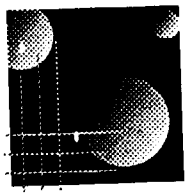


MIT
Space
Engineering
Research
Center

THE MIDDECK 0-GRAVITY DYNAMICS EXPERIMENT (MODE):

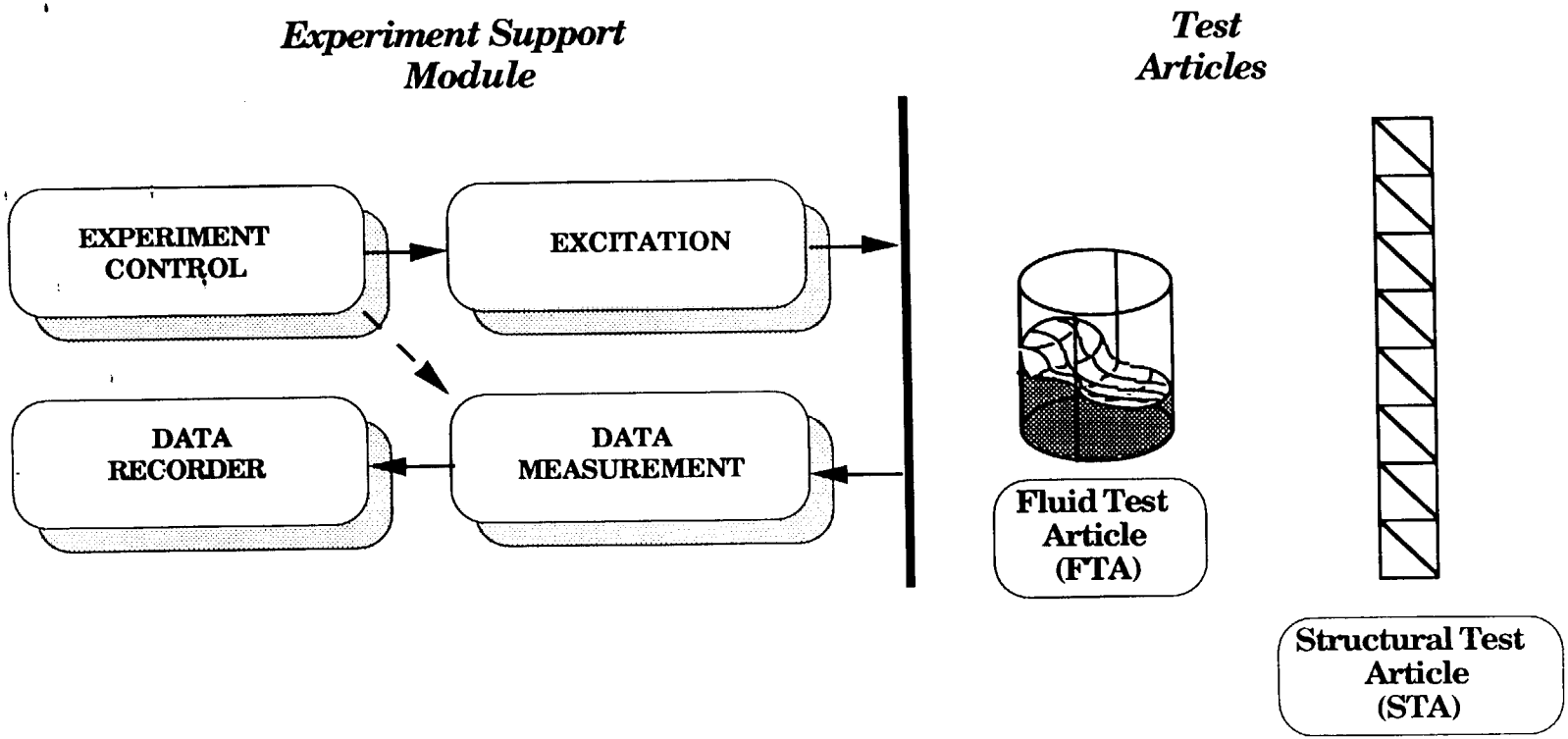
Prof. Edward F. Crawley

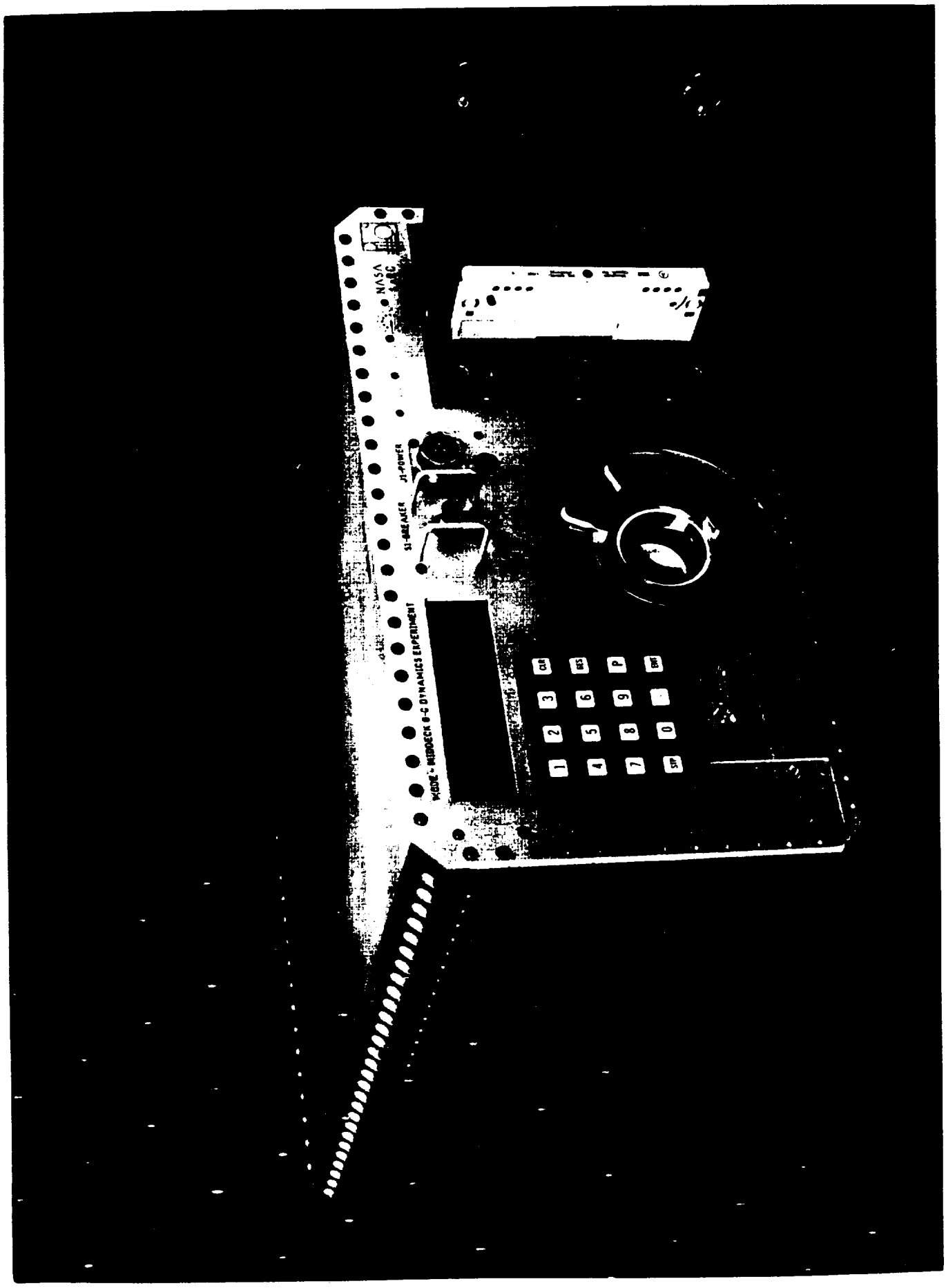
Dr. Javier de Luis

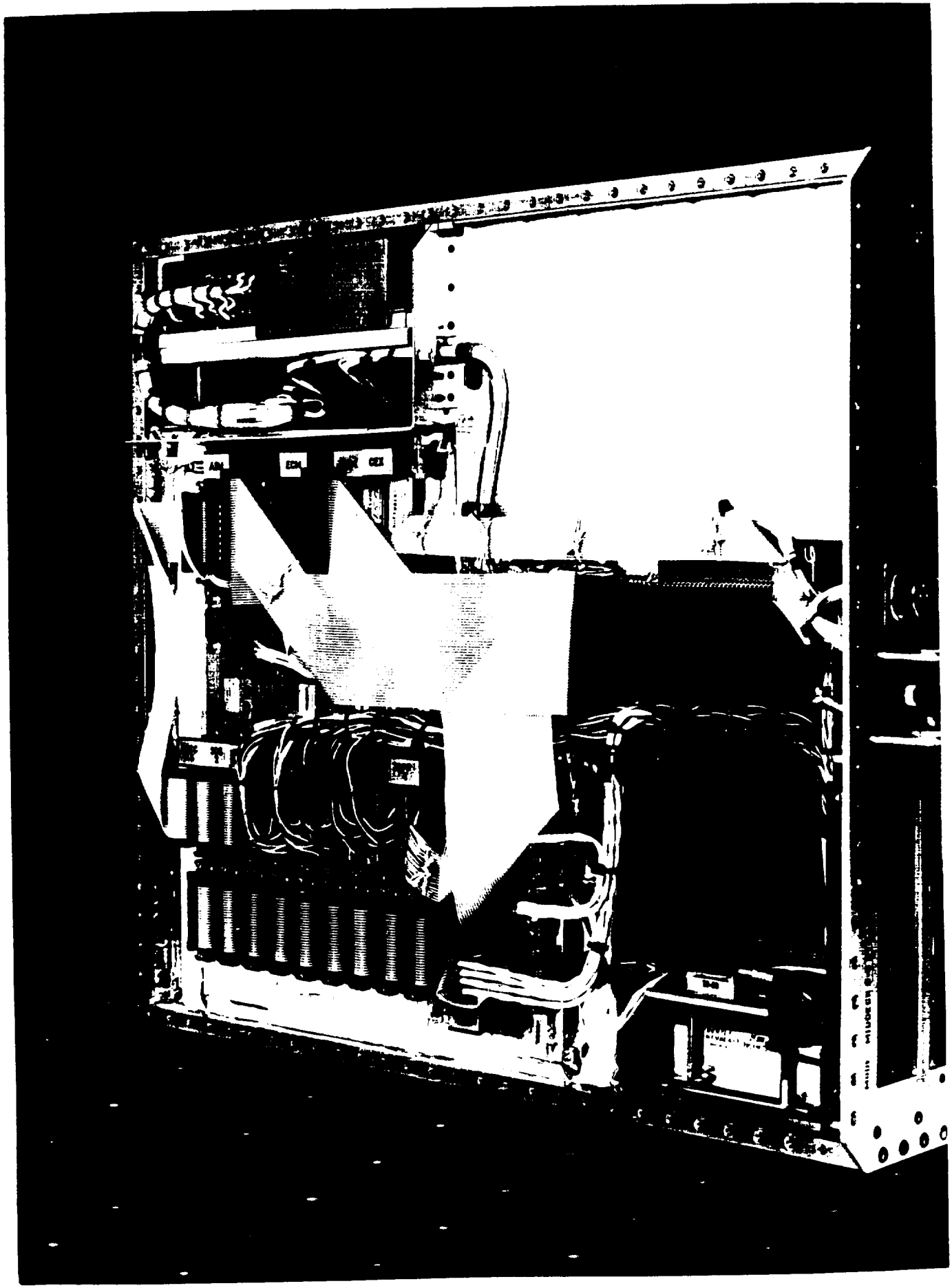
SERC Steering Committee

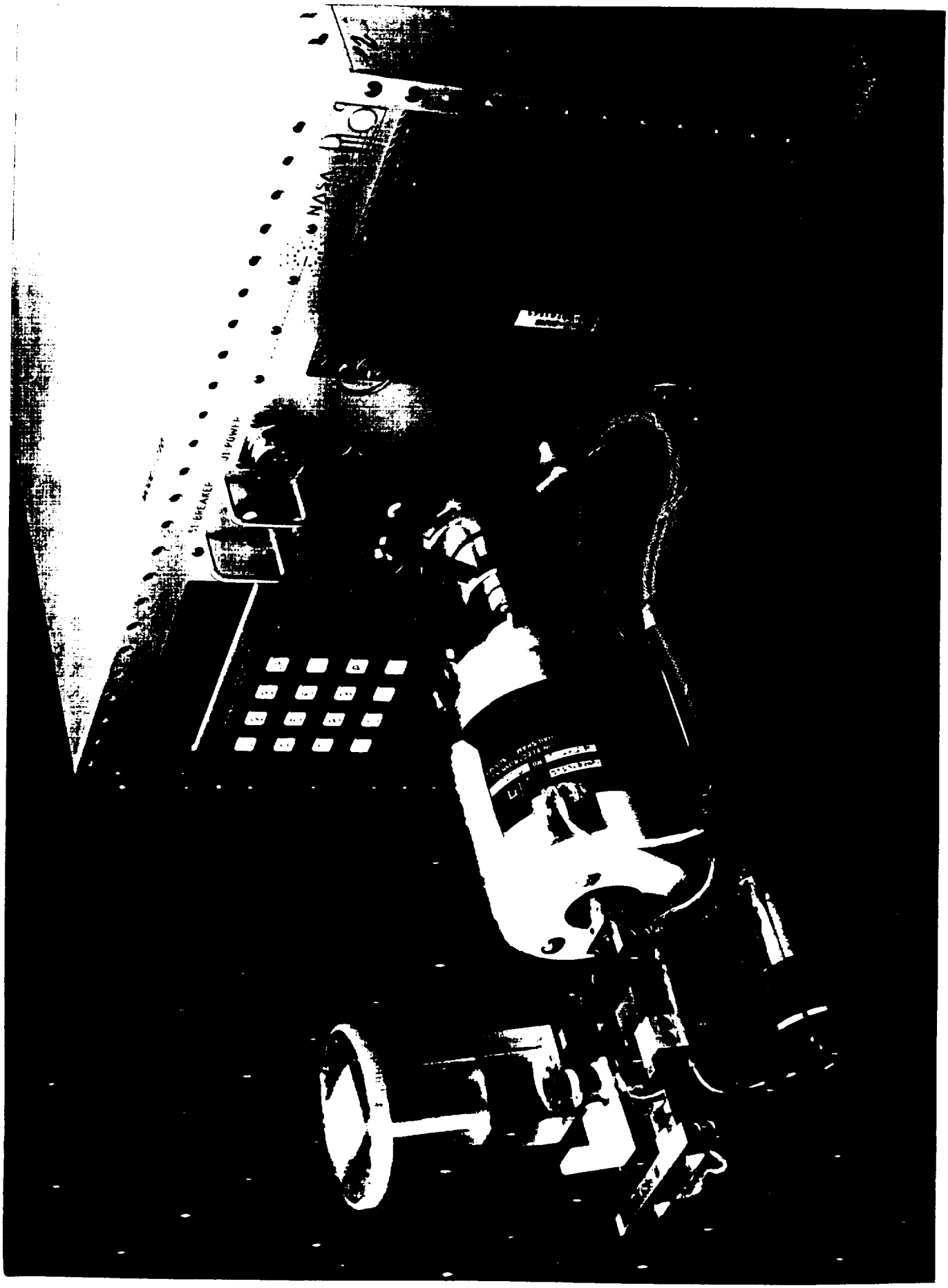
January 22, 1992

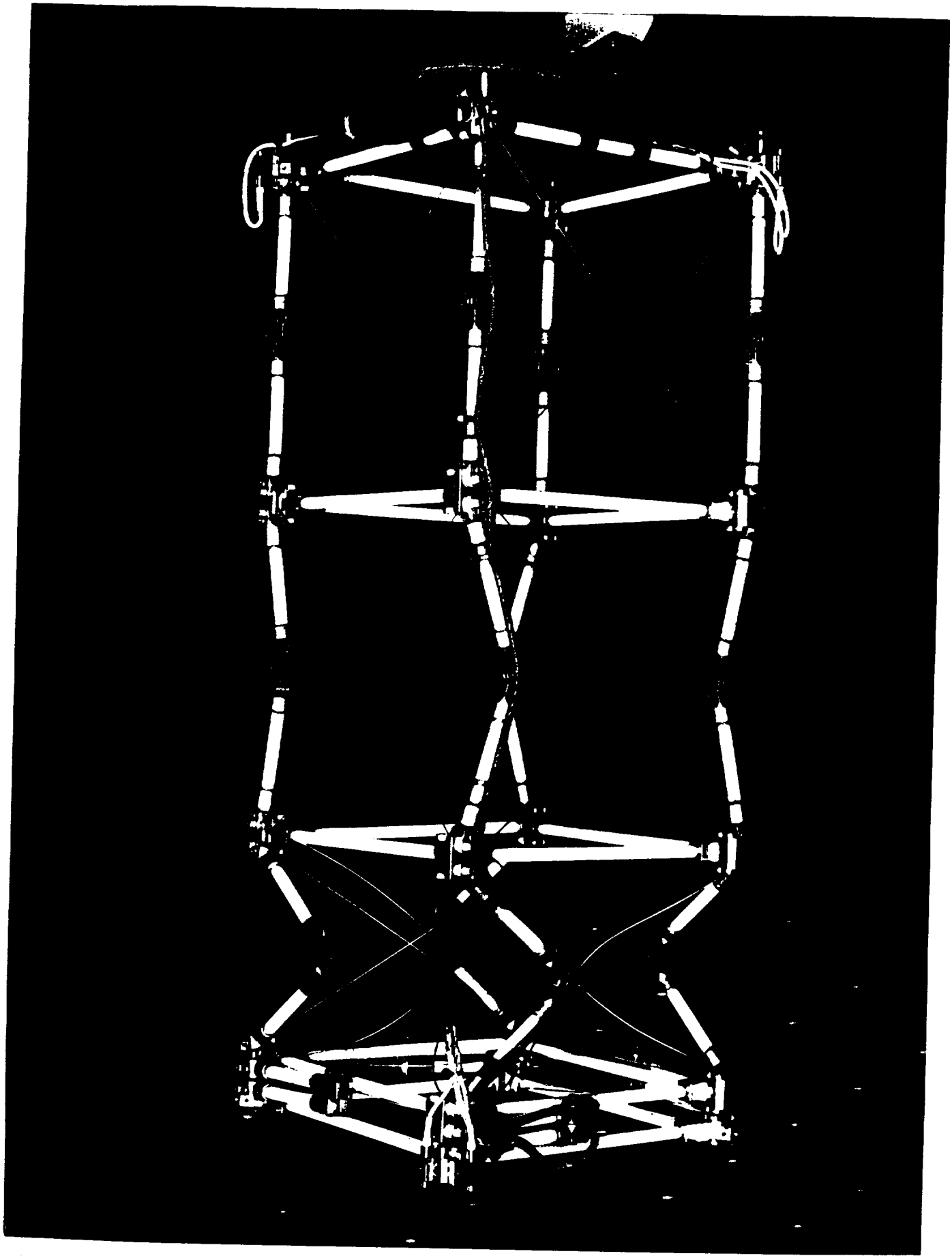
MODE FLIGHT HARDWARE ELEMENTS

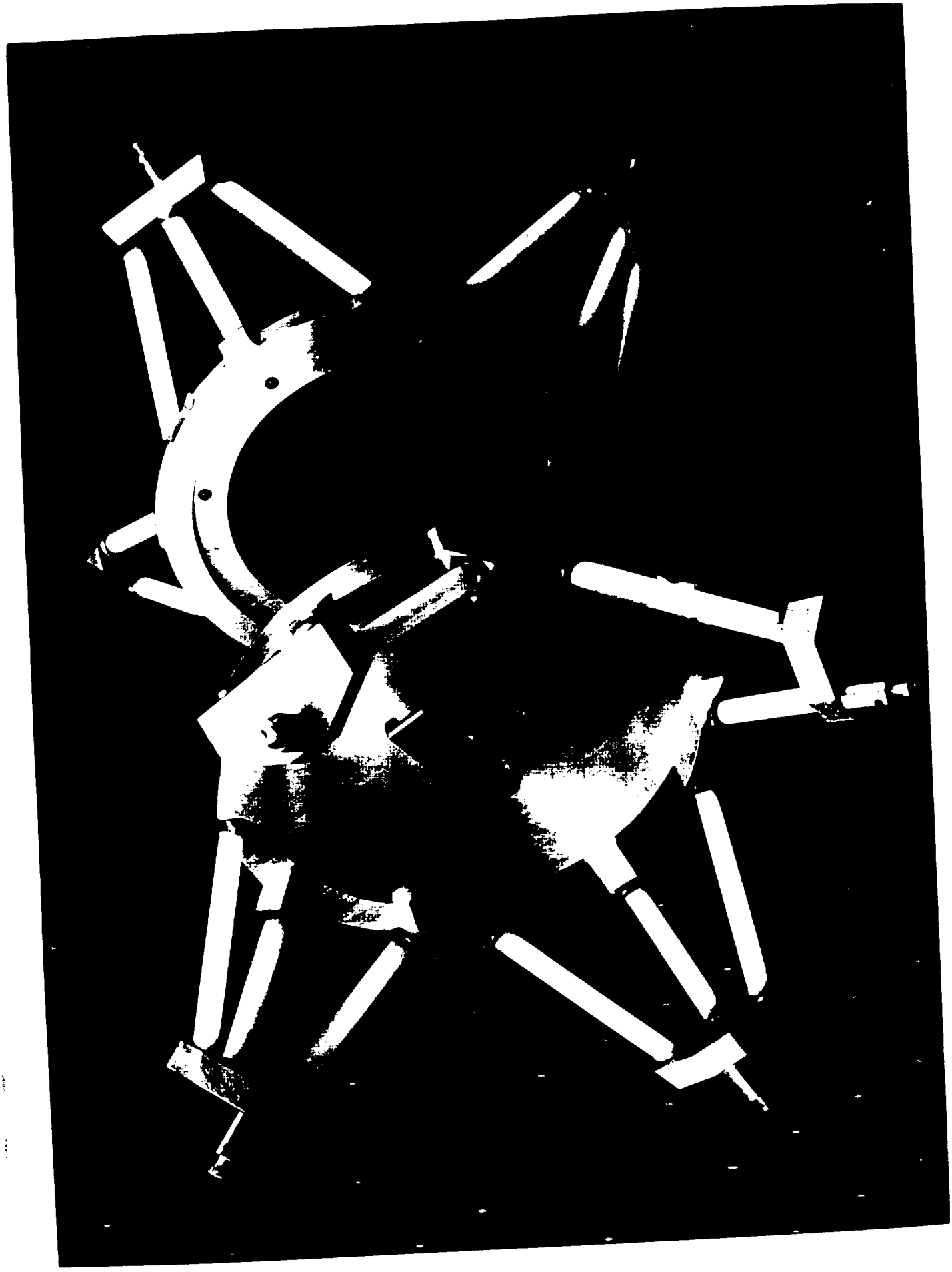












MODE SCIENCE OBJECTIVES

- Investigate two gravity-dependent nonlinear dynamic phenomena affecting future spacecraft:

Fluid Test Article (FTA)	Fluid slosh in a tank, uncoupled and coupled to spacecraft motions.
Structural Test Article (STA)	Nonlinear dynamics of truss structures.

- Both investigations complement OAST R&D base and enhance future space station/exploration missions.

MODE SCIENCE OBJECTIVES (CONT.)

Science objectives for both test articles include:

- Establishing a data base of dynamic response data in the ground and orbital gravity regimes.
- Understanding truss joint and fluid interactions with spacecraft motion.
- Using test results to verify nonlinear computer models developed at MIT.
- Using the knowledge obtained to more efficiently design spacecraft and their control systems.

MODE TEAM

Flight experiment funded by the NASA HQ In-Space Technology Experiments Program (In-Step)

Principal Investigator and science development team	M.I.T. Space Engineering Research Center
Sponsor	NASA Office of Aeronautics, Science, and Technology
Program monitor	NASA Langley Research Center
Hardware fabrication and integration team	Payload Systems Inc.
Co-Investigator	McDonnell Douglas Space Systems Co.

MODE IN THE UNIVERSITY ENVIRONMENT

- MODE provided focus and motivation for engineering education:

  20 undergraduate students

  7 graduate students

  2 postdoctoral students

- Student participation involved basic research and actual flight hardware fabrication and testing

FLIGHT OPERATIONS

- MODE was launched on-board Discovery, STS-48, on Sept. 12, 1991. Hardware was deployed in the Middeck by the crew during operations.
- Flight operations began on Friday, September 13.
- MODE operations occurred on Flight Days 2, 4 and 5.
- Operations were supported at JSC by a 10 person MIT/PSI/MDSSC/LaRC team.
- All planned test operations plus an additional 3 hours of testing were successfully completed yielding over 600 Mbytes of on-orbit data.
- Hardware was recovered within 24 hours after landing.
- Hardware is currently being used at MIT for ground science tests.

C-8

FLIGHT OPERATIONS (CONT.)

- Fluid data was obtained on :

  silicone oil, uncoupled, flat bottom tank
  silicone oil, uncoupled, spherical bottom tank
  water, uncoupled, flat bottom tank
  water, coupled, flat bottom tank
  water, uncoupled, spherical bottom tank
  water, coupled, spherical bottom tank.

- Structural data was obtained on:

  straight, 3 amplitudes, 3 pretension settings
  straight with α-joint, 3 amplitudes, 2 friction settings
  L-shape, 2 amplitudes, 2 friction settings
  L-shape with flex. appendage

SUMMARY

- MODE exploits the unique 0-g laboratory environment provided by the Space Shuttle.
- Provides NASA with a reusable dynamic test facility for testing dynamic systems in space.
- Complements OAST R&D base and enhances future Space Station/exploration missions.
- Team represents a unique consortium of university, industry, and government.
- Cost-effective flight experiment developed on schedule by a small core group of scientists, engineers, and students
- Provides mission relevant focus for engineering education.