Chapter 2

Current Situation in Space Science

Over the past quarter century the United States has developed a scientifically productive space science program. The largest number of missions have been dedicated to solar and solar-terrestrial physics; as a result of this sustained work, scientists are developing a good understanding of Earth's magnetosphere and its interactions with many solar phenomena. The Mariner, Pioneer Venus, and Viking missions have been flown to our neighboring terrestrial planets, Mercury, Venus, and Mars; Pioneer and Voyager spacecraft have returned a vast array of important and exciting data from Jupiter and Saturn in the outer solar system. The planned launch of the Space Telescope will increase our knowledge of the farthest reaches of the universe with imaging capabilities never before achieved in optical astronomy.

Over the past few years, however, there has been a significant downward trend of budgetary support for one subdiscipline* of space science, planetary exploration. (See app. A.) Recent budget cuts have now called into question the continuation, survival, and future viability of the U.S. planetary science program. In the view of the planetary scientists, the program is in danger of complete collapse. If the present trend in funding were to continue, the planetary science program would be extinct by the end of the decade.

In spite of the apparently greater resources at their disposal, problems confront solar and heliospheric physics, and X-ray and gamma ray astronomy, all of which have had their major missions deferred. Overall, only the launch of the Space Telescope and a possible repair of the Solar Maximum Mission remain in prospect. Indeed, there is no assurance that the United States will fly a major space science mission after the Space Telescope.

It was widely held in the OTA workshop that current funding for space science makes it impossible to maintain all the subdiscipline at viable levels. There is some possibility, however, that a relatively minor reapportionment in funding from hardware development to postmission data analysis could be a useful interim measure. Despite its best efforts to provide a balanced space science effort, the National Aeronautics and Space Administration (NASA) has found it necessary to reduce support in planetary research in an attempt to maintain previous commitments within the agency and to maintain the viability of the remaining projects.

Space scientists are especially concerned by four immediate problems:

1. lack of flight opportunity;
2. uncertain commitment to the range of disciplines;
3. lack of support for postmission data analysis; and
4. threatened loss of data from existing spacecraft.

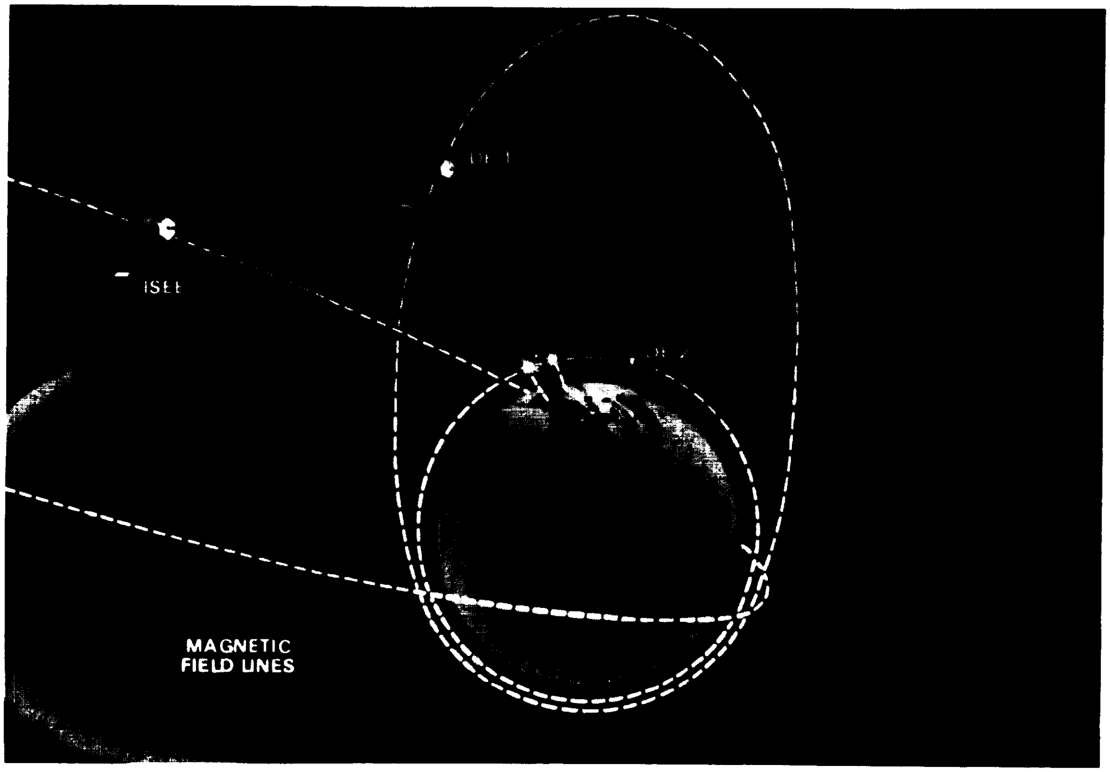
None of the disciplines of space science escapes the threat posed by these elements.

The area of most pressing concern to scientists, however, has been planetary exploration, where effected or proposed funding cuts of so percent in mission operations and data analysis and 30 percent in research and analysis, between fiscal year 1981 and fiscal year 1983, are resulting in significant reductions in basic research in planetary science programs at universities and NASA centers; if inflation is taken into account, these cuts are significantly larger. Some research laboratories and institutes such as the Jet Propulsion Laboratory, which have been operating for many years, may have to direct their efforts into other fields.

These cuts have seriously threatened to terminate productive, active spacecraft (Pioneer Venus Orbiter and Pioneers *10* and 11). Because of the current situation in planetary science funding, no experimenter can with any reasonable degree of assurance foresee the time when his experiment, if selected, will fly; no laboratory scientist can feel confident that a new research project will be funded long enough to come to fruition.

● In this document the word "subdiscipline" is taken to mean any branch of recognized disciplines; thus, X-ray astronomy is a subdiscipline of astronomy.

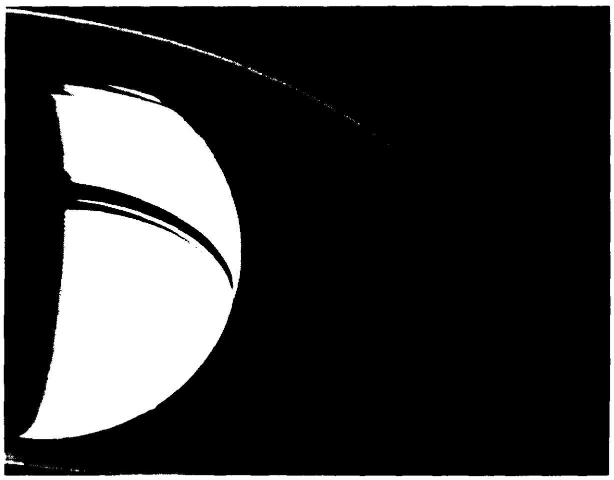
The Diversity of Space Science

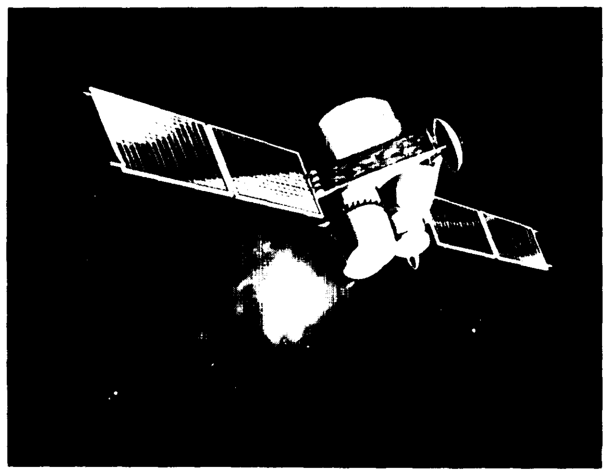


By releasing visible metal vapors at altitudes of about 1,450 km, NASA scientists were able to measure the electric fields that cause auroras in the underlying ionosphere by accelerating charged particles along the Earth's magnetic field lines. Measurements were made Apr. 12 and 28,1982, by particle detectors aboard two Dynamics Explorer satellites

Region of volcanic eruption on the Jovian satellite 10 is pictured from data returned from Voyager I's encounter with Jupiter, Mar. 4, 1981

Jupiter, its Great Red Spot, and three of its four largest satellites are visible in this photo taken Feb. 5, 1979, by Voyage 1, when the spacecraft was 28.4 km from the planet. The innermost satellite, 10, can be seen against Jupiter's disk





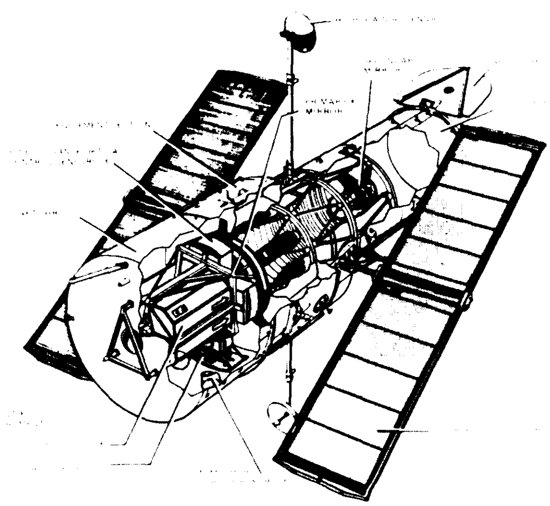


Photo credits: National Aeronautics Space Administration

Top: **Litter on Mars: the shroud which protected the surface sampler instrument on Viking II during the spacecraft's year-long journey from Earth lies shining on the Martian surface after its ejection**

Middle left: Image of the far side of Saturn and its rings, returned by Voyager II on Aug. 29, 1981

Middle right: **Artist's conception of the Gamma Ray Observatory**

Lower left: **The Space Telescope, to be launched into orbit from the Space Shuttle, will allow scientists to gaze seven times farther into space than ever before**

Throughout space science this problem is compounded by the maturation of the several space science disciplines. At present funding levels, the frequency of new missions for each major discipline has already decreased to about one per decade per discipline. The disciplinary category of planetary exploration and the subdiscipline of X-ray astronomy are perhaps affected the most by this situation; solar-terrestrial research and the atmospheric sciences also are approaching a critical level of support. Increasingly, universities and industry are assessing the opportunities to be so minimal that they will no longer pursue them; as a result, experienced scientists are leaving these fields, and students and other new researchers are not entering them.

This situation has been caused in large part by a trend toward fewer, more expensive missions. During the earlier stages of the national space program, there was, at least in the astronomy and physics disciplines, a broad mix of relatively inexpensive science opportunities (including experiments on sounding rockets and balloons) and facilities-class spacecraft (Orbiting Geophysical Observatories, Orbiting Solar Observatories, Orbiting Astronomical Observatories, Interplanetary Monitoring Platforms, Pioneers, etc.). This mix allowed for an active, growing community to do important, productive work. If one group failed to qualify for flight on a major observatory spacecraft, it might still qualify for a small project, in which the group could still maintain productive activity and could develop plans for the next major opportunity. Today, however, failure to qualify for a major mission is extremely detrimental to the long-term continuity of the proposing group, for there are insufficient funds set aside for the smaller projects. (These include such important interim activities as analysis of data from previous missions.)

A number of problems have attended the development of large, sophisticated missions. For example, because the Galileo mission to Jupiter is dependent on the shuttle, delays in the latter, and its associated upper stage, have caused the former to be delayed as well. The delay in Galileo caused its funding to be stretched out, and ultimately increased its costs.[1] For another example, maintaining balance within a discipline becomes a problem when, given a relatively constant space science budget, increasing outlays for one project, particularly a major one like the Space Telescope, reduces the funding for others.[2] Space science has been affected also in that the number of flight opportunities on the shuttle has been decreased and in that those missions which require a high-energy upper stage have been indefinitely postponed.

Another important aspect of the current situation is that the United States currently enjoys scientific and technological leadership in most of space science, but in certain areas, e.g., cometary research and ocean remote sensing, leadership could soon pass to the Soviets, the Europeans, and the Japanese. Failure of the United States to mount a mission to Halley's Comet puts U.S. scientists at a clear disadvantage with respect to the Europeans and the Soviets, both of whom will be flying such missions. A similar situation prevails in oceanography:

> Japan presently has an ocean satellite under development, MOS-1, scheduled for launch in 1985; it will carry all passive sensors. The European Space Agency is in the final stages of authorizing funds for ERS-1, scheduled for launch in 1986 or 1987–it will carry active and passive sensors. Canada is interested in flying a Synthetic Aperture Radar (SAR) with another country in the late 1980's.[3]

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[1] See app. B.
[2] See app. C.
[3] W. Stanley Wilson, "Oceanography From Satellites?" *(Oceanus,* XXIV, 3.