

PREFACE

The Data Analysis in Astronomy Workshop series, started more than 20 years ago, is aimed at providing an updated overview of advanced methods and related applications to data analysis issues in astronomy and astrophysics. The series, with its previous five sessions, strongly contributed to stimulate and enforce the scientific interaction between astrophysicists and data analysis community, which discussed, debated and compared methods and results, theories and experiments.

The first edition (Erice 1984) was mainly devoted to the presentation of emerging Systems for Data Analysis (MIDAS, AIPS, RIAIP, SAIA). New methodologies for image and signal analysis were also presented with emphasis on cluster and multivariate analysis, bootstrap methods, time analysis, periodicity, 2D photometry, spectrometry, and data compression. A session was dedicated to Parallel Processing and Machine Vision.

The second workshop (Erice 1986) reviewed data handling systems planned for large major satellites and on-ground experiments (CGRO, HST, ROSAT, VLA). Data analysis methods applied to physical interpretation were considered. New parallel machine vision architectures were presented (PAPIA, MPP), as well as contributions in the field of artificial intelligence and planned applications to astronomy (expert systems, pictorial databases).

The third edition (Erice 1988) was dedicated to emerging topics (chaotic processes, search for galaxy chains via clustering, search of burst with adaptive growing) for solutions in frontiers of astrophysics (γ -ray astronomy, neutrino astronomy, gravitational waves, background radiation, extreme cosmic ray energy spectrum).

The fourth workshop (Erice 1991) provided a review of large working experiments at different energy spectra (HST, ROSAT, CGRO); goals, problems, solutions, and results of data analysis methods to experimental data were discussed. The Italian/Dutch X-ray satellite SAX was also presented. A compared review of the surviving data-analysis systems from the Erice 1984 workshop was presented (MIDAS, ESIS, EXSAS, COMPASS).

The fifth edition (Erice 1996) mainly referred to the data analysis problems present in all the fields from radio to gamma-ray astronomy, and to the multi-wavelength approach, taking into account the currently advanced methods of data fusion, information retrieval, high-speed computing. A special session was devoted to the successful launch of the X-ray astronomy satellite BeppoSAX and to its early scientific results.

All proceeding of the Data Analysis workshops were published in the Ettore Majorana International Science Series.

The sixth edition (Erice 2007) held at the Ettore Majorana Foundation and Center for Scientific Culture, Erice, Italy, was the gateway to other scientific areas. The Workshop with the subtitle of “Modelling and Simulation in Science” addressed the basic approach to the world of simulation and modelling in three branches of Science — Astrophysics, Biology and Climatology. The present status of art and adopted research lines were reported and future developments anticipated. The impact of new technologies in the design of novel data analysis systems, the interrelation among different fields such as e.g. Cosmology, Bioinformatics, Earth environment, represented the logical fallout of the Workshop. The job of putting together outstanding people from different scientific areas was hard, but today more than ever, it seems appropriate to cite the phrase, quoted by many authors, “*A mind is like a parachute. It doesn’t work if it not open*”.

This proceedings includes all papers presented during the Workshop and it is organized in three main sections:

- *Astrophysics, Cosmology, and Earth Physics;*
- *Biology, Biochemistry, and Bioinformatics;*
- *Methods and Techniques.*

The success of the Workshop was the result of the coordinated effort of a number of people, from the entire Scientific Committee (Giorgio Fiocco, Sandro Fornili, Johannes Knapp, Maria Concetta Maccarone, Fionn Murtagh, Sankar Pal, Michele Parrinello, Bruno Sacco, Marco Scarsi, Alan Watson, and Bertrand Zavidovique) to the Local Secretary (Giosuè Lo Bosco), and all participants who presented contributions and/or took part in the discussions.

We wish to thank the National Institute for Astrophysics INAF, and the Università degli Studi di Palermo for their support and for including the Workshop in cultural events of the Bicentennial of the University of Palermo. Finally, we thank the entire staff of the Ettore Majorana Foundation and Centre for Scientific Culture for their support and invaluable help in organizing a successful Workshop.

Vito Di Gesù
Giosuè Lo Bosco
Maria Concetta Maccarone

*On the behalf of Prof. A. Zichichi (President of the EMFCSC)
the “DAA - Data Analysis in Astronomy” Workshops
are from now dedicated to “Prof. Livio Scarsi”
who was the enthusiastic inspirer of the series.*

Memory of Livio Scarsi (25 May 1927 - 16 March 2006)

Livio Scarsi was one of the major protagonist of the physics, astrophysics and space research of the 20th century. Born 25 May 1927 in Rocca Grimalda, Italy, his reach and exemplary scientific career is substantiated by the huge number of responsibilities, assignments, collaborations, academic and honorary positions and awards. Chairman of international research programs and space missions, Livio Scarsi has carried out functions of management and scientific advisor in many institutions, such as the Italian Consiglio Nazionale delle Ricerche, the Servizio Attività Spaziali (now Agenzia Spaziale Italiana), the European Space Agency and the Russian Academy of Science. Member of the Accademia dei Lincei, the Accademia Europea and the International Astronautics Academy, he was awarded the “*Bruno Rossi Prize*” of the American Astronomical Society and received the Laurea Honoris Causa of the *Université de Paris 7 Denis Diderot*.

Graduated in physics at the University of Genoa, Italy, he began his scientific activity in the field of elementary particles and cosmic rays. First as a student and then collaborator of Giuseppe Occhialini, he became a Physics Professor at the University of Milan and a collaborator of the Saclay Center of Nuclear Studies, France, pursuing his interests in the field of “new particles” of cosmic radiation using the technology of nuclear emulsions flown in the upper atmosphere with stratospheric balloons.

At the end of the 50’s he moved to the United States. At the Massachusetts Institute of Technology, with the Bruno Rossi Group; together with John Linsley he realized, in the desert of Volcano Ranch, New Mexico, the first giant array for Extensive Air Showers. Thanks to John and Livio they discovered the existence of cosmic particles of very high energy ($> 10^{19}$ eV).

Back in Italy, after a short parenthesis at the University of Rome, Livio Scarsi became in 1967 Full Professor of Advanced Physics at the Sciences Faculty of the University of Palermo, where he activated a new field of research: the High Energy Astrophysics. He continued pursuing his interests in the research on rare components of the Cosmic Radiation with detectors on board of stratospheric balloons and rockets. One of the most relevant scientific results was the detection of pulsed emission of Gamma Radiation above several GeV from the Crab Nebula Pulsar PSR0531+21.

This activity continues with COS-B, the first European survey satellite to explore the gamma-ray sky. COS-B provided the first complete map of the γ -ray emission in the Galaxy above 50 MeV, together with the identification of galac-

tic and extragalactic sources and the first catalogue of γ -ray sources above 50 MeV, promoting the gamma-ray astronomy to an adult and recognized branch of Astronomy.

In the course of the 70's, the research activities of the group led by Scarsi grew to such an extent as to necessitate the establishment in Palermo of the Istituto di Fisica Cosmica ed Applicazioni all'Informatica, IFCAI (now IASF Palermo), of the National Research Council, specifically dedicated to the realization of great projects of Space research. Livio Scarsi was appointed Director of the new Institute.

The inclusion of the name "Informatica" reflects his deep understanding and intuition of the fundamental role played by information science methods for a better understanding of complex experimental data. Following this idea, Livio Scarsi promoted, in the middle of the 80's, the "Data Analysis in Astronomy" Workshop series at the "Ettore Majorana Foundation and Centre for Scientific Culture" in Erice, Italy. This marked the beginning of similar symposia worldwide. With its five editions, the series has provided an updated overview of advanced methods and related applications to astronomy and astrophysics, allowing astrophysicists and computer scientists to discuss, debate and compare results and methods, both in theory and in experiments. The sixth edition followed the spirit and the indications Livio provided until few months ago.

The most remarkable success of Livio Scarsi has surely been the realization of the satellite for X-astronomy BeppoSAX, launched in 1996 and named in honor of Giuseppe (Beppo) Occhialini. BeppoSAX has been a space venture of extraordinary success and a landmark in X-ray astronomy. It has promoted a fundamental progress in the various branches of galactic and extragalactic high-energy astrophysics, documented by more than 2000 scientific articles and reports. The highlight is represented by the discovery of the source counterpart of the Gamma Ray Burst (GRB), solving a mystery remained untouched for about 30 years following the first detection of GRBs. For this, Livio Scarsi, as leader of the BeppoSAX Team, was awarded the *1988 Bruno Rossi Prize* of the American Astronomical Society.

Livio Scarsi entered in the new millennium with the proposal of a new and ambitious space mission. The project, named EUSO (Extreme Universe Space Observatory), concerns the realization of a sophisticated instrument for the detection of cosmic rays of highest energy. More than 100 researchers from scientific institutions in Europe, USA and Japan responded to this challenge. Livio will be remembered by his numerous colleagues and friends as the leader of great international collaborations. They will never forget Livio's juvenile enthusiasm and great humanity.

Antonino Zichichi