

The Development of a Modular Payload Structure for Student-Designed Sounding Rocket Experiments

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The Alaska Student Rocket Program was created to provide opportunities for university students from around the world to participate in sounding rocket experiments. The students involved in this program work together in interdisciplinary design teams to gain experience in engineering design and scientific investigations using sounding rockets. The fourth payload (SRP-4) is currently being prepared for launch from Poker Flat Research Range, Alaska in March 2002. This payload will include instruments designed and built by students at Toyama Prefectural University and Tokai University. The mechanical and electrical payload components feature a modular construction that will allow these student-designed components to be easily adapted to future student-designed sounding rocket missions.

The Alaska Student Rocket Program was created in 1991 to provide opportunities for university students from around the world to participate in sounding rocket experiments launched from the Poker Flat Research Range in Alaska. The high latitude location of this launch site provides opportunities for scientific investigations involving high latitude geophysical phenomena such as the aurora. The students involved in this program work together in interdisciplinary design teams to gain experience in design, construction, testing, launch operations, and data analysis of sounding rocket missions. In addition to providing the students with opportunities for professional development and international collaboration, these payloads also provide a low cost test bed for validating new and innovative payload components that might not yet be flight-qualified. By working closely with the aerospace industry, the Alaska Student Rocket Program can help to advance the current state-of-the-art in sounding rocket payload design by providing low cost opportunities for flight testing newly developed components and technologies.

The third student-built payload (SRP-3 / TR-1) was successfully launched to an apogee of 78 km on January 30, 2000. The fourth student-built payload (SRP-4) is currently being prepared for launch from Poker Flat Research Range near Fairbanks, Alaska in March 2002. This payload will be launched to an apogee greater than 90 km on an enhanced Orion rocket motor that will be obtained from NASA Wallops Flight Facility. The payload will be designed and built entirely by university students, with NASA and university personnel providing advice, guidance, and essential support functions such as radar tracking, wind weighting, and flight/ground safety oversight.

A modular design was adopted for the SRP-4 payload so that the student-designed components on this payload can be easily adapted to future payloads. Radio receiver and plasma instruments are being developed by students at Toyama Prefectural University to measure the density structure of the D region of the ionosphere. Magnetometer and sun-sensor instruments are being developed by students at Tokai University to measure the payload attitude relative to the geomagnetic field and the sun. Students at the University of Alaska Fairbanks are developing mechanical and electrical payload components with the following capabilities: 1) mechanical payload structure, nosecone, and electrical bus that allows payload decks and components to be easily installed and removed during integration; 2) two-stage parachute recovery system with pyrotechnic actuators to deploy the guide-surface drogue parachute and to unreef the 10-meter main parachute; 3) control electronics for the electrically-actuated pyrotechnic devices that control payload separation from the rocket motor and deployment of the parachute recovery system; 4) S-band telemetry transmitter with FM modulation and conformal, circularly-polarized patch antenna; 5) differential GPS tracking system with ground-based receiver and processing to extract the payload position from the GPS pseudorange data; 6) onboard flight computer; 7) flight instruments to gather housekeeping data; and 8) battery power system utilizing lithium ion batteries and switching regulators for maximum efficiency.

The long term goal for the Alaska Student Rocket Program after the launch of the SRP-4 payload is to create an intensive summer workshop in which university students from all over the world come to Fairbanks for ten weeks to participate in all aspects of a sounding rocket mission, including payload integration, testing, launch, and data analysis. These students will return to their home universities to collaborate on future student-built payloads that will be launched from Poker Flat Research Range in subsequent years. Our goal is to slowly expand the program until we can achieve a launch rate of one or more student-built payloads each year.