TO STUDY THE PROPERTIES OF PULSARS USING THE DATA AVAILABLE FROM RXTE

Uma Kamboj [1*], Kiranjot Kaur[1], Saqlain Bin Mushtaq[1], Neha Munjal[1]

[1]Department of Physics, Lovely Professional University, Punjab, India-144411

Abstract

A Neutron star is formed when an ordinary star dies and a rotating Neutron star is called a Pulsar. Study of pulsars have also been beneficial for time keeping as they are considered among the most accurate known natural time keepers. The current work is used to analyse the time period of a Pulsar using the secondary data from NASA data archive.

INTRODUCTION:

Pulsars are quickly rotating, extremely magnetised neutron stars that were first seen through pulsed radio emission at a very down radio observing frequency of 81 MHz.
A pulsar is a highly magnetized rotating neutron star or white dwarf that is emitting a beam of electromagnetic radiation.

There are different types of pulsars i.e. CRAB PULSAR and VELA PULSAR. The Crab Nebula is the supernova remnant in the constellation of Taurus. A neutron star that formed when a massive star collapsed. The Vela pulsar is about 1,000 light years away from Earth, spansis about 12 miles in diameter, and makes over 11 complete rotations every second, faster than a helicopter rotor. As the pulsar whips around, it spit up out a jet of charged particles that race out along the pulsar's rotation axis at about 70% of the speed of light

MATERIALS AND METHODS:

Types of Data:

Data is used the secondary data in this study because it is quick and easy,and also it is short this data is in refined form nd relatively takes less time.

Software used:

We have used the software program HEASOFT. The HEASOFT software environment was designed to make it effortless for external projects to add their own software package for a new instrument or mission. The guidelines provide an overview of the process of developing a new data analysis package. Projects are encouraged to contact the HEASARC early in the evolution process for further information and assistance.Most of the general FITS file handling tools that any project will need are already provided in HEASOFT. The only new tasks that typically need to be formed are the mission-specific calibration and analysis tools for the new mission. Several example programs (in C, Perl) are provided in the HEASOFT package and can be used as a templet for writing new software tasks. Simple process for compiling and linking the software are also provided, so the programmer can also concentrate on writing the specific data analysis algorithm and need not to spend much effort on the mechanics of how that task will be integrated within the HEASOFT environment. Each HEASOFT task that is formed should also consider a unit test suite, which includes a set of input data file(s) for the task and the expected output files or text output. This unit test is re-executed whenever any change is made up to the task or to the larger software environment (e.g., new versions of libraries or compilers) to assure that the new output is still identical to the previously generated output.The software modules must maintained within a suitable code to tracks all modifications to the code. The HEASARC presently uses the Git revision control system.The HEASOFT tasks must needs run on a wide range of computer platforms used by external scientists. HEASARC staff reconstruct the local "development" version of the entire HEASOFT package on several different level on a routine basis. These systems are then accessible for testing by local scientists at GSFC. The process of writing a HEASOFT program is so simple enough, however, so that many of the existing HEASOFT tasks have been written by scientists without extensive scheduling experience.

Different Parts of HEASOFT:

1. FITSIO

2. FTOOLS

3. HERAThe needs for using Hera are:

(a) the FV FITS file viewer and editing program must be installed on the local machine.FV is the local client portal to the Hera services.

(b) There must be broadband access to the Internet

(c) and also access to a standard web browser such as Firefox or Internet Explorer.

4. SAO Image DS9
5. PROFIT
6. XSTAR

Types of File Extensions:

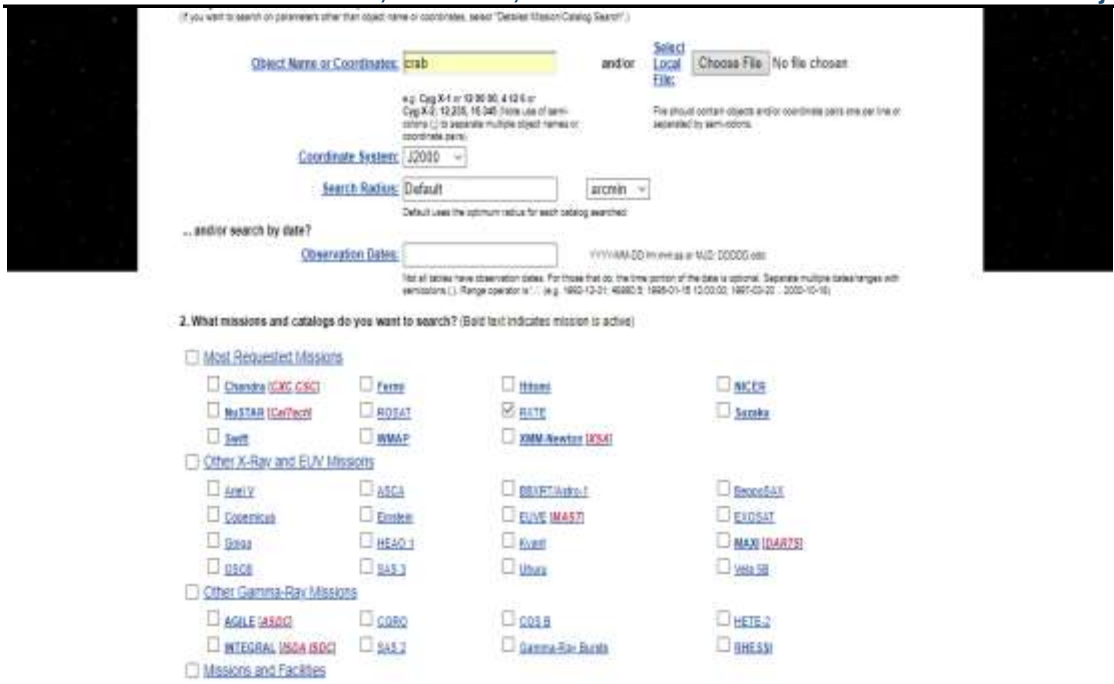
1. FITS FILE
2. TAR FILE
3. GPS FILE
4. LC CURVE

Steps to Download Data:

1. Firstly open the link given below:

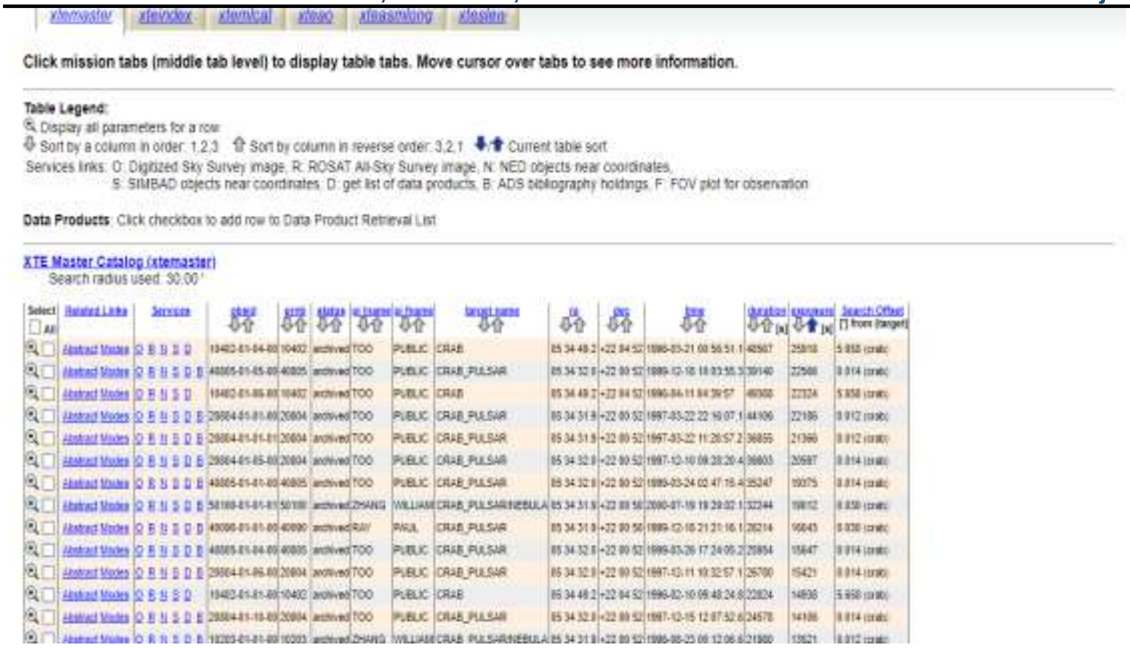
https://heasarc.gsfc.nasa.gov/docs/cgro/db-perl/W3Browse/w3browse.pl

2. In 1st dialog box, write Crab in the object name and in 2ndclick RXTE in most requested missions and then click on search button.



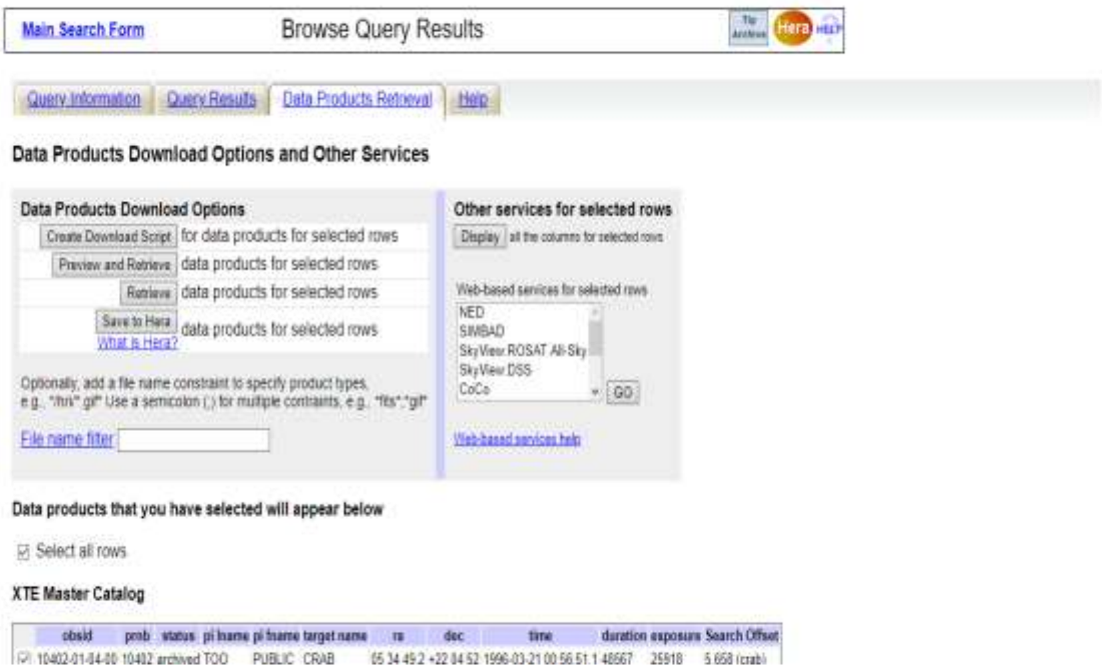
3. It will take some time and then click query results.

4. A table will pop up. Each row in the table is an observation with some exposure. Crab is a famous source, so there are a lot of observations and we can also search the same for Vela Pulsar.



5. To download a particular observation data, select it and click Retrieve Data Products for selected rows.

6. A new page will pop up. Click on retrieve and you will see a link to download the data.and from there the data can be downloaded.



About the Software:

After downloading the data,we can have the different plotting of data (Histogram) using the FV software.

Data Interpretation:

To study the time period of the crab pulsar. This pulsar is observed by the suzaku observation satellite equipped Hard X-ray detector (HXD).

Tool and Data used: fv, Fits file.

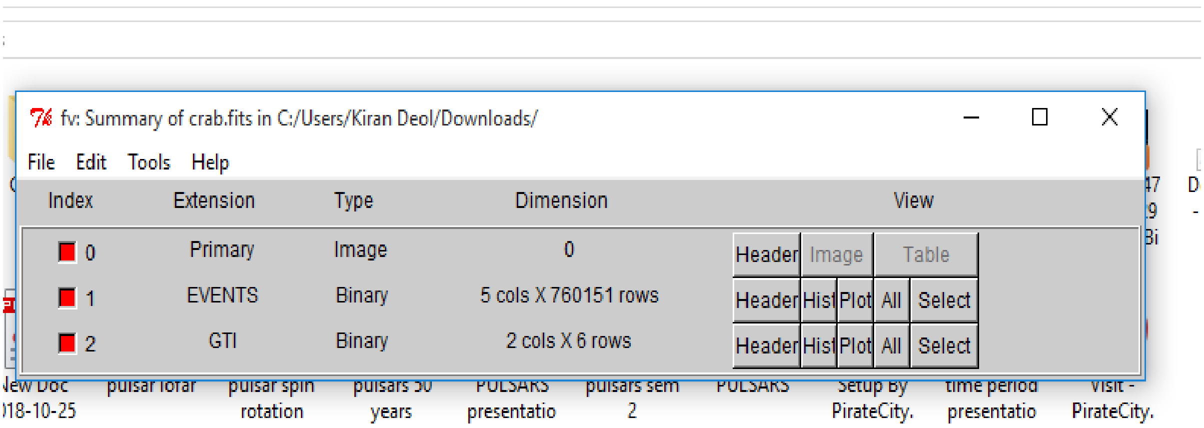
Pulsar and Neutron star: Crab.

Assignment Preparation: This assigment was prepared by Ken Ebisawa on 2008-12-25 and data was collected by the satellite on sep 15 2005.

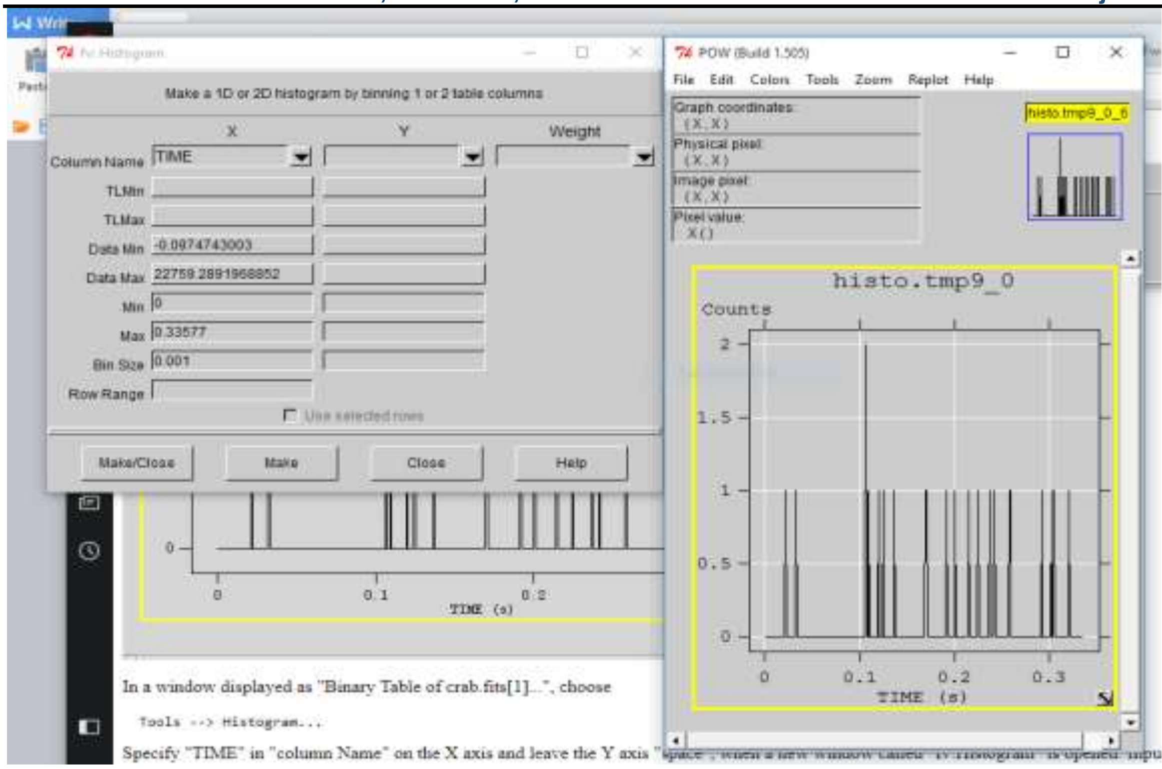
Time Analysis of Crab Pulsar:

Crab Nebula is a remant of supernova explosion that was first occured in 1054 AD. This pulsar is a revolving neutron star located at the centre of the crab nebula. The pulsar has magnetic poles as the earth has. pulsar has magnetic field strength about 1 trillion times as strong as that of earth. The pulsar is completely blinking like a beacon lamp,as two magnetic poles appears and disappears by turn. The revolving period of the pulsar is 0.03357701 sec precisely.

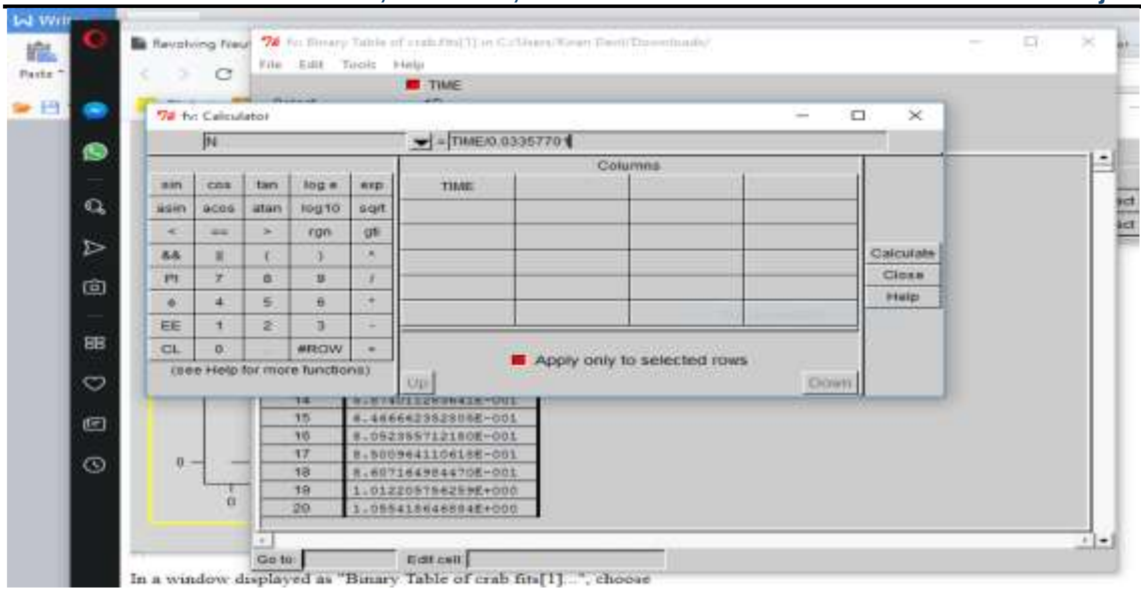
The data is in Fits file and it can be opened by using fv software.firstly,choose open file from the main menu of fv and select the file name. The file is divided into three extensions: in the “EVENTS” extension,the X-ray data is stored and from “ALL” all the contents of the “EVENTS” are shown. The detection time of the photon is written in the column called “TIME”. the origin of the detection time is called the starting time of the observation.



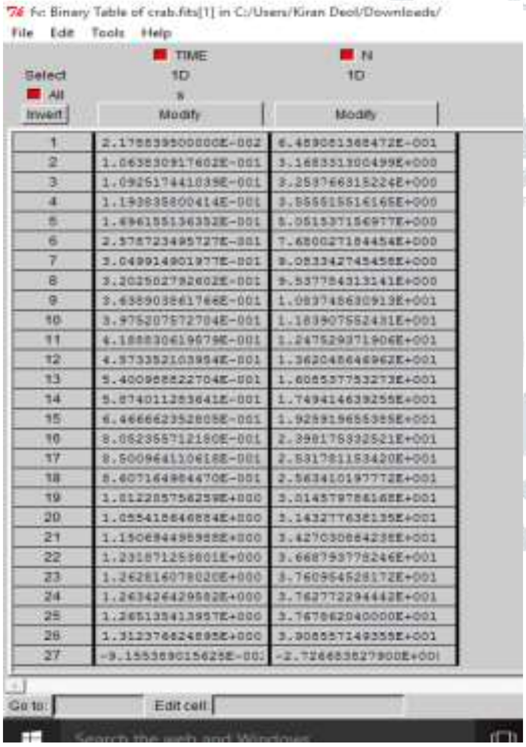
To see all data click on all,and to make histogram from tools click on Histogram. A table will be displayed ,from there specify time in column name on the x-axis and leave the y-axis space. And enter the minimum value=0.and maximum value=0.3357701 for 10 periods. And also enter the bin size=0.001.then click Make. Bin is the one unit period which means each time interval on the evenly divided time axis.



From the beginning,count the number of pulses N at the time when each photon reached. To find this divide the arrival time “TIME” of each photon b y the period “0.03357701”.where, N is the real number.

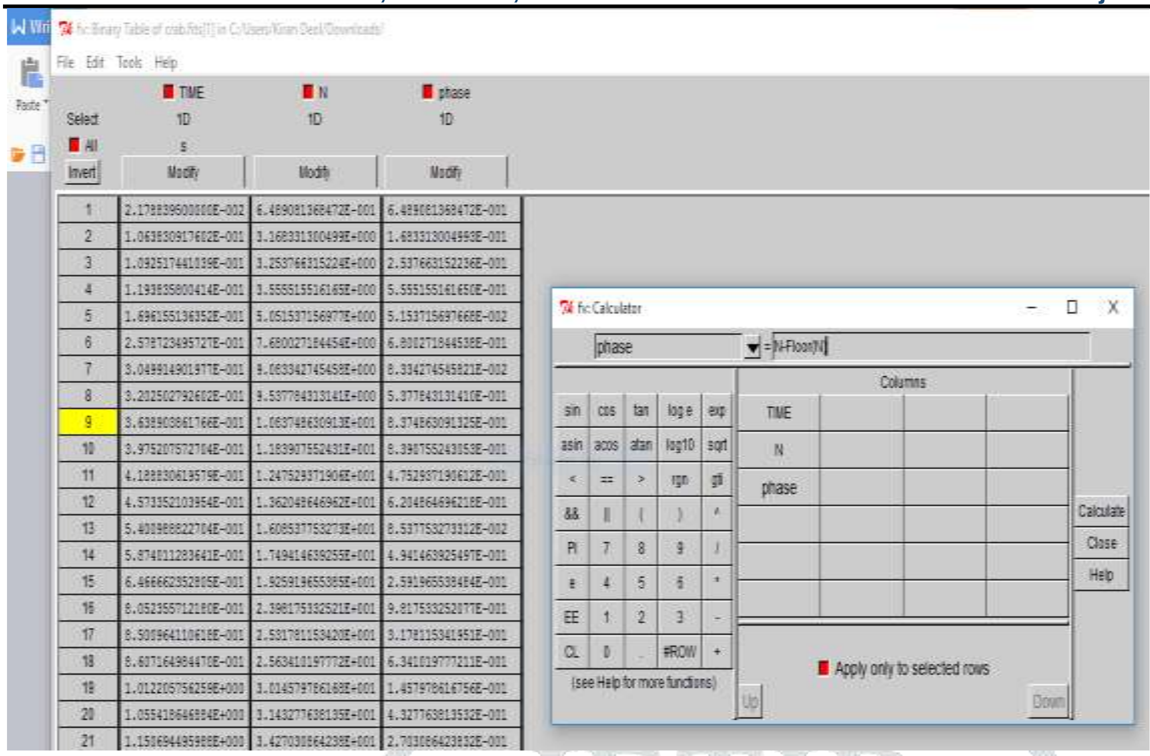


From tools,open calculator and type N=TIME/0.03357701 and click calculate. A new coulmn named N will be added to the data ,N is the real number.

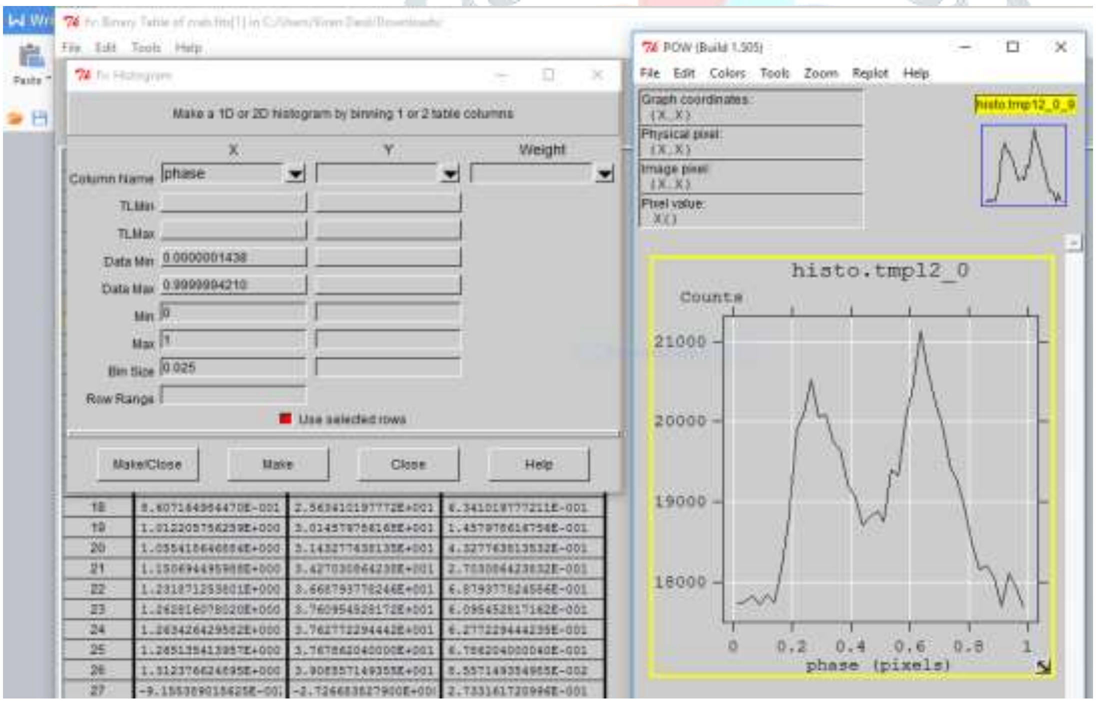


	TIME 1D	N 1D
1	2.175839500000E-002	6.480081368472E-001
2	1.063830917602E-001	3.168331300499E+000
3	1.092517441039E-001	3.253766815224E+000
4	1.193835800414E-001	3.555515516165E+000
5	1.696155136352E-001	5.051537156977E+000
6	2.578723495727E-001	7.680027184454E+000
7	3.049914901977E-001	9.083342745458E+000
8	3.202502792602E-001	9.537784313141E+000
9	3.638903861766E-001	1.083745630913E+001
10	3.975207572704E-001	1.183907552481E+001
11	4.188830619679E-001	1.247529371906E+001
12	4.573352103954E-001	1.362048646962E+001
13	5.400988822704E-001	1.608537753273E+001
14	5.874011283641E-001	1.749414639255E+001
15	6.466662352805E-001	1.925919655385E+001
16	8.052365712180E-001	2.398175332521E+001
17	8.500964110618E-001	2.531781153420E+001
18	8.607164984470E-001	2.563410197772E+001
19	1.012205756259E+000	3.014578786165E+001
20	1.055418646884E+000	3.143277638135E+001
21	1.150684495958E+000	3.427030864238E+001
22	1.231871253801E+000	3.668793778246E+001
23	1.262816078020E+000	3.760954528172E+001
24	1.263426429582E+000	3.762772294442E+001
25	1.265135413957E+000	3.767862040000E+001
26	1.312376624895E+000	3.908557149355E+001
27	-9.155369015625E-002	-2.726683627900E+000

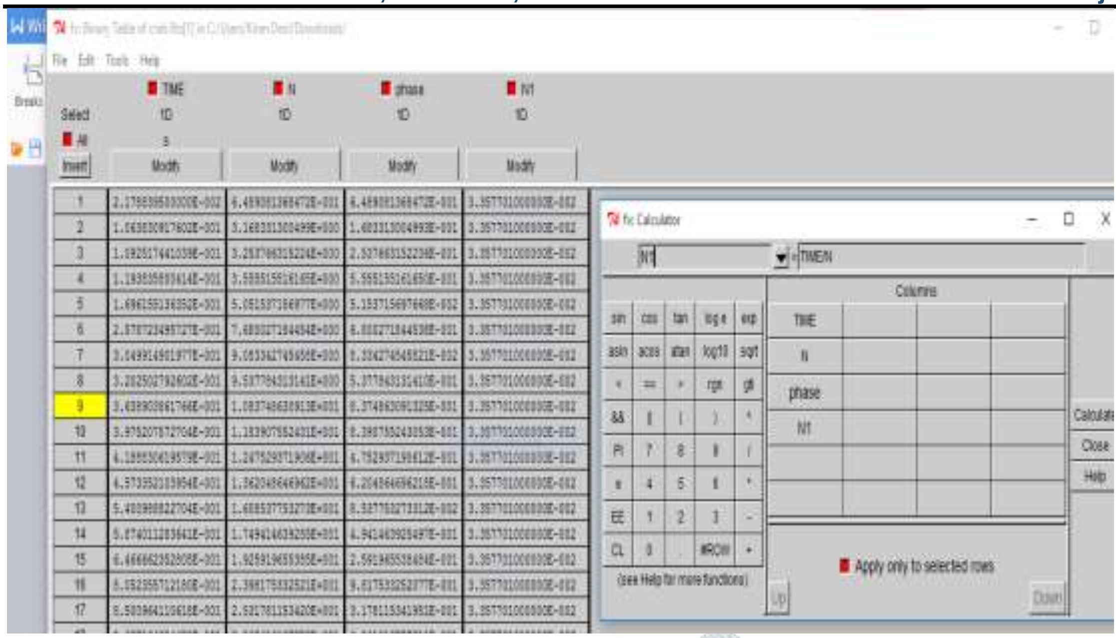
The decimal part of the N will only take values from 0 to 1,also mean the phase. The phase of each photon shows where the photon is detected in the pulse. And obtain the phase data onto a new column. In the calculator,type Phase= N-floor(N) and click calculate,a new column will be added called "phase" to the window and it can also be seen that phase is having the decimal part of "N".

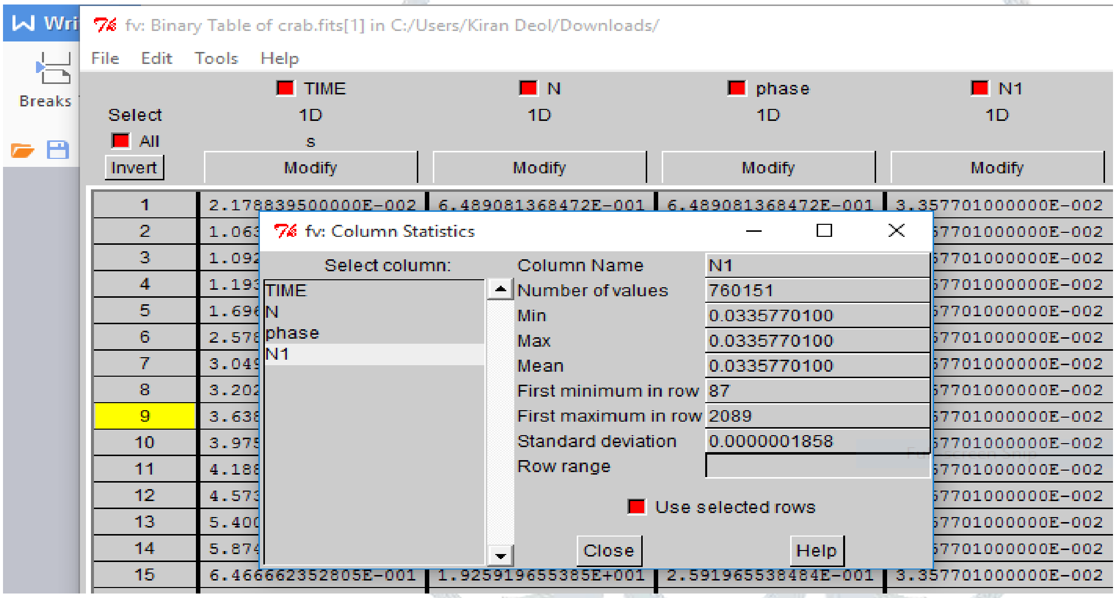


Now go back to the histogram again,specify "phase" to the x-axis and click make,after entering the values (Min=0,Max=1,and bin size=0.025).since 0.0335771 period is divided by 0.025 phase bin,and the length of one phase bin is 0.00084. it tells that 18000 to 21000 photons in one phase bin.as the pulsar revolves in one period,two magnetic poles appear and disappear turn by turn.it means there are two peaks.



Now,for time period enter N1=TIME/N in the calculator from the tools of the fv . A column will be added to the data named N1.





CONCLUSION: The data was collected from the official website of the NASA for the crab pulsar. The time period is calculated by the formula N1=Time/N . putting this formula in the calculator tool makes the new column and gives the time period for the given pulsar and mean of the time period can also be seen through the statistics. From the time period the RATE for the crab pulsar is also calculated.

It is the required time period of the crab pulsar that is 0.03357701.

Rate or frequency =1/Time Period

i.e. 1/0.03357701= 29.7822

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