Sounding Rocket Working Group

National Aeronautics and Space Administration

Meeting of January 10-11, 2017

Findings

1. Larger Diameter Rockets and Higher Performance Motors and Motor "Clusters"

Summary

The SRWG applauds the SRPO's initiative to investigate new rocket motors which enable both larger diameter payloads and higher altitudes (longer flight times). Larger diameter options and higher apogee motors, including motor clusters, enable truly transformational science opportunities particularly for astrophysics/solar telescope payloads. The SRWG looks forward to working with the SRPO to make these launch opportunities a reality.

Background

The Sounding Rocket Program Office (SRPO) continues to study various new motors and new motor configurations to increase maximum altitudes and, accordingly, increase flight times above 150 km, as well as new, larger diameter motors that will enable increased payload diameters. These new vehicles represent an opportunity for enhanced science return from suborbital platforms across the science disciplines. The SRWG encourages continued development of these capabilities in two focused areas presented to us at the January, 2017 meeting – the large diameter, higher performance "Gem 46" rocket, and the cluster motor combination -- the multiple-Terrier+Brant+Nihka motor, which can launch existing diameter payloads to considerably higher altitudes. We discuss these separately below.

The Gem 46 rocket represents a transformative opportunity for telescope payloads (i.e., for astrophysics and solar payloads) because 1-meter class telescope primary mirrors could be readily accommodated by using this larger diameter rocket and because it provides a considerably higher apogee than existing rockets in the program. The science return from telescope payloads is typically directly determined by the total number of photons that can be collected, which is proportional to the product of the telescope collecting area and the exposure time. A 1-meter telescope on a Gem 46 (with 1150s of observing time above 150 km) collects a factor of ~25 more photons than the largest telescope (40 cm) that can be flown in a traditional 17.26" diameter experiment on a Black Brant IX (300s of observing time above 150 km). This type of game-changing advance enables exciting new science opportunities such as Lyman-alpha escape from star-forming galaxies and extended spatial/spectral observations of key solar dynamics processes. Furthermore, this increased collection capability enables astrophysics payloads to access fainter targets, setting up rockets to carry on ultraviolet astrophysics in the post retirement era of the Hubble Space Telescope. For example, a high-altitude rocket flying a 1-meter class telescope could make a unique and critical contribution to the James Webb Space Telescope's search for biomarkers on Earth-like exoplanets, likely one of the most revolutionary science observations that JWST will perform. Observation of the star's ultraviolet spectrum is critical to modeling the origin of biomarker molecules and thus our assessment of whether or not these planets could truly host active biospheres.

Cluster motor combinations such as the proposed multiple-Terrier+Brant+Nihka system would enable science observing times of ~700s above 150 km and apogees ≥ 650 km but with traditional payload diameters. Such a system would more than double the observing time of typical astrophysics and solar payloads and would provide important new observing opportunities (higher apogees, particularly for multiple payloads) for geospace experiments. Furthermore, while most telescope programs desire recovery to keep program costs low and student training programs vigorous, using this system would be an attractive science enhancement opportunity for "end of life" missions, where an existing telescope payload is being flown for the last time.

2. Improving Cryogen Safety Requirements and Training

Summary:

Recent difficulties have been encountered with the implementation of measures designed to manage the safety risk of cryogens. The SRWG encourages the SRPO, in conjunction with NSROC and the experimenter community, to re-examine the current approach taken to cryogenic safety in the program. We believe that a document that clearly lays out the requirements for allowed cryogenic systems, and demonstrates several examples of systems that have worked well in the past, is needed. Further, safety training is a key ingredient for which the SRWG encourages that training options, supplied by SRPO or NSROC, perhaps through an on-line course, be considered.

Background:

The Sounding Rocket Working Group (SRWG) understands and fully supports the need to ensure a safe working environment. It is further recognized that work with cryogens represents a safety risk that must be managed. However, recent difficulties have been encountered with the implementation of measures designed to manage this risk. The SRWG encourages the SRPO, in conjunction with NSROC and the experimenter community, to re-examine the current approach taken to cryogenic safety.

Many instrument teams use liquid nitrogen (LN_2) for cooling experiment components prior to launch. Over the last few years, the approach to using LN_2 safely has changed, with much more emphasis on using equipment and procedures that have been approved by Safety offices. While the SRWG supports changes that improve any safety postures, the recent changes have also had a noticeable negative effect on the instrument teams' ability to use liquid nitrogen.

The current paradigm is that the instrument team states their needs and writes a set of procedures that then get processed through the relevant safety offices, often with multiple iterations with the research team. Because experiment teams do not have reference guidelines at the start, this is a long process, and experiment teams often have little knowledge of the options that could be used. While NSROC and SRPO provide very helpful advice and recommendations, this does not replace a definitive reference guide. This process often occurs within 6 months of launch. One end result is that the approved cryogenic procedures and settings may be different than the ones the instrument team has been using at their home institution. This process would be greatly improved by relying on reference documents and tested systems designs and procedures. This approach would improve efficiency for all involved, as well as help prevent surprises in the field that require extraordinary adaptive measures or even result in unfulfilled requirements.

Since the rules involving cryogenic handling seem to be in a state of flux, leaving experiment teams unclear on what will be allowed often until just before traveling to integration or the launch site, a suggested way forward is the development of a document that clearly lays out the requirements for allowed cryogenic systems, and demonstrates several examples of systems that have worked well in the past.

Additionally, as with most safety regimens, safety training is a key ingredient. Most experimenter institutions require team members who work with LN_2 to be trained in the safe handling of cryogens. We deem this training, plus the short in-person session that is carried out for WSMR operations by a WSMR safety officer at the start of a campaign, to be valuable and sufficient. If additional training is to be required, we request that an on-line course be provided. This is particularly important since the appropriate training may not be available at all experimenter institutions.

3. Encouraged by Water Recovery Progress

Summary

The SRWG is greatly encouraged by the work of the SRPO to enable water recovery for telescope payloads. In particular, the planned launch of an astrophysics payload with recovery from Kwajalein in 2018 is applauded. The community greatly appreciates the responsiveness of the program to meet these important science requirements.

Background

Over the past several years, the SRWG has urged the SRPO to develop water recovery for telescope payloads. Two benefits would immediately result from this action: (1) launches of telescope payloads could be carried out at Wallops and other ranges without the narrow constraints imposed by launches at White Sands, thus enabling higher performance motors to be used resulting in longer observing times; and (2) launch ranges in the southern hemisphere over water could thus be considered, enabling southern hemisphere astronomical targets to be studied.

The SRWG is very encouraged with the progress reported thus far by the program for water recovery of telescope payloads. We recognize that achieving this goal is not an easy task and we simply take this occasion to recognize the progress that has been presented to us and re-state the importance of this very significant program goal for scientific research.

Towards this end, we are thrilled that the program will be launching the McEntaffer astrophysics payload from Kwajalein in 2018 with recovery planned. We understand that recovery of telescope payloads is not yet a proven capability and has elevated risks. Nevertheless, the creative approach described at the SRWG of using the "Great Bridge" assets of Kwajalein are to be commended, particularly as this unique flight for an astrophysics payload will enable southern hemisphere celestial targets to be explored.

4. Telemetry Test Equipment at Experimenter Institutions

Summary

The SRWG reiterates its suggestion that NSROC consider providing a small number of experimenter teams with emulators to enable telemetry handshaking testing at home institutions before these experimenters arrive at WFF for integration. We believe that our previous finding was misunderstood and that the concerns that NSROC expressed can be alleviated. We look forward to establishing a "win-win" approach in which emulators are provided (as is standard in satellite programs) to an anticipated small number of experimenters who demonstrate a need for such hardware and have the necessary engineering expertise at their home institutions to use them effectively.

Background

As a follow-up from our previous finding (see Finding #4 from June, 2016 meeting), the SRWG reiterates the suggestion that NSROC consider loaning a small number of experimenters the emulators to enable telemetry handshaking testing at home institutions before experimenters arrive at WFF for integration. Providing such telemetry emulators is standard practice for satellite programs and enables many problems to be discovered prior to integration. Indeed, Wallops telemetry "suitcases" and PCM stacks have been made available on a case-by-case basis in the past to certain experimenter groups that requested them.

Nominally, such test hardware would consist of a non-flight, but functional TM stack with a computer bit-sync/decom card such as the Ullysix PCI-01. This would be loaned to the experimenter institution for verification that all signals are correct and that TM is correctly being transmitted through the experimenter electronics. While such systems are not inexpensive, they are not hugely expensive either. Surely, a pilot program with a few test emulators could be made available to certain experimenter teams that demonstrate a specific need for such hardware and expertise at the home institution to use them.

Because a loan of such equipment would be carried out prior to integration, teams would use local resources to solve problems and would arrive at integration with signals already verified. This promises to dramatically reduce integration time, saving time for both WFF and experimenter personnel because debugging would be minimal during integration. It would not replace verification of these signals at WFF, but would reduce time lost to getting these signals right in the first place. The time savings could rapidly recover the cost of these test systems and would also reduce time demands on WFF personnel allowing them to work on other projects.

The SRWG believes its initial finding suggesting that emulators be provided to experimenter teams was misunderstood. We would appreciate a dialog with NSROC so that we can demonstrate that our request is not only reasonable but also within the scope of the program. Furthermore, there appears to be a concern that NSROC would have to provide tech support for the checkout system. Experiment teams who would be using these emulators already have significant knowledge and technical understanding of the Wallops telemetry to implement the interfaces. The program is based on a partnership between the experimenter teams and Wallops and emulators would only be provided to teams that demonstrate that they are capable of operating the equipment with minimal assistance from WFF personnel. In other words, we suggest that such equipment only be made available to teams that have achieved an appropriate understanding of the Wallops telemetry system and interface. The telemetry emulators would require good accompanying documentation, but that information should be already on hand.

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