Measuring the flux densities of the Orion nebula, Crab nebula and 3C273 using the 26m HartRAO telescope

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Abstract

This paper discusses the measurement of the flux densities of the Orion nebula, Crab nebula and 3C273.

1 Introduction

The methods we are using are not limited to point sources and objects which possess disc-like brightness. They are equally valid with irregular celestial objects that vary in brightness across their extent. We seek to discover the flux density spectra of both the Orion and Crab nebulae and also investigate the flux density spectrum of the first pulsar to be discovered, 3C273

2 Theory

The following equations are extracted from Gaylard (2005)

$$\Theta_{\Sigma} = (\Theta_A^2 + \Theta_S^2)^{0.5} \quad (1)$$

$$K_S = 1 + (\frac{\Theta_S}{\Theta_A})^2 \quad (2)$$

where Θ_{Σ} is approximated by the θ_{HPBW} of the non-trivial source. Θ_A is approximated by the θ_{HPBW} acquired from the point source during the initial calibration. This enables us to calculate Θ_S, as used in the equation 2 to calculate the size correcting factor.

3 Procedure

Drift scans were taken of the Orion nebula, Crab nebula and 3C273. The information was manipulated as discussed in Carr (2005a). The flux densities were

discovered as discussed in Carr (2005b). The nebulae could not be considered either point sources or disc-like sources, and the correction factor given in equation 2 was utilised. 3C273 is a pulsar and can therefore be treated like a point source.

4 Results

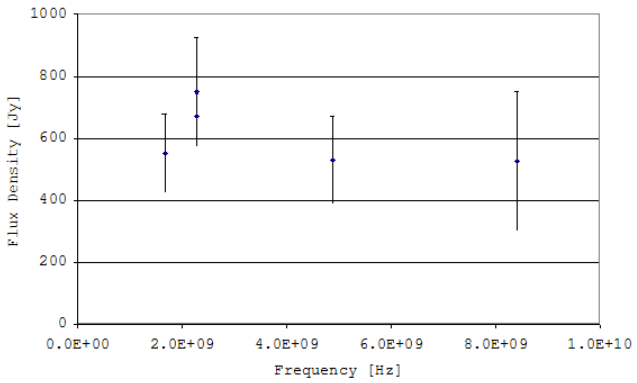

Figure 1: flux density spectrum for the Orion nebula: lcp receiver

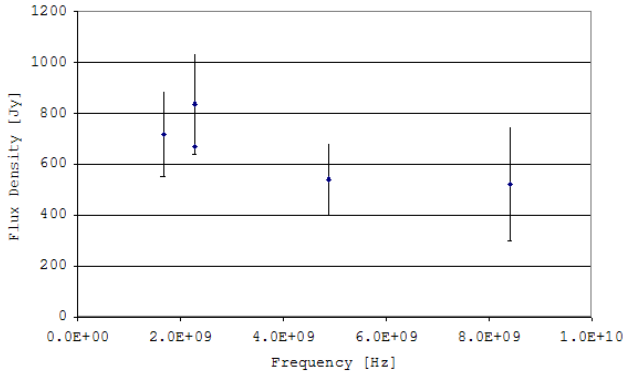

Figure 2: flux density spectrum for the Orion nebula : rcp receiver

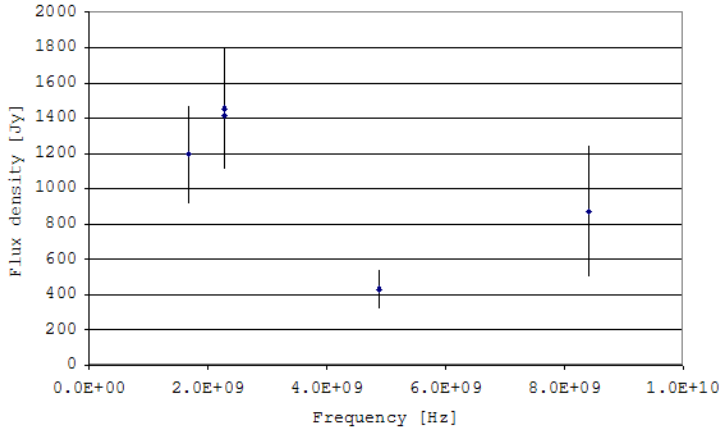

Figure 3: flux density spectrum for the Crab nebula : lcp receiver

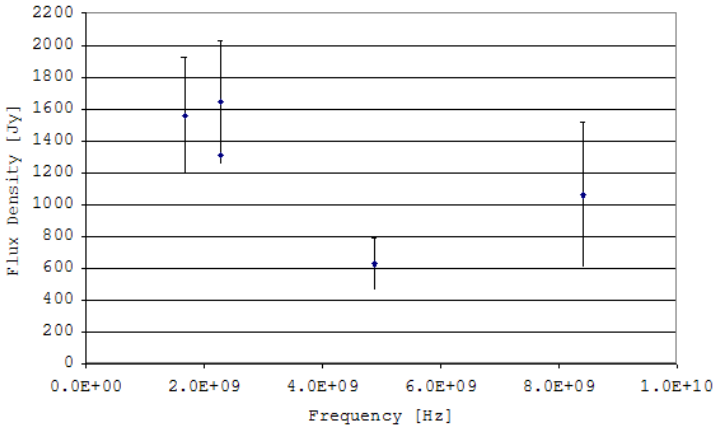

Figure 4: flux density spectrum for the Crab nebula : rcp receiver

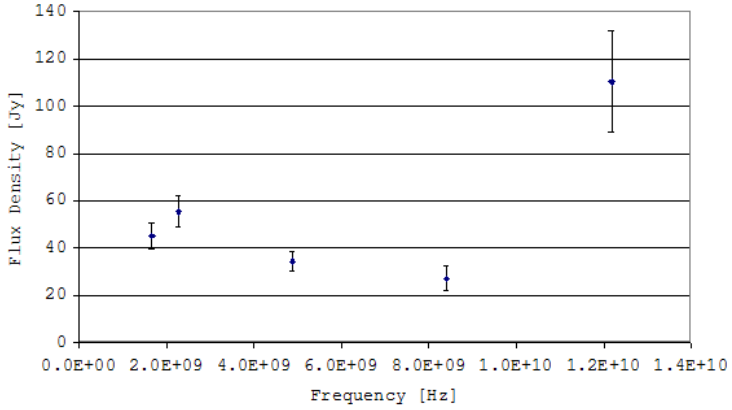

Figure 5: flux density spectrum for 3C273 : lcp receiver

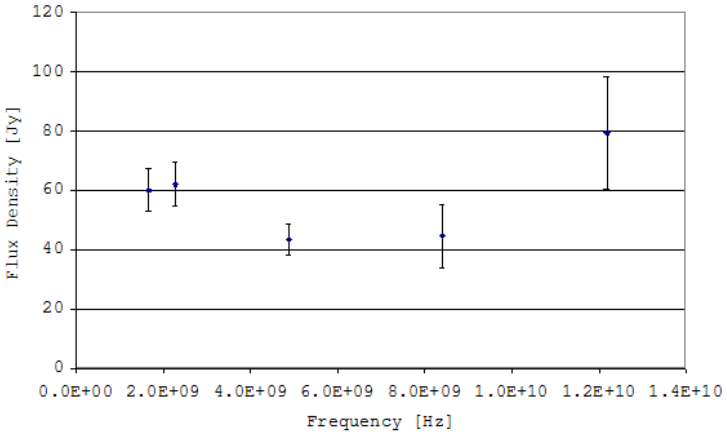

Figure 6: flux density spectrum for 3C273 : rcp receiver

5 Discussion

The separate flux density spectra, measured by both the left and right hand circularly polarised receivers, were maintained as they reveal polarity characteristics inherent to the sources. The Orion nebula shows no immediate preference for either left or right hand polarised radiation, as the measured flux densities for both polarisations fall within each others error bars. 3C273 seems to source more left hand circularly polarised radiation, as considerably higher flux densities are measured by the left hand circularly polarised receivers. The

Crab nebula seems to produce an abundance of right hand circularly polarised radiation, justified by the same reasoning.

6 Conclusion

Flux density spectra were successfully constructed for the Orion nebula, Crab nebula and 3C273 by acquiring the flux densities at each of the receiver wavelengths. Radiation from the Orion nebula was not polarised, while radiation from 3C273 and the Crab nebula were left and right hand circularly polarised respectively.

References

Carr, D. (2005a), *The calibration of the 26m HartRAO telescope*.

Carr, D. (2005b), *Measuring the brightness temperatures of Jupiter & Venus*.

Gaylard, M. J. (2005), *Practical Radio Astronomy a hi-math introduction*, Hartebeesthoek Radio Astronomy Observatory.