National Aeronautics and Space Administration

Dryden Flight Research Center

Presentation to the Portland State Aerospace Society

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Hugh L. Dryden Flight Research Center

Who, What, Why?

- Supporting NASA Johnson Space Center Driven to Explore Traveling Exhibit April 24-26 at the Oregon Museum of Science and Industry

- Present new and interesting information about NASA, and NASA Aeronautics

- Flight Operations Engineering Branch
  - Ensuring vehicle airworthiness
  - Performing systems design and integration
  - Aircraft technical and configuration management
  - Supporting system safety analysis
  - Coordinating flight readiness
  - Providing real-time flight support

Dryden Flight Research Center

Edwards Air Force Base

- Remote Location
- Varied Topography
- 350 Testable Days Per Year
- Extensive Range Airspace
- 29,000 Ft Concrete Runways
- 68 Miles of Lakebed Runways
- 301,000 Acres
- Supersonic Corridor

Dryden Aircraft Operations Facility

United States Air Force Plant 42, Palmdale, CA

- Palmdale Site 9 Complex
  - Ready access to USAF Plant 42 runway and facilities
  - 35 miles from NASA Dryden Flight Research Center
  - 422,000 square feet of floor space, including 210,000 square feet in this central hangar area
  - Since October 2007

Our Namesake

Why flight research?

". . . to separate the real from the imagined and to make known the overlooked and the unexpected. . .".

Dr. Hugh L. Dryden,
Administrator of NACA,
First Deputy Administrator of NASA

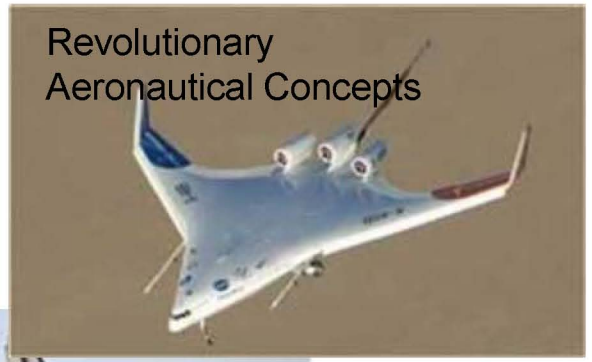
To Fly What Others Only Imagine

Mission Activity

Advancing Technology and Science Through Flight

- Mission Elements
  - Perform flight research and technology integration to revolutionize aviation and pioneer aerospace technology
  - Validate space exploration concepts
  - Conduct airborne remote sensing and science observations
  - Support operations of the Space Shuttle and the ISS

… for NASA and the Nation



Airborne Science Program

- Aligned with the Science Mission Directorate's Airborne Science Program
  - Program Objectives
    - Satellite Calibration and Validation
    - New Sensor and Algorithm Development
    - Process Studies
    - Next Generation NASA Scientist and Engineer Development
- Platforms
  - DC-8
    - Heavy lift
    - Long Range
    - Shirt-sleeve environment
  - ER-2
    - Very High Altitude
    - Long Range
  - G-III UAVSAR
    - Synthetic Aperture Radar
    - Repeat pass interferometry
  - Global Hawk
    - Unmanned
    - Extreme range and endurance

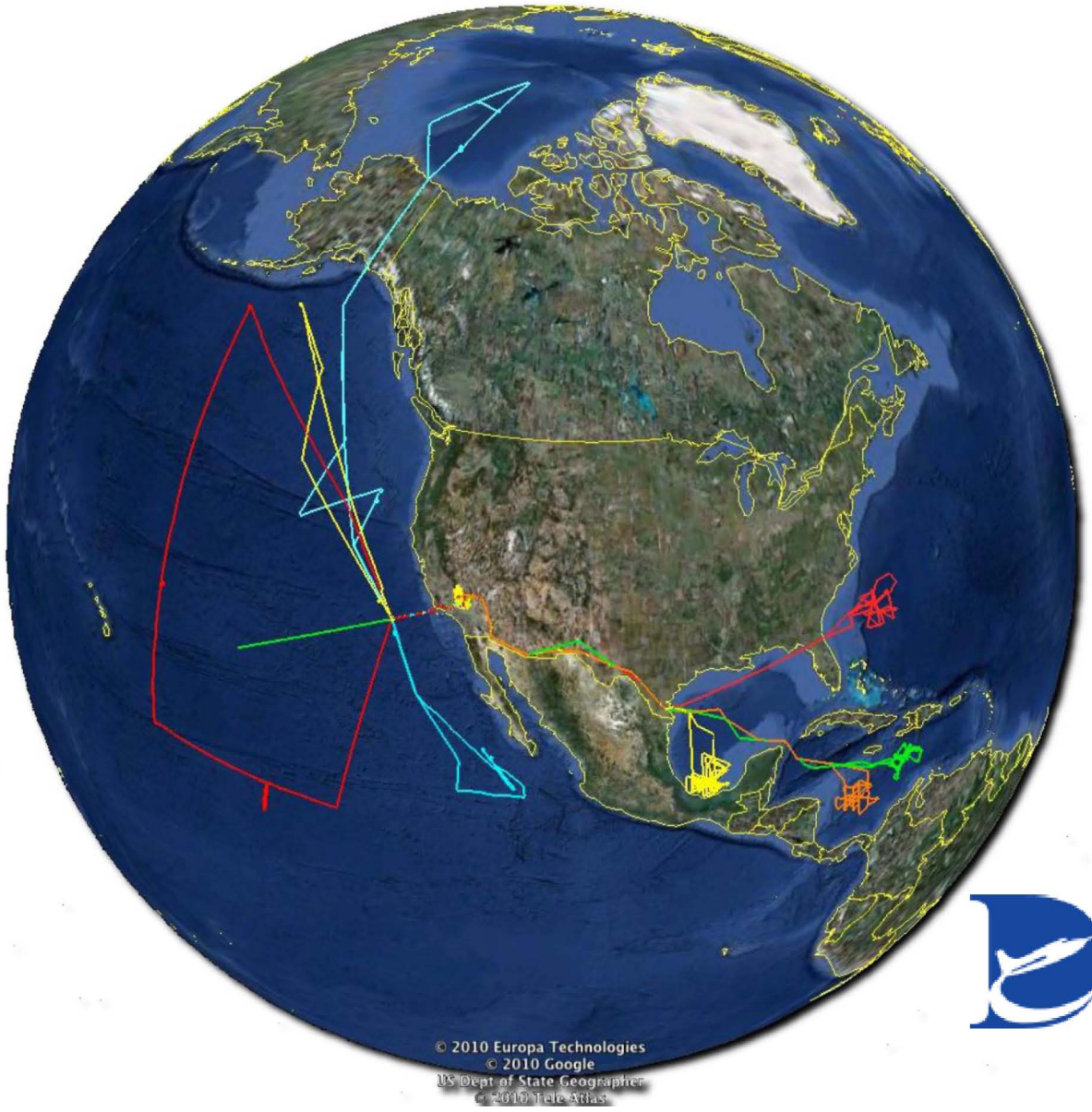
Global Hawk

- Three USAF Pre-Production Global Hawk aircraft have been transferred to NASA, two are operational.
- A combined NASA/Northrop Grumman team is maintaining, modifying, and operating the UAS through a 5-year partnership. (2008-2013)
- The first flight of the NASA Global Hawk occurred on 23 October 2009. Thus far, a total of 26 missions have been flown. The longest mission was to 85 deg N Latitude with an endurance of 28.6 hours.
- KQ-X Autonomous Aerial Refueling

Endurance	30 hours
Range	10,000 nmi
Service Ceiling	65,000 ft
Airspeed (55K+ ft)	335 KTAS
Payload	1,000-2,000 lb
Length	44 ft
Wingspan	116 ft

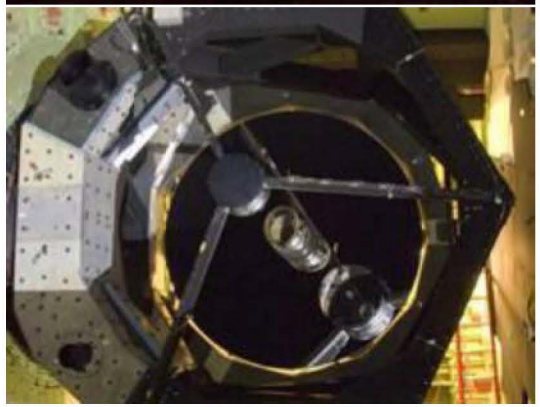
Global Hawk Science

- Global Hawk Pacific (GloPac) – Spring 2010.
  - Purpose: Exploration of trace gases, aerosols, and dynamics of remote upper troposphere and lower stratosphere regions.
  - Combination of 11 remote sensing and in-situ measurements.
  - 4 flights were conducted with a total of 83 flight hours.
- Genesis and Rapid Intensification Processes (GRIP) – Summer 2010
  - Purpose: Explore how tropical storms form and develop into major hurricanes.
  - Suite of 4 state-of-the-art instruments.
  - 5 flights have been conducted with a total of 114 flight hours. (2 Tropical Depressions, 1 Tropical Storm, 2 Hurricanes)
- Hurricane and Severe Storm Sentinel (HS3) Study



SOFIA

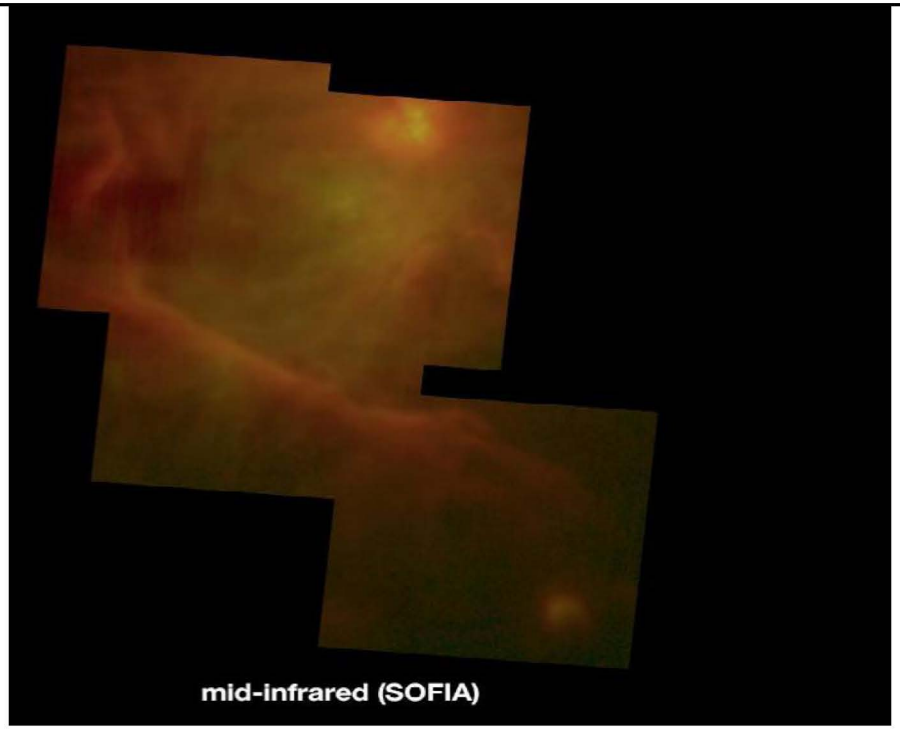
Stratospheric Observatory for Infrared Astronomy

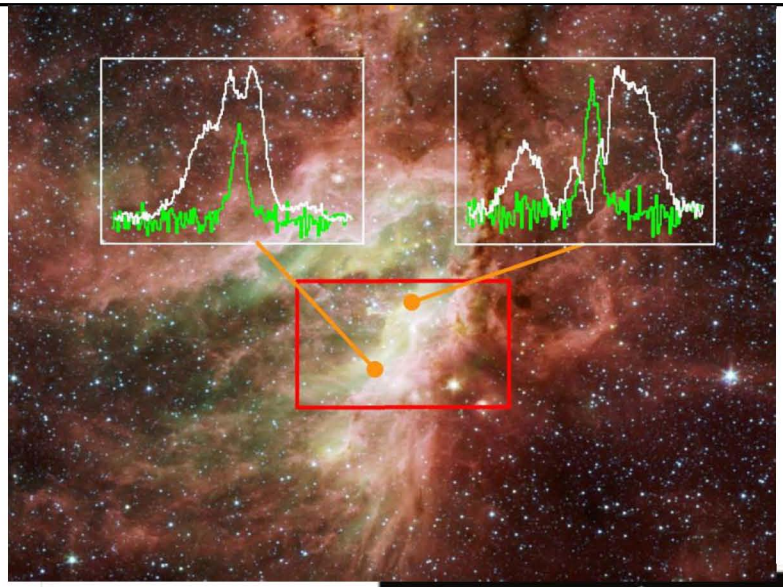


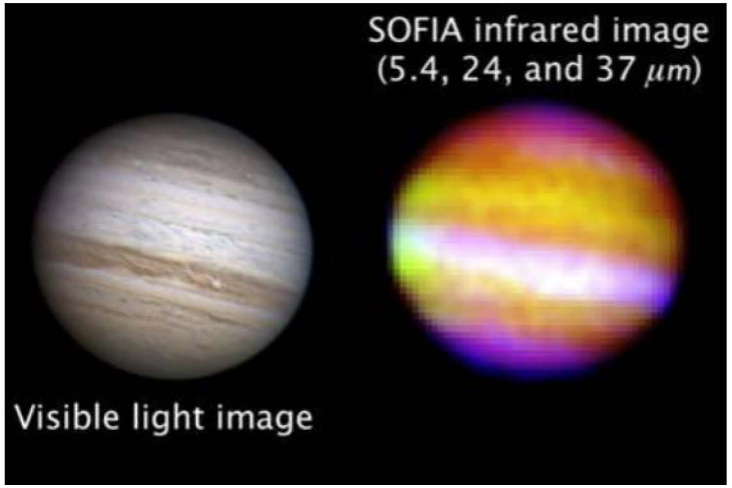
- SOFIA will provide astronomers with a key infrared window to the Universe
  - Formation of Stars and Planets
  - Interstellar Medium of the Milky Way
  - Galaxies and the Galactic Center
  - Planetary Science
- Joint program by NASA and DLR Deutsches Zentrum fur Luftund Raumfahrt (German Aerospace Center)
- Science Mission Operations - Universities Space Research Association (USRA) ,Deutsches SOFIA Institut (DSI)
- NASA Program Office – Dryden
  - Platform Project Office – Dryden
  - Science Project Office – Ames
- Major aircraft modifications:
  - German-built 100-inch (2.5 meter) diameter far-infrared telescope weighing 20 tons mounted in the rear fuselage
  - Mission and support systems
    - Mission Control and Communications System (MCCS)
    - Education and Public Outreach work stations Flight test operations
- First Open-Door Flight: Fall 2009
- First-Light : Spring 2010
- Initiation of Science Flights: Fall 2010

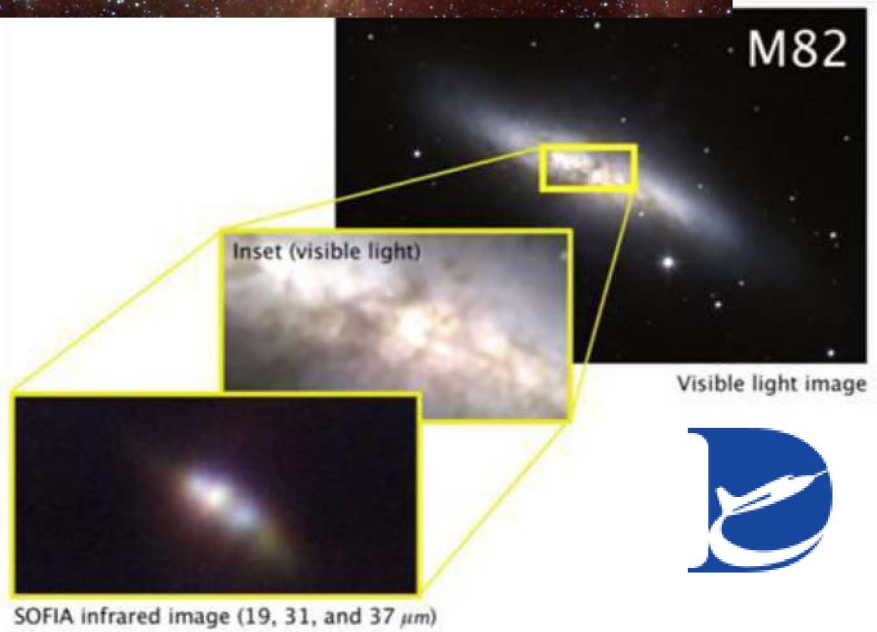
SOFIA – Platform

SOFIA – Science





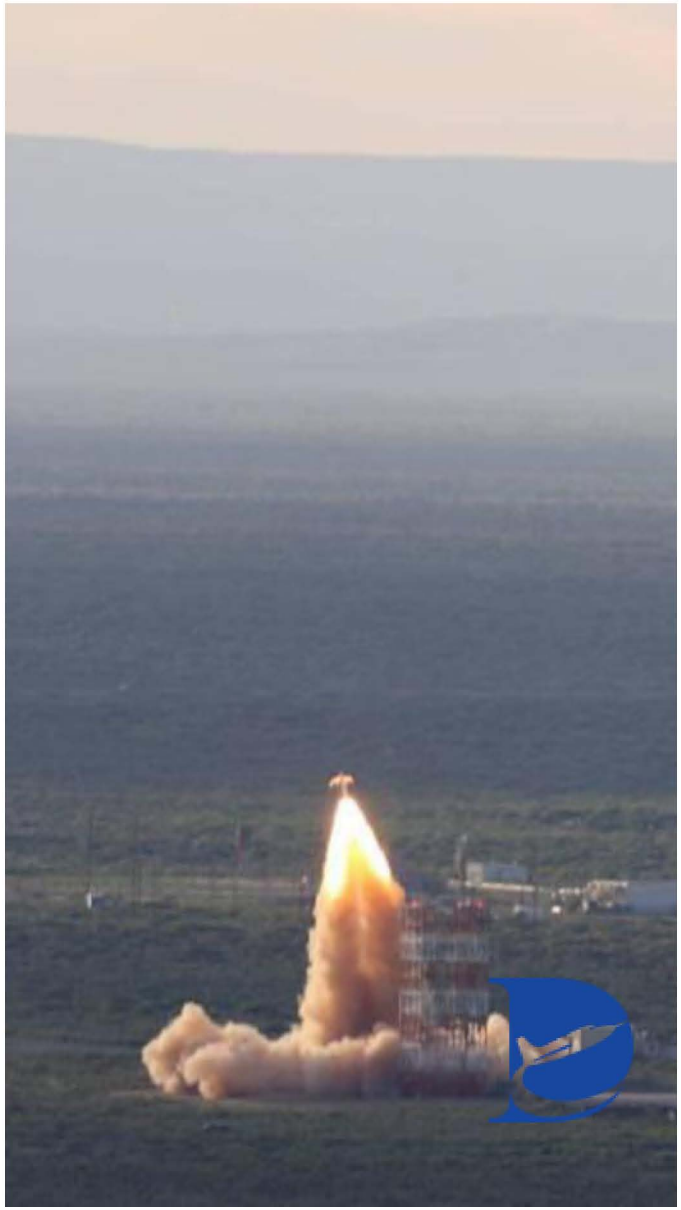




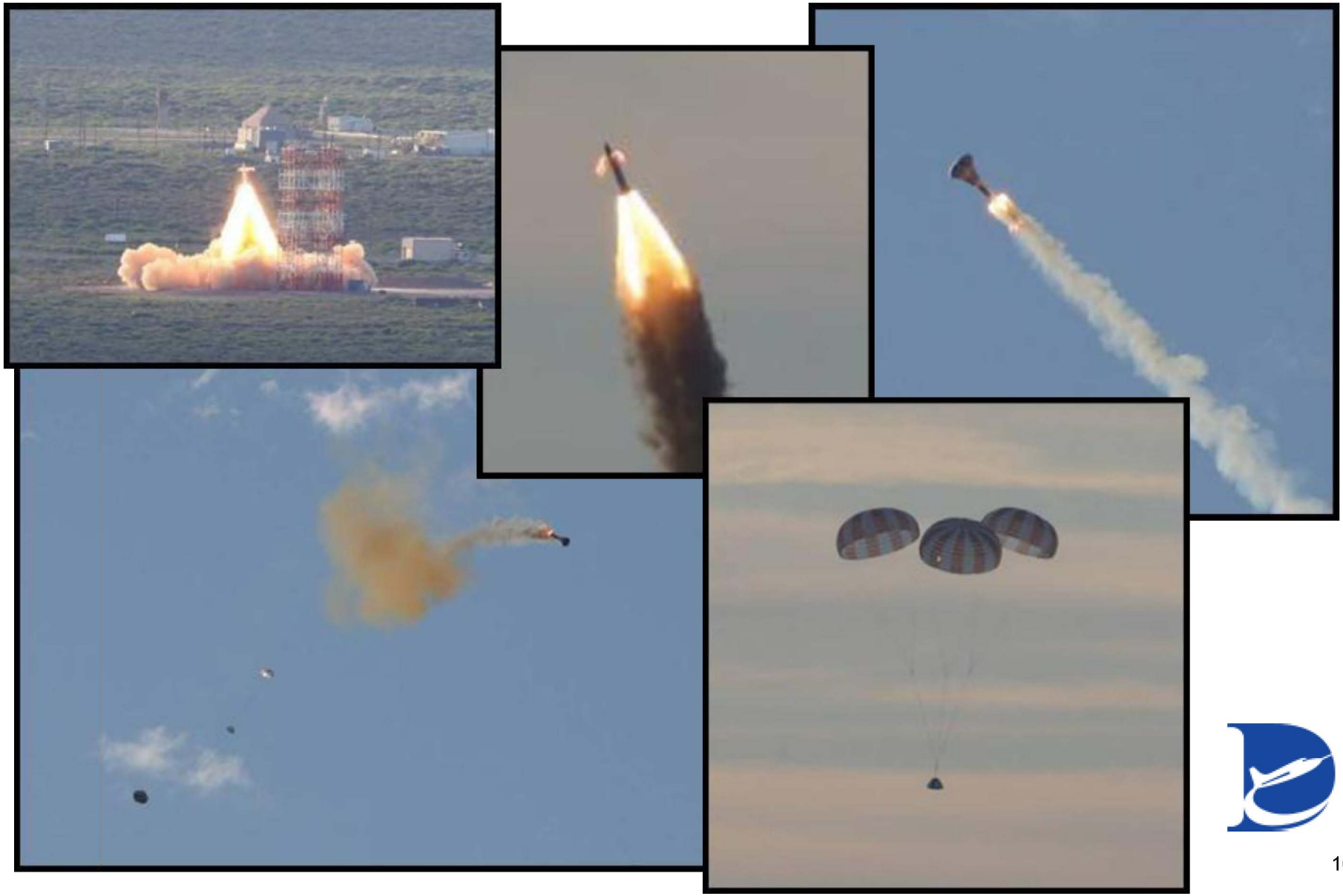
Exploration Systems

Launch Abort Flight Test

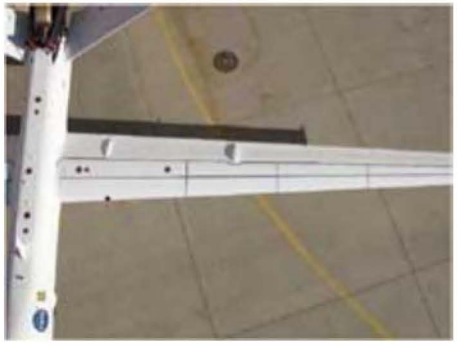
- Orion crew exploration vehicle includes a launch abort system (LAS) that assures crew escape after failure
- Lead Flight Test Vehicle (PA-1) Development and Test
  - Systems Engineering & Integration
  - Safety and Quality Assurance
  - Development Flight Instrumentation
  - Abort Test Booster Procurement Lead
  - Crew Module Integration and Test
  - Launch Facilities & Ground Support
  - Lead Flight, Ground, & Range Operations



Pad Abort 1 – May 6, 2010



Aeronautics Research



- Fundamental Aeronautics Program
  - Subsonic Fixed Wing
  - Supersonics
  - Hypersonics
- Aviation Safety Program
  - Integrated Resilient Aircraft Control
  - Integrated Vehicle Health Management
- Airspace Systems Program
  - Concepts & Technologies Development
  - Systems analysis, integration and evaluation
- Integrated Systems Research Program
  - Environmentally Responsible Aviation
  - UAS Integration in the National Airspace System
- Reimbursable/Partnerships (2011 SPG 1.4.4)
  - Technology Development
  - Systems Integration
  - Systems Validation

Blended Wing Body

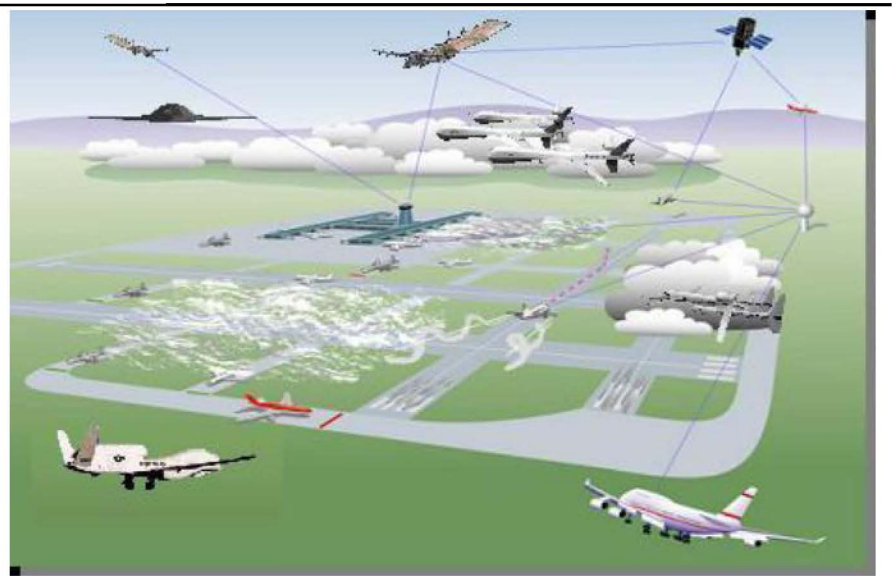
- The blended wing body (BWB) concept offers advantages in structural, aerodynamic and operating efficiencies over today's more conventional fuselage-and-wing designs. These features translate into greater range, fuel economy, reliability and life cycle savings, as well as lower manufacturing costs.

X-48B – Blended Wing Body

- Research partnership of Boeing, NASA, and AFRL
  - Design and fabrication contracted to Cranfield Aerospace
- Purpose
  - Evaluate low speed stability and control of blended wing body configuration in free-flight
  - Evaluate flight control algorithms
  - Evaluate prediction and test methods for blended wing body class vehicles
- Airframe
  - Remotely piloted from ground control station
  - 8.5% dynamically scaled (rigid body)
    - Wingspan: 20.4 ft
    - Weight: 525 lbf
    - Thrust: 54 lbf each (3 JetCat turbojets)
  - 20 control surfaces
    - 10 elevons
    - 8 split ailerons (4 clamshell pairs)
    - 2 winglet rudders

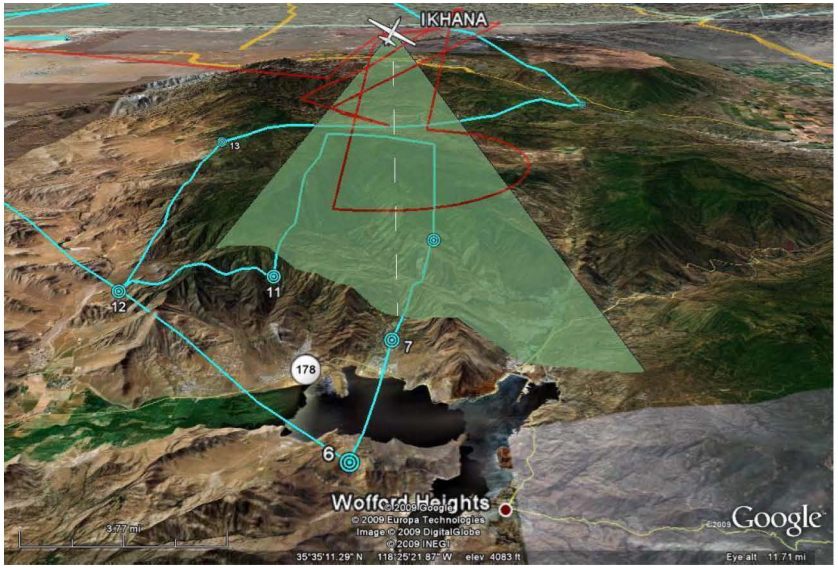
UAS Integration in the NAS

- Separation Assurance
  - Assessment of NextGen separation assurance systems for UAS in mixed operations
  - Flight tests with realistic latencies and trajectory uncertainty
- Human Systems Integration
  - Develop human factors guidelines for GCS operation in the NAS
- Communications
  - Frequency spectrum allocations issues
  - ICAO/FAA/RTCA Standards and Recommended for UAS
- Certification
  - Define UAS airworthiness requirements
  - Provide hazard and risk-related data
- Integrated Tests and Evaluation
  - Integrate and test concepts from the technical elements to demonstrate and test viability
  - Evaluate the performance of the research in a relevant environment (full mission human-in-the-loop simulations and flight tests)



IKHANA, Science and Pathfinding

- Western States Fire Mission
  - Certificate of Authority (COA), approval by FAA for a much large swath of Western US
  - Autonomous Modular Sensor (AMS) for thermal infrared imagery, downlinked real time, overlain on Google Earth, internet to National Interagency Fire Center in Boise, Idaho and fire incident commanders in the field
  - Operates like a digital camera with specialized filters to detect light energy at visible, infrared and thermal wavelengths.



IKHANA, Science and Pathfinding

- Automatic Dependent Surveillance-Broadcast, or ADS-B
  - Part of next generation air traffic control utilizing satellite navigation and GPS
    - Results in much greater accuracy in the display of an aircraft's position, velocity and altitude.

NASA Space Operations

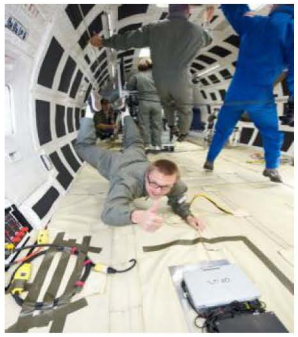
- Primary alternate landing site
- On-orbit communications support for International Space Station (ISS) and Shuttle Orbiter
- Telemetry support
- Shuttle Carrier Aircraft (SCA) maintenance and support
- 60 DFRC landing operations to date
  - Last landing operation STS-128, September 2009

Flight Opportunities

- *Fly early, Fly often.* Bridge the gap between testing space technology in a laboratory environment and demonstrating it in a mission-relevant operational environment

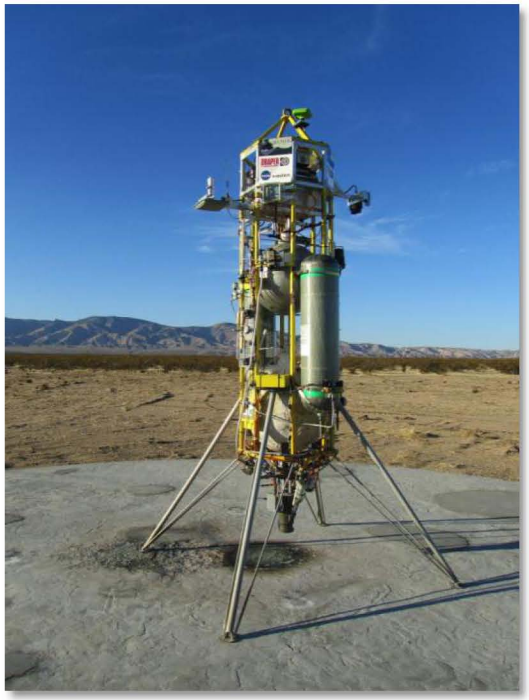
Flight Opportunity Platforms

- Parabolic Flight
  - Zero-G Corp Boeing 727
    - Zero – 1g, including 0.16g (lunar) and 0.38g (Mars) , 20-30s
    - Max 1.8g up to one minute.
- Suborbital Flight
    - Near Space Corporation, Tillamook, Ore.
    - Masten Space Systems, Mojave, Calif.
    - Up Aerospace Inc., Highlands Ranch, Colo.
    - Virgin Galactic, Mojave, Calif.
    - Whittinghill Aerospace LLC, Camarillo, Calif.
    - XCOR, Mojave, Calif
    - Armadillo Aerospace, Heath, Texa
- flightopportunities.nasa.gov/platforms/



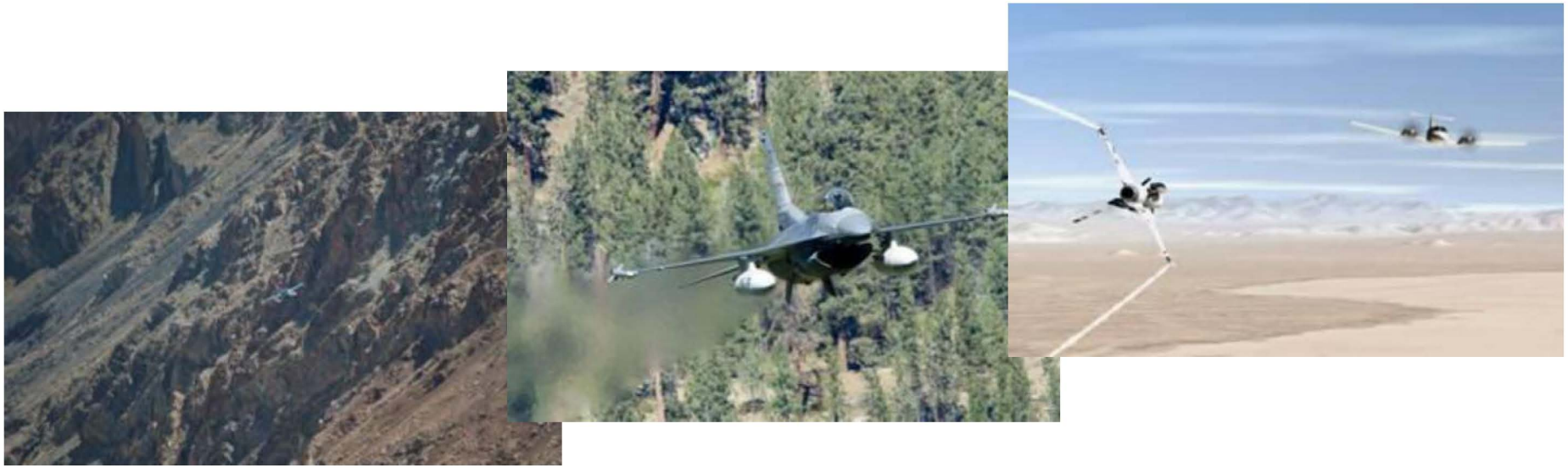
Flight Opportunity Testbed

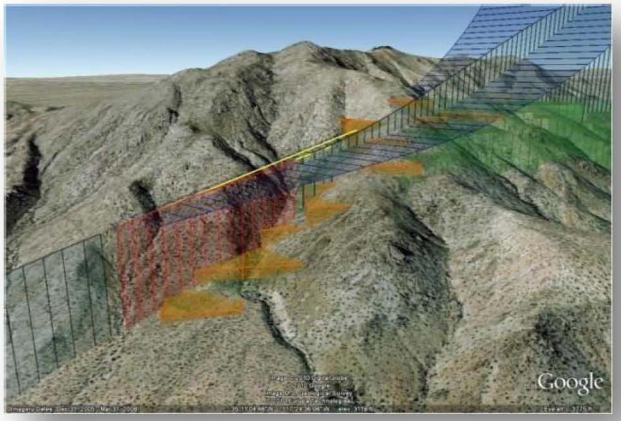
- Commercial Vertical Testbed (CVTB) development
  - Draper Labs, Cambridge, MA, tasked in Sept 2011 to rapidly develop a VTVL vehicle capability to allow for quick integration and demonstration of landing technologies
  - Uses Masten Space Systems Xombie vehicle and integrated Guidance Embedded Navigator Integration Environment (GENIE) as an interface with the stock flight control computer, allows customization of algorithms and allows future enhancements to test new technologies through flight demonstration.



Automatic Collision Avoidance Technology

Fighter Risk Reduction Program





Automatic Ground Collision Avoidance System

- Follow on work with DROID small UAV
  - Software adapted to Android smartphone
  - Linked to Piccolo autopilot
    - programmable, autonomous flight capable
- Follow on applications
  - Large Scale UAV
  - General Aviation
    - Standard smart phone with Auto-GCAS and Google world terrain database

Testbed Aircraft

- Testbed aircraft augmenting Dryden's one-of-a-kind research aircraft are available to support a wide variety of research missions.
  - Dragon Lady (ER-2)
  - Eagle (F-15B, F-15D)
  - Global Hawk (RQ-4)
  - Gulfstream (G-III)
  - Hornet (F/A-18)
  - Ikhana (MQ-9)
  - King Air (B-200)
  - Mentor (T-34)

- Testbeds provide platforms for sensor validation, aerodynamic, system, and propulsion research and test.


Questions?
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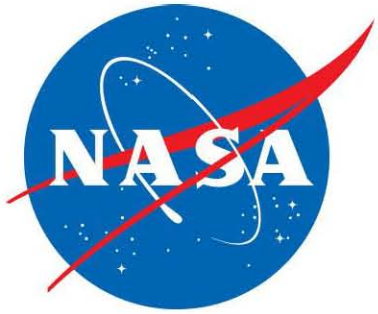
NASA