

# **Cosmic Background Explorer, COBE**

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# COBE

- The COBE Project was the most demanding from an engineering aspect because it had to be so precise. To achieve its goal of measuring the diffuse infrared and microwave radiation from the early universe, it had to be essentially perfect.
- It was “Nobel science.” Nothing like the instruments had ever been built before.
- Because COBE had cryogenic instruments with a dewar full of liquid helium cooled to a temperature of 2° Kelvin (-271° Celsius), the engineers had to be sure before you cooled it down that everything was right, because it would take six weeks to warm it back up and then cool it down again. There was a 100% failure rate along the way, when the instruments were placed in test dewars to test materials properties and electronics.
- COBE was designed to launch from Vandenberg Air Force Base on the Shuttle, where it would be inserted into a polar orbit at 12,000 pounds.
- Moving from a Shuttle launch to a Delta rocket because of the *Challenger* accident forced engineering to completely rethink every aspect of the spacecraft’s design with a total weight of 5,000 pounds.

## **Challenge Questions**

- **What is the responsibility of the DPM/T?  
How did you know how to do this?  
How much information did I have?**
- **How far should options be pursued?**
- **Who should be involved in alternatives/decisions?**
- **How would you make this Project more responsive regarding cost and schedule versus an in-house level of effort Project?**
- **How would you ensure the flight re-design is correct?**
- **How would you ensure that the scientists will understand the ‘behavior’ of the spacecraft on-orbit, i.e. ensure that they are actually measuring the background radiation?**

# COBE ReDesign

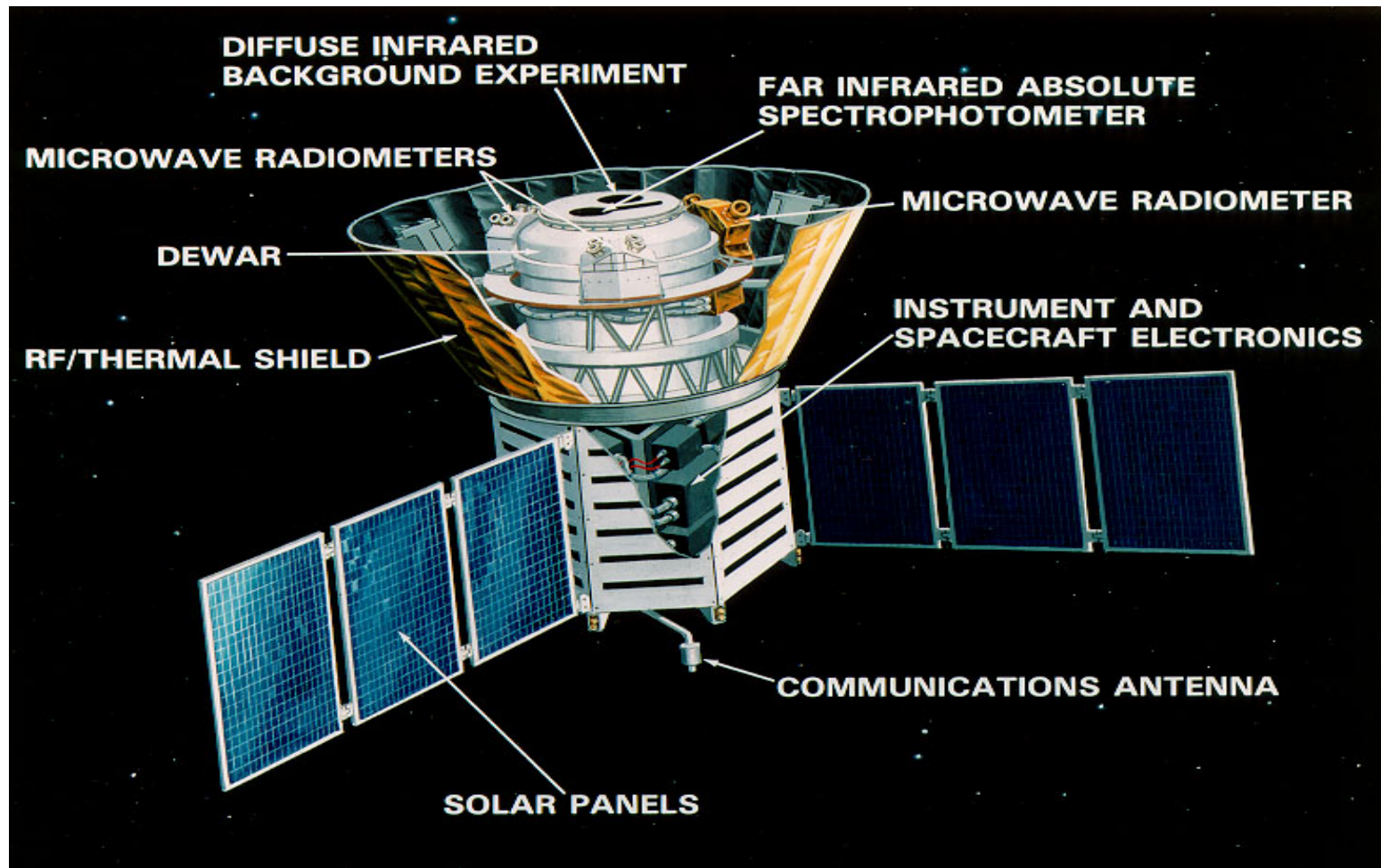
- **Trades:** Decision Making
- Skunk Works, Co-Located All Personnel
- War Room
- Peer Review (hand selected personnel) of re-Design
- **Experts:** Hinshelwood, Webb, Martin
- **Q/A** Empowered
- Read every GIDEP alert personally
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- **Testing:** Deferred tests, but never eliminated tests; ran for 2 weeks at the end
- Don't make a decision before you have to
- Keep your options open
- **Communication:** Encouraged anyone to talk with me anytime
- **Schedule pressures:** Used COBE Shuttle mockup for integration of spacecraft electronics in parallel with instrument development/testing
- **How did I know how to do this?**
- Observed other project Managers
- "B.P." Prudent, Practical, Patient, Perseverance, Protective (hardware and personnel)
- **Financial pressures**
- Project maintained budget, not Directorates
- Fix the ground system and spacecraft; develop the instruments
- Sold COBE Shuttle hydrazine propulsion system to DOD

# COBE Development

- **COBE was developed in house at GSFC for two reasons:**
  - **It was a training Program for future Managers. The GSFC Deputy Center Director, the GSFC Head of Engineering and a Division Chief worked on COBE**
  - **These instruments could not have been developed out of house. They had to be built in house and they learned and modified**
- **COBE required ~ 9years and 2,000 many years of effort, i.e. 4 ,million hours of engineering, scientist, and technician support because it was so difficult**
- **COBE cost was \$140M + 2,000 man years ~ \$450M**
- **COBE spacecraft was developed as a training Program and was basically single string with some redundancy Cost ~ \$50M**
- **COBE instruments were extremely difficult and required ~\$75M ; mostly in-house manpower**
- **COBE success can be attributed to the thorough test program. Single string designs are acceptable if they are thoroughly tested to remove infant mortality of components**
- **COBE was allowed to just run for 2 weeks after the qualification Program so that the scientists could learn all of the characteristics, idiosyncrasies, behavior, etc of the spacecraft and instruments**

# COBE

## COBE Satellite



# Achieving Program Excellence

- **“Productivity Is Never An Accident. It Is Always The Result Of Commitment To Excellence, Intelligent Planning And Focused Effort”**
  - **“Excellence Is Not A Skill. It Is An Attitude”**
    - **“The Excellence Is In The Details”**
- **“We Are What We Repeatedly Do. Excellence Then Is A Habit. If You Are Going To Achieve Excellence In Big Things, You Develop The Habit In Little Matters”**
- **“Excellence Is Not An Exception, It Is A Prevailing Attitude”**