GOES-R Spacecraft Features that Allow Near-Continuous Observation

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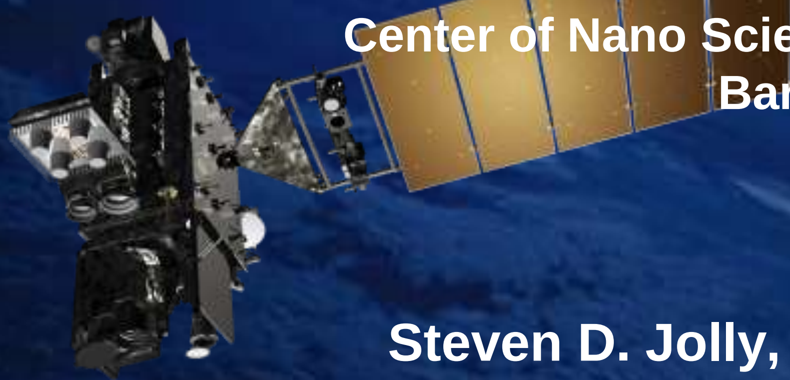

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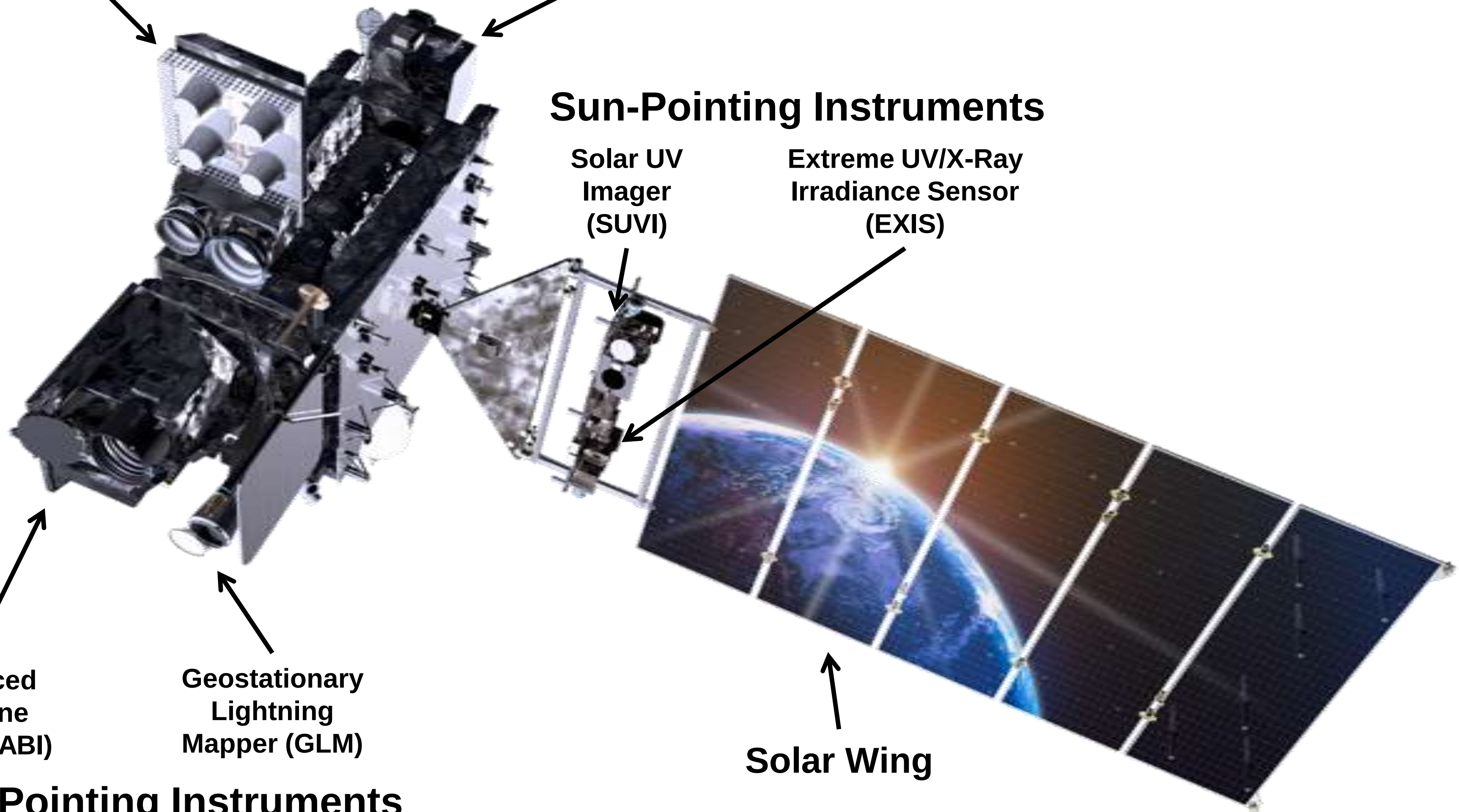
Introduction

- **GOES-R (Geostationary Operational Environmental Satellite R-Series) has Operational Capability for Near-Continuous Observation**
- **Enhances Ability to Observe, Predict, Communicate, and Maximize Weather/Climate Data at New Level of Fidelity and Timeliness**
- **Spacecraft Features that Allow Near-Continuous Observation and High-Fidelity Accurate Science Data Collection**
  - **Operate-through station-keeping**
  - **Operate-through momentum adjust maneuvers**
  - **Satellite does not require a yaw flip at any time of the year**

Introduction (concluded)

  - Fault management architecture allows for fault containment at the component level and avoidance of unnecessary safe hold entries for the satellite
  - Vibration isolation for the Earth-pointed instruments
  - Precision mechanisms and control electronics and an identification-based active solar array vibration damping controller for Sun-pointed instruments
- Together, these features strive toward 100% (Near-Continuous Observation) availability for this advanced weather satellite while maximizing science data collection (High-Fidelity Observation), assuring the acquisition and downlink of vital Earth and space observation data used for weather and climate prediction

GOES-R Architectural Overview

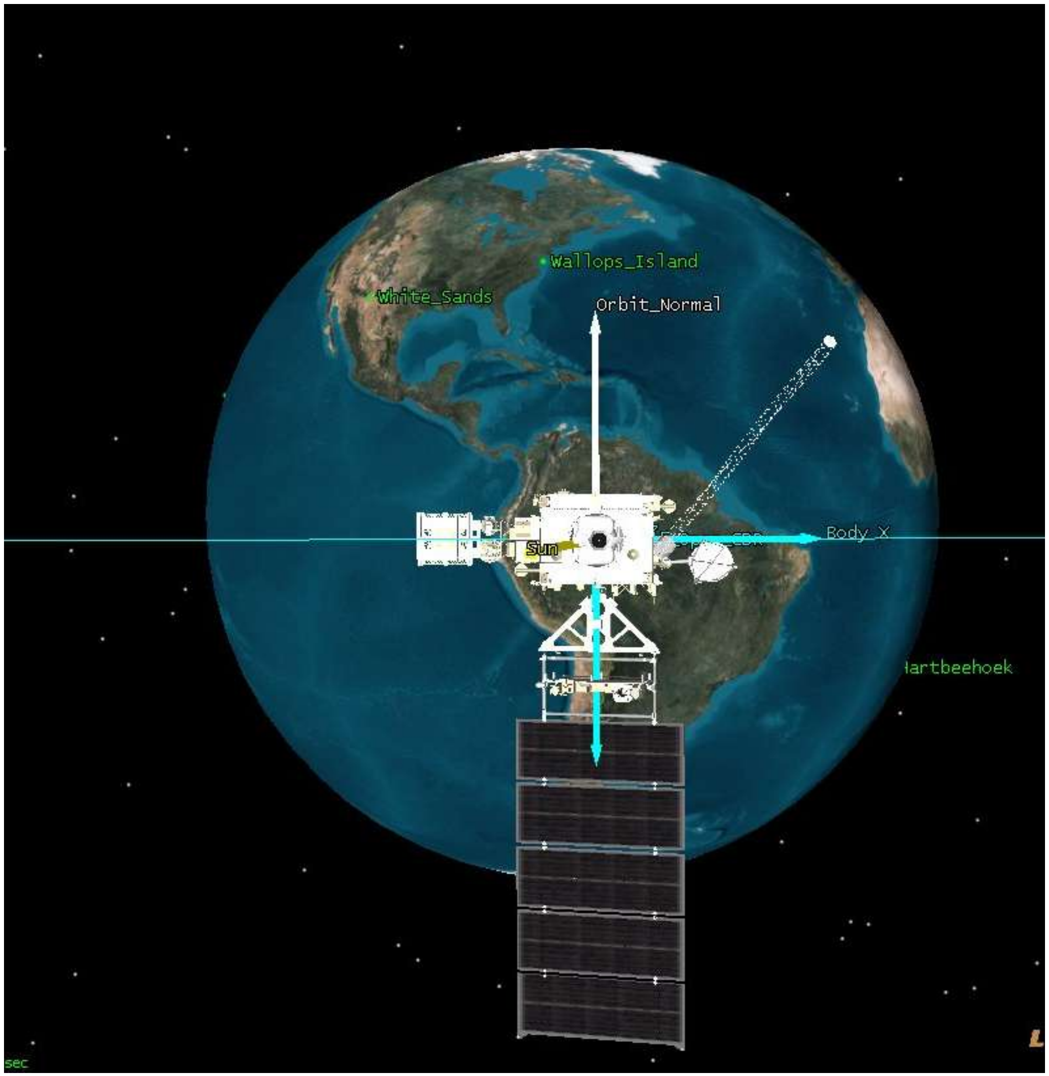


Operational Pointing

Earth-Pointing Instruments

and

Antenna Wing toward Earth



Sun-Pointing Instruments

and

Solar Wing toward Sun

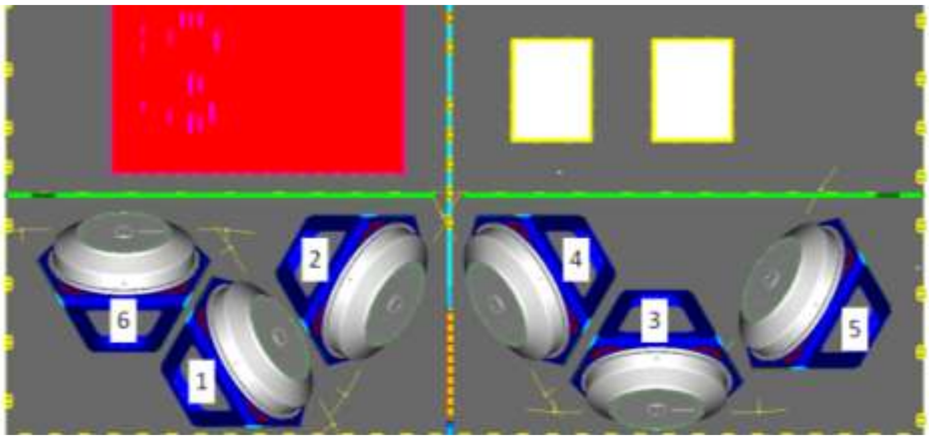
Station-Keeping and Momentum Adjustments

Operating through Periodic Station-Keeping and Momentum Adjustments Requires the Following Elements:

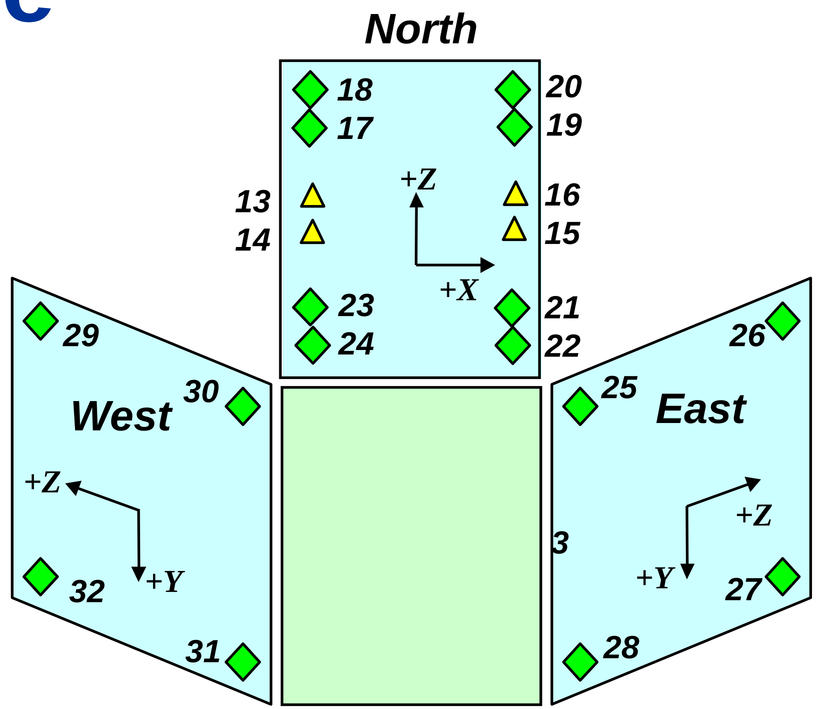
- **Reaction Wheel Assemblies (RWA)**
  - High-Torque, Low-Disturbance RWAs provide attitude control to minimize transients and cancel thruster torques for maneuver "operate through"
  - Also feed forward ABI-predicted interface forces and torques (PIFT) for scanning disturbances
- **Low-Thrust Operate-Through Thruster System**
  - Arc-Jets for north-south delta-V adjustments
  - Low Thrust REAs (LTR) developed and qualified for this mission with Thrust Level ~ 100 times lower than the current GOES thrusters (2 lbf) for momentum adjustments
  - Autonomous thruster calibration system calibrates the torques produced by thruster firing to maintain feed forward accuracy and minimize attitude transients

Thrusters have Very Accurate Repeatability for Precision RWA Feed Forward (Predictive) Control Algorithms

Hardware for Operate-Through Feature



Reaction Wheel Assemblies (RWAs)



Operate-Through Thrusters (LTRs and Arcjets)		
Thrusters	*N (lbf)*	*Function*
North LTR 17-24	0.10 (0.02)	Yaw/roll RWA momentum adjust (MA)
East/West 25-32	0.10 (0.02)	Yaw/pitch momentum adjust and E/W Delta-V
Arcjets 13-16	0.22 (0.05)	North/South Delta-V (2 fired simultaneously)

Initial Architecture Included Biannual Yaw Flip

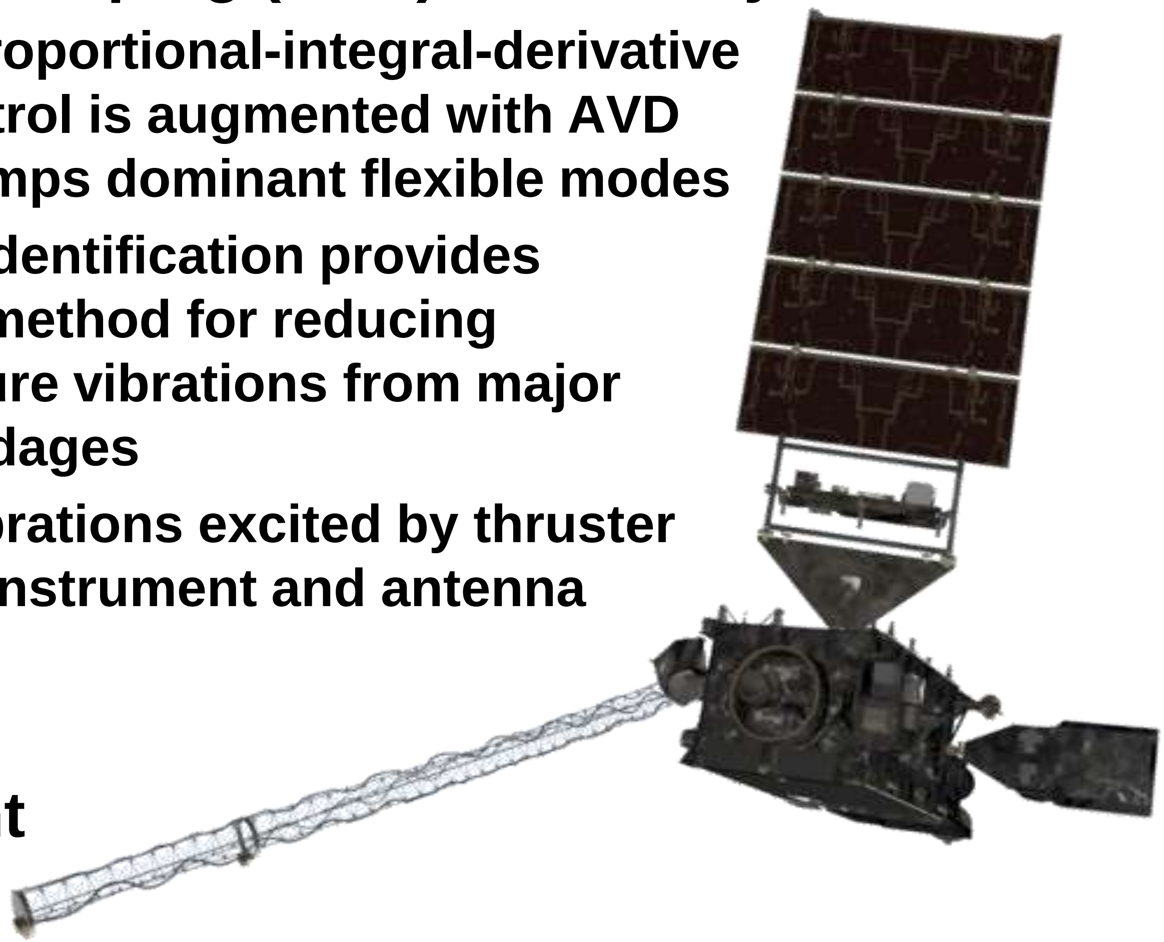
Note that Current Architecture Does Not Require Yaw Flip, Enhancing Availability

Fault Management System

- Fault Management System (FMS) provides detection, isolation, and recovery from single credible faults to maintain the health and safety
- FMS performs autonomous corrective action only when required to preserve the health and safety of the satellite
- FMS autonomously detects and responds to single faults affecting health and safety, while maintaining availability for easily correctable faults
- Health and Safety—Satellite is able to maintain the following:
  - Positive Power Balance
  - Thermal Balance
  - Command Receptivity
  - Engineering Telemetry Downlink
  - Non-Essential Component Constraints
- FMS Detects and Isolates Faults at Lowest Level to Keep Satellite out of Safe Hold if Possible to Preserve Near-Continuous Operation

Active Vibration Damping

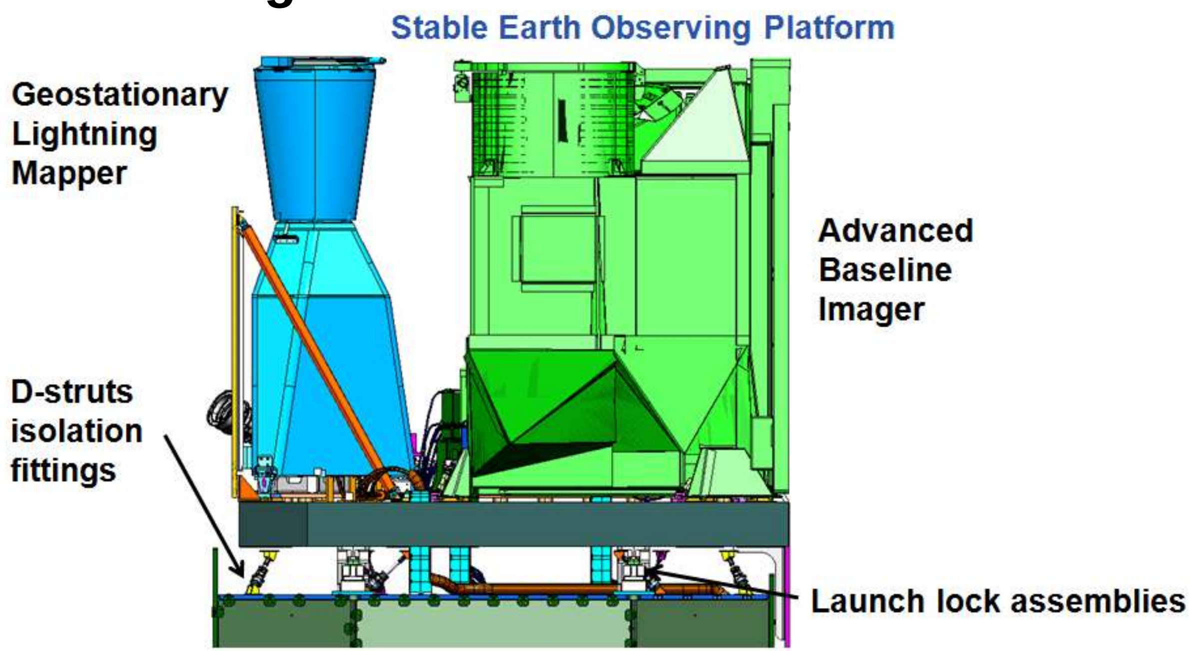
- **Active Vibration Damping (AVD) Control System**
  - **Low bandwidth proportional-integral-derivative (PID) attitude control is augmented with AVD controller that damps dominant flexible modes**
  - **Direct dynamics identification provides damping control method for reducing spacecraft structure vibrations from major spacecraft appendages**
  - **Reduces array vibrations excited by thruster firing to improve instrument and antenna pointing**



- **AVD is U.S. Patent Pending**
  - **U.S. Patent Application No. WO/2008/136881, (filing date Nov 13, 2008) (Goodzeit, Neil E., Weigl, Harald J., Applicants)**

Vibration Isolation for Nadir Platform

- **Earth-Pointing Platform (EPP) Active Vibration Isolation and Damping**
  - **Decouples Nadir instruments from spacecraft dynamics and disturbances**
  - **EPP is tunable to avoid instrument modes and cryo-cooler related disturbance**
  - **Enables "operate through" by reducing jitter effects of RWAs and transient effects of thruster firings**
  - **High-accuracy star trackers and IMU dynamically coupled to Earth-pointing Instruments on stiff bench with low thermal distortion**



Summary of GOES-R Spacecraft Features