Findings

Sounding Rocket Working Group

National Aeronautics and Space Administration

Meeting of June 29, 2006

I. MLRS Rocket Development

Summary. The SRWG applauds the development work with the MLRS rocket, as this promises to fill a much needed gap in the study of the mesosphere and lower thermosphere and ionosphere. We are particularly interested in the timeline regarding when this new capability will be available and the philosophy of the sub-system development with respect to the enhanced MLRS vehicle. Specific questions are provided in the background section below.

Background. The SRWG has followed the development of the small MLRS rocket system with much interest and is very happy with the progress demonstrated thus far. Indeed, we have provided input in past findings regarding science drivers to help guide the sub-system development priorities. The SRWG has a number of questions which are provided below.

The SRWG is very interested in trade studies concerning the MLRS apogee versus sub-system capabilities. What is the nominal apogee with the standard subsystems and what is the nominal apogee if the payload were to be very simple -- i.e., an inflatable sphere or small chemical release? Along these lines, we are particularly interested in knowing when the enhanced MLRS will become available, and whether the plan is for the enhanced MLRS to accommodate all of the standard sub-systems currently being developed for the standard MLRS vehicle. In other words, will the NSRODC developed payload/sub-systems be designed so that they might be simply bolted on to the higher performance vehicle when it becomes available?

Other questions include: What is the expected temperature of experiment section? Is the experiment section isolated from the Wallops T/M section? Is the MLRS vehicle in a class such that it might be more easily launched from remote (non-standard) launch sites in the US and abroad? The SRWG recommends that Wallops develop a payload to carry inflatable spheres such as those presented by Mr. Frank Schmidlin. Such inflatable sphere payloads have proven to be a workhorse for the miniature rocket program over the last several decades. Ultimately, the SRWG is very interested to learn the timetable for when the SRPO believes such a system will be available for science proposals to NASA HQ.

II. NSROC ACS/Attitude/Trajectory Manual

Summary. The SRWG is pleased that NSROC has released the first edition of the "Sounding Rocket Trajectory and Attitude Analysis Manual", particularly since the need for such a document has been long identified by the user community as essential to understanding how trajectory and attitude information are determined using data gathered by the NSROC sub-systems, including a discussion of the accuracy of the measurements.

The SRWG again reiterates its willingness to provide feedback on all sections of the manual.

Background. The success of the majority of NASA sounding rocket payloads relies on accurate measurements of trajectory and payload attitude. To this end, a variety of attitude sensors are utilized by the program, including gyros, sun sensors, horizon sensors, magnetometer, and star sensors, depending on the experimenter's needs as well as engineering requirements. As these attitude sensors have evolved over time and include new hardware developed in house by NSROC, detailed documentation of the operation of the sensors and their accuracies are essential. To this end, we applaud NSROC for producing a manual entitled, "Sounding Rocket Trajectory and Attitude Analysis Manual". This document has been long awaited by the sounding rocket user community, as discussed in our finding from the January 14, 2004 SRWG meeting.

With respect to the attitude sensors, the SRWG believes that the users are indeed the most appropriate persons to provide feedback on the operations and accuracies of the various NSROC attitude sensors. We thus suggest that small groups (2-3 persons each) organized by the SRWG, though not necessarily limited to SRWG members, provide detailed comments on the current version of the NSROC manual and work directly with the appropriate NSROC personnel to clarify points and identify any areas that may need further information. We suggest that one such team be comprised of solar and galactic/extragalactic astronomers who work with the solar and star sensors and a second team be comprised of geospace users who utilize the NSROC gyro and sun, horizon, and magnetometer sensor attitude descriptions.

With respect to trajectory data, the GPS system, C-band radars (skin track and beacon), TRADAT, and other techniques that provide accurate positional data of the sounding rocket payloads, the current version of the manual available to the SRWG at this time has very little discussion of the various trajectory techniques including their relative accuracies and limitations. The SRWG looks forward to more information on the trajectory measurements and would be very willing to provide feedback in this area as well.

III. Appraisal of NSROC ACS and Attitude Systems

Summary. The SRWG is interested to hear an assessment from SRPO as to the effectiveness of the transition of the various ACS and attitude systems from commercial vendors to the in-house systems. In particular, we are interested to learn how the new systems compare with the previous ones with respect to accuracy and performance, mass, power, volume, telemetry, cost, and ease of use, including the timeliness of providing accurate data products to the user.

Background. It has now been over 5 years since the new arrangement with NSROC has been enacted within NASA's Sounding Rocket Program. Chief among the new aspects of the program has been the transfer of all previously procured commercial ACS and attitude systems to in house design, fabrication, test, and evaluation of these sub-systems. In most cases, the in-house development has included extensive and challenging work. Although we have followed keenly the progress and success of these new systems over the last several years, the SRWG would appreciate having an assessment of how the new systems have fared. How do the in-house systems compare to the commercial ones in terms of accuracy and performance, mass, power, volume, telemetry, cost, and ease of use, including the timeliness of providing accurate data products to the user? What lessons have

been learned about taking on such projects? Is the net result worth the effort expended? Are some cases better than others, and why?

IV. Communication between NSROC and Experimenters During Design Period

Summary. The SRWG seeks to alleviate problems during the design phase of the missions that result from the need for final experiment design information from the scientists as well as from the lack of feedback from NSROC on their payload designs well before the Design Review. Ultimately, these problems appear to be best remedied with improved communication between NSROC and the experiment team.

Background. As representatives of the science user community, the SRWG seeks to alleviate problems during the design phase of the missions that result from the perceived lack of final experiment design information from the scientists as well as the lack of feedback from NSROC on their payload designs well before the Design Review. The SRWG emphasizes that, except in cases of re-flights, the science experiments are not "black boxes" that are pulled off of shelves, but rather are one-of-a-kind experiments that undergo a final design phase during the period between the MIC and Design Review, in parallel with the final payload design work by the NSROC engineers. In practice, at a reasonable time prior to the Design Review, a date should be established for finalizing details such as mechanical and telemetry interfaces between the experiments and the payloads. This "freeze date" should be established jointly by the Payload Manager and P.I. This approach requires good communication between the NSROC and Science Teams and has worked well for the program in the past. For new payloads, team meetings between the experimenters and NSROC payload teams have proven to go a long way towards identifying problems and working towards solutions.

Ultimately, the experimenters want to work with NSROC and the SRPO to achieve a successful Design Review that is scheduled when the design of experiments and payloads are complete. The experimenters are, for the most part, fully conscious of the schedule and the need to launch their payloads in a timely fashion. Rather than impose additional deadlines and reviews, the solution to the apparent problems regarding preparations for the Design Review appear to rest with good communication between NSROC and the experiment team including mutually agreed upon dates to establish final interface information.

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