cessfully. The first mission demonstrated the usefulness of inflight calibration lamps in understanding the behavior of the instrument in space. It also showed the flexibility possible in commanding an instrument on Spacelab from the ground. Solar spectral irradiance values will be published when the missing data are available and the calibration reduction has been completed.

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Astronomical Observations with the FAUST Telescope

Abstract. *The far-ultraviolet space telescope (FAUST) was flown on Spacelab 1 to provide wide-field imaging in the wavelength range 1300 to 1800 angstroms. Most of the developed film showed high levels of background exposure. Frames with a lower background included exposures of the Cygnus Loop supernova remnant and an exposure in the direction of the galaxy cluster Abell 2634. Several exposures will be used in a search for hot white dwarf stars.*

Space ultraviolet astronomy has entered the observatory-class era with powerful high-resolution instruments such as the International Ultraviolet Explorer. Next generation high-resolution instruments such as the space telescope are under development. However, there is a large class of scientific problems, as in all branches of observational astronomy, which require instruments with a deep-sky imaging and wide field-of-view capability. These include:

1) Cataloging of the ultraviolet brightness of members of a class of objects in order to provide a basis for understanding these objects and to identify anomalous members that require more detailed study. Such classes include extragalactic objects [quasi-stellar objects (QSO's), BL Lac objects, galactic nuclei] and galactic objects (ultraviolet stars, interacting binaries).

2) Imaging of extended objects to study the spatial distribution of emitting sources. Such sources include supernova remnants, galaxies, and galactic nebulae.

3) Study of the intensity and structure of the diffuse far-ultraviolet background, which may include both an extragalactic cosmological background and more local components that contribute a small-scale structure of great interest. Examples are zodiacal light, reflection nebulae, and high-latitude dust filaments.

4) Support of observational programs of high-resolution instruments, including the study of transient events (supernovae, novae, dwarf novae) and the location of QSO's and galactic objects for ultraviolet absorption studies of intervening matter. In general, deep, wide-field plates will provide valuable primary data on far-ultraviolet intensities of objects to be studied in greater detail.

The far-ultraviolet space telescope (FAUST) was included in the Spacelab 1 instrument complement to provide wide-field (8° diameter) imaging in the far ultraviolet (1300 to 1800 Å). During the Spacelab 1 mission, the instrument was located on a pallet in the cargo bay.

The instrument was operated from mission day 2 to day 6. A total of 47 exposures was taken. Instrument electrical, mechanical, and thermal performance were nominal throughout the mission.

The developed film showed high levels of background exposure on all frames except for a closed-door exposure, which showed the normal unexposed background level. Of the 45 exposures of astronomical objects, all but a few frames are at a density level that prohibits further analysis. An analysis of the source of the background experienced during Spacelab 1 will be published elsewhere (*1*). We present here preliminary astronomical results from some of the frames with lower background.

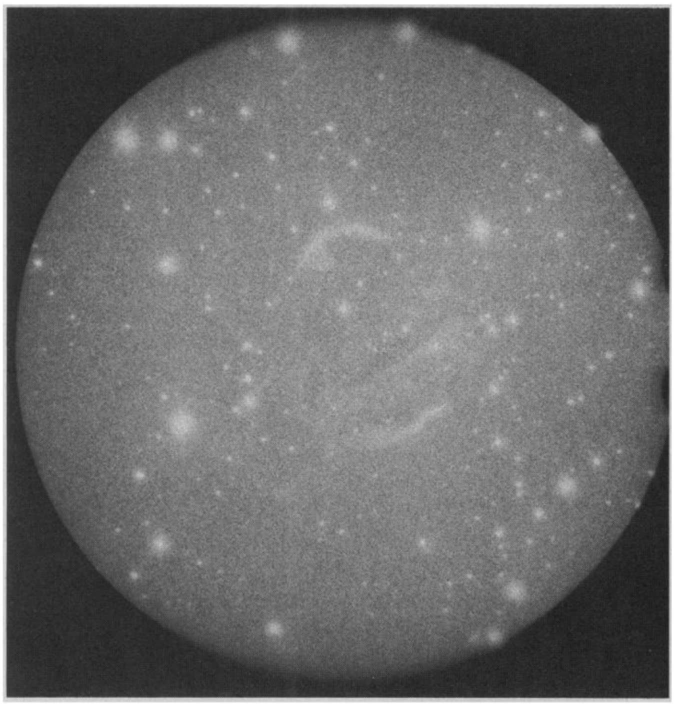
Experiment description. The FAUST telescope employs a Wynne optical configuration to image the field of view onto a flat focal plane (*2*). The image falls on a frequency-converting image intensifier tube, which transforms the ultraviolet image into an intensified optical image. This optical image is then recorded on 103a-O spectroscopic film.

The telescope has a CaF_2 window for a short-wavelength cutoff and the falling CsI sensitivity on the frequency converter tube as a long-wavelength cutoff. These two factors combine to give a 500-Å bandpass with maximum sensitivity at 1450 Å. The instrument has a measured angular resolution of 2 arc minutes. Preflight calibration showed that the instrument could detect a magnitude 17.5 source against a dark background in 10 minutes, assuming an A0 stellar spectrum.

FAUST observed a total of 22 separate targets on 21 nighttime passes. One dark exposure with the instrument door closed was also taken. An observation consisted of one, two, or three separate exposures from 1 to 15 minutes in duration.

Preliminary results. In Fig. 1 we show a 2-minute exposure of the Cygnus Loop, a supernova remnant (SNR) located about 1500 light-years distant. The age of the Cygnus Loop is estimated to be about 15,000 years, making it a relatively old SNR.

Middle-aged to old SNR's are in the radiative part of their lifetime and emit copious far-ultraviolet line emission. The far-ultraviolet emission spectra are dominated by the C IV 1549-Å and O III 1663-Å lines for shock velocities near 100 km/sec. Collisionally excited, permitted line radiation from these species dominates the cooling in the post-ionization layer of the shock, where gas temperatures are $\sim 10^5$ K. In models of homogeneous, stable shocks in a uniform medium (*3*) the ratio of total emission in the FAUST bandpass to the hydrogen $H\beta$ line intensity is a single-parameter



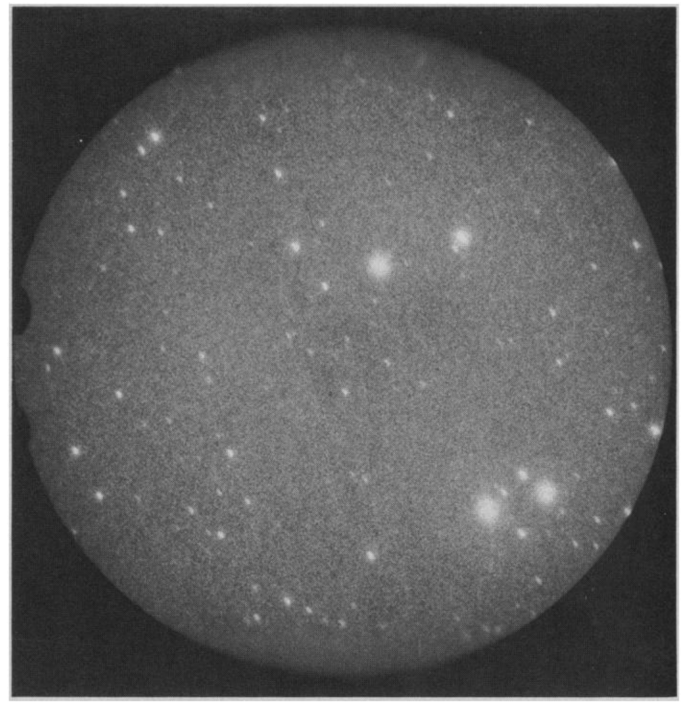


Fig. 1 (left). Cygnus Loop supernova remnant. North is to the top right of the frame. The high density of objects in the field is due to the low (10°) galactic latitude, which puts the view direction through the galactic plane. Fig. 2 (right). Exposure taken in the direction of the galaxy cluster Abell 2634. North is to the top of the frame. The four bright stars forming the trapezoid on the right consist of a magnitude 6 A0V star, a magnitude 6.5 A0 peculiar star, and two magnitude 7 B9.5 stars.

function of shock velocity. The FAUST image of the Cygnus Loop provides a complete map of the shock velocity field in the radiative portion of the nebula. This image yields information on the influence of inhomogeneities in the interstellar medium on shock structure and cooling, as well as acting as a probe of the small-scale structure of the interstellar medium around the SNR down to a scale of 0.5 parsec. Coupled with other optical line maps (*4*), evidence may be found of metal enrichment due to gain disruption, as well as nonsteady flow and other complicating processes. Thus our FAUST image provides a diagnostic of the interaction of the expanding Cygnus SNR shock and the ambient interstellar medium, which will illuminate the processes governing the evolution of all SNR's in an inhomogeneous interstellar medium.

In Fig. 2 we show a 2-minute exposure centered at a right ascension of 23 hours, 34 minutes and declination of +26.5° in the direction of the galaxy cluster Abell 2634. The galactic latitude of this field is −35°; thus the view is out of the galactic plane and the obscuring dust in the plane does not dim the view of more distant objects. This image is typical of several such exposures which will be used in a search for hot degenerate white dwarfs. Studies of the space density of these objects will provide a more accurate estimate of the luminosity function at this stage and allow a better determination of the rate of stellar evolution in the early hot white dwarf phase. Use of the 1500-Å flux in a color measurement is a better indicator of temperature than optical colors for objects with temperature >25,000 K. In addition, using ultraviolet instead of optical data, a more accurate extrapolation of the hot white dwarf's contribution to the interstellar radiation field at wavelengths shorter than 1500 Å can be made.

Identification on the FAUST film of white dwarfs and other intrinsically faint but interesting objects will be aided by the fact that the much more common main-sequence stars are easily identifiable or else are not seen at all. Main-sequence stars later than A5 do not have enough ultraviolet flux to register in the FAUST bandpass.

These exposures at high galactic latitude will also be searched for the far-ultraviolet counterpart of faint diffuse filaments at high galactic latitude seen on ground-based wide-field photographs at visible wavelengths (*5*). In the optical band these features are associated with dust scattering in our own galaxy at large distances from the plane. If detected in the FAUST image, these features would add support to the theory that they contribute to the far-ultraviolet background and help to resolve the long-standing controversy over the origin of this background (*6*).

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