Goddard Space Flight Center Topics and Research Areas of Interest:

Applied Engineering and Technology Directorate:

- Advanced Manufacturing (ref: NAMII.org)
- Advanced Multi-Functional Systems and Structures
- Micro - and Nanotechnology - Based Detector Systems
- Ultra-miniature Spaceflight Systems and Instruments
- Systems Robust to Extreme Environments
- Spacecraft Navigation Technologies
    - Spacecraft GNSS receivers, ranging crosslink transceivers, and relative navigation sensors
    - Optical navigation and satellite laser ranging
    - Deep-space autonomous navigation techniques
    - Software tools for spacecraft navigation ground operations and navigation analysis
    - Formation Flying

- Automated Rendezvous and Docking (AR&D) techniques
    - Algorithm development
    - Pose estimation for satellite servicing missions
    - Sensors (e.g., LiDARs, natural feature recognition)
    - Actuation (e.g., micro propulsion, electromagnetic formation flying)
- Mission and Trajectory Design Technologies
    - Mission design tools that will enable new mission classes (e.g., low thrust planetary missions, precision formation flying missions)
    - Mission design tools that reduce the costs and risks of current mission design methodologies
    - Trajectory design techniques that enable integrated optimal designs across multiple orbital dynamic regimes (i.e. earth orbiting, earth-moon libration point, sun-earth libration point, interplanetary)
- Spacecraft Attitude Determination and Control Technologies
    - Modeling, simulation, and advanced estimation algorithms
    - Advanced spacecraft attitude sensor technologies (e.g., MEMS IMU's, precision optical trackers)
    - Advanced spacecraft actuator technologies (e.g. modular and scalable momentum control devices, 'green' propulsion, micropropulsion, low power electric propulsion)
- CubeSats
    - CubeSat/Smallsat components
    - Technologies and systems to support NASA technology demonstration and risk reduction efforts
    - Miniature CubeSat/Smallsat systems for: power generation and distribution, navigation, communication, on-board computing, structures (fixed and deployable), orbital stabilization, pointing, and de-orbiting.
- On-Orbit Multicore Computing
    - High performance multicore processing for advanced automation and science data processing on spacecraft

    - Efficient inter-core communications, software partitioning, fault detection, isolation & recovery, memory management, core power management, scheduling algorithms, and software frameworks
- Integrated Photonic components and systems
    - Sensors, Spectrometers, Chemical/biological sensors, Microwave, Sub-millimeter and Long-Wave Infra-Red photonics, Telecom- inter and intra satellite communications.
- Radiation Effects and Analysis
    - Flight validation of advanced event rate prediction techniques
    - New approaches for testing and evaluating 3-D integrated microcircuits and other advanced microelectronic devices
    - End-to-end system (e.g., integrated component level or higher) modeling of radiation effects
    - Statistical approaches to tackle radiation hardness assurance (i.e., total dose, displacement damage, and/or single-event effects) for high-risk, low-cost missions.

Sciences and Exploration Directorate

The ***Earth Sciences Division*** plans, organizes, evaluates, and implements a broad program of research on our planet's natural systems and processes. Major focus areas include climate change, severe weather, the atmosphere, the oceans, sea ice and glaciers, geodesy and geophysics, and terrestrial ecosystems and the land surface. To study the planet from the unique perspective of space, the Earth Science Division develops and operates remote-sensing satellites and instruments. We analyze observational data from spacecraft and make it available to the world's scientists and policy makers. The Division conducts extensive field campaigns to gather data from the surface and airborne platforms. The Division also develops, uses, and assimilates observations into models that simulate planetary processes involving the water, energy, and carbon cycles at multiple scales up to global.

The ***Astrophysics Science Division*** conducts a broad program of research in astronomy, astrophysics, and fundamental physics. Individual investigations address issues such as the nature of dark matter and dark energy, which planets outside our solar system may harbor life, and the nature of space, time, and matter at the edges of black holes. Observing photons, particles, and gravitational waves enables researchers to probe astrophysical objects and processes. Researchers develop theoretical models, design experiments and hardware to test theories, and interpret and evaluate observational data.

The ***Heliophysics Science Division*** conducts research on the Sun, its extended solar-system environment (the heliosphere), and interactions of Earth, other planets, small bodies, and interstellar gas with the heliosphere. Division research also encompasses Geospace (Earth's magnetosphere and its outer atmosphere) and space weather—the important effects that heliospheric disturbances have on spacecraft and terrestrial systems. Division scientists develop spacecraft missions and instruments, technology

leading to next-generation miniaturized instruments, systems to manage and disseminate heliophysical data, and theoretical and computational models to interpret the data. Other research includes advanced software environments and data-mining strategies to collect, collate and analyze data relevant to the Sun and space weather, and advanced computational techniques such as parallel architectures and graphics processing units for the simulation of dynamic, magnetized plasmas and neutral gases in the heliosphere.

The ***Solar System Exploration Division*** conducts theoretical and experimental research to explore the solar system and understand the formation and evolution of planetary systems. Laboratories within the Division investigate areas as diverse as astrochemistry, planetary atmospheres, geochemistry, geophysics, geodynamics, space geodesy, extrasolar planetary systems, and comparative planetary studies. To study how planetary systems form and evolve, Division scientists develop theoretical models as well as the investigations and space instruments to test them. The researchers participate in missions; collect, interpret, and evaluate measurements; and publish conclusions based on this research. The Division archives and disseminates the data, provides expert user support, and offers education and public outreach programs about the Division's science missions and services.