SOFT X-RAY SPECTROSCOPY FROM THE X-RAY POLYCHROMATOR ON THE NEWLY REPAIRED SOLAR MAXIMUM MISSION

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INTRODUCTION

The X-Ray Polychromator (XRP) resumed operations on 24 April 1984 following the successful in-orbit repair of the Solar Maximum Mission Satellite. Since that time the two instruments that comprise the XRP, the Flat Crystal Spectrometer (FCS) and the Bent Crystal Spectrometer (BCS), have been used to obtain new spectroscopic data from active regions and flares. The FCS, in particular, has accumulated far more observations of soft X-ray line profiles than were obtained during SMM-I in 1980. For this short presentation, we have chosen two topics to illustrate the type of data that we have obtained since the repair.

OBSERVATIONS OF THE FE XVII LINE RATIOS

During the period of high activity in April and May 1984, the FCS was used to scan repeatedly Fe XVII lines in the 15-17A wavelength range. These neon-like lines are formed over a wide range of temperature and are consequently produced by both active regions and flares. During the decay of a GOES class M3 flare on 2 May 1984, there was a secondary energy release that resulted in the soft X-ray flux remaining essentially constant throughout the Fe XVII scans. We have derived the relative intensities for five Fe XVII lines observed during the flare decay. The resulting line photon flux ratios from the sum of ten scans, with respect to the line at 15.013A, are listed in the table below.

The theoretical values of these line ratios from calculations by Loulergue and Nussbaumer (1975) are shown in the table for comparison. While the uncertainties in the observed values are large in this current data set, there appears to be a systematic difference in the 17.051/15.013 ratio from their calculated value. We hope to better determine these ratios with future observations.

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FE XVII LINE RATIOS

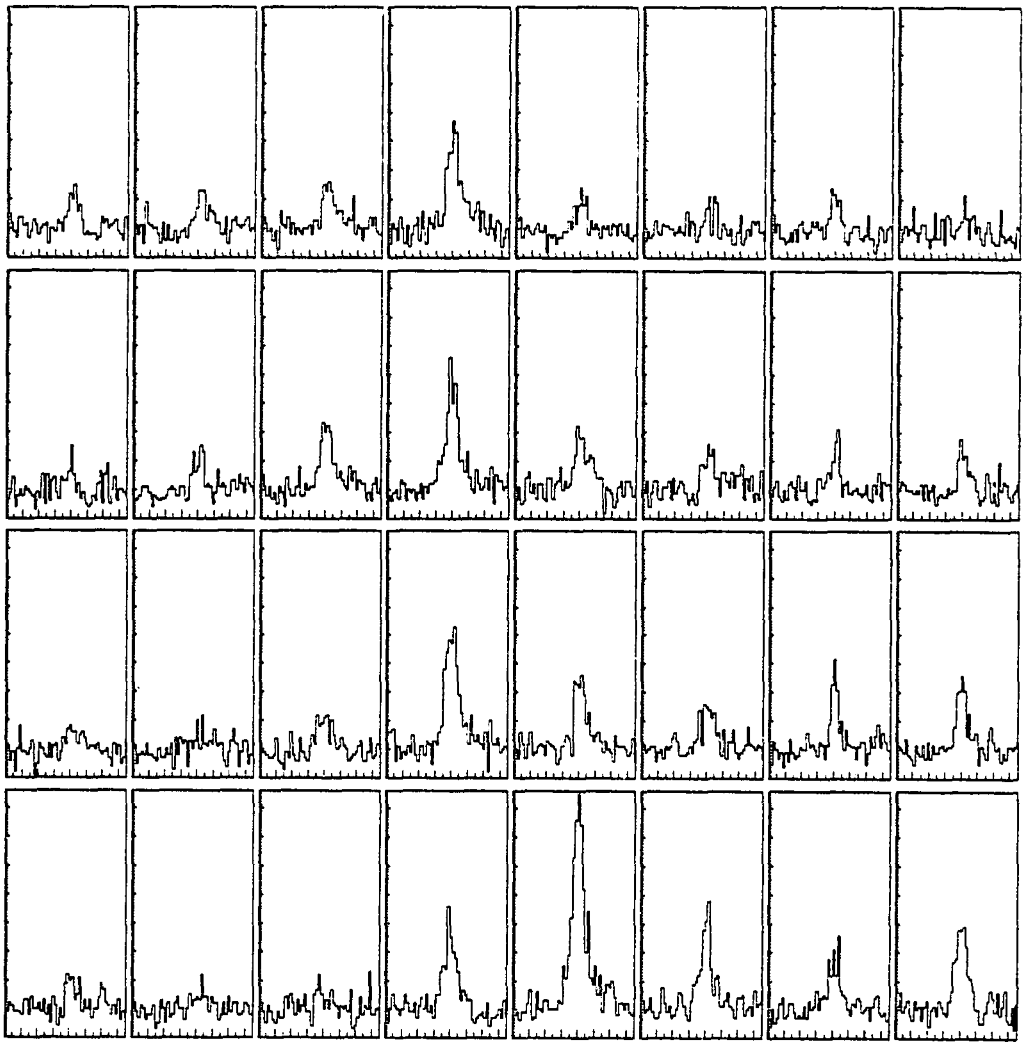
WAVELENGTH (A)	TRANSITION	MEAN OBSERVED FLUX RATIO	THEORETICAL (L & N)
15.013	$2p^6\ ^1S_0 - 2p^5\ 3d\ ^1P_1$	1	1
15.261	$2p^6\ ^1S_0 - 2p^5\ 3d\ ^3D_1$	0.35 (0.05)	0.31
16.775	$2p^6\ ^1S_0 - 2p^5\ 3s\ ^1P_1$	0.70 (0.07)	0.60
17.051	$2p^6\ ^1S_0 - 2p^5\ 3s\ ^3P_1$	0.90 (0.07)	1.12
17.096	$2p^6\ ^1S_0 - 2p^5\ 3s\ ^3P_2$	0.85 (0.07)	0.83

MASS MOTIONS IN AN ACTIVE REGION

Acton et al. (1981) gave the first evidence for significant mass motions in a quiescent active region. This result was based on a single observation of a limb active region and could not be confirmed by later FCS observations due to technical difficulties. With the renewal of operations we made observations of soft X-ray line profiles in an active region to further investigate this phenomenon. The figure below represents a sum of six 2x1 arcmin rasters over NOAA Active Region 4474 during a quiescent period, with Mg XI resonance line profiles taken at each of the 15 arcsec pixels. There were no significant variations from one raster to the next. The summed profiles are uniformly normalized to a peak rate of 100 counts s^{-1}.

We have fitted a Voigtian to each of these line profiles using a non-linear least squares technique to derive the wavelength and width of the lines. We find that the line profiles vary from the nominal width of the crystal rocking curve plus a thermal width equivalent to about 1-2 x 10^6K, consistent with the active region temperatures derived from the line ratios, to a thermal width of about 14.5 x 10^6K for the broadest lines. Such a high temperature thermal plasma would result in a substantial flux in the FCS higher temperature channels, which was not seen in these data. We conclude that the excess width is due to plasma turbulence thus confirming Acton's earlier result. If this line broadening were due solely to turbulence, the velocity would be 95 (+/- 30) km s^{-1}. We also investigated the possiblility of vertical plasma motions, but within the uncertainty of these data (+/- 20 km s^{-1}) none was detected.

FCS Spectroscopic Scan in a Raster
Mg XI Profile
Data taken on 28 April 1984



Wavelength Range 9.15 - 9.18 A

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