Astrophys Space Sci (2013) 348:155–162
DOI 10.1007/s10509-013-1551-x

ORIGINAL ARTICLE

The Stokes phase portraits of descattered pulse profiles of a few pulsars

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Received: 26 December 2012 / Accepted: 26 June 2013 / Published online: 17 July 2013

Abstract The observing signals from pulsar are always influenced by the interstellar medium (ISM) scattering. In the lower frequency observation, the intensity profiles are broadened and the plane of polarization angle (PPA) curves are flattened by the scattering effect of the ISM. So before we analyze the scattered signal, we should take a proper approach to clear scattering effect from it. Observing data and simulation have shown that the Stokes phase portraits I–U, I–Q and Q–U are also distorted by the ISM scattering. In this paper, a simulation is held to demonstrate a scattering and a descattering of the Stokes phase portraits of a single pulse profile of a pulsar. As a realization of the simulation method, this paper has studied the descattering of Stokes phase portraits of lower frequency observation of PSR B1356−60, PSR B1831−03, PSR B1859+03, PSR B1946+35.

Keywords Stars: pulsar · Interstellar medium

1 Introduction

ISM always cause scintillation and scattering effect to the pulse signals of pulsar (Scheuer 1968) and it may damages some of the observing data. The scattering effect of ISM to the pulse profile and the PPA curve have been studied by many authors (Rankin et al. 1970; Kuzmin and Izvekova 1993; Bhat et al. 2003; Li and Han 2003; Rusul et al. 2012). Some of them have put forward a several useful model to interpret the observing phenomena of pulse broadening and PPA curve flattening (Rankin et al. 1970; Komesaroff et al. 1972; Williamson 1972); some of them have studied a model to recover original pulse shape (Kuzmin and Izvekova 1993; Bhat et al. 2003) and PPA curve of some pulsars from scattering effect (Rusul et al. 2012).

As mentioned above, the Stokes parameters are disturbed by a scattering effect when the signal travels in the ISM, so it is natural to think that the ISM scattering can affect the Stokes phase portraits of I–Q, I–U and Q–U. Until now a very few attempts are made to the study of the Stokes phase portraits which hold additional information of the emission geometry of pulsar. Through frequent observation and studying, researchers put up a several models such as the Radius-to-frequency mapping (RFM) model (Lorimer and Kramer 2005) and the Rotating-vector model (RVM) (Radhakrishnan and Cooke 1969) which were closely related to the geometry of pulsar emission surface. But, recently, researchers (Chung and Melatos 2011a, 2011b) have analyzed the observing data of some pulsars in a Stokes phase portraits form and they found that the Stokes phase portraits of 24 pulsars have shown that the emission heights inferred from the Stokes tomography technic (Chung and Melatos 2011a) are different from the emission heights derived from the RFM model. The Stokes phase portraits of known low-latitude emission of 24 pulsars they examined revealed that the 60 % of them may well originated from high altitudes (Chung and Melatos 2011a). By considering the importance of studying the Stokes phase portraits, we continued the previous work (Rusul et al. 2012), in which

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