

ASCA observation of 4U1624-49

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Abstract. ASCA observations of the LMXRB 4U1624-49 reveal the presence of extended emission surrounding the X-ray source probably due to a dust scattered halo. The halo spectrum can account for the low energy excess seen in the dip spectrum.

1. Observation and Results

Several low mass X-ray binaries exhibit periodic irregular dips in their X-ray lightcurves (see White, Nagase, & Parmar 1995 for a review). 4U1624-49 shows perhaps the most dramatic dipping behaviour, with a dip recurrence period of 21 hr and dip activity lasting ~ 6 hr. The X-ray dipping phenomenon is understood as obscuration of a central X-ray source due to material located at the outer edge of the disk where the gas stream from the companion hits the accretion disk. The simple cold-absorption model fails to describe the dip spectrum, which instead shows an excess of counts at low energy when compared to the continuum spectrum. ASCA observed 4U1624-49 for one day in March 1993. Dips detected at the beginning and the end of the observation are not total. Erratic variability accompanied by partial hardening is seen in the first part of the dip, while substantial softening is seen in the lower intensity level of the dip. Either a multicolor disk blackbody (MDB) or a cutoff power law (CPL) model describes the out of the dip spectrum (OD) although the fit is formally unacceptable ($\chi^2/d.o.f.$ of 1.45, spectrum extracted in 3 arcmin radius). The measured N_H ranges between $6 - 8 \times 10^{22}$ atoms cm^{-2} . Using either MDB or CPL model to fit the low intensity dip spectrum (DP) gives a soft excess between 1-3 keV. The dip spectrum also shows line emission which is consistent either with a 6.4 keV broad line or with two narrow lines at 6.2 and 6.9 keV.

The soft excess is seen in most of the dip sources and different explanations have been proposed: ionization of the absorbing material by the central X-ray source; scattering emission in an accretion disk corona (ADC); rapid variations in absorption on a timescale faster than the accumulation time for the spectra; reduced abundances in the absorbing material. The dip spectrum has been successfully modeled by two components a direct (absorbed) and scattered into the

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line of sight (unabsorbed) where the relative flux between the two components gives an indication of the absorbing material. An alternative two component model, one extended and one compact (used for 4U1755-338 and 4U1624-46)

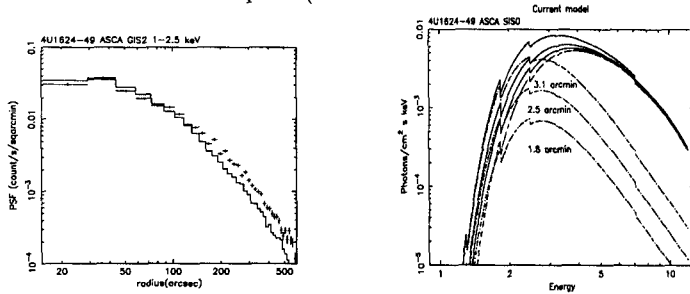


Figure 1. Left: GIS2 surface brightness compared to the prediction for a point source. Right: The individual contribution of the two component model spectra for the 3 extracted radii. The dotted line is the halo component, the dash-dot line the MDB component and the solid line the sum of the two components

explains the dip spectrum by obscuration of the compact component (Church *et al.* 1995). Another important effect is scattering off interstellar dust grains, which can cause a halo up to several arc minutes around the X-ray source, depending on the overall absorption. The spectrum of such a component is expected to be softer than the direct emission. Since 4U1624-67 shows an absorbed spectrum, the low energy excess in the dip could be explained by the presence of a dust scattered halo. The source surface brightnesses (crosses, Fig 1) in the GIS image (1-2.5 keV) deviates noticeably at radii greater than 120 arcsec when compared to the distribution expected for a point source (solid line). The contribution of this extra extended component in the energy band 1-2.5 keV is about 20 % at 9.5 arcmin, 6% at 3.5 arcmin and 1% at 2 arcmin. Since the halo should not vary, the amount of the soft excess should be constant in the OD and DP spectrum when extracted from the same region. By contrast spectra extracted with increasing region sizes should show different levels of contamination due to the halo. To model the halo component an additional power law was added to model. The OD and DP spectra were simultaneously and successfully fit with the slope and normalization of the power law component coupled across the spectra. The halo contribution to the total flux is 4 % and 18% for OD and DP spectra respectively. A second set of spectra taken during the dip were extracted using region size of 3, 2.5 and 1.8 arcmin radius. The 3 spectra were simultaneously fit to a two component model: a MDB to account for the 4U1624-49 emission and a power law for the halo. The contribution of the halo component is 10 % at 2.5 arcmin and < 3 % at 1.8 arcmin. These results suggest that the soft excess can be explained by a scattered component due to an interstellar dust halo instead of an accretion disk corona.

References

Church *et al.*, 1995, A&A.

White, N.E., Nagase, F., & Parmar, A.N. 1995, in *Accretion Driven X-ray Binaries*, eds. W. Lewin & J. van Paradijs. Cambridge University Press.