1995

NASA/ASEE SUMMER FACULTY FELLOWSHIP PROGRAM

MARSHALL SPACE FLIGHT CENTER
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

SXI MIRROR CHARACTERIZATION

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Introduction

The purpose of this test is to determine how well the SXI mirror will focus x-ray energy from the Sun as that will be its main function. The types of sources chosen for the test produce soft x-rays and are listed in Table 1.

Wavelength	Energy	Material
8.83 Å	1.41 keV	aluminum
10.0 Å	1.24 keV	magnesium
13.3 Å	0.935 keV	copper
44 Å	0.277 keV	carbon

Where: $Å \equiv 10^{-10}$ meter
$1 \text{ eV} = 1.60 (10)^{-19}$ Joule

Table 1

Optic

The SXI project utilizes grazing incidence optics which is a very mature technology. The optic is a cylindrical glass structure with one end formed into a parabolic shape and the opposite end formed into a hyperbolic shape. The inside of the optic has a high-quality surface finish. X-ray photons are reflected first by the parabolic surface then by the hyperbolic surface to bring the energy into sharp focus in the focal plane. To increase the effective collection area, several mirrors may be nested one inside the other. However, because the SXI telescope will be directed toward a brilliant source (the Sun), only one mirror will be needed (Ramsey et al., 1994).

Detector

The Proportional Counter chosen for this test is a type of detector which came of age in the early 1950s. Basically, it consists of a fine wire (anode) in the center of a methane-filled cylinder (cathode). The anode (wire) is held at a high positive potential relative to the cathode (cylinder). This anode wire is capacitively coupled to a pre-amplifier. The cylinder has a window which is transparent to x-ray energy. When x-ray photons enter the window and are absorbed, primary electrons are emitted and drift toward the anode (wire). As these electrons approach the high potential applied to the anode, they gain additional kinetic energy from the increasing electric field sufficient to ionize the methane gas producing secondary electrons. This causes an avalanche and, in effect, momentarily "shorts out" the high voltage causing a negative-going signal to be applied to the pre-amplifier. The amplitude of this signal is proportional to the energy of the absorbed photon. This signal is amplified and applied to a single-channel analyzer (SCA) (Decher et al., 1994).

Positioning System

[redacted]

The detector will be positioned with a three-axis linear stage. These stages are capable of moving in steps of 1 micron (10^{-6} meter). The test will take place in a vacuum ($\sim 10^{-6}$ Torr) to simulate the telescope's operation in space. Hence the need for remote positioning.

Test Setup

Refer to Figure One. The Reference Detector and Test Detector are as described above. The Reference is physically located in the center of the mirror and provides an indication of the flux (total number of photons) arriving at the mirror. The active area of the Test Detector is partially blocked by a vertical slit and only sees the photons focused by the mirror. Comparing the number of photons per time seen by both detectors yields an appraisal of the mirror's ability to focus. Basically, one x-ray photon being detected results in one pulse out of the SCA. The computerized data acquisition system will count the pulses from both detectors and store the data for later analysis.

Test Procedures

After much painstaking alignment of the system, the Test Detector will be moved to locate the focal plan of the mirror. Then, the Test Detector will be moved perpendicular to the beam in 12 micron increments. At each increment, an observation will occur consisting of allowing the two counters to increment (counting photons) until the Reference Counter reaches a preset number. The two counter values will be saved and the Test Detector will be stepped to the next position. During this step and count process, the data acquisition system will monitor temperature, gas pressure, and physical vibration.

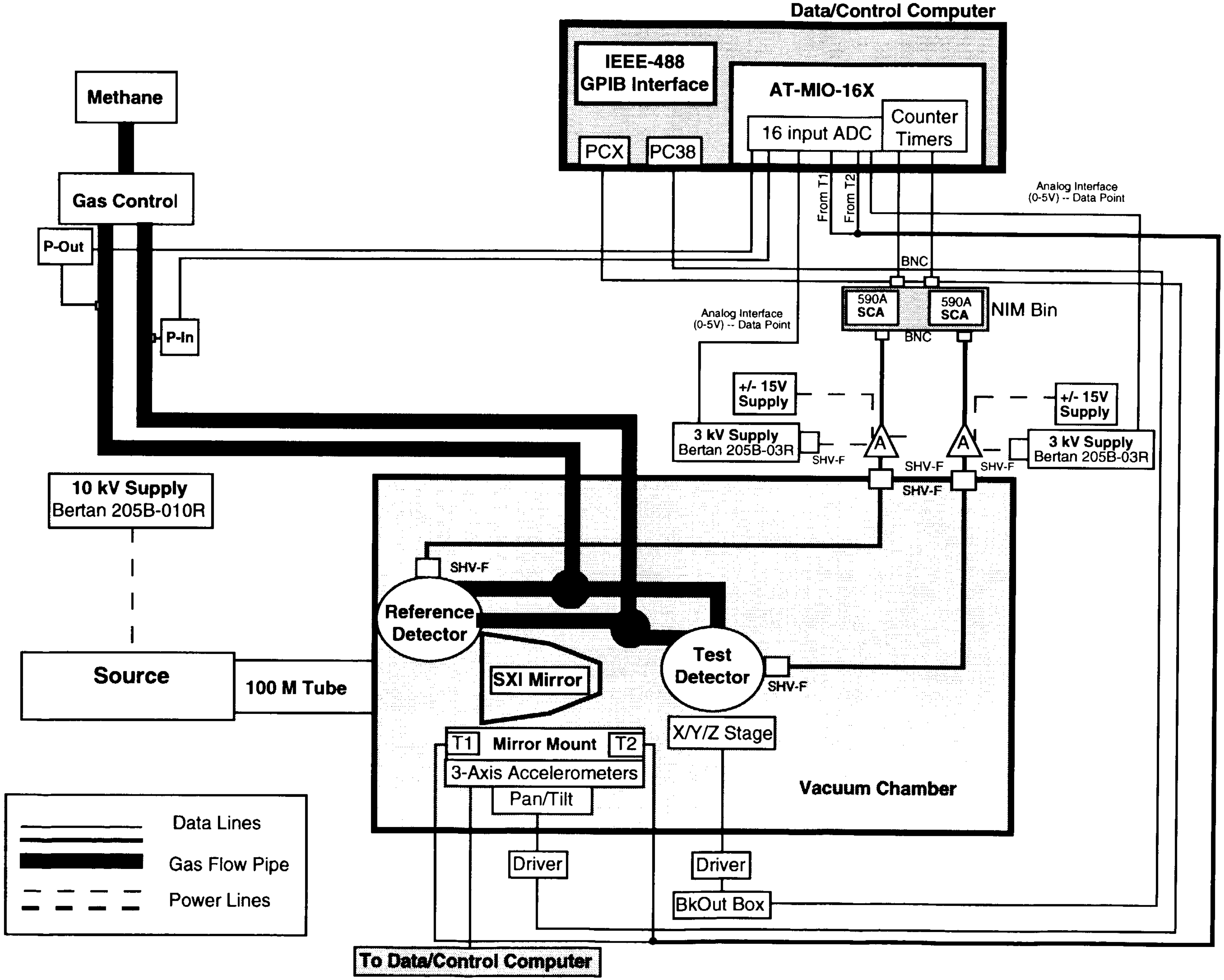

Figure One - SXI Mirror Characterization -- Data Acquisition and Control Block Diagram

References

Decher, R., Ramsey, B. D., Austin, R.: 1994, NASA Scientific and Technical Information Program. NASA SP-517.

Ramsey, B. D., Austin, R. A., Decher, R.: 1994, *Space Science Reviews.* 69, 139-204.