

Diffractive and refractive timescales at 4.8 GHz in PSR B0329+54

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We present the results of flux density monitoring of PSR B0329+54 at the frequency of 4.8 GHz using the 32-meter TCfA radiotelescope. The observations were conducted between 2002 and 2005. The main goal of the project was to find interstellar scintillation (ISS) parameters for the pulsar at the frequency at which it was never studied in detail. To achieve this the 20 observing sessions consisted of 3-minute integrations which on average lasted 24 hours.

Flux density time series obtained for each session were analysed using structure functions. For some of the individual sessions as well as for the general average structure function we were able to identify two distinctive timescales present, the timescales of diffractive and refractive scintillations. To the best of our knowledge, this is the first case when both scintillation timescales, $t_{\text{DISS}}=42.7$ minutes and $t_{\text{RISS}}=305$ minutes, were observed simultaneously in a uniform data set and estimated using the same method.

The obtained values of the ISS parameters combined with the data found in the literature allowed us to study the frequency dependence of these parameters over a wide range of observing frequencies, which is crucial for understanding the ISM turbulence. We found that the Kolmogorov spectrum is not best suited for describing the density fluctuations of the ISM, and a power-law spectrum with $\beta=4$ seems to fit better with our results. We were also able to estimate the transition frequency (transition from strong to weak scintillation regimes) as 10.1 GHz, much higher than was previously predicted.

We were also able to estimate the strength of scattering parameter $u=2.67$ and the Fresnel scale as 6.7×10^8 meters.

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