Technical Memorandum 80238

(NASA-TM-80238) X-RAY OBSERVATIONS OF AM HERCULIS FROM OSO-8 (NASA) 5 p HC A02/MF A01 CSCL 03A

N79-20945

Unclas
G3/89 19639

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FEBRUARY 1979

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

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ABSTRACT

The white dwarf binary system AM Herculis (2A1815+500) has been observed in X-rays at both low energies ($E < 10$ keV) and higher energies. The exact shape of the spectrum, particularly at the higher energies, has yet to be determined. Presented here are results from the high energy scintillation spectrometer on OSO-8. These are combined with results published elsewhere obtained concurrently with the proportional counter on the same satellite, thereby giving for the first time coincident observations of AM Her over the range 2-250 keV.

X-RAY OBSERVATIONS OF AM HERCULIS FROM OSO-8

The white dwarf binary system AM Herculis (2A1815+500) has been observed in X-rays at both low energies (E$\leq$10 keV) (refs. 1-3) and higher energies[2,4,5]. The exact shape of the spectrum, particularly at the higher energies, has yet to be determined. Presented here are results from the high energy scintillation spectrometer on OSO-8. These are combined with results published elsewhere[6] obtained concurrently with the proportional counter on the same satellite, thereby giving for the first time coincident observations of AM Her over the range 2-250 keV.

The OSO-8 instruments used to observe AM Her consist of a proportional counter (described by Pravdo *et al.*[7]) covering the photon energy range 2-40 keV, and a high energy scintillation spectrometer (described by Dennis *et al.*[8]) covering the range 20-250 keV.

The source was observed during the period 1977 October 1-10. The results presented here from the scintillation spectrometer cover the whole period, whereas the proportional counter spectrum is based on "quick-look" data taken during a total of approximately twenty percent of the period. The composite OSO-8 spectrum is shown in Figure 1. Also shown for comparison is the spectrum of Staubert *et al.*[5] obtained on 1977 September 20, the Ariel-5 results of Coe *et al.*[4] obtained during the period 1977 February 18-22 and the OSO-8 proportional counter spectrum obtained during the period 1975 October 11-12 (ref. 2). AM Her is an eclipsing binary system and all the data except that of Staubert *et al.*[5] have been averaged over the whole binary cycle. Since Staubert *et al.*[5] observed it for only part of a cycle, their results have been normalised by a factor of 0.83 This factor was obtained by comparing the phases of their observation periods with the 10-60 keV light curve of Swank *et al.*[2]

Variations in the spectral shape and intensity are apparent in the results up to 100 keV. Even if the Ariel-5 results[4] in this energy range are not considered because of their low significance (approximately 1.7 standard deviations), there remains a statistically significant difference between the results of Staubert *et al.*[5] and OSO-8 taken only 10-20 days apart. If a thermal bremsstrahlung spectrum, including the modified Gaunt factor, is fitted to each data set, then apparent order of magnitude changes in temperature seem to be occurring (*cf.* the temperature of $\leqslant$18 keV found by Staubert *et al.*[5] to their 1977 observations and the temperature of 170 keV fitted by Swank *et al.*[2] to their 1975 OSO-8 data).

The X-ray emission of AM Herculis has already been shown[9] to vary in soft X-rays ($E \leqslant 10$ keV) by a factor of approximately four from one binary cycle to the next. The results summarised in this work indicate that changes in spectral shape seem to be also occurring. Although the changes in intensity are most certainly real, the variations in temperature are not so well defined. The results from OSO-8 illustrate the confusion. In 1975 a single temperature fit to the data was found to be statistically unacceptable[2], whereas in 1977 the opposite was true (Swank, private communication). Furthermore, if the spectrum of Staubert *et al.*[5] is extrapolated to lower energies, then the flux in the 2-5 keV range would be at least one order of magnitude greater than that ever observed. Consequently, the latter results and the 1975 OSO-8 results suggest a spectral break being present, possibly at about 15 keV, on these occasions. The 1977 OSO-8 results, however require no such feature.

If the spectrum of AM Herculis is definitely shown to possess a spectral break on some occasions, then at these times it will be similar to that seen from Her X-1 (ref. 10) in which a break is observed around 25 keV. The reason for the break in the Her X-1 spectrum is thought to be due to the modification of the Thomson cross-section in the intense (10^{13} gauss) magnetic field of the neutron star. The magnetic field of the white dwarf in AM Her is, however, believed to be of the order of 10^8 gauss from optical polarization measurements[12]. The calculations of Canuto *et al.*[11] indicate that this would not be high enough to affect the X-ray photons. Consequently, if a break in the AM Her spectrum is subsequently confirmed, then some modified or alternate theory is required to explain it.

Finally, the upper limits obtained above 50 keV by Staubert *et al.*[5] and this present work make it unlikely that a gamma-ray tail, such as that seen at the 3.2 standard deviation level in the Ariel-5 data[4], existed on these occasions. In view of the possible spectral changes suggested by the results summarised in this work, however, the existence of such a feature on other occasions cannot be excluded.

Helpful discussions with Dr. Jean Swank are gratefully acknowledged. The work of the OSO-8 Project Scientist, Dr. Roger Thomas, and the personnel of COMTECH Incorporated is appreciated. MJC is in receipt of an NAS/NRC Resident Research Associateship.

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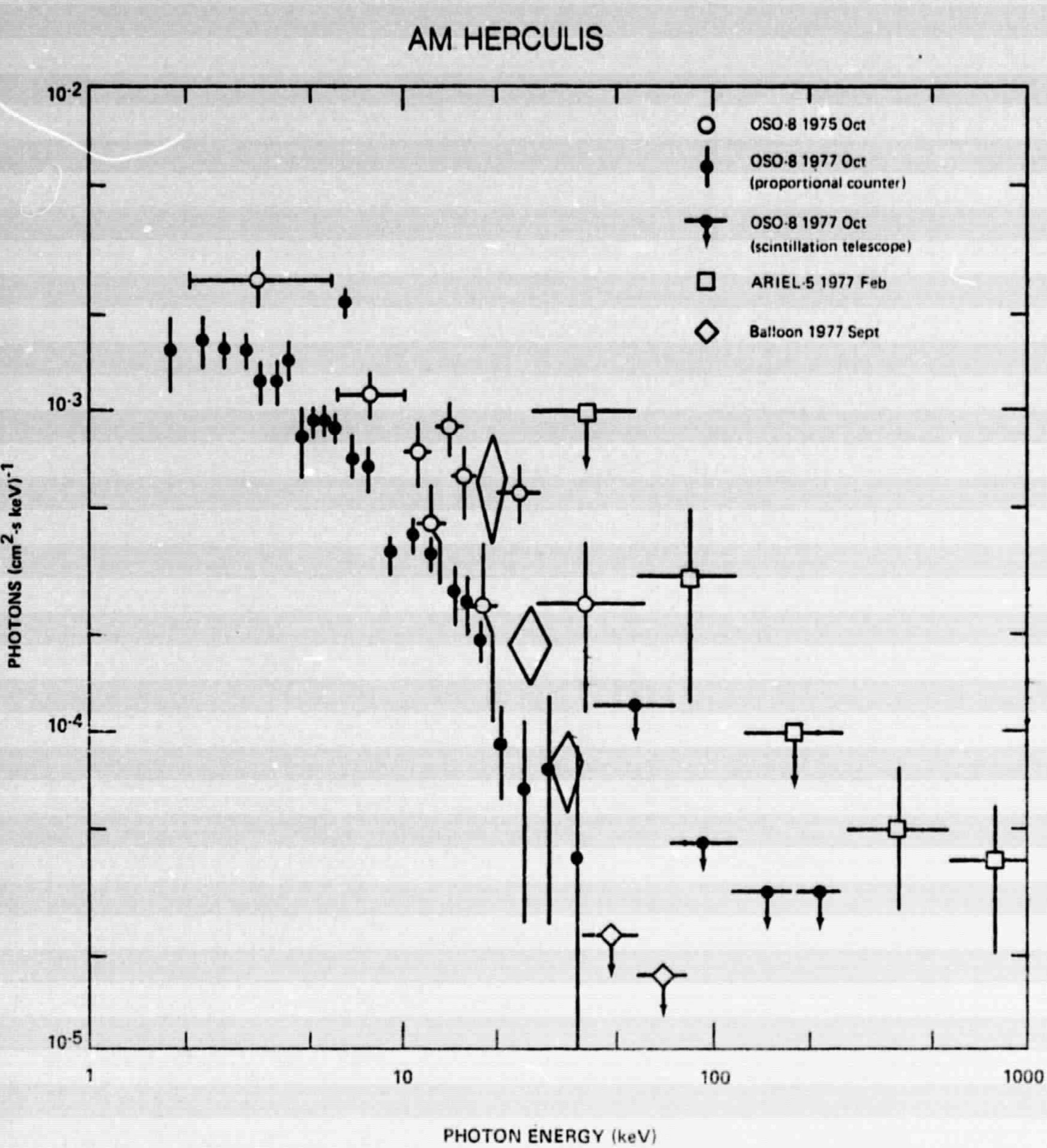

Figure 1. Measurements of the X-ray spectrum of AM Herculis. The OSO-8 data below 50 keV come from the GSFC proportional counter experiment (refs. 2 and 6), while the data above 50 keV come from the present work. The Ariel-5 data is from ref. 4, and the balloon data from Staubert *et al.* (ref. 5). Upper limits are indicated at the two standard deviation level.