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Introduction

Between 4–7 October 2004, a major symposium dedicated to the scientific aspects of the Gaia mission was held at the Observatoire de Paris, Meudon, France, as ‘Les Rencontres de l’Observatoire 2004’. Attended by 240 delegates, the four-day meeting was an opportunity to present the current status of the Gaia mission to the interested scientific community, and to hear about the results of investigations carried out in the various areas of the mission over the last four years.

The Gaia mission was proposed to ESA in 1994 as part of the ‘Horizon 2000 Long-Term Plan’, and supported by the Survey Committee if the achievement of accuracies of about 10 micro-arcsec at 15 mag could be demonstrated. It was approved by the ESA’s Science Programme Committee in 2000 after a two-year concept and technology study. From that time, the project has been through an intensive study phase which will end during the early part of 2005. The mission will then enter the detailed design and manufacturing phase shortly afterwards. The launch date is currently targeted for mid-2011. The Gaia 2004 Symposium was timed to coincide with the finalisation of this study phase.

The main purposes of the Symposium were: (i) to present to the scientific community the overall mission design, along with its detailed characteristics and performances; (ii) to bring to the attention of the scientific community the extraordinary potential of Gaia, and to share with the younger generation of scientists the expertise acquired during its preparation (and all phases of the Hipparcos mission); and (iii) to organise the next phases of scientific preparations of the mission: in particular the data reduction and, ultimately, preparation for the scientific exploitation of the data.

During the study phase, three major and closely related components of the project have been under study:

(1) A small ESA study team, led by study manager Oscar Pace, has directed two parallel industrial studies, undertaken by EADS Astrium and Alenia/Alcatel. The overall system aspects, including the payload, attitude control, and data handling sub-systems, launcher interface, thermal design, and the mass and power budgets, have been studied in detail. In addition, specific technical development activities have been running over the last two years in the most technologically critical areas to establish further confidence in their performance and feasibility: this includes a prototype of the large primary mirror manufactured in silicon carbide, flight representative CCDs, deployable sunshield, payload data handling electronics, etc.

(2) The scientific community, represented by ESA’s Gaia Science Team and chaired by the project scientist Michael Perryman, has directed the associated scientific studies and provided guidance to ESA on the technical aspects of the satellite and payload design impacting on the final mission accuracies. The goal of these activities is to converge on a satellite design which is scientifically optimised, and technically and financially feasible. Sixteen scientific working groups, representing more than 200 European scientists, were formed in 2004 to coordinate detailed scientific studies on aspects such as multiple and variable stars, solar system objects, relativistic formulation, on-board detection and data handling, accuracy analysis, etc. These groups have worked to improve confidence in the scientific objectives, the data processing requirements, and all other preparations needed before launch.

(3) The third major component of the Gaia end-to-end system is the data processing on-ground. This has always been understood to be a very challenging part of the mission, involving large data volumes, large numerical processing requirements, and numerous and complex algorithms including the core ‘global iterative solution’. Considerable attention has been given to this element over the past few years, with a comprehensive data simulation chain being built up under the direction of the simulation working group, and a detailed prototype of the data base and iterative solution now running on 18 months of mission data comprising 200 000 stars.

Presentations covered all scientific aspects of Gaia, and the detailed studies carried out by the working groups and science team over the past four years. These proceedings therefore represent a snapshot, as of October 2004, of the rapidly developing scientific aspects of the mission. As apparent in the 150 papers presented at the meeting, great advances have been made in all aspects of the mission design. Equally evident are the many challenges that lie ahead.

The three industrial organisations, EADS Astrium, Alenia, and Alcatel, as well as Observatoire de Paris, ESA, CNES, CNRS and INSU generously sponsored this Gaia 2004 Symposium. This allowed travel grants to be provided to 40 graduate and post-doctoral students. The many young scientists now involved in the Gaia mission, and attending the symposium, is a great testament to its interest and vibrancy.

As chair and co-chair of the Scientific Organising Committee, we acknowledge the contributions of all involved in making the symposium a success: the Scientific Organising Committee, the Gaia Science Team, and the International Advisory Committee; the Local Organising Committee under the leadership of Yves Viala; Karen O’Flaherty in charge of communication and proceedings aspects; the chairs of the various sessions; those who undertook the challenging but valuable task of summarising the poster contributions (David Katz, Ulrich Bastian, François Mignard, Michel Breger, and Xavier Luri); and of course the speakers and poster presenters.

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