(1) **Mentor:** Dr. Andrew C. Schuerger, University of Florida

(2) **Title:** Survival and Growth of Spacecraft Microorganisms under Mars Simulated Conditions.

(3) **Abstract:** Planetary protection protocols require that spacecraft targeted for landing on the surface of Mars must be assembled in cleanrooms and contain no more than $3 \times 10^5$ total spores (i.e., *Bacillus* spp.) per vehicle at the time of launch. The primary goal for this constraint is to reduce the potential forward contamination of Mars by terrestrial microorganisms on spacecraft. Numerous papers have demonstrated that the high UV flux at the surface of Mars can sterilize many microorganisms present on the exterior surfaces of spacecraft (e.g., Schuerger et al., 2006, Icarus, 181, 52-62). However, there is little data on the potential survival and growth of microorganisms when they are dispersed into Mars regolith and shielded from solar UV irradiation.

Recently, Schuerger and coworkers published work on the growth of several bacteria under simulated Mars conditions that mimic scenarios in which the bacteria are shielded from solar UV irradiation (Schuerger et al., 2013, Astrobiology, 13, 115-131; Nicholson et al., 2013, PNAS, 110, 666-671). Subsequently, 15 species in seven genera of bacteria have been identified capable of growth under martian conditions of 8 mbar, 0 °C, and CO$_2$-enriched anoxic atmospheres (called hypobarophiles due to growth at low pressure; Schuerger et al., 2013). Ongoing work is exploring the effects of low pressure (down to 8 mbar) on the metabolism and ultrastructure of *Serratia liquefaciens* (a hypobarophile) under Mars conditions.

The requested FSGC/SF summer intern will conduct new research to characterize the effects of Mars geochemistry on the survival and growth of bacterial hypobarophiles under simulated Mars environmental conditions. Schuerger has six Mars analog soils generated by colleagues at the Johnson Space Center, TX (described by Schuerger et al., 2012, Planetary Space Sci., 72, 91-101). The Mars analog soils include: (1) crushed basalt, (2) a sulfate-rich acidic soil, (3) an alkaline soil, (4) an aeolian dust component, (5) a high salt soil, and (6) a Phoenix analog soil. The intern will use these soils, Mars hypobaric chambers, a solar UV simulator, and several hypobarophile species to study the effects of geochemistry (i.e., the above analogs) on the survival and growth of bacteria under martian conditions. The research will be conducted in two phases: (1) effects of soil chemistry and sub-zero temperatures (down to -70 °C) on the survival of hypobarophiles under martian conditions, and (2) growth of bacterial cells in Mars analog soils incubated at 8 mbar, 0 °C, and CO$_2$-enriched anoxic atmospheres.

Results will help predict the risks for forward contamination of Mars during upcoming rover missions, and may help constrain the search for life on the surface or near subsurface of Mars.

(4) **Expected Student Contribution:** The student will receive experience in geochemical characterization of analog soils, growth and manipulation of microorganisms, operation of Mars hypobaric chambers, operation of a Mars UV/VIS illumination source, data analysis, and preparation of manuscripts. All work will be carried out in the Space Life Sciences Lab.

(5) **Expected Student Working Hours:** 8 hrs per day, 5 days per week.