XVII. Ulusal Astronomi Kongresi VI. Ulusal Öğrenci Astronomi Kongresi
31 Ağustos - 4 Eylül 2010, Adana

A LONG TERM X-RAY VARIABLE SOURCE @ GROTH-WESTPHAL FIELD

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Özet We present the analysis results of an X-ray variable source from The Groth-Westphal Field. J141648.7+522558 and J141649.4+522531 are close X-ray sources with 30 arcsec separation. Both sources have bright elliptical counterparts, as we observed by CFHTLS-D3 optical data. The sources are observed with X-ray observatories of XMM-Newton (on July, 2000) and Chandra (on August, 2002). By comparing the source fluxes at 2 epochs, we found a long term X-ray variable source. The source J141648.7+522558 has a Fx=4.9+/-0.4$\times10^{14}$ergs s^{-1}cm^{-2} at first epoch, but not detectable on the second observation by Chandra. While, the nearby source J141649.4+522531 has a consistent flux value of Fx=7.5+/-0.5$\times10^{14}$ergs s^{-1}cm^{-2} for 2 years. The intrinsic nature of this flux variability is investigated by considering extremely violent physical processes such as X-ray binaries and AGN.

1 Introduction

Active Galactic Nuclei (AGN) are the most famous steady X-ray sources in the extragalactic sky. X-ray observations provide a powerful tool in order to investigate the physical conditions in the central engine of AGN. The high spatial resolution of X-ray telescopes such as Chandra and XMM-*Newton* has led to the discovery of large populations X-ray sources. The time variability of X-ray sources in flux and spectra indicate the size and physical state of the emission regions (Uttley & McHardy 2004). The region known as the "Groth-Westphal strip" (Groth et al. 1994) has multiple observations in multi-wavelength studies. Various on-going and future follow-up projects have been or are being conducted on and around this field. As part of our TÜBİTAK project "*Cluster*

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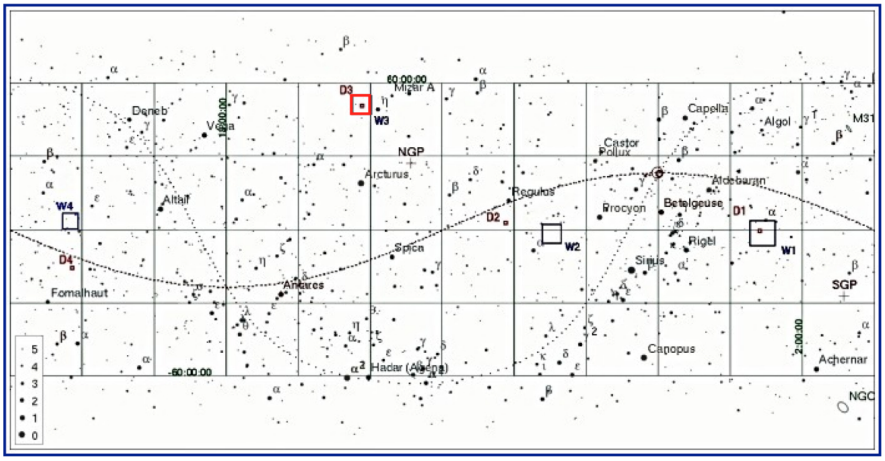
hunting in CFHT deep fields" (see Hudaverdi et al. 2010, #108 of this proceeding), Canada-France-Hawai Telescope (hereafter CFHT) data is examined in optical-band for BCG candidates and in X-ray band for cluster like extend (ICM) emission. Figure1 shows the locations of deep field at the sky. Covering 4 square degrees in four independent fields spread across the sky to have two fields visible throughout a given night at any time of the year. This work is analysis results of an exceptional X-ray source locates at CFHT-D4 field (red-square in Figure1). Long-term (∼2 years) X-ray source spectra is introduced and discussed in the following sections. We assume a flat universe throughout the work.



Şekil 1. The locations of CFHT fields. (http://www.cfht.hawaii.edu/Science/CFHLS/)

2 Observations and Data Reduction

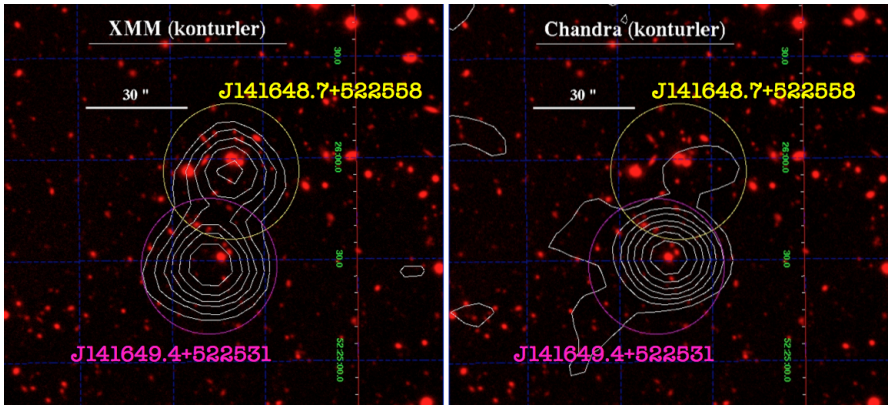
CFHT-D4 field is located in Groth-Westphal strip and thus have plenty of observations in X-rays. Considering the high resolution data of XMM-*Newton* and Chandra, we employ the longest observations among all. We have selected three of long (>20ksec) XMM-*Newton* observations which was performed at July, 2000. The region was observed with ACIS detector on the Chandra at August, 2002. The observation log is summarized in Table1 with Obs-ID, ra-dec, Obs-time and exposure values. Two telescope pointing has ∼2-year gap.

We employed the latest versions of analysis softwares for both detector; SAS 10.0 for XMM-*Newton* and CIAO 4.2 for Chandra, respectively. The routine cleaning procedures are applied to XMM-Newton data before merging the event files. Light curves are used to determine 2.7σ clipping around the average count-rate. The 0.5-2 keV energy band images are created for imaging analysis of X-ray

Çizelge 1. Observation journal for Groth-Westphal Strip.

Mission	Obs-ID	RA	DEC	Obs-Time	Exp. (sec)
XMM-*Newton*	0127920401	14 17 04.31	+52 23 51.7	2000-07-20	49981
XMM-*Newton*	0127921001	14 17 03.84	+52 23 51.6	2000-07-21	65711
XMM-*Newton*	0127921201	14 17 03.44	+52 23 50.8	2000-07-23	19588
Chandra	4357	14 17 43.60	+52 28 41.2	2002-08-12	85440

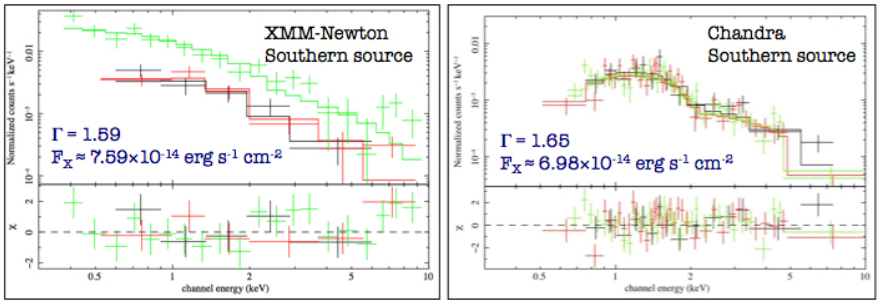
emission. The optical image is obtained from CFHT-D4 data. Figure2 shows R-filtered CFHT-D4 observation superposed with XMM-*Newton* (left) and Chandra (right) soft-band [0.5-2 keV] counter levels. The 2000 observation of XMM-*Newton* X-ray emission suggests a clear binary structure; J141649.4+522531 and J141648.7+522558. The southern source J141649.4+522531 was observed in 2002 with Chandra (Figure-2 right-pannel), while there was no detectable significant emission from J141648.7+522558 ∼2-year later.



Şekil 2. CFHT-D4 image overlaid by soft X-rays [0.5-2 keV] of XMM-*Newton* (*left*) and Chandra (*right*). The difference of in the northern-source brightness is evident.

In order to confirm this flux difference we spectroscopically inspect both sources. XSPEC, version 12.6.0 software is used for spectral-fitting. The counts are extracted from 30″ circles centered on X-ray peaks. The background emission is represented by the counts from the surrounding ring of 45″-60″ region. Finally, extracted spectra were grouped with 25 counts for each channel. The data were fit by a power-law model with a Galactic absorption column along the line of sight. Figure 3 shows the best fit spectra of the source J141649.4+522531 with

EPIC detectors of XMM-*Newton* (*left*) and ACIS detector of Chandra (*right*). The best-fit values are consistent within 90% error range; Photon-index is Γ=1.6 and $F_X = 7 \times 10^{-14}$ ergs s^{-1}cm^{-2}. The northers source J141648.7+522558 has a significant X-ray emission on 2000 XMM-*Newton* observation. The best-fit spectral model estimates Γ=1.59$^{+0.16}_{-0.23}$ and F_X=4.89×10^{-14} ergs s^{-1}cm^{-2}. Interestingly, the source has no significant X-ray emission after 2 years.



Şekil 3. J141649.4+522531 spectral fit of XMM-*Newton* (*left*) and Chandra (*right*)

The intrinsic nature of this long-term flux variability is described by extremely violent physical processes such as X-ray binaries and AGN. Higher photon counts is required for a clear-cut conclusion with better statistics. Thus the region will be inquired to X-ray telescopes for future observations with longer exposure. The authors acknowledge the support of TÜBİTAK Scientific Projects #108T226 and #109T092.

Kaynaklar

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