

SPACE OPERATIONS SYMPOSIUM (B6)
Mission Operations, Validation, Simulation and Training (3)

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THE 2014 EARTH RETURN OF THE ISEE-3/ICE SPACECRAFT

Abstract

In 1978, the 3rd International Sun-Earth Explorer (ISEE-3) became the first libration-point mission, entering a halo orbit about the Sun-Earth L1 point, where it was tracked by GSTDN stations. Four years later, a series of lunar swingbys and small maneuvers ejected ISEE-3 from the Earth-Moon system, accomplishing the first comet (Giacobini-Zinner) flyby in 1985, as the rechristened International Cometary Explorer (ICE). With greater distances, GSTDN could no longer communicate with ISEE-3/ICE, so arrangements were made to use 26m DSN antennas. In its 355-day heliocentric orbit, ISEE-3/ICE slowly drifted around the Sun such that it would return to the Earth's vicinity in 2014. Maneuvers in 1986 approximately targeted a 2014 August lunar swingby so the spacecraft might be recaptured into the Earth-Moon system [1]. In 1999, ISEE-3/ICE passed behind the Sun, where the spacecraft was tracked mainly to study the solar corona. In 2008, a single DSN pass with the Goldstone 70m antenna successfully detected ISEE-3/ICE's carrier signal, showing that the spacecraft communication system was operational. In 2013, several meetings assessed the viability of re-establishing a command capability with ISEE-3/ICE, with the goal of determining the health of the scientific instruments (as of 1999, all but 3 of ISEE-3/ICE's 12 particles and fields instruments worked) and performing a maneuver with less than the 150 m/s remaining delta-V capacity to target the 2014 August 10th lunar swingby. Most spacecraft documentation was lost, but enough material was found that those familiar with ISEE-3/ICE believed that the command capability could be re-established. The realization that, if ISEE-3/ICE could be captured back into a Sun-Earth L1 orbit, it could contribute to current efforts to monitor the solar wind upstream of the Earth, brought increased interest in late in 2013. After some inquiries, it was found that equipment used in 1999 for spacecraft commanding was discarded, so it was no longer possible to work with the spacecraft via the DSN. However, calculations showed that the 18m antenna at the Applied Physics Laboratory in Maryland could receive ISEE-3/ICE's carrier signal on 2014 June 9, and spacecraft checkout and commanding might be restored during the next two weeks, when the delta-V cost would be about half of the remaining capacity. This paper will describe these efforts to continue the saga of this pioneering spacecraft.

1. Roberts, C., Dunham, D., and Farquhar, R., *Advances in the Astronautical Sciences*, Vol. 69, Paper AAS 89-205, pp. 709-725, 1989.