

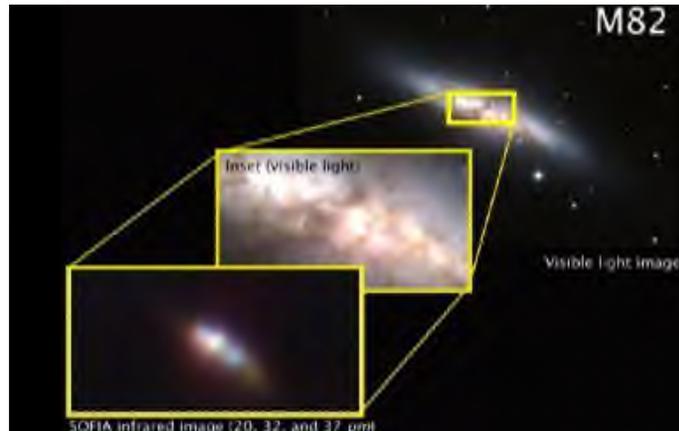
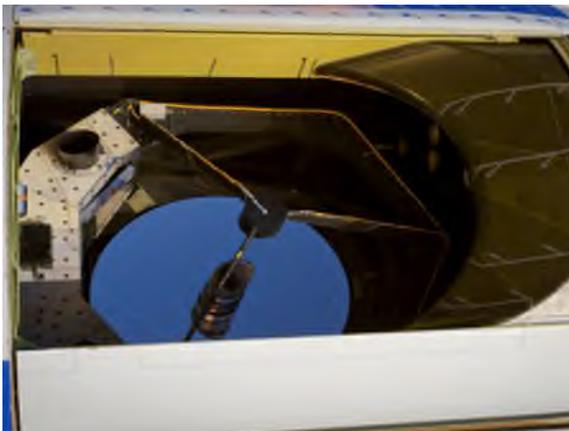
Juggling Act:

Re-planning & Building an Observatory....

Simultaneously!!!

Eddie Zavala - SOFIA Deputy Program Manager  
Patricia Daws - SOFIA Program Business Manager

February 10, 2011





# Purpose

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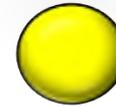
**This presentation discusses how the SOFIA Program, in the midst of a re-plan and system development phase, executed multiple simultaneous planning and business initiatives/requirements and integrated them into improved project management processes without impacting technical progress.**



# Overview



- ! The SOFIA Mission
- ! Before the Re-plan
- ! The Juggling Act
- ! Managing the Chaos
- ! Engage Existing and New Jugglers
- ! The Results
- ! KEY BREAKTHROUGHS
- ! Conclusion



# The SOFIA Mission...

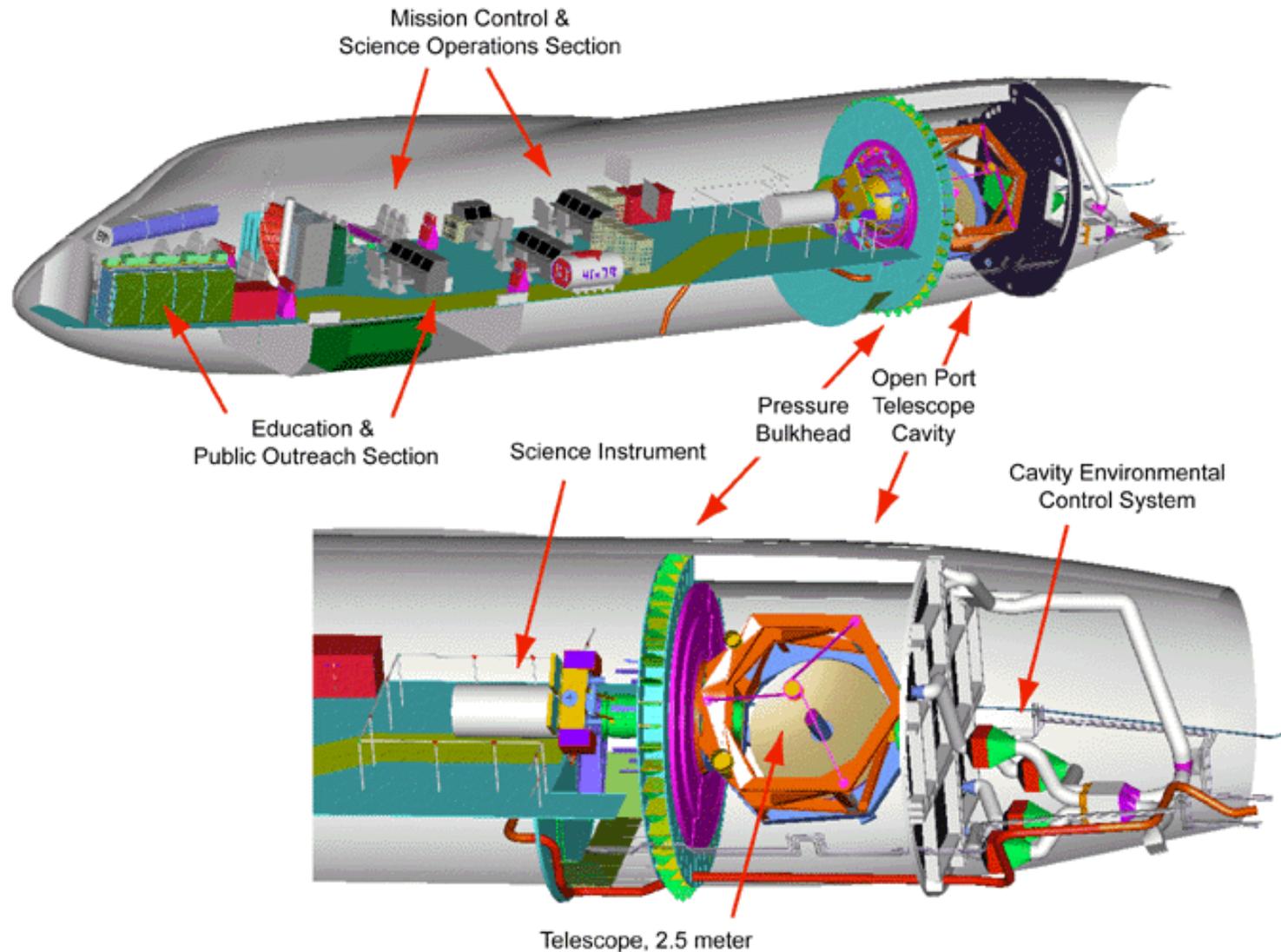


# Stratospheric Observatory For Infrared Astronomy (SOFIA)



# Layout of Personnel and Accommodations

(upper deck not shown)

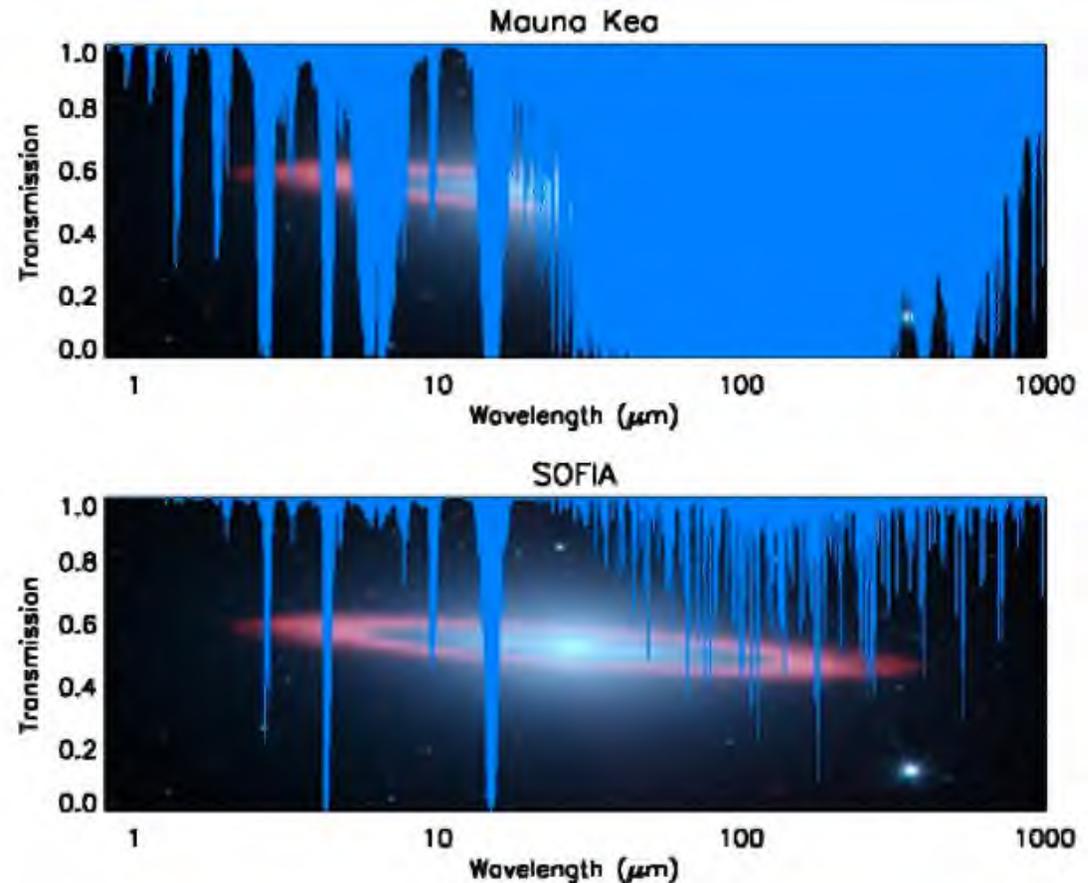




# Why SOFIA?

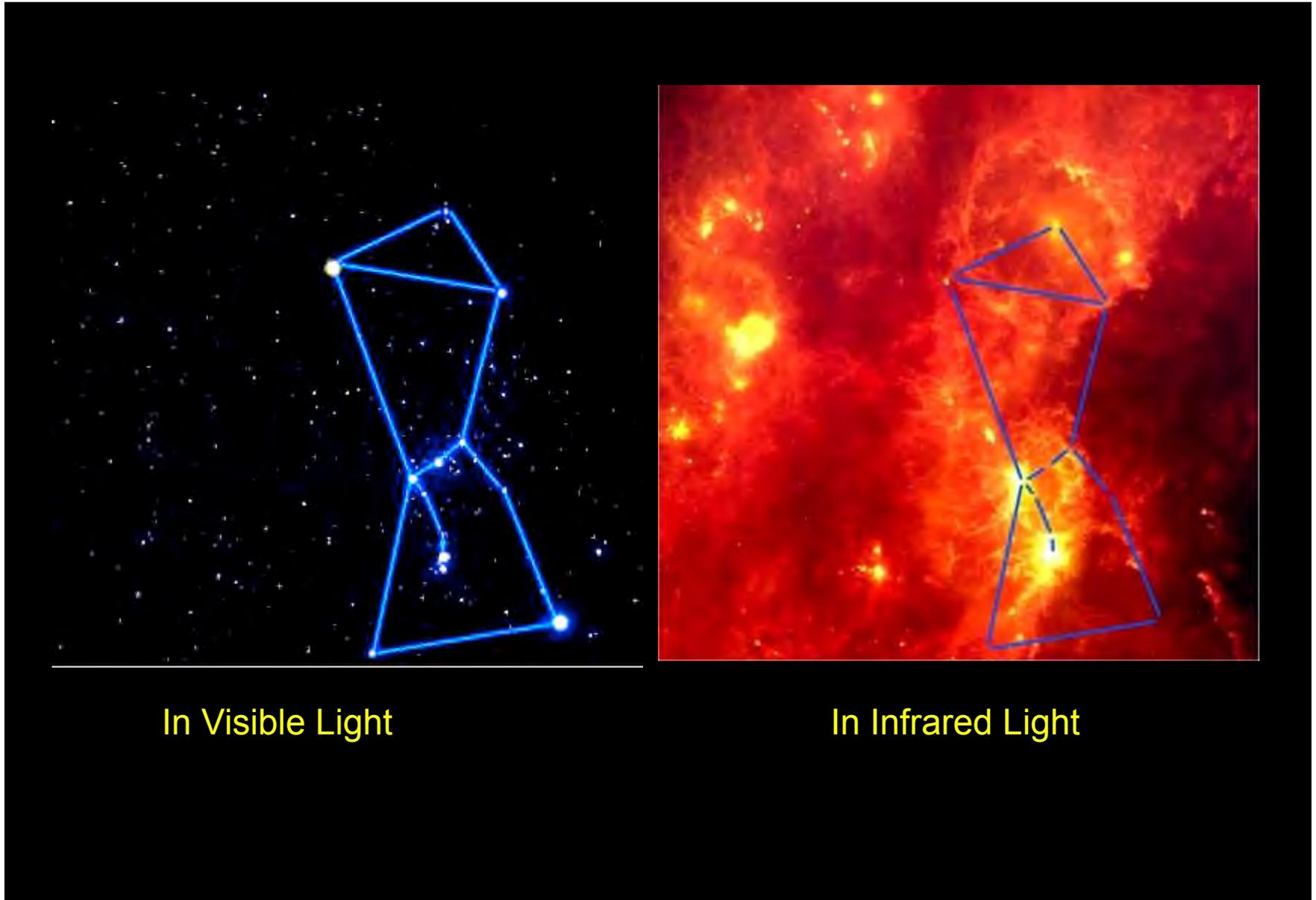


- ! Infrared information is important to gather astronomy science data
  - ! IR can see through dust
  - ! IR can detect cold gases and dust, other cool stars, and planetary objects
    - ! Forming stars have their light intensity peaks in the IR
  - ! IR can detect the content of the early universe through red shift of distant objects
- ! Infrared is filtered by moisture in atmosphere
- ! At 41,000 ft, above more than 99% of the water vapor
- ! Spacecraft consume infrared required cryogen's in 3 to 4 years
- ! Mobility: anywhere, anytime
- ! Long lifetime
- ! A near-space observatory that comes home after every flight



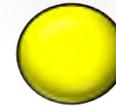


# The Orion Constellation



In Visible Light

In Infrared Light



Before the re-plan...





# Program Background



- ! The predecessor to SOFIA, the Kuiper Airborne Observatory (KAO), was decommissioned in 1995 to start SOFIA
- ! SOFIA established as a 80/20 partnership between US and Germany (NASA and DLR)
  - ! NASA receives 80% of available science time, DLR 20%
- ! Initial program model, was contractor led with NASA oversight (privatized)
- ! Program slated for cancellation in the spring of 2006
- ! Agency approves program for continued funding in the fall of 2006
  - ! Program restructured
    - ! Government led contractor supported
    - ! Two projects, Science and Platform
      - »! Science at Ames Research Center
      - »! Platform at Dryden Flight Research Center

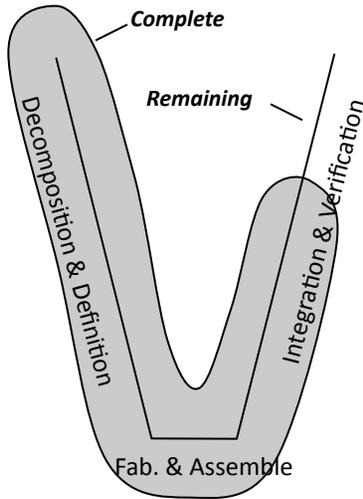




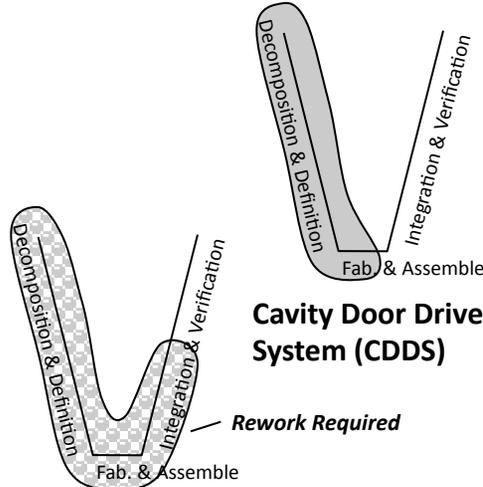
# Incremental / Phased Development Approach



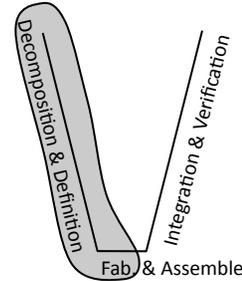
Status - Sept 2007



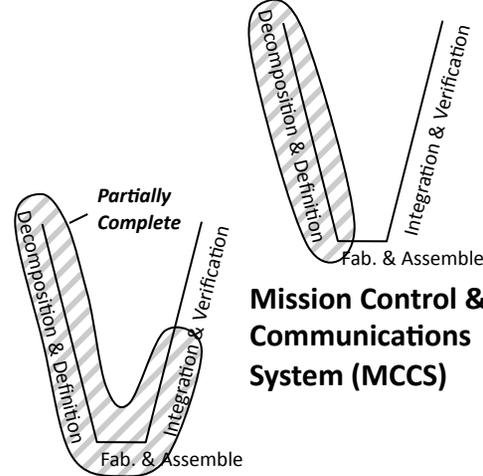
**A/C Modification Telescope Assembly**



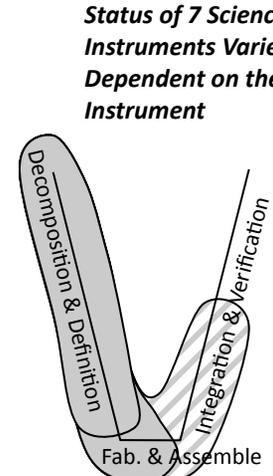
**Cavity Door System (CDS)**



**Cavity Door Drive System (CDDS)**

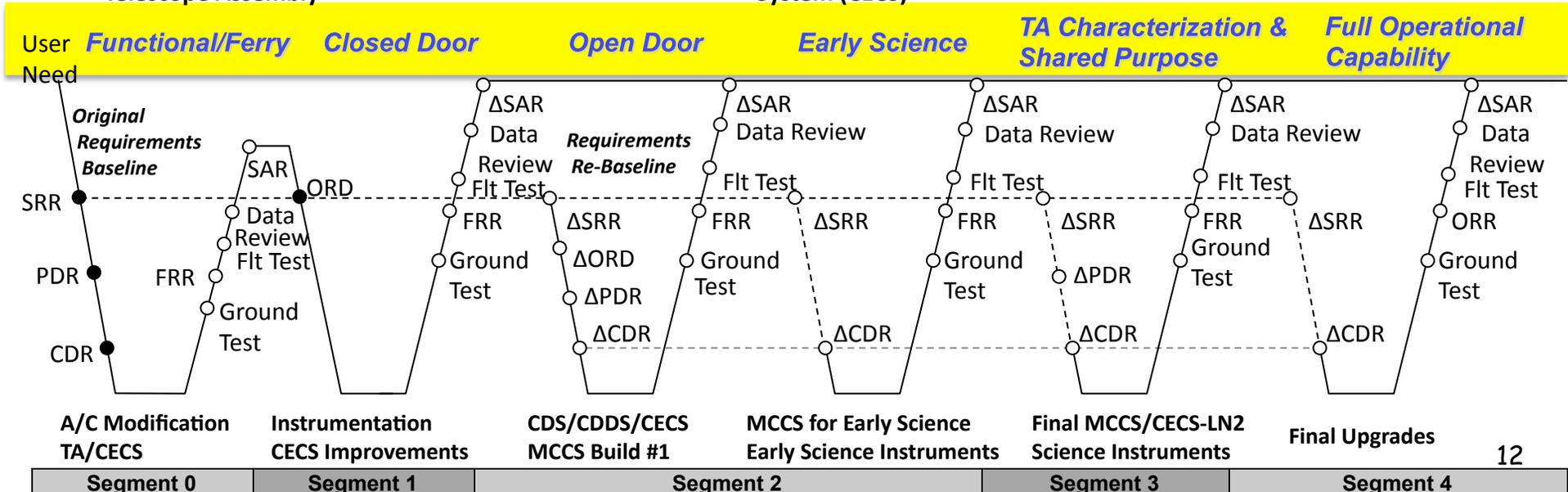


**Mission Control & Communications System (MCCS)**



**Science Instruments (SI)**

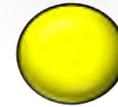
Status of 7 Science Instruments Varies Dependent on the Instrument





# Approximate Aircraft Configuration at Program Restructure, 2006





The Juggling...



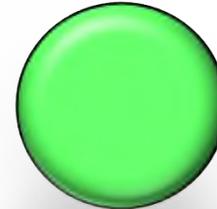
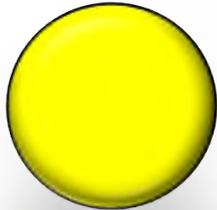


# Introducing the Juggler...

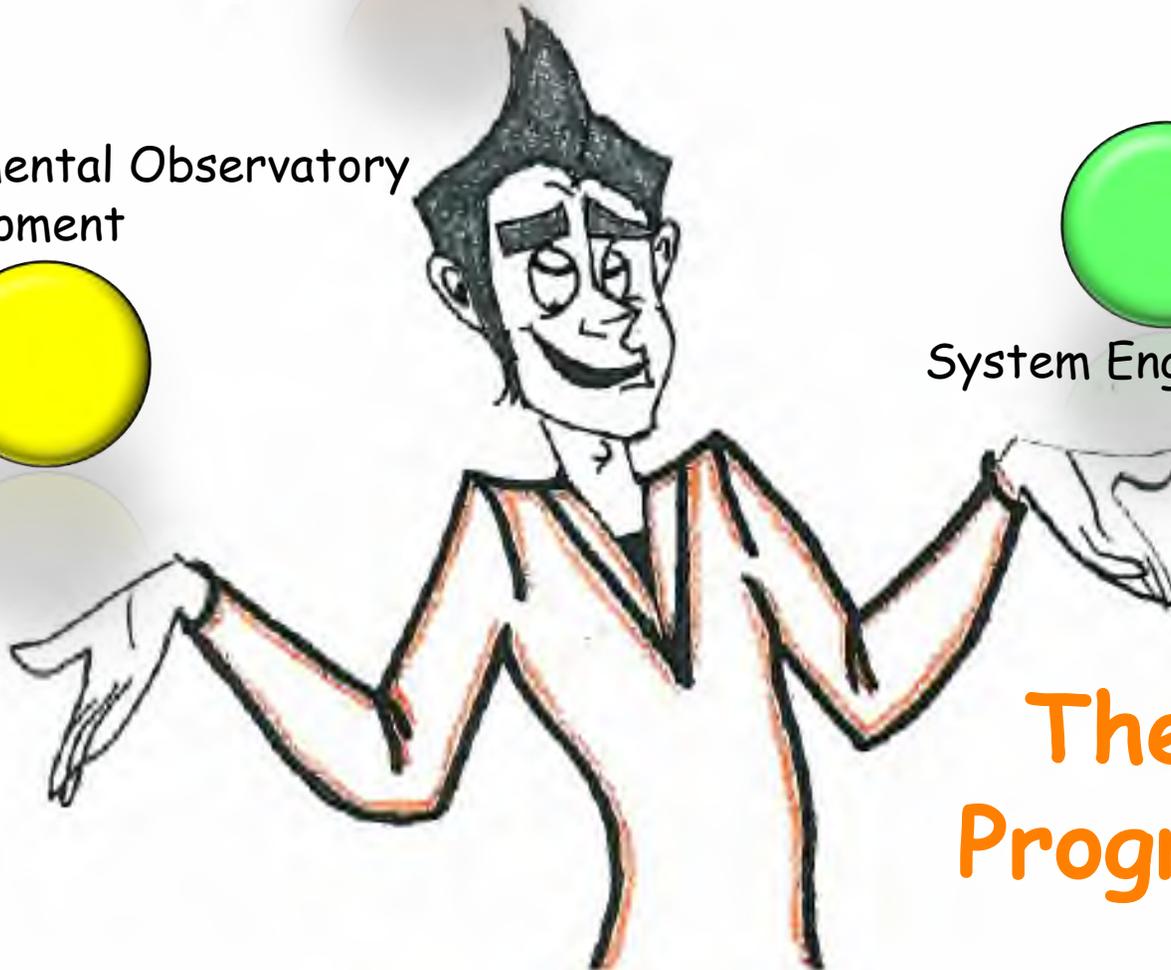


Program Restructure

Incremental Observatory  
Development



System Engineering & Integration



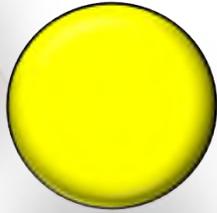
## The SOFIA Program Office



# Build a World-Class Observatory



Implementing the New Program Structure



Inter-leaving Development and Early Science  
(phased development approach)



Systems Engineering & Integration



Integrating the New Team



Science Community Expectations



Deploy working observatory capabilities and services

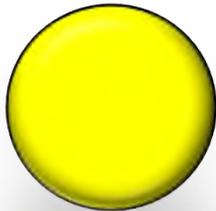


# New Challenges

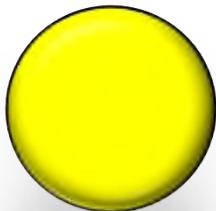
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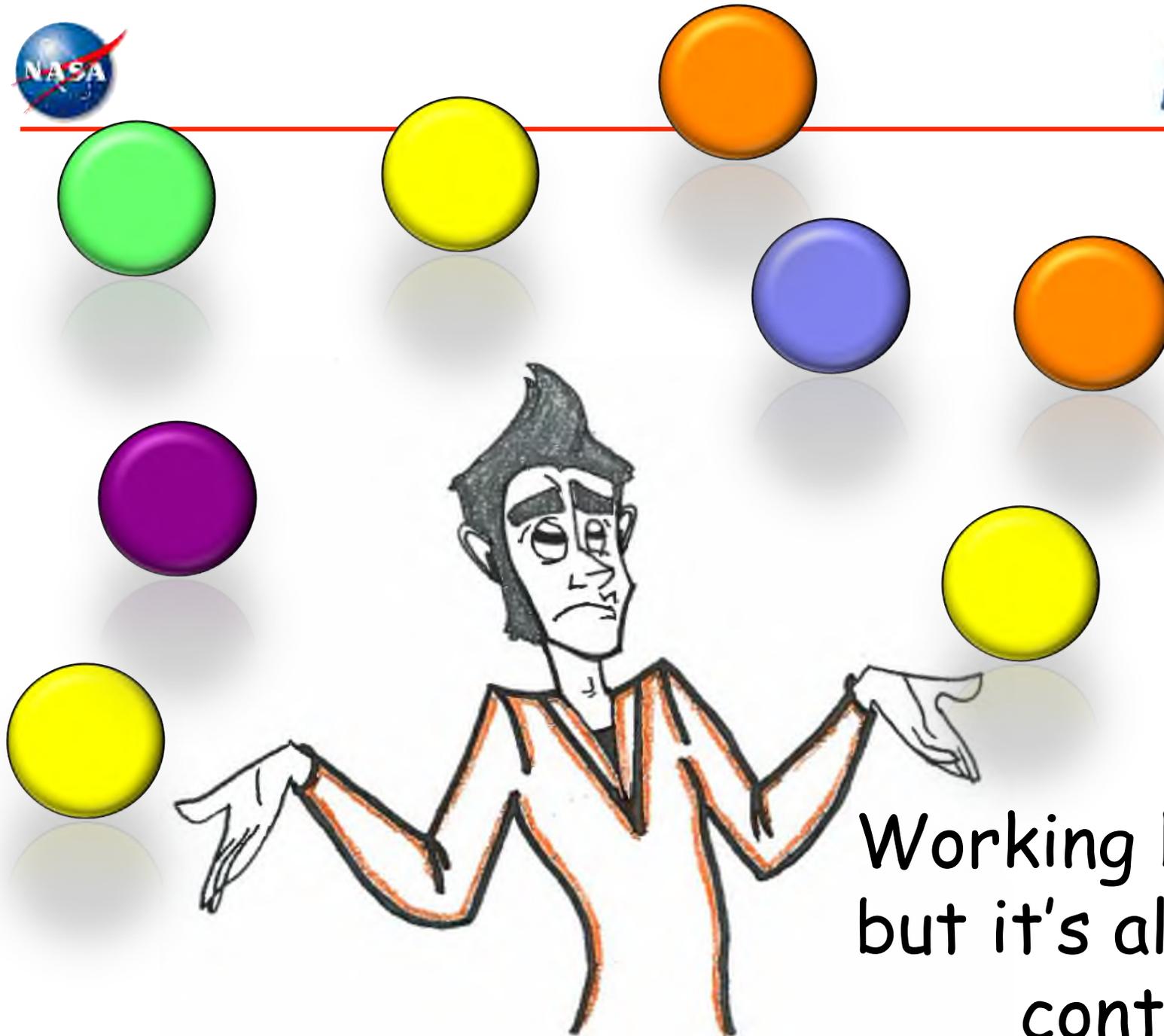
- ! Can you handle a few more balls in the air?
- ! Subsystem development schedule delays



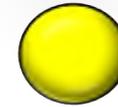
MCCS Development for Early Science



CDDS Technology Development Issues



Working harder,  
but it's all under  
control



The Impossible Act...

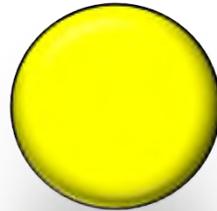




# The "fun" begins...



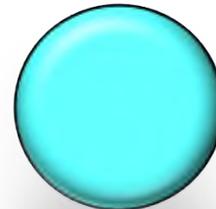
GAO Large Program Assessment/Audit



Technical Re-plan



Clear the flight envelope



Standing Review Board (SRB)



Get to the Initiation of Science Flights

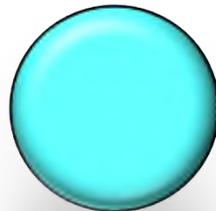
(but don't drop any of the other balls!!)



# And the fun keeps coming....



IG Pre Audit, Formal Audit, Recommendations



Earned Value Implementation

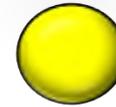


Joint Cost & Schedule Confidence Level (JCL)

(but don't drop any of the other balls!!)



Something's  
gotta give!!!!



Managing the Chaos...



# Take a timeout....



What's urgent?

What's feasible?

What added value can we get from these new requirements?

What's important?

What don't we know?

How are we going to get this done ?!





# Managing the Chaos...

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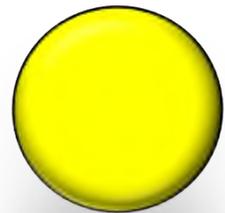
- ! Strategize....before you add more jugglers to the team, or even accept the balls
- ! Sequence the balls...don't try to accept them all at once
- ! Leverage skill and experience of existing jugglers...
- ! Learn new "juggling skills"
  - ! "Jugglers" and "juggling skills" equate to process improvement, functional groups, NOT additional staff



# Sequence the Balls



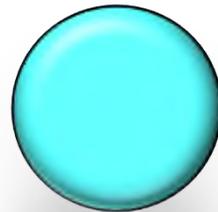
- ! The timing of when new balls get thrown in the mix is critical to keeping everything in the air



Technical Re-plan



Flight Test

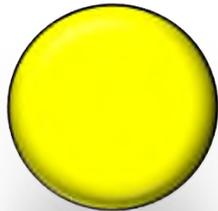


Standing Review Board (SRB)

- ! Technical re-plan required
- ! Same team preparing for initial flight test of the observatory
- ! SRB required...but urgent?



# Sequence the Balls

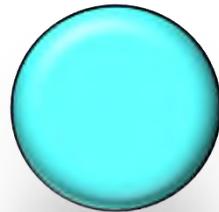


Technical Re-plan

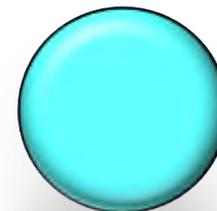


Flight Test

- ! **KEY DECISION:** Prioritize Flight Test over the SRB
  - ! Provided a pre-brief to the SRB to give them time to get familiar with the program, but minimize impact to the project teams
  - ! Top priority - Conduct Flight Test so that we can start science missions
  - ! Reschedule formal SRB after initial flight test phase complete
- ! **KEY DECISION:** Index the program to an interim baseline pending SRB recommendations



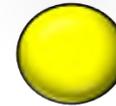
Interim  
baseline



Standing Review Board  
(SRB)



Engage Existing / New  
Jugglers...





# Engage Existing Jugglers...

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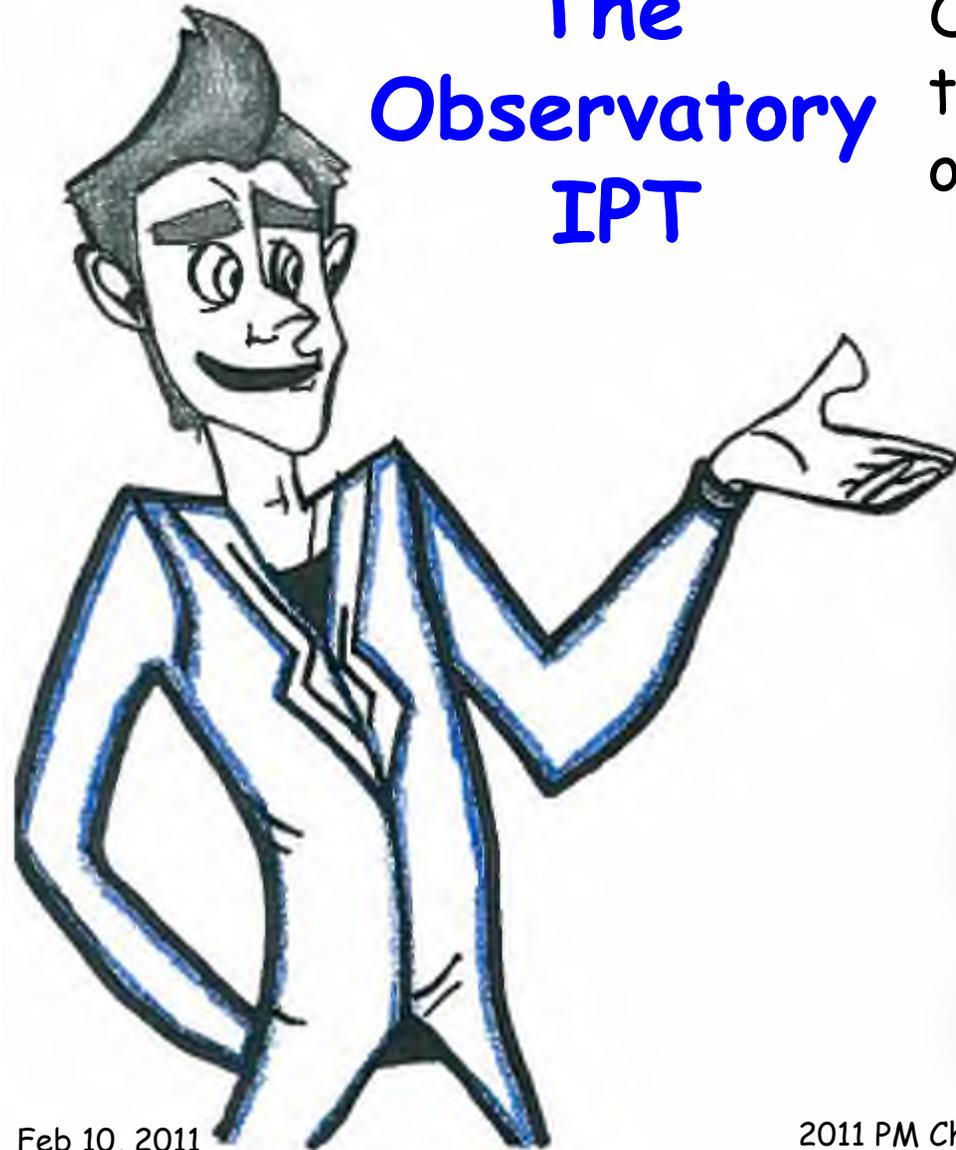
- ! Leverage existing team members and groups instead of adding to the confusion with new players
  
- ! Introducing...



# Juggler #2



## The Observatory IPT



Owens the key skills to keep the act going...developing the observatory

- Technical Coordination
- Requirements Management
- System Engineering & Integration
- Mission Preparedness & Execution
- Technical Risk Management



# Juggler #3

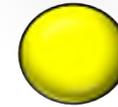


## Continuous Risk Management



CRM has a new **key skill...the**  
**THREAT DATABASE**

- Makes it easier for team to identify threats "on the fly"
- "any issue that keeps you up at night"
- Threats linked to milestones with quantified cost / schedule impacts
- Improved Program risk identification

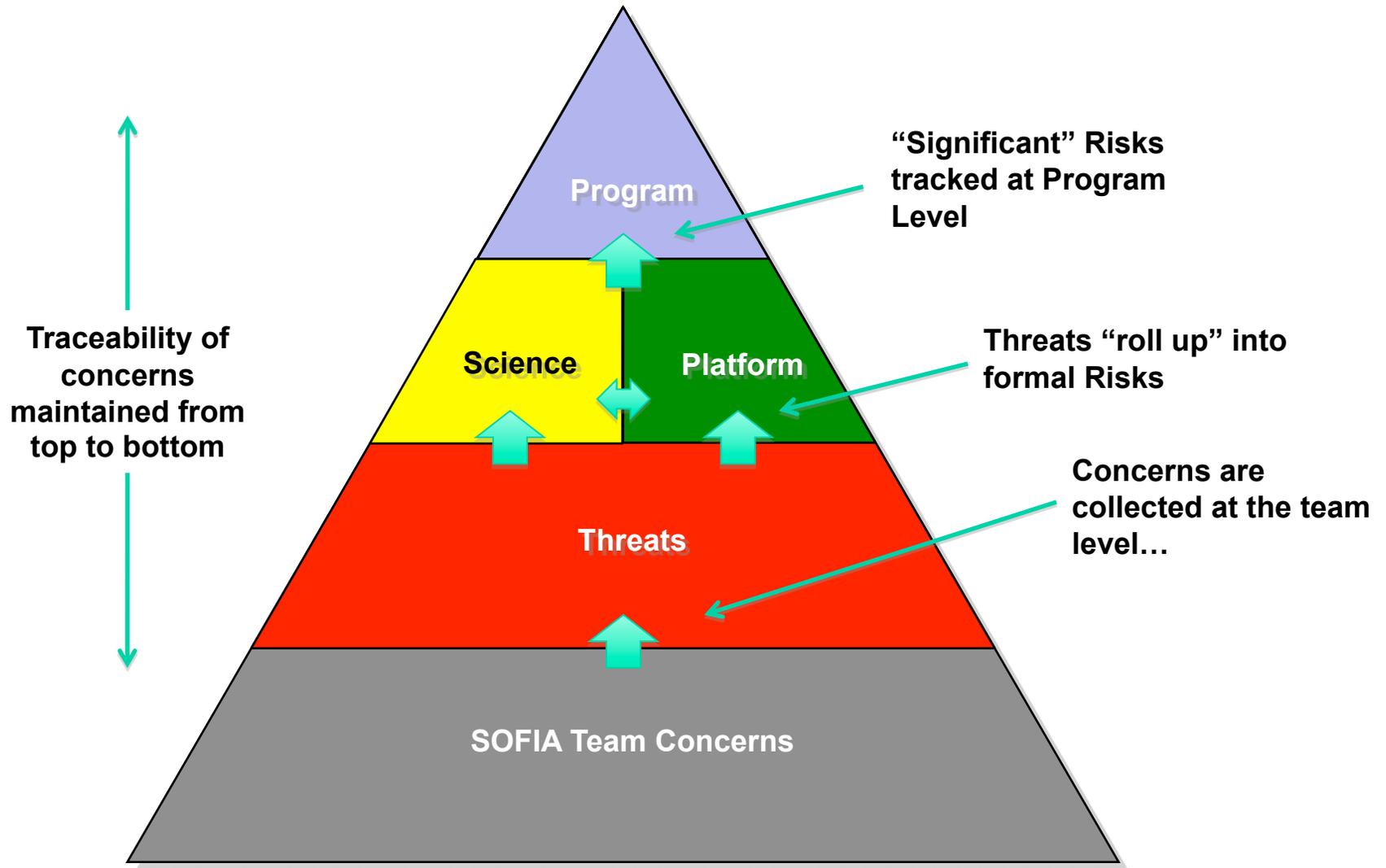


# The Threat Database...





# Communication of Concerns





# Risks, Threats, and the JCL

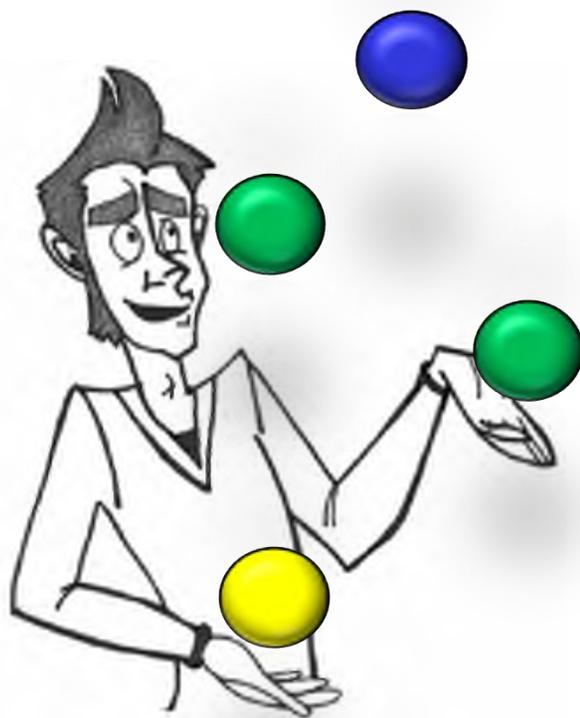


The threat database is used to populate the JCL risk register and the Risk Action Matrix at the Project and Program Level

The threat database proved to be a good predictor of likely schedule impacts and helped focus mitigations



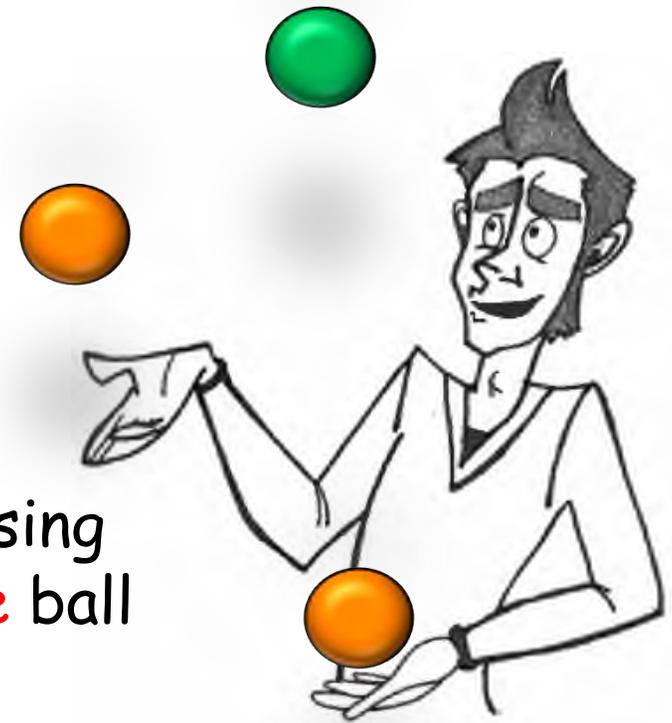
# Two Coordinated Jugglers



Observatory  
IPT



Synchronized by tossing  
the **Threat Database** ball  
back and forth



Continuous Risk  
Management



# Juggler #4



## Integrated Schedule & Budget



● Tune up key juggling skills to manage more balls in the air at one time

By teaming with other Jugglers, tossing balls back and forth, sharing the load...

● Leverage threat database for cost/risk integration (toss ball back and forth with CRM & Observatory IPT)

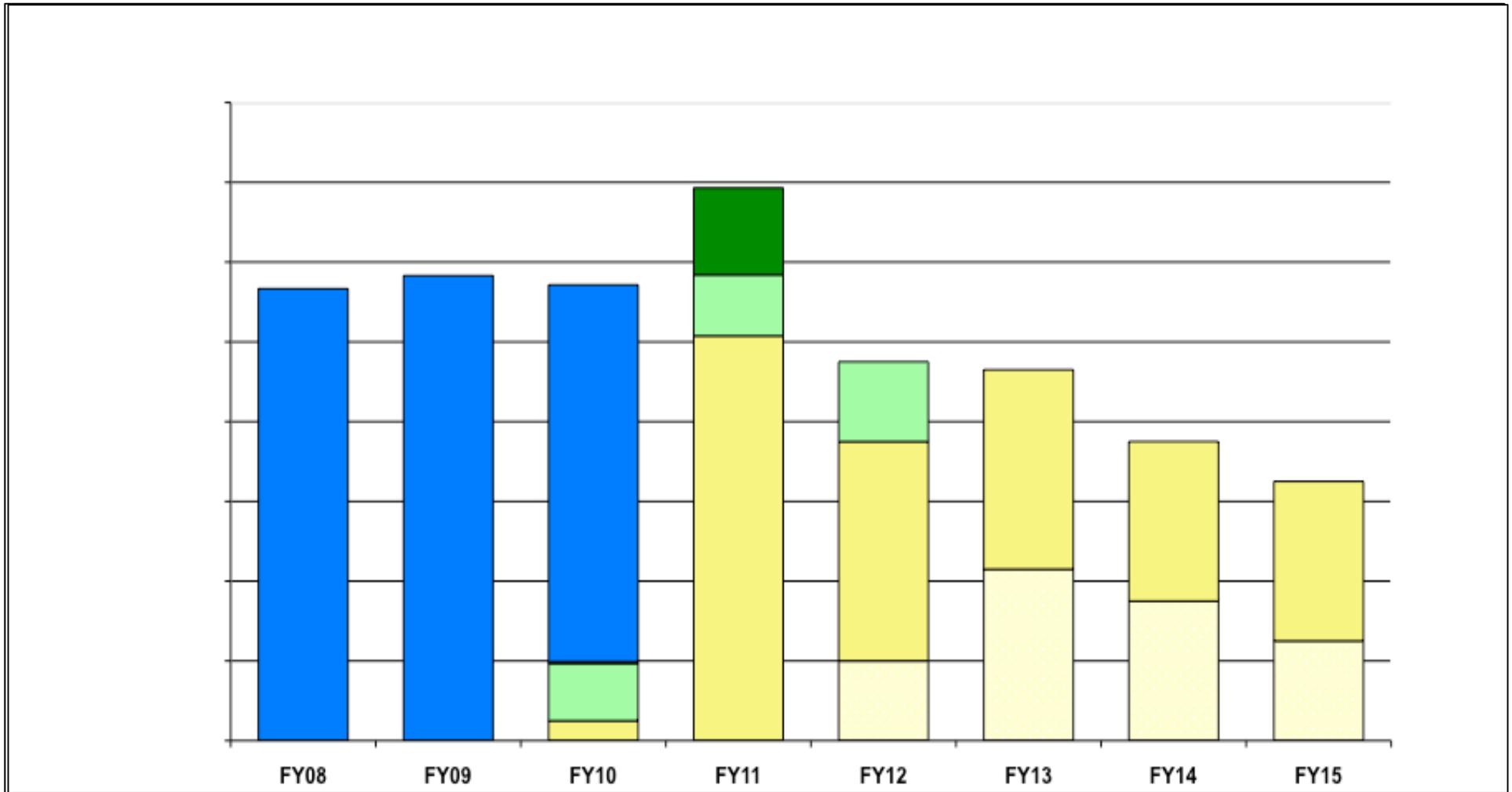
● Leverage existing budget data for schedule/cost integration (coordinating with SPO)

● Acquiring JCL implementation knowledge

● Integrated technical and reserve management strategy

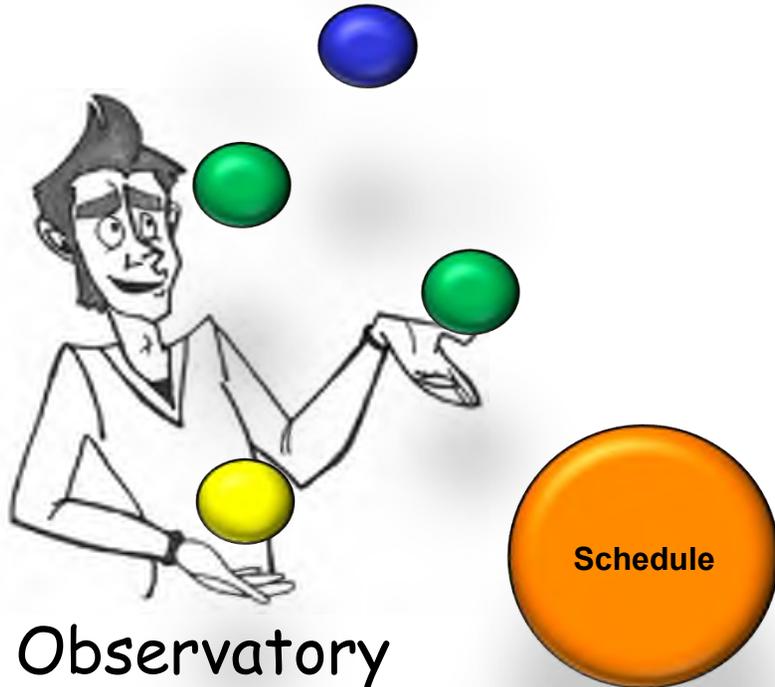


# Reserves Management Strategy

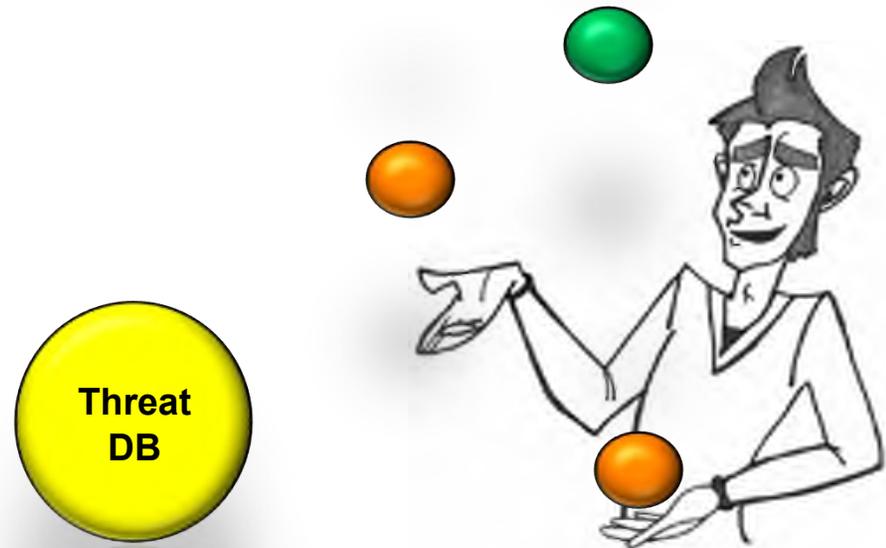




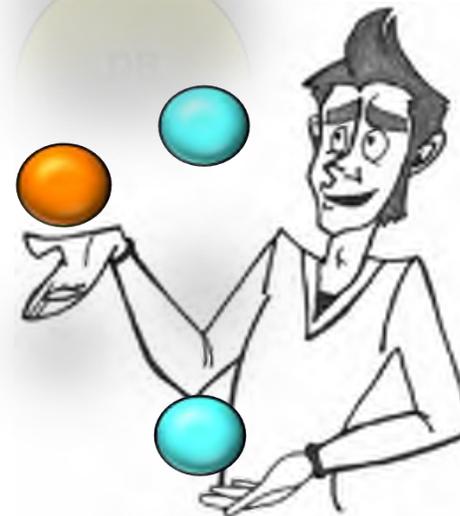
# Three Coordinated Jugglers



Observatory  
IPT



Continuous Risk  
Management

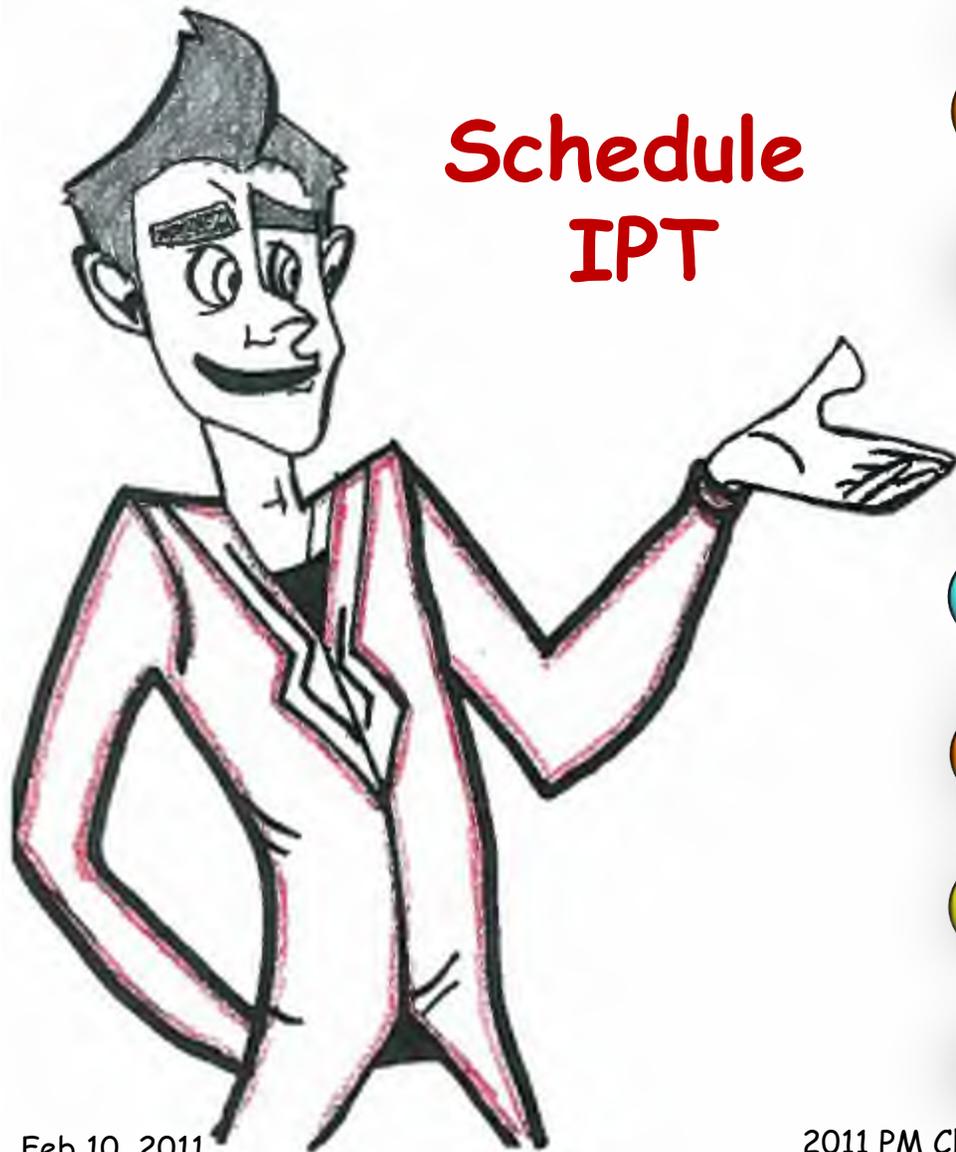


Integrated  
Schedule / Budget

Synchronized by tossing  
the **Threat Database and  
Schedule** balls back and  
forth



# Bring the New Juggler#5....



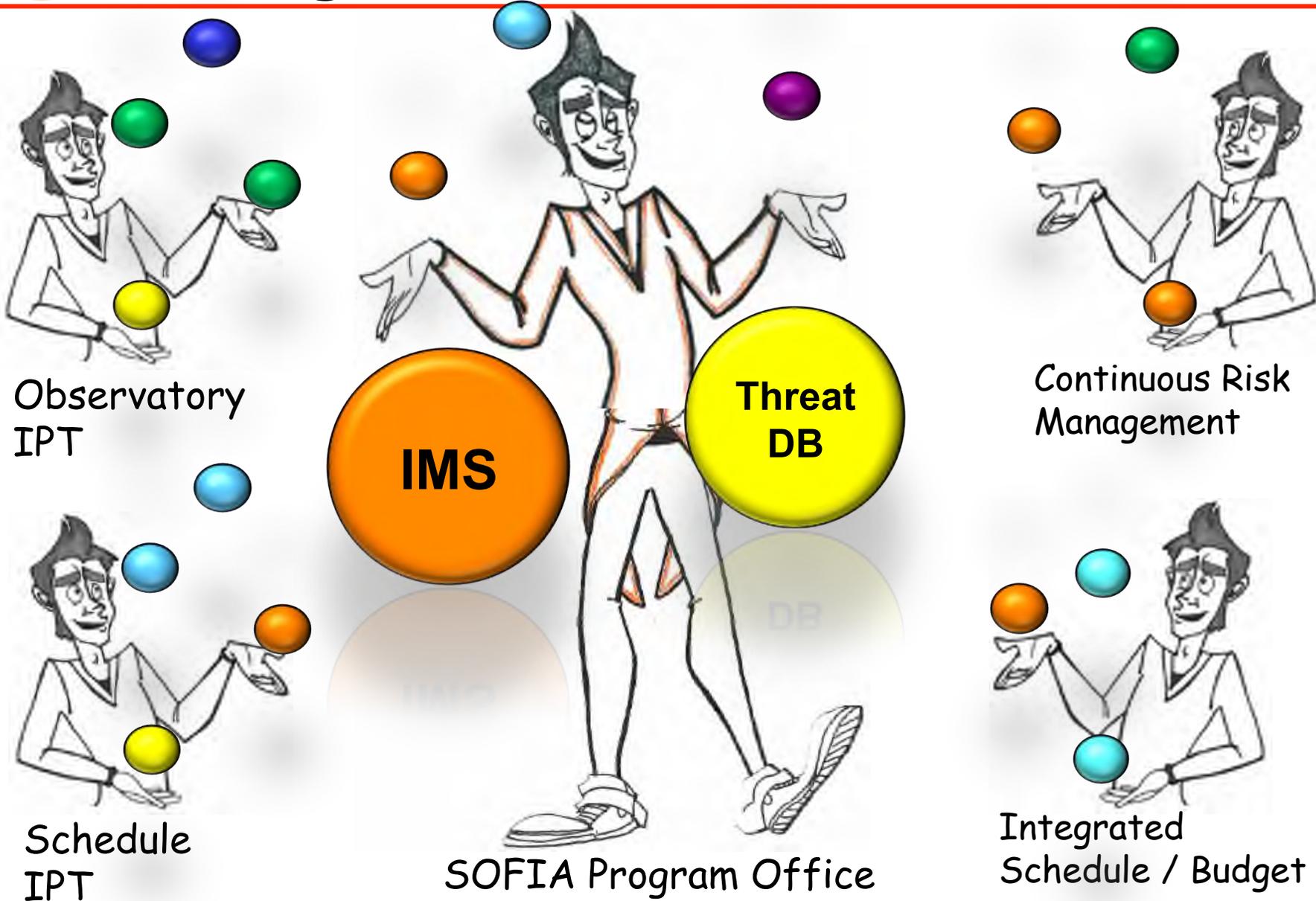
## Schedule IPT

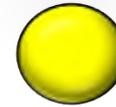
Integrates cross-functional knowledge to create a new skill

- **Integrated Master Schedule** with:
  - Tie to Threat Database via JCL Risk Registry
  - Resource Loaded Tasks
  - JCL plug-in
  - Leverage JCL for EVM Implementation
  - Institutionalize value-added processes and analyses
  - Ensure continual improvement and sustaining processes through coordination with other jugglers

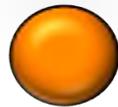


# Program-wide Coordination





# Results





# Accomplishments

---



- ! Can really work together and perform tricks!!!
  - ✓!Completed technical re-plan
  - ✓!Successful First Flight with 100% open door
  - ✓!Successful First Light through telescope in the air
  - ✓!Completed Envelope Expansion
  - ✓!Completed JCL
  - ✓!Successful SRB
  - ✓!Completed Re-plan with APMC
  - ✓!Completed EVM Implementation
  - ✓!Completed Observatory testing with Integrated MCCS/CDDS for Early Science.

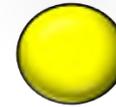
**✓!Initiation of Science Flights on Nov 30 / Dec 1, 2010!!!**



# Key Breakthroughs



- ! Key decisions made to set down balls...not drop them
  - ! Leveraged the results of technical re-plan
  - ! Re-sequenced SRB appropriately
  - ! Program indexed with an interim baseline
- ! Enhanced CRM processes
  - ! Threat database construct
  - ! Linking threats to specific activities, identify cost and schedule impact
  - ! Use threat database as primary source for JCL inputs
  - ! Feeder to traditional risk management - augment, don't replace
- ! Integrated Master Schedule
  - ! Resources, threats, JCL/EVM enabled
- ! Finding a way to dissolve traditional stovepipes
  - ! Key relationships (Business Manager, CE, SPO, PMs...)
  - ! Integrated products that allow for cross-functional use and enabled new teams to implement new requirements



Conclusion





# Conclusion

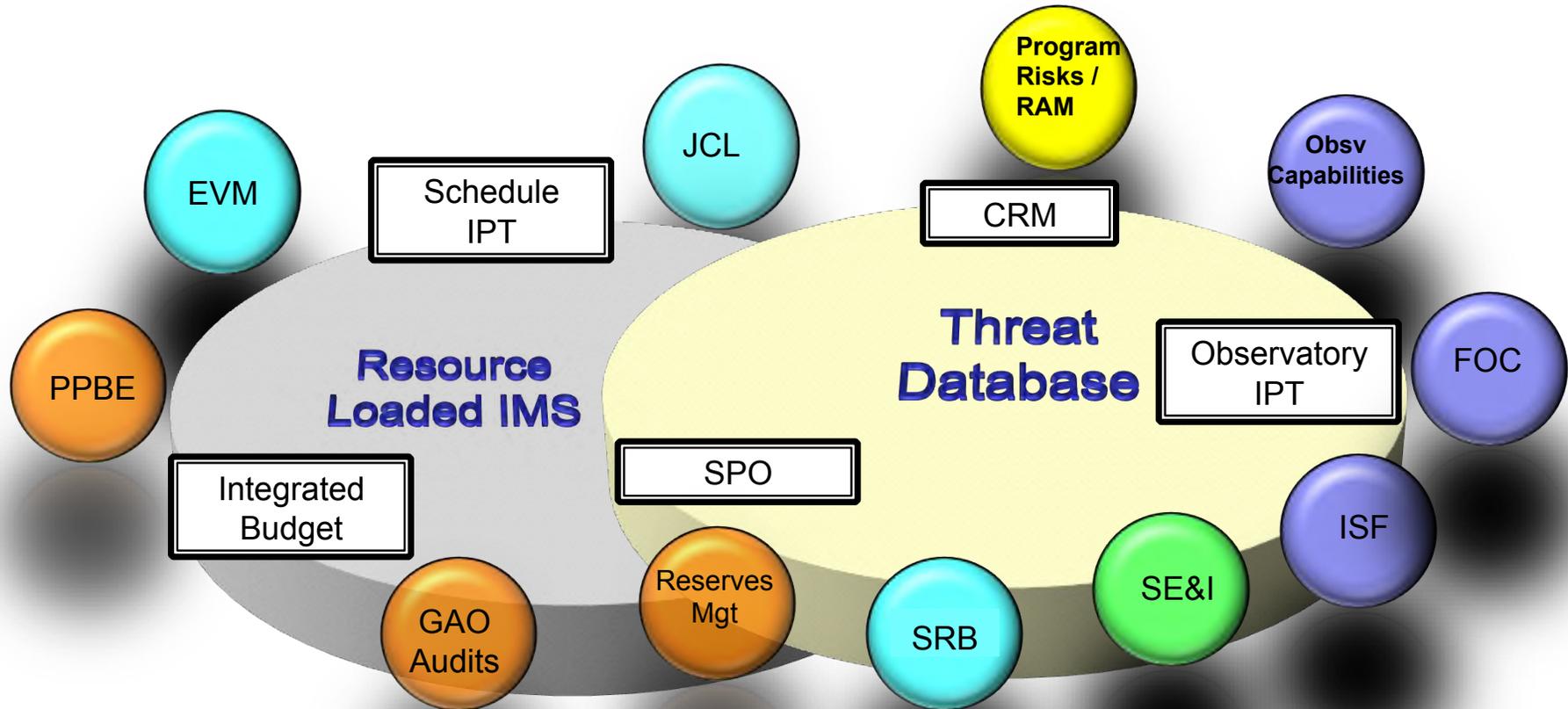
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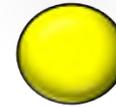


- ! The SOFIA Program found ways to leverage existing roles in new ways to meet the requirements without creating unmanageable overhead. The team developed strategies and value added processes - such as improved risk identification, structured reserves management, cost/risk integration - so that the effort expended resulted in a positive return to the program.



# The Improved Operating Model





Questions?





# SOFIA First Flight at Waco, April 26, 2007





# SOFIA Door Fully Open In-Flight, Dec 18, 2009



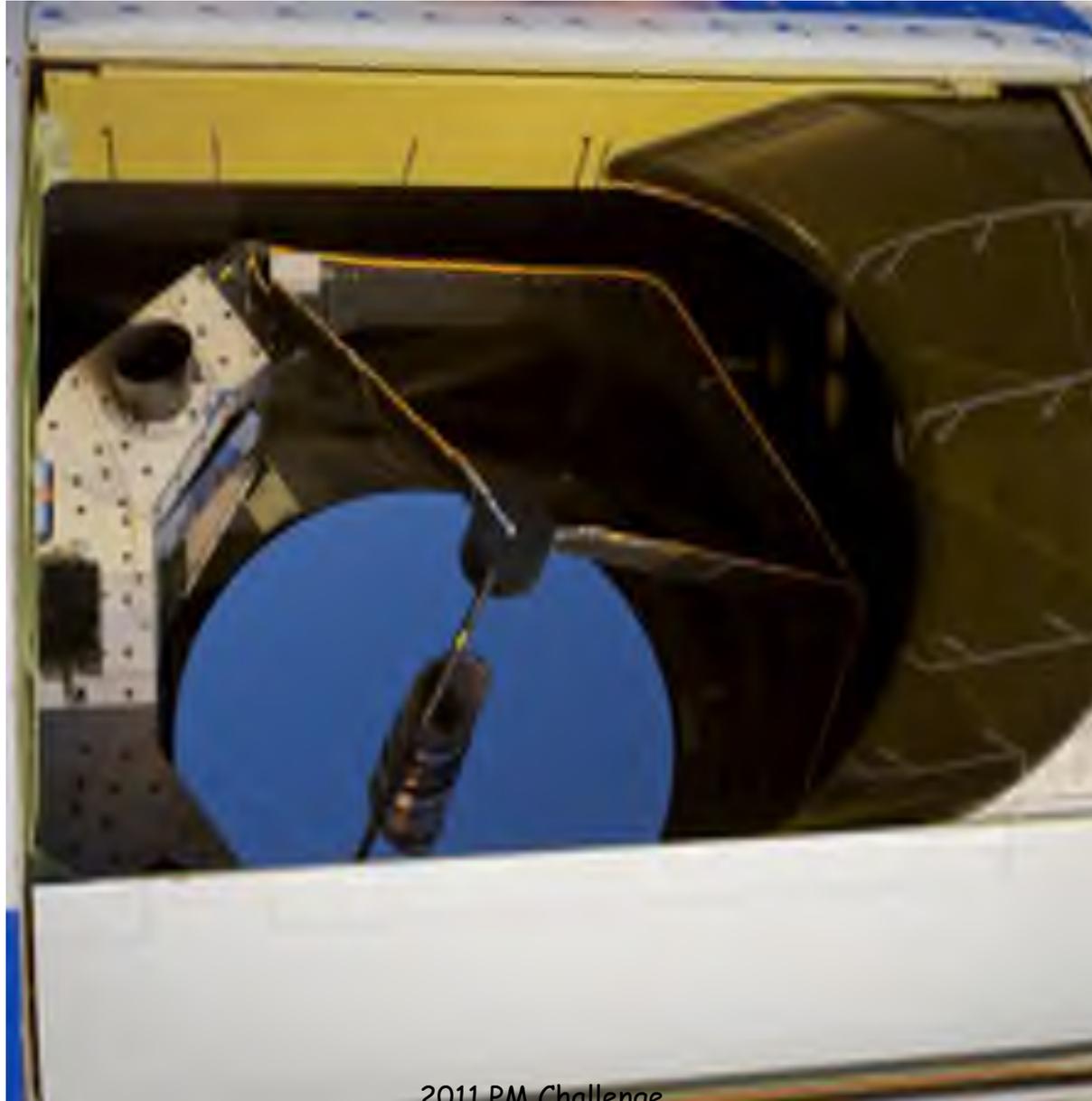


Successful 100% Door Open Landing; April 14, 2010





# Telescope in Aft Cavity

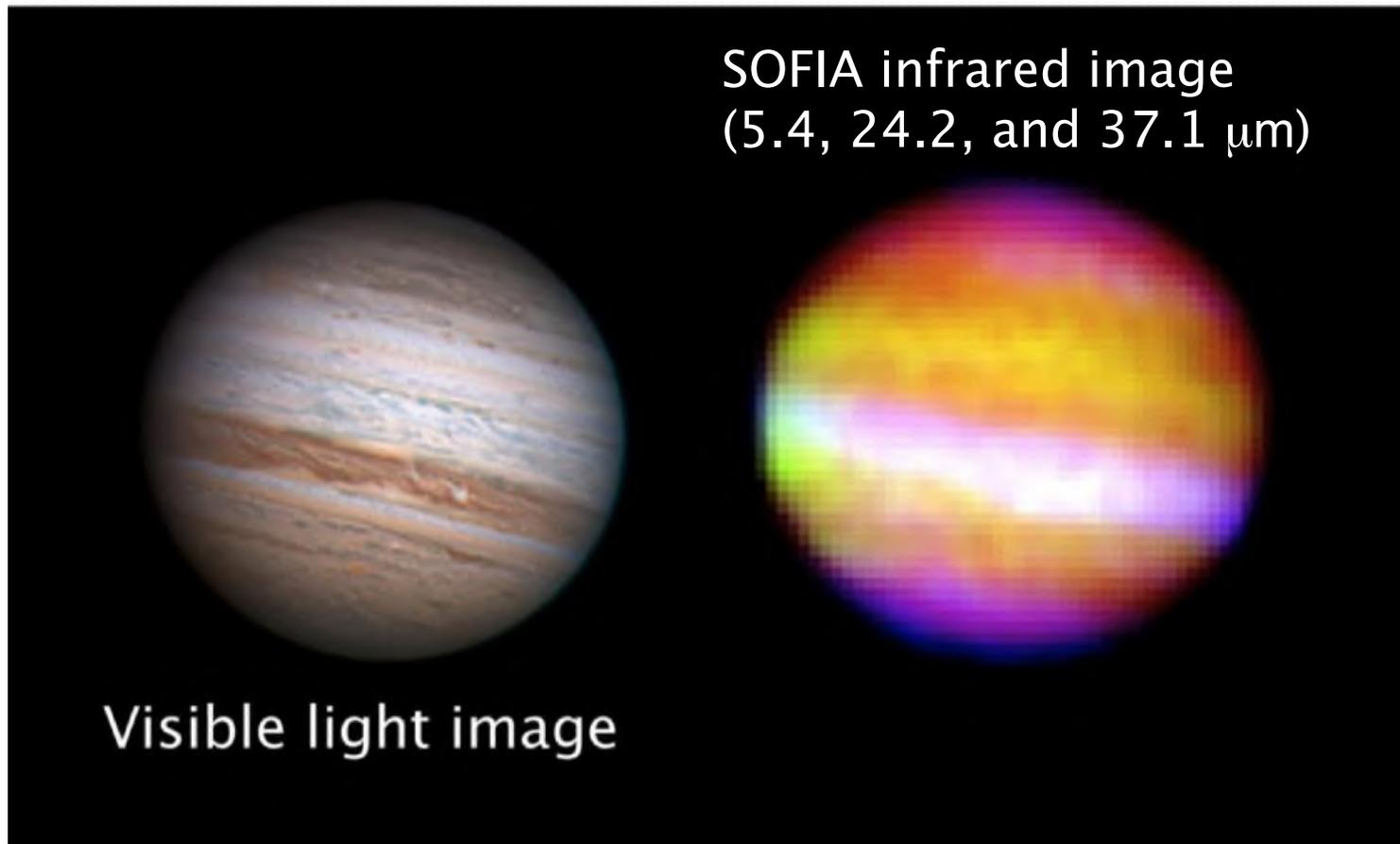




# SOFIA First Light Image - Jupiter

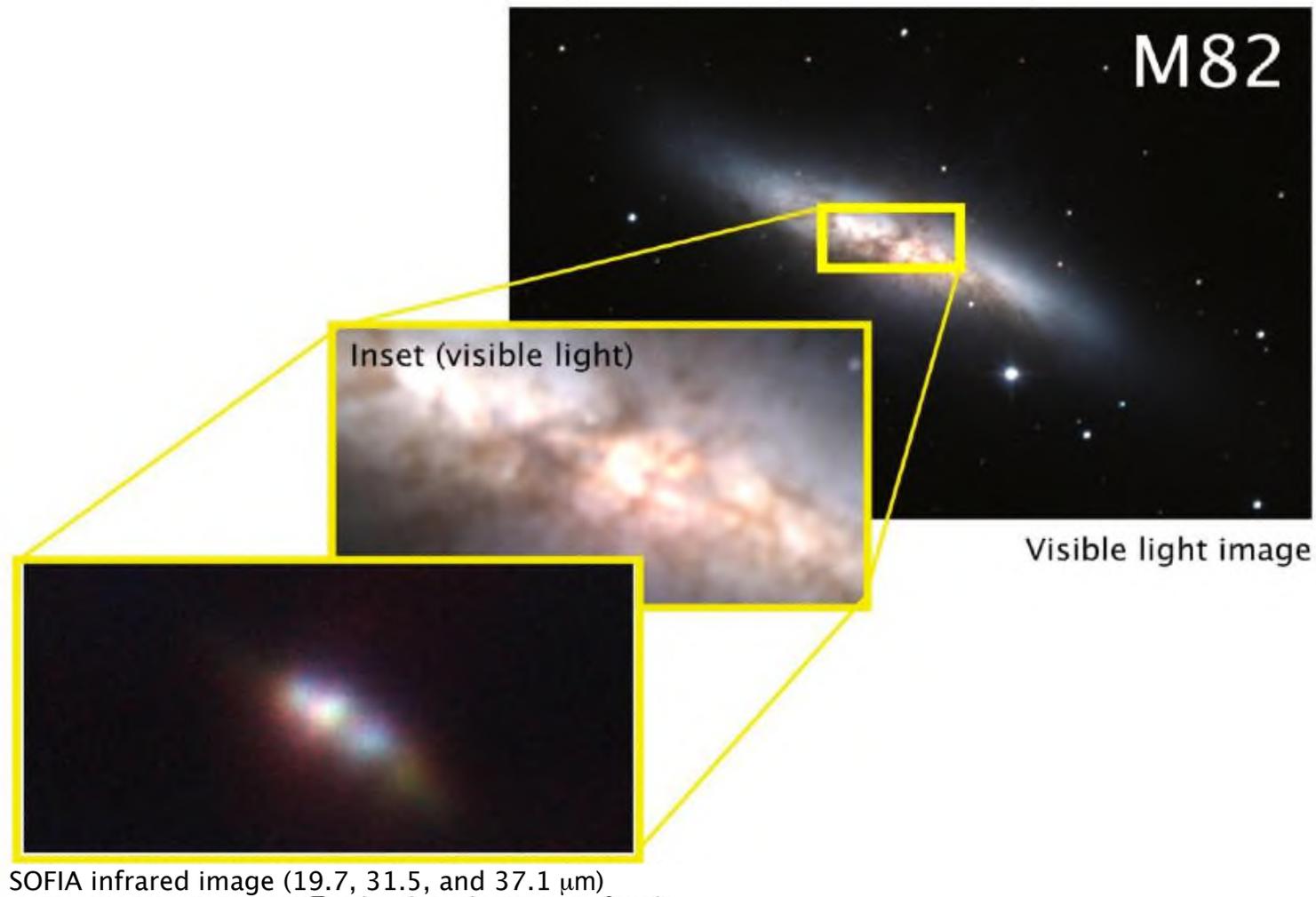


May 26, 2010





# SOFIA First Light Image - M82





# Initiation of Science Flights Nov 1 - Dec 1 2010

