



Columbia Accident Investigation Board

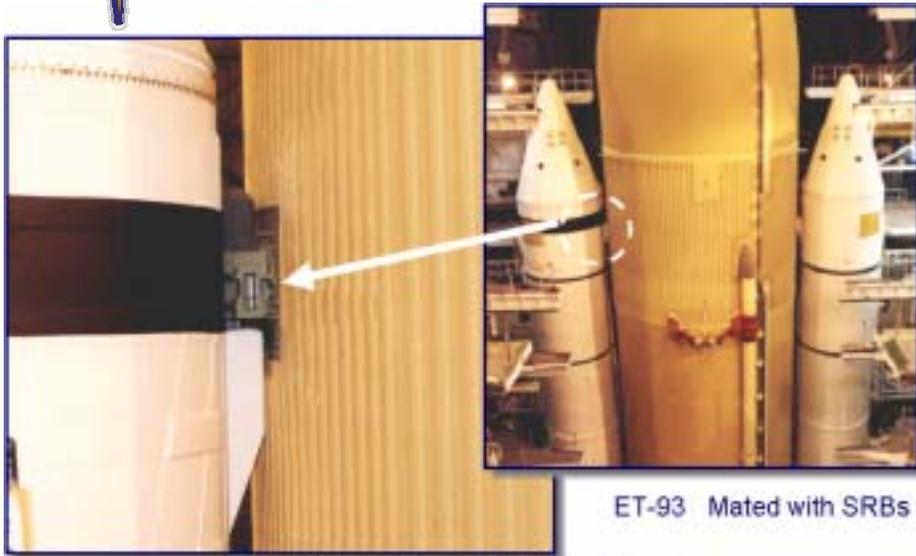
Areas **NOT** a Factor

- Solid Rocket Booster Bolt Catchers
- Kapton wiring
- Crushed foam
- Hypergolic Fuel Spill
- Space weather
- Asymmetric boundary layer transition
- Training and on-orbit performance
- Payloads
- Willful damage and security
- Micrometeoroids and orbital debris risks
- Orbiter Major Modification (OMM)
- Foreign object damage



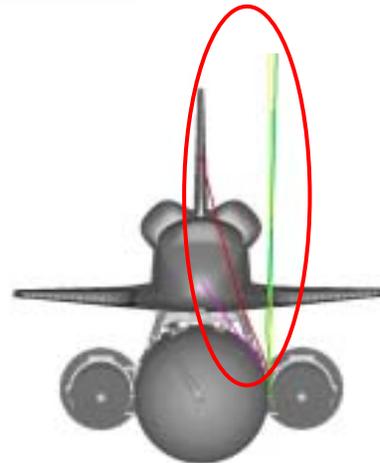
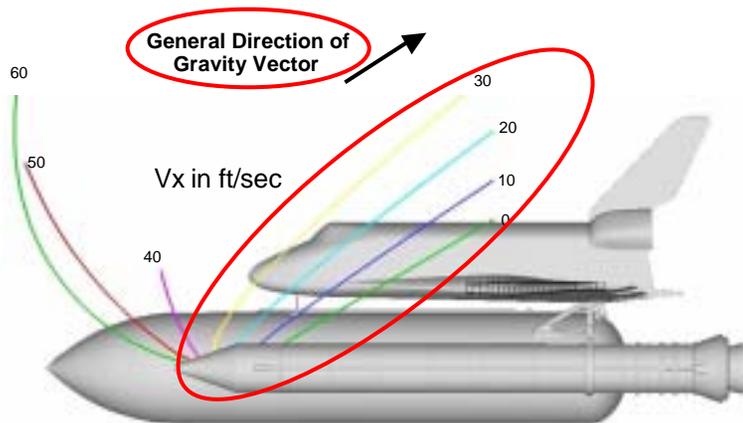
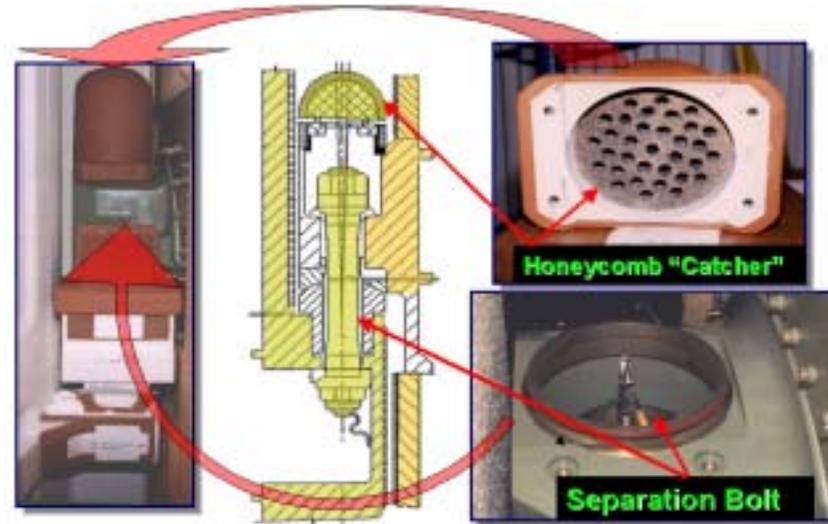
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Solid Rocket Booster Bolt Catchers



ET-93 Mated with SRBs

EB-1 Interface Shown (EB-2 Similar)



Flowfield Conditions at SRB Separation:

Analysis / (STS-107 BET)

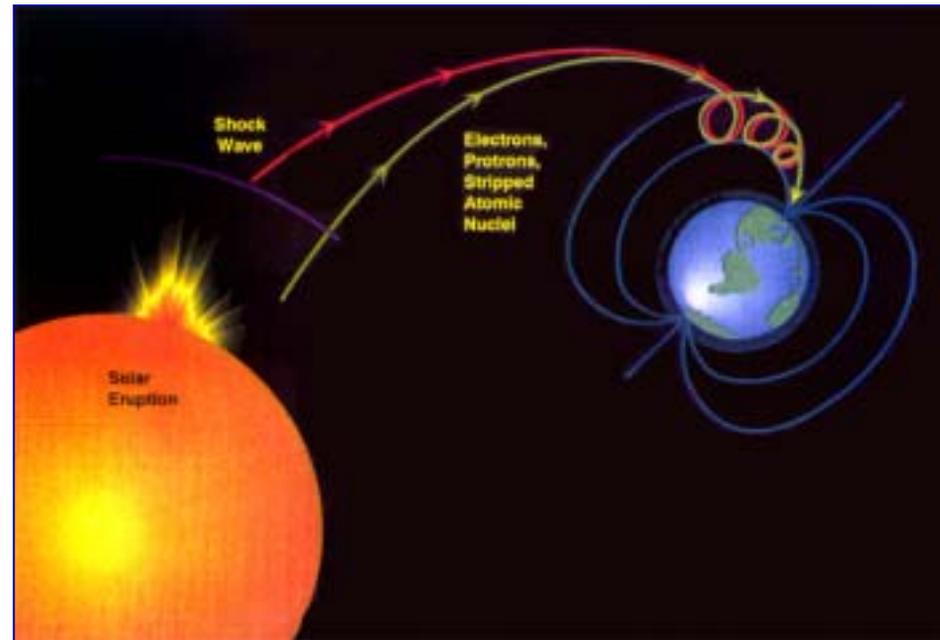
Altitude = 136,400 ft. / (155,000 ft)
 Mach = 3.94 / (4)
 Alpha = 0 degrees / (3.57 degrees)
 Beta = 0 degrees / (-0.02 degrees)
 Qbar = 52 psf / (26 psf)



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Space Weather

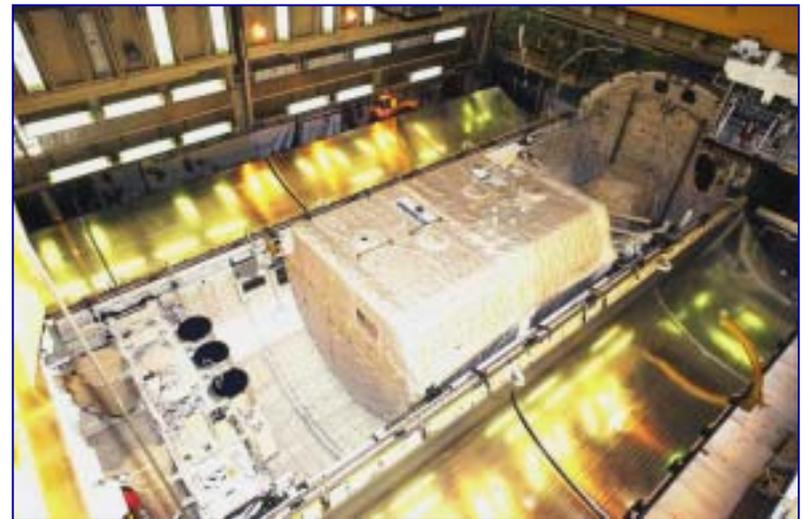
- Coronal mass ejection (a “**solar flare**”) of high-energy particles from the outer layers of the sun’s atmosphere occurred on 31 January 2003
- Shock wave from the solar flare passed Earth at about the same time that the Orbiter began its de-orbit burn
- Most solar flare effects were not observed on Earth until >6 hours after *Columbia* broke up
- Conclusion: Space weather was not a factor in this accident





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Payloads





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Willful Damage and Security



RCC panels



Wheel Well

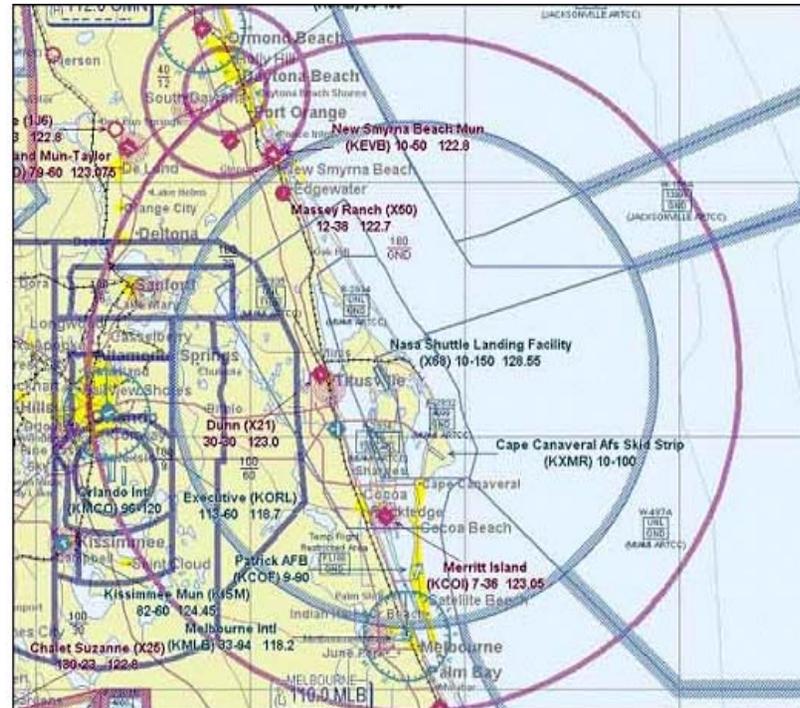


Inside Wing

Launch day assets included:

- Fighters
- Helicopters
- Sea surveillance
- Ground security
- Sensors

*“Tightest security ever
... briefed to NSC”*





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Foreign Object Damage Prevention

- Since 2001, Kennedy Space Center has used a non-standard approach to define foreign object debris. The industry standard term “Foreign Object Damage” has been divided into two categories, one of which is much more permissive

Processing Debris: “Any material, product, substance, tool, or aid generally used during the processing of flight hardware that remains in the work area when not in use, or that is left unattended in the work area for any length of time during the processing process, or that is left remaining or forgotten in the work area after the completion of a task or at the end of a work shift. Also, any item or substance in the work area that should be found and removed as part of a standard housekeeping, Hazard Recognition and Inspection Program walkdown, or as part of ‘Clean As You Go’ practices.”

Foreign Object Debris: “Processing debris becomes FOD when it poses a potential risk to the Shuttle or any of its components, and only occurs when the debris is found during or subsequent to a final/flight Closeout Inspection.”



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Briefing Overview

- Shuttle, Mission, CAIB
- Mishap Causes
 - Technical
 - Launch and Ascent Debris Strike
 - Re-Entry Sequence
 - Debris Reconstruction and Analysis
 - Areas Not a Factor
 - Organizational
 - History
 - Decision Making at NASA
 - Organization Structure and Culture
 - System Effects
- Lessons Affirmed





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Opening caveats reminder:

- **NASA excellence** (*vs. Shuttle Program 1 Feb 03*)
- **IG inspection versus CAIB comparison**