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VLA Images of two Extended Radio Galaxies

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Abstract. There is some evidence from earlier studies that the two sources $0235-197$ and $1203+043$ exhibit low frequency (< 1 GHz) variability. This work shows that both sources have linear polarizations, if any, below the detection limits at 320 MHz, so we cannot explain the variability as being due to instrumental polarization effects as has been suggested for 3C159. Refractive scintillation may be the cause of the variability in 0235−197. The radio source 1203+043 lacks any bright compact component thereby ruling out a refractive scintillation mechanism for its variability. Consequently, it is possible that claims of variability in this source are spurious. However, the 320 MHz VLA observations show that 1203+043 has an 'X'-shaped radio structure.

1. Introduction

As part of our investigation of steep-spectrum ($\alpha > 0.5$, S$\propto \nu^{-\alpha}$), low-frequency-variable (LFV; $\nu < 1$ GHz) sources (Mantovani et al. 1992), we have made a series of VLA images with sub-arcsecond resolutions of the two sources $0235-197$ and $1203+043$. The aim was to detect the high-brightness components required by the refractive scintillation model for low-frequency variability (Rickett 1986). Alternatively, the variability, detected with linearly polarized antennas, might be explained as an instrumental effect. The plane of polarization of the emission could be rotated by changes in ionospheric Faraday rotation relative to the antenna's dipole as found by Cerchiara et al. (1994) for 3C159. In order to test if ionospheric Faraday rotation is the cause of the apparent variability of 0235−197 and 1203+043 we have investigated the linear polarizations of these sources at 320 MHz with the VLA in the 'A' configuration and with the already available 5 GHz VLA C-array data. Both sources were also observed in the X (8.4 GHz) and U (15 GHz) bands. These observations allowed high resolution images of the 'hot spot' regions to be made. The images were combined with available, high-resolution, C band observations to produce rotation measures (RMs) for the outer parts of the sources. The images obtained at 320 MHz for the two sources are shown in Figure 1.

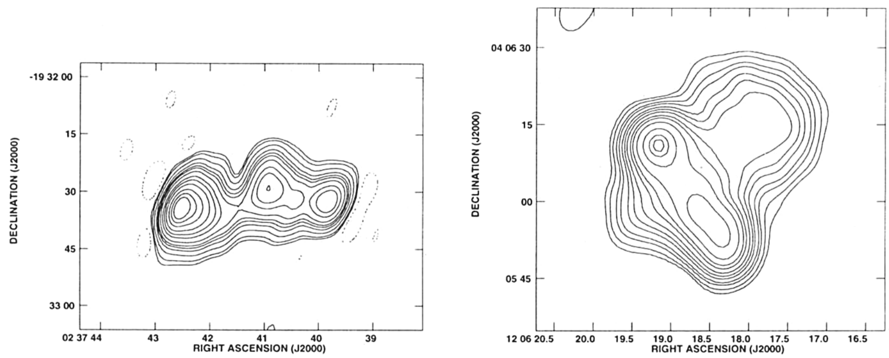

Figure 1. VLA image of 0235−197 and 1203+043 at 320 MHz. Contours are at −5, 5, 10, 20, 50, 100, 150, 200, 300, 500, 700, 1000, 1500, 2000, 2500 mJy beam^{-1}. The peak flux densities are 3430 mJy beam^{-1} and 800 mJy beam^{-1} respectively.

2. Conclusions

We have conducted a program of multi-wavelength VLA observations of the suspected low frequency variable sources 0235−197 and 1203+043. Since 0235−197 is not polarized at 320 MHz, its variability cannot be accounted for by instrumental polarization effects as in the case of 3C159. 0235−197 may contain a low frequency component sufficiently compact and bright as required by the refractive scintillation model for low frequency variability. Our observations have insufficient resolution to test this suggestion; low frequency VLBI observations are required for this purpose. However, this component would have to have extremely unusual properties among hot spots in radio sources.

In our high frequency images of 1203+043 we have identified the core of the radio source; its location indicates that the source has a large apparent asymmetry. At 320 MHz, this source shows no polarization. However, it does have an additional, steep-spectrum component at this frequency; this previously-undetected component lies perpendicular to the main axis and predominantly to one side. However, the overall morphology of 1203+043 at low frequencies seems similar to that of the 'X'-shaped sources like NGC326. From its morphology and component sizes, we conclude that 1203+043 is likely not variable at low frequencies and that its inclusion in such catalogs is spurious.

References

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Rickett B.J., 1986, ApJ, 307, 564