December)
Ricercatori astronomi: I. Busà, G. Catanzaro, M.G. Di Mauro
Collaboratore di elaborazione dati: A. Costa
Custodi/Portieri: M. R. Caruso (since 15 December)

Public examinations are in progress for the new following positions:

- no. 3 positions of Astronomo associato (selection in itinere)
- no. 1 position of categoria D1, Area Amministrativo Contabile (selection in itinere)

Adopting the benefits foreseen in the last CCNL, in particular the career advancements within the new classification categories, people are classified as follows:
7.1 People on duty (on 31 December 2001)

ASTRONOMI

Ordinari
(1) Bonanno G. (since 1 december 2001)
(2) Catalano S.
(3) Strazzulla G.

Associati
(1) Baratta G.
(2) Cutispoto G.
(3) Marilli E.

Ricercatori
(1) Antonuccio V.
(2) Becciani U.
(3) Bonanno A.
(4) Busà I. (since 15 september 2001)
(5) Catanzaro G. (since 15 september 2001)
(6) Cosentino R.
(7) Di Mauro M. G. (since 15 september 2001)
(8) Frasca A.
(9) Lanza A. F.
(10)Lanzafame G.
(11)Leone F.
(12)Leto G.
(13)Magazzù A.
(14)Messina S.
(15)Pagano I.
(16)Palumbo M.E.
(17)Scuderi S.
(18)Spadaro D.
(19)Ternullo M.
(20)Ventura R.

AREA AMMINISTRATIVO-CONTABILE

Categoria EP3
(1) Del Popolo S.
(2) Rapisarda M.L.

Categoria C5
(1) Mellini M.
(2) Tringale G.

Categoria C2
(1) Scafili M.

Categoria C1
(1) Costa P.
(2) Romania V.
AREA DELLE BIBLIOTECHE

Categoria D3
(1) Mangano A.

Categoria C3
(1) Domina D.
(2) Recupero D.
(3) Santagati L.

AREA TECNICA ed ELABORAZIONE DATI

Categoria EP2
(1) Massimino P. (ind elab dati)
(2) Sardone S. (ind. ottico-meccanico)
(3) Spinella F. (ind. elettronico)

Categoria EP1
(1) Lo Presti C. (ind. elab. dati)

Categoria D3
(1) Caripoli G.
(2) Catinoto E.
(3) Di Benedetto R.
(4) Sapienza G.
(5) Sciuto S.

Categoria D1
(1) Belluso M.
(2) Costa A.

Categoria C5
(1) Bruno P. (elab. dati)
(2) Greco V.
(3) Martinetti E.

Categoria C3
(1) Cali A.
(2) Carbonaro G.
(3) Gentile G.
(4) Lampò R.
(5) Miraglia M.
(6) Wanausek A.

Categoria C2
(1) Bellassai M. (uff. tecnico)

Categoria C1
(1) Occhipinti G.
(2) Miccichè A.

AREA DEI SERVIZI GENERALI, AUSILIARI E TECNICI

Categoria B4
(1) Puleo M. G. (ind. mecc.)

Categoria B3
(1) Cali M.
(2) Castorina G.
(3) Distefano A.  (ind. mecc.)
(4) Giuffrida A.  (ind. elab. dati)
(5) Saccone R.  (ind. amm.)
(6) Timpanaro M.C.  (ind. elettronico)

Categoria B2
(1) Corsaro G.
(2) Santocono O.
(3) Scuderi C.
(4) Ventimiglia A.
(5) Zingale G.

Categoria B1
(1) Caruso M. R.  (since 15 december 2001)