

Historical Celebration – 1968 – 1977 – 60 yrs UV Astronomy

1968

Stargazer
OAO-2
Code-PI Wisc
Exp Package,
Wipple-PI
High Res
Telescopes
Dec. 1968

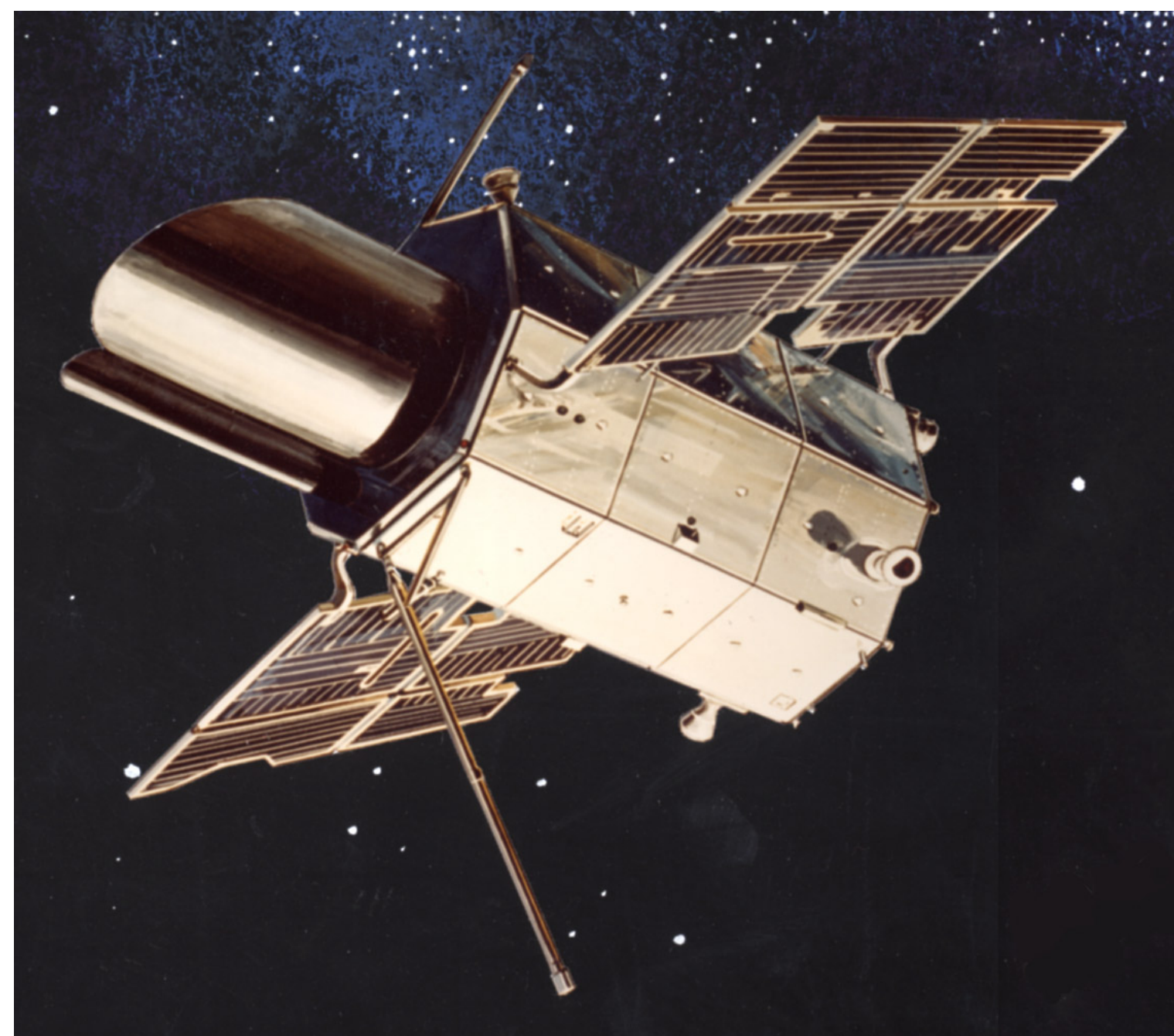
1969

H₂ from
Sounding
Rocket
Carruthers
1970

THE ASTROPHYSICAL JOURNAL, 161: L81-L85, August 1970
© 1970. The University of Chicago. All rights reserved. Printed in U.S.A.

ROCKET OBSERVATION OF INTERSTELLAR
MOLECULAR HYDROGEN
GEORGE R. CARRUTHERS
E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, D.C. 20390
Received 1970 June 22

ABSTRACT
The Lyman resonance-absorption bands of interstellar molecular hydrogen have been observed in the far-ultraviolet spectrum of the star ζ Persei. The column density of H₂ is estimated to be about 1.3×10^{18} cm⁻². The column density of interstellar atomic hydrogen, determined from the Ly α absorption line in the same spectrum, is about 4.2×10^{19} cm⁻². Hence, in this line of sight, where visual total extinction by dust is about 1 mag, nearly half of the total hydrogen may be in molecular form. This is in agreement with theoretical predictions.



OBSERVATIONS OF INTERSTELLAR LYMAN- α WITH THE ORBITING ASTRONOMICAL OBSERVATORY

B. D. SAVAGE AND A. D. CODE
Space Astronomy Laboratory, Washburn Observatory,
University of Wisconsin, Madison, Wis., U.S.A.

Abstract. The equivalent width of the blended line at Lyman α is given for 48 stars measured with the OAO-A2 scanning spectrometer. This provides an upper limit to the neutral hydrogen column density. In the Orion association these upper limits are significantly lower than the column densities determined from 21-cm emission line measurements. The determination of the Lyman α equivalent width for θ Ori by Carruthers is rediscussed and agreement between 21-cm absorption measures and Lyman α absorption is obtained for a spin temperature in the range of 40–70 K. It is suggested that the most likely explanation for the discrepancies found for the other Orion stars is that the 21-cm emission primarily occurs beyond the Belt stars. The correlation between the OAO blended equivalent widths and color excess, 4430 Å absorption, and interstellar sodium absorption are examined. Excellent correlation between sodium and hydrogen column densities is found.

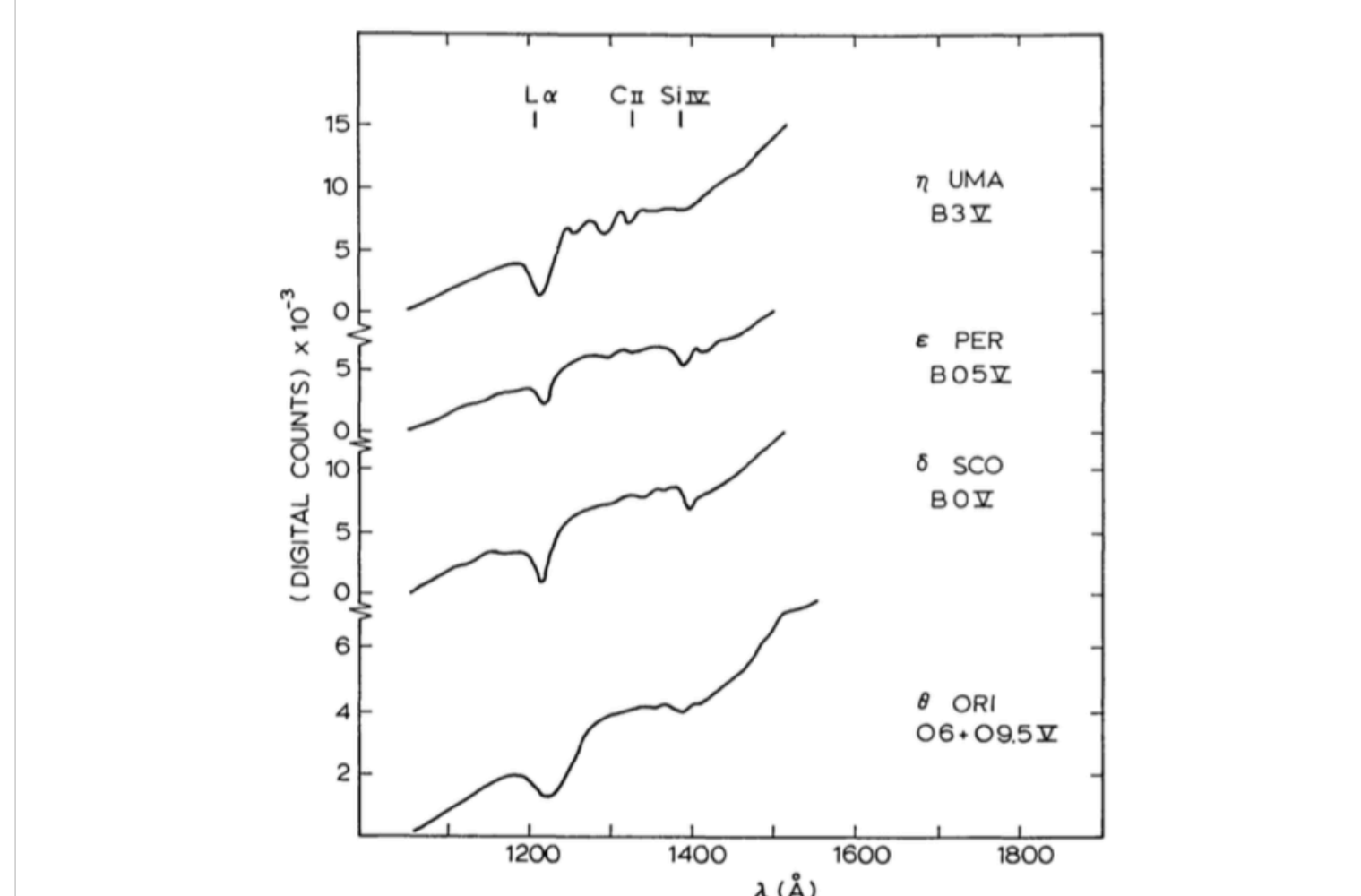


Fig. 1. Spectrometer scans in the region of Lyman α of 4 early-type stars with the OAO-A2 short wavelength scanner. Digital counts are plotted vs. wavelength.

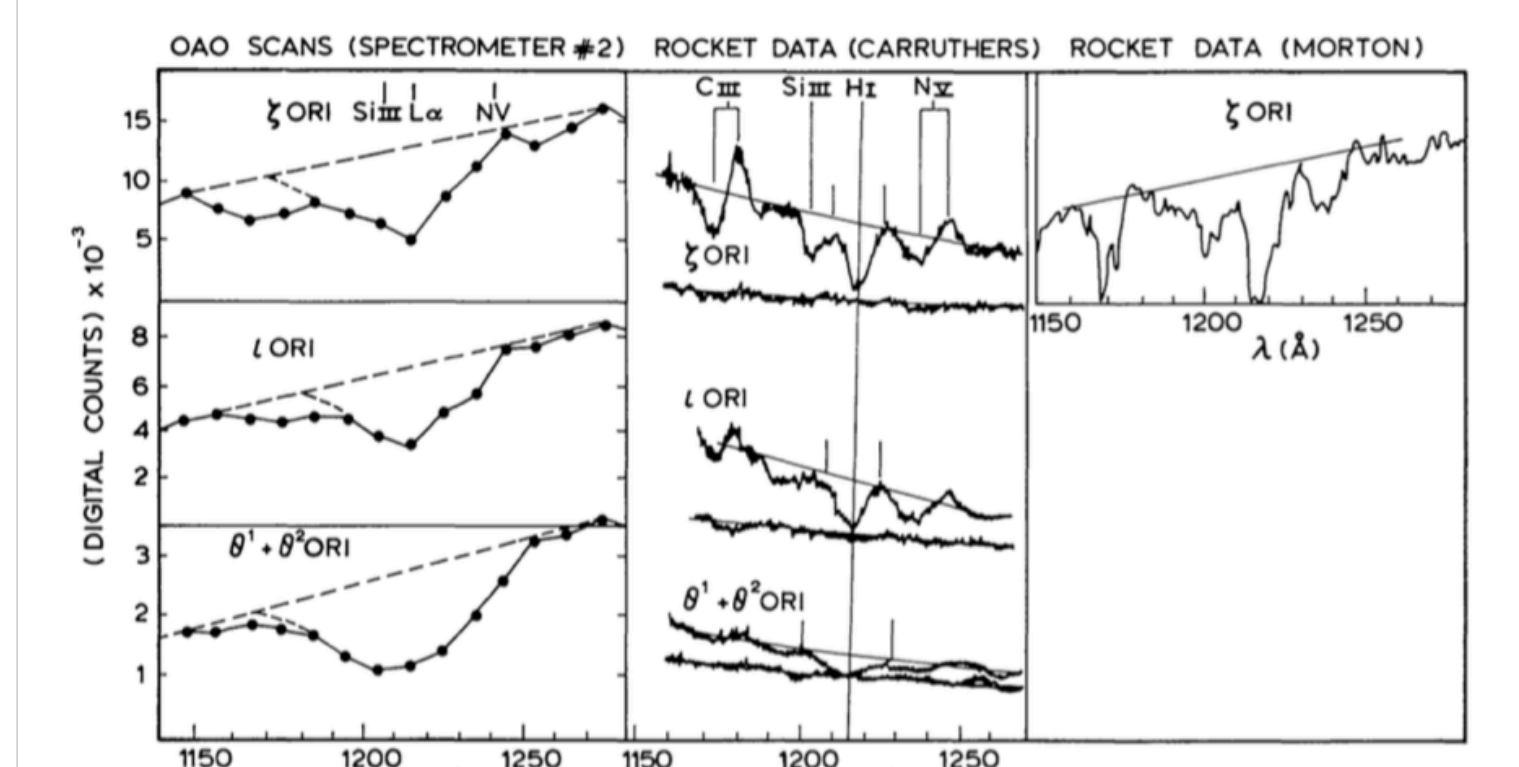


Fig. 2. A comparison of OAO-A2 scanner observations with rocket observations of Carruthers (1969) and Morton (1969). Dashed lines on OAO scans indicate adopted continuum level and period of Lyman α blend which is measured. For detailed information about the stars see Table I.

1970

Apollo 16 Lyman Alpha Imagery of the Hydrogen Geocorona

GEORGE R. CARRUTHERS, THORNTON PAGE, AND ROBERT R. MEIER
E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, D. C. 20375

Lyman α imagery of the hydrogen geocorona was obtained from the lunar surface during the Apollo 16 mission. The images are of 20° diameter fields, with 2 arc min limiting resolution, centered on the earth and about 12° upsun of the earth. The data confirm that the hydrogen geocorona is detectable above the interplanetary Lyman α background to more than 15 R_E in the upsun direction. In the antisolar direction there is a pronounced 'geotail' effect due to solar Lyman α radiation pressure, which is markedly asymmetric about the sun line. Comparison of the data with theoretical models shows quite good agreement, particularly in the vicinity of 3 R_E. In agreement with other observations the hydrogen density is lower than the theoretical density in the far-upsun direction, and very close to the earth there is a buildup of hydrogen on the dark side.

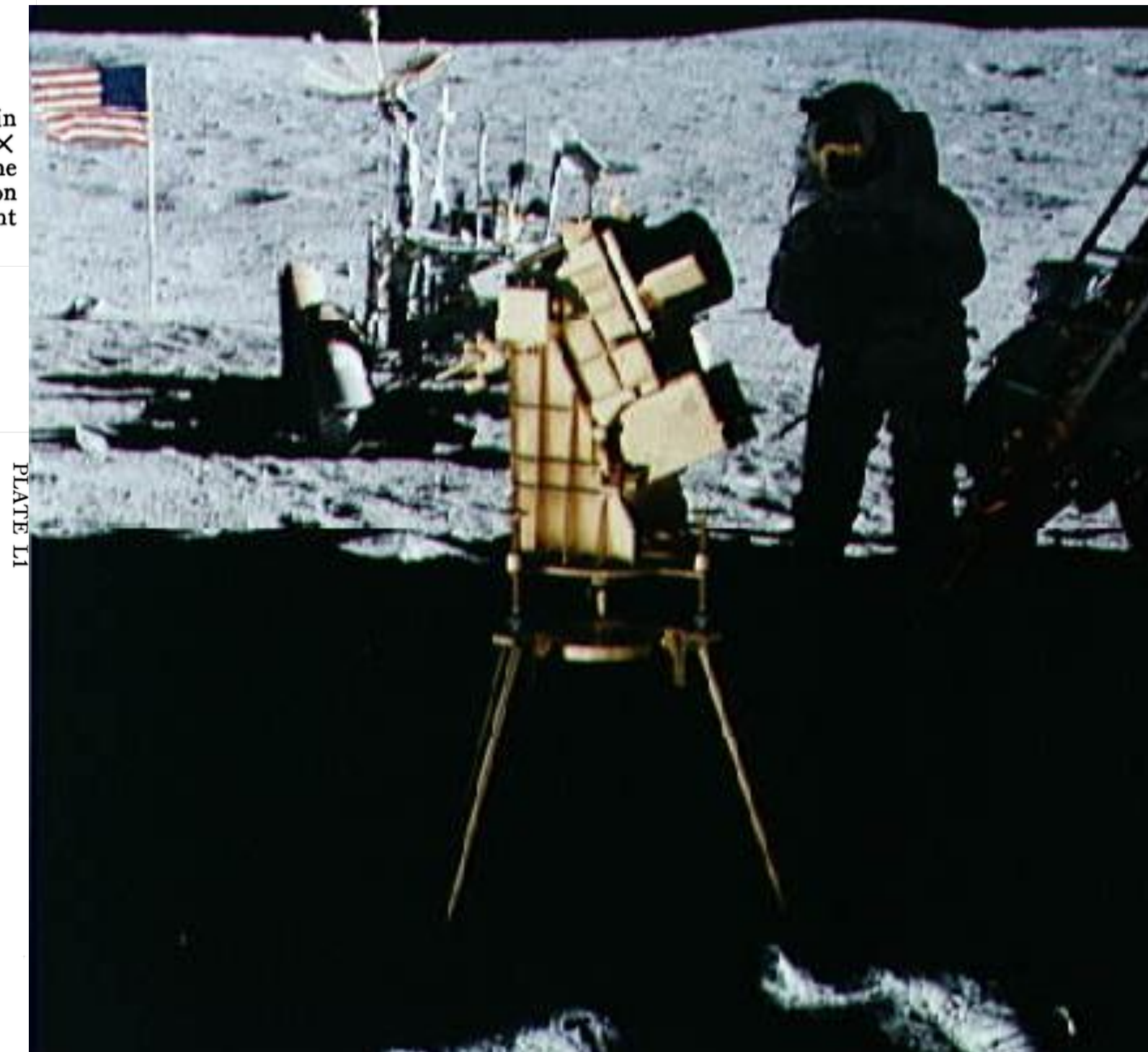


Fig. 1.—Comparison of laboratory spectra, made with a hydrogen-filled absorption cell and argon continuum light source, with flight spectra of ζ Per.
Continuation (see page L82)



Fig. 2. Print from S-201 frame 40, a 1-min exposure centered on the earth, wavelength range 1050–1600 Å. The hydrogen geocoronal Lyman α emission is the dominant feature. The dark limb is seen silhouetted against the interplanetary Lyman α background. The diagonal streaks in the upper portion of the picture are instrumental.

1971

Apollo 16
Carruthers
Apr. 1972

1972

Copernicus (OAO-3)
Princeton, Spitzer-PI
Aug. 1972

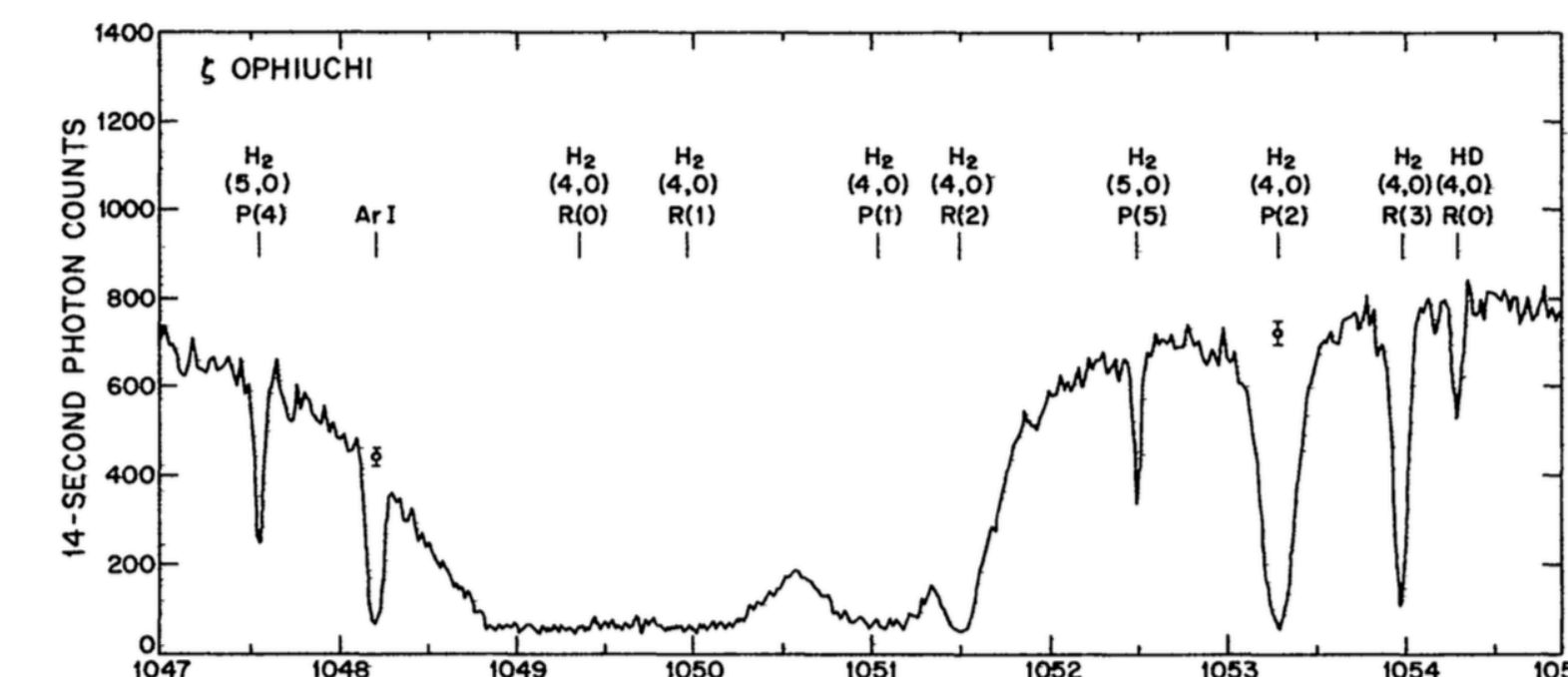
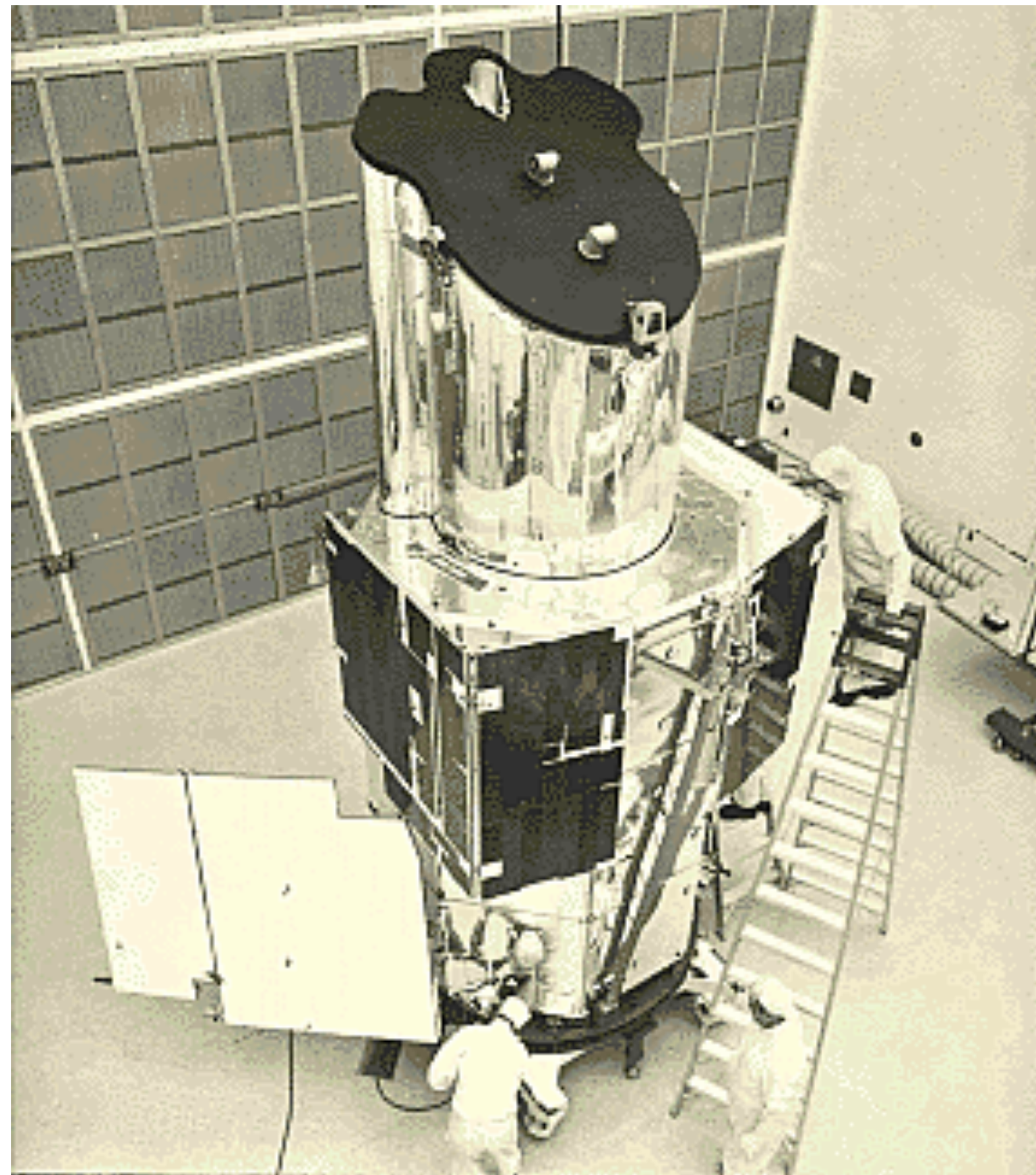


Figure 1 High-resolution scan of the O9.5 V star ζ Oph [$m_V = 2.56$, $E(B-V) = 0.32$] over an 8-Å interval. Error bars show the dispersion in photon counts expected from statistical fluctuations. The wavelengths of an Ar I line and of various rotational features in the (4,0) and (5,0) vibrational Lyman bands of H₂ and HD are shown by vertical lines.

No. 3, 1973
RESULTS FROM COPERNICUS
L125
DEPARTMENT OF PHYSICS
JOHNS HOPKINS UNIVERSITY
BALTIMORE, MARYLAND 21205
February 23, 1976

Dear Dr. Fletcher:

You have previously received the enclosed copies of Dr. Muller's correspondence with Senator Mathias urging that the Congress provide proper funding for the Large Space Telescope project.

Dr. Muller's point about the international contributions of American "know-how" in astronomical instrumentation is a significant one. The truly spectacular technological accomplishment that this observatory will represent – undoubtedly the most advanced, most complex and most perfect device that mankind has ever conceived – will stand for many decades as a beacon which will demonstrate our greatness and our character to the whole world. Therefore, the bicentennial year would be an excellent time to formally initiate the construction of the facility.

One study used quasars and the other used brilliant, distant galaxies as "standard candles" to see if their expansion rate was considerably greater long ago. In each case, this appeared to have been the case. That in each case the findings are so consistent is a striking fact. The term "standard candle" is applied to astronomical objects believed to be of uniform intrinsic brightness. This makes it possible to estimate an object's relative distance by the dimming of its light in its journey to an observer.

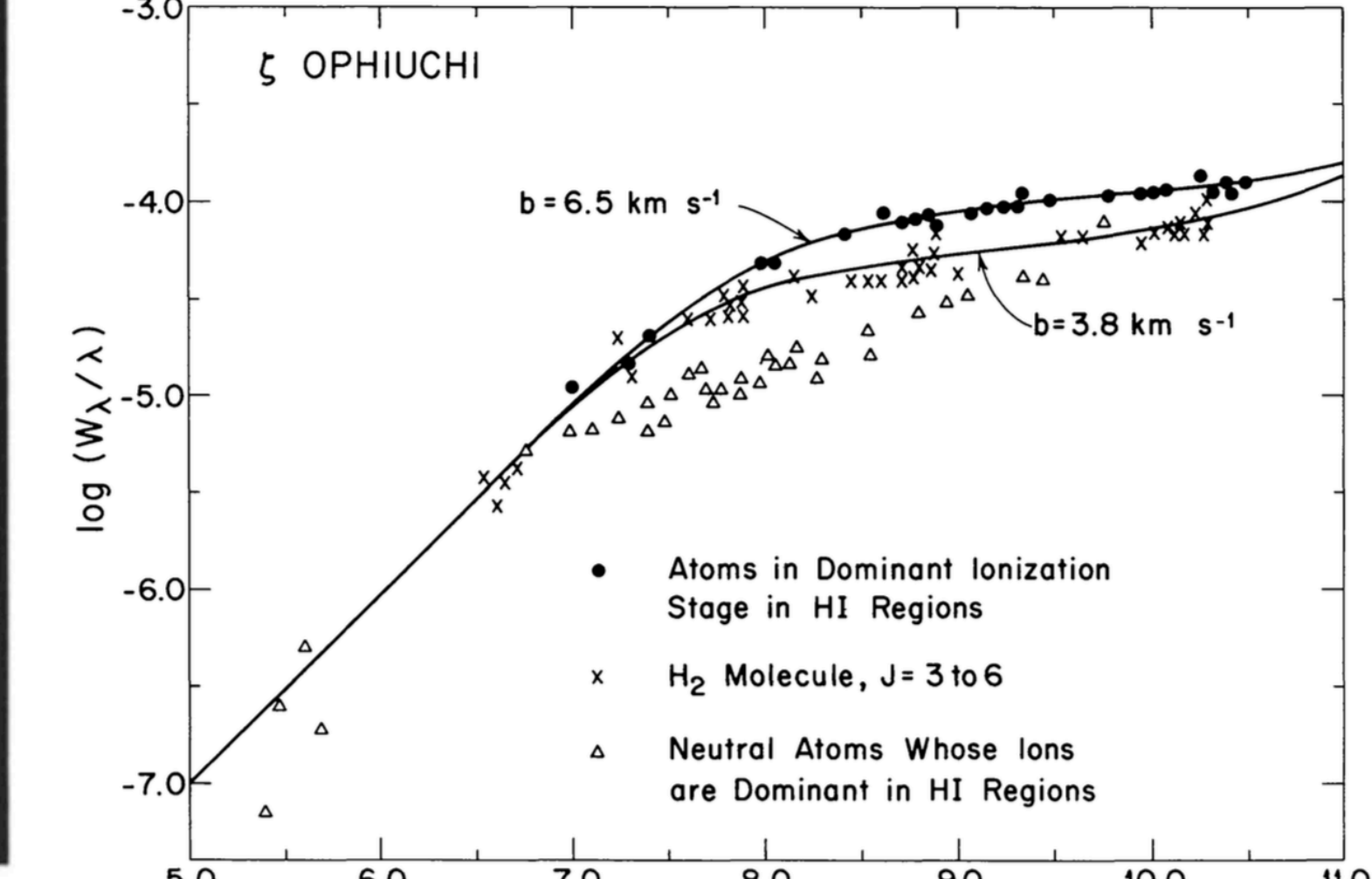


Figure 2 Curves of growth for different groups of interstellar lines in ζ Ophi. The filled circles represent lines produced by N I, Ar I, Mg II, Si II, S II, and Fe II; the triangles show C I, Na I, Mg I, S I, K I, and Fe I. The crosses represent H₂ Lyman lines from the rotational levels $J = 3-6$.

1974

Apollo 17
JHU, Fastie-PI
Dec. 1972



THE APOLLO 17 FAR ULTRAVIOLET SPECTROMETER EXPERIMENT

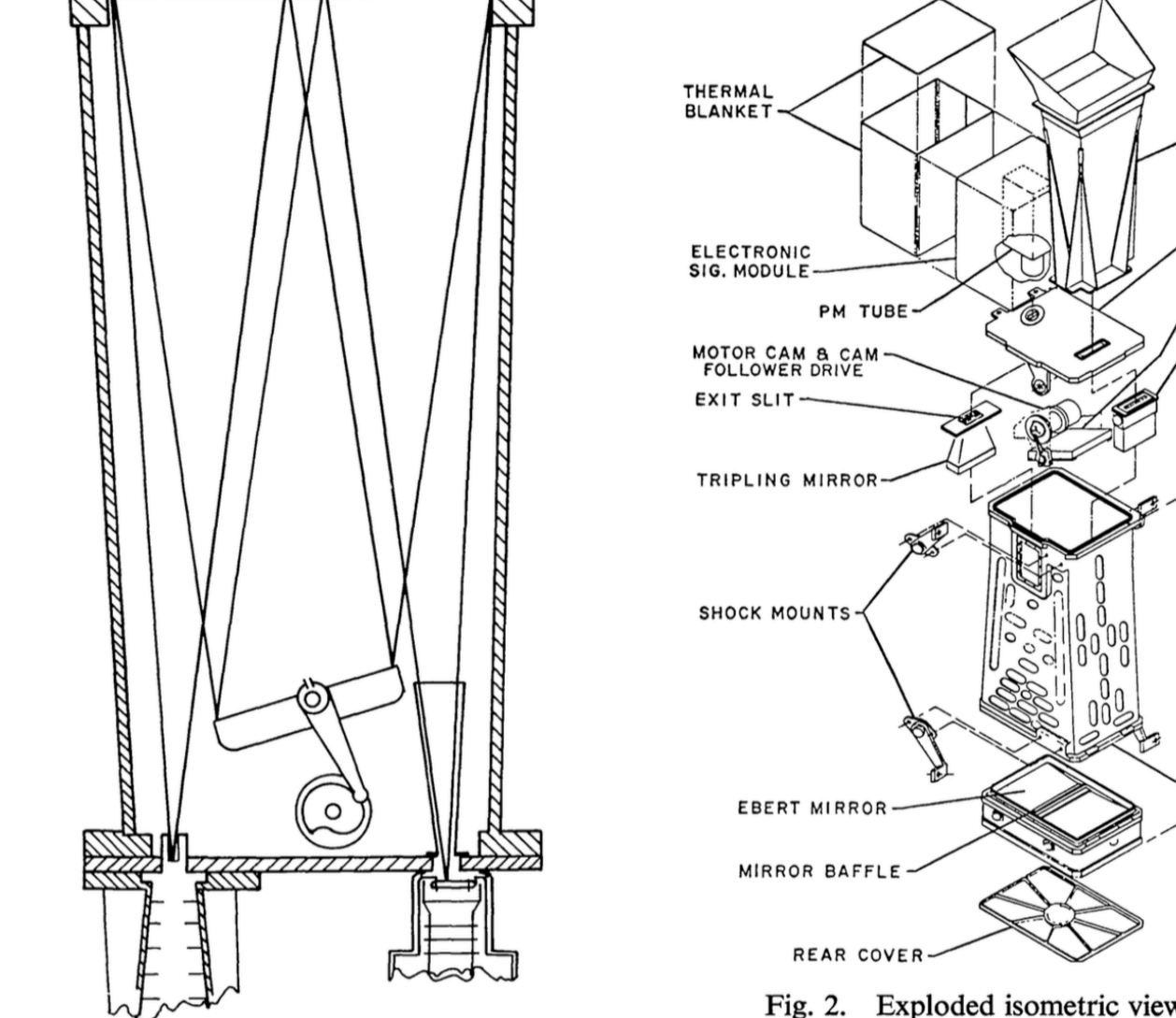


Fig. 1. Plan view of spectrometer optical system.
Fig. 2. Exploded isometric view of spectrometer.

Fastie Names Hubble 1976

DEPARTMENT OF PHYSICS
JOHNS HOPKINS UNIVERSITY
BALTIMORE, MARYLAND 21205
February 23, 1976

Dear Dr. Fletcher:

You have previously received the enclosed copies of Dr. Muller's correspondence with Senator Mathias urging that the Congress provide proper funding for the Large Space Telescope project.

Dr. Muller's point about the international contributions of American "know-how" in astronomical instrumentation is a significant one. The truly spectacular technological accomplishment that this observatory will represent – undoubtedly the most advanced, most complex and most perfect device that mankind has ever conceived – will stand for many decades as a beacon which will demonstrate our greatness and our character to the whole world. Therefore, the bicentennial year would be an excellent time to formally initiate the construction of the facility.

One study used quasars and the other used brilliant, distant galaxies as "standard candles" to see if their expansion rate was considerably greater long ago. In each case, this appeared to have been the case. That in each case the findings are so consistent is a striking fact. The term "standard candle" is applied to astronomical objects believed to be of uniform intrinsic brightness. This makes it possible to estimate an object's relative distance by the dimming of its light in its journey to an observer.

STUDIES DEAL A BLOW TO UNIVERSE THEORY

Continued on Page A1

Sincerely,
Wm. G. Fastie
Adjunct Research Professor
WGF:ec

1975

Davidson, Hartig, Fastie
3C273, Sounding Rocket
(21.054UG) Sept. 1977

“Suddenly we were no longer
astronomers, we were
Astrophysicists!” – William Fastie

Nature Vol. 269 15 September 1977

articles

Ultraviolet spectrum of quasi-stellar object 3C273

Arthur F. Davidson, George F. Hartig & William G. Fastie
Department of Physics, The Johns Hopkins University, Baltimore, Maryland 21218

The first direct observation of the ultraviolet spectrum of a quasi-stellar object (QSO) has been made with a rocket-borne telescope. The emission line spectrum of 3C273 is similar to the spectra of high-redshift QSOs, but no absorption is observed. The results provide important new constraints on theoretical models of QSOs, place a severe limit on the density of neutral hydrogen in the intergalactic medium, and suggest a cosmological origin for much of the absorption seen in high-redshift QSOs. Comparison of the ultraviolet spectrophotometry of low- and high-redshift QSOs suggests that the universe is closed, with $\Omega_0 \sim 1$.

off before flight. The spectrum observed in the target channel is displayed on the ground in real time by a multichannel analyser. The overall effective collecting area of the FOT varies between 11 and 5 cm² over the range 1,250–1,700 Å. Pre-flight and post-flight calibrations agree within the errors of less than 5%. The absolute calibration, obtained by comparison with measurements made with an NBS-calibrated photodiode, is accurate to about 10%. The instrumental resolution is about 10 Å over most of the spectrum and degrades to about 15 Å at the shortest wavelengths.

A unique rocket pointing system has been developed for the FOT by the Sounding Rocket Division of NASA's Goddard Space Flight Center. Two star-trackers are mounted behind the telescope primary, with adjustable mirrors which enable

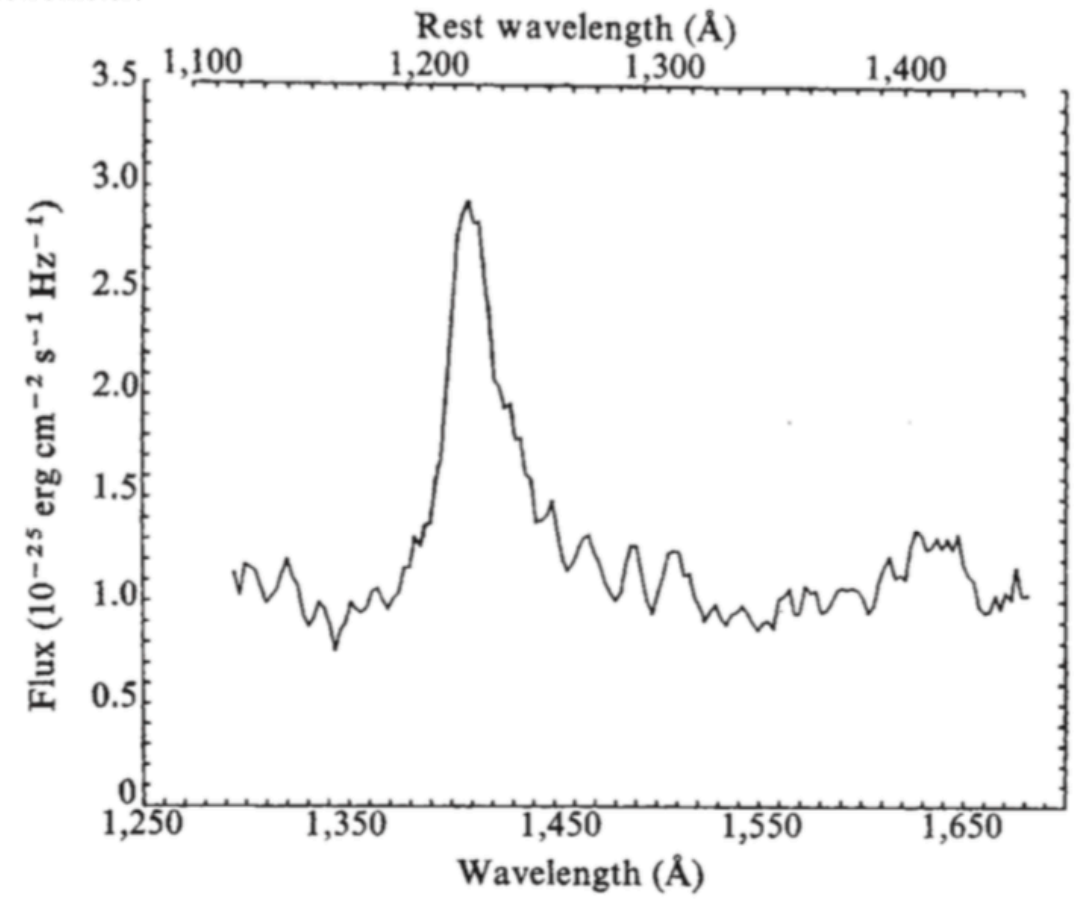


Fig. 1. The ultraviolet spectrum of the QSO 3C273. The strongest emission line is hydrogen Lyman α 1216 with a redshift z = 0.16. The asymmetry of the line is attributed to N IV λ 1240 emission. The broad feature at λ rest 1,400 Å is similar to that usually attributed to Si IV λ 1,105 and O IV λ 1,116 emission. There are also probable emission features which may be due to O II λ 1,164 and Si II λ 1,265. The continuum is flat, with no evidence of strong absorption shortward of Lyman α .

Idea of Ever-Expanding Universe Dealt a Blow by Two New Studies

By WALTER SULLIVAN
For example, if at night one tried to judge distances to many houses by the brightness of lights in their windows, it would help to know that the brightest light visible in each was a "standard candle" such as a 100-watt bulb.

In a search for such "100-watt bulbs" Dr. Alan R. Sandage of the Lick Observatory in California has for a number of years used quasars as "standard candles" in each cluster of galaxies. It has been previously reported that 30 or 40 of them were found. The quasars' light is dimmed by distance, but suggests enough slowing and cooling to see if their expansion rate was considerably greater long ago.

The term "standard candle" is applied to astronomical objects believed to be of uniform intrinsic brightness. This makes it possible to estimate an object's relative distance by the dimming of its light in its journey to an observer.



The New York Times
LANCE RESIGNS, 'CONSCIENCE CLEAR';
CARTER DEFENDS HONOR OF 'MY FRIEND'
September 15, 1977

Continued on Page A11, Column 1

Continued on Page A11, Column 1