IAA Study Group Status Report

Responsible Commission: Commission 1

Study Number and Title: Planetary Science Enabled by the New Generation of Cube-Sats and Miniaturized Scientific Instruments, 1.13

Short Study Description (repeat from Study Group Proposal):
In light of recent advances in science instruments and spacecraft technologies that have emerged in just the past couple of years, Cube-Sats and other very small spacecraft can now be considered for use in planetary exploration, either as adjuncts to larger missions on which they could “catch a ride” to the most remote and challenging destinations in the solar system, or in some cases, as stand-alone missions of their own.

The new generation of Cube-Sats that is emerging is also compatible with capabilities that exist within many universities. This enables students to gain first-hand experience in the design and development of spaceflight hardware, and hence provides an opportunity to further expand the workforce in space sciences and aerospace. If Cube-Sats are launched “piggy back” on larger missions, they also provide a low-cost opportunity for emerging nations to develop and test their capabilities in an endeavor that is currently a very expensive enterprise that requires decades of dedicated capacity building.

In this study we will focus first on the planetary science that can now be considered using these emerging capabilities. The assessment of science opportunities will be anchored in the planetary science priorities of those nations that already have long-term plans and priorities. A key element of the study will be identification of current capabilities and future trends in science instrumentation that are compatible with Cube-Sats and other very small platforms such as micro-rovers, balloon-borne planetary atmosphere probes, etc. A brief survey of emerging capabilities in spacecraft platforms, namely Cube-Sats, miniature rovers, etc. also will be completed in order to, finally, explore example mission concepts where all key elements come together in the pursuit of new scientific knowledge of the solar system.

Progress in past six months:
The team has met several times and has organized into a general team and three sub-teams. Leaders for each sub-team have also been selected. The sub-teams and respective leaders are (1) Science Team led by Dr. Julie Castillo, (2) Instruments Team led by Dr. Carol Raymond and (3) Spacecraft Team led by Dr. Pierre Bousquet. Each sub-team is assessing (a) what is possible today in the current state-of-the-art, (b) what will most likely be possible in the near-term up to next 5 years and (c) what is likely for the long term. Based upon their assessments, the sub-teams will make observations and recommendations that will be integrated by the general team into a final report.

The boundaries of the study have been discussed and agreed up. They are focused on the range that spans from “Cube-Sat” spacecraft in the mass range </=10 kg corresponding to a 3U to 6U form factor, and up to “Micro-Probes” in the </=25kg mass range. Our sub-
teams and general team will also look at standards to enable international collaboration, at the roles of universities, and at relevant technology trends. For mission implementation, a subdivision into three categories can be envisioned: (1) *in situ* spacecraft (orbiters, landers, rovers, penetrators, etc), (2) deep space probes with no fixed-point final destination (such as probes to conduct *in situ* magnetic field observations), and (3) Earth orbiters with relevance to planetary science (such as asteroid finders or technology demonstrators). Spacecraft in categories (1) and (2) can be free-fliers that make their way alone to their distant destinations in the solar system from, say, Geosynchronous transfer orbits to which they might be delivered as a secondary payload on a host launch, and those carried to a distant destination on a “mother spacecraft” bound for that destination as its primary target.

A report outline was also recently produced including a detailed outline of the science section.

The team plans to present results at the IAA Low-Cost Planetary Missions Conference (LCPM) in Berlin, June 2015, and has proposed a two “half-day” session event at the 2016 COSPAR Scientific Assembly in Istanbul.

**Website Study Information up to date?** (Study Group Membership, Study Plan and Schedule): under development

**Issues requiring resolution?** (recommend approach): None

**Product Deliveries on Schedule?** (If modified explain rationale):
Yes, our deliveries are on schedule with a preliminary report scheduled for next March, 2015 at the annual Paris Commission 1 meeting.

**Study Team Member Changes?** (List any Study Team Members that you wish to discontinue, and provide names plus contact coordinates of any Members you wish to add on the second page of this Study Update form.) Note: Complete contact information including email, tel. and fax must be provided for all additions. Only Members with complete contact information will be listed and receive formal appointment letters from the IAA Secretariat.)

**Name of person providing Study Group Status** (Study Group Chair or Co-Chair):
John Baker

**Status Report Date:**
August 14, 2014