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US Rosetta – Lessons Learned from Low Cost Participation in Flagship Missions

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Rosetta, an ESA cornerstone mission, after dropping a lander on the surface of comet 67P/Churyumov-Gerasimenko has embarked on a yearlong task of studying the nucleus and its environment. The Lander primary mission lasted approximately 60 hours after which the orbiter started the escort phase conducting observations from both far and close proximity to the nucleus. The orbiter mission includes close approach passes at distances as close as 6 km. The orbiter will escort the comet through perihelion, to a post-perihelion distance of about 2.5 AU. The prime scientific objectives of the Rosetta mission are to study the origin of comets, the workings of a nucleus as a 'machine,' the relationships between the nucleus and coma material, as well as that between cometary and interstellar material, and implications to the origin of the solar system.

Rosetta is an ESA cornerstone mission or what NASA calls a flagship mission. The approximate cost of the mission was 1 billion euro, it was under development for several years, its flight time is approximately 11 years, it is an international endeavor by 12 countries, and it was launched on a powerful Ariane V rocket. As much as Rosetta is a flagship mission, the cost of NASA's contribution is approximately \$150M or equivalent to the cost of payload for a Discovery class mission. NASA contribution includes 3.5 science instruments, about 40 Pi's and Co-I's, an Interdisciplinary Scientist, Deep Space Network support, formal navigation solutions around critical events such as the Mars gravity assist, and shadow navigation during comet operations, and a science scheduling software tool called ASPEN. Just as is the case with other NASA planetary missions, all Rosetta data, including those from European investigations, is being deposited in the PDS. To NASA, Rosetta is thus a low cost planetary mission minus the overhead of spacecraft development, launch vehicle cost and mission operations.

JPL managed NASA contribution to Rosetta. The paper will discuss lessons learned from the Rosetta mission in every area of participation: science, engineering, management, navigation, software development, operations, science planning, reviews, mission assurance, and systems engineering. The paper will discuss the ground segment, how the DSN and ESA assets are scheduled, and how both sides deal with changes, anomalies, coordination, priorities and availability. The final part of the paper will describe management agreements, structure, issues and their resolutions. Differences in the American and European mission design approach will be discussed and how Rosetta management reconciled them. A set of suggestions will be given to allow future international missions to use the optimal structure for science, engineering and management. Work at the Jet Propulsion Laboratory is supported under a contract between NASA and the California Institute of Technology.