IPTA 2011, Day 3
Pulsar Timing Practicum
Introduction to TEMPO2

D. Perrodin, M. McLaughlin, D. Lorimer, J. Verbiest

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1 Introduction

TEMPO2 is the new version of TEMPO, a software package widely used in the pulsar timing community. One of TEMPO2's advantages over TEMPO is the use of "plug-ins" (think "app" for your iPhone). The most important plug-in of TEMPO2 is "plk". With this plugin you can inspect, evaluate and improve your timing model and TOAs. Using the example files, try:

tempo2 -gr plk -f example1.par example1.tim

Notice some standard input arguments of TEMPO2:

-gr: determines the graphical interface or plug-in. Here we introduce the PLK plug-in. You can also create your own plug-ins.

-f: specifies the input file with the timing model (also called "par file", parameter file, or ephemeris) and the file with the times of arrivals (TOAs) (also called "tim file").

The order ("par" followed by "tim") is important.

2 Getting a solution for an isolated pulsar

In addition to pulse phase, there are four basic parameters to fit in TEMPO2:

1. F0 - spin frequency
2. F1 - frequency derivative (we won't consider higher derivatives here)
3. RAJ - Right ascension (J2000)
4. DECJ - Declination (J2000)

If you have data at multiple frequencies, it might be possible to fit for dispersion measure by the interstellar medium (DM), but we won't do that here.

3 Exercise

For each of the 5 sets of example parameter (.par) and TOA (.tim) files:

1. Identify a closely-separated set of TOAs (e.g., pick 3 neighboring TOAs). Isolate the set using SKIP/NOSKIP.
2. Fit for F0... if the RMS is of millisecond accuracy, go to next step, otherwise find another set.
3. Add neighboring TOAs and look at the pre-fit residuals
   * Watch out for phase wraps
   * Do you need to fit for F1, RAJ or DEC? If so, try one at a time
4. Save your work prior to each additional fitting parameter
   * when starting with short data spans, you will find that fitting different parameters produce the same results.
5. Center the epoch and weight the fit at the end... check your ephemeris with the ATNF catalog.