Spin Down Ages (SDA code) v 2.0
User Manual

Andrei P. Igoshev

July 23, 2014

1 Introduction

This manual describes how to use program `spin_down_ages.out` (SDA code v 2.0) in order to correctly analyse magnetic field decay for an ensemble of pulsars. The basic assumptions, algorithm and constraints are described in the article A.P. Igoshev & S.B. Popov 'Modified pulsar current analysis: probing magnetic field evolution' (2014) which is currently available in ArXiv.org `http://arxiv.org/abs/1407.6269`. A source code of the program, this manual and additional information are available via the Internet `www.pulsars.info/decay.html`.

2 Difference between v 2.0 and v 1.0

The actual difference between v 1.0 and v 2.0 is the method of smoothing. In the first version we fitted by polynomial, while in the second version we use sliding mean in a window, that found to be more stable in our tests. The first version is available under personal request.

3 License

4 System requirements

- C++ compiler (e.g. g++-4.7)
- GSL (GNU Scientific Library) - see official web-site for details `http://www.gnu.org/software/gsl/`

5 Content of .tar archive

- `data.txt` - data file as an example.

- `gpl.txt` - GNU General Public License
- `main.cpp` - the source code of program.
- `Makefile` - makefile to compile program [1]
- `readme.pdf` - this manual
- `readme.txt` - text version of this manual

6 Compilation

Check if your C++ compiler is called `g++`. If it is not the case, change a variable `comp` in `Makefile`. Also check if the path to GSL is correct. Then, type in console:

make

After succesful run, this command should create an executive file `spin_down_ages.out` in current directory.

7 Usage

To perform magnetic fields decay analysis for your sample, type following command in console:

```
./spin_down_ages.out name_of_data_file stat_file result_file
```

Here `name_of_data_file` is a plain text file contains periods (in seconds; first column) and derivatives of periods (second column). Each individual pulsar should be placed at separate line. The example of `name_of_data_file` can be found in archive, it is called `data.txt` and contains information about relevant pulsars[2] from the ATNF catalogue [3].

The result files are called `stat_file` and `result_file`. The first of them contains distribution of analysed radio pulsars by spin-down ages. The first column is sequence number of averaging interval, the second column is ten-base logarithm of spin-down age of respective interval and the third column is ten-base logarithm of pulsars relative quantity in interval. The approximation for $t(\tau)$ dependence is fitted on the base of this two last columns. The second result file is `result_file` which contains calculated real age (first column), $f(x)$ (second column) and spin-down age (third column).

The program provides in the standard console output chosen birthrate of visible pulsars (number per year) and $\tau_{\min}$. The example of program running is below:

```
username@computer:$ ./spin_down_ages.out data.txt stat.txt B_t.txt
Tau start: 4.95875
Birthrate: 0.000778204
Birthrate: 0.00076103
Birthrate: 0.000752585
Birthrate: 0.000748398
Birthrate: 0.000746313
Birthrate: 0.000745273
Birthrate: 0.000744753
Birthrate: 0.000744494
Birthrate: 0.000744364
Birthrate: 0.000744299
Birthrate: 0.000744267
```

[1] If you use a different than OS X operation system you should change the path to GSL as it is in your OS

[2] see the original article for explanation of selection rules for a sample

[3] see web-site `http://www.atnf.csiro.au/research/pulsar/psrcat/` and Manchester, R. N., Hobbs, G. B., Teoh, A. & Hobbs, M., AJ, 129, 1993-2006 (2005) for details

```
Birthrate: 0.00074425
Birthrate: 0.000744242
Birthrate: 0.000744238
Birthrate is: 0.000744238
```

Here the chosen birthrate (last value) is 0.000744238 visible pulsars per year[4]

[4]See Appendix B of the original article for information about meaning of this quantity.