NASA/DoD FLIGHT EXPERIMENTS
TECHNICAL INTERCHANGE MEETING

NASA IN-STEP / MDMSC
JITTER SUPPRESSION EXPERIMENT (JITTER)

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Edward V. White, Experiment Manager (314) 232-1479

McDonnell Douglas Missile Systems Company

BACKGROUND

- Many present and future systems would benefit from vibration suppression
  - Precision pointing
  - Precision dimensional stability
  - Micro-gravity
- Benefits are increased performance and reliability
  - Uncertain dynamics
  - Uncertain or unexpected disturbances
  - Increasingly severe disturbance environments
- Current users consider vibration suppression technology immature
  - Schedule and cost risk unknowns
  - Lack of in-space demonstrations
- Use of this technology on high value/high priority systems is unlikely without in-space testing and demonstrations

EXPERIMENT OBJECTIVES / GOALS

OBJECTIVES: Develop and demonstrate in-space performance of both passive and active damping systems for suppression of micro-amplitude vibration

- on an actual application structure
- operate despite uncertain dynamics and uncertain disturbance characteristics

Correlate ground and in-space performance

- Performance metric is vibration attenuation

GOALS: Achieve vibration suppression equivalent to:

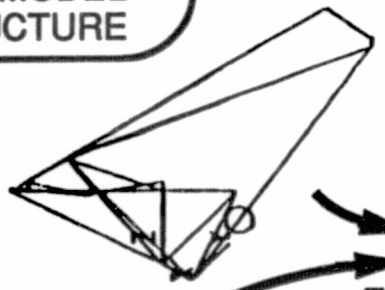
5% passive damping in selected modes

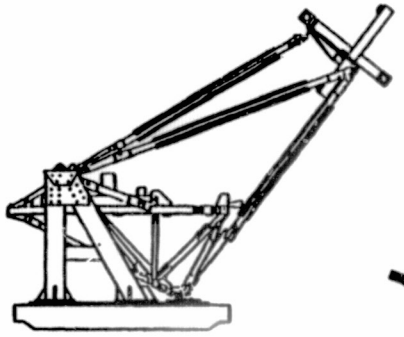
15% active damping in selected modes

(Baseline structure intrinsic damping is approx. 0.5%)

JITTER EXPERIMENT APPROACH

START WITH TEST VERIFIED FINITE ELEMENT MODEL AND STRUCTURE





MODIFY TO DAMPED EXPERIMENT CONFIGURATION

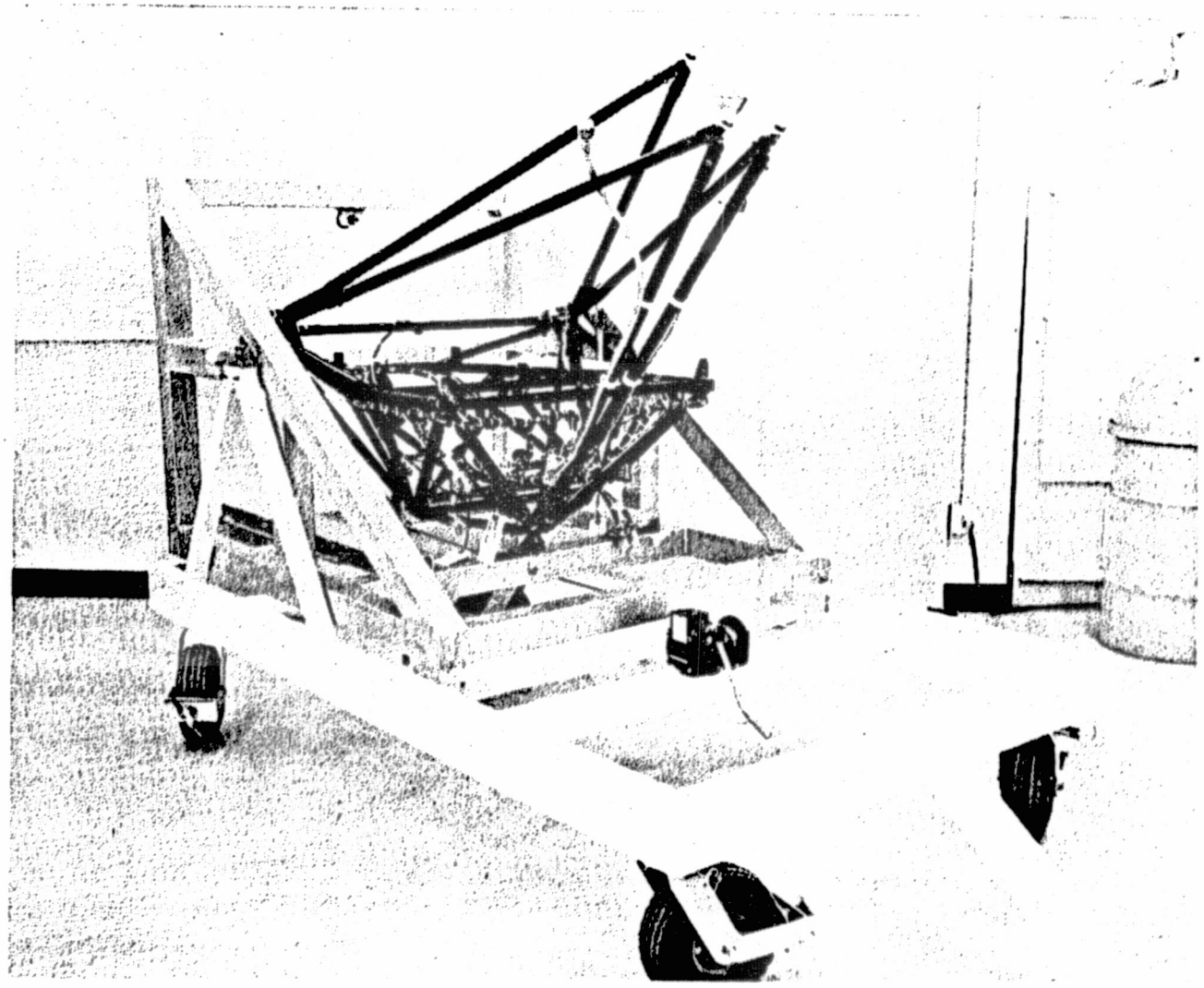
DEVELOP PASSIVE AND ACTIVE DAMPING SYSTEMS

GROUND TESTING: DAMPING SYSTEM PERFORMANCE AND FLIGHT CERTIFICATION

UPDATE GROUND BASED PREDICTIONS OF ON-ORBIT DAMPING PERFORMANCE

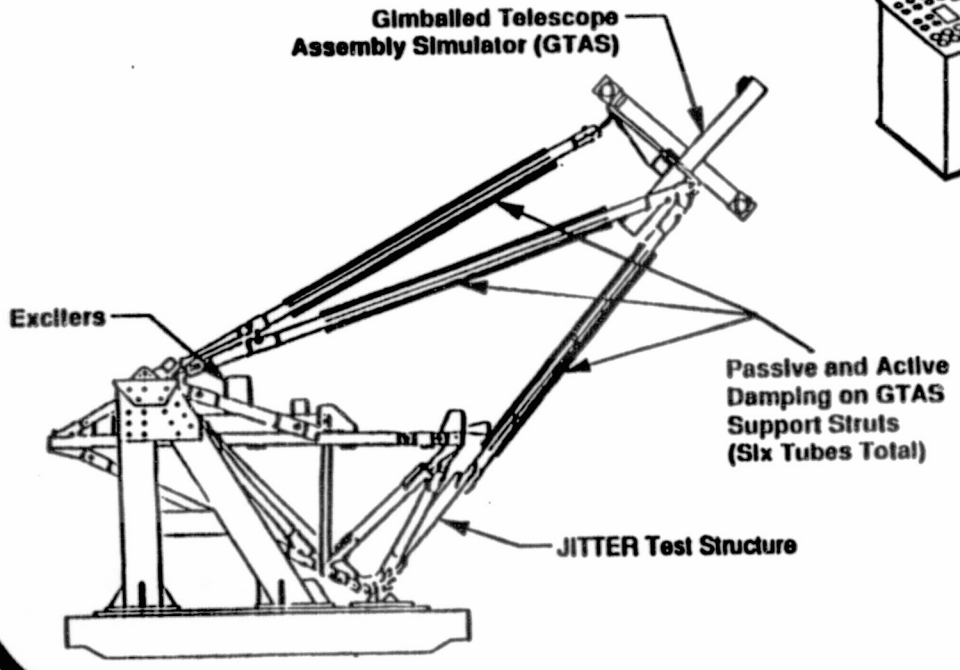
DETERMINE ON-ORBIT DAMPING PERFORMANCE AS MEASURED BY RESPONSE ATTENUATION

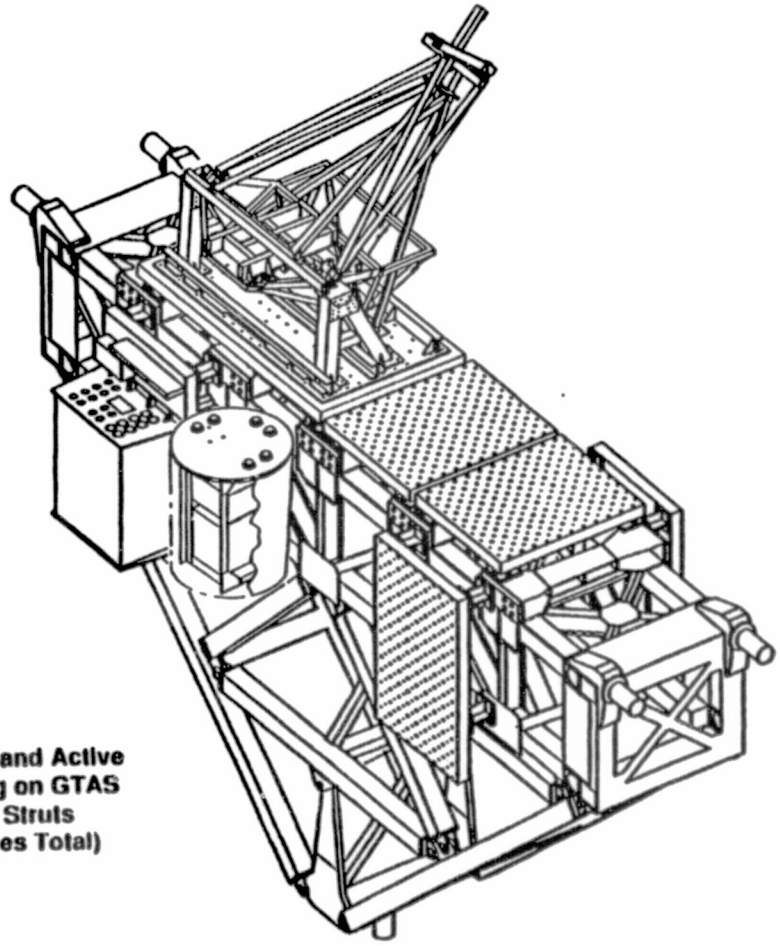
EXPERIMENT TAKES ADVANTAGE OF AN EXISTING PRECISION SPACE STRUCTURE



EXPERIMENT CONFIGURATION

- Uses Hitchhiker-M Carrier
- Accelerometers measure vibration suppression
- Sine, random and Shuttle background excitation





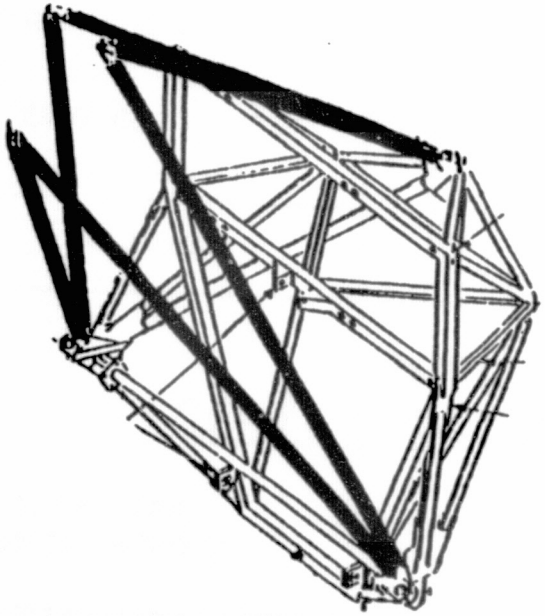
JITTER DAMPING SYSTEMS

Passive: Constrained layer viscoelastic material (stave configuration)

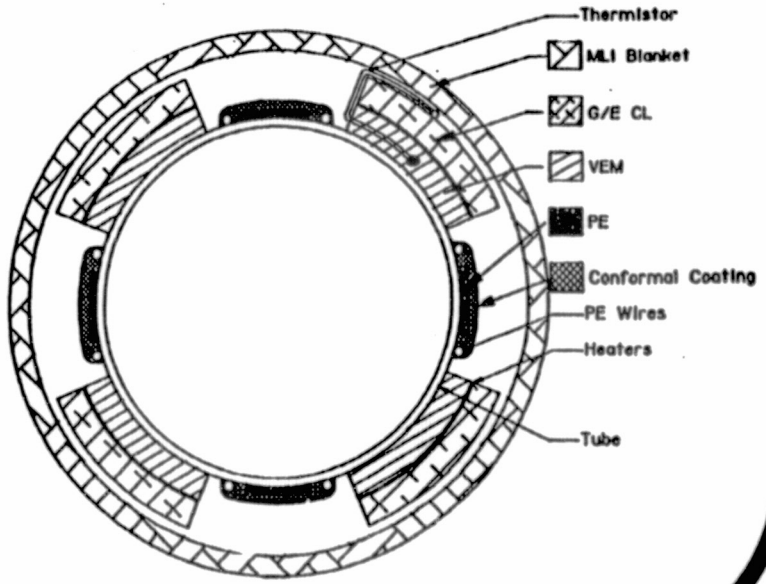
Active: Piezo-ceramic sensors and actuators with digital controller controlling both axial and bending strain

Frequency Range: 20 Hz to 200 Hz (covers 45 experiment modes)

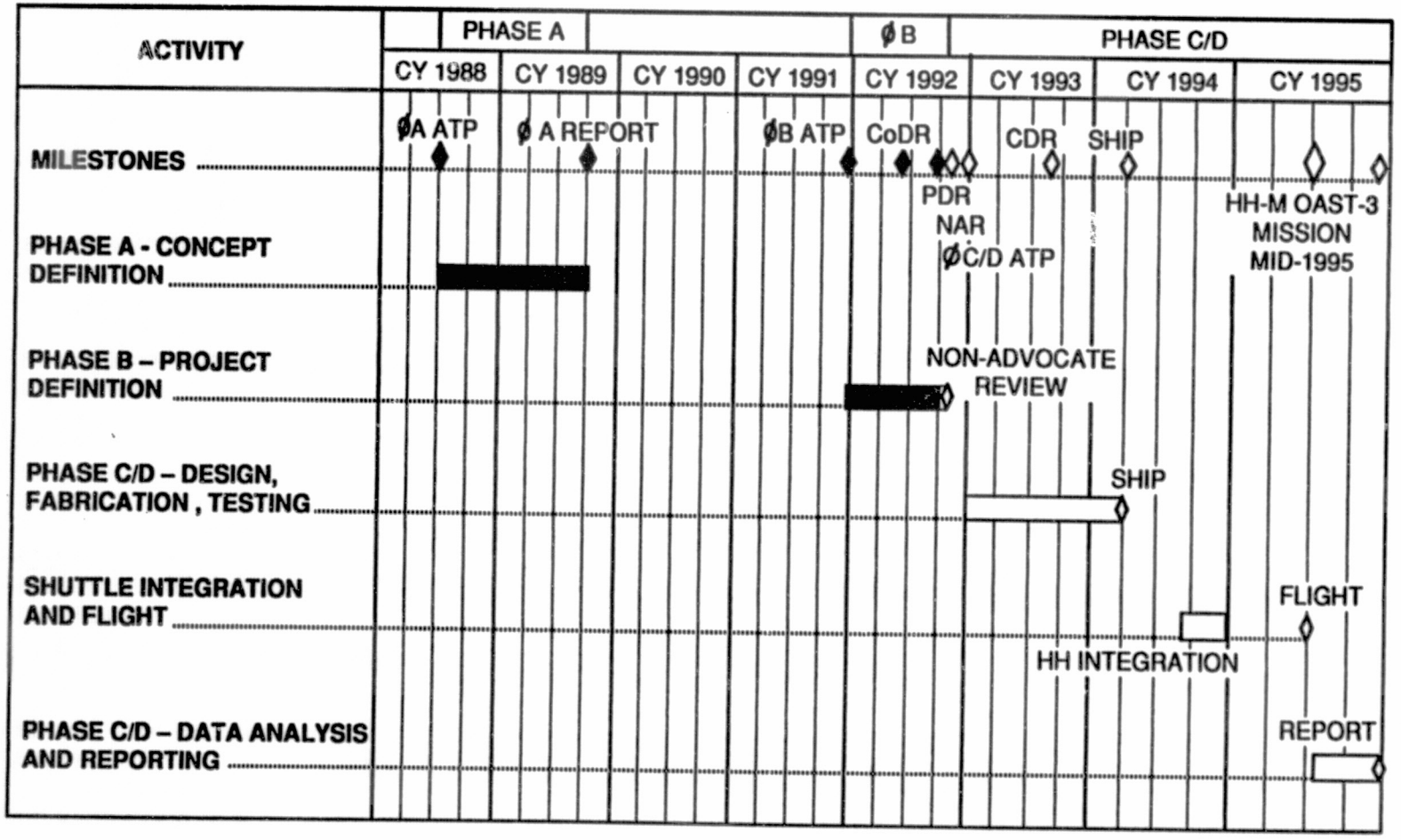
Both damping systems applied to six major struts



Strut Cross-Section



JITTER SUPPRESSION EXPERIMENT PROGRAM SCHEDULE



SPECIFIC TECHNOLOGY BENEFITS

- Uses an actual application structure to include complexities inherent in real systems
  - Representative size and structural complexity
  - Broad frequency range of interest results in uncertain dynamics
    - High modal density
    - Higher order mode shapes
    - Modal coupling with uncertain carrier vehicle modes
    - Effects induced by One-g strain levels
- Demonstrates performance of damping systems tolerant to uncertain and/or unexpected disturbances
- Development of effective passive and active damping designs compatible with Shuttle payload requirements
- Provides data for undamped structure, passive damping alone, active damping alone, and passive and active damping together
- Demonstrates effectiveness of passive and active damping systems against Shuttle environments (typical of manned vehicle platforms)