

Minute-scale Rapid Variability of the Optical Polarization in the Narrow-line Seyfert 1 Galaxy PMN J0948+0022

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Fermi Gamma-ray Space Telescope has recently detected MeV/GeV γ -ray emissions from five Radio-Loud Narrow line Seyfert 1 galaxies (NLSy1s). It is widely recognized that NLSy1 possesses a relatively light central black hole of $\sim 10^6$ – $10^7 M_\odot$ accreting at a very high rate near the Eddington limit. Hence, NLSy1 is considered to be a young AGN growing toward a super massive black hole which is believed to have a mass of 10^8 – $10^9 M_\odot$.

We report on optical photopolarimetric results of the radio-loud NLSy1 PMN J0948+0022 on 2012 December to 2013 February triggered by flux enhancements in the near infrared and γ -ray bands ([1,2]). We performed the optical photometric observations of PMN J0948+0022 from 2012 December 20 to 2013 February 20, using the HOWPol installed to the 1.5m Kanata telescope and the MITSuME installed to the 1.0m Murikabushi telescope [3]. Figure 1 shows a long-term history of R_C -band flux and spectral index. Figure 2 shows an enlarged view of temporal variation of the polarized flux (PF) and polarization angle (PA) on MJD 56281. The polarization degree (PD) reached $36 \pm 3\%$ at the peak of the shortduration pulse, while the polarization angle remained almost constant. The high PD and minute-scale variability in PF provides clear evidence of synchrotron radiation from a very compact emission region with a highly ordered magnetic field. Such micro-variability of polarization is also observed in several blazar jets, but its complex relation between total flux and PD are explained by a multi-zone model in several blazars. The implied single emission region in PMN J0948+0022 might reflect a difference of jets between RL-NLSy1s and blazars.

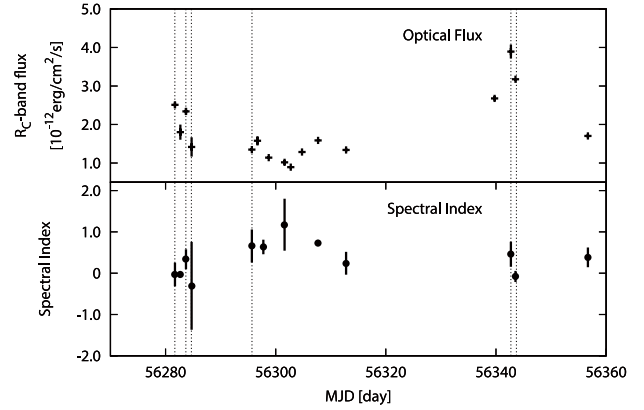


Figure 1: Long-term histories of the optical flux and spectral index taken by HOWPol and MITSuME. The upper panel shows a light curve in the R_C band. The lower panel shows a history of spectral index. The dashed lines indicate the dates when high-density photopolarimetric observations were performed.

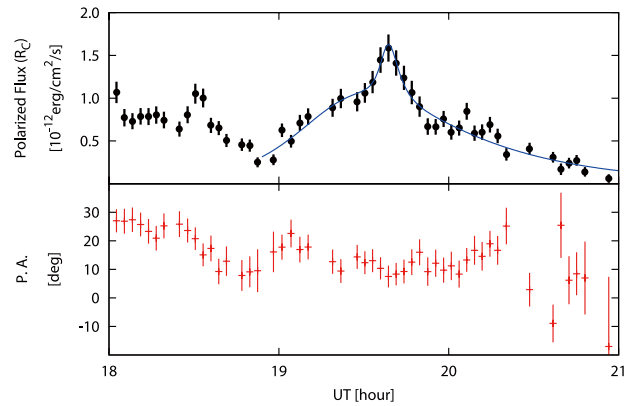


Figure 2: Time profiles of the polarized flux and polarization angle on MJD 56281. The solid line is the best-fit light curve.

References

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