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Analysis and discussion of a sample of 25 gigahertz-peaked spectra pulsars

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Abstract. We identified gigahertz-peaked spectra behavior from our radio interferometric observations at low frequencies using the Giant Metrewave Radio Telescope. We modeled the turnover spectra based on thermal free-free absorption in the interstellar medium. The free-free absorption is believed to be responsible for the inverted spectrum. Using the model, we were able to put some observational constrains on the physical parameters of the absorbing matter, which allows us to distinguish between the possible sources of absorption.

Keywords. pulsars, radio spectra

In recent years a new class of pulsars has been identified with a distinct spectral nature showing a turnover around 1 GHz. These sources, named the gigahertz-peaked spectra (GPS) pulsars, exhibit the typical power law spectrum at higher frequencies, but at low frequencies their observed flux decreases with frequency and the corresponding spectral index becomes positive. The GPS phenomenon in pulsars was first identified by Kijak, Gupta & Krzeszowski (2007) and have subsequently been established as a separate group within the pulsar population by Kijak *et al.* (2011a, b, 2013), Dembska *et al.* (2014). Using the newly acquired interferometric data and the previously published flux measurements we constructed the spectra for all pulsars that either exhibit the GPS behavior or had been suspected to do so before our recent observations. So far 25 GPS pulsars were identified, a number that is steadily growing over the past few years Kijak *et al.* (2017a, b).

It is very likely, that the GPS phenomenon in pulsars is a result of thermal absorption of the pulsar flux in peculiar neutron star environments or in the dense interstellar medium along the line of sight. The idea of the thermal free-free absorption as the source of the low frequency spectral turnovers in pulsars was first proposed by Sieber (1973) and later was proposed to explain the GPS spectra of pulsars and magnetars by Kijak *et al.* (2011a, 2013). A detailed study was conducted by Lewandowski *et al.* (2015) and Basu *et al.* (2016), Rajwade, Lorimer & Anderson (2016), where the low frequency turnover in the spectral shape was successfully modeled using thermal absorption. A comprehensive analysis of the currently known GPS pulsars using the model is shown in Kijak *et al.* (2017a, b). The appearance of the GPS spectrum is related to the peculiar environments (such as PWNs, HII regions, etc.) around these objects (see also Rożko *et al.* in the same proceedings). Here, we present a sample of 25 gigahertz-peaked spectra pulsars in Table 1 and examples of new GPS pulsars in Figure 1.

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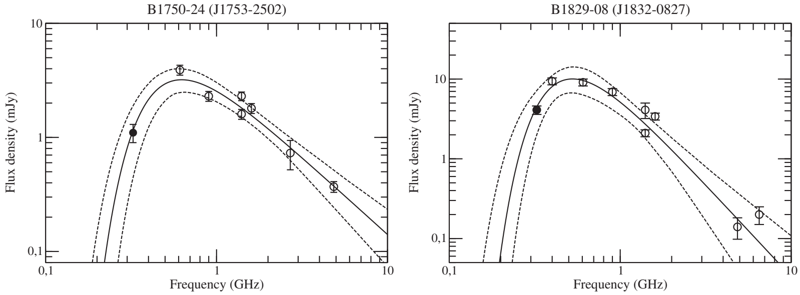

Figure 1. Examples of new GPS pulsars (Kijak *et al.* 2017b). The empty symbols show flux from the literature. Our measurements were denoted by filled circles. The solid line represents the thermal absorption model fit for the observed data with 1σ envelope (dashed lines).

Table 1. The remarks column indicates definite or possible associations of the neutron star with a supernova remnant nebula (SNR), a pulsar wind nebula (PWN), an H II region, or an unidentified X-ray source from the HESS catalog.

PSR	DM (pc cm^{-3})	Age (kyr)	ASSOCIATION
B1054−62	320	1870	H II (BBW 328)
B1259−63	146	332	Be star
J1550−5418	830	1.41	Radiomagnetar, SNR
J1622−4950	820	4.03	Radiomagnetar, SNR, PWN?, H II
B1641−45	479	359	HESS, (near Westerlund 1 globular cluster)
J1723−3659	254	401	
J1739−3023	170.0	0.16	PWN
J1745−2900	1778	3.40	Radiomagnetar, SGR A*
B1750−24	672.0	0.59	
B1754−24	179	0.29	3EG
B1800−21	234	15.8	SNR, HII (W30)
J1809−1917	197	51.3	X:bow shock PWN SNR?, H II?, HESS
B1820−14	651	3.75	
B1822−14	357	195	SNR, H II
B1823−13	231	21.4	X:PWN
B1829-08	300	0.16	XRS:PWN
B1830-08	411	0.15	XRS:PWN
J1835−1020	114	810	
B1838−04	325	461	3EG
J1841−0345	194	55.9	H II?
J1852−0635	171	567	
J1901+0510	429	313	
J1905+0616	256	0.12	SNR ?
J1907+0918	358	38	SNR ?
J2007+2722	127	404000	

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