National Aeronautics and Space Administration






NASA Armstrong Research
CENTER OVERVIEW

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NASA Armstrong Mission

Advancing Technology and Science Through Flight

1. Perform flight research and technology integration to revolutionize aviation and pioneer aerospace technology

2. Validate space exploration concepts

3. Conduct airborne remote sensing and science observations

NASA Armstrong Vision

To Separate the Real from the Imagined Through Flight

Space Shuttle ALT

Lunar Landing Research Vehicle

F-8 Digital Fly-By-Wire

M2-F1

X-43

X-29 Forward Swept Wing

Helios

X-15

NASA Armstrong Vision

To Separate the Real from the Imagined Through Flight


X-56A


Low-Boom Flight Demonstrator


D8


Prandtl

SOFIA


Towed Glider Air-Launch System


X-57


Dream Chaser

What Does Armstrong Really Do?

- Armstrong has facilities and requisite expertise to conceive, design, analyze, fabricate, integrate, maintain, and conduct disciplinary research, flight research, and flight test on modified or unique research vehicles and systems
- Armstrong's strength is in integration of developmental systems – integration of systems into a vehicle (fundamental aero type work) or of vehicles into a system (unmanned aircraft system [UAS] in the National Airspace System [NAS])
  - Combination of engineering, operations, and safety skills inherent in workforce and flexible/lean processes to manage risk down to the right (acceptable) level
- While majority of work is aircraft-based, skills applied to non-aircraft work (vehicle integrated propulsion research, ground test, Orion Pad Abort [PA]-1 integration, X-43, lifting bodies, Lunar Landing Research Vehicle, etc.)
- Technical staff is experienced with various aircraft types, flight regimes, systems – not restricted to a certain class of aircraft
  - Same people to work subsonic, supersonic, hypersonic systems

NASA Armstrong Flight Research Center

Edwards AFB, California

- Year-round flying weather
- 301,000 acres remote area
- Varied topography
- 350 testable days per year
- Extensive range airspace
- 29,000 feet of concrete runways
- 68 miles of lakebed runways
- Supersonic corridor
- U.S. Air Force Alliance

NASA Armstrong Science Operations Building 703

Palmdale, California

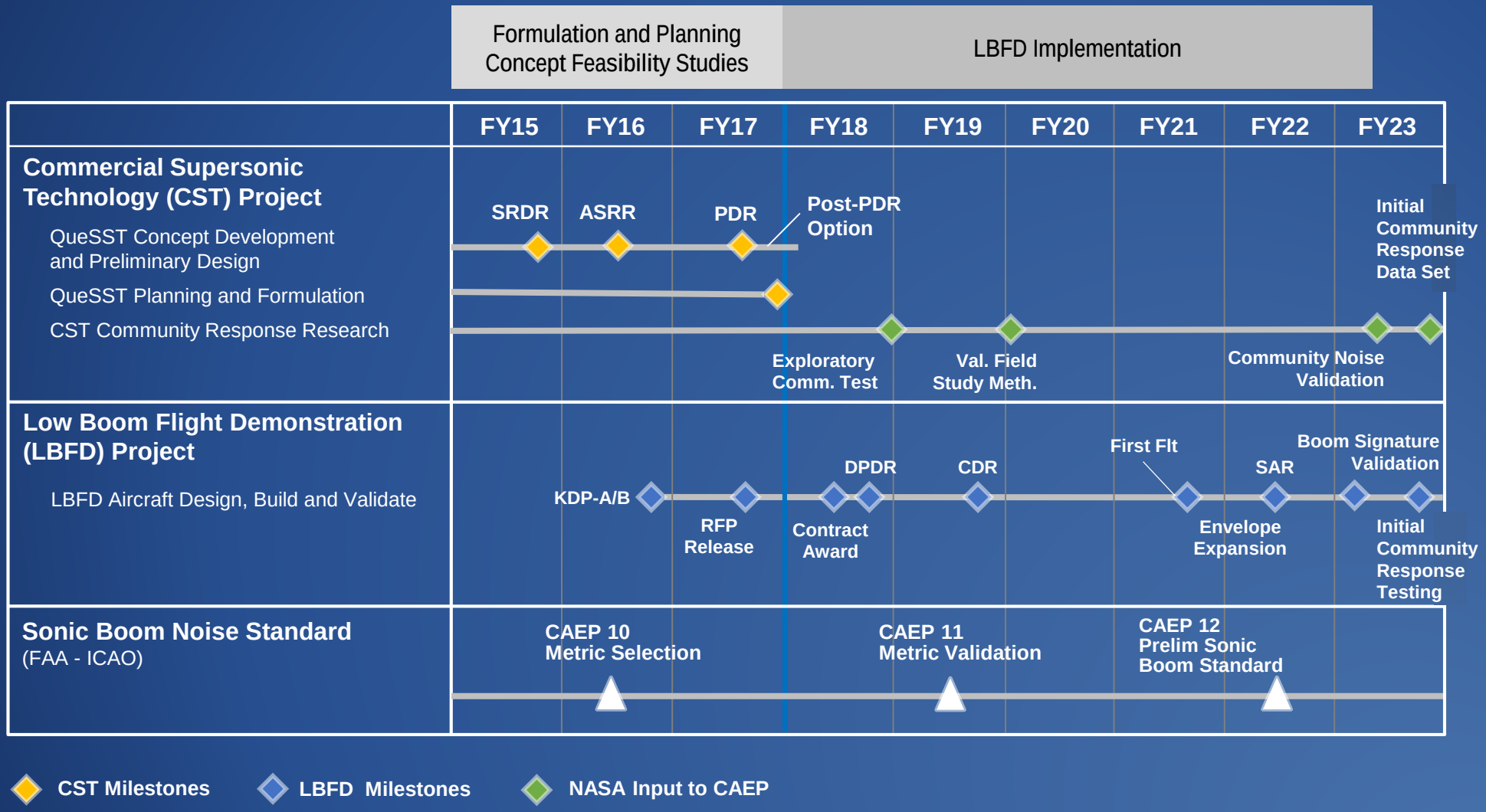
Home to

- Stratospheric Observatory for Infrared Astronomy (SOFIA) – Astrophysics
  - Boeing 747
- Earth Science – Airborne Science
  - DC-8
  - ER-2
  - C-20A

Low-Boom Flight Demonstrator (LBFD)

Collecting data that could make supersonic flight over land possible, dramatically reducing travel time in the United States

LBFD Program Schedule

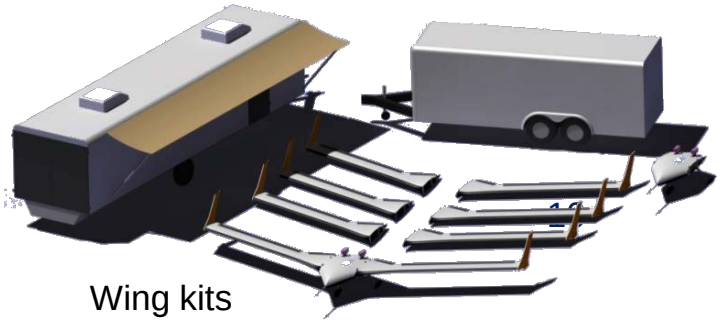


Basic Program Overview: MAD – MUTT – X-56A

- AFRL teamed with NASA and Lockheed: Multi-Utility Aeroelastic Demonstration (MAD)
  - › Develop a Multi-Utility Technology Test-bed (MUTT) unmanned aircraft
  - › **Active aeroelastic control and gust load alleviation (GLA) research**
  - › **Develop multiple flutter mode control system for an unstable vehicle**
- Two Lockheed X-56A aircraft were made
  - › Fido (tail number [TN] 01, flown by Lockheed) – 8 flights (stiff wing); crashed/destroyed November 2015
  - › Buckeye (TN 02, flown by NASA) – 8 flights (stiff wing) + 6 flights (flex wing)
- TN 02 Buckeye – NASA-owned; NASA-grown flight control system
  - › 2018: Currently in flexible wing flight phase, leading up to flutter research
    - Flex wing first flight (August 2017)
    - **Ongoing:** Fly 1-2 times per week through end of April 2018
    - **Next flight (No. 15): Collect data to determine flutter suppression control law margins at 80 knots**
    - **Challenges:** Sensitive to winds, turbulence, GPS jamming, lakebed conditions

Armstrong Flight Research Center

28-foot span, 480-pound GTOW, 150 knots, 10,000 feet altitude, emergency recovery chute.



Wing kits

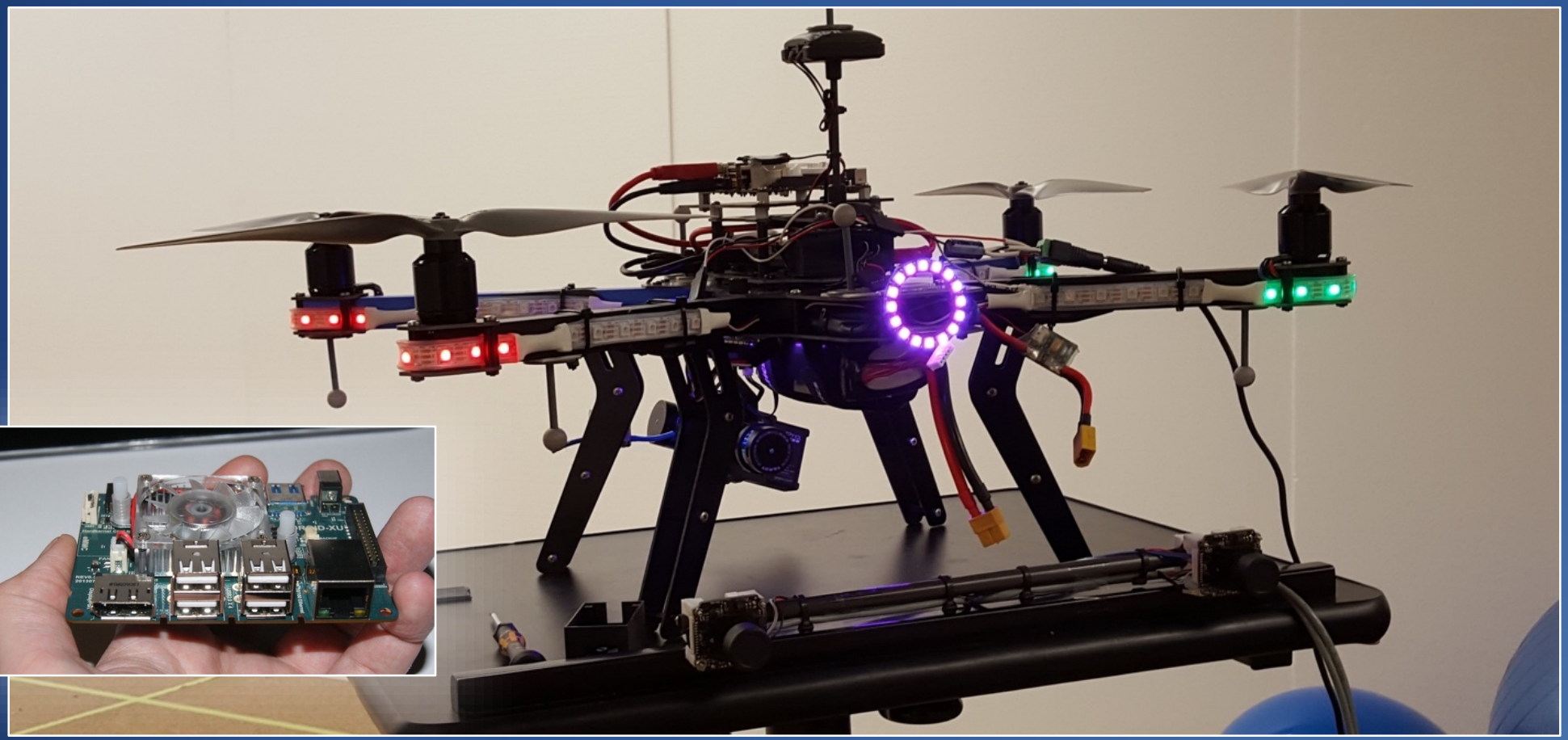

Mod 4

X-57 Maxwell

Improving commercial aircraft energy and environmental impacts

Autonomous Systems

Advance autonomous technologies to improve safety and efficiency of future vehicles



NASA Earth Science

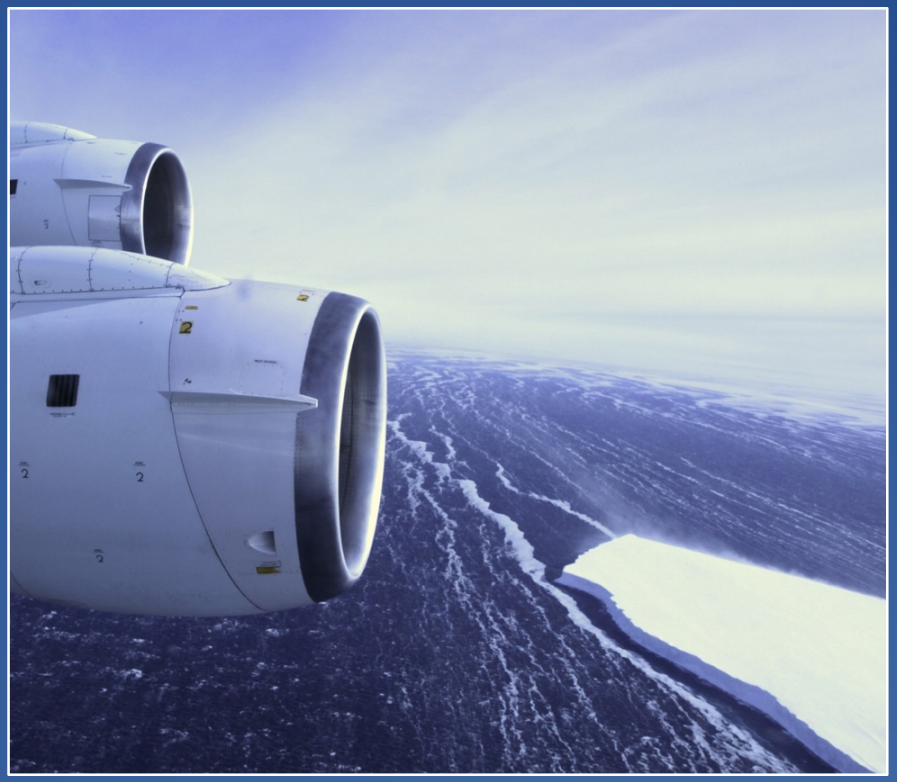
Focus areas and NASA Armstrong's role

Airborne Science Program focuses on

- Weather
- Climate change and variability
- Earth surface and interior
- Water and energy cycle
- Carbon cycle and ecosystems
- Atmospheric composition

Armstrong's role is

- Obtain high-resolution measurements
- Support new space-based sensor development
- Satellite calibration and validation
- Develop next-generation Earth scientists and engineers

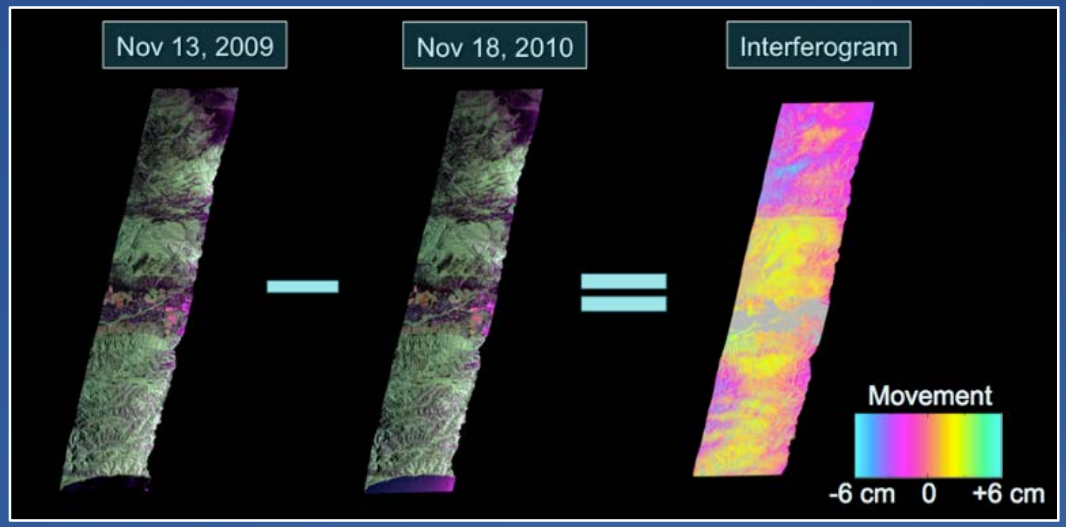


Satellite Instrument Development and Global Earth Science Studies

Understanding Earth's systems, global climate change

Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR)

Joint venture with Jet Propulsion Laboratory using an airborne radar to study Earth science with emergency response potential



UAVSAR images of San Andreas fault

NASA's Gulfstream III with UAVSAR pod

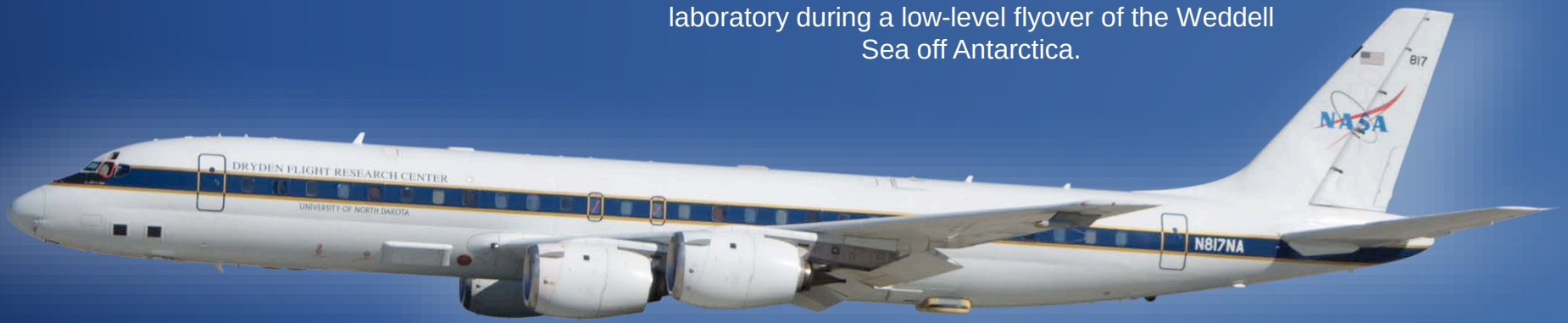
Satellite Instrument Development and Global Earth Science Studies

Developing tools to enhance predictions of weather and climate

Operation IceBridge (OIB)

Six-year field campaign, the largest airborne survey of Earth's polar ice

Sea ice is seen from NASA's DC-8 flying science laboratory during a low-level flyover of the Weddell Sea off Antarctica.



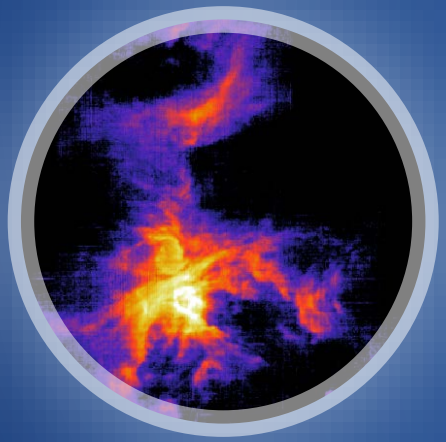
Infrared Astronomy in the Stratosphere

Making discoveries about our solar system and the universe

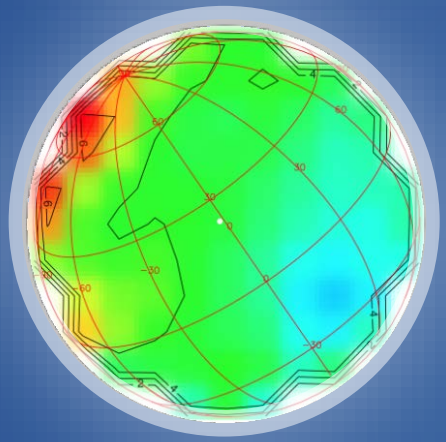
Stratospheric Observatory for Infrared Astronomy (SOFIA)

World's largest flying observatory features a 106-inch primary mirror and a telescope that weighs 37,500 pounds

Missions fly above 99% of the Earth's water vapor, enabling studies of the universe at infrared wavelengths



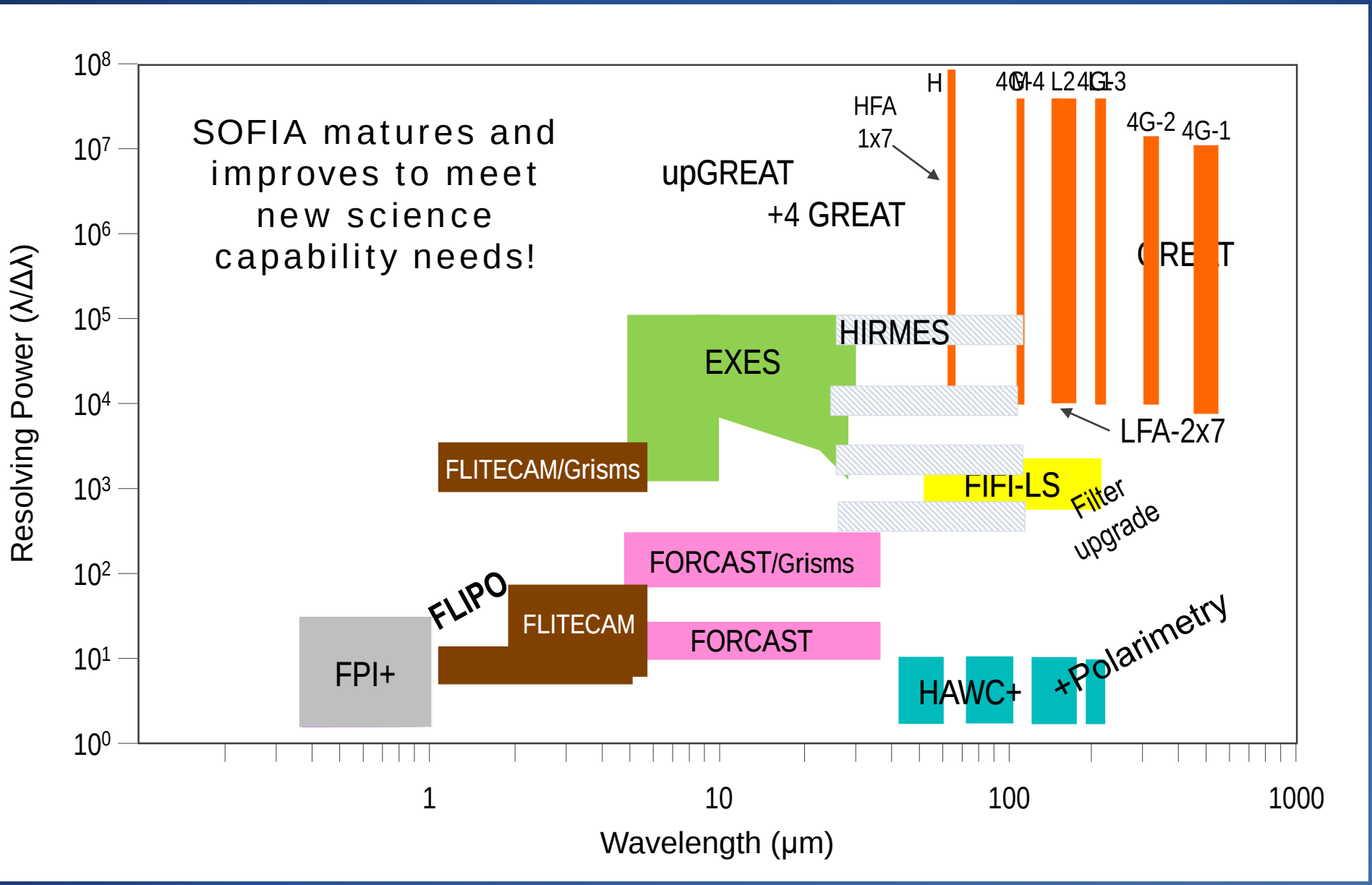
Birth of Stars and Planets



Path to Life: Our Interstellar Origins

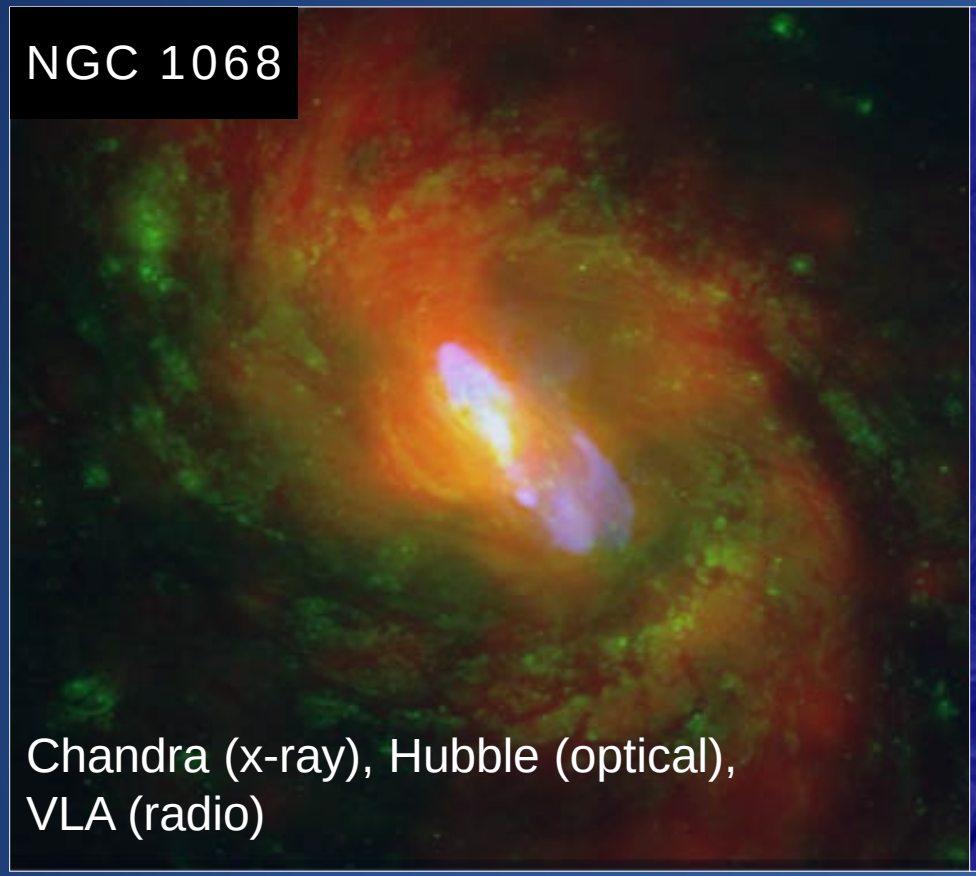
Extreme Environments

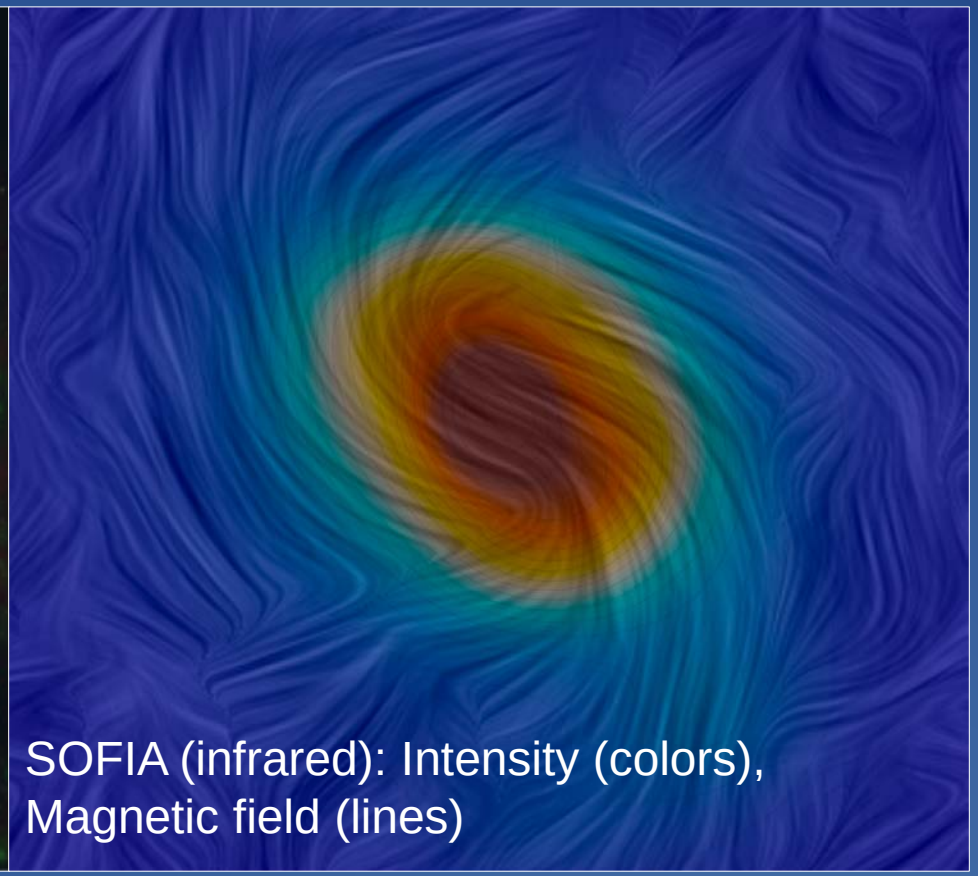
SOFIA Science Instrument Evolution



Instruments span an unprecedented wavelength range by a single observatory.

Star and Galaxy Formation





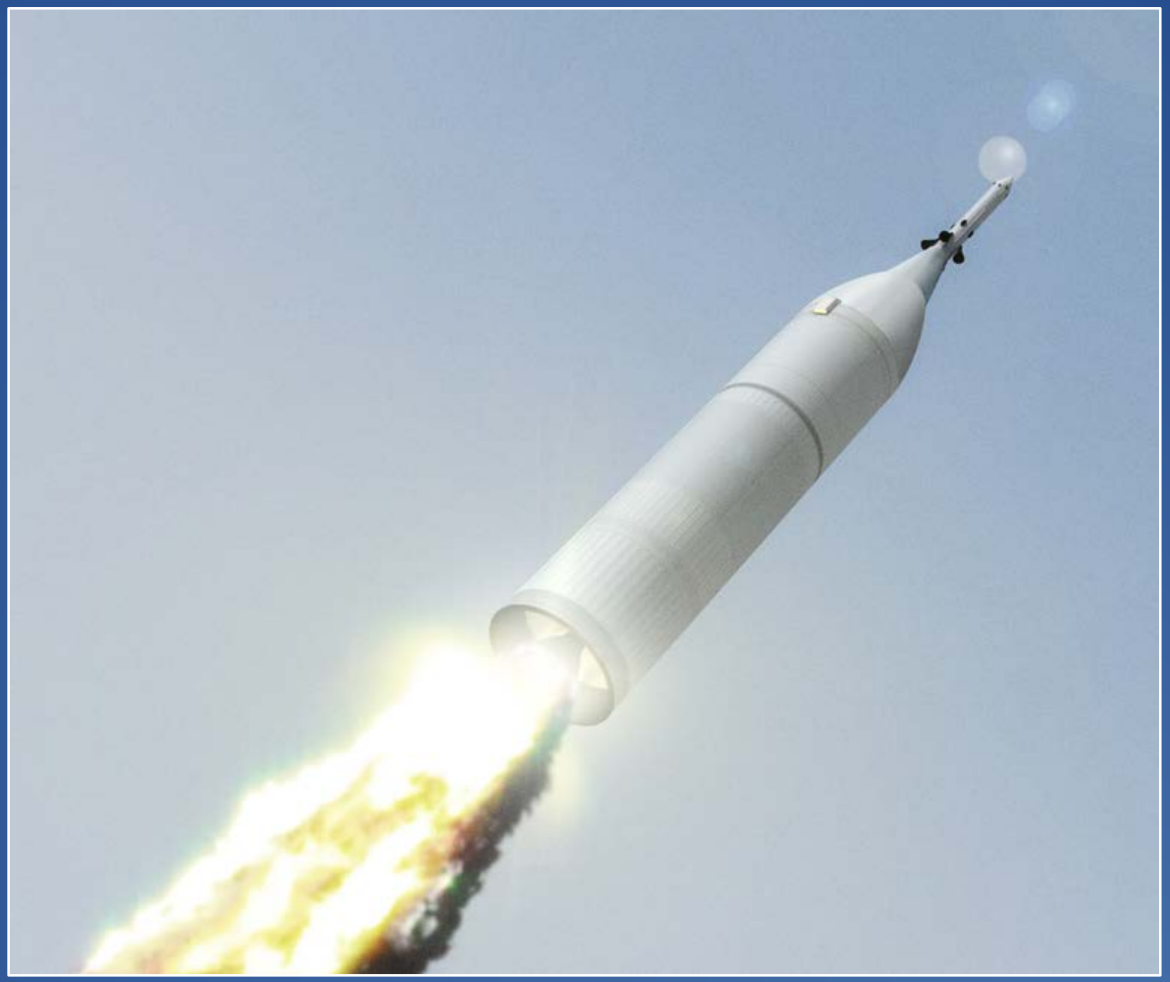
Do magnetic fields control the spiral structure of this galaxy?

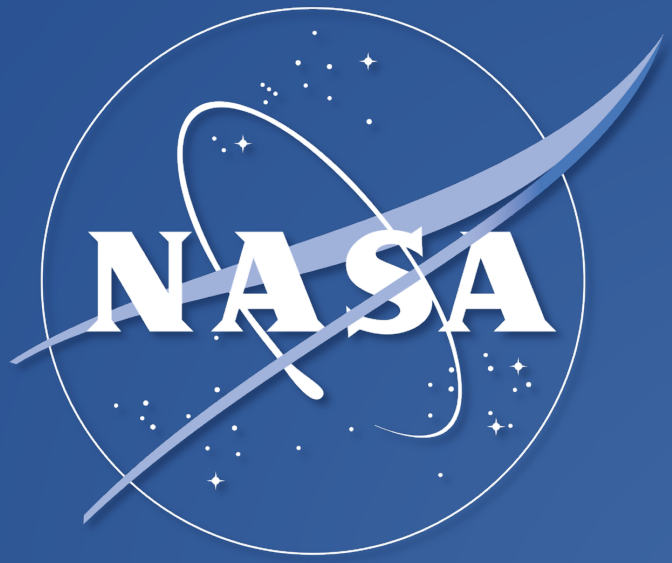
A new instrument on SOFIA is allowing astronomers to study the role of magnetic fields in star and galaxy formation

Exploring space beyond low Earth orbit

Ascent Abort (AA)-2

Demonstrate Orion's Launch Abort System can safely separate and maneuver the crew module away from launch vehicle during an abort in transonic and maximum dynamic pressure flight conditions




NASA