Galileo's makeover for a long, hot journey

Even if the space shuttle returns to flight on Aug. 4 as currently scheduled, and does nothing else to keep the long-awaited Galileo mission to orbit Jupiter from departing as planned on Oct. 8 of next year, the effects on Galileo will be far greater than just the time consumed in getting the shuttle fleet going again. Because of the 3½-year launch delay in the mission, a journey of six instead of 2½ years to reach the giant planet, and a route that will carry the craft so close to the sun that the solar intensity will be about twice that for which it was originally designed, Galileo is having some changes made.

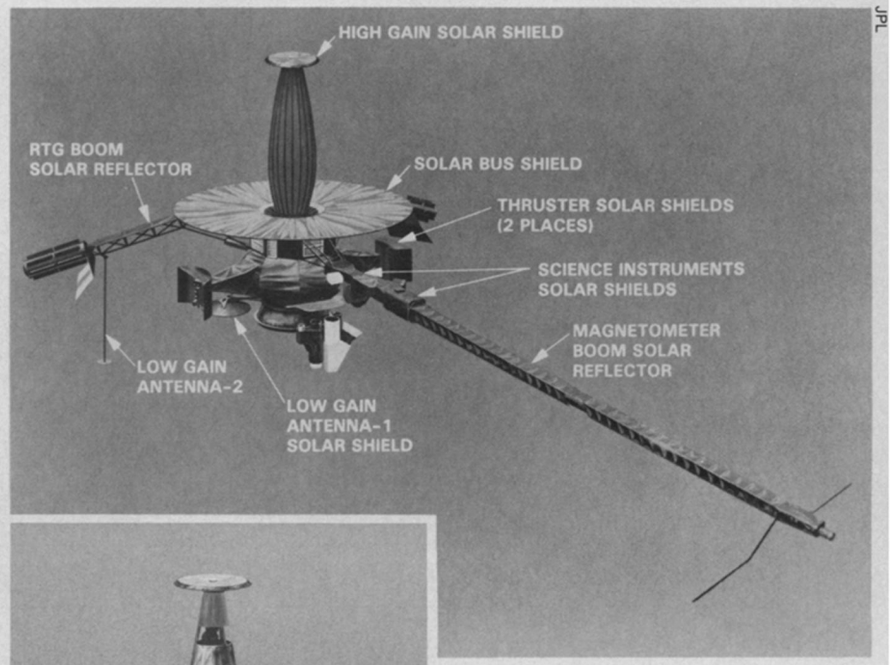
The spacecraft is essentially in two parts. By far the larger is the orbiter, which will photograph and study the planet and its major moons (as well as Venus, earth, the moon and two asteroids on the way). Attached to the orbiter in a protective canister for most of the trip will be the probe, which will finally emerge to descend by parachute through the Jovian atmosphere. Most of the changes are on the orbiter, to protect it from the sun's heat near Venus with a variety of shades, insulation panels and other devices. For example, the orbiter is designed so that its huge, dish-like, high-gain antenna will face the earth from Jupiter, but during the initial trip in toward Venus, necessary for a "gravity assist" to provide some additional acceleration, the antenna will be folded around a central mast like the petals of a yet-unopened day lily. Even then a small shade will be mounted atop the mast, and a larger shade will be mounted at the mast's base, protecting the components beneath.

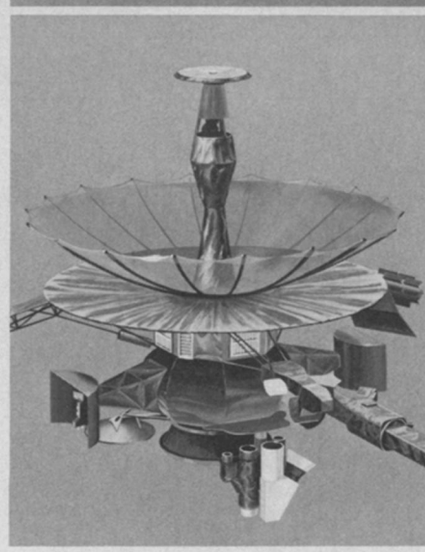
The center line of the spacecraft must always face the sun, notes William J. O'Neil, Galileo Science and Mission Design Manager at the Jet Propulsion Laboratory in Pasadena, Calif., so that the sunshine does not strike unprotected areas by slanting in around the shades. In case the craft threatens to drift out of line, an added sensor is being provided that will enable the craft automatically to shut down the possibly offending systems (such as leaky gas thrusters) in case the primary system fails. Without it, failure of the primary system would be "catastrophic," he says. "This is so crucial, we could have fatal damage if we had an exposure of even tens of minutes to unshaded heat. There'd be no chance of survival without these shades. It's not a matter of conservatism."

An additional modification necessitated by the Venus flyby is a twin to another of the orbiter's antennas, pointing in the opposite direction from the existing one because the original antenna will be facing away from the earth while the craft is heading inward from earth's orbit. A different kind of change is the substitution of better-fabricated memory chips for some electronic equipment, due to reliability problems discovered during testing.

As for the probe that will sample Jupiter's atmosphere, the parachute that will control its descent into the atmospheric depths is being replaced because it has been tightly packaged so long waiting for its brief use that it has developed creases that could result in cracking. Also being changed on the probe, managed by NASA's Ames Research Center at Moffett Field, Calif., are existing batteries and some other equipment — not because of signs of any malfunctions, but simply because they were designed for a 10-year lifetime that will have been exceeded by the time the delayed mission reaches its goal.

Changes have also been made to some of Galileo's scientific instruments, again, not because of potential failures, but because of new insights over the passage of time. The orbiter's ultraviolet spectrometer is being augmented to expand its range, because the two Voyager spacecraft that visited Jupiter found that the "plasma torus" in the orbit of its moon Io emits most of its energy at extreme ultraviolet (EUV) wavelengths. The idea had been suggested even before Voyager 1 confirmed the EUV emissions in 1979, O'Neil says, but by the time Voyager's data had made it persuasive, the originally planned launch date had left insufficient time to modify the already planned instrument. In addition, there have been state-of-the-art improvements to the orbiter's energetic particle detector, and improved detectors and other modifications have been provided to the probe's net-flux radiometer.





Sunshades and reflectors are being added to Galileo (above) to protect it from the sun's heat, because the Jupiter-bound vehicle will pass closer to the sun than originally planned. One shade will shield the folded high-gain antenna, which will later open like the petals of a flower (left).

But more than hardware is being affected by the long-delayed and stretched-out mission. "A number of the younger people on the program have taken advantage of the delay to go back to school, with the intention of returning," says O'Neil. In addition, Lawrence Colin, former project scientist of the Galileo probe as well as the Pioneer Venus mission, has been rehired as a consultant for Galileo after retiring last year from NASA Ames. And perhaps even more to the point in the matter of Galileo's delayed arrival at its destination, O'Neil notes that some of the mission's principal scientists, already prominent in their fields when the team was selected, will be in their mid-70s by the time their data start coming back from Jupiter.

— J. Eberhart