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Chapter 2

Robert Farquhar: The Father of Halo Orbits and Much More*

Irene Farquhar,[†] David Dunham,[‡] Kjell Stakkestad,[§]
James V. McAdams,^{**} Bobby Williams,^{††} Roger Maurice Bonnet,^{‡‡}
Florian Renk,^{§§} Klaus Schilling,^{***} Kuninori Uesugi,^{†††}
and James L. Green^{‡‡‡}

Abstract

Robert Farquhar left an impressive trail of accomplishments starting very early in the Space Age. His seminal 1969 Stanford University doctoral thesis, “The Control and Use of Libration-Point Satellites,” was published in 1970 as

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[†] Dr. Irene Farquhar, United States.

[‡] Dr. David Dunham, Kinetx, Inc., United States.

[§] Mr. Kjell Stakkestad, Kinetx, Inc., United States.

^{**} Mr. James V. McAdams, Johns Hopkins University Applied Physics Laboratory, United States.

^{††} Dr. Bobby Williams, Kinetx, Inc., United States.

^{‡‡} Prof. Roger Maurice Bonnet, COSPAR, France.

^{§§} Dr. Florian Renk, European Space Agency (ESA), Germany.

^{***} Prof. Klaus Schilling, Zentrum für Telematik, Germany.

^{†††} Prof. Kuninori Uesugi, ISAS/JAXA, Japan.

^{‡‡‡} Mr. James L. Green, National Aeronautics and Space Administration (NASA), Goddard Space Flight Center, United States.

NASA Technical Report R-346, still a valuable reference on the topic. He worked with John Breakwell to develop the first theoretical basis of halo orbits about the collinear libration points of the three-body problem. He showed how a satellite in a halo orbit about the Earth-Moon L2 libration point could be used as a communications link for a farside landing.

After Apollo, he became interested in multiple comet flyby missions and a halo orbit about the Sun-Earth L1 point. Largely through his efforts, in 1978 ISEE-3 became the first libration-point mission. By taking advantage of ISEE-3's high-energy orbit relative to the Earth, he used a complex series of lunar swingbys to send ISEE-3 to fly by Comet Giacobini-Zinner in 1985, the first comet mission. A byproduct was his discovery of the double-lunar swingby technique that was not only crucial to ISEE-3's success, but also used by other international missions that studied the Earth's geomagnetic environment.

Around 1990, Bob was largely responsible for the establishment of NASA's Discovery program of lower-cost planetary exploration missions. The first-launched of these in 1996 was the Near Earth Asteroid Rendezvous (NEAR) mission to (433) Eros; Bob envisioned its clever orbit and was the Mission Manager following its launch. In 2000, NEAR became the first spacecraft to orbit an asteroid, and the first asteroid lander a year later.

Bob was the Mission Manager during the prelaunch and early operations of the MESSENGER mission, which in 2011, became the first spacecraft to orbit Mercury. Bob also was instrumental in establishing the first NASA New Frontiers medium-class planetary mission, called New Horizons, that explored the Pluto system in 2015. Bob played important roles for both the trajectory and the politics to help make the mission a success.

Thus, Bob's legacy extends across the solar system. Bob lived to relish the successful New Horizons flyby of the Pluto system, but sadly, he passed away three months later, before all of the stunning images had been sent back to Earth. Bob's innovative trajectory designs have been used for many missions, and his ideas are bound to be applied to many future missions.