

## FOREWORD

The study of high-energy cosmic radiation and astro-particle physics is of fundamental importance to understand which are the primary physical processes that take place in various classes of celestial objects such as e.g. clusters of galaxies, active galactic nuclei, supernova remnants, pulsars, etc ... These cosmic radiations are also instrumental for the study of fundamental physics, dark matter, cosmic antimatter, and their properties. Italy has a long (and internationally recognized) tradition in these fields. The Italian community has been always very active and strongly engaged both at the level of experimental design and execution, of data analysis/interpretation and of modeling/theory.

The first experiment on astro-particle in Italy were related to the measurements of Cosmic Rays (tightly connected with research on elementary Particles) from the ground or from “space” (with balloon experiments), followed by balloon and rocket experiments to detect  $X$  and  $\gamma$  Rays from extrasolar sources. The first attempt by Italian scientists to carry on Astrophysical observations from Space can be traced back to the early 60’s (just after the launch of the first satellites, Sputnik, in 1957) with the “heroic” tentative to detect  $\gamma$  radiation from Cygnus A using a balloon experiment launched from the roofs of the Istituto di Fisica di Bologna (Braccesi, Ceccarelli and Saladin, 1960, *Il Nuovo Cimento*, 17, 691B). Slowly space astrophysics and, in particular, high-energy astrophysics (Palumbo, G.G.C., 2011, *Nuclear Physics B Proceedings Supplements*, Volume 212, p. 34-49.), has become one of the major fields of modern Astronomy and several groups in Italy gave fundamental contributions to satellite missions (e.g. OSO-6, TD 1A, COS-B, EXOSAT), culminating with the the largest and most successful effort of Italian High Energy Astrophysics, the Beppo-SAX Mission (1996 - 2002, see Piro, L., 2013, *Memorie della Societa Astronomica Italiana*, v.84, p.522).

After the successes of the ongoing missions to which the national community has contributed substantially (e.g. XMM, INTEGRAL, AGILE, Fermi, PAMELA, AMS, CALET, Swift, NuSTAR etc), it is important to understand the “state of the art” in the fields of high energy astrophysics and astro-particle physics. This understanding will be instrumental for: 1) collect ideas for possible space missions of potential interest for the reference community; 2) understand which technologies must be developed to carry out the most appropriate missions of national interest.

An implementation agreement between ASI and INAF (in close connection with INFN) was signed to support the national community in the study of high energy astrophysics and astro-particle physics with the aim of represent the “state of the art” in the fields of high energy astrophysics and astro-particle physics and guaranteeing an important positioning in upcoming international initiatives in the sector. This agreement has produced more than 450 papers in refereed journals with topics going from high energy emission from stars and compact galactic objects to X-ray emission from Active Galactic Nuclei and clusters of galaxies, time domain astronomy, cosmic rays and dark matters, to conclude with few prospects for future experiments/missions. The main results obtained are reported in this volume. We thanks the Science Assistant Editors, Stefano Covino and Marcella Brusa, for the help and support in the preparation of this volume.

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