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VLBA Polarimetry of GPS Quasar OQ172

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Abstract. We present a study of the VLBA polarimetry of GHz-Peaked Spectrum (GPS) quasar OQ172. GPS quasar OQ172 is one of the source with the extremely highest rest-frame rotation measure (RM>20,000 rad/m^2). By analyzed our of VLBA polarimetry observation, we found the Rotation Measure on C & X band would be well fitted by linear relationship of the square of λ^2. Combined other evidences of physical environment in the core of OQ172, we suggest that this source might be a young AGN.

Keywords. Galaxies: jet – galaxies: nuclei – quasars: individual: OQ172

1. Introduction

GHz-Peaked Spectrum (GPS) radio sources are characterized by their compact size (L<∼100 pc) and convex spectrum peaked at ∼0.5-10 GHz observed frequencies (O'Dea *et al.* 1991). Like most GPS sources, the z=3.529 QSO OQ172(J1445+0958) shows no kpc-scale radio structure. OQ172 also has an extremely high rest-frame rotation measure (RM>20,000 rad m^{-2}; Udomprasert *et al.* 1997), one of the highest among ∼20 known high-RM sources. Only 10 mas (R_{proj} ∼70 pc) from the VLBI core, the RM falls to <100 rad m^{-2}. This very steep RM gradient may explain the low polarization (χ =P/I) in the core and inner jet, as compared to the higher values of χ downstream. In order to better understand the circumnuclear environment of OQ172, we performed a VLBA polarimetry observation.

2. Results and Discussion

After the data reduction, the linear polarization details would be obtained for every frequencies. When the polarized emission propagates through a magnetized plasma, the polarization plane will rotates with wavelength lamda according to the following expression (e.g. Taylor 1998),

$$\mathrm{RM} = 812 \int_0^L \mathrm{n_e B_{\parallel} dl} \ \ \mathrm{rad\ m^{-2}}, \tag{2.1}$$

where RM is the rotation mature in rad m^{-2}, n_e is the electron number density in cm^{-3}, $B_{\|}$ is magnetic field in mG, and the integral is taken over a passage l in pc alone the line of sight from the observer. In order to examine whether the variation of χ at different frequency is associated with Faraday rotation, we investigate the relationship between χ and λ^2 at each frequency. Linear least-squares fit for χ and λ^2 can be obtained for core and some inner jet region in OQ172 from our observation. Figure 1 presents the mas-scale Rotation Measure (RM) fit within 5 & 8 GHz frequencies respectively. Note that when the redshift correction was applied to the wavelengths, the RM values from core component and innermost component in the rest frame of OQ172 are extremely high,

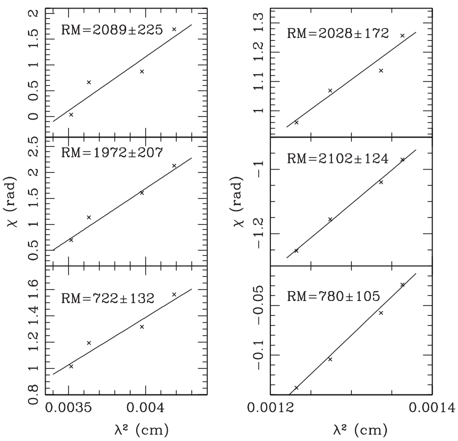

Figure 1. Rotation Measure for GPS quasar OQ172 in core and inner jet part on C and X band.

up to 40000 rad m^{-2}. However, the RM value goes down very low since a much smaller change in position angel χ at the outer jet region in OQ172, such as C2 & X2 component. It is clear to see that the RM value diminishes along with the jet direction, with a gradient of about several hundreds rad m^{-2} mas^{-1} toward the southwestern jet. From results of our observation, the RM values at 5 GHz from core region to outer jet part are consistent with the results obtained from Udomprasert et al (1997). At the same time, by using our simultaneous multi-frequency observation, the GPS absorption mechanism of OQ172 would be studied. And the some physical parameters, such as electron density n_e, magnetic filed $B_{\|}$, were discussed under each absorption mechanism. A further evidence for the unusual physical environment in the core of OQ172, the near-infrared spectrum shows a typical Hβ broad emission line FWHM of ~3,700 km s^{-1}, but an unusually large width of 2,200 km s^{-1} for the narrow [OIII] 5007Å line (Hirst *et al.* 2003). Assuming that Narrow Line Region (NLR) gas dynamics is mainly governed by the inner nuclear bulge gravitational potential (e.g., Nelson & Whittle 1996), this observed narrow line width is abnormally larger than the value calculated by $M_{BH} - \sigma_{[OIII]}$ relationship in AGNs ($M_{BH} \sim 3.98 \times 10^9 M_\odot$, Wu 2009), which suggests a large mass within the NLR, and/or strong interactions between the emerging jet and dense material therein.

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