Kanata optical monitoring of radio galaxy NGC 1275

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Abstract

NGC 1275 is a radio galaxy, located at the center of Perseus cluster. The multi-wavelength spectrum from radio to gamma-ray of NGC 1275 is similar to that of blazars, and it shows a variable gamma-ray activity. NGC 1275 showed broad emission lines in optical band and a Fe-K line in X-ray band which are similar to Seyfert galaxies. Therefore emission of accretion disk dominates in optical and X-ray bands. In previous works (e.g., Yamazaki et al. 2013), there was no evidence about time variability in the optical bands from 2010 to 2011, and X-ray bands from 2006 to 2011. On the other hand, Aleksic et al. (2014) showed a variability in gamma-ray and optical bands by the data of MAGIC between October 2009 and February 2010, Fermi-LAT and KVA in between and August 2010 and February 2011. In their paper, optical variability was also reported. Fukazawa et al. 2016 (astro-ph) has reported gradually brightening of NGC 1275 in X-ray correlated with gamma-ray activity from 2013 to 2014. Based on these results, we expect a jet origin brightening in optical band during the same time period. We performed optical and near-infrared photometry using HONIR installed on the 1.5 m Kanata telescope since February 2015. Furthermore, we analyzed X-ray archival public data of XRT onboard the Swift satellite, and also investigated time variability correlation between X-ray and optical bands.

Key words: AGN Jet, Radio Galaxy, Kanata Telescope, Swift, Fermi

1. NGC 1275

NGC 1275 is a radio galaxy located at the center of Perseus cluster, and object position is RA = 03h:19m:36.21s, Dec = +41:29 ':57.9 ". As shown in Fig. 1, the emission from NGC 1275 has been observed in the broad-band energy range from radio to gamma-rays. NGC 1275 showed emission lines in optical band and X-ray band, suggesting that the emission associated with the accretion flow exists. On the other hands, there are strong variabilities in gamma-ray band. Recently, MAGIC and VERITAS (both of them are Atmospheric Cherenkov Telescope) reported the detection of very-high-energy gamma-ray activity from NGC 1275 during the same epoch in Oct. 2016. Therefore, the jet must contribute to the emission of NGC 1275 in the radio and gamma-ray band. But the radiation mechanism and the structure of jets have not been understood yet.

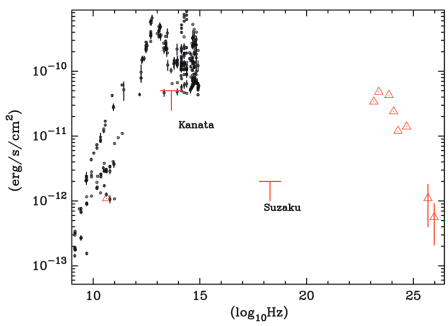

Fig. 1: The spectral energy distribution of NGC 1275 (S. Yamazaki et al 2013)

2. Data Reduction

2.1. Swift satellite and XRT

The Swift is a multi-wavelength observation satellite launched on November 20, 2004. Swift has three instruments; Burst Alert Telescope (BAT), X-ray Telescope (XRT), and UV/Optical Telescope (UVOT). The XRT focuses on X-ray with 23.6 x 23.6 arcmin FOV and 0.2-10 keV energy range.

2.2. X-Ray Data Analysis

We used public data of Swift XRT obtained from July 2007 to November 2016. The bright emission from the Perseus cluster was also observed, and thus we extracted the XRT spectrum within 0.3 arcmin of NGC 1275, and

performed the spectral analysis of AGN. The background spectrum was obtained at the position of 60–65 arcsec from NGC 1275, and then subtracted from NGC 1275 spectrum. We fitted all the XRT spectra with wabs*pegpwrlw in the XSPEC model.

2.3. Kanata telescope and HONIR

Kanata is 1.5m Ritchy-Cretien telescope at Higashi-Hiroshima Observatory. It has 1 Cassegrainfocus and 2 Nasmythfocuses. Hiroshima Optical and Near-Infrared camera (HONIR), installed on the Cassegrainfocus, can take image in the optical and near-infrared (NIR) band simultaneously. Observed targets are focused especially on variable objects such as blazars, supernovae, and gamma-ray bursts.

2.4. Optical observation and Analysis

We took data on 45 nights in February 2015 - November 2016. Optical data were obtained in the V and R bands, and NIR data in the J bands. The host galaxy and extended nebula are very bright, and thus it is hard to subtract the emission from these components. Table 1 shows the number of data obtained with HONIR.

Table 1: Kanata Telescope photometry data list

year	V	R	J	Ks
2015	42	36	42	36
2016	150	141	151	141

3. Results Of X-ray And Optical Data

Fig. 2 shows light curves, based on all Fermi achival gamma-ray data and Swift X-ray data. There are strong variabilities in gamma-ray band. We can see significant brightness increase around MJD 5550 and 57000 in both gamma-ray and X-ray. Fig. 3 shows multi-wavelength light-curve from 57300 to 57800. In s short time-scale, no obvious synchronized feature among the bands can be seen.

4. Summary and Feature work

In this work, we analyzed X-ray data of Swift-XRT and optical and NIR data of HONIR. We compared these results with gamma-ray archive light curve of Fermi-LAT. Currently we do not see a significant correlation between optical and Gamma-ray for the short-term gamma-ray variability. Because the optical flux estimation is still not optimized in this work, we are improving the optical flux estimation.

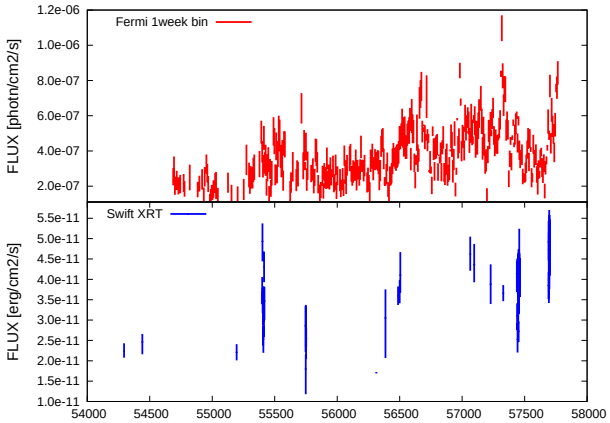

Fig. 2: Fermi and Swift whole period light-curve

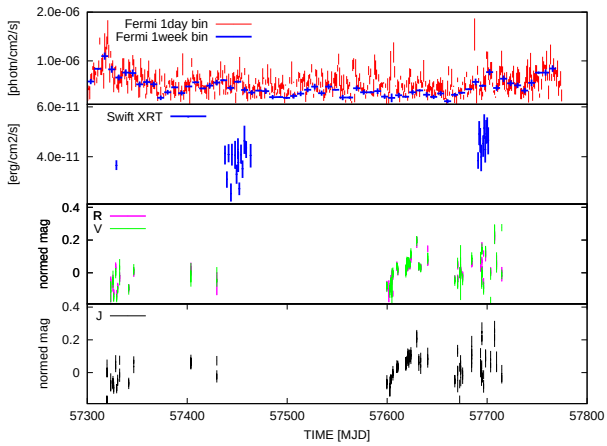

Fig. 3: Multi-wavelength light-curve from 57300 to 57800[MJD]. From the top of figure, Fermi gamma-ray, Swift X-ray, Kanata optical and Kanata near infrared.

5. References

References

Aleksic, J., et al. March 6, 2014, A-2013-22951 arxiv

Yamazaki, S., et al. "X-Ray and Optical Monitoring of a Gamma-Ray-Emitting Radio Galaxy,NGC 1275" 25 April 2013

Fukazawa, Y., et al. "X-ray variability of GeV gamma-ray emitting radio galaxy NGC 1275" 12 August 2016

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