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# The View From NASA Headquarters: Trends And Changes in Mission Operations And Data Analysis Programs

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**Abstract.** The Astrophysics Program at NASA is mission oriented. With seven flying missions and twenty additional (international collaborations) planned, NASA provides an ever increasing amount of exciting astrophysical data, and supports a large portion of astrophysics data analysis. There have been significant efforts during the past seven years that support the development of astronomical data analysis software and systems. The future contains many changes that offer us significant challenges. I describe here some of those changes, and NASA's responses to them.

## 1. Introduction

NASA supports seven astrophysics missions at present; they are: the *International Ultraviolet Explorer* (*IUE*), the *Hubble Space Telescope* (*HST*), the *Röntgen Satellite* (*ROSAT*), the *Compton Gamma Ray Observatory* (*CGRO*), the *Extreme Ultraviolet Explorer* (*EUVE*), and the *Advanced Spacecraft for Cosmology and Astrophysics* (*ASCA*). Figure 1 shows the Astrophysics Mission Plan Chart which lists all current NASA astrophysics missions, planned and in progress, as of January 1995. (All launch dates are subject to change.) While the chart indicates the broad scope of the NASA astrophysics missions, it is important to realize that NASA supports not only the mission, but also the associated mission science centers and/or mission data archives. Many mission-related software and archive developments were outgrowths of the 1987 Astrophysics Data System (ADS) Workshops. In response to these workshops, discipline archive centers were established in two of three Astrophysics disciplines: the High Energy Archive (HEASARC) and the Infrared Archive (IPAC). The Astronomical Data Center at the NASA Space Science Data Center (NSSDC) continues to support the archival needs of the broader astronomy community. In 1989 NASA also funded the Astrophysics Software and Research Aids Program (AS&RA) and the development of various software facilities through the Astrophysics Data Program (ADP).

Many developments related to the support of astronomical software coincided with a time of growth and mission expansion. NASA maintains some of those software tools by continuing to fund, for example, FITS, the HEASARC BROWSE, *HST* image reconstruction, CASA/*IUE* access, the IDL astronomy library, and SkyView.

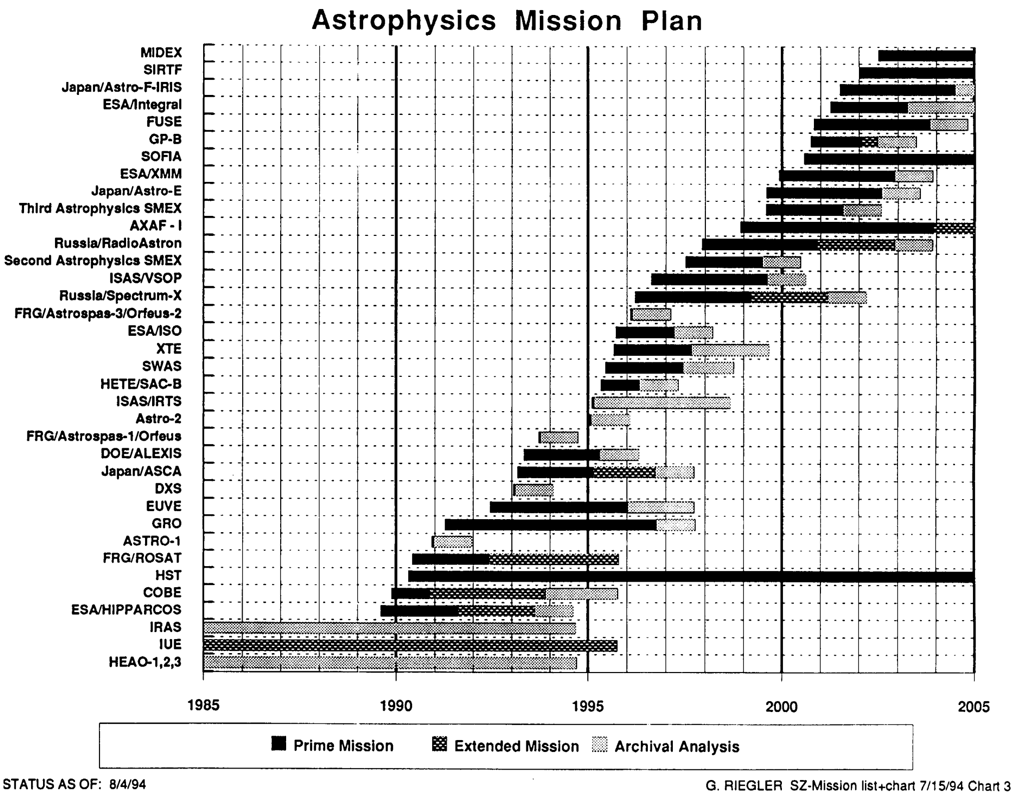


Figure 1. NASA Astrophysics Mission Plan as of January 1995.

## 2. Changes for MO & DA

The environment continues to change. The directives from the NASA Administrator and the White House are clear: They want smaller, faster, better, and cheaper missions. They want to see a revolution in concepts, not an evolution of old concepts. In addition we now need to show that new projects represent the diverse population of scientists. In a broader sense, perhaps the most significant change is that the previous pre-eminence of science has been replaced by drivers of technology, economics, education, and public outreach.

When funding increased year to year, NASA could continue programs so long as they produced valuable data. Now that funding is level and is expected to decrease, we ask the science community to use a new paradigm to help us restructure old programs and select new programs. Programs must maintain the highest likely science return, improve our technological leadership, and yet remain cost-effective.

### 2.1. Changes to the ADS and Mission Programs

As an example of the restructuring, consider the Astrophysics Data System which was designed to enable remote, coherent access to distributed astrophysics data holdings. The program was characterized by very high science return with minimal oversight from NASA Headquarters. ADS achieved an impressive growth, especially with its abstract service. But as information technology evolved, the World-Wide Web, the Mosaic interface, and other Internet tools became very popular for remote data access. NASA responded to customer concerns and preferences, and, guided by cost efficiency, redirected the ADS project. The ADS project will reduce the classical remote access to distributed data holdings and concentrate on the abstract service.

Other restructuring plans affect the data analysis plans for several flying missions. *IUE*, *ROSAT*, *EUVE*, and *GRO* will complete their missions within the next few years. A Senior Review Panel recently held a comparative review of their science merits to determine if their requests for mission extension are valid. Acceptable requests for mission extension now must show credible plans for mission continuation past the prime phase at one-third to one-half of the prime phase funding level. In the future NASA will cap post-launch costs. A project may stretch its observing time if it can find ways to cut operating costs so the cap is maintained. This reduced scope and reduced cost come with increased risk that varies with size of mission. However, an Explorer-class mission, or a "Small Explorer," after completion of its primary science objective, can accept more risks than an Observatory-class mission early in its intended lifetime.

### 2.2. Changes to the Software Funding Environment

NASA supports many projects related to the development of software and data analysis tools. Some support is provided directly to institutions such as the HEASARC, IPAC, and ADC, and some projects are supported through the Astrophysics Data Program (ADP). The ADP began in 1986 as the "Space Astrophysics Data Analysis Program." The purpose of the ADP is to optimize the scientific return from space astrophysics missions, and to enable broad scientific investigations requiring analysis of data from one or several space-based data sets.

Previous funding cycles for the ADP considered three types of proposals. Type 1 proposals were for research involving space astrophysics data sets, Type 2 proposals were for applied research to improve and enhance space-based observing and data analysis, and Type 3 proposals were for applied research to improve access to, and management of, space-based astronomical data. Software projects faired well in the ADP: during each of the last three cycles (FY92, FY93, and FY94), ADP projects of types 2 and 3 received 45–49% of the total funding. Contrary to rumors, this funding percentage did not drop in the latter years.

During the FY88–92 cycles, NASA selected software-related proposals on the basis of their *general* usefulness to science. To verify whether or not the objectives were met, NASA conducted a survey of 13 ADP software projects funded during this period. Of the 13 projects surveyed, only 10 ever produced a product. Of the 13 projects, 8 sent their product to at least one person outside their own institution. Except for one or two high-usage products, the others, on average, were used by only two or three other persons. The basic objective—providing tools for the science community—was often not met!

In response to the changing environment and to correct the problem, NASA will improve the selection process for software development projects. NASA support for these projects will continue within the ADP, but the previous—

somewhat strained—distinction between Type 2 and Type 3 proposals will be dropped: The old Type 2 and 3 Proposals are combined into a new Type 2. ADP will solicit proposals for:

- **Science research** (previously Type 1). The Type 1 proposals are those whose dominant emphasis is the analysis and interpretation of data from the above-named space astrophysics missions.
- **Software tools** (previously Types 2 and 3). The Type 2 proposals may include the writing of algorithms for analyzing data, planning space-based astronomical observations, correlating or displaying space-based astronomical data; deconvolving sources in crowded fields, absolute radiance calibration techniques, statistically modeling the appearance of the sky in specific wavelength regions, providing tools for the NASA/IPAC Extragalactic Database (NED); improving or adding reduction or analysis packages to any of the Astrophysics Science and Data Centers or to Astronomical Data Reduction and Analysis Systems; or other similar software activities. In addition, Type 2 proposals may include research to improve access to, and management of, space-based astronomical data.

A more significant change to the program concerns the peer review of proposals. In the past the Type 1 proposals were considered in competition only with each other for funding. Similarly for Type 2 and Type 3. This new cycle will put all proposals, regardless of type, into the same competitive base. This new procedure will ensure that all proposals share and are judged on the common goal of improving the scientific output from NASA Astrophysics mission data. Instead of artificially separating software development proposals from other ADP proposals, all proposals will be reviewed in the science-topical panel where they would generate the most direct benefits. Each proposer will designate the science-topical panel where the proposed software development effort will have greatest impact. The research areas are: Solar System; Star Formation and Pre-Main Sequence Stars; Main Sequence Stars; Post-Main Sequence Stars and Collapsed Objects; Binary systems; Interstellar Medium and Galactic Structure; Galaxies; Large-Scale Cosmic Structures. In addition to their usefulness for science, each proposal's cost effectiveness will be considered as selection criterion.

With the help of the science and technical communities NASA can meet the new challenges of producing first class and cost-effective science We solicit your best efforts and cooperation to continue providing the best science and data analysis tools.