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Autonomous, Free-flying Nanospacecraft for Space Physics Measurements

Raymond Goldstein [1]((818) 354-0241; raymond.goldstein@jpl.nasa.gov)
Manfred Boehm [2]((650) 424-4070; boehm@europa.spasci.com)
Kristina A. Lynch [3]((603) 862-3871; kristina.lynch@unh.edu)
Hamid Javadi [1]((818) 354-5655; hamid.javadi@jpl.nasa.gov)
Richard A. Wallace [1]((818) 354-2797; richard.a.wallace@jpl.nasa.gov)

[1]Jet Propulsion Laboratory California Institute of Technology 4800 Oak Grove Dr., Pasadena, CA 91109, United States
[2]Lockheed Martin ATC 3251 Hanover St., Palo Alto, CA 94304, United States
[3]Institute for the Study of Earth, Oceans, and Space University of New Hampshire, Durham, NH 03824, United States

Multi-spacecraft missions have become an important theme in trying to unravel spatial and temporal variations in space plasmas. The recent successful flight of the four hockey puck size free-flyer magnetometers (FFMs) as part of the Enstrophy suborbital mission launched from Poker Flat, AK gives confidence in the ability to deploy fleets of such nano-spacecraft in conjunction with single or multi-spacecraft missions. The free-flyers (FFs) would be carried by and ejected from each of the conventional size spacecraft comprising the mission. The FFs would thus extend the spatial coverage and measurement capability of the primary spacecraft. The only instruments that the Enstrophy FFMs carried were 3-axis magnetometers, but in order to complement the magnetic field measurements in future missions we envision using several sets of FFs, each set carrying a different type of instrument. This would allow maintaining the small size of each FF while minimizing compatibility problems of accommodating conflicting requirements into a single FF (where such accommodation is extremely difficult). This approach also reduces resource (e.g. power) requirements for each FF. So, for example, a magnetospheric mission such as Multiprobe could carry a set of FFMs as well as a set of FFs bearing a miniature particle or wave instrument. With relative ejection speeds of the order of a few m/s the FFs remain close enough that the data from each set can be easily correlated. Sets of these nanosat FFs could also be carried and deployed by spacecraft on planetary missions. Several example missions will be discussed in detail.

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Membership Number:
Raymond Goldstein
AGU - 01892836

Contact Information:
Raymond Goldstein
Jet Propulsion Laboratory California Institute of Technology
4800 Oak Grove Dr.
Pasadena, CA 91109, United States
ph : (818) 354-0241
fax : (818) 354-8895
e-mail : raymond.goldstein@jpl.nasa.gov

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exp. [date not shown for security]
cardholder: Raymond Goldstein
billing zip: 90042
ph: (818) 354-0241
e-mail: raymond.goldstein@jpl.nasa.gov

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