Global Hawk - Platform and Opportunities

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Agenda

- NASA Airborne Science facilities
- NASA Global Hawk platform
- GHOST on the NASA Global Hawk
  - Timescales
  - Design issues
  - Testing
  - Operations

NASA Airborne Science facilities Primary Objectives

- Satellite Calibration and Validation

  Provide platforms to enable essential calibration measurements for the Earth observing satellites, and the validation of data retrieval algorithms.

- Support New Sensor Development

  Provide sub-orbital flight opportunities to test and refine new instrument technologies/algorithms, and reduce risk prior to committing sensors for launch into space.

- Process Studies

  Obtain high-resolution temporal and spatial measurements of complex local processes, which can be coupled to global satellite observations for a better understanding of the complete Earth system.

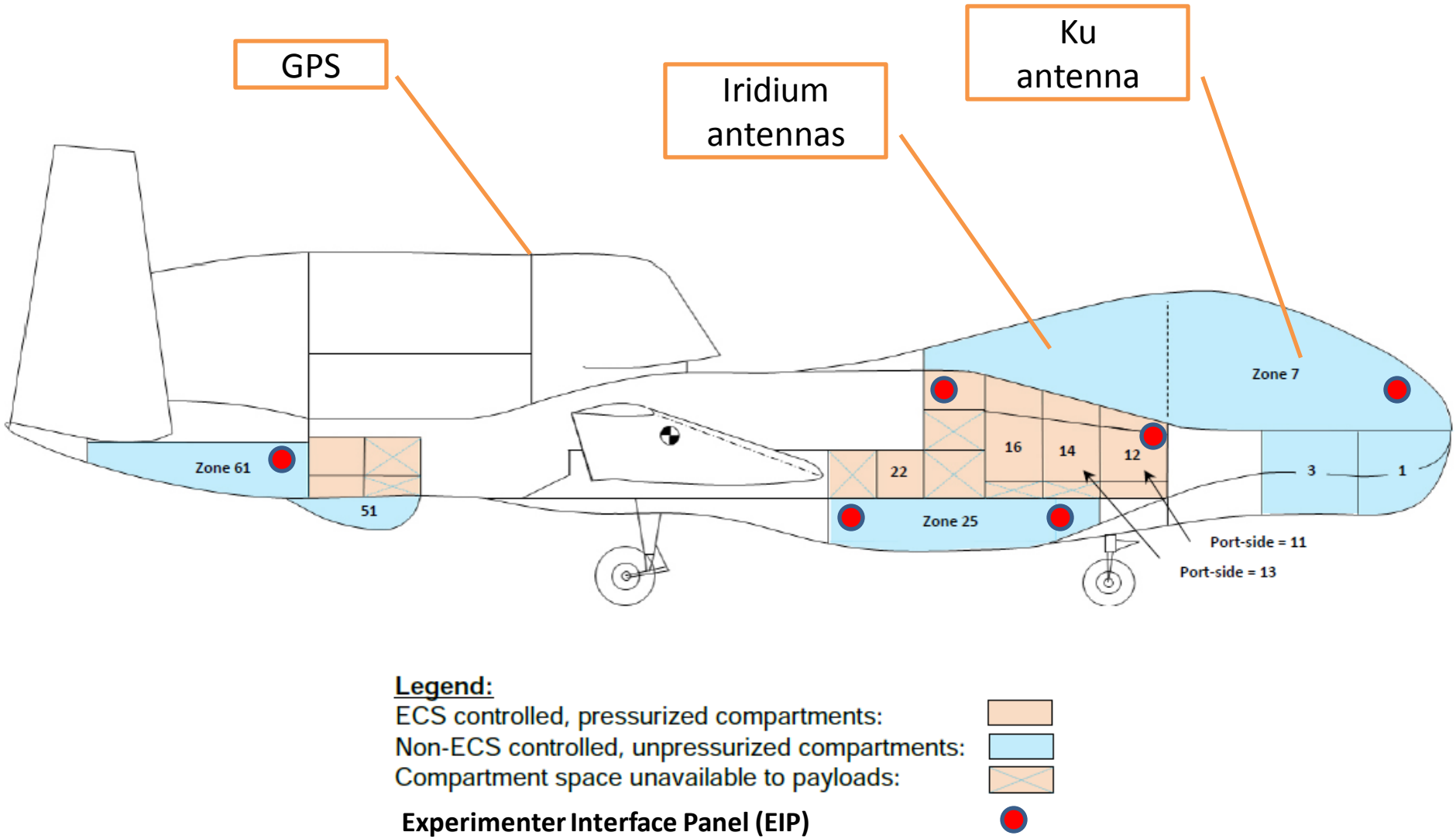
- Develop the Next-Generation of Scientists and Engineers

  Foster the development of our future workforce with the hands-on involvement of graduate students, and young scientists/engineers in all aspects of ongoing Earth science investigations.

NASA Airborne Science facilities Aircraft Operated

Aircraft		Center	Duration (hours)	Useful Payload (lbs)	GTOW (lbs.)	Max Altitude (ft)	Air Speed (knots)	Range (Nmi)	NASA SMD User Fee (per flight hour)
C-20A (G-III)		AFRC	7.00	2,500	69,700	45,000	460	3,400	$3000
DC-8		AFRC	12.00	30,000	340,000	41,000	450	5,400	$6500
ER-2		AFRC	12.00	2,900	40,000	70,000	410	5,000	$3500
Global Hawk		AFRC	30.00	1,900	25,600	65,000	345	11,000	$1800 +$60K/week access
P-3 Orion		WFF	14.00	14,700	135,000	32,000 MSL	400	3,800	$3500

NASA Global hawk



Legend:

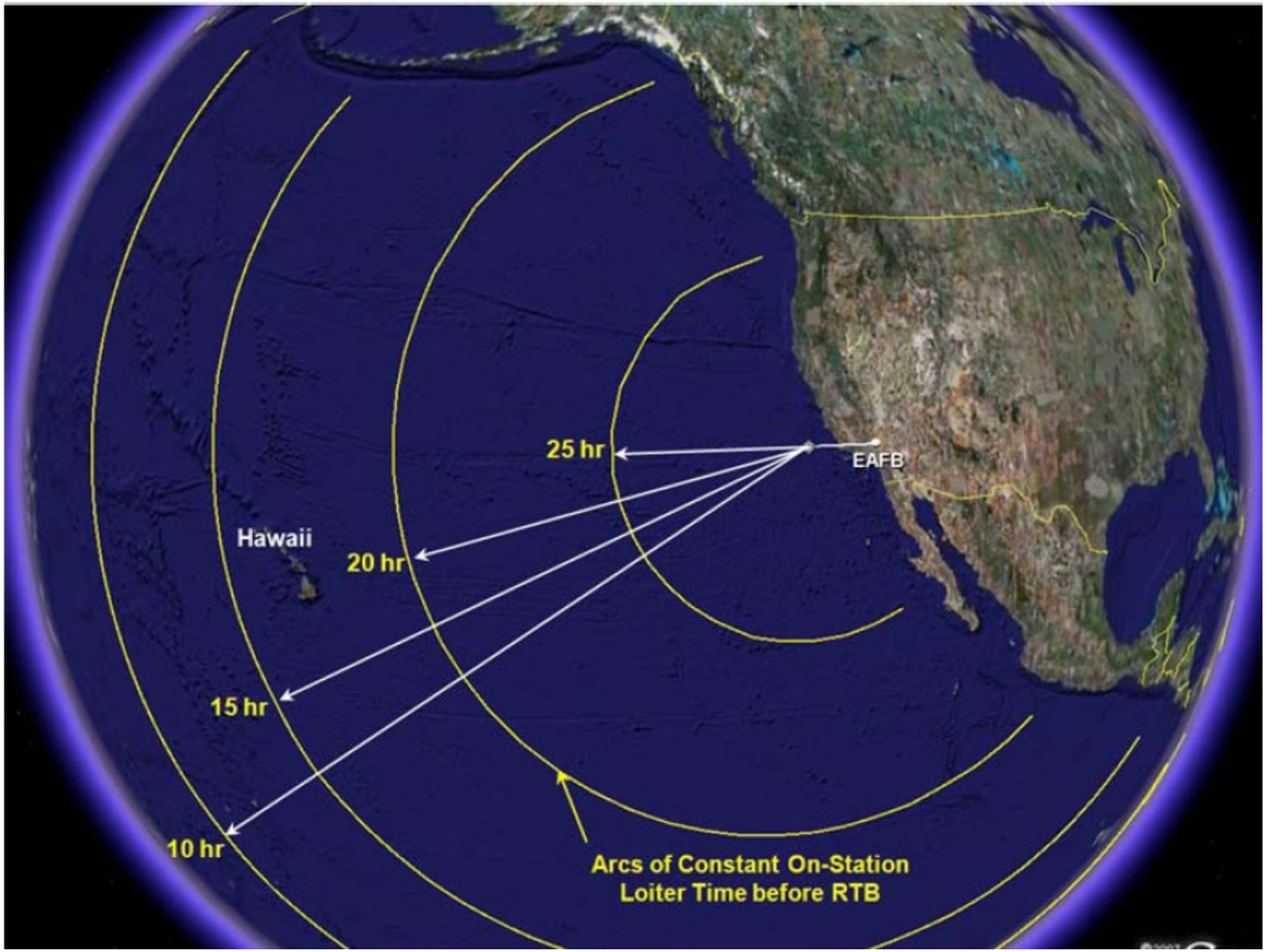
ECS controlled, pressurized compartments:

Non-ECS controlled, unpressurized compartments:

Compartment space unavailable to payloads:

Experimenter Interface Panel (EIP)

Range and Loiter from AFRC



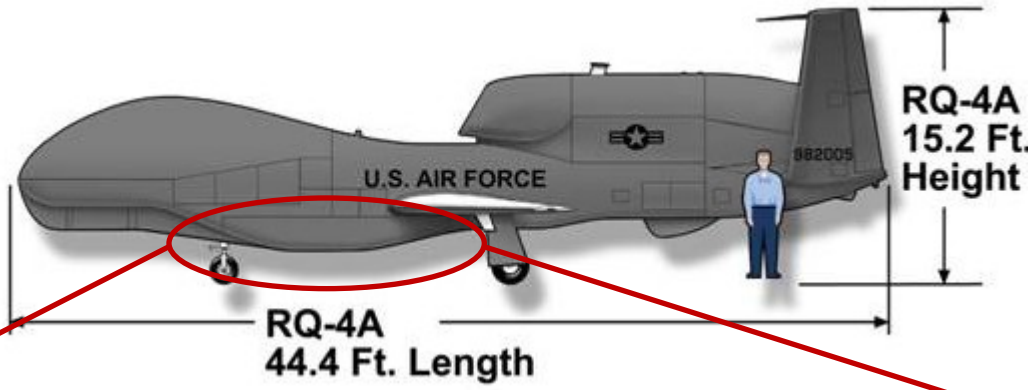
GHOST: GreenHouse Observations of the Stratosphere & Troposphere

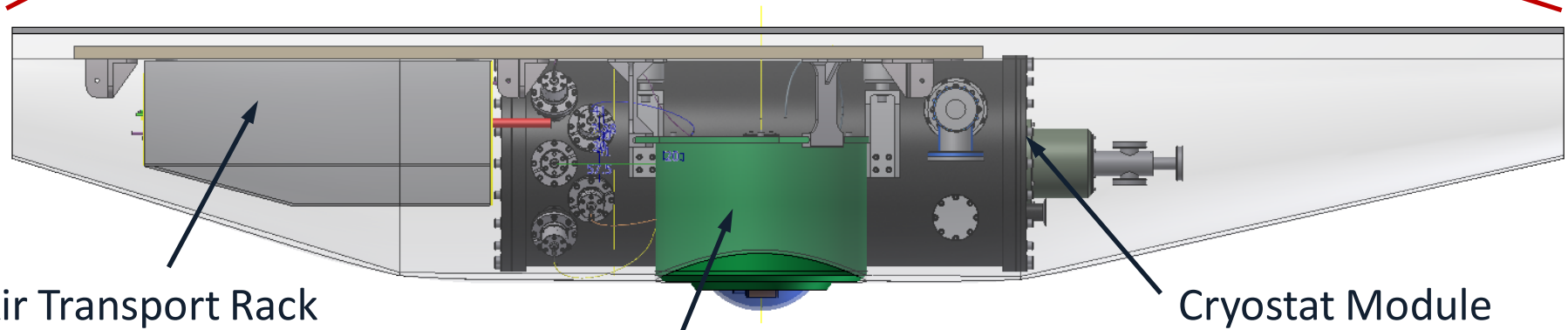
GHOST is a novel, multi-order, SWIR spectrometer developed from studies of space based instruments.

GHOST was designed and built by the UK ATC to operate at high altitude (60,000 feet) on the NASA Global hawk UAV.

It first flew in March 2015 over the Pacific.

	Band 1	Band 2	Band 3	Band 4
Function	Aerosol, pressure	CH_4 and CO_2	Aerosol, CO_2	CO, CH_4, H_2O, HDO
Band (µm)	1.25 – 1.29	1.59 – 1.68	2.04 – 2.09	2.31 – 2.39
Resolution (nm)	<0.1	<0.25	<0.15	<0.25





Air Transport Rack

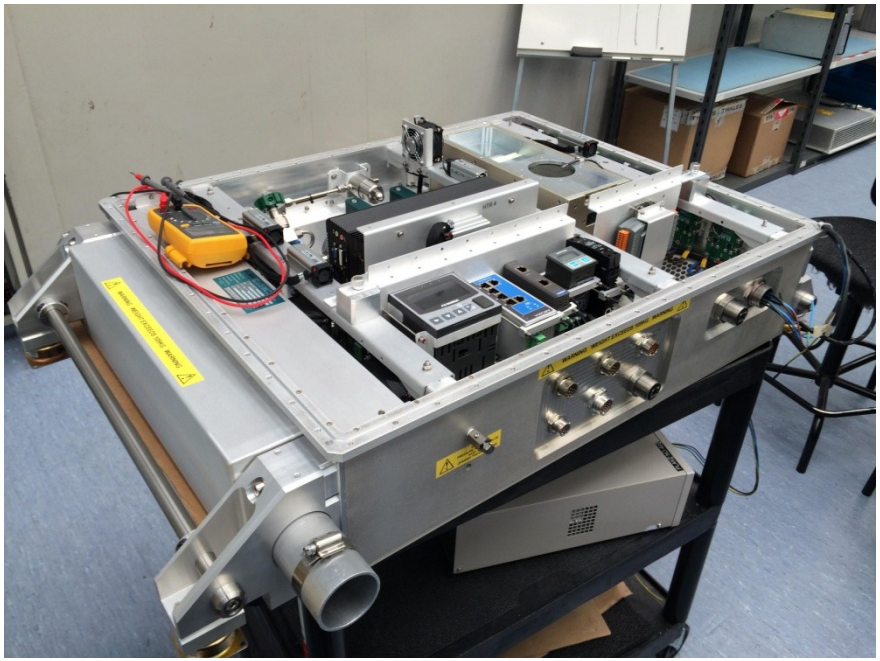
Cryostat Module

Target Acquisition Module

GHOST on the Global Hawk

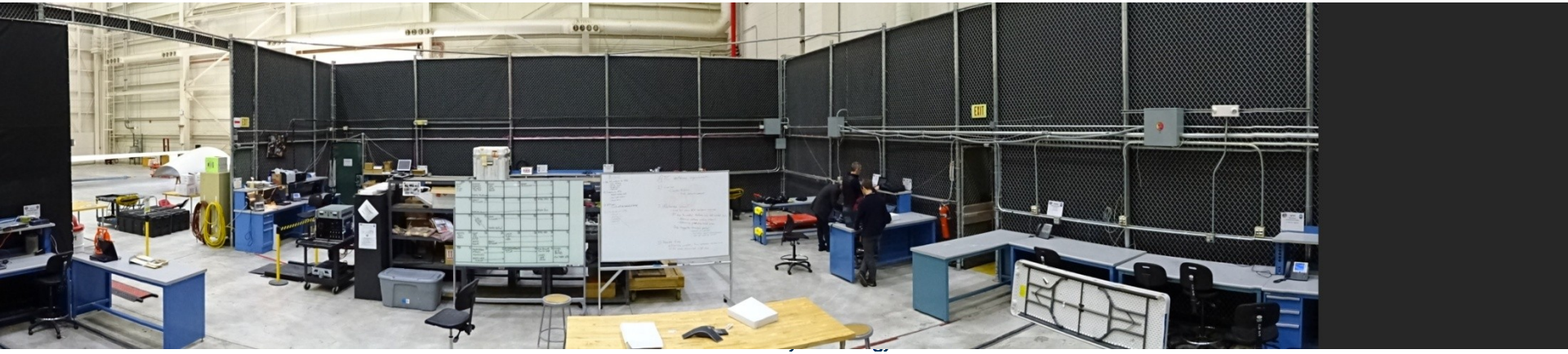
- Grant sign-off Summer 2013
- GHOST Design and build
  - PDR Sept 2013
  - CDR Dec 2013
  - Build 2014
  - Testing Sept-Dec 2014
- Environment testing Jan 2015
- Installation & functional testing Feb 2015
- First range flight Feb 26th, 6 hours up to 55k-ft
- Science flights March (see Paul Palmers talk)

Build for Global Hawk



- Environment in Stratosphere (20km) – air at 0.05 Bar and -65°C
- Flight Duration (>20hrs) consumables & data
- Global Hawk – Unmanned aircraft (automation) & ITAR restrictions
- Load Tests
- Vacuum tests, ATR pressure tests
- Cryogenic tests
- …even fixings were an issue

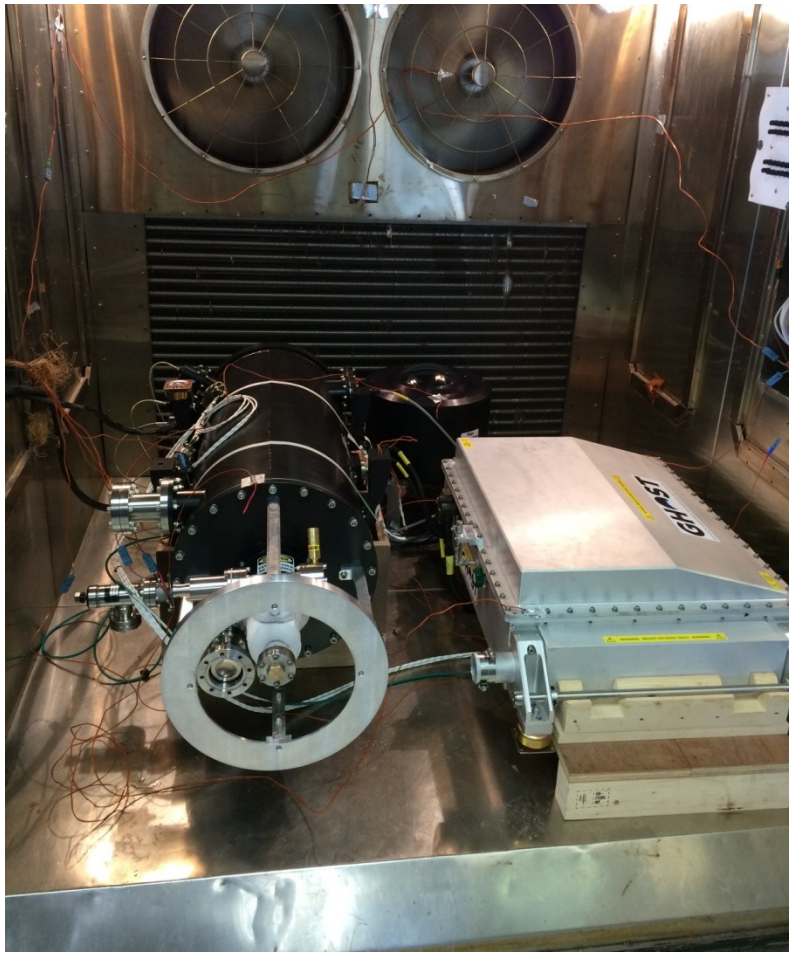

U.S. AIR FORCE


EXIT


NACA
6063
X-1E

TVAC Testing

-65ºC 0,05 bar & 40ºC atmospheric pressure (operational)



Vibration testing

Each module, each axis, operational to 3g

Comms and operations testing

Installation

Operations


NASA
BATTERY ACCESS
BATTERY ACCESS
ARMSTRONG FLIGHT RESEARCH CENTER

GHOST during the range flight.

Successes

- Cryostat hold time – much longer than expected (> 30 hours)
- Cryostat (instrument) stability
- Automation, with intermittent comms.
- Environmental stability of equipment
- Pointing and tracking
- Flights
- Data ?

Problems

- Cryostat external fixings (leaks)
- Bad communications
- Dome icing (visibility)
- Lengthy process
- Operations