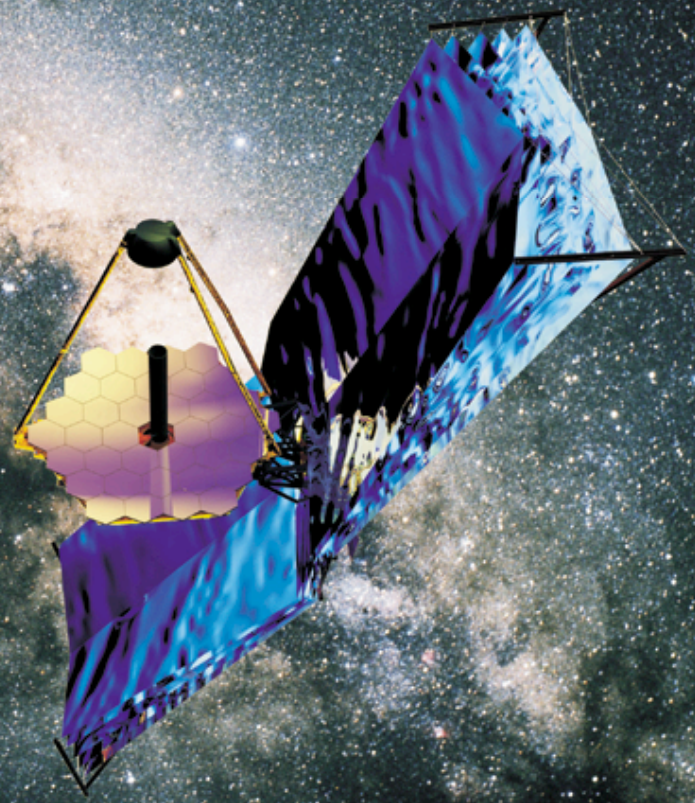
NEXT GENERATION
JWST
SPACE TELESCOPE

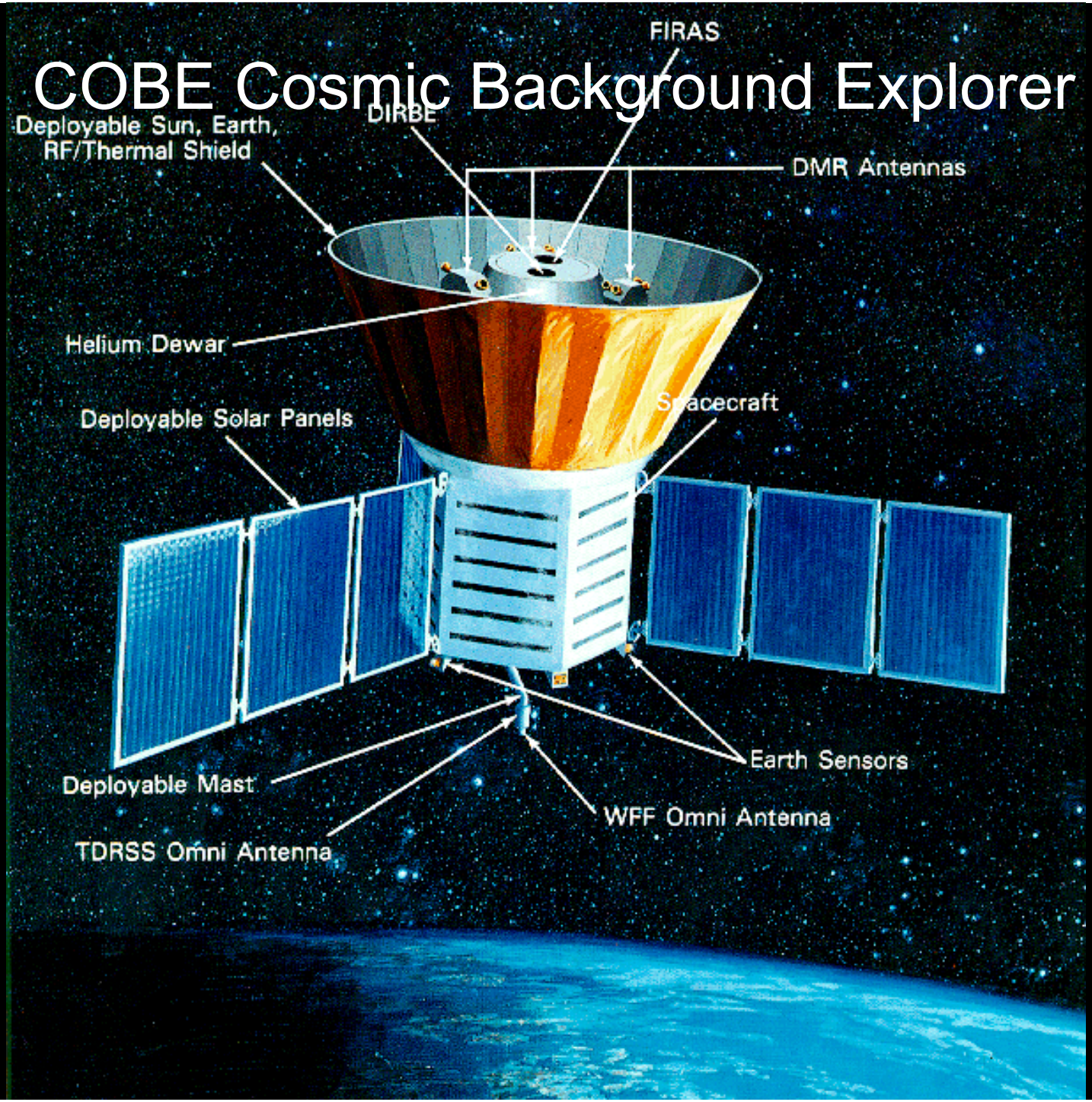


John Mather, Senior
Project Scientist, GSFC
9/28/04

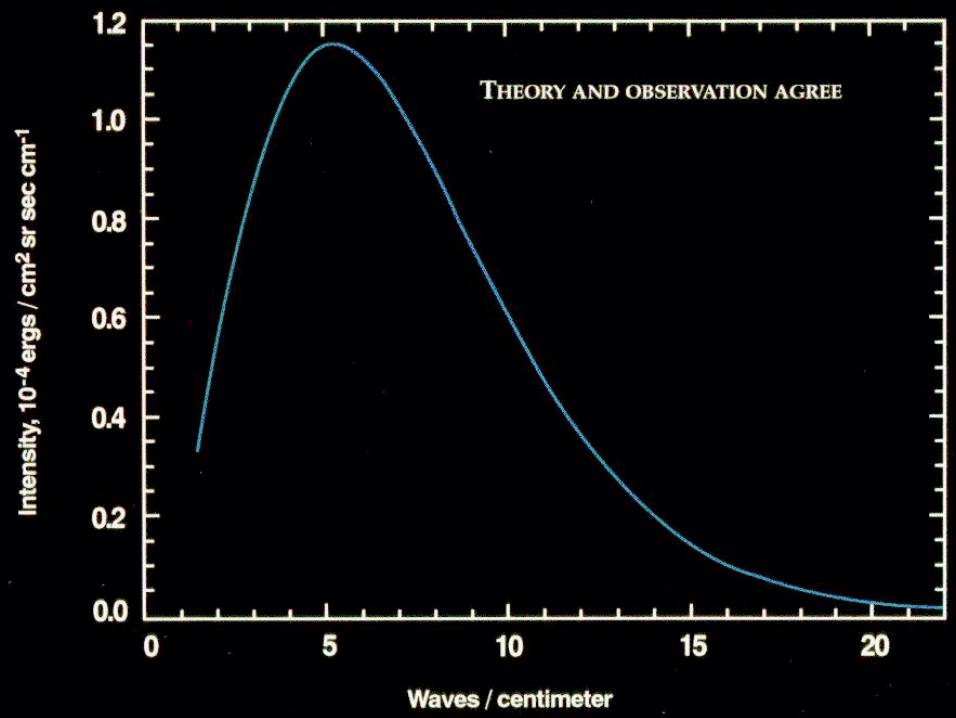
Introduction

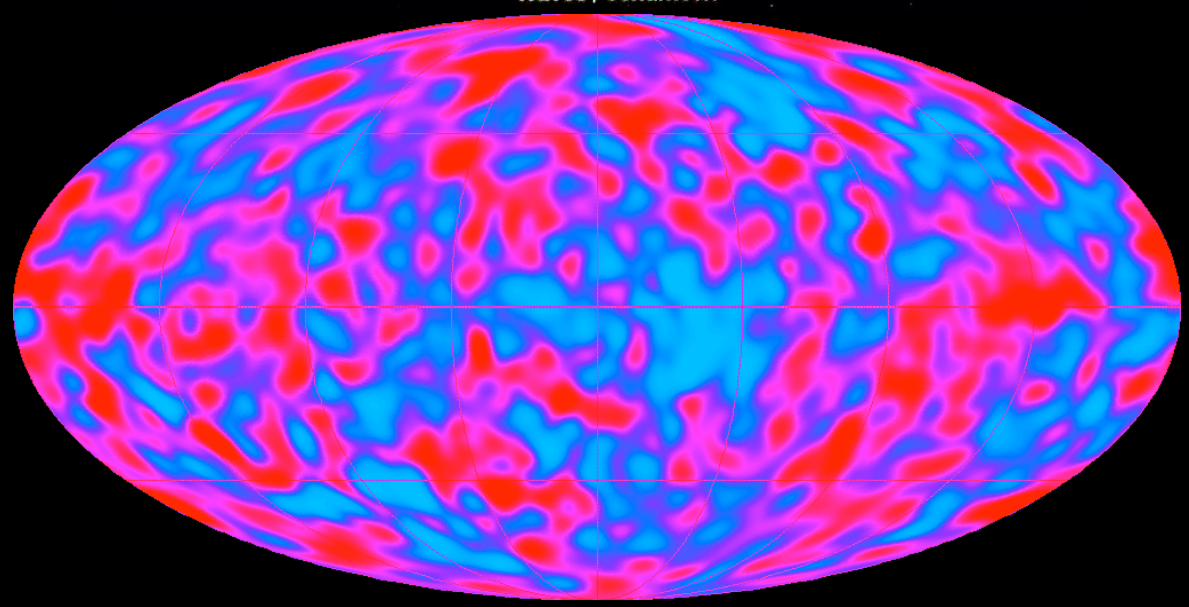
- What's a risk?
  - Something intrinsically chancy, that can't be controlled or predicted
  - Definition depends on available resources, talent, point of view, consequence of failure, who's paying, and who's thinking about it
- Why take risk?
  - Exploration and science are ALWAYS about the unknown, uncontrollable, unpredictable universe

COBE Cosmic Background Explorer



Cosmic Microwave Background Spectrum from COBE





JWST James Webb Space Telescope

Scientific successor to Hubble - look for first galaxies, study star and planet formation

But, need cold telescope, far bigger than Hubble and bigger than rocket, in deep space, with 4 instruments

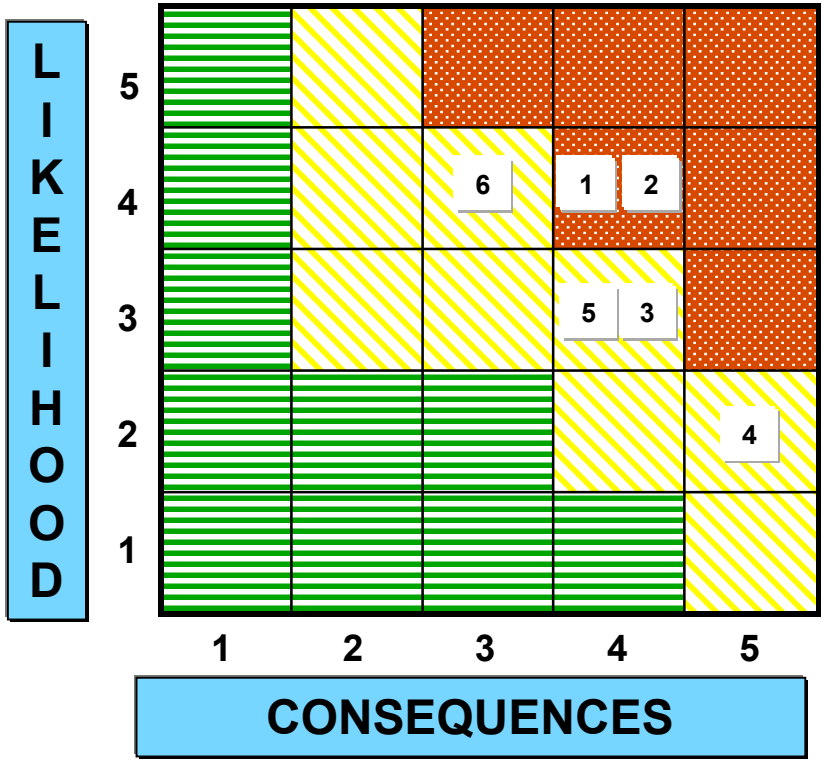
Joint project of NASA, ESA, and CSA

Highest astronomy priority of National Academy of Sciences

Advanced Mirror System Demonstration (AMSD) Beryllium Mirror

1.2 m flat-to-flat light-weighted, semi-rigid, beryllium mirror

JWST Top Risk List



LxC Trend	Rank	Approach	Risk Title
➡	1	M	Beryllium Mirror Fab Schedule
➡	2	M	Wavefront Sensing & Control (WFS&C)
➡	3	M	Beryllium Mirror Performance
➡	4	M	Inter-agency approval of Ariane 5
➡	5	W	Plum Brook Sustainability
➡	6	W	Tinsley Staffing

Criticality

- High
- Med
- Low

L x C Trend

- ⬇ Decreasing (Improving)
- ⬆ Increasing (Worsening)
- ➡ Unchanged
- **New** New since last month

Approach

- M - Mitigate
- W - Watch
- A - Accept
- R - Research

Psychology of inanimate objects

- If something is not tested, it will fail later, probably when it can't be fixed
- If something is tested, it will fail and we'll have to fix it and test it again, at great cost
- If there is no spare part or backup plan, the item will fail
- If tests are made only to verify expected function, the part will fail in some other way
- Recommendation: plenty of test hardware, plenty of brainstorming about failure modes, lots of external review to protect against faulty thinking

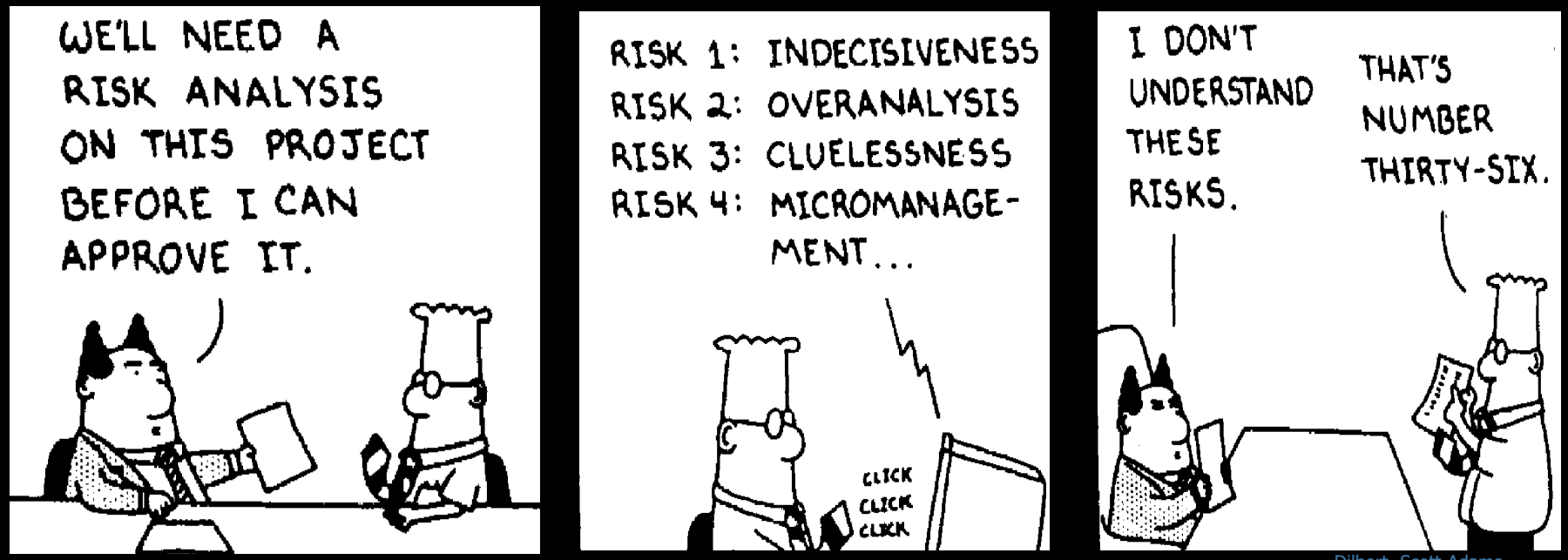
Personal Risk Management

- I know 8 people who fell off a ladder or a roof
- I knew (of) several who died of too much exercise, including a quality assurance expert
- One was murdered
- One died young for no known cause
- Conclusion: can-do people are not programmed to appreciate L*C

Summary & Implication

- Greatest risk is lack of imagination
  - See possibilities
  - Estimate likelihood
  - Appreciate consequence
- We're easily blinded by thinking about the resources we have
- Nature doesn't care what we think

Understanding Risk



Dilbert Scott Adams

The End

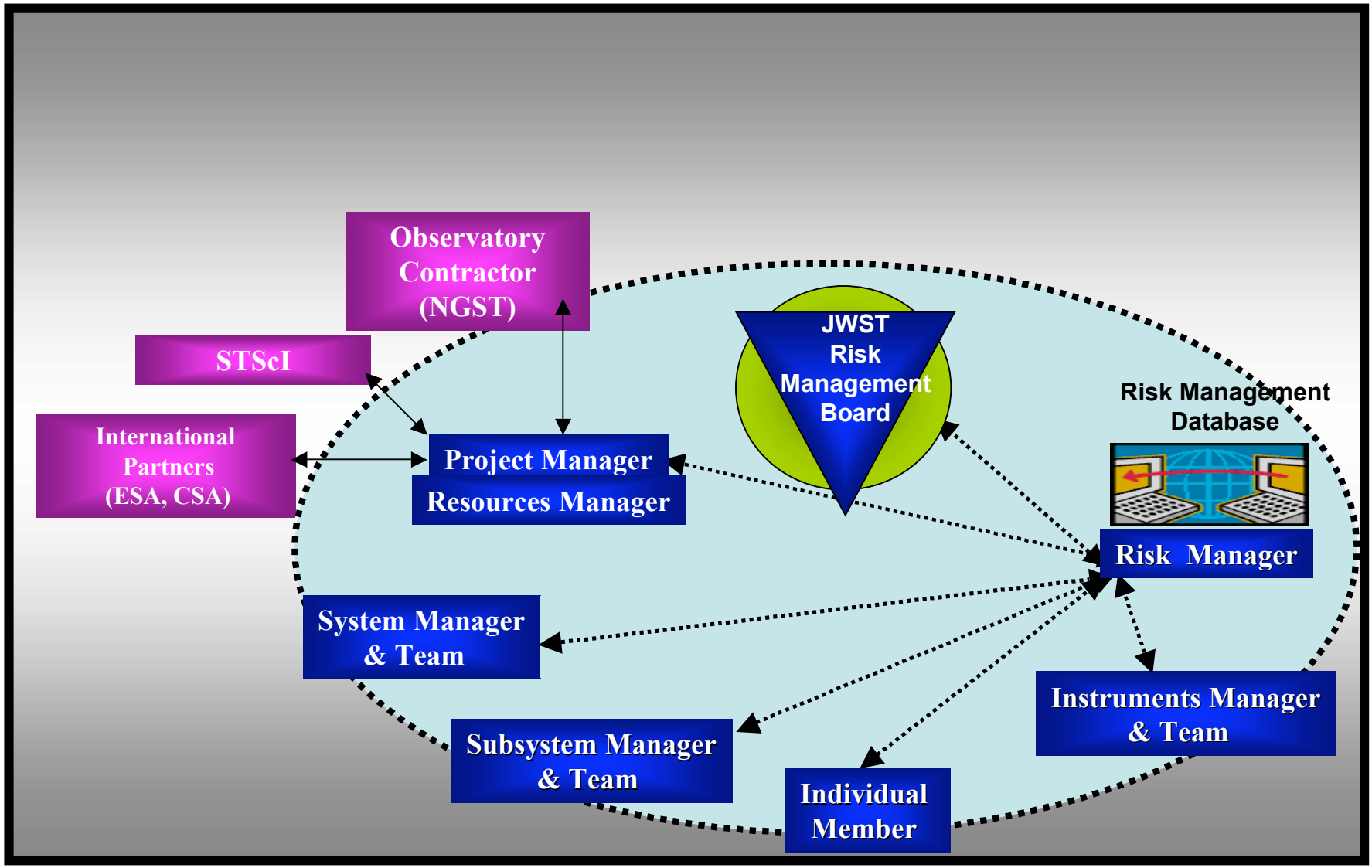
COBE Risk Management

- No formal risk management plan
  - FMECA (Failure Modes and Effects Criticality Analysis) was done by a contractor late in project
- Little appreciation of risk probability * severity issues
- No risk reduction by parallel efforts, because no $
- Didn't appreciate the chance of wrong thinking, so not enough small-group peer reviews

Major COBE Risks were social

- Concept: what if we forgot to think about a new effect due to cryogenics, noise, superfluid helium, spinning spacecraft, etc.?
  - Cold cables wouldn't flex
  - Aluminum distorted on cooling
  - Systematic errors hidden in noise, averaged for years
    - Magnetic susceptibility of RF switches
    - Electrical interference between computer clock, picked up by the ultrasensitive detectors
  - Light coming up from Antarctica stressed power system
  - Conclusion: PI or team inexperience is a major risk
- Test: what if we can't afford to test something?
  - Nature doesn't care if we can afford it or not
  - What if something breaks in test? We won't have resources to fix it, so why test?
  - After Challenger we know: management attitude is a major risk

Risk Communication Process for JWST



JWST RM Process

- JWST Risk Management Plan was identified as the best model plan for a complex project that complies with NASA procedures and guidelines and is available at the NASA HQ'S best practices website
- All JWST Senior managers had the CRM (Continuous Risk Management) training and are well aware of the definitions of Primary Risks and Acceptable Risks
- JWST Risk Management Board meets twice a month to analyze, plan, and mitigate risks. Each system lead maintains their own risk list and communicates to the higher board on a regular basis
- Our international partners (ESA, CSA) and contractors (NGST, STScI) maintain their own risk database and transfer their primary risks to our database
- PRA (Probabilistic Risk Assessment), FTA (Fault Tree Analysis), FMEA (Failure Modes Events Analysis) is done by experts in every group for Mission Success Analysis

JWST Risk Management Tool

- All members were provided with basic training on risk management and the use of the home grown web based tool
- JWST RM Tool resides in the internal website and is accessible to every member of the team including contractors and international partners
- The Risk Manager and group leaders related to a risk is automatically notified through electronic mail when a new risk is submitted or any changes are made
- All changes are recorded in the history of a risk
- The Safety Manager is notified electronically if a risk has any safety issues
- Primary risks are ranked among the top risks and reviewed on a regular basis

James Webb Space Telescope
(with a little COBE history)

Project Manager:	Phil Sabelhaus
Deputy Project Manager:	John Decker
DPM-Resources:	Jonathan G. Bryson
Senior Project Scientist:	John C. Mather
Prime Contractor:	NGST
Science Ops Center:	STScI
Public Web Site:	www.JWST.nasa.gov

September 28, 2004