Sounding Rocket Working Group

National Aeronautics and Space Administration

Meeting of July 11-12, 2017

Findings

1. New Talos-Oriole-Oriole Motor

Summary

The Sounding Rocket Working Group (SRWG) is extremely excited about the potential offered by the Talos-Oriole-Oriole (TOO) vehicle for longer duration flights, as presented by the Sounding Rocket Project Office at the last meeting. Again, we recognize and thank the SRPO for being so responsive to our longstanding desire to have longer duration flights, particularly for the astrophysics and solar telescope payloads which seek to maximize "hang time" above 150 km altitude. Flights with ~700 seconds above 150 km for a 1000 pound payload may be expected to yield significant new science results from sounding rocket payloads. The SRWG provides a few follow up questions for subsequent discussion.

Background

The possible availability of the Talos-Oriole-Oriole (T-O-O) vehicle for routine, long duration flights, as presented by the Sounding Rocket Project Office at the last meeting, is welcome news by the Sounding Rocket Working Group. Providing ~700 seconds above 150 km for a 1000 pound payload are expected to yield significant new science results. This new vehicle responds to our continued plea for longer duration flights for telescope payloads, in particular, and we thank and acknowledge the SRPO for working to make such an enhanced performance vehicle a reality.

As presented at the meeting, NSROC appears to have a good plan in place to study topics such as guidance feasibility and Oriole fin development. The SRWG provides below a number of follow up questions related to the vehicle for subsequent discussion:

-- What ranges can support the T-O-O vehicle? This knowledge will assist researchers in determining science targets while allowing planning for future launch campaigns.

-- Although we understand that recovery will not be available during the initial validation and use of the motor, what are the options for recovery, if any, down the road?

-- What are the telemetry options? Some solar and astrophysics rockets have very high data rates that currently require onboard storage that are subsequently obtained with recovery. If recovery is not an option, then telemetry rates on the order of 100 Mbps would be needed for some payloads to benefit from the new vehicle.

2. New Technology/Mesosphere rockets including "Multi-Launch" capability

Summary

A long standing goal of the geospace community has been the development of a small rocket that can be used to investigate the mesosphere and lower ionosphere/thermosphere (sampling between 30 km and 100 km or perhaps as high as 120 km). This finding reiterates that the development of this vehicle remains an important goal for scientific community which should be captured on the sounding rocket "technology roadmap" as an important goal. Ideally, such a vehicle could provide multiple launches on a given day or night. Previous attempts to develop this vehicle/payload (namely the Mosquito program) appear to be on hold. The SRWG asks what are next steps to revive this or a similar activity. Background material is summarized below.

Background

To thoroughly investigate the mesosphere and lower thermosphere (30km - 120km) and its unique characteristics, there is a need for rockets that can be launched relatively inexpensively with a 30-60 minute cadence over the course of several hours, including simultaneous launches along different azimuths to provide spatial coverage. See previous SRWG Findings on this topic: June 2010 (Finding #2), February 2010 (Finding #3), July 2008 (Finding #1), June 2006 (Finding #1), and June 2005 (Finding #4).

In the early 2000's, NASA WFF developed a miniaturized avionics module for the Super-Loki Dart (MET-P) and studied the possible use of the MRLS/Mesquito motor for 4-inch diameter payloads. After some test flights, it was found that the new motor was not suitable as replacement for Viper and that the cost of small sounding rockets was larger than anticipated. The SRWG requests updates on the cost and availability of technology that might enable a modern successor, including, in particular:

- small motors capable of reaching 100-120 km apogee,
- extreme lightweight GPS and TM technology,
- new TM capabilities,
- and inflatable payloads.

The SRWG also asks whether a standard technique for mesospheric investigations could be developed under the leadership of NASA. For example, in the past, NASA's passive, inflatable falling sphere technique provided background measurements of winds and temperature between 30 – 85 km in many sounding rocket campaigns since the 1970s. These were provided by a resident researcher at Wallops (Mr. Frank Schmidlin, who has since retired.)

The SRWG proposes a sub-committee that would organize a community workshop (for example, at the next NSF sponsored CEDAR meeting) to gather input from the science community on rocket needs for the mesosphere in order to define the requirements for a standard technique and to which it invites Wallops personnel and the appropriate NASA HQ discipline scientist.

3. Changes in the Range Safety Manual

Summary

The SRWG noted with interest the proposed changes to the Range Safety Manual discussed at the meeting. We provide comments on two areas of proposed change: "Safety on the pad" and "Electrostatic discharge control".

Background

The SRWG noted with interest the proposed changes to the Range Safety Manual. We would like to comment on two areas of proposed change:

1. *Safety on the pad.* The launch pad is recognized as one of the most hazardous areas of the sounding rocket environment, and pad activities have long been treated with the utmost levels of precaution and prevention. This careful attention to ensuring that pad work proceeds safely has produced an excellent long-term record of safety in this realm. With this backdrop, the committee was surprised to learn of plans to relax longstanding policies on operating "isolated" electrical systems during arming operations. While we understand that this change is being advocated as a way to streamline processes that have been approved recently though case-by-case Equivalent Level of Safety rationales, we would hasten to point out that there is value in looking at high-potential situations in the detail that a case-by-case review affords. From the SRWG perspective, the extra care provided by looking at each case in detail is well worth the extra effort required to understand all of the details of such systems. For example, it is of high importance to understand what "electrically isolated" means and to what degree of reliability the systems in question are actually electrically isolated. Therefore, the SRWG urges a cautious approach and a thorough review of this proposed change to the safety manual.

2. *Electrostatic discharge control.* Uncontrolled electrostatic discharge (ESD) has the potential to disrupt a wide range of electrical systems, large and small, hazardous and non-hazardous. As electronic feature sizes diminish and front-end sensitivities of instruments improve, ESD becomes an increasingly larger concern. The SRPO and NSROC have, along with the rest of the world, recognized and mitigated these increasing vulnerabilities by implementing more rigorous ESD control plans -- measures that the SRWG continues to enthusiastically support. It is in this light that the SRWG finds surprising the proposal to waive requirements for electrostatic dissipative coats in high-humidity environments. The coats provide a good measure of protection, and the current rules simplify their usage. Some sensitive circuitry can be damaged by discharges that originate from only a few volts potential difference, and it is reasonable to expect that even in a high humidity environment, such potentials can arise. Again, the SRWG urges a thoughtful and thorough approach when considering this proposed change to the Range Safety Manual.

4. Verifying Coarse Attitude Data and Magnetic ACS Performance

Summary

The SRWG continues to be concerned about the verification of coarse attitude data (primarily for the Geospace rockets) prior to delivery to the experimenter. There does not appear to be a well-defined procedure that NSROC uses to check the accuracy of the attitude that they provide post flight. Further, in preparation for the recent Poker campaign last winter, a number of rockets were switched from the magnetic ACS to inertial ACS systems late in development because of the performance of the magnetic ACS system was uncertain. This was puzzling to the P.I.'s. The SRWG suggests a round table discussion on both of these topics during the next SRWG meeting.

Background

Over the course of many Sounding Rocket Working Group meetings, the accuracy of the coarse attitude systems, based primarily on gyros, has been discussed. The need for a simple verification system to catch large errors was established. (See previous findings, such as #4 from the June, 2007 meeting and #2 from the June, 2006 meeting as well as several others from preceding meetings) in which this has been discussed.) At one point, an attitude handbook was written but, to our knowledge, exists only as a draft, or at least has not been circulated. Furthermore, many years ago, the "box test" on the rail was instigated to make sure the gyros were performing nominally. Are the box test results incorporated into this verification scheme, and if so, how?

Problems with the timing were also identified as a source of attitude errors, particularly for the roll data. During the last Poker campaign, the identification (labelling and sign) of the various attitude channels was shown to be ambiguous (and different between payloads). The usual comparison with the attitude magnetometer data as a means to check the overall attitude data is now very difficult for the users since that magnetometer data, which previously was available as analog housekeeping channels, are now buried in a bit stream which is difficult to decipher. The SRWG would like to have clarifications on the validation and verification procedures for the coarse attitude data.

Furthermore, at the latest SRWG meeting, we heard that a new attitude system, the Tern INS, will soon become available. The SRWG was surprised to learn this. Does this new system provide improved performance? Perhaps lower mass, power, and cost? How will its data be verified?

Finally, although the actual pointing performance of the ACS systems for geospace payloads appears to be working very well, we were surprised that the magnetic ACS systems slated for at least two rockets last winter at Poker were both changed to inertial systems because the performance of the magnetic system was not trusted by the NSROC engineers. This was also a surprise, for which the SRWG requests insight.

The SRWG suggests a round table discussion on these topics as part of the next SRWG meeting.

5. Sounding Rocket Presence at Major Conferences

Summary

The SRWG suggests that the visibility of the rocket program be featured at select scientific conferences to promote the unique science that can be obtained from sounding rockets in all disciplines -- Astrophysics, Planetary, Solar, and Geospace -- and to encourage younger scientists and engineers to avail themselves of this tremendous program and the opportunities that it presents.

Background

We were heartened to hear the presentation by George Albright of his recent efforts at NASA HQ, articulating the interdivisional benefits of the Sounding Rocket Program (SRP) to advancing NASA's scientific and technical workforce.

Indeed, an important aspect of the SRWG mission is the encouragement and support of new PIs and groups, to ensure a future NASA workforce that is innovative and diverse. Towards that end, the working group sees a critical need to raise awareness, within the Astrophysics, Planetary, Heliophysics, and Geospace research communities, of opportunities offered by the NASA Sounding Rocket Program for gaining hands-on experience in the fielding of space missions, while performing cutting edge science and advancing of new technologies.

Thus, we strongly encourage the Sounding Rocket Project Office (SRPO), supported by NASA HQ and the NASA Sounding Rocket Operations Contractor (NSROC), to establish a high visibility presence at national scientific conferences, such as the annual Fall American Geophysical Union and Winter American Astronomical Society meetings. We recommend this presence include a dedicated "eye catching" booth, featuring typical hardware and information pamphlets, staffed by SRPO, NSROC, and Sounding Rocket PIs (current and former). Such a forum will provide an opportunity for current PI's and program managers to "school" potential new PI's, while promoting the benefits of the SRP to the targeted community. It will also provide an informal space for SRPO, NSROC and Sounding Rocket PIs to catchup on new capabilities, share experiences and exchange lessons learned.

We believe that articulating the value of the SRP to its diverse Astro, Helio and Geospace communities goes hand-in-hand with raising the profile of SPO at HQ, and will ultimately yield a more vibrant program.

6. Wilt Sanders' Retirement — Appreciation

The Sounding Rocket Working Group expresses its sincere appreciation and deep gratitude to Dr. Wilt Sanders, who managed the Astrophysics Sounding Rocket program at NASA HQ so effectively for over a decade and who retired this summer. Wilt is one of our own, having worked on many sounding rocket payloads during his career and having served on this committee. Further, as a result of Wilt's leadership of the rocket program in

Astrophysics at HQ, the flight rate of payloads with both UV and X-ray telescopes has increased, fostering new discoveries and the development of new instrument technology. Furthermore, Wilt has encouraged and funded many young rocket P.I.'s in Astrophysics, helping to ensure that Astrophysics investigations would continue with new and innovative ideas. He also has been steadfast in his commitment to a rocket campaign in Australia, enabling Southern Hemisphere astronomical targets to be explored with sounding rocket technology. The sounding rocket program that Wilt Sanders helped foster has enabled unique scientific achievements to be carried out in space, reflecting highly on both NASA and the United States. We acknowledge Wilt's unwavering support for, and his tireless dedication to, NASA's Sounding Rocket Program.

NASA Sounding Rocket Working Group

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