Instrument Synthesis & Analysis Laboratory

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Acronym List

- AO Announcement of Opportunity
- CAD Computer Aided Design
- COBE Cosmic Background Explorer
- DIRBE Diffuse Infrared Background Experiment
- DMR Differential Microwave Radiometers
- Energetic X-ray Imaging Survey Telescope
- FIRAS Far Infrared Absolute Spectrometer
- FTE Full-Time Equivalent
- GSFC Goddard Space Flight Center
- GPM Global Precipitation Measurement
- GEO Geosynchronous Earth Orbit
- HEO Highly Elliptical Orbit
- HST Hubble Space Telescope
- IDC Integrated Design Capability
- IMDC Integrated Mission Design Center
- ISAL Instrument Synthesis & Analysis Laboratory
- JWST James Webb Space Telescope
- LOE Level of Effort
- NGST Next Generation Space Telescope
- SDO Solar Dynamics Observatory
- STS Space Transportation System
- TDRSS Tracking and Data Relay Satellite System
- WFF Wallops Flight Facility
Introduction

Instrument Synthesis and Analysis Laboratory

• What I am going to talk about:

- My background in instrument development
- Historic instruments at Goddard
- Development of the Integrated Design Capability at Goddard
- Anatomy of the Instrument Synthesis & Analysis Laboratory

COBE - 1984

Instrument Synthesis and Analysis Laboratory

[Diagram of COBE spacecraft]
Why an Integrated Design Capability?

- Previous concept design process:
  - Too many meetings
  - Too many people
  - Too low on the priority totem pole
  - Tied up too many resources
  - Took too long to complete
  - Incomplete collaboration between disciplines
  - Inconsistent or non-convergent results
  - Infrequent interaction with the “customer”
  - Did not always meet customer needs or expectations

Proven state-of-the-art engineering...

- Reduced cost and schedule for development of end-to-end space mission and remote sensing conceptual designs
  - Previous engineering process:
    - Study duration: ~ 6 months
    - Level of effort (LOE): 2.5 FTEs
  - IDC engineering process:
    - ISAL study duration: 1 - 2 weeks
    - ISAL approx. LOE: ~0.3 FTE
    - IMDC study duration: 4 - 5 days
    - IMDC approx. LOE: ~0.3 FTE
Proven state-of-the-art engineering con’t

Increased capabilities and improved consistency across studies

Hands-on involvement of the customer in the design process
- Customer needs and/or expectations routinely met or exceeded

Concurrent engineering environment
- All disciplines working together and all at the same time
- Consider all aspects of the mission life-cycle at the same time

Increased and improved collaboration between subsystem disciplines
- Infuse the end-to-end system perspective into the entire team
- Improve product consistency, quality and system level convergence
- Improve technology infusion, especially for cross-discipline items

IDC Competencies – Broad, Diverse, Customer Driven

Integrated Mission Design Center
- LEO, HEO, GEO, libration orbits, interplanetary and deep space, balloon
- Single spacecraft missions, formation flying, constellations, distributed systems
- Uncontrolled or controlled deorbit and recoverable payload modules
- Expendable vs. non-expendable launch vehicles
- Custom vs. commercial spacecraft tradeoffs
- Nanosats to large satellites

Instrument Synthesis & Analysis Laboratory
- Imagers, Cameras
- Spectrometers
- Lidars
- Gamma-Ray to IR Telescopes
- Solar Physics Instruments, Spectroheliographs
- Passive or Microwave Radiometers
- Optical Molecular Sensors
- Planetary & Lunar Orbiter Instruments
- Large Weather Satellite Instruments
- Geochemistry experiments
IDC Strategic Benefits

- **New Business Support**
  - First line of engineering analysis for Directorate/Center sanity check
  - First responder team for evaluating and assessing potential GSFC new work
  - In place, efficient as well as flexible, operational design environment to mature design concepts
  - Produce mature design concepts that improve competitive position and provide firm basis for future life cycle activities
  - "Hands on" involvement of the customer in the design process resulting in conceptual designs that better meet customer needs

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Strategic Benefits con’t

- **Cross life-cycle support**
  - Lead trade study execution and/or maturing of design concepts
  - Support Tiger Team and/or Red Team activities
  - Support Confirmation Review preparation and evaluation
  - Support acquisition evaluations
  - Support risk mitigation process

- **Technology Support**
  - Identification and/or evaluation of enabling technologies
  - Mechanism for infusing new technologies into future concepts
  - Technology roadmap development
Why go to the ISAL?

* Clear Proven Objectives

* Successful History

* Unprecedented Resources

Clear Objectives

* To provide a rapid and sustainable instrument development environment with clear, efficient processes and skilled engineers.

* To provide a capability for quick and efficient trade studies of instrument architectures and concepts.
  - Supports different maturity levels
  - Direct AO response
  - Trade Studies in advance of AO
  - Instrument Incubator Program projects
  - Space Exploration Studies - new NASA Directives

* To streamline and optimize instrument system design for Phase A, including cost, risk and technology assessment.
Successful History

- Operational facility since Spring 1999

- Completed more than more than 60 studies since its inception

- Experience with Earth Science, Space Science and Space Exploration instrument projects
  - Aquarius (Sea Salinity Study) selected for Earth Science
  - SDO and GPM have asked for designs
  - EXIST selected as part of the decadal plan by the National Academy of Sciences
  - NGST (now JWST) early studies done in the ISAL

Unprecedented Resources

- Cadre of highly-skilled discipline engineers
  - Collaboration of clients, discipline engineers, and scientists to discuss concept viability
  - Provide customized level of service
  - Detailed designs with significant analysis

- State of the Art Facility

Strong Leadership Team

Unified ISAL management and operations with the Integrated Mission Design Center (IMDC) to form the Integrated Design Capability (IDC) in Spring 2001
ISAL Engineering Skills

- Systems
- Science Liaison
- Thermal/Cryogenics
- Optical
- Electro-Optical
- Electronics
- Electro-Mechanical
- Opto-Mechanical

- Mechanical Analysis
- Detectors
- Cost Modeling/grass roots
- Laser Technology
- Microwave Technology
- Flight Software
- Orbital Debris
- Mission Success/Risk

ISAL Sample Product
Structural Analysis

Analysis Process & Products