

# Integrating Science and Exploration

National Aeronautics and  
Space Administration



**MARSHALL**  
SPACE FLIGHT CENTER



# S&T Organizational Structure

**Science and Technology  
Office**  
Dave Burns, Dennon Clardy,  
Corky Clinton & Tom Inman

**Program  
Planning &  
Control Office**  
ST02  
Brent Harper

**Chief Scientist**  
Gary Jedlovec (acting)

**Chief Technologist**  
(vacant)

**Partnerships and  
Formulation Office**  
ST03  
Rae Ann Meyer

**Science  
Research and  
Projects Division**  
ST10  
Jody Terek

**Exploration Technologies  
and Systems  
Development Division**  
ST20  
Allen Bacskay

**Planetary  
Missions Program  
Office**  
ST30  
Brian Key (acting)

**Technology  
Demonstration  
Missions Program  
Office – ST40**  
Ginger Flores

**Centennial  
Challenges Program  
Office ST21**  
Monsi Roman

**Technology  
Transfer Branch**  
ST22  
Terry Taylor

**Space Technology  
Development Branch**  
ST23  
Mike Lapointe

**Exploration Systems  
Development  
Branch ST24**  
Jason Adam

**Earth Science  
Branch**  
ST11  
Gary Jedlovec

**Astrophysics  
Branch**  
ST12  
Nasser Barghouty

**Heliophysics &  
Planetary Science  
Branch ST13**  
Renee Weber

**Science  
Projects  
Branch ST14**  
Todd Holloway

**Science Test  
Branch**  
ST15  
Jeff Kegley

**Chandra Program  
Office**  
ST16  
Helen Cole

# Technology Demonstration Missions Program Office



## Future Applications for SMD Missions:

- Deep Space Atomic Clock (DSAC)
- Deep Space Optical Communications (DSOC)
- Evolvable Cryogenics Project (eCryo)
- Green Propellant Infusion Mission
- In-space Robotic Manufacturing and Assembly (IRMA)
- Laser Communications Relay Demonstration

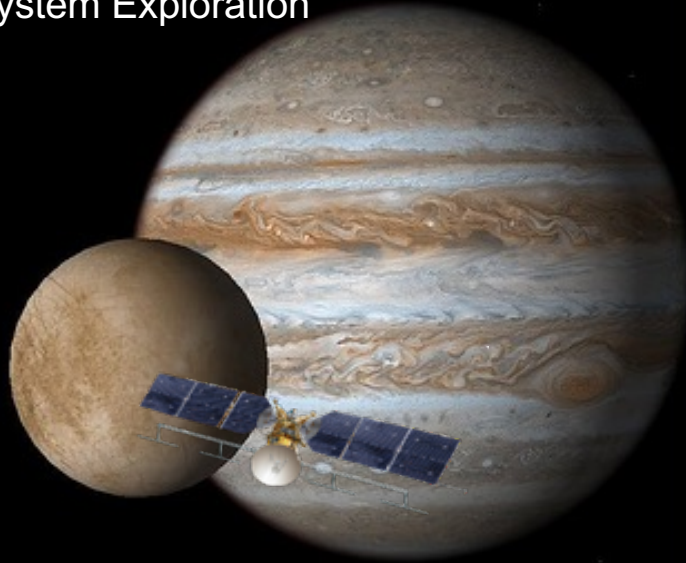
## Current Application for Mars 2020:

- Mars Oxygen In-Situ Resource Utilization Experiment
- Terrain Relative Navigation

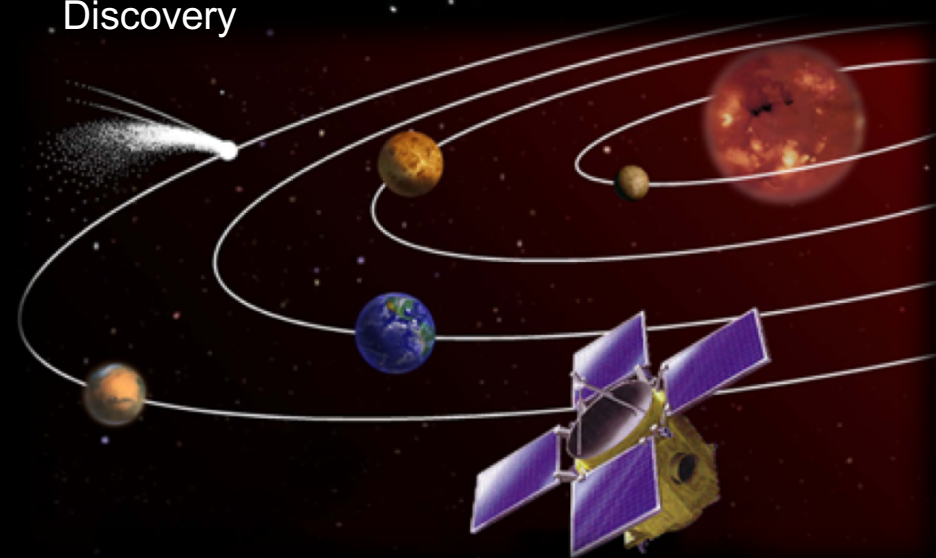


# Planetary Missions Program Office

Solar System Exploration



Discovery



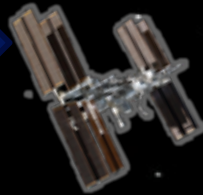
New Frontiers



# Developing Technologies for Deep Space Exploration

## Test Bed for Space Environments

- In Space Manufacturing



## Planetary Missions

- NEA Scout / Solar Sail
- Landers / Lander Enabling Technologies

## Long Duration Missions

- Evolvable Cryogenics
- Composite Technologies
- Advanced Life Support Systems

## Propulsion Tech

- Nuclear Thermal Propulsion
- Chemical Propulsion
- Lox Methane Engines
- 3D Printing for Rocket Engines







- Black Holes, Neutron Stars, Nebula, and Pulsars in the X-ray
- Gamma-ray Bursts
- Extreme-energy Particles and their Sources

## Astrophysics

## Planetary

- Planetary Missions Program Office
- Planetary Surfaces, Interiors & Atmospheres
- Planetary Science Integration with MSFC Exploration Capabilities

ar Transition Region and Magnetic Atmosphere  
 ermal Plasma/Plasmasphere Modeling,  
 ysis, and Instrument Development  
 yses of Ionospheric Disturbances

## Heliophysics



## Earth

- Energy and Water Cycle Processes
- Research to Applications
  - SPoRT
  - SERVIR
- Earth Science Data Informatics
- Disaster Detection & Monitoring

# Science Research & Projects

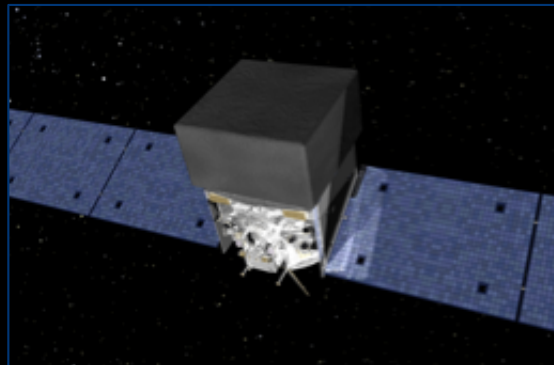
## X-Ray Team

- Chandra X-ray Observatory
- High-energy balloon program
- X-ray detectors and focusing optics
- Measurements of the Sunyaev-Zel'dovitch (S-Z) effect in clusters of galaxies
- Development of instruments for planetary exploration
- Planning, technology development, and testing for future astrophysics missions



## Relativistic Astrophysics Team

- Fermi Gamma Ray Burst Monitor (GBM)
- Participate on Science Team for Neutron star Interior Composition Explorer (NICER)
- Data sharing and joint analysis of gamma ray and gravitational wave observations
- Gravitational Wave astrophysics, including LIGO and LISA

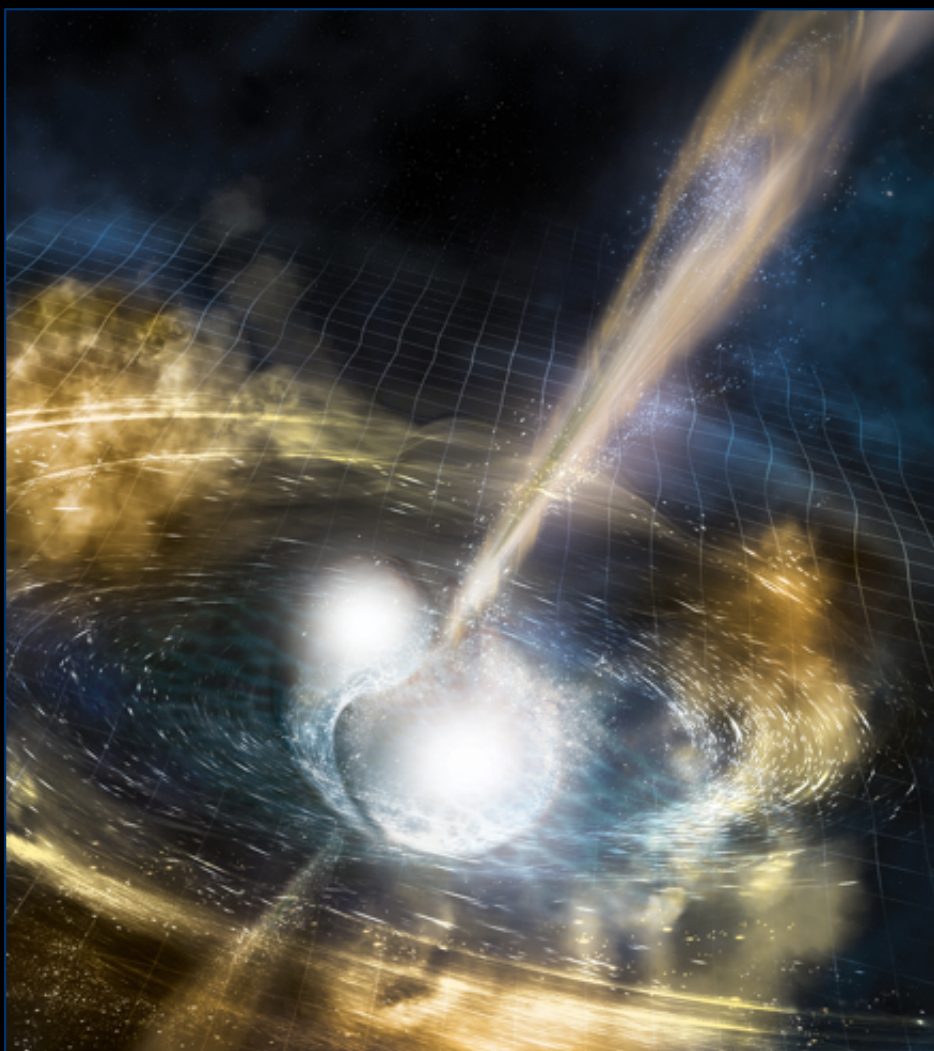


## Cosmic Ray Team

- TBD



# Multimessenger Astrophysics at MSFC



**GRB170817A / GW170817** – The beginning of the multimessenger astronomy era.

- GBM was the first to identify the event, promptly notifying LIGO/Virgo network of a short GRB
- MSFC scientists contributed to analysis of gravitational wave data and led analysis of GBM data
- MSFC scientists led joint analysis of gamma-ray and gravitational wave data.

GBM & LIGO/Virgo have a long-standing collaboration

- Unique data sharing agreements between collaborations
- Joint analysis of data
- Paved the way for continuing a close working relationship in the future.