ARCETRI ASTROPHYSICAL OBSERVATORY

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INTRODUCTION

The 1995 Report of the Arcetri Astrophysical Observatory is a comprehensive summary of the scientific effort of our Institute. It has been prepared while our community is under shock because of the sudden death of Dr. Brunella Monsignori Fossi, which occurred on Monday, January 22 1996.

Brunella was a dear friend and an outstanding colleague for all of us. Her impact on the Observatory's activity and everyday's life was enormous. She was well known scientifically and the driving force behind all public activities of Arcetri aimed at spreading astronomy among the general public. If something had to be done and she had accepted the task of doing it, we could be sure that it would be done, properly and on time (last but not least, the organization of the Symposium on Cool Stars last October 1995). She died suddenly, at her working desk and all of us will miss her immensely.

This Report is the result of the work of Riccardo Cesaroni with the assistance of Guido Ceppatelli, Francesco Palla, Sperello di Serego Alighieri, Marcello Felli, Luca Fini, Giannina Poletto, Piero Salinari and Gianni Tofani.

It illustrates the activities of the Observatory which cover a large range of topics in modern astrophysics with special emphasis on observational and theoretical studies of solar and stellar physics, diffuse matter, external galaxies and high energy astrophysics. These are carried out in a broad context of collaborations at an international and national level and, locally, with the Department of Astronomy and Space Physics of the University of Florence and with the center for Infrared Astronomy of the National Research Council.

The Report also shows the presence of an intense effort in ground based astronomical techniques related to Arcetri's commitments in the national programs such as the Large Binocular Telescope (formerly, Columbus telescope), the Galileo project, the TIRGO telescope, the Themis telescope, as well as in the on-going radioastronomical programs. This combination of observational, theoretical, technological activities is developing in a very satisfactory way.

Finally, our Observatory has the great pleasure of hosting each year a large number of foreign visitors who come to Florence attracted by the beauty of the surroundings and, hopefully, also by the possibility of working in a stimulating scientific environment. I am particularly grateful to those who spent with us several months and often promised to return.

I wish to thank all those who made it possible for Arcetri to continue to carry out the research summarized in this Report. In particular, many thanks are due to the administrative, scientific and technical staff of the Arcetri Astrophysical Observatory for their day-by-day activity and to Riccardo Cesaroni and collaborators for preparing the Report.

Franco Pacini
Director
Florence, February 1996

1 SUN AND SOLAR SYSTEM PHYSICS

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Solar research in Arcetri covers a wide range of instrumental, observational and theoretical projects. These range from studies of the solar neutrino emission, to the analysis of photospheric, chromospheric and coronal phenomena, and to theoretical studies of the transport of polarized radiation in magnetic fields. Work is usually done in close cooperation with colleagues from national and foreign Institutions: ground-based data used in observational analyses are collected either with Arcetri instrumentation or via guest observing programs at foreign facilities, whereas space data are available to Arcetri scientists through collaborations with international teams. Details on individual works are illustrated in the following sections.

In the area of solar instrumentation, the Italian Panoramic Monochromator (IPM) is in the final stage of test (see solar instrumentation section for details) and will be installed at the THEMIS solar telescope (Canary Islands) in summer 1996. This will provide the solar community with a new observational capability: we expect coordinated THEMIS-SOHO observations to be especially helpful in clarifying the links between events occurring at different levels in the solar atmosphere.

Solar system studies have mainly focused on cometary physics, and, within this area, the impact of Comet Shoemaker-Levy 9 (1993e) with Jupiter has attracted a great deal of interest.

1.1 The Global Sun

Global Sun studies have mainly concentrated on solar physics problems which are interconnected with neutrino astronomy and helioseismology and provide direct information about the internal structure and dynamics of the Sun. Since 1995 several new experiments for the investigation of the Sun interior have been operational and they use helioseismology as the main method for the study of solar interior. In this respect the 1995 efforts have been aimed at developing and applicating new methods to the search and analysis of acoustic and gravity oscillations. The fine structure of each individual solar mode can be revealed, without any previous hypothesis about its shape, using the Fourier Power Averaging technique [B37]. This method has been applied to IPHIR and IRIS data, and the best estimations of the frequencies, amplitudes, line widths and the rotational splitting for low spherical order p-modes have been determined. The derived line shapes clearly show a strong asymmetry in the amplitudes and in the line widths of components with different spherical number in the rotationally split multiplets. These asymmetries are shown by the irradiance as well as by Doppler velocity shift measurements [B36][A70].

The temporal behavior of low-order global p-modes has been studied on the basis of a continuous data set, 160 days long taken by the IPHIR experiment and of ground-based IRIS network data covering 1990–1994. A quasi 26-days variation of the visible amplitude of p-modes has been found; this variation is very close to the period of solar rotation [B35]. It could be caused either by line shape modifications induced by solar activity processes, or by the periodicity of the excitation. It would be very interesting and important for the theory of excitation of stellar oscillations to distinguish between these possible explanations.

Calculations of g- and f-modes in a seismic model of the Sun, capable of reproducing the already detected p-modes, have been published [B38] and will be used for comparison with the expected results of GOLF project onboard the SOHO mission.

The last results of solar neutrino measurements in Homestake and in GALLEX experiment have confirmed the presence of the deep minima in 1994 which had been predicted long in advance, on the base of temporal behavior investigations of different global solar parameters.

1.2 Photosphere and Chromosphere

A better understanding of the role of the magnetic field on the observed polarized radiation and of the velocity field of the plasma in quiet and active regions is the main goal of present studies. Oscillations and asimmetries of photospheric line profiles are observed and analyzed to model the physical properties of the solar atmosphere. Theoretical and observational investigations are dedicated to the study of solar flares in the chromosphere and in the corona, in order to determine their origin and behaviour.

After the installation of a new dome at the Solar Tower, during the first half of 1995, the spectro interferometer has been used to continue the observations (50 days) of solar oscillations in quiet and active regions on the 5576.1 Å Fe I line [F11]. Data reduction and a comparison with a large set of similar observations, carried out over a solar cycle from 1984 up to now, are now in progress.

During July–August 1995, the IPM (Italian Panoramic Monochromator) – to be installed on the THEMIS solar telescope (in Canary Islands) in the second half of 1996 – has been used [F10] at the Solar Tower in Arcetri to obtain monochromatic images of the whole Sun in the 5576.1 Å FeI line. A study of solar oscillations and large scale motions based on this data set is in progress. Preliminary results confirm the expected performances of the instrument and, in particular, its high wavelength stability (see Solar Instrumentation Section for details).

Broadband circular polarization in sunspots, discovered about 20 years ago, is believed to be due to the spectral lines contained in the passband, and can be produced either by NLTE effects or by velocity gradients. Even in the latter (simpler) case, it has a complicated dependence both on the atmospheric parameters and on the lines' parameters. Some schematic situations where the polarization can be computed analytically, have already been studied [A78].

On a purely theoretical side, during this year, M. Landolfi of Arcetri Observatory and E. Landi of the University of Florence, have nearly completed the monograph 'Polarization in Spectral Lines', which will be hopefully published within the current year by Kluwer Academic Publ.. The book will contain a general introduction to polarization, the deduction of the fundamental equations describing the generation and transfer of polarized radiation, and several applications of the theory to the interpretation of solar and stellar polarimetric measurements.

Minor transient activity phenomena (as Ellerman bombs, persistent bright points, weak flares, etc.) provided very interesting targets to be investigated because of their importance in clarifying the basic mechanisms of energy storage, release and transfer occurring in an apparently simple structure. In other words, they may be considered as the *low energy tail* of a wide phenomena distribution in which major flares represent the *high energy asymptote*. For a better comprehension of these phenomena it is very important to combine high spatial and temporal resolution observations of the photosphere and chromosphere (where the activity phenomena are driven) with Soft and Hard X-rays images of the corona (where the primary energy release and instability trigger are believed to occur).

The results of the multispectral analysis of an elementary flare have been already published [A11][A61] and a study has been started on how a minor activity phenomenon as an Ellerman bomb is related to the possible emission at coronal levels. One of the first results was the detection of sudden upward mass motions occurring at the onset of Ellerman bombs (–5 km s^{-1}), changing to downward motion of +6 km s^{-1}few minutes after the maximum emission. Similar motions were also detected in the elementary flare, where the upward motion at the onset has been interpreted as the photospheric trigger of the disruption mechanism. No clear one-to-one coronal counterpart of the Ellerman bomb was found, but there are indications that the coronal weak loops overlying the Ellerman bomb were "activated" some tens of minutes before its development [B10].

An observing program [F9] of activity phenomena has been performed in February 1995 in collaboration with the Mees Solar Observatory (Hawaii) and with the japanese satellite Yohkoh, using the instrumental capabilities of the NSO Sacramento Peak Observatory. As a result the following data have been obtained, while observing a big flare (class M2): spectra in the range 3750–4150 Å with a time resolution of 5 sec; images with a broad-band continuum filter with a time resolution of 2.4 sec; images at different wavelengths with the Universal Birefringent Filter (He I-D_3, Na D_2, H_α –1.5, H_α, H_α +1.5) with a time resolution of about 10 ses for each wavelength; images at H_α +1.5 with the Zeiss Filter, with a time resolution of 2.4 sec.

This flare was observed in Soft and Hard X-rays bands with instruments onboard the Yohkoh satellite. Unfortunately some instruments (BCS and HXT) were not observing during the early impulsive phase and data have been obtained only for the maximum phase. The data have been processed using the Yohkoh package. The analysis of the data is in the preliminary stage.

Before concluding this Section, routine activity that has been going on during 1995, in support of future observational projects has to be mentioned. In particular, in preparation to VLA observations, images of the Sun (in white light and H_α, as well as solar magnetograms) available via Internet, have been daily analyzed, with the purpose of identifying the characteristics of active regions (in the 40 to 70 degree longitude belt), which are best suited for microwave linear polarization measurements. In preparation to THEMIS observations, coordinated with SOHO, of solar active and quiet regions, inversion routines to analyze spectropolarimetric data have been worked out.

1.3 Corona

Four major research areas can be identified in coronal studies: a) modeling coronal mass ejections, b) relationship between solar wind and coronal phenomena, c) coronal heating mechanism, d) extension and revision of spectral data and numerical codes for the prediction of high temperature spectra.

In solar physics from space, the leading event of the year has been the successful launch of SOHO (Solar Heliospheric Observatory), in December 1995. SOHO will undoubtedly supply a wealth of new data which will keep the solar community busy for quite a few years. In preparation of the first data sets, that will be shortly available, as part of a collaborative program with scientists from Marshall Space Flight Center (S. T. Suess) and the University of Alabama (S.-T. Wu and A.-H. Wang) in Huntsville, the problem of the origin of different kind of Coronal Mass Ejections (CME), as a function of the pre-existing streamer configuration, has been analyzed. MHD models of CME have been constructed and it has been pointed out how the global energy content of the pre-CME configuration determines the type of CME which will eventually develop [A57]. We expect SOHO experiments, and, in particular, the UVCS experiment, to which the Arcetri community more directly collaborates [A31], to observe many CMEs, allowing us to test the reliability of different models.

The Ulysses mission, meanwhile, keeps providing us with exciting new observations of still unexplored regions of the solar system. Data at high heliographic latitudes are now available, and a study of the polar solar wind, aimed at the identification of the remnants, if any, of fine scale coronal structures at distances of the order of 2–3 AU, has now been completed. This work gave negative results, inasmuch no unambiguous identification of coronal flux tubes at such large distances has been possible [A107].

The spacecraft Ulysses has been used in an experiment of solar coronal sounding [F8].

The long standing problem of coronal heating is far from being solved. One of the difficulties that have to be faced is the lack of observational evidence that would put theories on more solid grounds. In an attempt to identify a means to allow the recent "nanoflare" heating theory to be tested, a technique to determine the flare energy distribution is being devised [A88][D19]. This may possibly be relevant also for the recent flare theories, where large events are envisaged to be a cumulative process resulting from the presence of a high index nanoflare energy distribution.

The development in flare research as a consequence of the observations made by the SMM mission have been summarized in the Monography "The Many Faces of the Sun", now in press, to which Arcetri contributed co-leading the chapter "The Gradual Phase of Flares"– together with Scientists from The Netherlands, USA and Poland [B70].

An extensive upgrading has been made of the Arcetri spectral code for optically thin plasmas, which now includes the possibility to evaluate proper level populations for the most interesting ions.

A general revision of atomic data available in the literature or by private communications, (observed and theoretical energy levels, collision strengths, radiative transitions) allows line intensities to be computed as a function both of temperature and density, giving a powerful tool for temperature and density diagnostic of astrophysical plasmas.

The number density population is computed for temperatures ranging between 10^5 to 10^8 K and electron densities ranging from 10^8 to 10^{15} cm^{-3}. Special care has been given to the iron ions from FeIX to FeXXIII, and many ions pertaining to the C-like, N-like and O-like isoelectronic sequences have been added.

A public version of the Arcetri spectral code for optically thin plasmas is available on Mosaic page at Center for EUV Astrophysics (Berkeley) and at the Arcetri Observatory.

This detailed theoretical predictions will be particularly useful in studying the high resolution observations which will be acquired by the Coronal Diagnostic Spectrometer (CDS), SUMER and UVCS on SOHO.

The good results obtained using these data to study the spectra observed in the extreme ultraviolet by EUVE, has suggested to extend the updating in collaboration with the members of the "SOHO UV Spectroscopic Diagnostic Working group" in order to develop a larger Database of atomic data as complete as possible to be provided for the analysis of the spectra observed in the present and future solar space missions (e.i. HiRES, SOHO) [A95][B7].

Many of these lines fall in the EUV spectral region and have been observed by SERTS in the spectra of quiet, active and flare regions. In collaboration with scientists of Goddard Space Flight Center a detailed investigation has been performed of the temperature, density, and differential emission measure for different activity conditions. This work has been particularly profitable also to test instrumental calibration and performance.

1.4 Cometary Physics

The long lasting program for the measure of the water production rate on some periodic comets with IUE satellite has been continued. The aim of this program is to check the possibility of evaluating non-gravitational forces by measuring the asymmetry of the water production rate with respect to the perihelion (program Festou and Tozzi).

Comets 29P/Schwassmann-Wachmann 1, 95P/Chiron and 19P/Borrelly have been observed at the TIRGO telescope and preliminary data for comet 19P/Borrelly have been presented at the 27th DPS meeting (Division of Planetary Science of AAA) [B76]. Data are being processed and results show no outburst in comet 29P/Schwassmann-Wachmann 1 (one of the objectives of the program). The observations of comet 19P/Borrelly have been terminated (data are in the elaboration phase) while new observations of 6P/d'Arrest have been started and are still going on.

During the impact of comet Shoemaker-Levy 9 with Jupiter in July 1995, IR photometry at high temporal resolution has been obtained with the Arcetri portable IR photometer (described in Stellar section). The data of this experiment are the basis of a work in preparation, however preliminary results have been presented in [B68] and [A28]. The data are of special interest because of their temporal resolution, the highest among all observations of this peculiar event, and because the wavelength of our observation (3.1 μm) fills a range which is little studied. This has allowed a study of color and temperature evolution of the material rising above the Jovian clouds. Searches for oscillations in the Jupiter atmosphere have been limited by the special observing conditions, and have so far yielded negative results.

A ToO (Target of Opportunity) proposal for cometary observations with HST has been accepted: the aim of the proposal is the study of the CO and CO_2 abundances in new comets.

During 1995 more work has been done on the determination of orbits of minor planets. The D200 ephemeris code is now commonly used to compute definitive orbits with all the perturbations due to the major planets. Most of the derived orbits are similar to those published by the Minor Planet Center (M.P.C.). Experience has shown that sometimes our preliminary orbits are closer to the correct ones than those found by the M.P.C. Only seldom it has been impossible to find an orbit from which to derive an ephemeris useful for planning purposes. Some work has been done in predicting the future positions of bodies which were observed for a short period of time. In some cases these positions have been useful for the recovery of the asteroid. In other cases the uncertainties of the initial orbit were so large that this work was almost useless. Nevertheless we will continue to predict future positions when and if necessary.

In the frame of a cooperation with Dr. U. Munari in Asiago, photographic plates are taken with the small Schmidt telescope at Cima Eckar, processed in Florence by M. Tombelli and the data analyzed before being sent to the Minor Planet Center. The preliminary results have shown several problems due both to the measuring machine and to the approximate times given to the plates: in a short time these problems will be solved to allow several nights of observations in the first months of 1996.

2 STELLAR PHYSICS

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Research in Stellar Physics is carried out at Arcetri by a team which closely cooperates with scientists from the Department of Astronomy and Space Physics of the University of Florence and from various national and foreign institutions (including the Observatories of Torino, Milano, Padova, Catania and Palermo, the MPE in Garching, the MPIA in Heidelberg, the MPG-AG in Jena, the Observatoire de Toulouse, the University of Maryland, the National Solar Observatory in Tucson, the Center for EUV Astrophysics in Berkeley, the European Southern Observatory at La Silla, and others).

In the following sub-sections research projects completed during 1995, or still in progress, are illustrated.

2.1 X-ray, UV and Radio Emission from Stellar Coronae

Much of the activity of the cool star group at Arcetri in the course of the year has been devoted to the organization of the *Ninth Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun* held at Palazzo degli Affari, in downtown Florence, from October 3 to 6, 1995. The Workshop was attended by nearly 300 scientists from more than 30 countries, and provided an important forum to discuss the latest results on the physics of solar-type phenomena in other stars. The Proceedings are being edited by R. Pallavicini and A.K. Dupree and will be published by the Astronomical Society of the Pacific.

Studies on stellar coronae and stellar flares have been continued using X-ray and EUV observations from space, in collaboration with researchers at the University of Maryland (S. White), the Laboratory for Space Research in Utrecht (R. Mewe, J. Kaastra) and the Brera Observatory (G. Tagliaferri) [B58][B59]. In the X-ray band, data from the Japanese satellite ASCA have been analyzed for the young stars AB Doradus and HD 35850 [B82][B48][B71][B81]. Archive data from *Einstein* and *EXOSAT* on RS CVn binaries have been reanalyzed in a systematic way for comparison with new data from current (*ROSAT*, *ASCA*) and future (*SAX*) missions [B54]. At the same time, collaboration to future X-ray satellites (*SAX*, *XMM*) has been continued.

Cool stars, in the spectral range 70–700Å, have been observed by the EUVE experiment. In particular, ATMic, the binary star EQ Pegasi, a quiescent phase of AU Mic have been studied in detail: EQ Peg UV data have been acquired for the first time, as part of a guest observing program; AU Mic had already been observed, but at a very active phase. Eq Peg UV emission has been detected in all the spectrometer channels, and the identification of a large number of lines of highly ionized iron allowed the temperature distribution and the electron density to be evaluated [A36]. With the new observations of AU Mic it has been possible to point out the differences between plasma conditions at a pre-flare time and at a quiescent state: the high temperature component is now absent and densities are lower. The photometric study of AT Mic has revealed several small flare-like brightenings and a big flare, just at the end of the observational interval: the spectrally resolved data allowed the differential emission measure to be evaluated and the identification of high ionization stages of iron (FeXXII and FeXXIII) to be identified [A35][B15][A82].

Analysis of these data has been performed using an updated version of the Landini and Monsignori Fossi spectral code: detailed equilibrium equations for the calculation of the atomic level populations, as well as iron ions from FeIX to FeXXIV, and ions of the C-like, N-like and O-like isoelectronic sequences, have now been included in the code [D11][B52][B51][D10]. The code was also essential for the study of the corona of α Centauri, whose characteristics have been compared with those of the solar corona [B14].

Stellar coronae and flares have been studied also with radio techniques. The Effelsberg 110 m radiotelescope has been used for a 2-year observational campaign [F30] of the active binary system UX Arietis, which revealed a highly variable emission and showed evidence for a long term periodicity in the occurrence of events (i.e. above 200 mJy) events [B75][B46]. This is the first observational evidence of periodicities in the radio flaring activity of RS CVn stars. The collected data-set also contains a few flare spectra, which give information about radio emission during the flare rising phase [B74]. These spectra have been interpreted in terms of gyro-synchrotron emission from a non-thermal distribution of relativistic electrons in a dipolar magnetic field. The time evolution of the electron distribution can be modeled by assuming a constant injection of newly accelerated electrons and by taking into accounts the effects of radiative and collisional losses [A110].

2.2 Optical Spectroscopy and Polarimetry

Optical follow-up spectroscopic and photometric observations have been carried out, in collaboration with researchers at Catania (G. Cutispoto, M. Rodonò) and Milano (G. Tagliaferri), for a sample of serendipitous stellar sources detected in X-ray and EUV surveys [A22][A65].

Work on Lithium abundance has been continued both for field stars and for members of open clusters, using high-resolution spectrographs (CASPEC, CES) at ESO. A large sample of field subgiants has been studied, as well as solar-type stars in the young cluster IC 2602 and in the old cluster M67 [B61][B65][B66][B64] [F38][F39]. These researches are being carried out in collaboration with L. Pasquini and S. Randich at ESO. Li abundances and chromospheric emission have also been investigated in a sample of post-T Tauri stars that are late-type companions of visual binaries with early-type primaries. Action in support of the scientific case for a high-resolution spectrograph for the Italian National Telescope *Galileo* have met so far with limited success, but are expected to be, in the near future, more successful.

Modeling of stellar atmospheres, through a semi-empirical approach, where model parameters are adjusted to reach a good agreement with observational data, has been carried out for a number of stars. This technique proved to be a good means to understand stellar atmospheric structures, providing as well some insight into the heating mechanisms. After completion of a semi-empirical model for the quiescent state of the dM3.5e star Ad Leo, a model for a giant flare on the same star has been constructed, and the flare filling factor has been determined [B47][A80].

Atmospheric models for two dM stars, Gl 588 and Gl 628, which have photospheric characteristics similar to those of the Ad Leo star, are now being developed. Because Gl 588 and Gl 628 are non-emission stars, and Gl 628 is considered a "basal" star – i.e., defines the minimum level of chromospheric activity – the comparison between the chromospheres of the three stars will provide crucial information for understanding the mechanisms of chromospheric heating. Intensity and profiles of the four highest Balmer lines; of the Ca II k, Na D, and Mg b lines; of the infrared lines of Ca and Na, and of the continuum between 3500 and 9000 Å are evaluated and compared with observational data. This is a much wider set than used in previous works, which aimed at reproducing only the Ca II K line or the highest Balmer lines, and allows for a better identification of the model constraints. Observations of Gl 588 and Gl 628 have been obtained at ESO, in La Silla, using the Boller & Chivens and the CASPEC Spectrographs.

The study of the magnetic configuration of Ap stars, based on broadband linear polarization measurements acquired over the last few years, in cooperation with J.L. Leroy (Observatoire de Toulouse), with the Pic du Midi 2m telescope, has been continued during 1995. Combined use of these data and of spectropolarimetric measurements (yielding the so-called longitudinal and surface magnetic fields) suggests a composite picture: for some of the observed stars, a dipolar magnetic configuration is consistent with the data, while slight deviations from this model are required for other stars. In the latter case, a "modified" dipolar structure, characterized by a larger inclination of field lines in the equatorial region, seems to provide the configuration which better accounts for the observational data set [A3][A32][A103].

2.3 Near IR Spectroscopy, Speckle Interferometry and Lunar Occultations

High spatial resolution measurements of the angular diameter of late-type stars can be obtained via the lunar occultation technique, in the near IR bands. Angular diameters, ranging from 0.002 to 0.010 arcsec, of some late-type giant stars, have been measured for the first time, with the IR photometer at TIRGO. These measurements, coupled with the determination of the bolometric fluxes, allow a direct evaluation of the effective temperature of these stars, a parameter, which, for the latest spectral types, is still poorly known. So far, we collected a database including ≈ 30 stars, of spectral types from K5 to M9, which will be used for the first reliable determination of spectral types below M5. A thesis, which makes use of this data set, is now in progress.

The occultation technique has been used also for analyzing carbon stars, and, in particular, their circumstellar shells. In particular, red giant stars are known to exhibit phenomena such as pulsation and dust production, with extensive dust shells. A multi-wavelength study of the near-stellar environment around some carbon stars, on the basis of data acquired by means of a cooperative effort among observatories located in three different continents (including TIRGO), focussed on this topic [A50].

By means of the lunar occultation technique, it is also possible to search for binary stars, with sub-arcsecond separation. This is an ongoing routine project, carried out mostly at TIRGO, but in other observatories as well. A second paper on this subject is in press [A89], and a third list of newly discovered binaries is in preparation. Their typical separations are of the order of few hundredths of an arcsecond. A few cases, where the separation is only a few milli-arcseconds, should be included among the highest accuracy measurements in this field.

A further research area that can be explored by means of high angular resolution techniques involves the identification of stars with very low masses, such as brown dwarfs. This study is carried on in cooperation with astronomers in Germany and has led, so far, to the identification of a triple system, for which both ground-based, and HST observations, have been collected [B42]. This candidate is unique because of its tight orbit around the primary. This situation is expected to allow for a direct determination of the star mass, while most objects are identified only on the basis of their colors and energy distribution.

In a completely different field, IR (and optical) spectra of NGC 6302 have been used to determine the origin of high excitation ('coronal') lines in planetary nebulae. It has been demonstrated that the observed lines arise in a relatively cool ($\leq$20,000 K) gas, photoionized by the hot central star. The presence of a significant amount of hot ($\gg 10^5$ K) collisionally ionized gas, produced by fast shocks, is therefore excluded, and previous claims favouring shock excitation of coronal lines are definitely rejected [A84]. As a by-product of this work, computed atomic parameters of [NeV] ground state lines in the FIR have been found to be overestimated by a factor of $\simeq$3: this might have dramatic consequences for the interpretation of ISO spectra of active galaxy nuclei.

3 STAR FORMATION AND EARLY STELLAR EVOLUTION

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The study of the interstellar medium, with particular reference to the problem of star formation and early stellar evolution, is one of the main fields of interest of the Arcetri scientific community. Research activities cover both the observational and theoretical domains. Theorists have developed numerical models to study the early phases of molecular core formation, including the effects of magnetic fields and gravity. The appearance of such structures and the treatment of line profiles have been modeled both numerically and analytically. Several projects have focussed on the interaction of winds, outflows and jets from young stellar objects with the environment. Finally, models of the pre–main-sequence of low- and intermediate-mass stars have been refined to take into account effects such as accretion and pulsation.

From the observational side, a large number of telescopes have been used to collect data at different wavelengths. Near-infrared observations of star forming regions have been gathered at the TIRGO, Calar Alto and Nordic Optical telescopes. Much effort has been devoted to radio line and continuum spectroscopy using the 32 m Medicina and the 30 m IRAM antennas, the Caltech Submillimeter Observatory, the James Clerck Maxwell Telescope, and the VLA and Plateau de Bure interferometers. Large scale surveys to determine the frequency of binary and multiple systems among young stars have been performed in collaboration with various observatories all over the world. Finally, a large effort has been put into the final preparation of the scientific programmes to be carried out by the ISO satellite that was successfully launched in November 1995.

In the following subsections, a brief outline is presented of the main research projects and results on Star Formation and Early Stellar Evolution carried out at Arcetri over the past year or published in the course of 1995.

3.1 Molecular Clouds

The line width–size relation in massive cloud cores has been studied and compared with the one found in low-mass cores [A22]. These empirical relations have been analyzed in the context of an equilibrium model of a spherically symmetric dense core which incorporates both thermal and nonthermal motions. Differences in the slope and in the intercept of the line width–size relation between massive and low-mass cores imply significant differences in density structure, pressure profile, mass infall rate, and probably in the masses of stars which form. In particular, massive cores are denser and have steeper density profiles than low-mass cores.

High spectral resolution and high sensitivity observations of the J=1$\rightarrow$0 transition of N_2H^+ at 93 GHz have been made toward the quiescent low-mass cloud core L1512 in Taurus [A8]. The relative frequencies of the seven hyperfine components of this transition have been determined with precision $\sim$ 1 kHz. The hyperfine coupling constants have been determined with precision an order of magnitude higher than previously in the laboratory. High spatial and spectral resolution observations of N_2H^+, C_3H_2, HC_3N, and C_2S have been made to study dense cloud structure.

A survey in the NH_3(1,1) and (2,2) inversion transitions [A81] has been performed towards a selected sample of IRAS point sources. The large number of detections confirms the existence of warm, dense molecular gas associated with these objects. In particular, it is found that sources with greater colour temperatures are likely to hide very young massive (proto)stars.

Single dish [A85] and interferometric [A112] observations at millimetric wavelengths were performed to investigate the molecular environment surrounding newly borned massive stars. For this purpose, the 2.7 mm transitions of methyl cyanide (CH_3CN) and its isotopomers were observed towards two ultracompact HII regions. Such observations have confirmed the existence of dense ($n_{H_2} \simeq 10^7$ cm^{-3}), hot (> 100 K), small (0.1 pc) cores surrounded by a thin, colder halo, ten times larger. These cores reveal a temperature gradient increasing towards the centre and show rotation around the axis of more extended molecular outflows detected in the $^{13}CO(1$–$0)$ line. The mass of the rotating cores is estimated to be $\sim 10^3\ M_\odot$. In order to confirm the previous scenario, numerical models have been developed: such models reproduce the line profiles emerging from a core-halo structure with given temperature and density. The observed profiles of all the CH_3CN lines detected have been fit, thus confirming the hypothesis of a dense, hot core surrounded by a low-density, colder halo.

New investigations have been carried on with high angular resolution observations [A75][B80] towards a limited number of molecular clumps that present the typical signposts of massive star formation. Finally, a research that addresses the question of whether high-latitude molecular clouds can form stars has started [A106].

On the theoretical side, work is in progress to investigate the physical and chemical properties of star forming regions. In particular, the study of the collapse phase of molecular cloud cores was continued in collaboration with Susana Lizano (UNAM-Mexico) and Frank Shu (Berkeley-US). The investigation is aimed at following the magnetically-controlled fragmentation of flattened disk-like density structures surrounding young stars or small clusters. The observational implications of theoretical models for the collapse of molecular cloud cores in the presence of magnetic fields have been considered in [A25], where the appearance of infalling envelopes on young stars was been computed in the V, I, J, and K bands using a Monte-Carlo technique. Also, the emission of dust in the far-infrared has been computed and compared with recent observations of infrared sources at 1.3 mm.

An analytical model for computing the line profile emerging from an optically thick molecular clump with embedded HII region has been developed in the limit of zero line-width [A14]. Such model has been applied to fit the NH_3(4,4) line observed towards ultracompact HII regions.

Finally, two problems related to dust grains have been attacked: (1) the rate equations for chemical reactions on dust grain surfaces; (2) grain-grain collisions in oblique shocks and grain-mantle evaporation as a way to explain the observed enhanced abundances of certain molecular species (e.g. SiO) towards young stellar objects associated with jets and molecular outflows.

3.2 Massive stars, HII Regions and their Environment

Different and complementary approaches were used to search for the earliest phases of massive stars. Several pieces of evidence suggest that H_2O masers are one of the best indicators for selecting the target fields and that the study of their association with near IR sources, UC HII regions and hot molecular cores are the necessary follow-ups to unveal the earliest Young Stellar Objects. Along these lines two main field of research were followed: 1) the continuation of the single dish observations of H_2O masers with the Medicina radiotelescope (with a large effort to patrol the emission of a selected list of objects in order to study their variability) [B31] and 2) more accurate high resolution studies of selected star forming regions, using informations at many different wavelengths (in particular near IR, radio continuum and molecular observations).

In the first field the occurrence of H_2O masers in HII regions was completed by comparing the Medicina water maser atlas and radio recombination lines observations. It was found that maser do not overlap too much with diffuse HII regions and occur primarily in the earliest evolutionary phases, before the formation of a diffuse HII region [A17]. In a study of a selected list of bright IRAS sources associated with molecular clouds it was confirmed that water masers are closely connected to molecular outflows [A64]. Finally, the occurrence of maser emission among ultracompact HII candidates has been determined [A18].

In the second field a combination of near IR array images (J,H,K and Brγ, H_2) [B72], VLA continuum and H_2O masers observations, and molecular observations were used to study in detail a large number of selected star forming regions: BD+40° [A46], AFGL5142 [A30], the S155/Chepeus B interface [A53], NGC6334 I [A87], and a large sample of H_2O masers associated with molecular outflows [A54].

The common denominator of all these studies is the discovery of a new and very early evolutionary phase in the star formation process. Very crudely, when the HII radius is very small, of the order of the dust survival distance ($\sim 4\ 10^{14}$ cm) and the star is still embedded in a high density molecular core, the free free emission will be strongly self-absorbed, and consequently no UC HII region will be observable, while there will be a very hot dust cocoon which is observable at K band even though obscured by large A_v. H_2O maser are present in this phase and show pronounced variability. Small scale molecular outflows, H_2 jets and high density molecular peaks are usually found around the early type stars [B30].

The study of the effects of the radiation from massive stars on the ambient gas has continued. A numerical code has been written which computes the physical conditions and the emission in many observable lines in photon dissociation regions (PDR) where time-dependent hydrogen chemistry is important [A29]. Currently, the code is applied to the neutral shells which surround the hot cores of planetary nebulae and to the infalling envelopes around intermediate and high-mass stars. Observational work on PDR which combines observations of the radio CII recombination lines and of the fine structure line of CII at 158 μm to photodissociation models has also continued.

A powerful software package, called MATADOR, to manipulate 3D data-cubes has been developed and applied to the analysis of supersonic motions in giant HII regions [A38][B34].

3.3 Winds, Outflows and Jets

Theoretical studies are aimed to model the outflow properties as a result of the interaction of fast neutral winds with the ambient molecular cloud. In particular, two problems have been addresses: the geometrical characteristics of mixing layers between a molecular medium and a conical neutral jet with high (>100) Mach number, and the thermal properties (with particular reference to the cooling mechanisms) in momentum conserving mixing layers [A33][A27].

Deep (21 cm) spectral maps acquired at the VLA unveil the intermediate velocity counterpart of the fast neutral wind in L1551. Some of the results have been used to implement a hydro code for the propagation of jets in non homogeneous molecular media, taking into account radiative coolings together with ionization-dissociation effects; such simulations are presently in progress.

A knowledge of the physical conditions (i.e., temperature, density and ionization fraction) along the jet is of great importance for our understanding of their formation and evolution mechanisms. A study of jets associated to T Tauri stars using long-slit optical spectra has started. The first results for the star RW Aurigae [A59] show that the jet is mostly neutral (ionization fraction of few percent) and has temperature of about 5000 K. Its properties are consistent with the idea that the jet is ionized very near the star and is then recombining without further ionization. The physical conditions of the optical jets around young stellar objects were critically analyzed. The standard theory invoking shock fronts is unrealistic but the observed properties of the jet knots are naturally explained by soft compressions caused by damped Kelvin-Helmholtz instabilities generated at the jet–ambient contact discontinuity. These compressions force the gas to recombine and radiate its internal kinetic energy in form of optical/IR lines [A1].

3.4 Pre–Main-Sequence Stars

Several aspects of the early phases of stellar evolution have been studied.

3.4.1 Mass Accretion

Mass-infall is observed in several Herbig Ae/Be stars, i.e., pre–main-sequence stars of intermediate mass. The origin of the infalling gas is uncertain: it could be a residual manifestation of the more massive accretion which gives birth to the star, or a phenomenon associated to the early stages of the formation of planetary systems. In the latter case, the gas is produced by the evaporation of solid bodies (proto-comets or planetesimals) on star-grazing orbits. Theoretical model calculations have been performed to constrain the physical conditions of the infalling matter [A91] and its possible origin [A74]. The effects of residual mass accretion on the global evolutionary tracks and as a source of instability have been analyzed in the case of both low- and intermediate-mass stars [B55].

3.4.2 Binary and Multiple Stars

Observational studies of multiplicity of young stars have been carried out by means of high angular resolution techniques such as speckle interferometry, speckle holography and lunar occultations. Some of the results include the assessment of the binary frequency among T Tauri stars in the Taurus and Ophiuchus star forming regions. A summary of all available information at present points towards a binary frequency higher than among main sequence stars, with possible differences from one region to the other [A51]. However definitive conclusions still need a larger statistical basis. Therefore, efforts have been initiated to follow lunar occultation events that are going to take place in the southern part of the Taurus region, yet unprobed by this technique. In particular, observing programmes have been approved in Mexico and at the russian 6m telescope, where the Arcetri portable fast photometer will be deployed.

In parallel to this continuing research, similar studies for higher mass young stars are also beginning to yield results [B41][B67]. For instance, it appears that multiplicity and particularly the presence of circumstellar envelopes are even more common among Herbig Ae/Be stars, although the sample is in this case even smaller and further studies are necessary.

A theoretical investigation of the predicted infrared-coronal line emission from colliding winds in young binary systems has been conducted [A58].

3.4.3 Embedded Clusters and Young Open Clusters

The study of the stellar population associated with Herbig Ae/Be stars has been continued. A sample of 14 stars has been analyzed in detail using data obtained with ARNICA (TIRGO-Gornergrat) and IRAC2 (ESO-La Silla). The project is aimed at determining empirically the conditions that lead to the formation of stars in groups/clusters rather than in isolation. A first result has been obtained that shows a clear trend of the clustering properties with the spectral type of the central star [A109]. Data on another sample of about 15 stars have been collected and is presently under study.

Spectroscopic observations have been made for the young open cluster NGC 6913 field [A113]. Totally, the spectra of 100 stars of the cluster field, which have membership probability greater than 50%, are obtained and classified. Reddening is estimated on the basis of MK classification. The variable extinction across NGC 6913 is analyzed and discussed. From the spectroscopic observations, it is found that the spectral type distribution covers from O7 to K3. There are only 2 O-type stars in this OB association. 40 and 33 percent of the total cluster field stars (P 50%) are B and A type stars respectively, and the F, G, K stars amount to 25 percent. Considering the fact of the membership uncertainty, the distance of this cluster is evaluated to be between 1.30 and 1.45 kpc.

3.4.4 Interstellar Medium

The evolution of the light elements D and ^{3}He in the interstellar medium represents a crucial test for models of cosmological nucleosynthesis. With the help of sophisticated numerical models for the evolution of gas and stars in our Galaxy, we have been able to quantify a serious inconsistency between the observational data and the predictions of chemical models concerning the abundance of ^{3}He. Work is in progress to provide an answer to this dilemma.

On the other hand, the predicted evolution of D is found to be in good agreement with the observational data [A26][B32][B56], although the recent observations favoring a high primordial abundance of this isotope may require a drastic revision of our current understanding of galaxy formation and evolution [A45].

The study of the role played by molecules in the primordial gas prior to the formation of galaxies has been finally concluded. The possible observational signatures produced by the most promising of these molecules, Lithium hydride, have been analyzed in detail and found to be generally below the threshold of detectability by current instrumentation even under the most favourable formation conditions [A94]. Finally, investigations on the effects of molecular formation and cooling on the mass of the first stars have been carried out [A44][A108].

4 EXTRAGALACTIC AND HIGH ENERGY ASTROPHYSICS

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As in the past years, the properties of galaxies, both active and normal, and the study of their environment, and of their constituents – nuclei and diffuse interstellar matter in particular – are the main topics of extragalactic research in Arcetri. Both the observational and the theoretical aspects of the research are addressed, with active collaborations between scientists at Arcetri and colleagues at other Institutions. A brief description of the active projects and of the main results obtained in 1995 is given below.

4.1 Active Galaxies

Various lines of research are open in this field, concerning both theoretical and observational work, in the optical and in the near infrared, mostly on Seyfert galaxies and on radio galaxies.

4.1.1 Seyfert galaxies

On the theoretical side the X-ray emission (2–10 keV) from Seyfert 1 nuclei has been studied. It is proposed to interpret the emission as due to inverse Compton scattering of thermal photons by relativistic electrons. In this scheme the thermal electrons are produced inside the same cloud where they are reprocessed and they do not give any contribution to the observed UV radiation [A55].

The stellar content of active galaxies was investigated by means of near infrared spectroscopy of atomic/molecular stellar absorption features, namely Si 1.59 μm, CO(6–3) 1.62 μm and CO(2–0) 2.29 μm. These proved to be a powerful tool to accurately determine the non-stellar nuclear continuum and to trace red supergiants which are the remnants of old ($> 10^8$ yr) nuclear starbursts. Such old starbursts are found to be common in type 2 Seyferts while Sy1's do not show any evidence of starburst events in the last $\sim 10^9$ yr. This result is compatible with an evolutionary scenario HII $\rightarrow$ Sy2 $\rightarrow$ Sy1 while indicates that Seyferts of different types are intrinsically different objects [A43].

A detailed imaging and spectroscopic study of NGC4945 at visual (3700–10000 Å) and IR (1.1–4.0 μm) wavelengths revealed a spectacular conical structure produced by a nuclear starburst wind which blew a conical cavity in the host galaxy. The line ratios in the cone are typical of low excitations LINERS. Shock excitation at the surface of the cavity provides a likely explanation for the line emission although photoionization by X-rays associated with the superwind or the suspected Seyfert nucleus detected in hard X-rays cannot be excluded [A73][P1].

Observations of optical ([FeVII], [FeX], [FeXI], [SVIII]) and IR ([SIX], [SiVI], [CaVIII], [SiVII], [SiIX]) coronal lines in NGC1068 were used to study the physical/dynamical conditions of the emitting gas and to constrain the shape of the ionizing spectrum. The coronal lines appear to arise predominantly in outflowing gas within the ionization cone aligned with the radio jet. The line ratios argue against collisional ionization but are consistent with photoionization by radiation from the active nucleus. The required UV/soft X-ray continuum appears to be somewhat softer than that currently inferred from observations of the polarized light believed to be reflected from the obscured AGN [A104].

4.1.2 Radio galaxies

The study of anisotropies in the optical/UV emission from radio-loud AGN has continued, with the objective of improving our understanding of the Unified Model. In particular, the redshift dependence of the "alignment effect" has been studied [A15], a detailed model of dust scattering in radio galaxies has been developed [A72], the possibility that the [OIII] lines are anisotropically emitted has been studied [B19] di Serego Alighieri 1996), and further evidence of the presence of quasars in distant radio galaxies has been obtained [A67].

Thanks to a postoctoral fellowship provided by the IGPP – Lawrence Livermore National Laboratory (California, USA), an observing program with the W.M. Keck 10m telescope has been started in collaboration with Wil van Breugel (IGPP-LLNL), R. Antonucci (UCSB), H. Spinrad (UCB), A. Dey (UCB & IGPP-LLNL) and T. Hurt (UCSB). The program was aimed to detailed spectropolarimetry of radio galaxies with $0.7 < z < 1.8$. Six objects were observed in two runs (March and July 1995). The main results can be summarized as follows : (1) high linear polarization of the UV continuum is detected in all the 5 galaxies; (2) the observed $P(\lambda)$ are either flat or blue; (3) the perpendicularity of $\vec{E}$ to the UV continuum axis and the constancy of $\theta(\lambda)$ suggest that scattering is the dominant polarization mechanism; (4) the detection of the MgIIλ2800 emission line in polarized flux in at least 3 galaxies suggests that the incident radiation comes from an obscured quasar nucleus and is emitted anisotropically along the radio axis. In particular, the broad and polarized MgIIλ2800 in 3C 324 has velocity and equivalent widths consistent with those observed in radio-loud quasars [A63]; (5) the polarized flux continua can be reproduced by a dust and/or electron scattered radio-loud quasar spectrum; (6) the lower or null polarization of the [OII]λ3727 line implies that this line is emitted isotropically outside the obscuring region; (7) in the two galaxies analysed in detail so far [A66][A63], we observe *spatially extended* polarization along the UV continuum axis, implying that scattered light is a necessary ingredient to explain the alignment effect.

Other spectropolarimetric observations have been made at the Lick 3m telescope (August 1995) in collaboration with E. Moran (IGPP-LLNL) and T. Hurt (UCSB) in order to search for obscured quasars in a sample of IRAS galaxies.

A sample of radio galaxies at low redshift has been observed at the NOT 2.5m telescope in collaboration with V. Piirola (Turku, Finland) in order to study the UV and optical morphology and to compare them to those observed at high z.

An observing program is in progress in order to search for dust continuum emission in high redshift galaxies. The observations are made at the ESO-SEST millimetric telescope in collaboration with W. Freudling (ESO). During the last run in July 1995 we had a 3.2σ detection of a galaxy at z >3, and observing time has been allocated in 1996 at SEST, JCMT and IRAM to confirm the discovery.

HST observations have been allocated (28 orbits) to perform UV spectroscopy and polarimetry of a sample of low redshift radio galaxies (in collaboration with R. Antonucci, T. Hurt, W. van Breugel, A. Dey and H. Spinrad).

A related area of research, concerning stellar populations at high redshift has been started with a comparative study of the spectral synthesis models with the aim of finding observational clues to the age of the stellar populations at early epochs.

4.2 Normal Galaxies

4.2.1 Spiral galaxies

The reduction and analysis of the near-infrared (NIR) data collected at the TIRGO telescope on samples of normal spirals has been continued. This project is aimed at the quantitative determination of the physical parameters of the large scale galactic components (disk, bulge, and active nucleus). To these aim, one- and two-dimensional algorithms for the decomposition into the various components both in a parametric and non-parametric way have been developed. In conjunction with the availability of accurate rotation curves, such data provide the only reliable information on the large scale dynamical behaviour of the components and of the putative dark halos. The use of NIR images is crucial for such studies, due to the reduced extinction and to the more direct link to the mass content [A71].

A parallel line of research has been started by building a Montecarlo code for the radiative transfer (of the four Stokes parameters) with absorption and multiple scattering by dust. This is used to simulate photometric and polarimetric images of model galaxies at various wavelengths. When compared with actual images, such simulations will be able to map with unprecedented precision the star and dust distribution and properties in galaxies [B3][A60].

The 21 cm redshift survey in the anticenter Zone of Avoidance has continued, but is now quiescent due to the refurbishment of the Arecibo dish. The aim of the project is to help unveiling the large scale structures behind the Milky Way at low to intermediate redshift (<10000 km s^{-1}) [A86]. Presently redshifts and images of selected samples of putative galaxies at low galactic latitude are being collected using the VLA and the facilities of the Whipple Obs. (CfA).

The search for 22 GHz water maser emission in M31 has continued with the 32 m radiotelescope in Medicina. So far the search, which was confined to the optical HII regions, has been unsuccessful. The search has then been extended to the (about 100) far infrared sources identifiable on the high resolution IRAS maps. The absence of strong masing sources in Andromeda, contrary to what is observed in our Galaxy, is a puzzling result. The search is now complete but for 11 sources.

In galaxies oriented randomly along our line of sight, it was found that the outer disk warping affects the total 21-cm line widths and that therefore there are systematic effects in the determination of distances, rotation velocities and dynamic masses of spiral galaxies using the Tully-Fisher relation. Since M33 is one of the main calibrators for the extragalactic distance scale, the velocity field in this galaxy has been determined in detail using 21 cm line data and a tilted-ring model has been developed [A96].

The IR project on normal Galaxies, conducted at TIRGO, is now in the phase of the reduction and analysis of the data collected, and is being followed by an analogous project in a different part of the sky, which is already obtaining results [A101].

4.2.2 Elliptical galaxies

The study of the stellar populations responsible for the UV rising branch in ellipticals [A4] has continued with the discovery of UV bright central spikes in a few galaxies in the Virgo cluster. In particular the UV spike in one object has been found to be highly variable, consistently with the disruption of a star captured by a central black hole [A49].

4.3 Theoretical models of AGNs

A long standing problem concerning AGNs is the survival of the Broad Line emitting clouds that are thought to be present in the inner parsecs of AGNs. Since the motion implied by line widths are of the order of thousands of km s^{-1} with respect to the surrounding hot, confining medium, the growth time of Kelvin-Helmholtz instabilities should disrupt the clouds at a very fast rate. The stability of pressure confined clouds has been reconsidered [A111]. A well-known paradox exists according to which stabilization of barely subsonic motions requires a mass larger than the cloud's Jeans mass, so that all clouds are bound to be destroyed, either by KHI or by self-gravity. By examining realistically radiative fluids which are stable with respect to thermal instabilities, it has been possible to derive for them the dispersion relation for shear layers. It has been shown that shear layers of identical fluids are stabilized by the inclusion of radiative effects, while those for fluids with large density contrasts are destabilized, when compared with the adiabatic case, in the linear regime. Numerical simulations then show that these clouds, for any density contrast, are stabilized even when gravity is entirely neglected.

A related research area (with P. Pietrini, Univ. of Florence) intends to build a self-consistent scenario to explain both the UV-X spectrum and the dynamics and structure of the central regions of AGNs. To this aim a study was addressed to a wind driven by the energy deposition of relativistic particles produced close to the central black hole. Cold clouds, emitting UV continuum photons, are formed due to a thermal instability occurring in the wind. During this process, shocks develop that accelerate further particles *in situ*; these particles Compton scatter the UV photons into the soft X-ray band. The extension of the model to explain BALQSOs is currently in progress.

The correlations existing in variability at different frequencies represent an important clue for our understanding of AGNs. Detailed modeling of outbursts observed across the electromagnetic spectrum is being investigated under different assumptions in order to determine the importance of the various physical processes.

4.4 ISM in External Galaxies

A study of the fluid instabilities occurring in a photoionized gas has been carried out [A20]. A new type of instability (thermo-reactive) due to the coupling of ionization and thermal energy has been found to exist in such a system. The consequence is that multiphase equilibrium states are not reached and previously forbidden temperatures may be dynamically achieved. In addition, sound waves are often unstable. The nonlinear evolution of such perturbations is currently under study: if sound waves are damped they may contribute an important heating for the medium, whereas if they grow they may produce a complicate shock pattern, favoring, for example, star formation.

Following a previous study dedicated to the dynamics of the thermal conductive/cooling fronts, a detailed investigation has been done of the entire class of self-similar solutions admitted by conductive/cooling systems using Lie groups [A99]. In particular, some attention has been devoted to the relationship between nonlinear development of thermal instability and self-similar solutions. Consequences for the thermal evolution of nonequilibrium media have been explored. A cosmological model based on the physics of conductive/cooling fronts has been developed to explain the occurrence of the Lyα forest absorption lines observed in the spectra of distant quasar [A69]. Although still in a preliminary manner, the model successfully explains several observed properties of the intergalactic clouds responsible for the absorption. At the moment, extensive numerical simulations are underway to assess the robustness of the model predictions.

Dust is known to exist well above the Galactic plane and in the halo. It has been proposed (with M. Shull, JILA) that dusty flows may arise above the cavities produced by multi-supernova explosions in the disk. Such winds are accelerated by the large radiation pressure produced by hot gas and OB stars in the optically thin chimney. If a relevant amount of dust can be injected in the halo it may have important cosmological implications, for example for QSO counts. Observational tests of the model results have been searched in a IR observational campaign (with R. Dettmar, STScI) at TIRGO. The most promising observational technique for this high latitude dust is scattered light. To this aim a Monte Carlo code has been developed in order to produce 3D scattering and polarization maps for a realistic model galaxy (bulge + disk) [A60]. In addition this code is used also to study the problem of the optical depth of spiral disks. Finally, the charge of dust grains in hot plasmas has been investigated, using a refined statistical method that improves substantially the previous estimates [A13].

4.5 Intergalactic Medium and Cosmology

Global, turbulence-dominated models for multiphase media have been developed [A105]. This model predicts that the energy budget of the ISM in galaxies is dominated by the turbulent energy injected by supernova explosions. An interesting application concerns the chemo-dynamical evolution of dwarf galaxies [A100]. In this scenario supernovae regulate the metal production and mass loss from the parent galaxy. However, the physics of the outflow is strongly dependent on the history of the interstellar pressure in the galaxy which is regulated by supernovae. Hence, chemical and dynamical properties of such galaxies are intimately connected. Several observational correlations found among, *i.e.,* metallicity, HI velocity dispersion and star formation history of the galaxy, may be explained in this way.

Recent observations have shown the existence of a population of low-b Lyα intergalactic absorbers. Previous models have tried to reproduce this result suggesting that a break in the ionizing background radiation field must be present at the HeII edge. However, this conclusion is rather weak since the model assumes thermal and ionization equilibrium, while the cooling time for Compton cooling on the MWB is longer that the Hubble time at $z = 3$. Time-dependent calculations are used [A98] to reproduce the above result and to set limits on the size and evolution of Lyα clouds. In addition, a theoretical study is devoted to the origin of the Lyα absorbers in the halos surrounding the low-mass dark matter halos in the context of CDM models. The conspiracy of feedback effects due to star formation and the UV ionizing background due to QSOs is shown to regulate the physical properties of the absorbers at high redshifts.

4.6 High Energy Astrophysics

The study of shocks in which the relativistic particles, produced by a Fermi mechanism, are dynamically relevant is still in progress. A reasonably fast and stable code has been developed in order to obtain the distribution of particles accelerated by an arbitrary velocity profile, by including also synchrotron losses [B1]. The velocity profile may be derived consistently with the relativistic component, by means of a two-fluid approximation. This project is aimed to provide a self-consistent scenario for a cosmic-ray dominated shock, when radiative losses may become important.

The supernova remnant G11.2–0.3, in which recent X-ray observations revealed a composite (plerion + shell) nature, has been modelled, in order to explain the origin of the apparent dominance of the magnetic field over the relativistic particles. It has been shown that the present appearance of the remnant does not necessarily imply a strong unbalance between the generation of magnetic fields and that of relativistic particles; it may be explained, instead, as the result of the evolution of a pulsar-powered remnant in interaction with the surrounding medium [A93].

5 FUNDAMENTAL PHYSICAL PROCESSES: DYNAMICS

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The research activity on these topics has mainly dealt with a further development of a new theoretical approach to a quantitative description of Hamiltonian chaos based on a Riemannian formulation of newtonian dynamics.

More precisely, the investigation has focused on the relationship between chaotic behavior of geodesic flows and curvature properties of the manifolds whose geodesics are natural motions of standard Hamiltonian systems. Opposite limits have been considered: two-degrees of freedom systems [A62][A47] and the thermodynamic limit of infinite particles [A9] where the analytic computation of the Lyapunov exponent has been possible for the first time. At variance with hyperbolicity of geodesic flows of abstract ergodic theory, chaos in geodesic flows associated to physical systems mainly stems from positive curvature fluctuations. On the basis of this novel result, recent naive attempts to tackle gravitational many-body systems with these differential-geometrical tools have been criticized [A12] and it has been shown how to progress toward a reliable result for the scaling behavior – as a function of specific energy – of the dynamical instability time of a collection of gravitationally interacting point masses. A Hamiltonian model representing a feasible laboratory experiment has also been studied [A10], this experiment is being realised at the European Laboratory for Nonlinear Spectroscopy in the hope to obtain in the near future experimental evidence of the predicted theoretical and numerical evidence of long-lasting non-equilibrium states in Hamiltonian systems. The existence of chaos in Quantum Mechanics has also been studied in an electromagnetically driven Hydrogen atom [A77].

6 ACTIVITY AT THE GORNERGRAT IR TELESCOPE TIRGO

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The 1.5 m infrared telescope TIRGO is located in the Gornergrat North tower, at 3200m above sea level. The station is the national facility for infrared observations, open also to foreign scientists. In 1995, 33 programs have been approved (partly as guest observing and partly as service observing programs) within 38 observing sessions for a total amount of 250 nights. The Service Observing was requested for 8 programs and was held in 42 nights.

The "Pilot Projects" criteria of time allocation have been continued with the consequent reduction in the number of selected programs.

Scientists from Italy, Switzerland, Germany, Spain, England, France, USA, Finland, Sweden, Hungary and Romania are actively involved in the observations.

We give in the following the complete log of 1995 observing sessions:

First Semester
Gavazzi G. et al., (Osservatorio Astronomico di Brera, Osservatorio Astrofisico di Arcetri) "The Tully Fisher relation in the Coma Supercluster"
Massaro E. et al., (Istituto di Astronomia, Roma) "Fotometria ottico-IR di blazar simultanea con osservazioni CGRO"
Salvati M. et al. (Osservatorio Astrofisico di Arcetri, Univ. of Florence, CAISMI-CNR) "Fast relative photometry of two Seyfert nuclei with ARNICA"
Gennari S. et al. (Osservatorio Astrofisico di Arcetri, Univ. of Florence) "Test of LonGSp, the new spectrometer of TIRGO"
Iovino A. et al (Osservatorio Astronomico di Brera) "Near Infrared Observations of Compact Groups"
Lorenzetti D. et al. (Istituto di Fisica dello Spazio Interplanetario) "Multiplicity of Young Stellar Objects: IR Imaging of L1630"
Richichi A. et al. (Max-Planck-Institute für Astronomie, Heidelberg, Germany, Osservatorio Astrofisico di

Arcetri) “Misure ad alta risoluzione angolare di sorgenti stellari mediante occultazioni lunari”
Robberto M. et al., (Osservatorio Astronomico di Torino, Univ. Bologna) “TC-MIRC imaging of circumstellar matter in the mid-IR”
Tozzi G.P. et al., (Osservatorio Astrofisico di Arcetri, Univ. of Florence, CAISMI-CNR) “Spectroscopy and Imaging of Comets in the IR region”
Tozzi G.P. et al., (Osservatorio Astrofisico di Arcetri, Univ. of Florence, CAISMI-CNR) “Activity of Distant Comets: Schwassmann-Wachmann 1 and Chiron”
Testi L. et al., (Osservatorio Astrofisico di Arcetri, IAS-CNR) “Exploring the Engines of Molecular Outflows”
Testi L., et al., (Osservatorio Astrofisico di Arcetri, Univ. Nacional Autonoma de Mexico) “H2 Line Mapping of the Outflow Source L1551”
Jenness T. et al., (Mullard Radio Astronomy Observatory, Cambridge, U.K., Osservatorio Astrofisico di Arcetri) “A search for protostellar cores in FIR sources associated with H_2O masers”
Mannucci F. et al., (Osservatorio Astrofisico di Arcetri. Univ. of Florence, Max-Planck Inst. für Astronomie Heidelberg, Germany) “Near-Infrared Search for Primeval Galaxies”
Comte G. et al. (Observatoire de Marseille, France, Osservatorio Astronomico di Padova) “IR Observations of Blue Compact Dwarf Galaxies”
Dettmar R.J. et al., (Universität Bochum, Germany, Osservatorio Astrofisico di Arcetri) “The Distribution of Dust and Stars in Edge-on Spiral Galaxies”

Second Semester
Jenness T., (Mullard Radio Astronomy Observatory, Cambridge, U.K., Univ. of Florence, Osservatorio Astrofisico Arcetri) “A search for protostellar cores in FIR sources associated with H2O masers”
Patriarchi P. et al., (Osservatorio Astrofisico di Arcetri, CAISMI-CNR, Osservatorio Astronomico di Padova) “Near-IR extinction in stars obscured by individual clouds”
Ábrahám P. et al., (Osservatorio Astrofisico di Arcetri, Univ. of Florence) “An unbiased survey for young stellar objects in the dark cloud complex L1188”
Lorenzetti D. et al., (Istituto di Fisica dello Spazio Interplanetario, Frascati, Roma) “Multiplicity of young stellar objects: IR imaging of L163”
Felli M. et al., (Osservatorio Astrofisico di Arcetri, Univ. of Florence) “Near-infrared mapping of ISOGAL fields in the northern hemisphere”
Robberto et al., (Osservatorio Astronomico di Torino, Univ. Bologna) “Imaging nell’IR termico con TC-MIRC”
di Serego Alighieri S. et al., (Osservatorio Astrofisico di Arcetri, Univ. of Florence) “The 4000A break in distant radio galaxies”
Mannucci F. et al., (Osservatorio Astrofisico di Arcetri, Univ. of Florence) “Studio dell’evoluzione dello spettro continuo dei quasars tramite fotometria infrarossa”
Richichi A. et al., (Osservatorio Astrofisico di Arcetri) “Misure ad alta risoluzione angolare di sorgenti stellari mediante occultazioni lunari”
Richichi A. et al., (Osservatorio Astrofisico di Arcetri, Max-Planck Inst. für Astronomie, Heidelberg, Germany) “Osservazioni di occultazioni nella regione di formazione stellare del Toro-Auriga”
Tozzi G.P. et al., (Osservatorio Astrofisico di Arcetri) “Spectroscopy and imaging of Comets in the IR region”
Brand J. et al. (Istituto di Radioastronomia, CNR, Center for Astrophysics, Cambridge, USA) “NIR observation of a narrow-line galactic star forming region”
Williams P.M. et al (Royal Observatory, Edinburgh, U.K., Osservatorio Astrofisico di Arcetri, CAISMI-CNR) “Eruptive dust shell formation by Wolf-Rayet stars”
Cohen M. et al, (Univ. of California, Berkeley, USA, Osservatorio Astrofisico di Arcetri, CAISMI-CNR) “A search with ARNICA of candidate galactic WR stars”
D’Onofrio M. et al., (Univ.di Padova, Osservatorio Astronomico di Capodimonte) “The fundamental plane of E and S0 galaxies in the Near-IR”
Hamilton D. et al., (Max-Planck Inst. für Kernphysik, Heidelberg, Germany, Osservatorio Astrofisico di Arcetri) “Infrared photometry of mutual events of Saturn’s major satellites”

Better weather conditions and more reliable instrumentation have increased the hours of observations with respect to the standard percentages. On the average, about 37% of the time was used for good quality observations. Failures or maintenances were limited to 5% of the time, the remaining being wasted due to bad weather conditions. A global amount of 2500 hours were available for observations with two runs from January to May and from September to December. The observations covered about 930 hours.

Most of the observations were carried out with ARNICA, the new imaging camera now a standard instrument at TIRGO. Many programs, either of the survey type or ad hoc observations of peculiar objects, have produced large amounts of data in different astrophysical topics. Data span from galaxies to early type stars and star-forming regions. Many of them have good astronomical quality and they have been analyzed and published. To be noticed, the number of papers dealing with TIRGO data has further increased in this year. At least 9 papers can be added to the literature enclosed in the present Report [A2][A30][A46][A50][A53][A56][A71][A76][A79][A89][A92][A50][A101][B16][B33][B40][B57][B73][B77][C8].

New improvements in the TIRGO instrumentation may be found: i) in the development of the software for lunar occultations with ARNICA, with more flexibility in the schedule and a better sensitivity of about 2 magnitudes and ii) the remote control of the telescope and instrumentation hardware [B33], which allows at present time remote testing and in the future remote observing.

Other successful results of this year have been obtained with LONGSP, the new long slit spectrometer, equipped with the engineering NICMOS 3 array. The instrument is now working on a regular basis with an easier interface to the user.

The mid-infrared camera TCMIRC has passed two testing phases with positive results. A final test is planned in March 1996.

7 INSTRUMENTATION PROJECTS

7.1 Large Binocular Telescope Project

Contributors: D. Bonaccini, C. Del Vecchio, L. Fini, L. Miglietta, D. Puccetti, P. Salinari.

The Large Binocular Telescope Project (formerly Columbus Project) is a collaboration between Italy, where Arcetri is the centre of activity, the University of Arizona and other research institutes in the US to build the largest telescope presently planned for the Northern Hemisphere. The telescope will be equipped with two large primary mirrors (8.4 m diameter) and is designed to achieve top class performances in a variety of observing modes at near-ultraviolet, visible, and infrared wavelengths. The observing modes include diffraction limited imaging (single pupil and interferometric, providing up to 23 m maximum base line), wide field imaging multi-object spectroscopy (one degree field), high resolution spectroscopy.

In 1995 the construction design of the telescope and of the enclosure, that had been started in 1994, continued and came close to its conclusion. At the end of 95 the design of many complex telescope subsystems (primary mirror actuators and hardpoints, motors, hydraulic supports, swing arms, derotators) was completed, while the main structure of the telescope was undergoing the final optimisation before proceeding to the detailed design. The final design of the telescope structure and of the mirror cells should be completed by the end of the spring 1996. In a similar status was at the end of 95 the design of the enclosure: the design of the pier and of the telescope interface at its top was completed, while the rest of the building was completely defined and partly designed.

The stop to all construction activities on the top of Mt. Graham, consequence of a legal action against the US Forest Service, unfortunately continued during all 1995. At the very end of the year a new bill, that would resolve the quarrel, was presented and approved in the US Congress but it was not yet operative at the time when this text was written. It is considered likely that the site will be legally available for construction work in the Spring 1996.

The preparation for the casting of the first primary mirror continued at the UoA Mirror Lab during 1995 and the casting is foreseen for mid 1996. The grinding and preparation for polishing of the 6.5 m MMT mirror was completed in parallel, testing the process that also the LBT mirrors will experience.

Of the many other activities, it is worth mentioning those oriented to produce and test secondary mirrors at UoA, those oriented to measure experimentally the performances of the supports of the secondary mirrors at Arcetri, and those oriented to test components and procedures for aluminium stripping and deposition on board the telescope in collaboration with the the Observatory of Bologna . Activities related with the development of adaptive optics for LBT are reported elsewhere in this report.

7.2 Adaptive Optics systems for large telescopes

Contributors:: V. Biliotti, D. Bonaccini, G. Brusa, C. Del Vecchio, L. Fini, P. Ranfagni, P. Salinari, P. Stefanini.

The scope of adaptive correction of the blur induced by atmospheric turbulence is to sharpen the astronomical images to the limit posed by diffraction, therefore achieving higher angular resolution and, at the same time, higher sensitivity. The gain is potentially larger for larger telescopes, but also the system complexity increases dramatically. Two adaptive optics systems have been developed in parallel by the Arcetri group in the last few years: the TNG Adaptive Optics Module, in collaboration with the Observatory of Padova, and the Adaptive Secondary Project , in collaboration with Politecnico di Milano and Steward Observatory. The first one will provide low order correction in the near infrared soon after first light of the Galileo telescope, while the second is aimed at developing a much more ambitious system for high order correction, to be used in its initial version on the 6.5 m MMT-Conversion and, on a longer time scale, by LBT and Galileo.

During 1995 a laboratory model of the TNG Adaptive Optics Module was completed and tested with success at Arcetri [B28]. The laboratory model uses the same electronics and opto-electrical components as the telescope unit, but with a simpler optics. The next step is the integration of the components tested in the laboratory within the final focal plane module.

The Adaptive Secondary Project accomplished very significant steps in 1995. A simple prototype using 25 actuator was set up and fully confirmed the conceptual approach and the prediction of the numerical simulations [B9]. In particular it confirmed that it is possible to dynamically control the shape of a very thin mirror by floating it on many electromagnetic force actuators (voice coils) that are not in physical contact with the mirror. It also confirmed in real life the expected performances of the capacitive sensors used to close the local position loop, the system bandwidth and control stability. At the same time essentially all the technical problems related with the construction of the first Adaptive Secondary unit for the MMT telescope found adequate solutions [B13]. At the end of 1995 it was decided to proceed to built a second prototype, still with a reduced number of actuators (36 instead of the about 380 foreseen for the MMT unit) but including all the basic design features of the MMT unit and second generation digital controls. Briefly the feasibility and conceptual design phase of the Adaptive Secondary Project was positively concluded at the end of 1995 entering a new phase.

Further fields of active research in Adaptive Optics were the developments of high order wave front sensor, the study of techniques to retrieve the atmospheric tip-tilt perturbation using Laser Guide Star [A48], and, more generally, techniques to improve performances of high order adaptive systems using artificial reference stars [A68][B5].

7.3 Infrared Instrumentation

Contributors: C. Baffa, V. Biliotti, G. Comoretto, V. Gavryusev, S. Gennari, F. Lisi, E. Oliva., A. Richichi

The study for the first light IR instrument of the Galileo telescope (named NICS, Near Infrared Camera/Spectrometer) has been completed and the project entered the phase of construction at the end of 1995. The optics design was completed to match the HAWAII 1024×1024 HgCdTe array detector, the chromatic performances of IR transmitting crystals and glasses were analysed in details, achromatic pairs with excellent chromatic performances were identified and used in the optical design of NICS [A42]. Cryo-mechanical design will be finalised on February 1996, the electronics for control and data acquisition have been completed by the end of 1995. The first tests are scheduled on summer 1996.

The TIRGO IR long slit array spectrograph (LONGSP) was completed , tested at the telescope and made available to common users in 1995. LONGSP is a near-infrared grating spectrometer equipped with cooled reflective optics (except the field lens), a grating arranged in Littrow configuration and a Rockwell 256×256 NICMOS III "engineering grade" array detector, of which the best subsection of about 40×128 pixel is used. The covered spectral range is 0.95–2.5μm and the resolving power is about 1000 depending on the order and wavelength. The slit field of view is about $3'' \times 60''$. Its optics and cryo-mechanical system were completely developed and assembled in the IR laboratory at Arcetri. From test observations we derived a sensitivity on line flux of about 2 10^{-17} W m^{-2} (1 σ, integration of 60 seconds).

An important aspect of the infrared instrumentation is the software needed to control, transfer display and reduce the data taken with IR array detectors. New software tools have been produced in 1995 to allow remote control of IR array observations carried out at the TIRGO Observatory [B33], that will be made available to all users in 1996. New activities started in 1995 to create a public data archive of the TIRGO observations and to produce the software for the IR camera of the Galileo Telescope

Worth mentioning are developments and refinements of previously built instruments: the TIRGO IR camera (Arnica) and the fast IR photometer for lunar occultations. Arnica was adapted for use at the Nordic Optical Telescope and had there a successful observing run, the fast IR photometer was improved in software and hardware to allow observations at the 2.2 m telescope at the San Pedro Martir Observatory in Mexico, and will soon be used at the 6m telescope in Russia and at other telescopes.

7.4 Radioastronomical Instrumentation

Contributors: R. Barletti, C. Comoretto, G.P. Curioni, D. Panella, G. Tofani.

The main activity of the radioastronomical group has been the development of new hardware and software with special reference to the use of the two radiotelescopes of the Istituto di Radioastronomia di Bologna (Medicina and Noto). In particular the following developments have been done:

A new autocorrelator is currently being built. The digital section has been completed and tested. The radio frequency converters have been designed and partially built. The instrument layer of the control software has been developed and tested [C1].

A cryogenic receiver for spectroscopic observations in the 330–355 GHz band has been built in collaboration with the Rutherford Laboratory. The instrument has been tested at the Tirgo infrared telescope using the acusto-optic spectrometer developed at Arcetri as a backend. A program to control both for the receiver and the spectrometer has been written.

The 43 GHz receiver has been tested during a 10 days run at the Medicina radiotelescope [F49]. The efficiency is of the order of 10–15% and the receiver temperature 50 K. The receiver was used for a VLBI run on the SiO line and for a test run of spectroscopic observations of the SiO maser.

A technique for measuring the surface quality of a reflector has been used on the Medicina radiotelescope. The technique uses amplitude measurements of the far field, and a fitting algorithm developed at the University of Napoli to retrieve the phase of the radio wavefront [F20].

Within the program aimed to upgrade Medicina and Noto radiotelescopes, a study of the electromagnetic performance of the antenna has been carried out. A new feed configuration at the Cassegrain focus has been considered, with a cluster of receivers around the focal axis. The beam pattern and gain degradation at various frequencies have been evaluated Monorchio and Tofani [C10].

A VLBI run [F31] was performed on May 1995 on the source DA193 as part of a general project [A34] for the improvement of the dynamic range of the European VLBI network maps.

An extended gravitational wave search using the spacecraft Ulysses has been completed using the NASA DSN network and the Medicina and Kashima (Japan) antennas. The search was conducted for a total of 45 days, and is sensitive to sources in the millihertz range. Limits on black hole masses for an hypothetical supercompact binary system in the center of our galaxy have been derived [A5]. The spacecraft Ulysses has been used in an experiment of solar coronal sounding [F8].

Use of the new autocorrelator for multiwavelength pulsar observations has been investigated, taking also profit of all the receivers installed on the 32 m antenna of Medicina (Bologna) [B2].

7.5 Solar Instrumentation

Contributors: F. Cavallini, G. Ceppatelli, F. Fabiani, G. Falcini, T. Grisendi, S. Paloschi.

The renovation of the electric and control systems of the Solar Tower telescope and spectrograph completed in the last part of 1993 and during the spring 1994, was followed in 1995 by the installation of a new dome, and will continue in 1996 with a completely new re-building of the automatic guiding system. In this way the telescope will be fully controlled by a PLC, connected to the Observatory network, from top and bottom of the Solar Tower and from the UBF laboratory.

The construction of the Italian Panoramic Monochromator (IPM), which, in the frame of an Italian-French collaboration, will be installed on the THEMIS solar telescope, has been going on through 1995. This instrument, which basically consists of a servo-controlled Fabry-Perot interferometer (Queensgate Mod. ET-50), mounted in tandem with an Universal Birefringent Filter, makes monochromatic images of the solar surface, in the wavelength region between 4600 and 6800 Å, with high spatial ($\sim 0.2''$) and spectral resolution ($\lambda/\Delta\lambda = 262,000$).

In order to obtain also a high wavelength stability, the interferometer has been enclosed in a pressure tight chamber and has been thermostatized within $\pm 5\,10^{-3}\,^{\circ}$C. In this way, the residual drift of the instrumental profile is very small (typically $\approx$ 20 ms^{-1} over a period of a day). Moreover, a wavelength control, which uses the 6438 Å line of a Cd^{114} lamp, allows the residual drift to be measured with a precision of about $\pm 1\mathrm{ms}^{-1}$ rms.

The same spectral lamp can be also used to measure the spectral dishomogeneities on the final focal plane ($\approx 250\,\mathrm{ms}^{-1}$) that are produced by the flatness errors of the interferometer plates ($\lambda/200$ after coating). A spectral homogeneity of the field of view ($51''$) of $\pm 10\mathrm{ms}^{-1}$ rms can be attained.

Two CCD cameras (512×512 square pixels, 19.5 μm in size), developed at Rome II University, are used as detectors and allow simultaneous imaging in monochromatic and white light (for destretching procedures).

The 1995 has been devoted to complete the optical, mechanical and electronic parts of the IPM, accounting for the constraints imposed by the need to adapt the instrument to the French telescope. In particular, the principal problems which have been solved are the following: a) the optics and the mechanics have been designed to match the condition that the instrument must be composed by an horizontal and a vertical part, each one with imposed maximal dimensions; b) because the access to the instrument will not be frequent, many optical components have been supplied with different actuators to allow the remote instrumental control and setting-up; c) a cooling system has been designed to eliminate any thermal dissipation due to electronics, spectral source, interferometer and UBF thermostatic systems.

The control software for the IPM has been developed and it is now under test. The software (built in C language under HPUX-10.1 with X11, Motif1.2 and HP-SICL libraries) allows the complete control of the instrument using an HP745 Workstation, connected to the acquisition systems (two PC's and CCD Cameras) and to the main computer of the THEMIS telescope. The user's interface is a window with a menu bar to choose interactively the appropriate sequences of operation on the instrument. The options in the menu bar allow both a single and groups of operations on the IPM. A running observation program can be prepared just pushing the appropriate buttons and filling the fields which appear: a specific option in the menu bar runs the prepared observing program. A preliminary work has been made to define the keywords FITS for the images obtained by IPM.

Installation of the IPM on the THEMIS solar telescope (Canary Islands) is scheduled for the second half of 1996.

In July–August 1995 the IPM has been used [F10] at the Solar Tower in Arcetri to obtain monochromatic images of the whole Sun in the 5576 Å FeI line. Analysis of solar oscillations and large scale motions, based on this data-set, is now in progress. Preliminary results confirm the expected performances of the instruments and, in particular, its high wavelength stability.

8 COMPUTING AND DATA ANALYSIS

8.1 Introduction

The Computing facilities of the *Osservatorio di Arcetri* are based on an Ethernet Local Area Network supporting TCP/IP as main networking protocol. Unix, MS-DOS, Windows and MacOS are the main operating environments. The LAN is part of a Metropolitan Area Network covering most scientific institution in Florence and Pisa (MAN Toscana) and, through it, to the Italian Scientific Network (GARR) and to the rest of the world.

8.2 Computing Facilities

The overall structure of the Arcetri's LAN is shown in Figure 1. The LAN is partly based on "thick" cabling, part on "thin" branches connected via repeaters; a fiber-optic link connects two separated buildings.

The main computing support for the research work is provided by a set of Unix based Sun workstations with three servers. All the stations are Sparc based and most of them provided with local disk space to avoid high network load. A number of Personal Computers running either MS-DOS or Windows or Linux are also connected to the LAN, as well as some MacIntoshes and X-Terminals.

The TCP/IP protocol suite is the main networking environment, while a gateway is provided to integrate a small LocalTalk network of MacIntoshes within the LAN.

A small Novell based LAN supports the accounting offices: it is, anyway, electrically separated from the main LAN to improve security and ease of management.

The Arcetri's LAN is connected through a router and a fiber optic cable to the nearby DIPARTIMENTO DI FISICA where a node concentrator of the "MAN Toscana" is located. The link has a speed of 10 Mbit/s. The "MAN Toscana" is a Metropolitan area network resulting from a joint project of the Italian CNR, the Universities of Florence and Pisa and Telecom Italia. It consists of two 140 Mbit/s loops in Florence and Pisa connecting all the main scientific institutes and laboratories in each town; the two loops are connected by a 34 MBit/s link and provide access to the Italian Scientific Network (GARR) via a main link at Pisa and a backup connection in Florence. The GARR network is part of the Internet.

Great effort has been devoted in the past to the adoption of an homogeneous operating environment: all the workstations in the LAN are operated under Unix; During 1995 most of the workstations have moved to the Solaris 2.4 Operating Systems and only some older stations still use SunOS 4.3.1.

The configuration and distribution of operating system and application files has been automated by the use of an **rdist** procedure, so that the homogeneity of the environment can be better guaranteed.

Some of the PC's connected to the LAN are operated under Linux and are thus well integrated with the workstations, other are used as X-Terminals with X-11 emulating software under MS-Windows.

The software application running on the LAN comprehends all the main astronomical data analysis systems including $\mathcal{AIPS}$, GILDAS, iraf, MIDAS, Xanadu; as well as commercial packages such as IDL, Macsyma. Some specific packages are also used for technical applications such as FEM analysis (Ansys), mechanical design and project support (Autocad, Automanager); real time systems developed (VxWorks, LynxOS).

All the widely used utilities and packages, such as TEX, LATEX, Smongo, etc. are also available.

8.3 Software Development and New Services

Within the frame of a long lasting cooperation with ESO Image Processing Group, the support and maintenance of the ASTRONET Graphic library is a continuing task. AGL, a portable device independent graphic library, provides the basic support for the plotting utilities of the ESO's Midas package for astronomical data analysis.

The WWW server has been improved with the aim to provide a fully operational information service about the *Osservatorio di Arcetri* and its scientific activities both for internal users and the general public.

In the same framework the study of the employment of WWW techniques for automated information management has been continued [C7][C8].

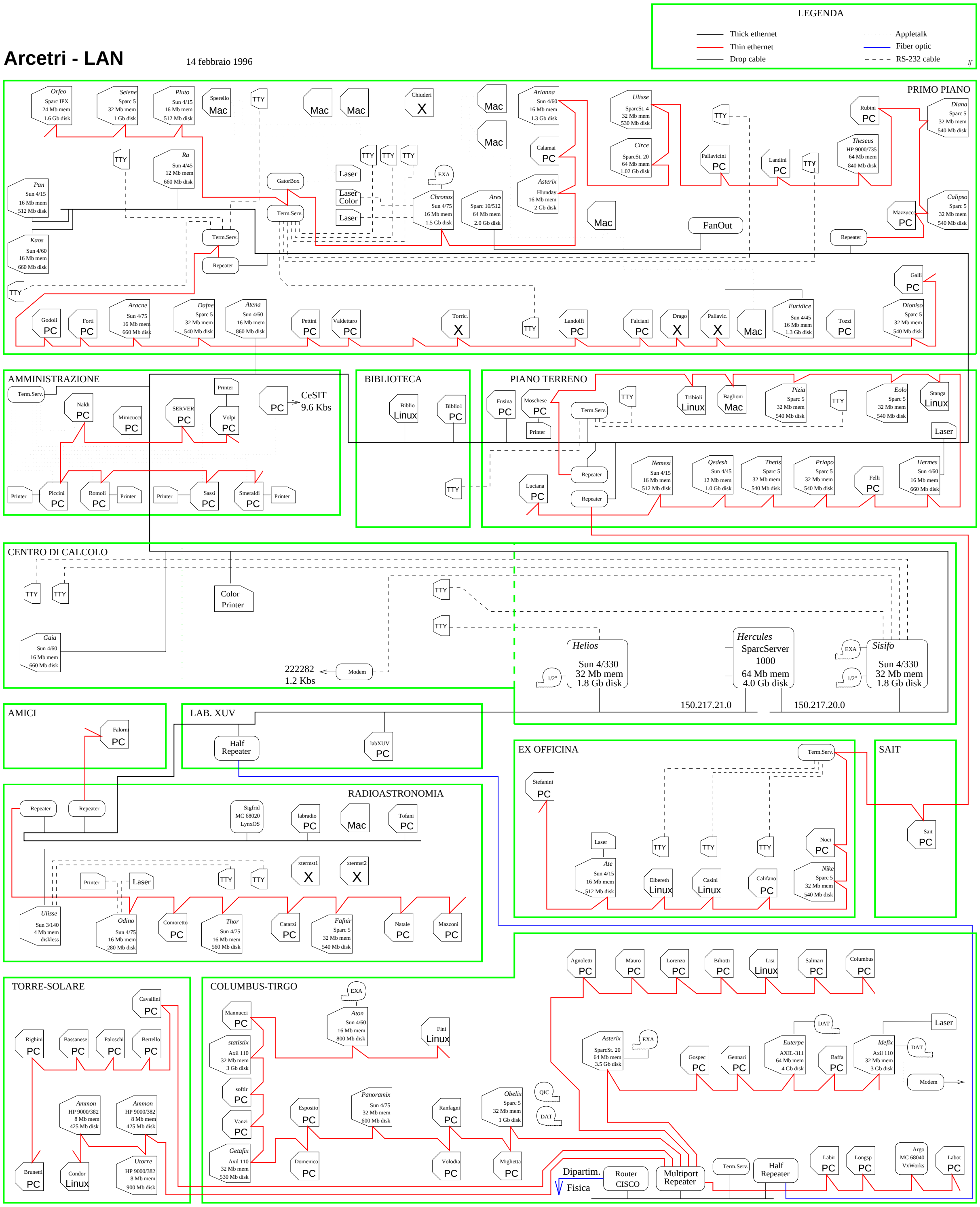

Figure 1: Structure of the Arcetri's LAN

9 EDUCATIONAL ACTIVITY FOR THE GENERAL PUBLIC

This report is presented in an incomplete form due to the sudden death of Dr. Brunella Monsignori Fossi, responsible for many years of this activity.

The Observatory staff continued in 1995 the usual activity, which included:

a) Day-time visits: 60 groups of pupils (∼2500) have visited the Observatory to observe the sun and to participate in demonstrations and in the lessons.

b) Night-time visits: 74 groups (more then 5000 visitors) have visited the Observatory at the nigth-time. The observations take place close to the first Moon quarter. The Amici telescope is used to observe the Moon, planets and other celestial objects. This program is a collaboration together with to the Regione Toscana and the “Comitato per la divulgazione dell’astronomia” and provides also support materials such as written reports, astrolabes, video-cassettes, poster and photos.

c) A Course on “The story of the Universe: from a remote past to a distant future”, attended by ≈ 500 people, has been given by G. Poletto (6 lectures) and S. di Serego (1 lecture) at “Università dell’Età Libera” in Florence.

d) A special educational program was prepared during the *Settimana della cultura scientifica in Italia*, sponsored by the Ministero dell’Università e della Ricerca Scientifica e Tecnologica: 7 days of open house day-time and nigth-time visits (∼ 1500 visitors).

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[D2] Cesaroni, R. : Chemistry of Star-forming Regions, "Ammonia and methyl cyanide in UC HII's: the case of G10.47+0.03 and G31.41+0.31", Leiden, March 29–31.

[D3] Ferrara, A. : The Physics of Lyα Forest Clouds, "The nature and Origin of Lyα Forest Clouds", STScI, Baltimore, June, 18–21.

[D4] Ferrara, A. : Interplay between Massive Star and the ISM in Galaxies, "Chemo-Dynamical Evolution of Dwarfs Galaxies", IAP, Paris, July 3–8.

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COLLOQUIA GIVEN AT OTHER INSTITUTES

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Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA: "Dense cloud cores: a summary of three years spent at CfA", September 1995.

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Marshall Space Flight Center, Huntsville, U.S.A.: "A search for fine scale structures in the far solar wind", November 1995.

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Physical Research Laboratory, Ahmedabad, India: "The Arcetri Lunar Occultation Program", November 1995.

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OBSERVING CAMPAIGNS

[F1] Abraham, P., Palla, F., Stanga, R., Testi, L., Walmsley, C.M. : TIRGO, Gornergrat, 1995 October (9 nights).
"An unbiased survey for young stellar objects in the dark cloud complex L1188"

[F2] Arcetri Radioastronomical Group : Medicina 32-m telescope, 1995 (several weeks during the whole year).
"22 GHz H_2O masers and 23 GHz NH_3 inversion transitions"

[F3] Benson, P.J., Caselli, P., Myers, P.C. : Haystack 37-m telescope, 1995 February (50 hours).
"A survey of dense cores for C_2S and HC_3N"

[F4] Benson, P.J., Caselli, P., Myers, P.C. : Haystack 37-m telescope, 1995 March (4 days).
"N_2H^+ and C_3H_2 in dense cores"

[F5] Caselli, P., Myers, P.C. : Haystack 37-m telescope, 1995 January (40 hours).
"A study of the N_2H^+ hyperfine structure in L1512"

[F6] Caselli, P., Benson, P.J., Myers, P.C. : FCRAO 14-m antenna, 1995 May (6 days).
"Mapping low mass cores in N_2H^+"

[F7] Caselli, P., Myers, P.C. : FCRAO 14-m telescope, 1995 June (20 hours).
"Multimolecular analysis of a quiescent massive core in Orion B"

[F8] Bird, M., Comoretto, G., Ambrosini, R., : Istituto di Radioastronomia, Medicina antenna, 1995 March 1–11.
"Solar coronal sounding experiment with S/C Ulysses"

[F9] Cauzzi, G., Falchi, A., Falciani, R., Smaldone, L.A. : Sacramento Peak, 1995 February.
"Observations of active regions on the Sun"

[F10] Cavallini, F. : Torre Solare – Osservatorio di Arcetri, 1995 July, August (8 days).
"Observations, using the Italian Panoramic Monochromator for THEMIS, of full disk images of the Sun at different wavelengths inside the 5576 Å FeI line to obtain data for solar global oscillations and large scale motions."

[F11] Ceppatelli, G. : Torre Solare – Osservatorio di Arcetri, 1995 July, August, September (50 days).
"observations on the 5576.1 Å FeI line of the following phaenomena: solar oscillations in quiet regions near the disk center"

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[F13] Cesaroni, R., Churchwell, E., Felli, M., Walmsley, C.M. : Plateau de Bure interferometer, 1995 Jan–Apr (3 configurations).
"A search for high mass protostars"

[F14] Chandrasekhar, T., Richichi, A., et al. : Mt. Abu, India, 1995 December (4 nights).
"Near-Infrared Observations of Lunar Occultations"

[F15] Chavarria, C., Richichi, A., Mayorga, R., Leinert, Ch. : San Pedro Martir, Mexico, 1995 November (3 nights).
"Lunar occultations of young stellar sources in the near IR. I. The southern Taurus star forming region"

[F16] Cimatti, A., Piirola, V. : NOT, 1995 September (4 nights).
"The UV continuum of low redshift radio galaxies"

[F17] Cimatti, A., Freudling, W. : SEST, 1995 November (30 hours).
"A search for cold dust in high redshift radio galaxies"

[F18] Codella, C., Palla, F., Valdettaro, R. : Effelsberg 100-m telescope, 1995 June, September, December.
"22 GHz H_2O line observations towards high-latitude molecular clouds"

[F19] Dettmar, R-J., Ferrara, A. : TIRGO, 1995 April (6 nights).
"Dust Distribution in Spiral Galaxies"

[F20] Di Filippo, D., Comoretto, G. : Istituto di Radioastronomia, Medicina antenna, 1995 Oct–Dec (10 nights).
"Holographic measurements of the antenna surface"

[F21] di Serego Alighieri, S., Borelli, S., Cimatti A., Stanghellini, L., Villani, D.: : Loiano, 1995 May (2 nights).
"Il break a 4000Å come indicatore di età delle popolazioni stellari in radio galassie lontane"

[F22] di Serego Alighieri, S., Borelli, S., Stanga, R., Villani D.: : TIRGO, 1995 November (8 nights).
"The 4000Å break in distant radio galaxies"

[F23] di Serego Alighieri, S., Cimatti, A., Fosbury R.A.E.: : ESO-3.6, 1995 Mar 2 nights.
"Is the [OIII]5007 line partially obscured in powerful radio galaxies?"

[F24] di Serego Alighieri, S., Cimatti, A., Manzini A., Villani, D.: : Loiano, 1995 October (4 nights).
"La natura del continuo blu–UV nelle radio galassie lontane"

[F25] di Serego Alighieri, S., Stanga, R., Villani, D.: : NOT, 1995 August–September (8 nights).
"The Radio Universe at Low Flux Density Levels: Follow-up of the Westerbork Northern Sky Survey"

[F26] Festou, M.C., Tozzi, G.P. : IUE, 1995 Jan 95 - Dec. 95 (8).
"The gas production curves of comets 19P/Borrelly and 6P/d'Arrest"

[F27] Hamilton, D., Richichi, A., Baffa, C., Calamai, G., Harper, D., : TIRGO, Gornergrat, 1995 Service Observing.
"Infrared Photometry of Mutual Events of Saturn's Major Satellites."

[F28] Hoare, M., Beckwith, S., Richichi, A. : Calar Alto, Spain, 1995 August (3 nights).
"Near-IR Speckle Imaging of Luminous Young Stellar Objects"

[F29] Hofner, P., Kurtz, S., Churchwell, E., Walmsley, C.M., Cesaroni, R., Olmi, L. : Owens Valley Millimeter Array, 1995 Feb–Mar (3 configurations).
"A young stellar object in G29.96–0.02"

[F30] Massi, M. , Neidhöfer, J., Torricelli-Ciamponi, G., Chiuderi-Drago, F. : Effelsberg, 1995 January-December.
"Multifrequency observations of UX Arietis"

[F31] Massi, M., Rioja, M., Sanghera, H., Moscadelli, M. : VLBI with: Effelsberg,Medicina,Noto,Jodrell Bank, Westerbork, Simeiz,Shangai,Urumqi, 1995 May, 12 hours.
"Investigation of the EVN closure errors using the compact radio source DA193"

[F32] Melchiorri, F., Signore, M., Encrenaz, P., Maoli, R., Palla, F.: IRAM, 30-m, 1995 September (6 nights).
"Search for primordial molecules in damped Ly-α absorbers"

[F33] Moorwood, A.F.M., Oliva, E., Marconi, A.: : ESO-NTT, 1995 Mar 3 nights.
"Optical and IR coronal lines in active galaxy nuclei"

[F34] Moran, E., Cimatti, A., Hurt, T. : Lick, 1995 December (4 nights).
" The nature of IRAS galaxies"

[F35] Natale, E., Tofani, G., Palagi, F., Panella, D., Ellison, B.N., Jones, A., Matheson, D.N., Piantini, C. : TIRGO infrared telescope, 1995 July (10 nights).
"Sviluppo di un Ricevitore a 350 GHz per Osservazioni Astronomiche"

[F36] Oliva, E., Origlia, L., : ESO-NTT, 1995 March (3 nights).
"The mass to light ratio of CD galaxies"

[F37] Palla, F., Codella, C., Valdettaro, R. : Medicina 32-m telescope, 1995 June, September.
"22 GHz H_2O masers and 23 GHz NH_3 line observations towards high-latitude molecular clouds"

[F38] Pallavicini, R., Pasquini, L. : ESO CASPEC, 1995 February(3).
"Lithium in solar-like dwarfs in the old cluster M67"

[F39] Pallavicini, R., Randich, S., Pasquini, L. : ESO CES, 1995 December(6).
"Lithium and chromospheric activity in tidally locked binaries"

[F40] Richichi, A., Baffa, C., Calamai, G., Lisi, F. : TIRGO, Gornergrat, 1995 Service Observing.
"Misure ad alta risoluzione angolare di sorgenti stellari mediante occultazioni lunari"

[F41] Richichi, A., Calamai, G., Lisi, F., Leinert Ch. : TIRGO, Gornergrat, 1995 October (6 nights).
"Osservazioni di occultazioni nella regione di formazione stellare del Toro–Auriga."

[F42] Richichi, A., Leinert Ch. : TIRGO, Gornergrat, 1995 Service Observing.
"Near-IR Photometry of Speckle Interferometry Standard Stars"

[F43] Richichi, A., Leinert Ch., Stecklum, B., Lisi, F., Calamai, G. : Calar Alto, Spain, 1995 January (5 nights), September (3 nights), October (6 nights).
"Lunar occultations of stellar sources in the near IR"

[F44] Salvati, M. : TIRGO, 1995 January (6 nights), February (6 nights).
"Fast relative photometry of two Seyfert nuclei with ARNICA"

[F45] Stecklum, B., Howell, R., Richichi, A., Thamm, E. : Wyoming IR Observatory, 1995 July (3 nights).
"Near-Infrared Observations of Lunar Occultations"

[F46] Tafalla, M., Myers, P.C., Mardones, D., Caselli, P., Benson, P.J. : IRAM 30-m telescope, 1995 December (26 hours).
"L1544: a collapsing starless core?"

[F47] Testi, L., Giovanardi, C., Lizano, S., Palla, F. : TIRGO, Gornergrat, 1995 February (5 nights).
"H_2 line mapping of the outflow source L1551"

[F48] Testi, L., Felli, M., Cesaroni, R. : NOT, Canarie, 1995 September (2 nights).
"A search for massive protostars in hot-cores"

[F49] Tofani, G., Panella, D., Natale, E., : Medicina radiotelescope, 1995 April (10 days).
"Test of 43 GHz receiver"

[F50] Tozzi, G.P., Feldman, P.D., Stanga, R., Morbidelli, L., Calamai, G.: TIRGO, 1995 Feb.(8).
"Activity of Distant Comets"

[F51] van Breugel, W., Antonucci, R., Spinrad, H., Cimatti, A., Dey, A., : W.M. Keck, 1995 March(1 night).
"Spectropolarimetry of High Redshift Radio Galaxies"

[F52] van Breugel, W., Antonucci, R., Spinrad, H., Cimatti, A., Dey, A., : W.M. Keck, 1995 Jul (2 nights).
"Spectropolarimetry of High Redshift Radio Galaxies"

[F53] Walmsley, C.M., Cesaroni, R., Olmi, L., Hofner, P. : Plateau de Bure interferometer, 1995 Feb–Nov (4 configurations).
"CH_3CN towards G29.96–0.02 and G19.61–0.23"

NATIONAL AND INTERNATIONAL COOPERATIONS

Cavallini, F. CNR technical committee for the UBF, Member
CNRS-INSU, THEMIS telescope "Bureau de projet Franco-Italien"
Ceppatelli, G. CNR technical committee for the UBF, Member
Collaborating to THEMIS project
Member of the French-Italian committee for BASS2000 archive
JOSO WG2 on "Focal Plane Instrumentation"
OSO WG2 on "Solar Data Bases"
Member of the JOSO working group on Solar Line Asymmetries
Felli, M. ISO-ISOGAL Project, Co.I
Fini, L. IPG/ESO (MIDAS Graphics)

Gavryusev, V. IRIS – International Research of the Interior of the Sun
Gavryuseva, E. IRIS – International Research of the Interior of the Sun GOLF – Global Oscillations of Low Frequency
MDI/SOI – The Michelson Doppler Imager for the Solar Oscillations Investigation
Monsignori Fossi, B.C. Co-I, Coronal Diagnostic Spectrometer (SOHO)
Co- Experimenters, An Extreme Ultraviolet spectroscopy mission for interstellar plasma diagnostics, solar chromosphere physics, and ionospheric energetics
Associate Scientist SUMER Spectrometer (SOHO)
Associate Scientist UVCS Spectrometer (SOHO)
member of SOHO - UV spectroscopic diagnostic working group
Oliva, E. Mission Scientist associated for the Infrared Space Observatory (ISO)
Palla, F. Consultant LWS Team for the Infrared Space Observatory (ISO)
Pallavicini, R. Mission Scientist for the High Throughput X-ray Spectroscopy Mission (XMM)
High-resolution Spectrograph for the National Telescope *Galileo*
Poletto, G. UVCS-SOHO, Co-I
Ulysses, Science Team member
CDS-SOHO, Affiliated Scientist
Salinari, P. Deputy Director Large Binocular Telescope Project
Salvati, M. SAX, a satellite for astronomical research in the X-ray range, Observing Program Working Group, Member
JETX, joint european telescope for X rays, to be flown aboard the Spectrum X-γ satellite, Observing Program Working Group, Member

POSITIONS HELD IN SCIENCE POLICY COMMITTEES

Baffa, C.: Membro del consiglio scientifico del CAISMI-CNR
Membro del gruppo di Computer Engineering dello IEEE
Bandiera, R.: Consiglio scientifico del CAISMI-CNR, Member
Barletti, R.: Member of the Board of the Italian Astronomical Society
Ceppatelli, G.: Member of the the Solar section of the Gruppo Nazionale di Astronomia.
di Serego Alighieri, S.: head of the TNG Management Group
Adaptive Optics Scientific Committee, Chairman
TNG Archive Working Group, member
TNG LDS Scientific Committee, member
Operation Subcommittee of the Observatory of Roque de los Muchachos, member
Finance Subcommittee of the Observatory of Roque de los Muchachos, member
ESO User Committee, Italian representative and Chairman
TNG Instrument Committee, member
ESO, FORS Instrument Science Team, member
Felli, M.: Member of the Board of Teramo Observatory
Fini, L.: Membro del Comitato di Gestione Astronet
Ferrara, A.: Fourth Tetons Conference "Interstellar Processes II", SOC, Member
Gavryuseva, E.: IRIS – International Research of the Interior of the Sun
Lisi,F.: Time Allocation Committee of the TIRGO Telescope
Scientific Committee for the Focal Plane Instrumentation of the Galileo Telescope
Massi, M.: Scientific Organizing Committee of the conference "Radio Emission from the Stars and the Sun" (Barcelona, 3–7 July, 1995, Member)
Natta, A.: Member of the Observing Time Allocation Committee of ISO
Member of the Observing Time Allocation Committee of TIRGO
SOC, "The role of dust in the formation of stars", ESO workshop, Garching-bei-München, September 11–14
Director of "Corso di Astronomia Infrarossa", Scuola Nazionale di Astrofisica, Ciclo 95–96, II Corso, Asiago, ottobre 9–14
PhD committee member, M. Corcoran, Trinity College, Dublin (Dec. 1995)

Oliva, E.: Member of the circumstellar panel of the observing time allocation committee (OTAC) for the ISO satellite
Instrument Science Team member for the ISAAC-VLT project
Instrument Science Team member for the TNG IR imager/spectrograph NICS
Instrument Science Team member for the TNG adaptive optics system
Pacini, F.: Arcetri Observatory, Director
National Research Council (CNR), Member of the Physics Committee
ESO Council, National Delegate
International Astronomical Union, Vice-president
Max Planck Institute für Astronomie-Fachbereit, Member
Space Science Reviews, Member of the Editorial Board
Astronomy and Astrophysics Reviews, Member of the Editorial Board
Palla, F.: SOC, "Galactic Star Formation", Ringberg Castle, Bavaria, Germany – June
SOC, "JENAM '95", Catania – September
Member of the observing time allocation committee (OTAC) for the IRAM radiotelescope
Pallavicini, R.: ESA XMM Science Working Team (Member)
ESO Time Allocation Committee (Expert Adviser for the panel on Low Mass Stars)
HST Cycle 6 Time Allocation Committee (Expert Adviser for the panel on Cool Stars)
SAX Time Allocation Committee (Chairman of the panel on Thin Plasmas)
COSPAR Alternate Italian National Representative
IAU Commission 36 *Theory of Stellar Atmospheres* (Vice-President)
SAX Observation Program Working Group (Chairman for the subgroup "Stellar Coronae")
Scientific Committee for a High-resolution Spectrograph for *Galileo* (Chairman)
Memorie Società Astronomica Italiana (Editor-in-Chief)
Solar Physics, Member of the Editorial Board)
Scientific Organizing Committee of the *Ninth Cambridge Cool Star Workshop* (Chairman)
Poletto, G.: Organizing Committee of IAU Commission 10 *Solar Activity*, Member
Committee on Space Research – COSPAR *Research in Astrophysics from Space, Scientific Commission E*, Member
Arcetri Representative in the National Astronomy Group – GNA
Richichi, A.: Commissione Scientifica Ottiche Adattive per il Telescopio Galileo
ESO VLT Interferometry Steering Panel
Salvati, M.: Council for Astronomical Research, Member
SAX Steering Committee, Member
SAX Time Allocation Committee, Member
Arcetri Astrophysical Observatory, Member of the Board and Deputy Director
Teramo Astronomical Observatory, Member of the Board
Salinari, P.: Brera-Merate Observatory, Member of the Board Member of the LBT Scientific Advisory Committee

COLLOQUIA GIVEN AT ARCETRI

Hilde Domgoergen, University of Bonn "Photoionization problems in the interstellar medium", Jan. 12
Thomas Straus, Dipartimento di Astronomia e Scienza dello Spazio, Firenze "Spettroscopia bidimensionale della fotosfera solare", Jan. 19
Simone Esposito, Dipartimento di Astronomia e Scienza dello Spazio, Firenze "Sistemi ottici adattivi per grandi telescopi", Jan. 26
Claudio Codella, Dipartimento di Astronomia e Scienza dello Spazio, Firenze "Associazione tra sorgenti maser H_2O e regioni HII", Feb. 2
Anna Pasquali, Dipartimento di Astronomia e Scienza dello Spazio, Firenze "Fenomenologia del mezzo circumstellare di stelle calde ed evolute", Feb. 9
Gian Paolo Tozzi, Osservatorio di Arcetri "La Cometa Shoemaker-Levy", Feb. 16
Guido De Marchi, Dipartimento di Astronomia e Scienza dello Spazio, Firenze "Effetti dinamici sull'evoluzione stellare negli ammassi globulari", Feb. 23

Luca Fini, Osservatorio di Arcetri “Il World Wide Web e l’Astronomia”, Mar. 2
Domenico Bonaccini, Osservatorio di Arcetri “Ottiche adattive ad Arcetri: lo stato attuale”, Mar. 9
Gianluigi Bodo, Osservatorio di Pino Torinese “Instabilità e turbolenza in getti astrofisici”, Mar. 23
Alvio Renzini, Dipartimento di Astronomia, Università di Bologna “Recenti sviluppi nello studio delle galassie ellittiche con lo Space Telescope”, Mar. 29
Emanuele Pace, Dip. Astron. e Scienza dello Spazio Università di Firenze “Applicazioni dei rivelatori a CCD”, Apr. 6
Dave Sandler, Steward Observatory, University of Arizona “Recent developments of Adaptive Optics”, Apr. 10
Adalberto Giazotto, Università di Pisa “Il progetto VIRGO”, Apr. 13
Tim Jenness, MRAO Cambridge UK “H2O maser: signposts of star-formation?”, Apr. 27
K. S. Balasubramaniam, National Solar Observatory and Phillips Lab. Sunspot, New Mexico “Observational diagnostics of energy buildup in solar activity”, May 2
Maryvonne Gerin, ENS-Parigi “Reflection Nebulae in the Near Infrared”, May 4
Monique Pick, Observatoire de Paris-Meudon “The Ulysses’ Odyssey”, May 11
Francesco Melchiorri, Università “La Sapienza”, Roma “Le anisotropie del fondo cosmico: conoscenze attuali e prospettive di sviluppo”, May 18
Emiliano Ricci, Laboratorio di Ricerca Educativa, Università di Firenze “Storia del concetto di massa”, May 25
Peter Abraham, Konkoly Observatory, Budapest, Hungary “The structure of the interstellar medium in Cepheus: bubbles, clouds, and cores”, June 1
Yasuo Tanaka, MPE, Garching bei München “Recent ASCA results on AGNs”, June 6
Ronald Hes, Dunsink Observatory, Irlanda “Observational test of AGN unified schemes”, June 8
Rosa Gonzales, University of California, Berkeley “Tracing the dynamics of disk galaxies with optical/IR photometry”, June 15
Michel Perault, Ecole Normale Superieure, Paris “Small scale structure of pre-star forming clouds”, June 22
Steve Balbus, Dpt. of Astronomy, University of Virginia “The legacy of Kuiper’s curious result: accretion disks and their stability”, June 29
Matt Malkan, UCLA “Using the Keck Near-Infrared Camera to Find Protogalaxies”, Sep. 14
Mike Shull, University of Colorado “Implications from the HeII Gunn-Peterson effect”, Sep. 18
Christoph Leinert, Max Planck-Institut fur Astronomie “Binarity in low mass stars”, Sep. 21
Ed Salpeter, Cornell University “Galaxy pairs and galaxy catalogs”, Oct. 2
Jan Palous, Università di Praga “Galaxies: the Dissipative Dynamical Systems”, Oct. 5
Ralf Dettmar, Università di Bochum “Diffuse Ionized Gas in the Disk-Halo Interface of Spiral Galaxies”, Oct. 12
V. Radhakrishnan, Raman Research Institute, Bangalore “Applied Hydro-Aero Dynamics: flying over water, or the fastest sailing crafts on Earth”, Oct. 16
Greg Taylor, NRAO, Socorro “The environment and evolution of powerful radio galaxies”, Oct. 17
Mitch Begelman, JILA, University of Colorado at Boulder “Approaching the speed limit: very fast jets in AGNs”, Oct. 19
Roberto Fanti, Dipartimento di Fisica, Università di Bologna “Radiosorgenti compatte: progressi verso la comprensione dell’evoluzione delle radiosorgenti extragalattiche”, Oct. 25
Susana Lizano, UNAM “Photoevaporated globules in HII regions”, Nov. 9
Constance Bréart de Boisanger, Commissariat a l’Energie Atomique Bruyères-le-Châtel “Gas dynamics in regions of high-mass star formation”, Nov. 16
Piero Salinari, Osservatorio di Arcetri “Lo stato del progetto LBT”, Nov. 23
Ute Lisenfeld, MRAO Cambridge “The far-infrared/radio correlation of normal and starburst galaxies”, Nov. 30
Yuri Shchekinov, Rostov State University “The gaseous halos of spiral galaxies: do we understand them?”, Dec. 7
Edvige Corbelli, Osservatorio di Arcetri “Warps galattici e la scala delle distanze cosmiche”, Dec. 14

“LAUREA” THESES SUPERVISED BY ARCETRI ASTRONOMERS

Simone Bianchi: “Estinzione e polarizzazione della radiazione nelle galassie a spirale” – Marzo (C. Giovanardi)

Cecilia Clementi: “Geometria e dinamica hamiltoniana con applicazioni a sistemi con transizioni di fase” – Marzo (M. Pettini)

Lando Caiani: “Dinamica di sistemi hamiltoniani con transizioni di fase” – Aprile (M. Pettini)

Guglielmo Iacomelli: “Dinamica regolare e caotica in meccanica quantistica” – Aprile (M. Pettini)

Alessandro Manzini: “Modelli di diffusione per le radio galassie” – Aprile (S. di Serego Alighieri)

Elena Bougleux: “L’idruro di litio nell’Universo primordiale” – Luglio (D. Galli)

Silvia Maltagliati: “Studio della popolazione stellare associata alle stelle di Herbig Ae/Be” – Luglio (F. Palla)

Alberto Ortolani: “Spettroscopia X di sorgenti stellari attive” – Luglio (R. Pallavicini)

Cristina Sorelli: “Fenomeni di accrescimento di materia in stelle di pre–sequenza-principale” – Luglio (A. Natta)

Nancy Aharpour: “Spettroscopia ad alta risoluzione di stelle giovani” – Settembre (R. Pallavicini)

Alberto Caruso: “Prestazioni del fuoco interferometrico del large binocular telescope nel vicino infrarosso” – Ottobre (D. Bonaccini)

PhD THESES SUPERVISED BY ARCETRI ASTRONOMERS

Claudio Codella: “Studio dell’associazione tra sorgenti maser H_2O e regioni HII” (M. Felli)

Simone Esposito: “Sistemi ottici adattivi: sviluppi tecnologici e simulazioni numeriche” (D. Bonaccini)

SCIENTIFIC AND TECHNICAL STAFF (as of December 1995)

Name	Position	Ext
Agnoletti Franco	Collaboratore tecnico	293
Arena Placido	Funzionario tecnico	231
Baffa Carlo	Ricercatore astronomo	298
Bandiera Rino	Astronomo associato	279
Barletti Raffaele	Astronomo associato	278
Biliotti Valdemaro	Assistente tecnico	288
Bonaccini Domenico	Ricercatore astronomo	207
Brunetti Enrico	Assistente tecnico	209
Calamai Giovanni	Astronomo ad esaur.	310
Caselli Paola	Ricercatore astronomo	253
Cavallini Fabio	Astronomo ad esaur.	200
Ceppatelli Guido	Astronomo associato	200
Cerruti Sola Monica	Funzionario tecnico	310
Cesaroni Riccardo	Ricercatore astronomo	215
Cimatti Andrea	Ricercatore astronomo	297
Comoretto Giovanni	Astronomo associato	215
Corbelli Edvige	Ricercatore astronomo	255
Curioni Giampaolo	Collaboratore tecnico	223
Curioni Piero	Collaboratore tecnico	219
Del Vecchio Ciro	Ricercatore astronomo	261
di Serego Sperello	Astronomo associato	311
Ducci Dario	Assistente tecnico	305
Esposito Simone	Funzionario tecnico	207
Fabiani Fabio	Operatore tecnico	208
Falchi Ambretta	Astronomo associato	236
Falcini Gilberto	Agente tecnico	213
Felli Marcello	Astronomo ordinario	240
Ferrara Andrea	Ricercatore astronomo	285
Fini Luca	Astronomo associato	307
Forti Giuseppe	Astronomo ad esaur.	236
Galli Daniele	Ricercatore astronomo	249
Gasperini Antonella	Bibliotecaria	237
Gavryusev Vladimir	Astronomo visitatore	308
Gavryuseva Elena	Astronomo visitatore	230
Gennari Sandro	Ricercatore astronomo	294
Giovanardi Carlo	Astronomo associato	239
Grisendi Tito	Collaboratore tecnico	201
Landolfi Marco	Astronomno ad esaur.	256
Lisi Franco	Astronomo associato	289
Margaglio Aless.	Assistente tecnico	295
Massi Maria	Ricercatore astronomo	260
Mazzucconi Fabrizio	Ricercatore astronomo	250
Miglietta Luciano	Ricercatore astronomo	305
Monsignori Fossi B.	Astronomo associato	246
Natta Antonella	Astronomo associato	239
Oliva Ernesto	Astronomo associato	311
Pacini Franco	Direttore	232
Palla Francesco	Astronomo associato	249
Pallavicini Roberto	Astronomo associato	252
Paloschi Sergio	Funzionario tecnico	202
Panella Dario	Assistente tecnico	221
Pettini Marco	Funzionario tecnico	242
Piccini Giuseppe	Operatore tecnico	271
Poletto Giannina	Astronomo associato	252
Puccetti Daniele	Operatore elabor. dati	291
Ranfagni Piero	Funzionario tecnico	308
Richichi Andrea	Ricercatore astronomo	230
Rossi Emilio	Agente tecnico	222
Salinari Piero	Astronomo ordinario	290
Salvati Marco	Astronomo ordinario	258
Stefanini Paolo	Collaboratore tecnico	212
Tofani Gianni	Astronomo ordinario	217
Torricelli Guidetta	Ricercatore astronomo	260
Tozzi Gian Paolo	Funzionario tecnico	252
Tribioli Francesco	Collabor. elabor. dati	269
Valdettaro Riccardo	Operatore tecnico	242
Walmsley Malcolm	Astronomo ordinario	253

ADMINISTRATION AND GENERAL SERVICES (as of December 1995)

Name	Position	Ext
Fusina Renzo	Agente amminist.	283
Marcucci Danilo	Agente servizi aus.	214
Marcucci Paolo	Operatore uff. tecnico	211
Masini Emanuela	Agente servizi aus.	233
Minicucci Massimo	Collab. tecnico	266
Naldi Luigi	1° dirigente	267
Nannelli Luciana	Manutentore	280
Pearce Vivienne	Agente servizi aus.	233
Piccini Giulia	Collabor. amministr.	263
Poggi David	Custode	229
Romoli Lucia	Assistente amministr.	263
Sassi Elisa	Vice dirigente	264
Smeraldi Silvestra	Assistente amministr.	264
Venturi Rossella	Manutentore	273
Volpi Paola	Agente amministr.	266

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