## Poker Flat Research Range: combining ground- and rocketbased investigations

Richard Collins with Katrina Bossert, William Bristow, Mark Conde, Anthea Coster, Christopher Fallen, Donald Hampton, Miguel Larsen, Kristina Lynch, Michael Stevens, Michael Taylor, Denise Thorsen, Colin Triplett, Roger Varney, Bifford Williams...



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## **Poker Flat Research** Range (PFRR)

First launch on 5 March 1969 (50 this year).

Barium cloud released near altitude of 100 miles.

Since 1969 there have been 339 rocket launches from the range, with four launches in January 2018.



GEOPHYSICAL INSTITUTE STUDY OF AURORA SPROUTS SPACE WINGS IN SERIES OF ROCKET SHOTS DESIGNED TO TEST INFLUENCE OF EARTH'S ELECTRIC FIELD

After 20 years of studying the aurora, University of Alaska re-searchers have begun taking their studies into space atop two

three-stage rockets launched from the university's Poker Flats Rock-et Range, 30 miles north of Fairbanks.

In a month-long series of rock-experiments called SECEDE III, researchers from UA's Geophysical Institute are helping create arti-ficial barium clouds at the upper fringe of the earth's atmosphere to study high altitude winds and the enigmatic electric field that nvelops the planet and extends far out into space like a comet's tail.

SECEDE III is jointly sponsored by the Defense Atomic Support Agency, the Advanced Research Proects Agency and The Atomic Energy

CRAFT WORKSHOP SET AT UA MUSEUM

The University Museum will present a working exhibit dur-ing the Festival of Arts be-ginning Saturday from 1 p.m. to 5 p.m. in the museum.

The workshop showing bead work, ivory carving, and birch bark work will feature Mrs. Hannah Solomon, Mrs. Mabel Charlie and Mrs. Mabel Charlie and Mrs. Melvin Olanna. The workshop will continue on Sunday and on March 22 and 23, 29 and 30, and on April 5 and 6 from to 5 p.m.

Commission is providing technical assistance with the project. In all, six rockets will be used

In all, six rockets will be us to inject barium into the atmo-sphere at altitudes ranging from 70 to 120 miles. Two Geophysical Institute rockets, transferred to the new UA research facility from the new UA research facility from a test range in Ft. Churchill, Canada, are wild cards to be launched into active auroral cur-tains on short notice in order to probe the pheonomena with sophisticated instruments.

The barium technique, explains Dr. T. Neil Davis, head of the UA project and assistant director of the Geophysical Institute, is one way to measure the planet's elec-tric field. The other involves the use of instrumented booms 50ft. or longer on rockets and satel-lites, but this method presents more mechanical problems than the barium cloud techniques implemented by the UA research teams, according to Davis.

Payloads of barium and copper oxide are rocketed aloft to form the clouds. "When the rocket reaches the intended altitude, the reaches the intended altitude, the powderod chemicals are ignited and the barium is vaporized," Davis said. Two clouds, initially lot miles in diameter, are formed with each shot. The lower cloud appears green and drifts with the high natis said. "is positively charged and drifts under the influence of the electric field. the electric field. CONT. ON PAGE 8



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### **PFRR Ground-Based Instrumentation**



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### **PFRR Ground-Based Instrumentation**











### **PFRR Ground-Based Instrumentation**



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# **The Horizontal E-Region Experiment** (HEX)



Arc

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## Enstropy



Enstrophy flew across an auroral arc over Kaktovic with a cluster of "hockey puck" magnetometers.

Enstropy provided measurements of the spatial structure of the currents around the arc.



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## **Wave Coupling in the Arctic**



Planetary waves drive sudden stratospheric warming events with systematic reversals of the circulation and gravity wave forcing.



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## The Mesosphere Lower Thermosphere Turbulence Experiment (MTeX)







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MTeX measured turbulence in the upper mesosphere while lidar measured gravity wave activity.

Low levels of turbulence are associated with low levels of gravity wave activity.

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## **Super Soaker**

The goal of the Super Soaker experiment was to study upper atmospheric response to locally concentrated water vapor

Included 3 sounding rockets

1 with 220 kg  $H_2O$  (~1 bathtub) explosively released at 85 km

2 rockets with chemical tracers (TMA) for wind measurements

Use TMA trails and coordinated groundbased measurement from lidars and a temperature mapper to observe the formation of ice clouds and any changes in temperature and winds at water release altitude





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### **Super Soaker - Release**



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## **Super Soaker – Cloud Formation**



Cloud formed 18s after release in high temperatures (~ 225 K).

Model analysis indicates rapid cooling by water vapor.

Rapid cooling depends on spatial structure of water.



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### **Key PFRR Features**

- Extensive on-range and downrange observatory capabilities to support science missions from PERR, UAE scientists have instruments across Alaska and routinely support NASA sounding rocket Principal Investigators when formulating launch decisions.
- UAF faculty frequently called upon to help candidate PIs formulate their mission proposals.
- PFRR launches have synergy with NSF-funded instruments; PFISR, • SuperDARN, meteor radar, lidars, imagers.
- Fairbanks, GI and UAF offer extensive support capabilities machine and electrical shops, university laboratories, local vendors, and extensive logistics options.





# **Closing Thoughts**

- Use facility at Kodiak to launch CubeSats that orbit over Alaska to study auroral substorms.
- Use US Array to host dense array of GPS-GNSS receivers to map ionosphere.
- Mesospheric Grand Challenge.
- Invite researchers who wish to develop rocket proposals as PIs to work with UAF faculty who have experience with rocket proposals.
- Invite students to consider graduate student and post-doctoral opportunities at University of Alaska Fairbanks.
- Acknowledge support from NSF, NASA and DoD.



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