Paper ID: 66035
oral

55th IAA HISTORY OF ASTRONAUTICS SYMPOSIUM (E4)
Scientific and Technical Histories (2)

Author: Dr. David Dunham
KinetX, Inc., United States

Mr. Craig Roberts
United States

THE SOLAR AND HELIOSPHERIC OBSERVATORY, THE LONGEST HALO-ORBITING MISSION

Abstract

The Solar and Heliospheric Observatory (SOHO) is a joint ESA/NASA mission, built by a European consortium led by Matra Marconi Space, launched with a Lockheed Martin Atlas rocket by NASA on 2 December 1995, and operated by NASA from the Goddard Space Flight Center. On 14 February 1996, SOHO was inserted into a halo orbit almost identical to that of the first halo mission, the Third International Sun-Earth Explorer (ISEE-3) [1]. However, rather than use a tight control strategy like ISEE-3 used while in its Sun-Earth L1 orbit, SOHO used simpler, more fuel optimum "orbital energy balancing" maneuvers to cancel the unstable component of the motion [2].

Although SOHO's planned mission was only two years, now after more than 25 years, the spacecraft is still operating, returning valuable images of the Sun and of thousands of small sun-grazing comets, and measurements of the solar wind upstream of the Earth (like ISEE-3). Three years before the launch, it was suggested that SOHO might save some fuel by entering a large-amplitude, slowly evolving Lissajous orbit rather than a halo orbit [3]. It's fortunate that the SOHO project didn't select that option, which would have caused communication losses when the spacecraft passed too near the Sun, as seen from the Earth, starting about ten years after the launch; the quasi-periodic halo orbit avoids those losses.

On 24 June 1998, SOHO lost its lock on the Sun during gyroscope calibrations and maneuvers. Attempts to recover lock failed and contact with SOHO was lost the next day. SOHO started spinning, losing power as its solar arrays no longer pointed at the Sun. A month later, SOHO was located using radar from Arecibo and Goldstone. A carrier signal was received on 3 August and the recovery team was able to slowly recover the spacecraft during the next three months; SOHO had not drifted very far from its halo orbit, which was soon recovered with small maneuvers. All of SOHO's gyros failed by late December. A gyroless operations mode was devised and implemented in February 1999.

[1] D. W. Dunham et al., "The Third International Sun-Earth Explorer, the first halo orbiter", IAC 2021 paper IAC-21,e4,2,x65968, 2021.

[2] D. W. Dunham and C. E. Roberts, "Stationkeeping Techniques for Libration-Point Satellites", Journal of the Astronautical Sciences, Vol. 49, pages 127-144, 2001.

[3] D. W. Dunham et al., "Transfer Trajectory Design for the SOHO Libration-Point Mission", IAF Paper 92-0066, 1992.