

Abstract

The study on pulsar map aims to (1) create an interstellar map to the solar system based on known pulsars, and (2) create a pulsar map that points to other planetary systems. The data for each pulsar comes from the Australia Telescope National Facility (ATNF) database, and the SIMBAD astronomical database is used to find stars with life habitats. The TRAPPIST-1 star system was selected for this study. It is a star system in which some of the planets are in habitable zones that could support life. According to the results, a pulsar could not be detected in all directions. This depends on the pulsar's pulse width and the angle of observation. The pulse width of each pulsar varies depending on the pulsar's rotation period. So not all pulsars can be used, it depends on the area where the signal is observed.

Introduction

A pulsar map is the starburst-like diagram that shows the location of the solar system relative to known pulsars. In 1971, the pulsar map was sent into space with Pioneer 10 spacecraft in the hope that any creatures that discover the ship will be able to comprehend the pulsar map. Pulsars are all different because of their rhythmic radiation. To determine the positions of the solar system, it needs at least three pulsars to find the intersection of the pulsar's radio beam. The pulsar map is made up of 14 pulsars, with the dash representing binary numbers and the intersection of the pulsar's radio beam representing the solar system's positions. The binary numbers represent each pulsar's self-rotation rate, while the length of the line drawn between the solar system and each pulsar represents the distance between the two. We are interested in how to create and read the pulsar map as well as how to make a map with destination on another exoplanet.

Materials and Method

PART 1: Create a pulsars map using ATNF

1. Define the pulsar data required for mapping, including pulsar spacing, galactic coordinates, rotation period, and distance of the galactic center.
2. Find the desired pulsar information from ATNF database.
3. Convert each position's coordinates into a cartesian coordinate system, with the sun as the centerpiece.
4. Choose pulsars that meet the following criteria for mapping: 1) Earth distance, 2) rotation period less than 1 second, 3) variety of directions.
5. Create a map using the rotation period of the pulsar in a binary number system based on the HI transition unit.

PART 2: Create a pulsar map for other planetary systems

1. Obtain the coordinates of TRAPPIST-1 data from the SIMBAD astronomical database and convert them into cartesian coordinate system. Then move the center from Earth to TRAPPIST-1.
2. Use the equation to calculate the pulsar's pulse width. (Lorimer & Kramer, p. 70, 2005):

$$\rho \approx \frac{5.4 P^{-\frac{1}{2}}}{s}$$

P is the rotation period of the pulsar, and ρ is beam angle (see Figure 1).

3. Determine the angle at which the pulsar is visible from trappist-1 (angle A), which must be less than 2ρ . As shown in Figure 2.

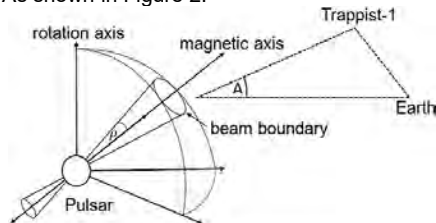


Figure 1: Pulsar Geometry

4. Select pulsars based on the following criteria: 1) a pulsar that can be observed from Earth, 2) a pulsar that is close to Earth, 3) a pulsar with a rotation period of less than 1 second, and 4) a pulsar with a variety of directions.

5. Make a map

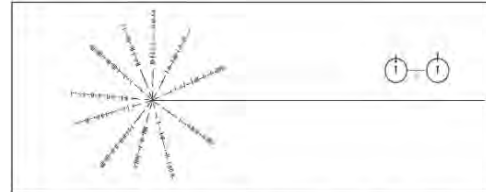


Figure 2: Pulsar map that pointing to solar system

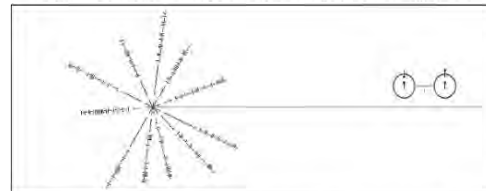


Figure 3: Pulsar map that pointing to TRAPPIST-1

Conclusions and Discussion

PART 1: Creating a pulsars map using ATNF

A pulsar map can be created by converting galactic coordinates to cartesian coordinates and selecting a pulsar with a close distance to Earth (see Figure 2). Choose a pulsar with a variety of directions and shorter rotation periods of 1 second as they become longer and signal more accurate over time. This pulsar map, on the other hand, will show the rotation period of pulsars in HI transition vibration period units.

PART 2: Creating a pulsar map for other planetary systems

To choose a pulsar, the pulsar's pulse width must be determined versus the angle at which the pulsar is observed to predict whether radio waves can be detected in that planetary system. Result is shown in figure 3. Different pulsars could also be used to make pulsar maps for other stars.

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References

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