



AETD

*WE BUILD THE
SYSTEMS OF
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TODAY*

Applied Engineering and Technology Directorate

AETD Overview

Felicia Jones
Director of AETD

January 21, 2015

NASA Goddard Space Flight Center

engineering

AETD Vision

The Applied Engineering and Technology Directorate provides multidisciplinary engineering expertise for the development of cutting-edge Science and Exploration Systems and technologies.

AETD's talented and diverse workforce is committed to expanding today's engineering boundaries through the application of emerging technologies to develop high performance, cost effective solutions to the most challenging problems in Science and Exploration. We will achieve this within our laboratories and those of our many valued present and future partners.



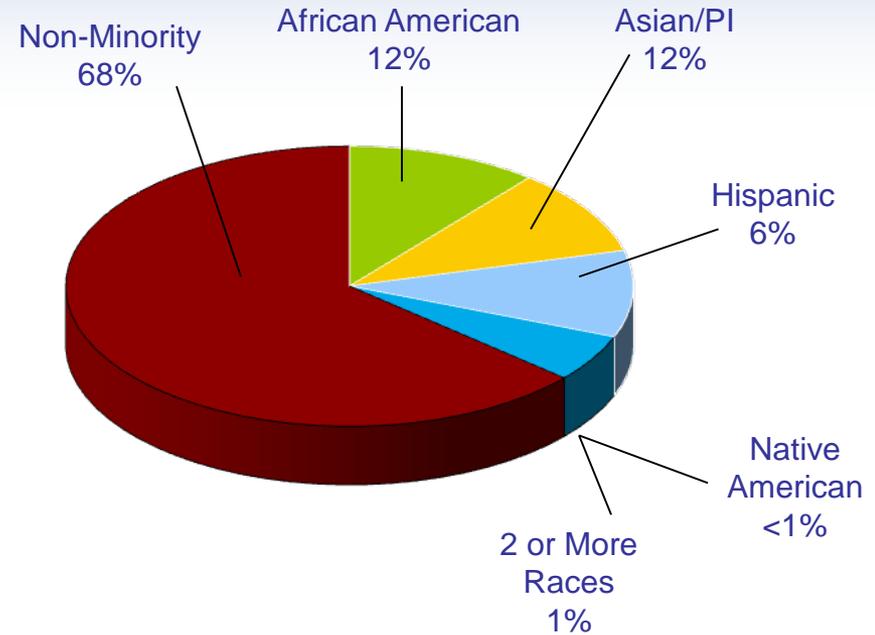
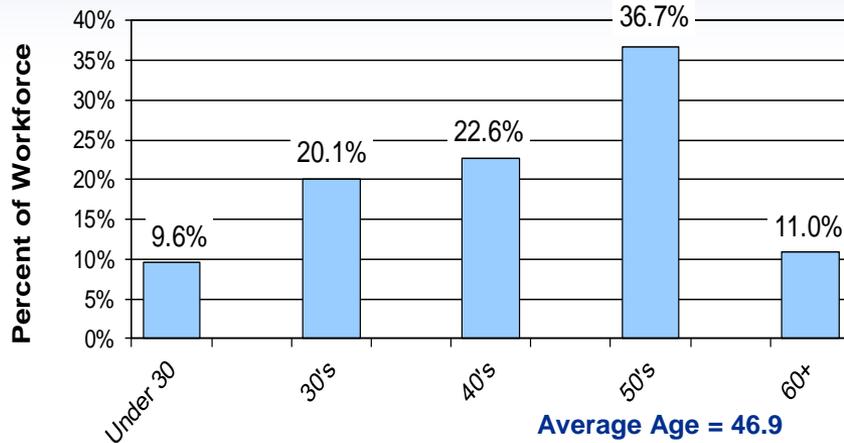
NASA Goddard Space Flight Center Applied Engineering and Technology Directorate—
Enabling the "Reality of Tomorrow"

Applied Engineering & Technology

- A diverse, talented and highly educated workforce. Unique facilities and laboratories. All working as one to serve the Science and Exploration communities and making the Nation's Vision for Space Exploration a reality.
 - AETD holds one third of the Center's civil service population
 - AETD is the main source of the Senior Technical and Management pipeline
 - The success of NASA/GSFC Projects depends upon the technical competence and capability of AETD
 - AETD is the steward for engineering excellence and Engineering Technical Authority at GSFC

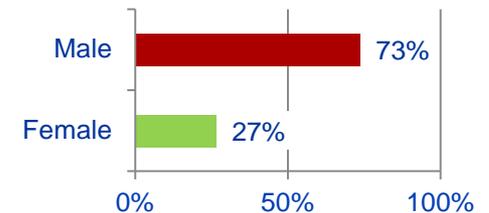
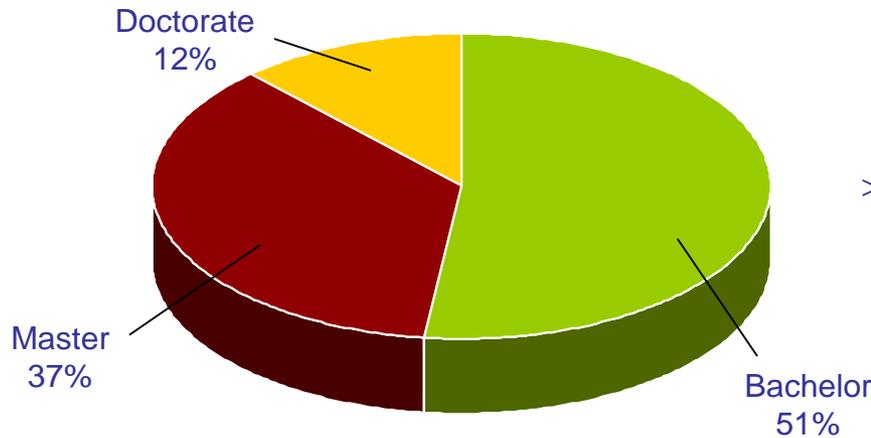
AETD Workforce*

Age Distribution of AETD Workforce



~1290 Employees

>93% Engineers and Technicians



*Statistics as of September 30, 2014

Engineering and Technology Expertise

1. End-to end mission system design and implementation:

- Thermal Systems
- Large Optical Systems
- Environmental Testing
- Flight Dynamics Analysis
- Spacecraft Propulsion
- Mechanical Structures/Mechanisms
- Mission Systems Engineering & Implementation
- Avionics Architecture & Implementation
- RF & Optical Communication Systems
- Command & Data Handling Systems
- Power Systems & Electrical Systems
- Ground Support Equipment Design & Implementation
- Guidance, Navigation & Control Components & Systems
- Flight & Ground Software Systems
- Systems Integration, Test & Verification
- Access to Space Carrier Systems
- Ground Command & Control Systems
- Mission Planning & Scheduling Systems
- Data Processing, Analysis & Modeling Systems

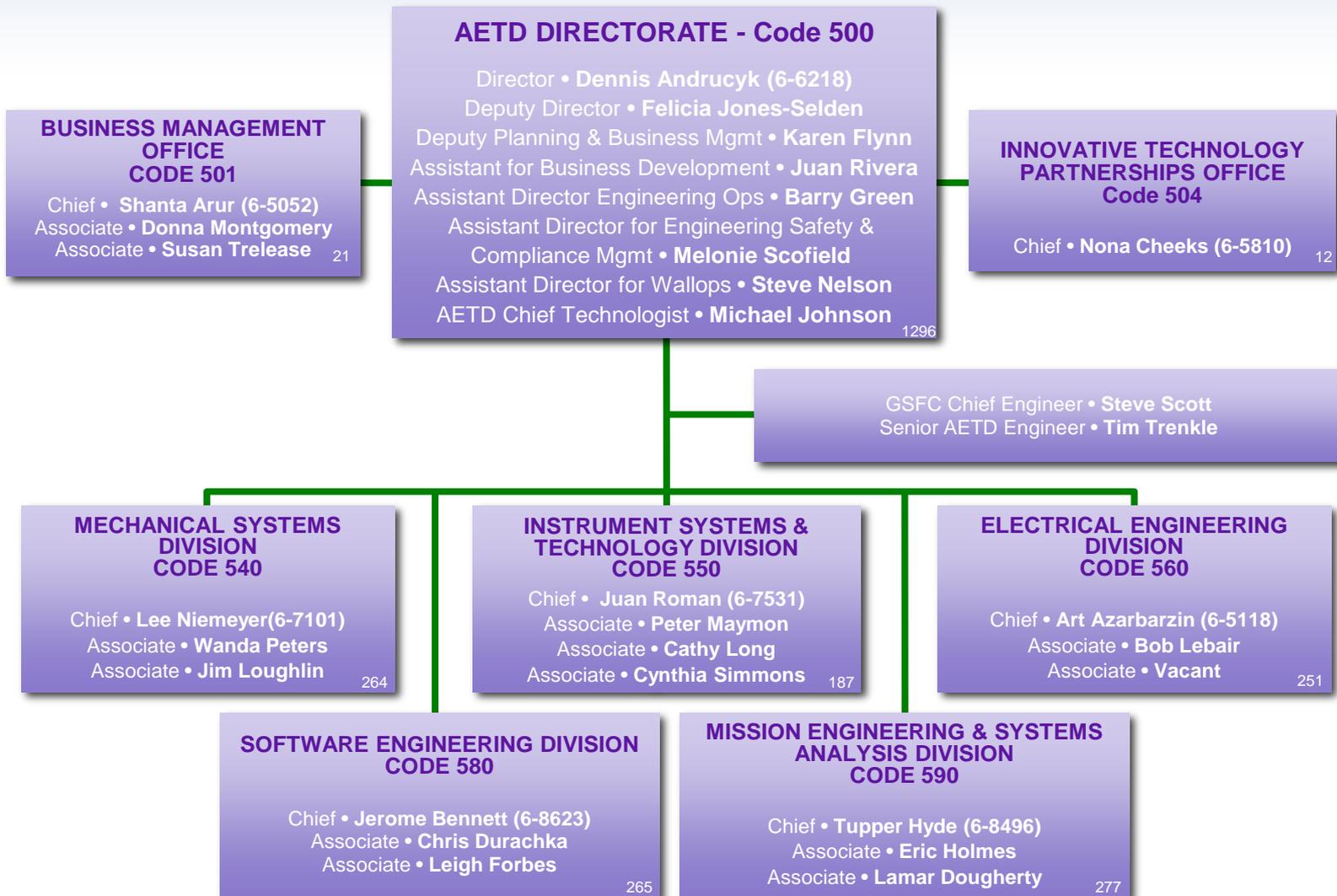
2. Engineering competencies in support of scientific instrumentation:

- Detector Systems
- Optics, Lasers & Electro Optics
- Cryogenics & Fluids Systems
- Active/Passive Microwave Systems
- Payload/Instrument Systems Engineering

3. Cross-cutting engineering disciplines:

- Materials
- Autonomy
- Contamination Control
- Electromechanical Systems
- Wavefront Sensing & Control
- Electronics Parts & Radiation
- Data Management & Analysis
- Microelectronics & Signal Processing
- Machining/Fabrication Technologies
- Network Systems & Technology
- Computing Environments & Technologies

Applied Engineering and Technology Directorate





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Business Management Office (BMO) Code 501

engineering

BMO Mission

- AETD's Business Management Office provides administration and management of all AETD resources in support of the Directorate's institutional and programmatic objectives
 - Financial planning and budgeting
 - Budget execution
 - Programmatic and institutional workforce planning and analysis
 - Outreach and Education for Center-wide activities that require support of AETD's engineers
 - Financial administration of the Center's engineering services contracts
 - Financial administration of the test services and fabrication services pools



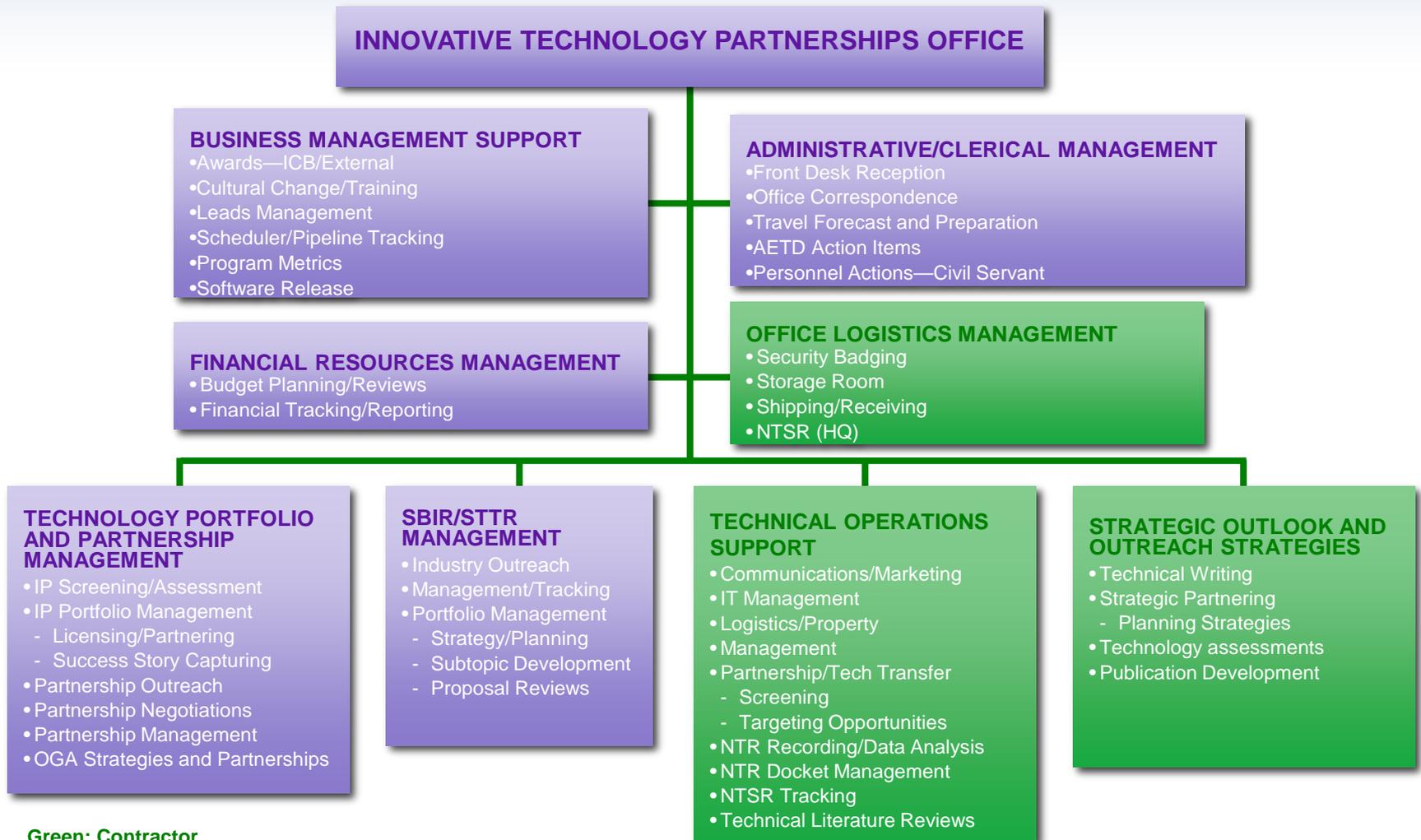
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Innovative Technology Partnerships Office (ITPO) Code 504

engineering

ITPO Organization Responsibilities



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ITPO Mission

- The ITPO fosters technology innovation through technology transfer, partnering, and engaging small business and non-profit organizations' participation in NASA Goddard's research and technology solutions
 - Manage Goddard's intellectual property assets (portfolio of documents flowing from inventions and discoveries resulting from Goddard research and technology developments)
 - Evaluate disclosed technologies and develop licensing and partnering strategies
 - Grant licenses for Goddard patented and copyrighted inventions
 - Define innovative approaches for Goddard partnering needs (strategies, target opportunities, negotiate partnership agreements) and serve as experts and technical POC's for partnerships
 - Oversee planning and execution of Goddard's role in NASA's Small Business & Innovative Research (SBIR) and Small Business Technology Transfer (STTR) Programs
 - Coordinate Goddard software assistant release process, Goddard inventions and contributions board, in-reach and out-reach for communications and technology marketing activities and projects



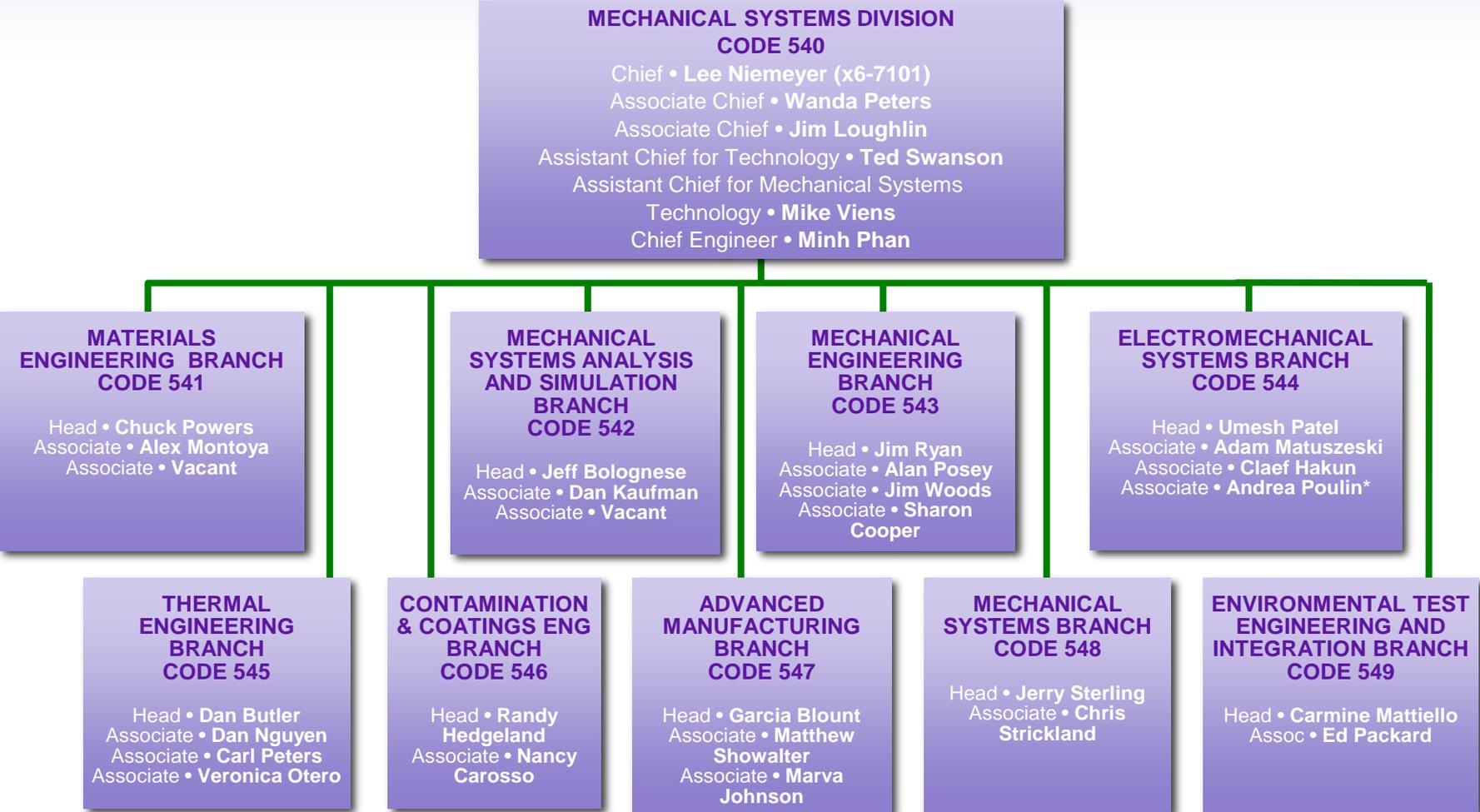
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Mechanical Systems Division (MSD) Code 540

engineering

MSD Organization



*Acting

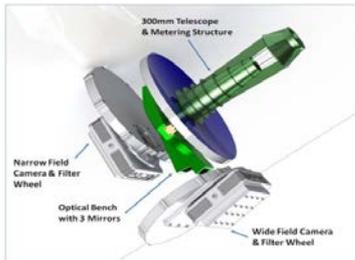
MSD Mission

- The Mechanical Systems Division (MSD) provides end-to-end multi-disciplinary mechanical and thermal systems capabilities and technology development to:
 - Design
 - Analyze
 - Fabricate
 - Assemble
 - Integrate
 - Verify and Validate On Orbit
 - Support
- ... advanced scientific instruments and support platforms for ground-based, suborbital, and orbital science and exploration missions
- Discipline engineering support includes materials, structural analysis, mechanical design, thermal, electromechanical, contamination/coatings, manufacturing, and environmental testing and integration for both in-house flight hardware development and oversight for out-of-house developed instruments and missions

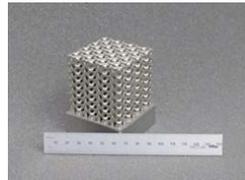
MSD Technology

MSD is aggressively pursuing the in-house development of several new technology thrusts that have significant potential to win new work and/or materially improve equipment performance in future Goddard missions.

Additive Manufacturing

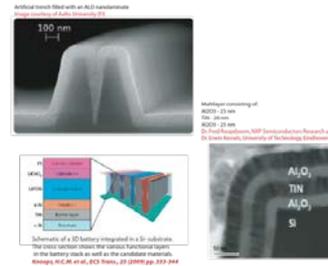


0.3m Telescope, all parts fabricated via Direct Metal Laser Sintering

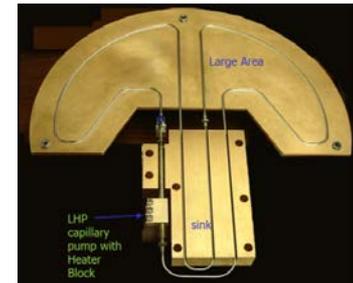


High Stiffness, Dimensionally Stable Optical Bench Metal Matrix Composite Core Material Sample

Advanced Thermal Control Techniques



Nanolamination Multimaterials using Atomic Layer Deposition



Cryogenic Loop Heat Pipe for Large Area Cooling

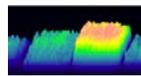
Goddard Composite Materials Engineering Technology: Go-CoMET

Develop and Maintain the Most Current Standards in:

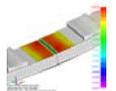
1. Design
2. Fabrication
3. Quality Control
4. Analysis
5. Test
6. Embedded Thermal Control
7. Embedded Sensors



1



3

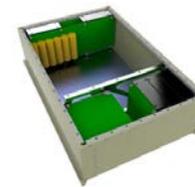
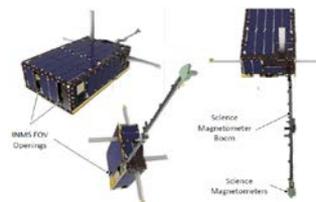


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SmallSat and CubeSat Development



Goddard Modular SmallSat Architecture - Standard SmallSat spacecraft bus optimization to enable maximum capacity for various science instrument

- Dellinger CubeSat design, analysis, fabrication, test
- 12-month development cycle

MSD Facilities



Space Environment and Materials Testing at WFF



Materials and Mechanical Testing at Greenbelt



Manufacturing and Plating Labs



Spacecraft and Instrument Integration Facilities



Thermal Tech Lab



Contamination and Coatings Labs



Space Environment Test Capabilities

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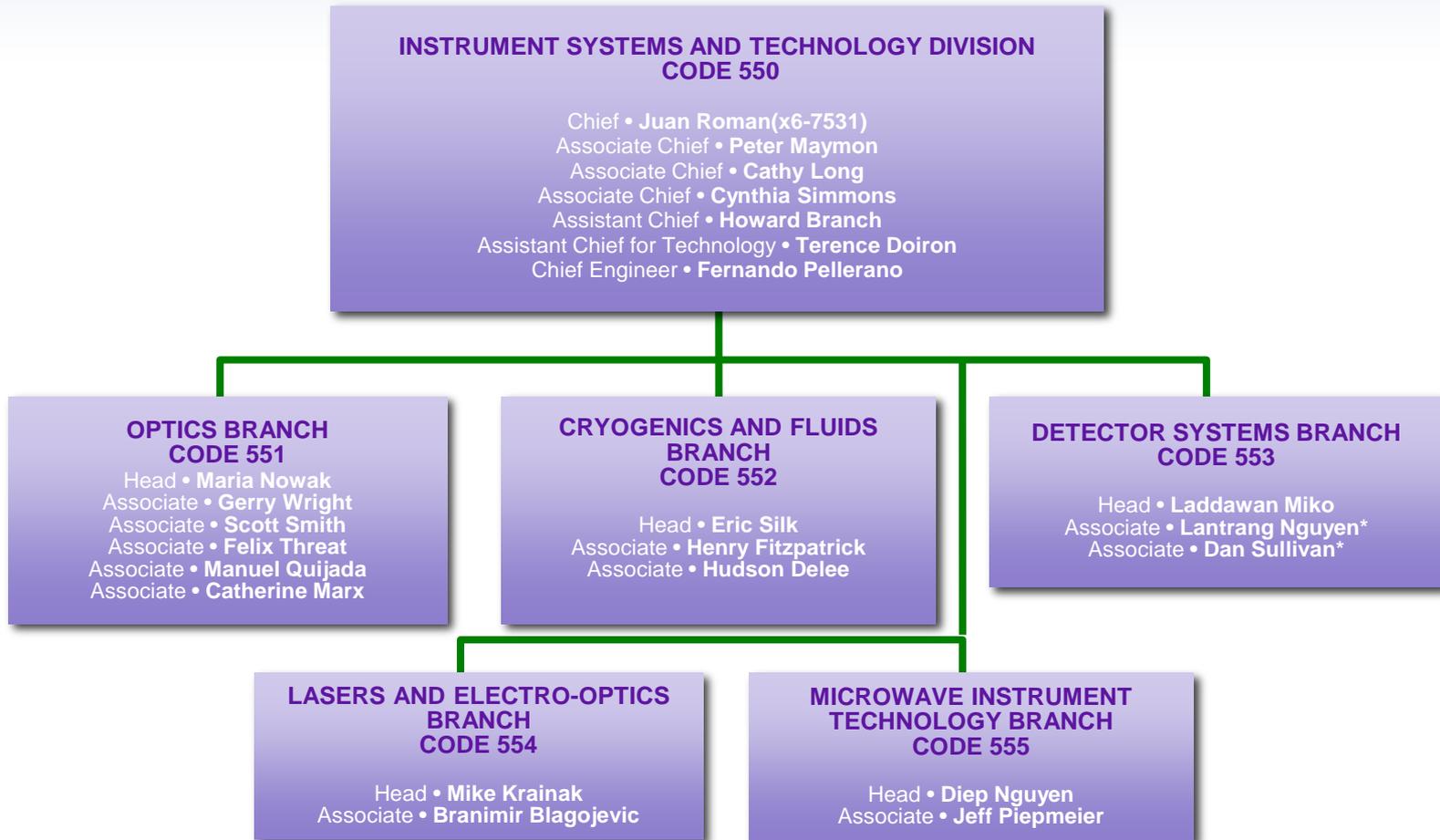
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Instrument Systems & Technology Division (ISTD) Code 550

engineering

ISTD Organization



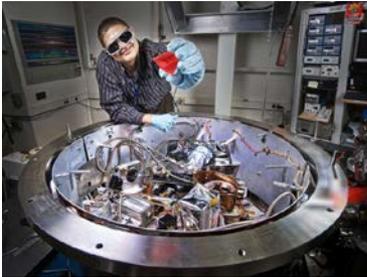
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ISTD Mission

- The Instrument Systems and Technology Division (ISTD) provides end-to-end multi-disciplinary instrument systems and technology development to:
 - Design
 - Analyze
 - Fabricate
 - Assemble
 - Integrate
 - Verify and Validate On Orbit
 - Support
- ... advanced scientific instruments for ground-based, suborbital, and orbital science and exploration missions
- Discipline engineering support includes optical, cryogenics, lasers and electro-optics, detectors, and microwave leadership for both in-house flight hardware development and oversight for out-of-house developed instruments

ISTD Technology

Advanced Optical Systems



CHARMS (cryogenic index of refraction measurement tool)

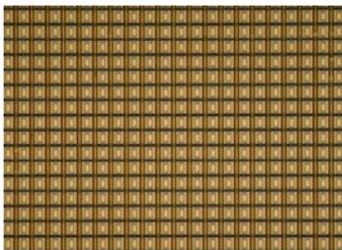


Black Carbon Nanotubes

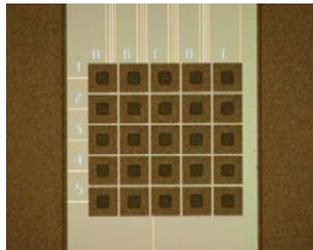


High-speed Computational Optics

Detector Arrays



Quantum Well Infrared Photodetector Array



Magnetic Microcalorimeter X-ray Array

Cryogenic Systems

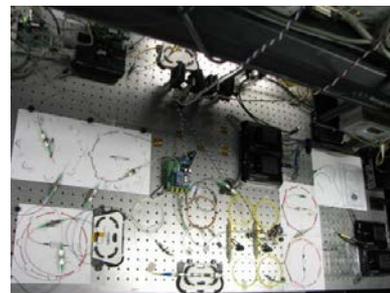


Continuous Adiabatic Demagnetization Refrigerator



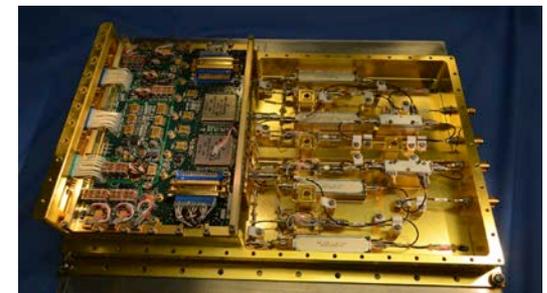
Long Term Cryopropellant Storage for Exploration

Laser Systems



Wavelength Division Multiplexed Fiber Laser

Microwave Instruments



Microwave Radiometer Front End

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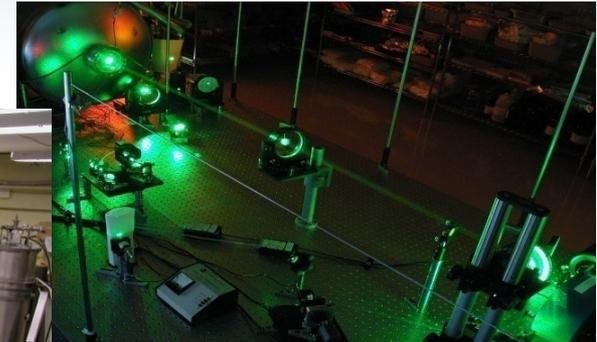
ISTD Facilities



Large Volume Coordinate Measurement



Cryogenic Test Facility



Laser and Electro-Optics Laboratory



Two-meter Optical Coating Facility



Detector Development Laboratory (DDL)



Detector Characterization Laboratory (DCL)



Microwave Instrument Development Lab

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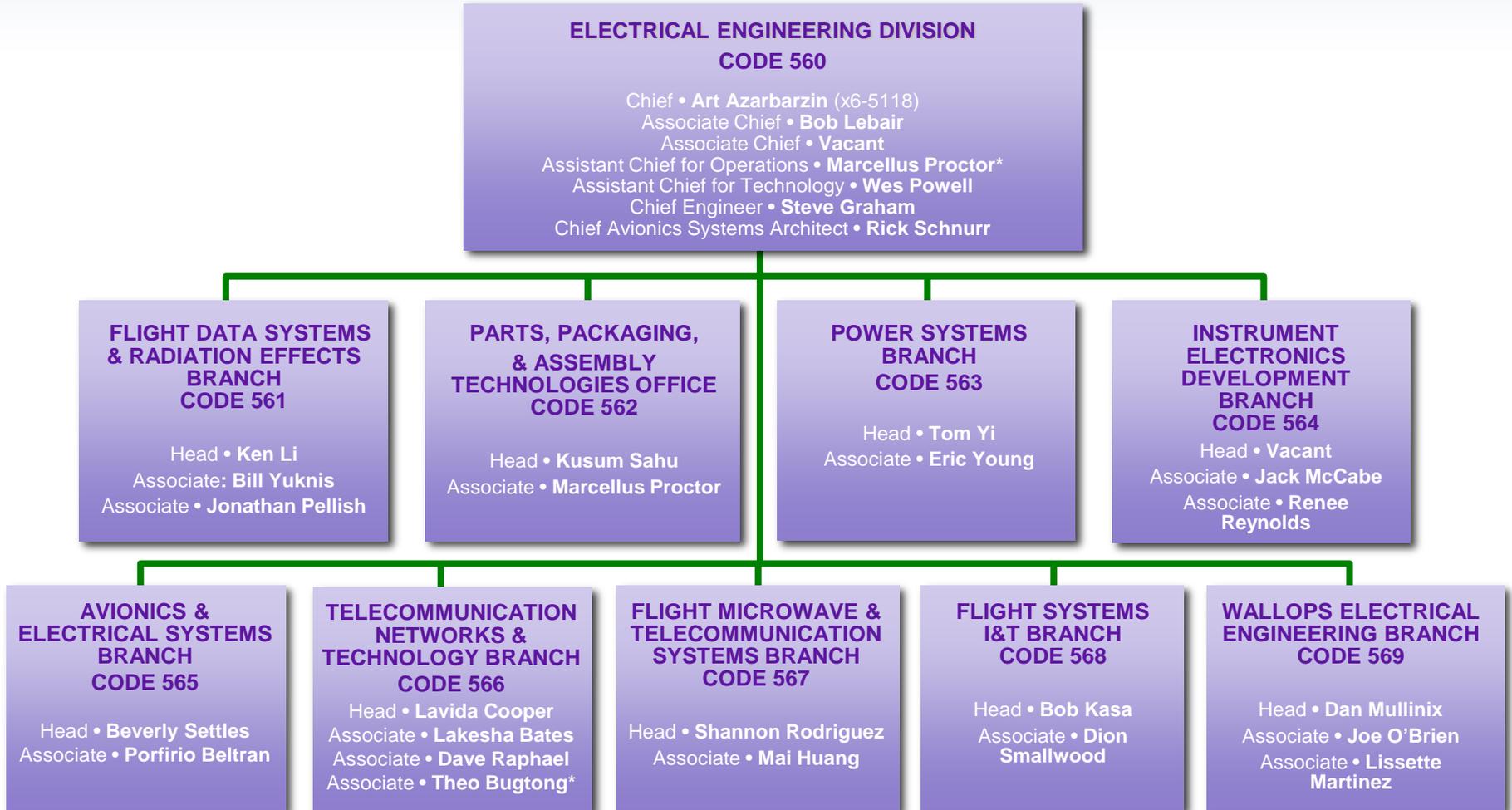
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Electrical Engineering Division (EED) Code 560

engineering

EED Organization



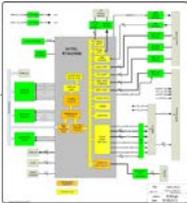
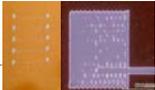
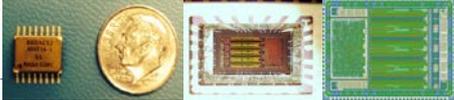
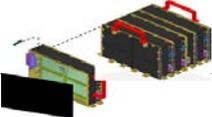
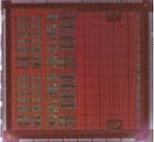
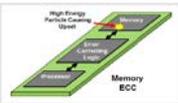
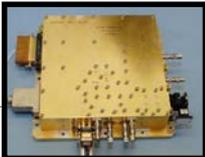
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EED Mission

- The Electrical Engineering Division (EED) provides end-to-end multi-disciplinary electrical systems capabilities and technology development to:
 - Design
 - Analyze
 - Fabricate
 - Assemble
 - Integrate
 - Verify
 - Validate on Orbit
 - Operate
- ... electrical/electronic components, subsystems, and systems in advanced scientific instruments and support platforms for ground-based, suborbital, and orbital science and exploration missions
- Discipline engineering support includes electronics parts and packaging, fiber optic design and manufacturing, photonic component testing, command and data handling systems, electrical power systems, RF and optical communication systems, network ground systems, end-to-end communications systems, microelectronics and signal processing, electrical systems, flight harnessing, electrical ground system hardware, electromagnetic interference/compatibility, and flight systems integration and test for both in-house flight hardware development and oversight for out-of-house developed instruments and missions

EED Technology

Targeted Capabilities	Instrument Data Acquisition and Control					
	Miniaturization					
	Radiation Effects					
	Avionics					
	Communications					

Technology Readiness

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EED Facilities



Radiation Effects Test Facilities
Damage Van de Graff Test Chamber



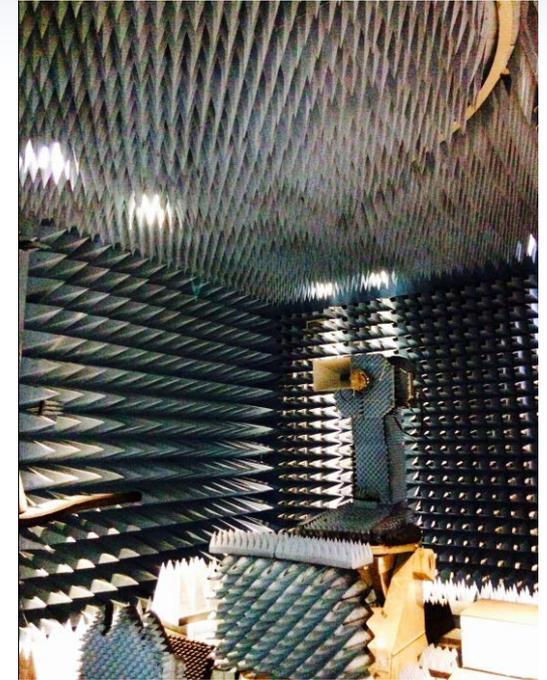
Microelectronics Assembly Laboratory



Microwave Electronics Test
and Assembly Laboratory



ATLAS Harness Fabrication
Laboratory



Goddard Electromagnetic Anechoic
Chamber (GEMAC)

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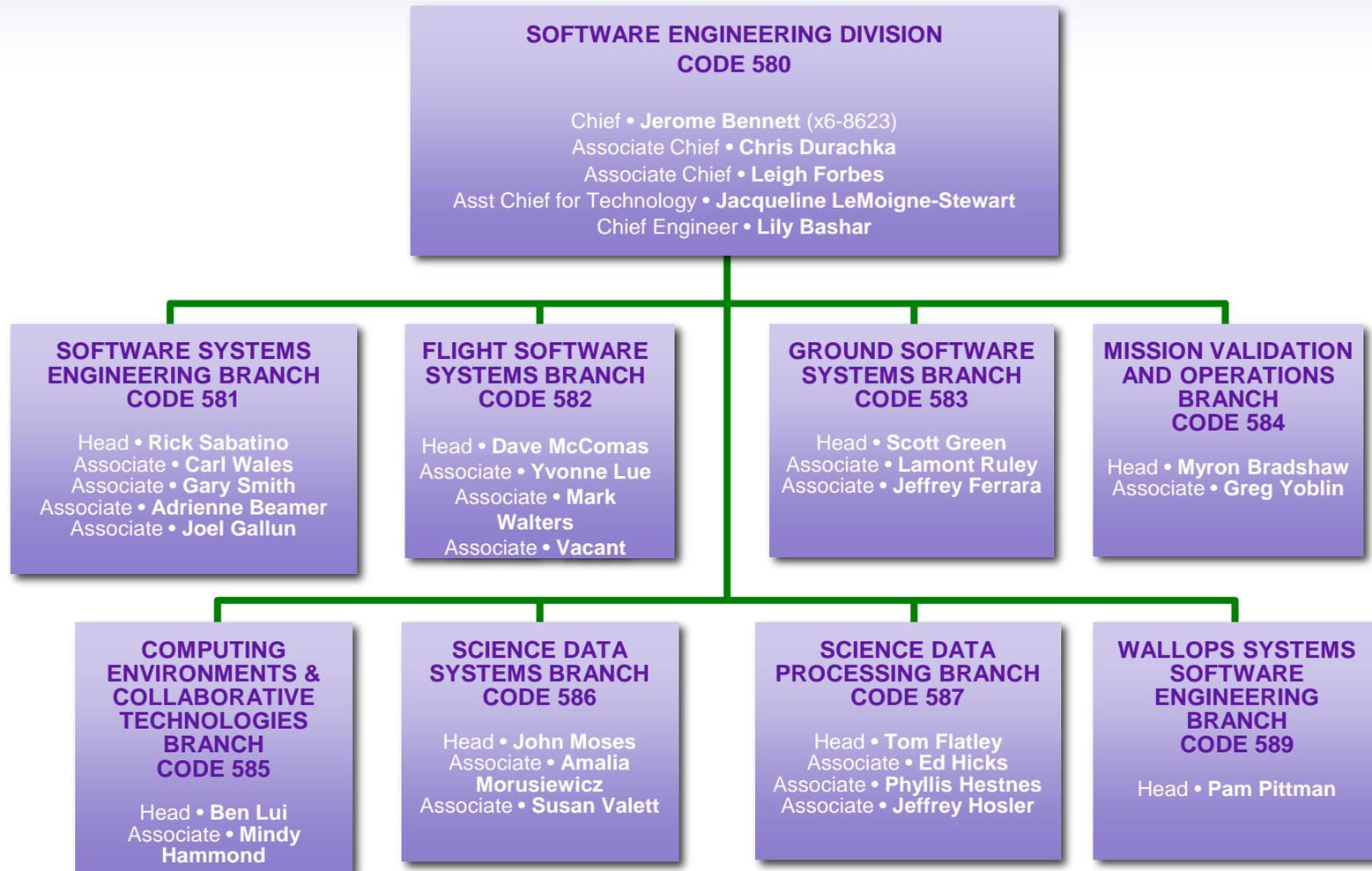
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Software Engineering Division (SED) Code 580

engineering

SED Organization



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SED Mission

- The Software Engineering Division (SED) provides end-to-end software systems solution, expertise, and software technologies to:
 - Design
 - Develop/Build
 - Integrate
 - Simulate
 - Verify and Validate On Orbit
 - Operate
- ... advanced scientific instruments and support platforms for ground-based, suborbital, and orbital science and exploration missions
- Discipline engineering support includes spacecraft and instrument flight software, ground command and control systems, science and mission planning and scheduling systems, science data processing systems (including on-board/in-flight systems), and science data analysis and modeling systems for both in-house flight hardware development and oversight for out-of-house developed instruments and missions

SED Facilities

The Flight Software Technology Advancements Development and Test Lab is used to assemble, integrate, and test flight software technologies using simulators prior to proposing on future missions.



The Code 587 Science Data Processing Lab is used to assemble, integrate, and test SpaceCube avionics systems prior to delivering to customer.

Top left: Software engineers test their code on the SpaceCube platform that will control an ISS payload.

Bottom left: Electrical and mechanical engineers work on a SpaceCube data processing system bound for the International Space Station.



The Goddard Mission Services Evolution Center (GMSEC) provides mission enabling, cost/risk reduction solutions for current and future missions.



The ASIC SIDECAR Lab is used to develop and test software that will be used in conjunction with detectors on mission like JWST and TIRS.



The Wallops Mission Planning Lab (MPL) is the mission analysis, design, visualization, and evaluation facility for sub-orbital and special orbital missions.

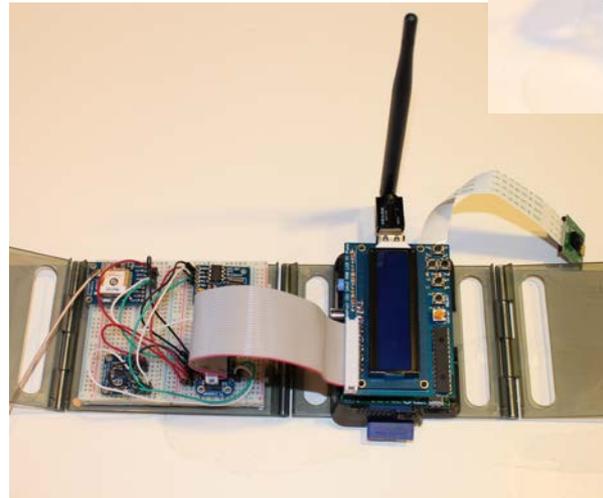
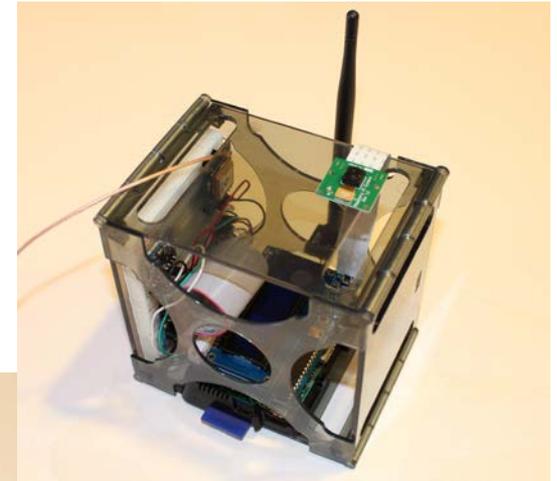
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SED Technology



The SpaceCube Family—SED is developing advanced on-board processing capabilities to meet the computational Science requirements of future missions (e.g., those including hyperspectral and SAR instruments). Capable to reconfigure and adapt on the fly, those capabilities will enable to produce data products on-board for direct downlink and to perform rapid detection and real-time reaction to Science and "first-responder" events.

Pi-Sat: A Low Cost Distributed Mission Test Bed—SED has prototyped ultra-low cost, preconfigured, easy to use development systems for Distributed Spacecraft Mission (DSM) flight software research and for CubeSat/SmallSat flight software research and development."



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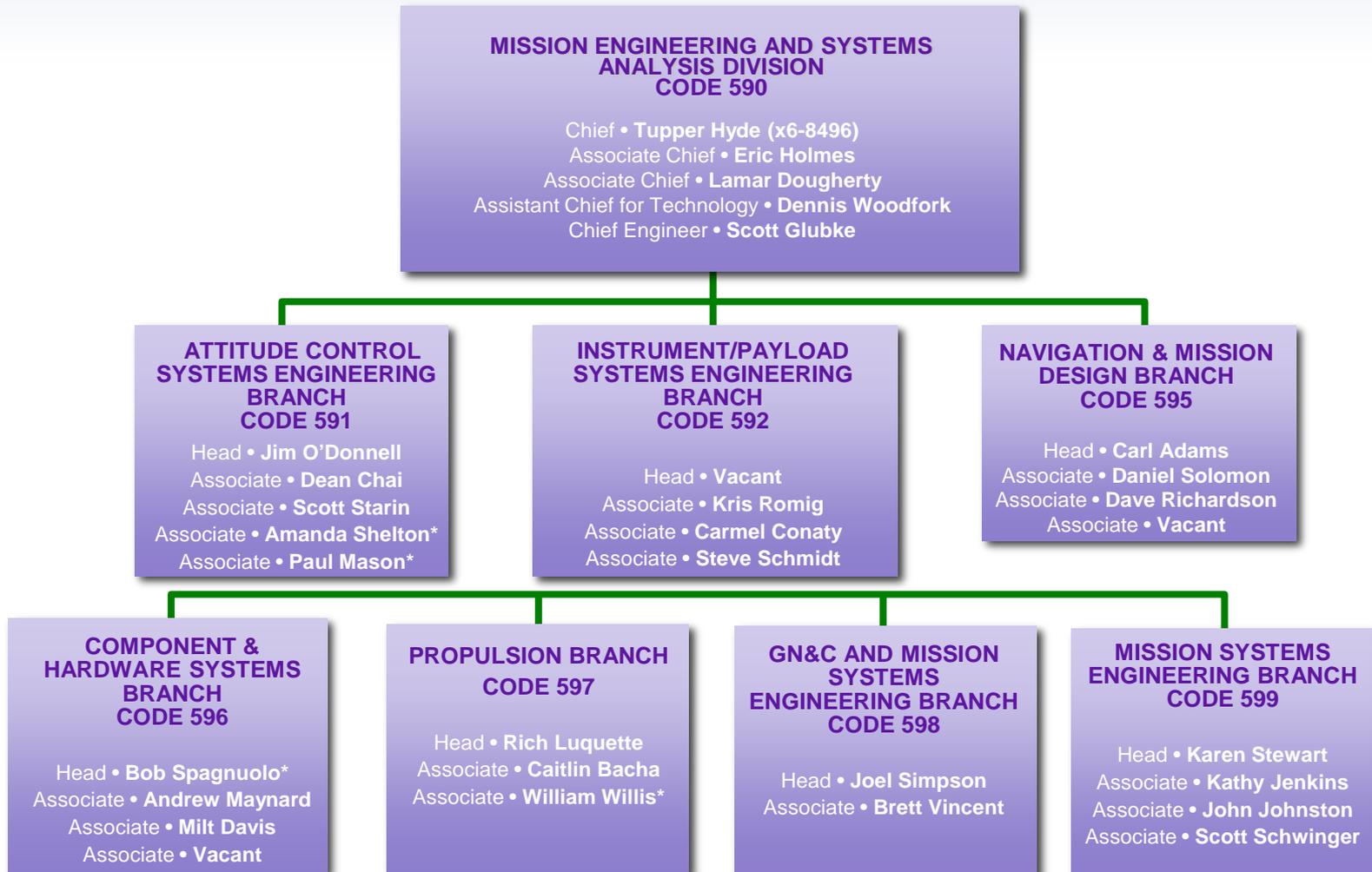
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Mission Engineering & Systems Analysis Division (MESA) Code 590

engineering

MESA Division Organization



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MESA Division Mission

The Mission Engineering and Systems Analysis Division (MESA) provides end-to-end mission systems engineering and guidance, navigation, and control capabilities and technology development to:

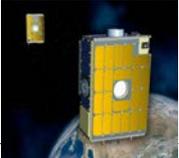
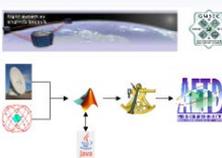
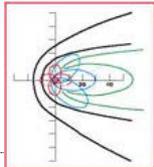
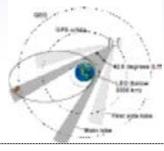
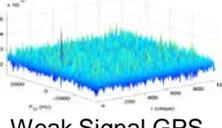
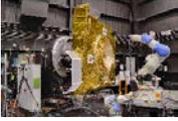
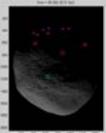
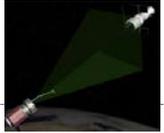
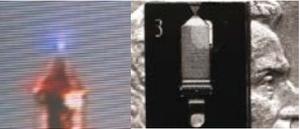
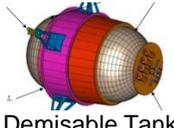
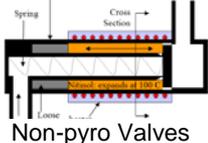
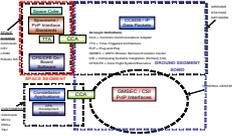
- Conceive
- Design
- Analyze
- Implement
- Verify and Validate On Orbit
- Support

... advanced scientific instruments and support platforms for ground-based, suborbital, and orbital science and exploration missions

Discipline engineering support includes attitude and orbit determination and control, spacecraft propulsion, trajectory design, mission architecture, and mission systems engineering for both in-house flight hardware development and oversight for out-of-house developed instruments and missions.

MESA Technology

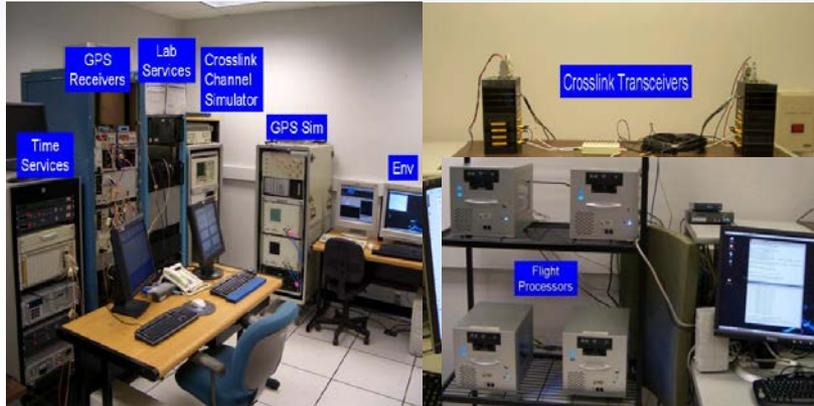
Enabling Technologies for Next Generation Navigation, Positioning, Pointing, Propulsion, and Space Systems & Integrated Mission Design

Targeted Capabilities	GN&C Tools						
	GN&C Hardware						
	Rendezvous, Capture and Landing						
	Propulsion						
	Space Systems and Integrated Mission Design						

Technology Readiness

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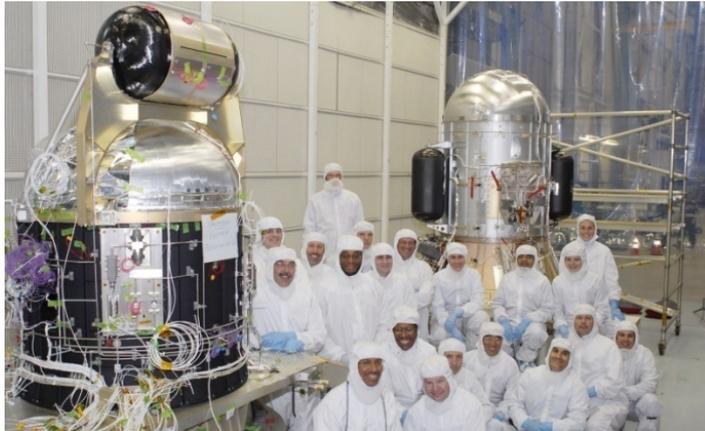
MESA Division Facilities



Formation Flying Testbed (FFTB)



Flight Dynamics Facility (FDF)



Propulsion System Final Assembly



Flight Dynamics 3-D Immersive Visualization Environment



Wallops Island Flight Facility

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