J. Astrophys. Astr. (2011) **32,** 333–335

Phase-Resolved Spectra of PSR B0525+21 and PSR B2020+28

J. L. Chen[1,2], H. G. Wang[3,*] & N. Wang[1]
[1]*Xinjiang Astronomical Observatory, 150, Science-1 Street, Urumqi, Xinjiang 830011, China.*
[2]*Graduate University of the Chinese Academy of Scienes, 19A Yuquan Road, Beijing 100049, China.*
[3]*Center for Astrophysics, Guangzhou University, Guangzhou 510006, China.*
[*]*e-mail: cosmic008@yahoo.com.cn*

Abstract. Using the published data of multi-frequency time-aligned pulse profiles from Kuzmin *et al.* (1998), we calculate the phase-resolved spectra of PSRs B0525+21 and B2020+28. The results reveal that conal-double pulsars have common 'M'-shaped phase-resolved spectra.

Key words. Pulsar—emission mechanisms—phase-resolved spectra.

1. Introduction

It is well known that pulse widths and shapes of average pulse profiles vary with frequency for many radio pulsars, which indicates that the spectra depend on pulse phases. In literature, some authors analysed the component spectra for normalised phases (e.g., Lyne & Manchester 1988), based on the conjecture of emission radius to frequency mapping (RFM, Cordes 1978), i.e., emission at different frequencies is generated at different locations in the pulsar magnetosphere (hence different phases). Whereas Chen *et al.* (2007) calculated the spectra for absolute phases (phase-resolved spectra) for PSR B1133+16, and argued that phase-resolved spectra are physically significant to reveal the spectral variation in pulsar magnetosphere. In this paper, we analysed the radio phase-resolved spectra of PSRs B0525+21 and B2020+28, which shows the same type of spectral feature as PSR B1133+16.

2. Data reduction and results

Similar to PSR B1133+16, PSRs B0525+21 and B2020+28 are typical conal-double pulsars (Rankin 1990), of which the width of the average profile decreases with frequency. With the assumption that the spectrum at any phase interval is described as a single power law, $I \propto f^{-\alpha}$, the relative spectra index with respect to a reference phase interval, i.e., $\lambda = -(\alpha_{\rm i} - \alpha_0)$, can be obtained by fitting the relative intensity $I_{\rm i}/I_0$ and observing frequencies, where subscripts 'i' and '0' correspond to arbitrary and reference phases, respectively. The pulse profiles at 0.1, 0.2, 0.4, 1.4 and 4.7 GHz for PSR B0525+21 and 0.4, 0.6, 1.4 and 4.7 GHz for PSR B2020+28 are obtained from the papers by Kuzmin *et al.* (1998). The pulse profiles are divided into 32 and 26 phase bins of equal width for PSRs B0525+21 and B2020+28, respectively.

Figure 1 shows 'M'-shaped phase-resolved spectra for these two pulsars, which is approximately symmetrical between the leading and trailing halves. The spectra are

steep at the edge of the pulse profiles, while flatter in the middle, accompanied by a 'bridge' in the center. Combining the results derived from PSR B1133+16 (Chen *et al.* 2007), it shows that the 'M'-shaped phase resolved spectra may have common features for typical conal-double pulsars with narrowing pulse profiles at higher frequencies. It indicates that the physical condition or process are almost symmetric in the leading and trailing halves of the pulsar magnetosphere for these pulsars.

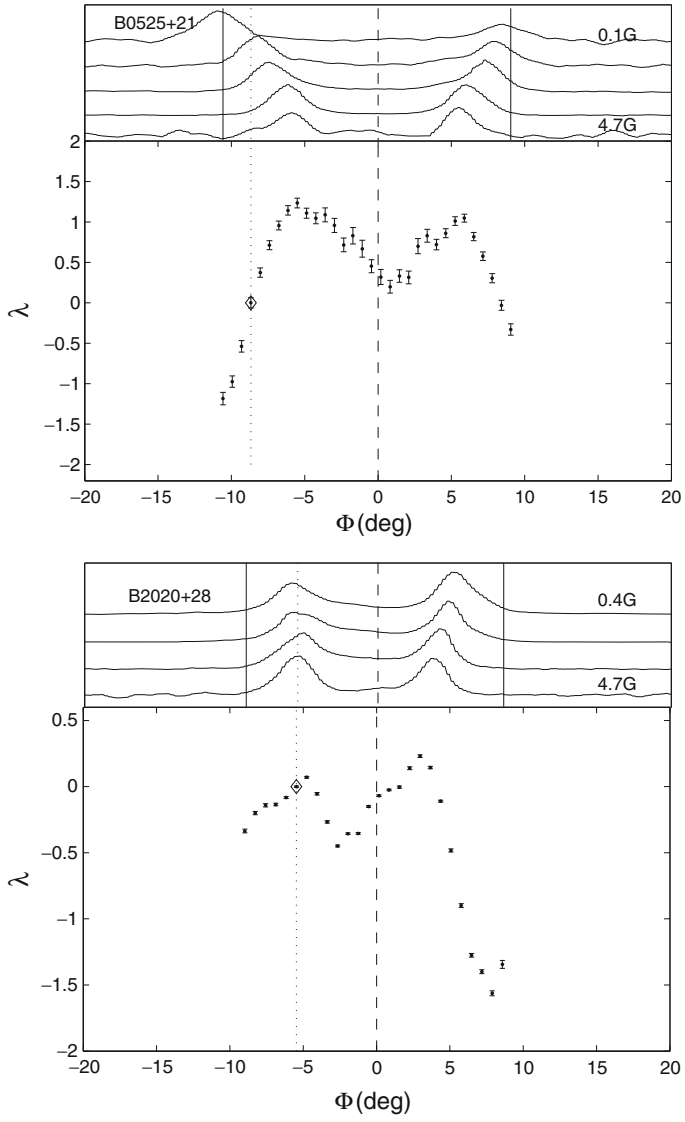

Figure 1. Average pulse profiles (upper) and phase-resolved spectra (lower) for PSRs B0525+21 and B2020+28, and the diamond in the lower panel represents relative spectra index at the reference phase. The solid lines in the upper panel are pulse profile boundaries, and the dashed and dotted lines correspond to the central phase and the reference phase, respectively.

Acknowledgements

This work was supported by the Knowledge Innovation Program of the CAS No. KJCX2-YW-T09, Bureau of Education of Guangzhou Municipality (No. 11 Sui-Jiao-Ke (2009)), GDUPS (2009) and NFSC project 10673021.

References

Chen, J. L. *et al.* 2007, *Chinese J. Astron. Astrophys.*, **7**, 789.
Cordes, J. M. 1978, *Astrophys. J.*, **222**, 1006.
Kuzmin, A. D., Izvekova, V. A., *et al.* 1998, *Astron. Astropys., Suppl. Ser.*, **127**, 355.
Lyne, A.G., Manchester, R. N. 1988, *Mon. Not. R. Astron. Soc.*, **234**, 477.
Rankin, J. M. 1990, *Astrophys. J.*, **352**, 247.