

論文 / 著書情報  
Article / Book Information

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種別(和文)	論文要旨
Type(English)	Summary

## 論文要旨

## THESIS SUMMARY

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申請学位 (専攻分野)： 博士

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要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words )

Pulsars are rapidly-rotating and highly-magnetized neutron stars. Their magnetospheres are very efficient natural particle accelerators which can produce beamed electromagnetic radiation in broad energy bands. Therefore pulsars have been observed as pulsating source at various wavelengths from radio to  $\gamma$ -ray. The *Fermi Gamma-ray Space Telescope (Fermi)* have increased the number of detected  $\gamma$ -ray pulsars to more than 200 from seven by the earlier missions. Nearly half of them are “young” (characteristic age  $\tau_c < 100$  kyr) pulsars, whereas the other half of them are “millisecond” pulsars. Comparison of  $\gamma$ -ray pulsation with other energy pulsation have revealed populations of “radio-quiet”  $\gamma$ -ray pulsars. Multiwavelength studies of pulsars have yielded keys to understanding the radiation mechanism in the pulsar magnetosphere.

In this thesis, we focus on a young pulsar PSR J2022+3842. It has the pulse period  $P$  of 48.5 ms and its derivative  $dP/dt$  of  $8.6 \times 10^{-14}$  s/s, indicating that it is similar to the well-studied Vela pulsar in its spin-down energy rate  $dE/dt$  of  $3.0 \times 10^{37}$  erg/s<sup>-1</sup> and its characteristic age  $\tau_c$  of 8.9 kyr. In  $\gamma$ -ray sky, PSR J2022+3842 is a faint source and located in a high background area called “Cygnus region”. Although radio and X-ray pulsations were observed by Arzoumanian et al. (2011) and Arumugasamy et al. (2014), PSR J2022+3842 had not been detected as a  $\gamma$ -ray pulsar before this work. We re-analyzed the high-energy (>100 MeV)  $\gamma$ -ray data obtained with the Large Area Telescope (LAT) on board the *Fermi*. We performed  $\gamma$ -ray spectral and timing analyses using the *Fermi* Science Tools, TEMPO2, and other standard tools.

We made a  $\gamma$ -ray sky model based on the third *Fermi* LAT catalog for point sources. To compare the  $\gamma$ -ray timing and spectral analysis with those in other energy bands, we analyzed the radio data obtained with the Robert C. Byrd Green Bank Telescope (GBT), the X-ray data from *Rossi X-ray Timing Explorer (RXTE)* and the X-ray Multi-Mirror Mission (XMM-Newton).

We report the robust detection of  $\gamma$ -ray pulsation from PSR J2022+3842. Its spin-down energy rate  $dE/dt$  is the fourth largest among all the known  $\gamma$ -ray pulsars. Its  $\gamma$ -ray pulse profile has a narrow main pulse peak and a faint inter-pulse peak at the same phases as those in the radio and X-ray pulse profiles. The  $\gamma$ -ray pulse shape and the phase separation are typical of young pulsars while the phase lag of the  $\gamma$ -ray peak with respect to the radio peak is 0.07, the smallest among the known pulsars. We also found anomalous behavior such as a very small glitch around MJD 55470, sudden shifts of the pulse period and its derivative before MJD 55000 and after MJD 55070, and sudden reduction of pulse intensities. Spectral investigation shows a large photon index  $\Gamma$  of  $-3.3$  implying a contamination of the pulsar wind nebula of PSR J2022+3842. The  $\gamma$ -ray flux of PSR J2022+3842 seems to vary in coincidence with the unusual timing event.

In conclusion, we successfully established PSR J202+3842 as a  $\gamma$ -ray pulsar. Although PSR J2022+3842 is a typical Vela-like pulsar in its pulsar parameters, it shows unique properties in its pulse shape, spectrum and glitch. PSR J2022+3842 also showed an anomalous frequency variation coincident with a temporal flare, implying a new transient phenomenon in the pulsar magnetosphere. These results would help constrain the radiation mechanism and the magnetosphere geometries of young pulsars.

This thesis is structured as follows. In Chapter 2 we overview the current understandings of pulsars and recent observations. Chapter 3 describes the properties of PSR J2022+3842. Then the instrumentations, data sets and analysis method we used in this study are described in Chapter 4 and in Chapter 5. Results of the timing and spectral analysis are presented in Chapter 6. In Chapter 7, we discuss the observational results of PSR J2022+3842 comparing other pulsars. We give our conclusion in Chapter 8.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note：Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).

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