# Drone Video Platform—Collision Avoidance, Situational Awareness, and Communications STL-039-17, Year 2 of 2

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# Challenge

At the beginning of FY 2018, the collision avoidance task of this project was dropped because it had become a “commercial off-the-shelf” product for rotary drones, but it was still considered a very difficult problem for fixed wing drones.

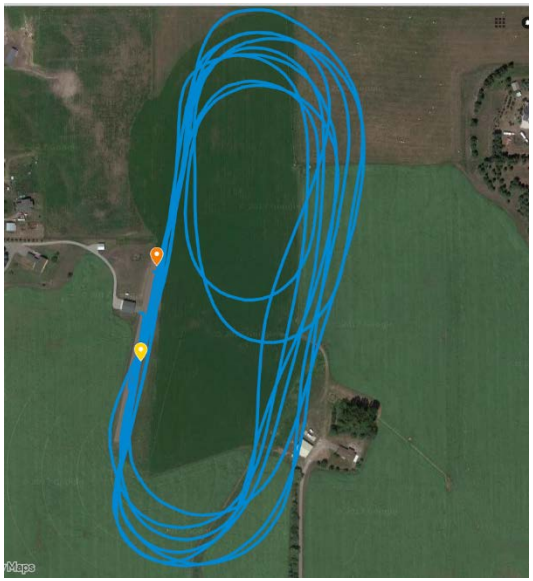
In the second quarter of FY 2018, R. Trainham took over the project and decided to redirect efforts into testing a variety of sensors on a variety of platforms. The core module task was also dropped from the project because it duplicated what was already available commercially.

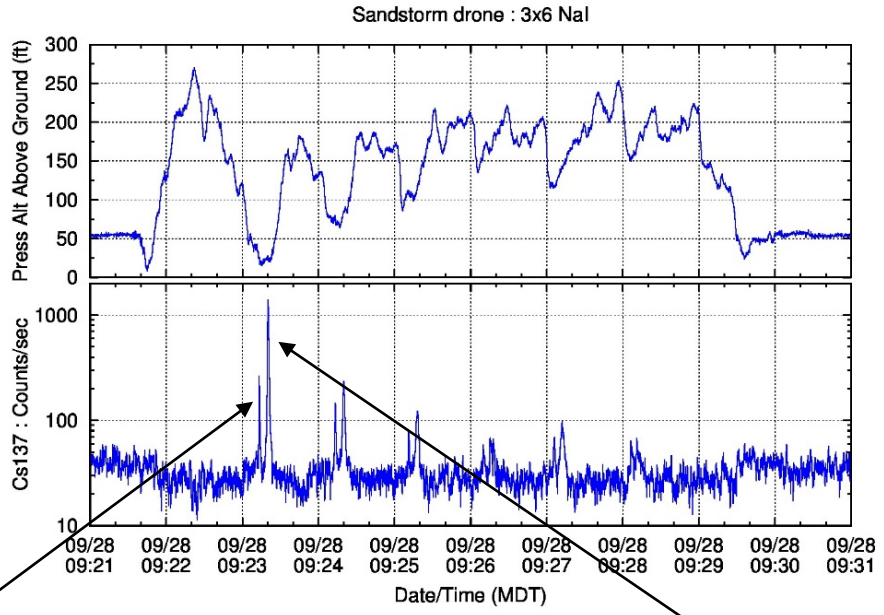
Since last year’s SDRD final review, we have conducted flight tests in Idaho, Montana, Nevada, and Wisconsin. We have flown five different gamma detectors, a chemical detector and sampler, an optical spectrometer, and a point LIDAR on quadcopters, hexcopters, and the fixed wing T-28 and Sandstorm.

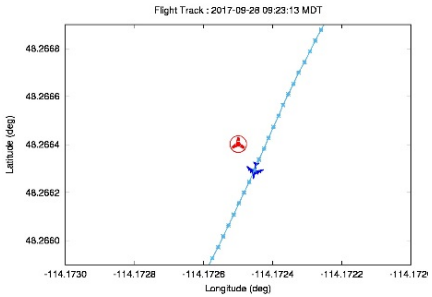
We have collaborated with H3D, USI, Virginia Tech, and ORNL.

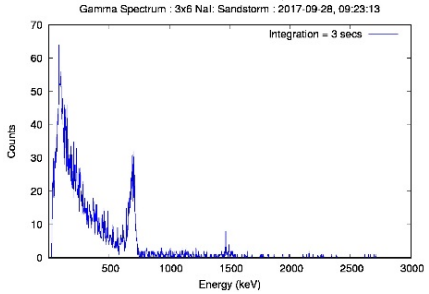
In the coming year, we will continue those collaborations, and will add BYU and INL as collaborators.

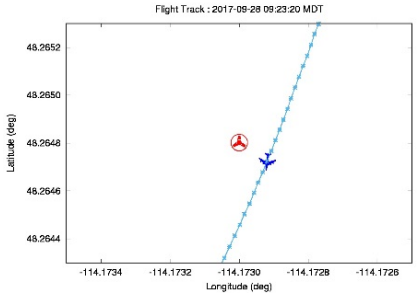
# Results 3×6 NaI on the Sandstorm in Montana

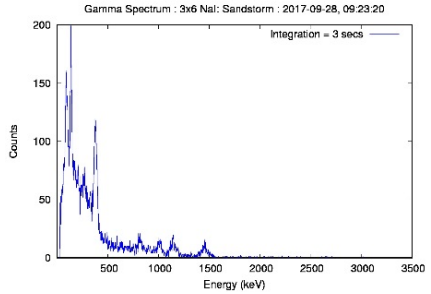




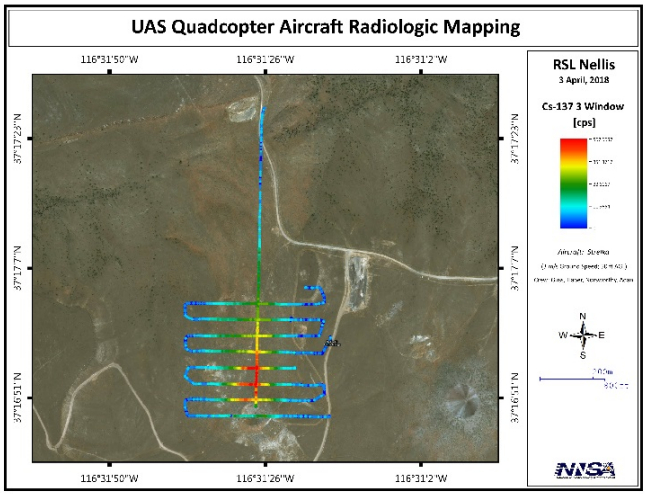




**The double peaks in the strip chart are from the different sources placed at different locations.**

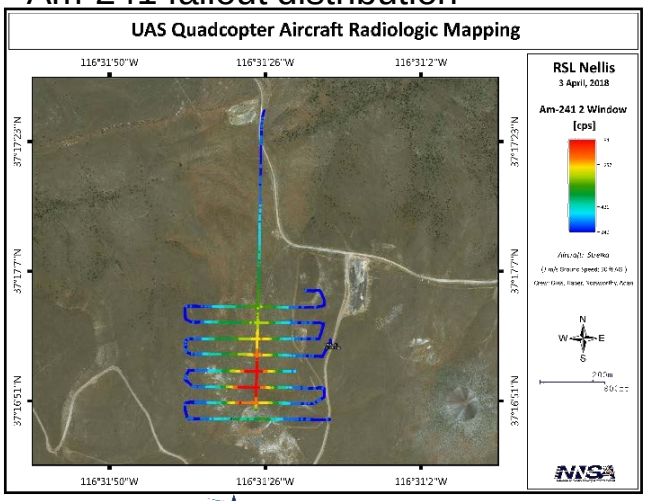
**The airplane icon is placed at the location of the highest signal rate. The angle of the icon is set by the GPS course direction, and the track dots are separated by the GPS sample interval of 200 ms.**

# Results $LaBr_3$ on the ORNL Strelka at the Palanquin Crater

Cs-137 fallout distribution




Am-241 fallout distribution




$LaBr_3$ has twice the energy resolution of NaI.


The $LaBr_3$ detector flew on March 30, 2018.

The Palanquin test on April 14, 1965, was #12 in the Plowshare series. The yield was 4.3 kT, and it left a 240 ft crater. The fallout from the venting blew north of the crater.

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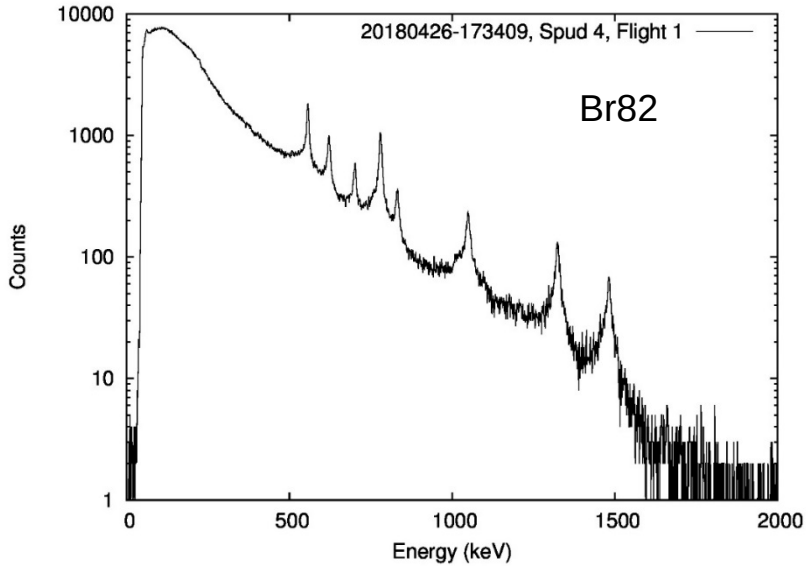
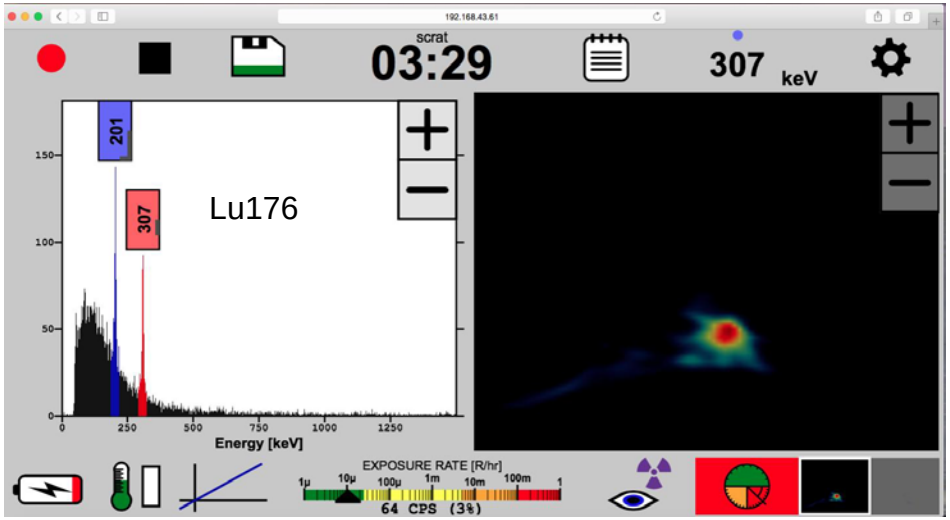
# Results Virginia Tech Hexcopter with Apollo and Stubby at INL




We tested automated gamma surveying, imaging, and the 4G LTE data link.

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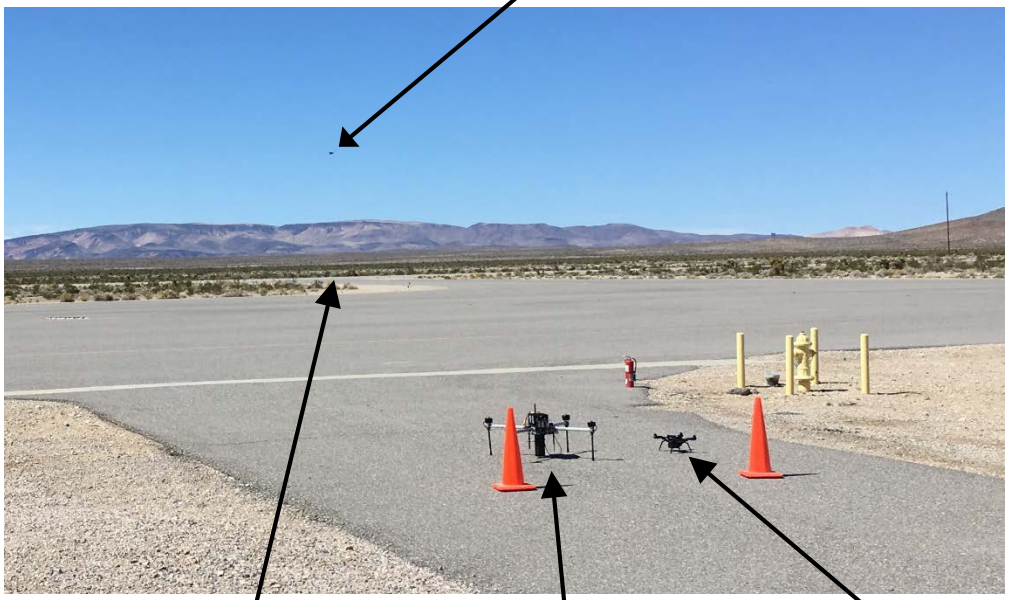
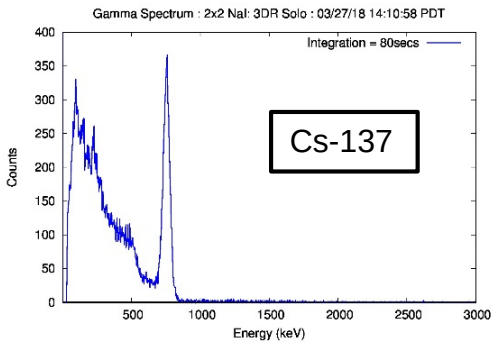
# Results

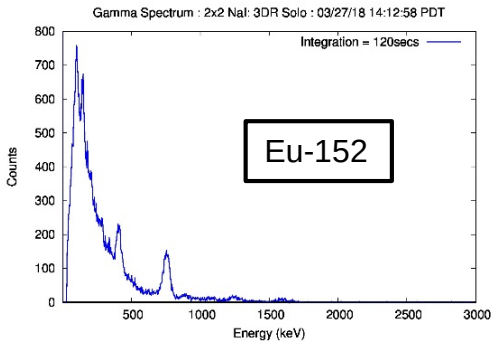
## RadSolo at DRA

Radiation level at the drone

STL 3DR RadSolo with “Stubby” 2 × 2 NaI






Eu-152 Source

ORNL 3DR Solo

ORNL Strelka with $LaBr_3$

The strip charts and the spectra are displayed in real time in a web browser.

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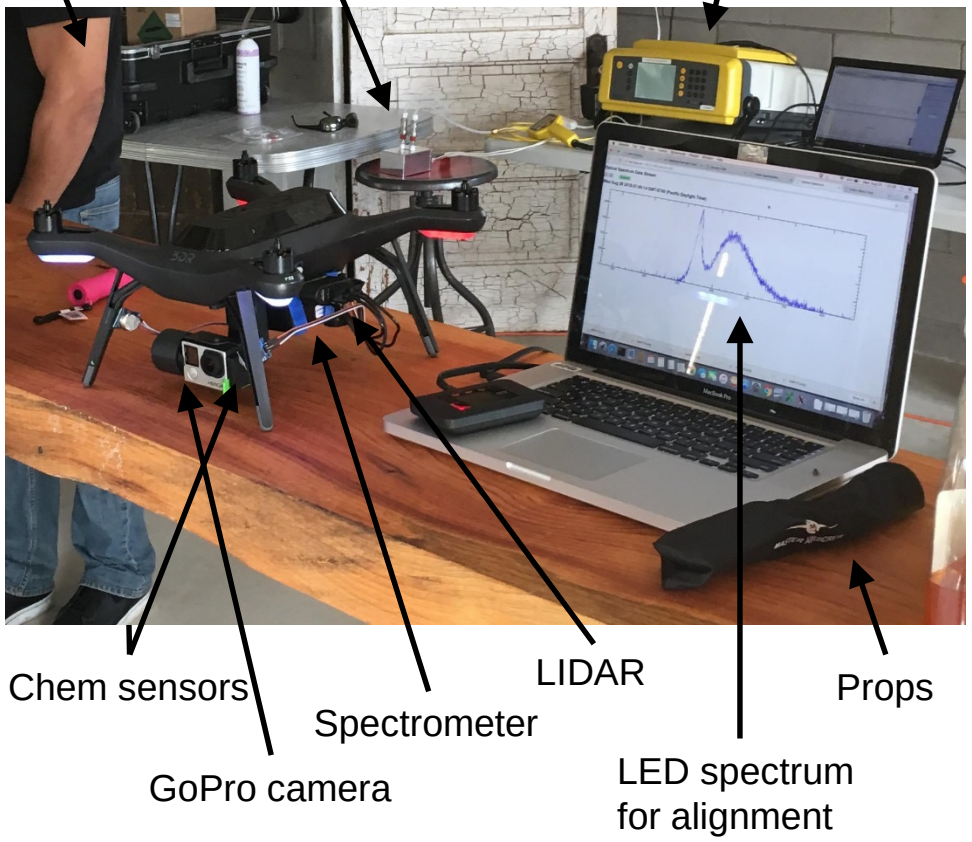
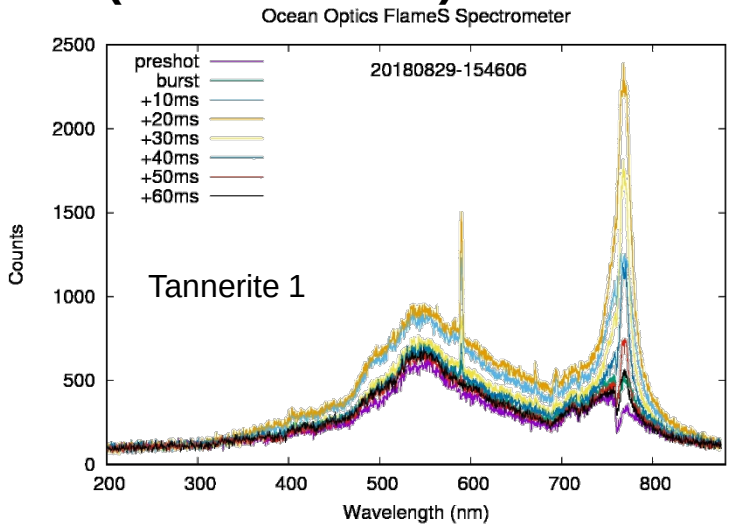
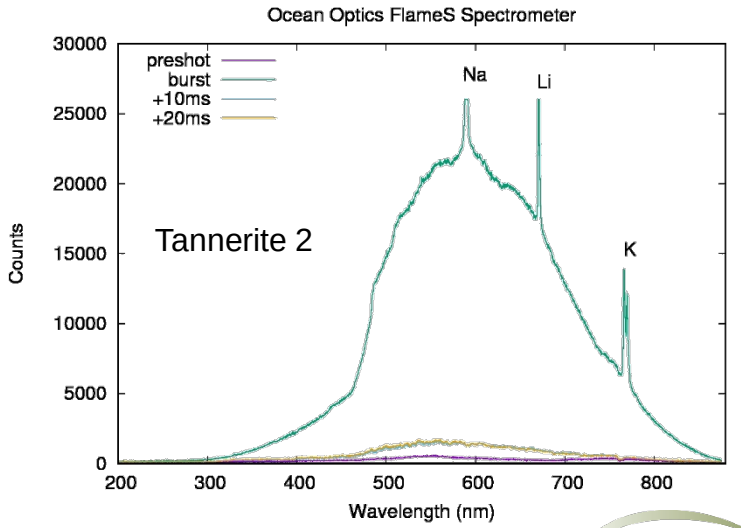
# Results

## SpectroSolo in Wisconsin

### Ocean Optics Flame S spectrometer (200 to 850 nm)



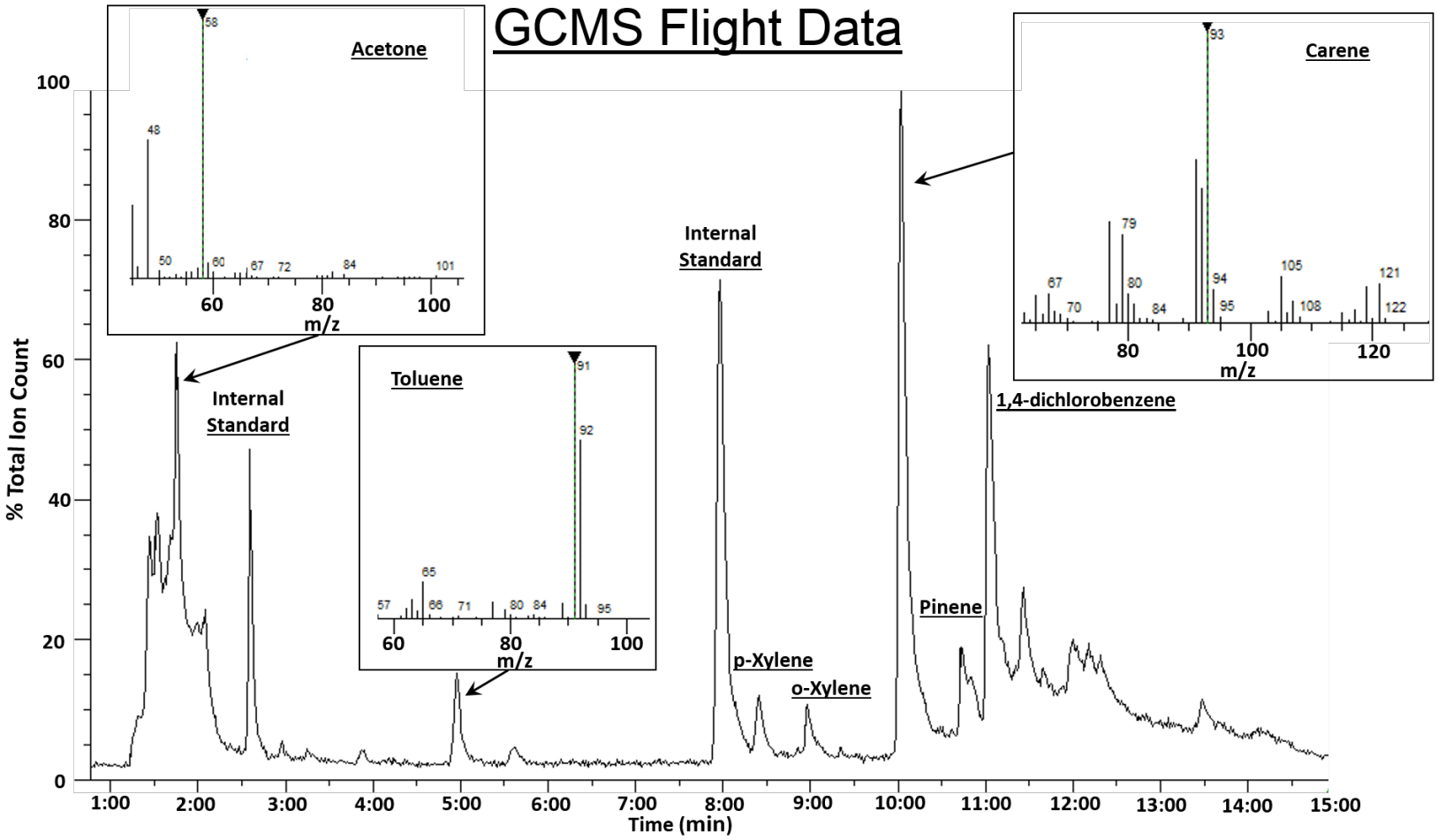

Spectrometer, chem sensor chips, and GoPro camera run simultaneously, and are all controlled by the onboard Cortex-A9 computer of the 3DR Solo.

# Results

## ChemSolo in Wisconsin

# Results ChemSolo in Wisconsin (cont.)

## Plume sample collected by the quadcopter over the bonfire

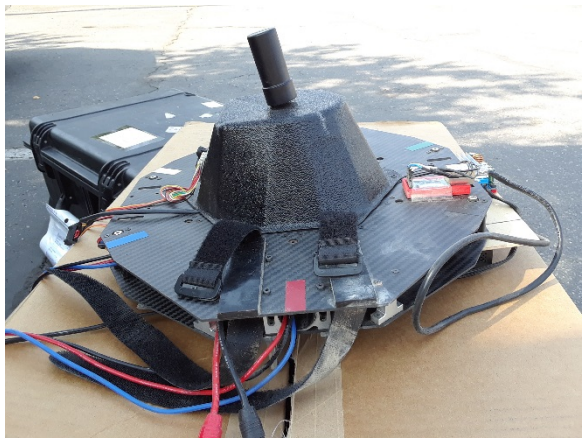



Smoke from rags soaked with acetone and kerosene burning in barrels was sampled during quadcopter flyovers of the fires.

# Path Forward

## Cheaper and expendable hardware needed

**On July 26, 2018, the Virginia Tech hexcopter carrying the Apollo and Stubby detectors crashed at INL.**



The cause was a prop failure.

The hexcopter and pod were totaled, but both detectors survived.

Payloads need to be cheaper and considered expendable!

# Impact

Another Palanquin mission with the Virginia Tech hexcopter flying Apollo and Stubby is scheduled for September 20 to 28.

Beyond visual line of sight (BVLOS) flight with Sandstorm and the 3×6 NaI is scheduled to take place at Yucca Lake the week of October 8.

We are currently planning the FY 2019 schedule, and we plan to fly a neutron detector (CLYC), a multispectral IR detector, multipoint LIDAR, other chemical detectors, and possibly a mass spectrometer. Any suggestions?

We also wish to test an aerial drop of a rotary drone by a fixed wing drone. This would allow missions that are long range and require long dwell times.

We are discussing a new generation of the H3D Apollo gamma imager.

We are discussing a new Virginia Tech heavy-lift, long-duration rotary drone.

We will collaborate with Cammy Peterson's group at BYU on adaptive automated flight planning, and will conduct a test of the algorithms at the NNSS.