Z Chamaleontis: an XMM-Newton overview.

A.A. Nucita[1 2] E. Kuulkers[3] B.M.T. Maiolo[1],F. De Paolis[12],G. Ingrosso[12],D. Vetrugno[12]

[1]Dipartimento di Fisica, Università del Salento, Via per Arnesano, I-73100 Lecce, Italy

[2]Istituto Nazionale di Fisica Nucleare, Sezione di Lecce, Via per Arnesano, I-73100 Lecce, Italy,

[3]European Space Astronomy Centre, SRE-O, P.O. Box 78, 28691, Villanueva de la Cañada (Madrid), Spain,

1. Introduction

A cataclysmic variable (hereafter CV) is a binary system constituted by a white dwarf (the primary) accreting material from a late main-sequence star by means of the formation of a Roche lobe (for a review, we refer to [1]). In non-magnetic CVs (with magnetic field $\lesssim$0.1 MG), the accretion occurs via a Keplerian disk so that as much as half of the total potential gravitational energy is dissipated by the viscosity, while the other half is radiated away by the boundary layer (BL), i.e., the region between the inner disk and the white dwarf surface. In this picture, the radiation emitted by the disk peaks in the optical and ultraviolet bands, while the BL mainly radiates in the extreme ultraviolet and X-rays, typically with luminosities in the range 10^{30}–10^{32} erg s^{-1} ([2], [3]; for a review on X-rays from CVs we refer to [4]).

Systems in which the secondary star eclipses the white dwarf, i.e. those characterized by high line-of-sight inclination angles, offer the possibility to test whether the X-ray photons originate in the BL and constrain its size. However, these observations are complicated by eclipsing CVs having very low X-ray flux during an eclipse phenomenon because the X-ray photons are in part absorbed by the accretion disk. The *XMM*-Newton satellite [5] is particularly helpful because of the large effective area and the possibility to observe the source simultaneously in the optical band via the optical monitor (OM) instrument.

X-ray eclipses have been observed by the *XMM*-Newton satellite in various CVs, including OY Car ([6], but see also [7] for a detailed study) and HT Cas [8]. In both cases, it was possible to find that the X-ray emitting region (possibly a BL) has a size comparable with that of the central white dwarf, confirming the mass accretion scenario for a dwarf nova system.

Another binary system that is particularly suitable for these kind of studies is Z Chamaleontis, i.e. a dwarf nova of the SU Ursae Majoris subclass, which is often defined by outbursts and superoutbursts. The binary systems are highly inclined ($81.6^0 - 81.9^0$) to the line-of-sight, thus deep eclipses must affect the observed optical light curve. This provides the opportunity to study in detail the source and extract the binary system parameters: Z Chamaleontis contains a secondary star orbiting the central white dwarf[1] at the orbital period, $P_{orb} \simeq 1.78$ hr. As first observed by [10], Z Chamaleontis also shows evidence of a cyclical period change of about ~ 30 yrs. This variation could be due to a tertiary component (possibly a brown dwarf, see [11]) orbiting the binary system.

In this report, we present the result of a ~ 99 ks XMM-Newton observation of the Z Chamaleontis. We performed a spectral analysis of the data taken by the EPIC camera, and a timing analysis of the observed X-ray and optical OM light curves. We found that a multi-temperature plasma component absorbed by ionized material is required to describe the data. In particular, we estimate that the total absorbed flux in the 0.2-9.0 keV band is $F^{Abs}_{0.2-9.0} = (4.1 \pm 0.1) \times 10^{-12}$ erg s^{-1} cm^{-2}, which, when accounted for absorption and bolometric correction, corresponds to a bolometric luminosity of $L_X^{Bol} = (6.9 \pm 0.1) \times 10^{30}$ erg s^{-1} at a distance of 97 pc. The mass accretion rate onto the white dwarf turns out to be about 1.1×10^{-11} M$_\odot$ yr^{-1}. Our analysis of the optical and X-ray eclipse light curves (see Figure 1) and the mid-eclipse times of Z-Chamaleontis, in addition to the eclipse (during which the observed EPIC count rate is 0.033 ± 0.003 count s^{-1}), implies that the X-ray light curve contains dips (at the orbital phases 0.30 ± 0.02 and 0.73 ± 0.02) that can be naturally explained as absorption effects by intervening stable gas clouds close to the accretor.

We address the reader to the original paper [9] for further details on the analysis.

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[1]From the optical eclipse, the mass of the white dwarf and its companion were estimated to to be $M_{WD} \simeq 0.54$ M$_\odot$ and $M_c \simeq 0.081$ M$_\odot$, respectively.

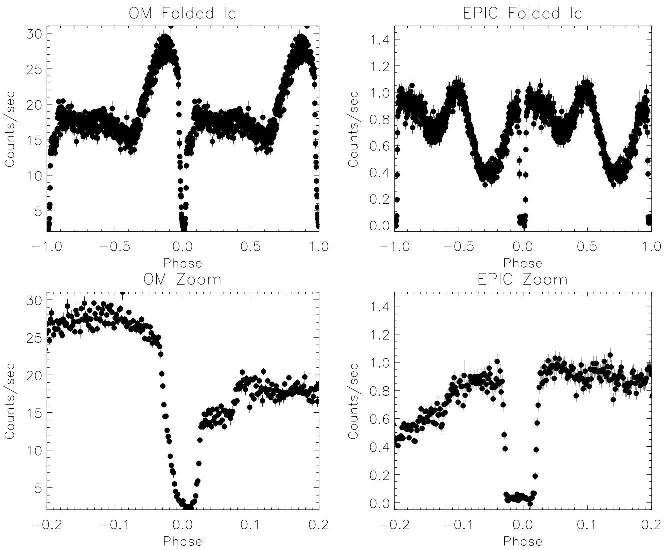

Figure 1. Upper panels: two orbital periods of the OM (left) and EPIC 0.2-10 keV (right) light curves. Bottom panels: a zoom around both the optical and X-ray eclipse.

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