



National Aeronautics and
Space Administration



Engineering Directorate

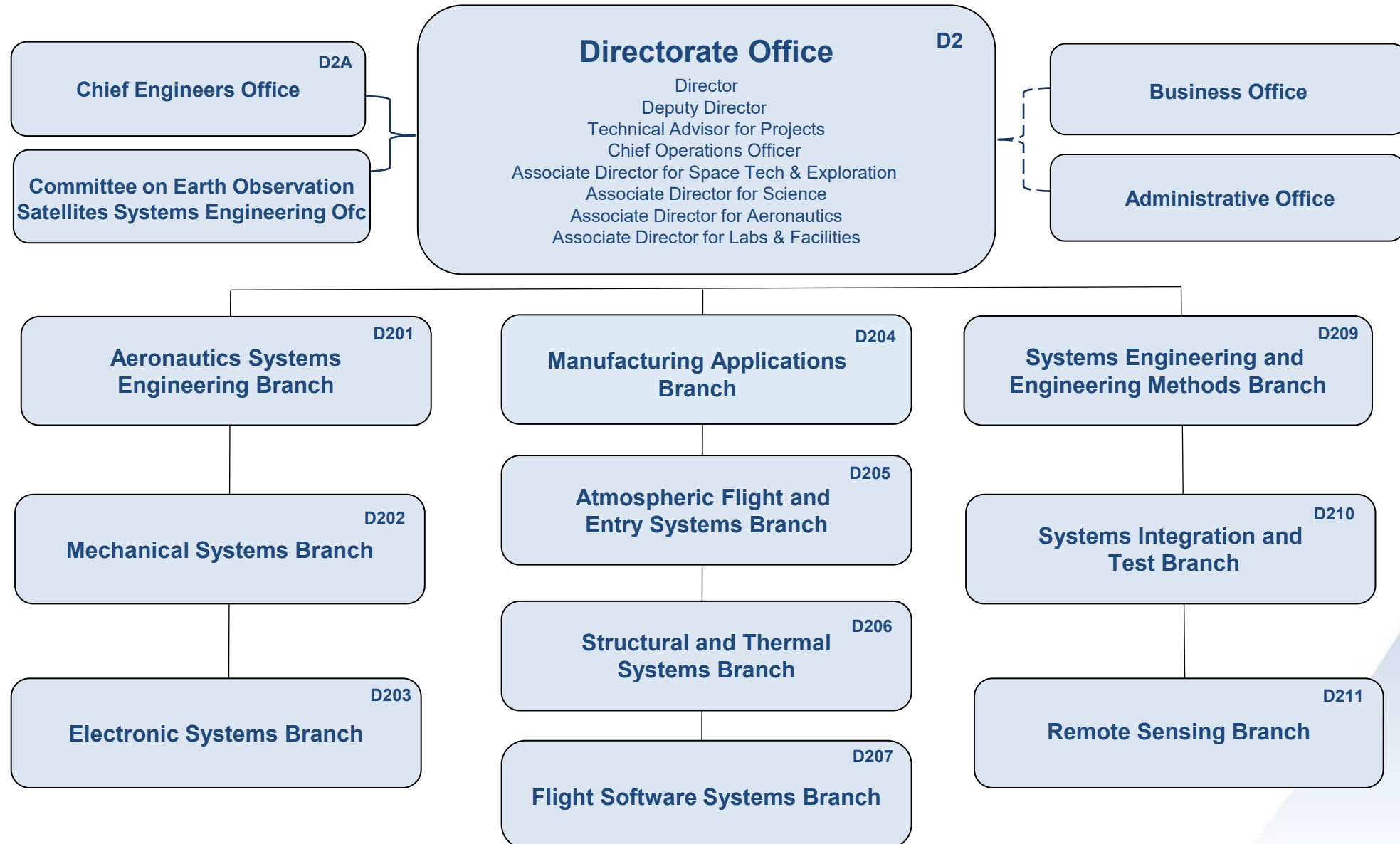
Overview

August 2021





Engineering Directorate





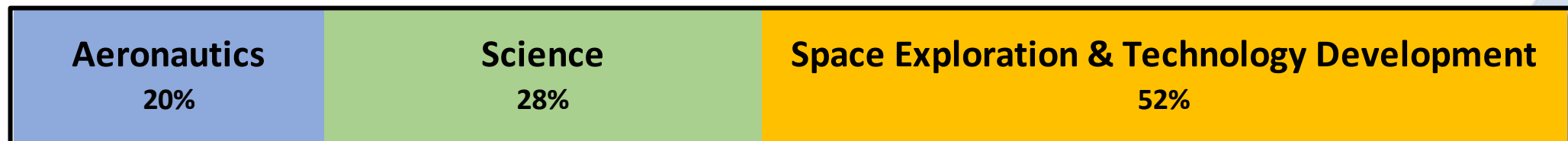
Engineering Directorate



What we do

The Engineering Directorate provides system concepts, advanced technology solutions, ground test systems, flight systems, and operational systems to support the research, technology, and development objectives of the Agency aeronautics, science and exploration missions.

Our Customers



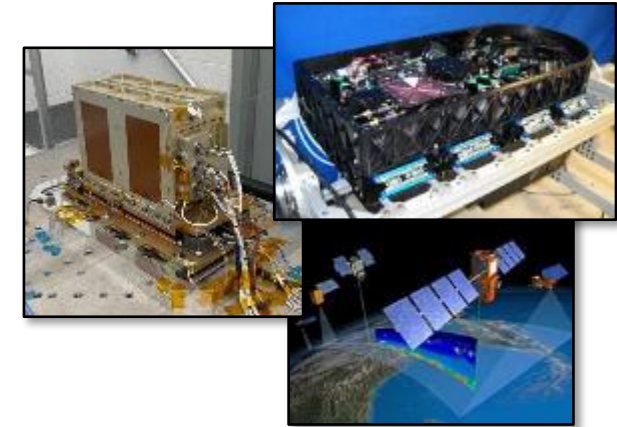
Engineering Capabilities and Expertise



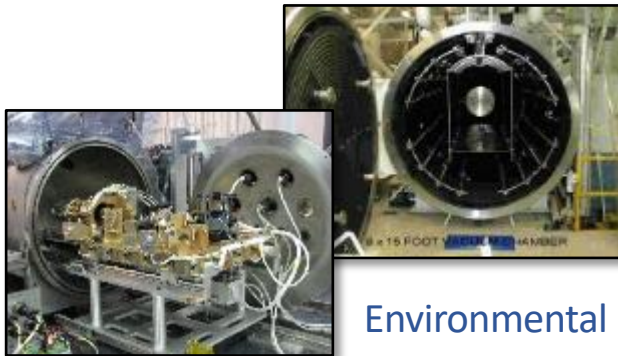
Flight Systems



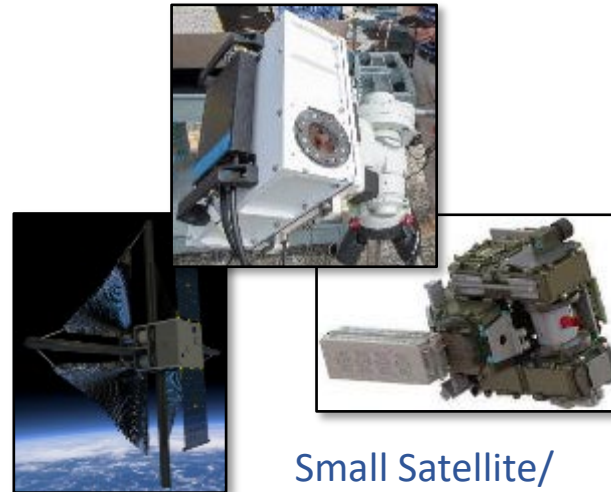
Entry, Descent & Landing



Measurement Systems,
Laser/Lidar Technology



Environmental
Testing



Small Satellite/
Rapid Development

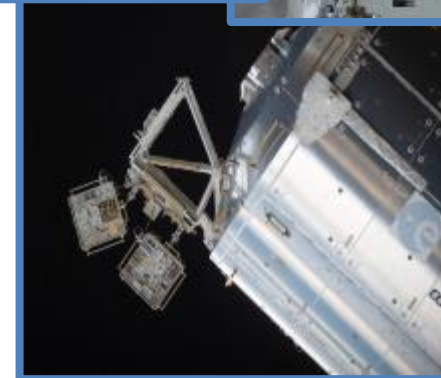


Manufacturing and
Instrumentation

- **Flight Systems** – Provide integrated aerodynamic, aerothermodynamic, flight dynamics, mechanical, structural, thermal, optical, electronics, and flight software systems design, development, and validation to enable the Center research mission in atmospheric sciences and the development, test, evaluation, and integration expertise to support the deployment of instruments, payloads, technology demonstrators, and flight vehicle systems.

➤ **Functional Capabilities:**

- Mechanical/Structural System Development
- Structural and Thermal Analysis
- Electronic System Development
- Optical System Development
- Software Engineering
- Hardware Assembly, Integration, and Testing
- Requirements Definition and Planning
- Management and Administration





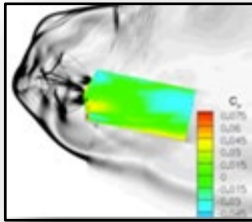
Entry, Descent & Landing (EDL)

Slowing down, approaching, connecting or touching down on any body with significant gravity; with or without atmosphere



Modsim Advancement

- Analysis code development -- Computational fluids, structures, flight mechanics, guidance and control algorithms (autonomous)
- Flight testing and wind tunnel V&V
- Instrument development



HPC CFD



Direct Force Control



Integrated Composites



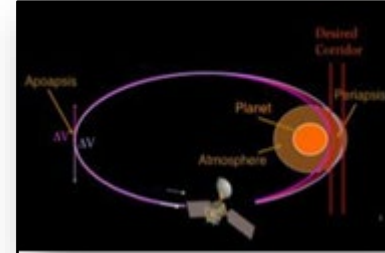
HIADs

Flight Vehicle Tech Development

- Aeroshells & thermal protection
- Navigation systems
- Aero Maneuvering – Trim tabs, morphing, RCS, GNC algorithms
- Decelerators -- Parachutes, HIADs, SRP
- Landing systems



Outer Planet Aerocapture



Autonomous Aerobraking

Mission and Vehicle OML Design

- Mission architecture development
- Vehicle concept generation and trades
- Systems analysis, assessment and optimization –
 - Includes CFD and tunnel testing
- Atmosphere modeling

Vehicle System Development

- Systems Engineering – requirements and validation
- Performance simulation and assessment
- Aerodatabase generation
- Structural/thermal and mechanical design
- Guidance and control design
- Electronic systems development
- Flight software generation
- Hardware fabrication
- Systems Integration and testing

Operations Support

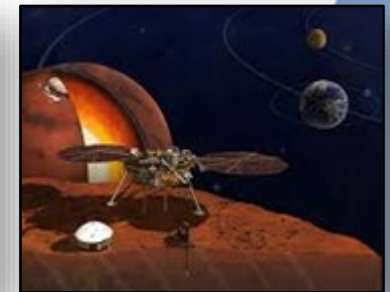
- Mission animation
- Atmosphere updates
- Trajectory analysis
- Comm LOS/image acq. timing
- Flight computer coefficients
- Entry console staffing

Post-Flight Processing

- Data analysis/reconstruction
- Mission archiving



'11 MSL/MEDLI



'18 Mars InSight



'14-'19 Mars MAVEN



'21 Mars 2020

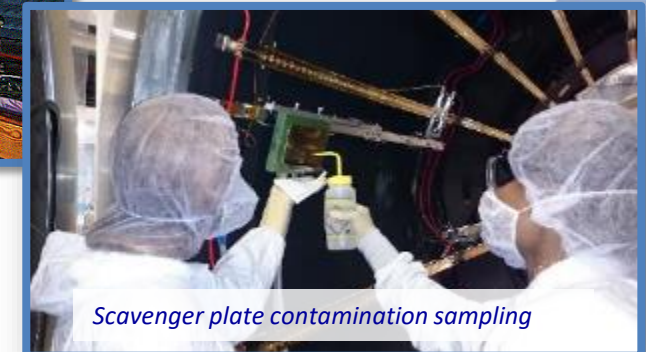
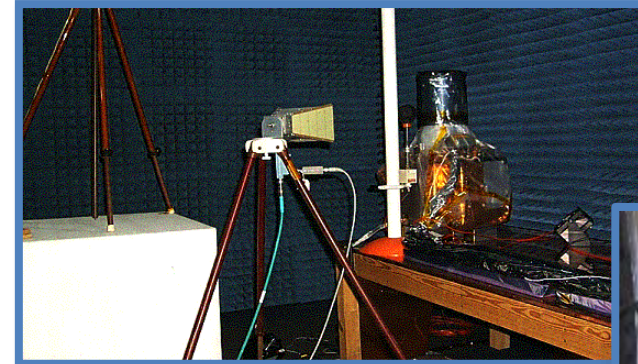
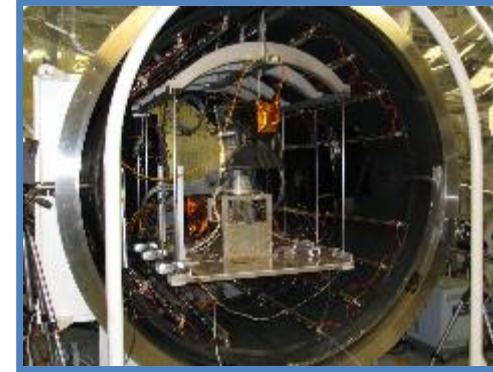
➤ **Measurement Systems and Lidar/Laser Technology** – Conduct lidar and solid-state laser technology development, electro-optic radiation detection and sensor system technology development. Provide analysis, advanced concepts, laser materials, components, system development, risk reduction, technology maturation, engineering model demonstrations, testing, integration, and flight qualification to support the development of active remote instruments to support atmospheric characterization, and landing systems.

➤ **Functional Capabilities**

- Electronic System Development
- Remote Sensing System Development
- Software Engineering
- Sensor/Electro-Optical System Development
- Lidar/Laser System Development
- Hardware Integration and Environmental Testing
- Requirements Definition and Planning
- Management and Administration



Facility	Usable Test Volume		Characteristics
Thermal Vacuum Chambers			
5 ft x 5 ft	4 ft-6in x 4 ft-3in x 4 ft-6in		Graphite heaters (3000°F), <5x10E-6 Torr
6 ft x 6 ft	3 ft-6 in x 5 ft x 4 ft-10 in	ISO-7 Cleanroom	GN2 thermal shroud (-150C - +150C), <1 x10E-6 Torr
8 ft x 15 ft	6 ft-8in x 14 ft	ISO-7 Cleanroom	Quartz Lamps, LN2 shrouds, <1x10E-6 Torr
Vacuum Ovens (x3)	2 ft. x 2ft X 2 ft-6 in	ISO-7 Cleanroom	Hot walls with cold plate (-30C to +200C), <1x10E-6 Torr
Vibration Testing			
LING Model 308V	1ft mounting cube, 1.5in stroke		3000 force-lb, sin
UNHOLTZ-DICKIE T-2000	45in x 28in slip table, 1in stroke		24000 force-lb, sin
UNHOLTZ-DICKIE T-4000	48in x 61.5in slip table, 1in stroke		40000 force-lb, sin
Mass Properties			
Space Electronics KSR1320		Mass, MOI, and CG Test articles up to 1320lb	
Electromagnetic Compatibility			
Radiated & Conducted emission/susceptibility		9m x 6m x 5.5m	Provide testing per MIL-STD-461 and similar
Cleanroom		40 ft	ISO 6



Complete ability to test spaceflight hardware

Small Satellite and Rapid Development

Mission Formulation

- Systems Studies of Mission Architectures
- Integrated Engineering Design
- Concept of Operations
- Science and Technology Demonstrations
- Concept to Flight

Technology Development

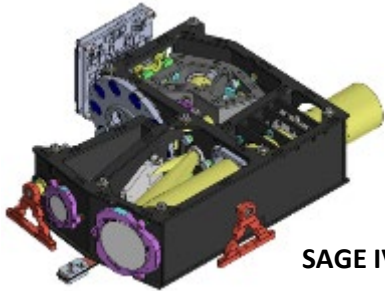
- Hardware Concept Development
- TRL Maturation
- Component and System Performance Testing and validation
- Modeling and Analysis

Mission Development

- Project Management
- Cost and Schedule Development
- Systems Engineering
- Systems Integration
- Environmental Testing

Mission Operations

- Data Reduction and Analysis
- Mission Control Center



SAGE IV (solar occultation to retrieve vertical profiles of aerosols and gases in the stratosphere)



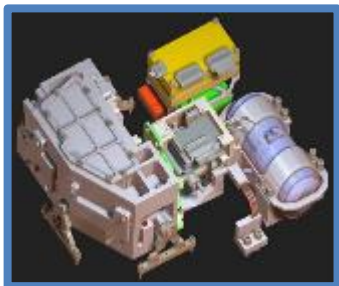
ACS3 (solar sail deployment and control Technology Demonstration)



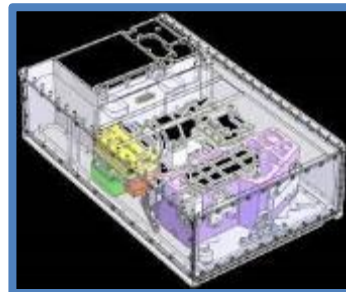
ATHENA (Earth Radiation Budget Technology Demonstration)



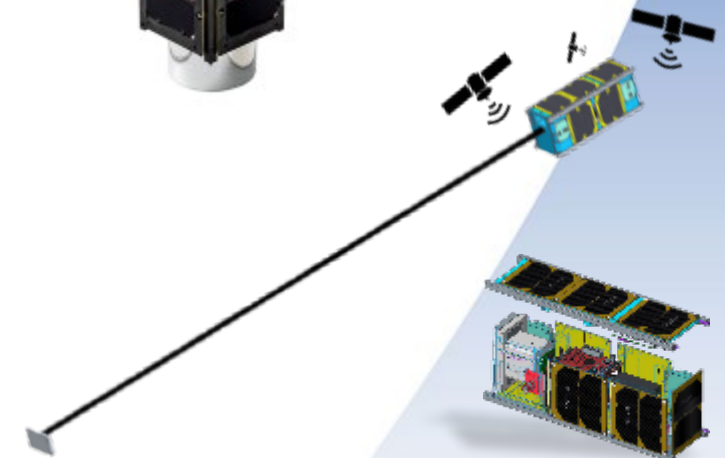
SHIELDS-1 (Radiation shielding material characterization)



ARCSTONE (Lunar Calibration Standard for on-orbit instruments)



GPX-2 (in-space GPS validation and occultation science)



- **Fabrication/Manufacturing Technology** – Produce unique spaceflight hardware, prototypes, and test articles utilizing state-of-the-art manufacturing techniques, equipment, and expertise in support of a broad portfolio of aeronautics, science, human exploration, and space technology missions. Develop and install measurement sensors within test articles to collect performance data and/or measure environmental test conditions.

➤ **Functional Capabilities**

- Metals Fabrication
- Precision Machining
- Computer Aided Manufacturing
- Composite Manufacturing
- Additive Manufacturing
- Casting
- Ceramics
- Test Article Instrumentation

