REQUEST FOR PROPOSAL:
Design of An Electrodynamic Tether Demonstration Mission for Highly Agile Spacecraft

I. OPPORTUNITY DESCRIPTION

Electrodynamic tethers (EDTs) have the potential to provide propulsion for orbit-raising, orbit-lowering, and inclination-changing for space missions, without the direct use of propellant. The purpose of this project is to develop a demonstration mission specifically aimed at demonstrating the EDT concept for highly agile spacecraft. That is, the mission should explore the boundaries of performance that is possible using an EDT for orbit-changing maneuvers.

There is a strong possibility that this mission design will lead to an actual EDT demonstration mission.

II. PROJECT OBJECTIVE

The objective of this project is to produce a complete system design to serve as the basis for a proposal to deploy an electrodynamic tether demonstration mission in space. The design must provide, at a minimum, tethered spacecraft, tether control mechanisms, power subsystem details, thrusters and internal actuators for attitude and position control, a power system, a metrology system, and a command and data handling system. The thrusters need not be described in detail; however thruster I_{sp} requirements over the mission lifetime must be calculated and shown to be within range of current thrusters.

III. REQUIREMENTS AND CONSTRAINTS

The fundamental requirement is to demonstrate that an electrodynamic tether can be used to maneuver a spacecraft.

Further requirements are as follows:

a) Develop metrics for characterizing the agility of an EDT spacecraft

b) Characterize the limits of the performance capabilities of and EDT spacecraft

c) Develop a basic science mission to complement the EDT demonstrator (*i.e.*, the mission should do something other than just demonstrate the EDT)

d) The system lifetime must be a minimum of one year.

IV. DATA REQUIREMENTS

The proposal should

a) describe the system architecture;

b) explain from first principles how the design was chosen;

c) explain the launch vehicle selection process;

d) describe the type of tether control mechanisms to be used, and give the basis for the confidence that the chosen mechanisms will work;

e) describe how the experiment will be deployed, including any deployment mechanisms to be used;

f) describe the power requirements and the power system design, including load, solar arrays, batteries, etc.;

g) describe how the experiment will be operated;

h) describe the command and data handling system, including telemetry and data storage requirements;

i) include performance predictions;

j) describe the end-of-life disposal procedures; and

k) include cost estimates for production, deployment, and operations.

VI. REFERENCES

1. Beletsky, V. V., and Levin, E. M. *Dynamics of Space Tether Systems*, Advances in the Astronautical Sciences, Vol 83, 1993

2. Cosmo, M. L. and E. C. Lorenzni, *Tethers in Space* (Past, Present and Future), NASA Marshall Space Flight Center, Alabama, 1997
Available at course website

3. Tomlin, D. D. *et al*, "Space Tethers: Design Criteria," NASA TM 108537, Marshall Space Flight Center, Alabama, 1997
Available at course website

Other references will be made available on course website.