ASTRO-1 and ASTRO-2 payloads

ASTRO was a SPACELAB astronomical payload that flew on two Shuttle missions: STS-35 (December 1990) and STS-67 (March 1995).

ASTRO-1 was the primary payload of STS-35. It was designed to make round-the-clock observations of celestial objects in the solar system and in deep space in ultraviolet (UV) and X-ray wavelengths. ASTRO-1 included three UV telescopes: the Hopkins UV Telescope (HUT), the UV Imaging Telescope (UIT) and the Wisconsin UV Photopolarimeter Experiment (WUPPE). They were mounted on the Instrument Pointing System (IPS). A fourth telescope, the Broad-Band X-ray Telescope (BBXRT) and its Two-Axis Pointing System (TAPS) rounded out the ASTRO-1 payload. If the Shuttle Challenger had not been tragically lost in January 1986, ASTRO-1 might have flown in March 1986 for extended observations of Halley's Comet. Unfortunately, ASTRO-1 suffered technical issues with its IPS. The BBXRT was not affected. Despite those pointing problems, the full suite of telescopes was able to obtain 231 observations of 130 celestial objects over a combined span of 143 hours. Science teams at Marshall and Goddard estimated that 70% of the mission's astronomical objectives were completed. In particular, the goal of the UIT was to observe UV radiation from space since most UV radiation is absorbed by Earth's atmosphere and cannot be studied from the ground. The ASTRO-1 UIT provided the first accurate observations of UV radiation from the universe.

Despite its IPS problems, ASTRO-1 was considered by NASA to be a "proven scientific performer", and the updated ASTRO-2 was the primary payload carried by STS-67. It was composed of the same three UV instruments of ASTRO-1, along with an IPS, but did not include the BBXRT. The three ASTRO-2 telescopes together had a mass of 7885 kg and were attached to a pair of SPACELAB pallets in the Shuttle's payload bay. The ASTRO-1 IPS had been extensively modified for this mission and an Image Motion Compensation System (IMCS) had been added. It was designed to eliminate the effects of "jitter" induced by crew movements and thruster firings and helped to refine the telescopes' pointing and stability. This was vital for the UIT, whose images were recorded on film, with individual exposures lasting as long as 30 minutes. The ASTRO-2 IPS and IMCS performed flawlessly. The WUPPE team gathered more than three times as much data as had been gathered during ASTRO-1, the UIT investigators reported that all planned celestial targets had been acquired, and the HUT scientists announced more than

100 successful observations. The extensive ASTRO-2 observations supplemented those of ASTRO-1. In particular, the ASTRO-2 UIT was able to capture almost twice the UV spectrum of its predecessor. As STS-67 launched at a different time of year from STS-35, data were collected from portions of the sky that ASTRO-1 was not able to view. Jupiter also fell under ASTRO-2 scrutiny. HUT investigators focused on its immense magnetosphere and its volcanically active moon, Io. A recent eruption on Io had deposited material onto the surface and into its tenuous atmosphere, prompting HUT co-investigator Paul Feldman to seek evidence of changes in the number of sulfur and oxygen ions in its environment. “As Io orbits Jupiter once every 42 hours,” noted one of NASA’s news summaries, “some of this material is left behind, forming a donut-shaped torus of sulfur and oxygen plasma around Io’s orbit.”