Sounding Rocket Working Group

National Aeronautics and Space Administration

Meeting of July 10-11, 2019

Findings

1. Maintaining Year-Round Operations at Poker Flat Research Range

Summary

The Poker Flat Research Range in Fairbanks, Alaska is a national asset, having provided a critical and essential element to NASA's sounding rocket program for over 50 years. Although the rocket flight rate at Poker varies from year to year, the SRWG strongly urges that Poker be kept available for scientific research each year. From a programmatic standpoint, we urge NASA to actively encourage rocket missions to be launched from Poker, where scientifically viable, including not only Geospace missions, but also Astrophysics and Solar missions, particularly since Poker provides land recovery operations and extended observing periods at low cost compared to White Sands. We further emphasize that the Poker Flat Science Operations Center (SOC) fulfills a vital role with state-of-the-art ground-based measurements that provide a unique baseline for scientific research year-round, providing the underpinnings for numerous sounding rocket research missions, in addition to critical measurements during the rocket flights themselves.

Aware that budgets are tight, the SRWG urges NASA to seek creative partnerships with the University of Alaska, as well as NSF (where appropriate), to reduce infrastructure costs yet keep the rocket range and in particular, the SOC, operational year-round.

Background

Owned and operated by the Geophysical Institute at the University of Alaska, Fairbanks, the Poker Flat Research Range is a unique and extraordinary national asset, having provided a critical and essential element to NASA's sounding rocket program for over 50 years. Among the many outstanding features provided by this research range include the following:

-- Unique high latitude location in the auroral zone with trajectories capable of reaching the polar cap

-- Provision for multiple, simultaneous rocket launches with five active, environmentally controlled launch pads

-- Ability to launch, track, and receive high rate data from multiple payloads on a single rocket with apogees ranging from 100 km to over 1000 km

-- Ability to provide downrange scientific observations using ground-based instruments and cameras (essential for precise triangulation of luminous vapor trails), including simultaneous measurements during rocket launches with real-time communications and longer-term observations critical for scientific understanding and research

-- Close proximity to the world-class NSF incoherent scatter radar, PFISR

-- A Science Operations Center (SOC) in a dedicated, modern building with state-of-the-art instruments and auroral viewing facilities, including real-time communications and displays as well as multiple year records (and archives) that provide unique observations (with real-time, simultaneous displays) and decades-long baselines and trends

-- Ability to recover payloads on land, including those which gather sealed air samples at pre-determined altitude increments within the stratosphere and mesosphere

-- Ability to launch "tailored" trajectories, including rockets with large horizontal velocities at low altitudes

-- State-of-the-art tracking and telemetry systems support, including multiple, simultaneous 10Mbps (and higher) telemetry links

-- US range with close proximity to a major airport, hotels, and the Univ. of Alaska machine shops

These are some of the many reasons why the Poker Flat Research Range is the optimum site for numerous rocket missions and helps underscore why this invaluable national resource has proven to be so important to the nation's space program.

Although most auroral experiments require darkness afforded by winter conditions, other scientific phenomena require other specific seasons to meet their research objectives (e.g., noctilucent cloud research in summer; upper atmosphere wind observations at all seasons). Accordingly, the SRWG emphasizes that the Poker Flat range should be able to support the capability to launch rockets at any time during the year, while recognizing the need to coordinate with various local environmental and recreational entities, particularly between the months of May and September.

In addition to its high geomagnetic latitude, a significant advantage of launches from Poker is the availability of several downrange sites that can be used for simultaneous observations. Such sites include Fort Yukon, Kaktovik, Toolik Lake, Venetie, and Coldfoot, among others. Several of these downrange observing sites include precision scientific instruments that are outfitted with good communications including internet data transfer for real-time observations. The availability of such observations is mission critical for many projects. Although the allowable launch trajectories from Poker are restricted azimuthally, the large number of downrange sites enable ground observing from neighboring azimuths. These sites are spaced to ensure near magnetic conjugacy for a large number of apogees along the flight path.

A key strength of Poker is its Science Operations Center (SOC) located on the range with state-of-the-art ground-based instrumentation including all-sky cameras, high frame rate narrowband cameras, meridian scanning photometers, Fabry-Perot interferometers and magnetometers that are operated continually and are routinely used to monitor and identify the geomagnetic conditions required for mission success, as well as to obtain mission critical data through the rocket flight. These measurements are often required not just during the mission launch window but for a period of 1-2 solar rotations (or longer) beforehand (~27 days per rotation). Historical observations are frequently used by experimenters in the proposal stage to develop a feasible experimental methodology and are also used by experimenters to specify minimum success criteria and geomagnetic conditions required for launch. Experimenters sometimes utilize the SOC one year prior to the launch window in order to test ground-based instrumentation and operating schemes that will be used during launch.

The SOC provides long term, continuous ground measurements that are used by the entire experimental community and are essential for sounding rocket researchers to both understand the geophysical environment and plan and design experiments. The Sounding Rocket Working Group believes that it is essential to keep the SOC and its ground-based measurements active year-round. Recognizing that such year-round activities might require support beyond that provided by the standard operations contract, the SRWG suggests that, in cases where significant additional support is needed, perhaps non-NASA users of the SOC facility might be able to participate in cost sharing.

Due to the extremely large scientific scope of research carried out by NASA's sounding rocket program, the SRWG believes that determining which seasons are most important scientifically is both difficult and unwise. NASA's rocket program allows experimenters to propose investigations of any scientific problem in space that can be demonstrated to be compelling and timely. This extremely broad scope is a laudable feature of NASA's sounding rocket research program and ensures that the doors of research will be kept open for unpredictable discoveries and observational programs in the decades to come. Accordingly, as the focus of research topics varies considerably from year to year and potentially could require observations over many different seasons, the SRWG is not comfortable with SOC operations restricted to only a portion of the year.

The SRWG urges NASA to seek creative arrangements with the University of Alaska, as well as NSF (where appropriate), to reduce infrastructure costs yet keep the rocket range and in particular, the SOC, operational year-round.

Finally, from a programmatic standpoint, we urge NASA to actively encourage rocket missions to be launched from Poker, where scientifically viable, including not only Geospace missions, but also Astrophysics and Solar missions, particularly since Poker provides land recovery operations and extended observing periods at low cost compared to White Sands.

2. Improving Communications Between the PIs and Mission Management

Summary

The SRWG recognizes the critical importance of timely communication between SRPO, NSROC, and the PIs and their teams. At the July 2019 meeting, several programmatic and logistical issues were identified by the SRPO that appear to be related to the frequency and type of communication between the PI and his/her NSROC teams. The SRWG finds that: (1) guidelines for the level and nature of communication between PIs and their Mission Managers (MMs) should be modified to increase informal communication, particularly regarding resource costs of different options and the probability of schedule slips; (2) program, mission processes, points of contact, and salient logistical guidelines – such as for Technical Assistance Agreements -- should be improved and explicitly provided by the SRPO; and (3) in the interest of better communication between SRPO and the wider science community, the Sounding Rocket Handbook should be updated to include updated technology and capability descriptions on a regular, approximately 5-year schedule.

Background

Several presentations from the SRPO at the July 2019 meeting touched on a variety of logistical difficulties encountered during missions that incurred either great cost or handicapped capability, including:

(1) Extra costs and difficulties incurred by a late request from the PIs for a launch slip;
(2) TAA processes and timelines.

In particular, since many of the costs and logistical complications of the NASA Sounding Rocket Program are hidden from PIs, the culture at SRPO and NSROC of accommodating all requests to the best of their ability can lead to unnecessary schedule stress on NSROC personnel and increased expenditures that could instead be used to fund other elements of the Program. We certainly don't want to change this culture, but unwitting overuse of it could be avoided if PIs were informed of rough dollar costs and workload implications of different choices.

The consensus of the SRWG was that these issues were symptomatic of limited communication between the Mission Oversight Monitor (MOM), Mission Manager (MM), and PIs, particularly with regards to the logistics and costs of schedule, management, and design choices the PI makes that may or may not have an actual impact on science return. To help mitigate this, we suggest explicitly communicating simple expectations for PIs as regards their responsibility about informing MMs of schedule changes, TAA requirements, logistical costs and complications, and any other salient information that will allow them to make better decisions about fielding campaigns, team planning, and other management decisions. One suggested solution is to explicitly encourage regular one-on-one informal telephone meetings between the PI and MM on an approximately monthly basis, particularly as experiments approach integration and flight. The MM can explicitly and regularly ask questions regarding schedule, foreign national involvement, as well as communicate any complications or logistical arrangements that need to be made by the SRPO or NSROC. The intention is that these communications needn't be either formal or take much time, but are intended to be more of a "gut check" to ensure both sides are communicating their status, expectations, and needs on a more regular basis than is currently the case. Additional telecoms involving the MOM are also important but might occur less frequently.

A second conclusion from the SRWG is that some form of communication from the SRPO should be provided to new or returning PIs upon the selection of a mission by NASA. This should include mission roles and responsibilities, points of contact, process flow, expectations around foreign national team members, launch date slips, and other crucial logistical information. At the moment, this kind of knowledge appears assumed or is handed down implicitly, and the concern is that PIs may not even know what questions to ask or who the points of contact are, as processes and structures can evolve. To address this concern, we suggest a letter of welcome or similar short communication from SRPO be provided to PIs shortly after their proposal is selected by NASA. A generic form of such a letter could be included in the Sounding Rocket Handbook with links to appropriate sections of the SRHB.

Finally, with the rapid development and evolution of capabilities and technologies in the sounding rocket program, the SRWG members believe that the information in the Sounding Rocket Handbook can quickly become dated. As a result, we suggest a program of regular updating of this publication be implemented. The hope is that this is not an onerous task, but rather that outdated or deprecated capabilities be stricken from the publication, while information about exciting new capabilities that would be available for new payloads be added. We recommend on average a 5 year update schedule.

3. Advantages of a 10 year Contract for NSROC IV

Summary

The SRWG strongly believes that the NASA Sounding Rocket Operations Contract (NSROC) IV is much better suited to a 10 year cadence rather than the 5 year period of performance utilized for NSROC II and III. A 5 year contract puts at least a two year (out of every 5) burden on the small and oversubscribed Sounding Rocket Program Staff; keeping them from putting this time into the sounding rocket program. Further, the sounding rocket program requires personnel with expert skills that are unique to sounding rockets. At every contract turn-over, we risk some of these key personnel remaining with the losing contractor. This is a serious risk to the program. The SRWG strongly urges all parties (SRPO, HQ) to strenuously request a 10 year period-of-performance for the upcoming NSROC IV contract.

Background

The NSROC I contract had a 10-year period of performance. This allowed some stability to the program where the sounding rocket program staff were not perpetually preparing or evaluating their main contract. Further, the NSROC staff with key expert skills, had long-term commitments to the program. NSROC II and NSROC III were reduced to 5-year periods-of-performance. Especially for NSROC II, multiple key personnel were lost to the sounding rocket program as they remained with the losing contractor. The repercussions of this loss were felt for years within the program. For NSROC III, the two competitor contractors merged into one entity. A 10 year contract vehicle would improve this situation and mitigate the inevitable and significant disruption to the program caused by the NSROC contract change, significantly reducing risk to the program.

4. Continued Support for a Solar Campaign

Summary

A solar flare campaign has been proposed to allow multiple solar viewing instruments to launch during a solar flare. The SRWG recognizes this campaign will benefit the sounding rocket program by allowing new instrumentation specifically targeting flare observations to be developed, as well as collecting valuable flare data with existing or modified flare-capable solar payloads. The capability of performing the campaign (launching multiple rockets, having long launch window) is already within the capabilities of the program. Additionally, this campaign could well utilize existing assets, namely Poker Flat Research Range, that does not normally operate during the summer months. The SRWG strongly supports the Solar Flare Campaign.

Background

Historically, solar sounding rocket instruments have been launched from White Sands Missile Range (WSMR), which is a busy range with little flexibility in scheduling or changing a launch time. Additionally, to launch from the NASA launch site on the southern side of the range, a major road and the White Sands National Monument must close starting roughly an hour before the scheduled launch time. Because of this, solar scientists are provided, at most, a one-hour launch window and encouraged to launch as early in that window as possible. This limited window precludes the ability of an instrument to launch into an event like a solar flare. Instruments that are specifically designed for solar flare observations therefore cannot be matured through the sounding rocket program and instruments with significant solar flare capability cannot be fully tested via a standard launch at WSMR.

Launching during a solar flare would require a launch window longer than the single day typically provided at White Sands. We estimate a nominal launch window of 4 hours a day for 2 weeks. Though this is much longer than typical solar launch windows, this a standard launch window for many geospace missions. Additionally, to enhance scientific outcome, it would be beneficial to launch multiple instruments into the same flare. Because solar instruments generally launch on Black Brant IX, this requires at least two large launchers. Finally, solar instruments generally require recovery due to the cost of the instrument and, due to large data sets and limited telemetry, retrieve the data that is saved on board. There are two potential matches for this list of requirements, either a launch from Poker Flat Research Range or a launch from a northern range at WSMR that does not require a road or national monument closure. If instruments are selected through the H-FORT competition to participate in a solar flare campaign, we anticipate that the SRPO would work with Instrument PIs to determine which range best meets their requirements.

5. Verifying the Accuracy of the Tern Attitude Data and Search for New Attitude Devices for Small Payloads

Summary

The SRWG is excited about the promise of the new, accurate attitude knowledge provided by the Tern system for Geospace payloads. The SRWG seeks confirmation (via in-flight comparisons with solar sensors or other measurements) that the attitude knowledge provided by the Tern is verified and is good to its promised accuracy of at least 1 degree, particularly the roll data at spin rates of (say) 1 Hz or more.

In addition, the SRWG notes that there are numerous new small sub-payloads that require attitude knowledge (good to 1 degree or better) yet do not require pointing. We encourage the program to find a reliable attitude (gyro?) system that can be used in such small payloads without requiring solar or star sensors or magnetometers.

Background

Whereas astrophysics and solar payloads typically require sub-arc-second pointing, geospace payloads often require simple attitude knowledge, with an accuracy of at least 1 degree. Such attitude data has been provided by many different gyro systems over the years. The verification of such attitude data, however, has proven elusive, particularly with respect to the roll data. Errors might typically appear due to either unknown mechanical offsets or timing offsets, where we note that on payload spinning at 1 Hz, a 2.8 msec error is equivalent to a 1 degree roll error.

In recent meetings, the SRWG has learned of new capabilities with respect to coarse attitude knowledge available primarily for Geospace payloads via the new Tern attitude system. The

SRWG seeks confirmation that the attitude knowledge provided by the Tern is verified and is good to at least 1 degree, particularly the roll data at spin rates of 1 Hz or higher. Such confirmation may be provided via comparison with solar sensors or other simultaneous measurements on the same payload.

In addition, the SRWG notes that there are numerous new small sub-payloads that require attitude knowledge (good to 1 degree or better). We encourage the SRPO to find a reliable, inexpensive attitude (gyro?) system that can be used in such small payloads without requiring solar or star sensors or magnetometers.

NASA Sounding Rocket Working Group

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