# PINT, a python package for pulsar timing

Marion Spir-Jacob

What is PINT ?

‣ PINT is a Python package for pulsar timing
‣ Completely independent from Tempo2 for crosscheck purposes
‣ Works with Python 2.7 or versions more recent than 3.5
‣ Based on NumPy and Astropy
‣ Documentation here: http://nanograv-pint.readthedocs.io/en/latest/
‣ Github: https://github.com/nanograv/PINT

‣ Goes from the times to the phases and a bit beyond (for instance, it contains the H-test)

‣ Two main terms:
  ➡ The phasing terms (period, derivative of period, etc)
  ➡ The delay terms (various relativistic effects)

PINT architecture
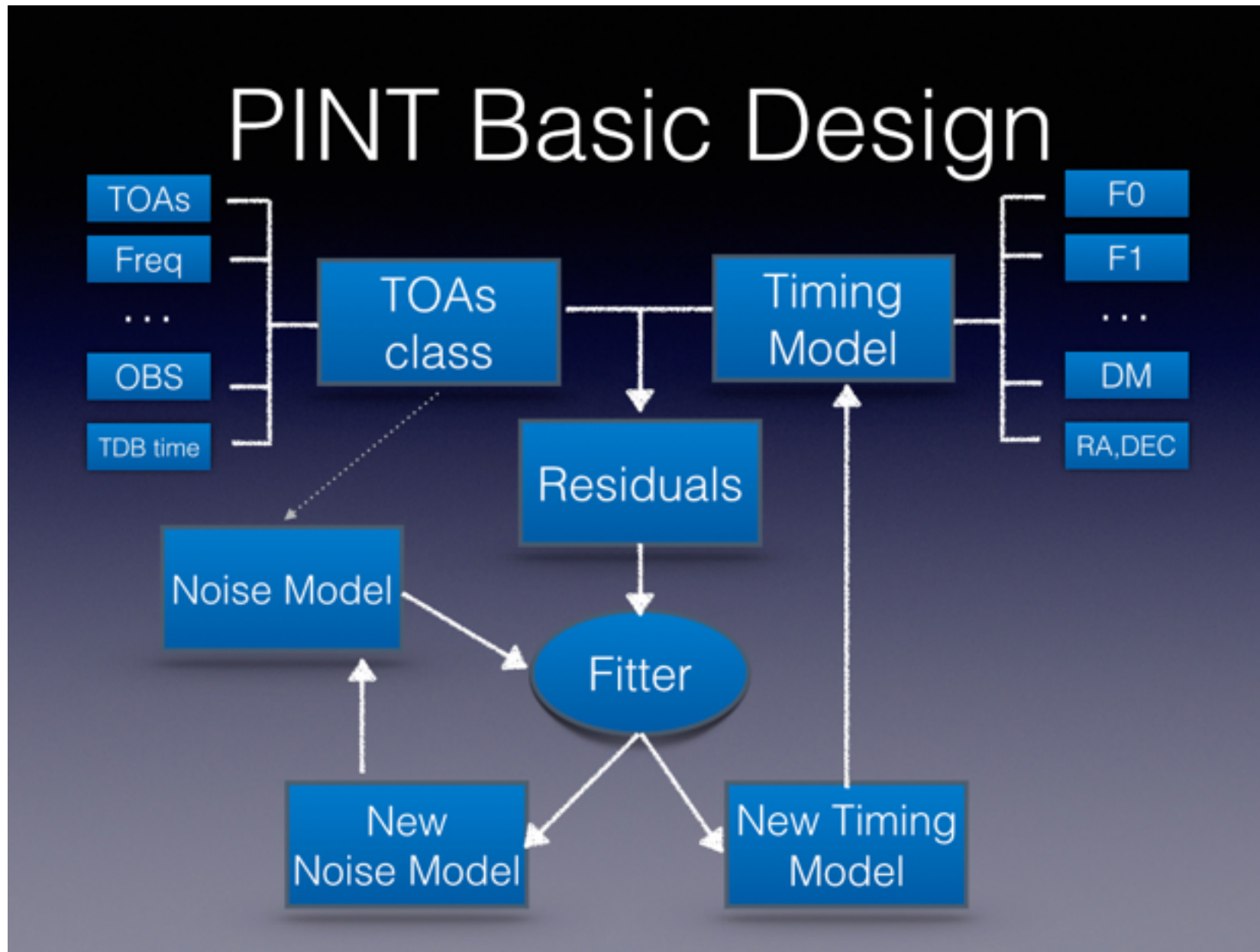


- The input data are the TOAs (times of arrival) which are declared or loaded with an information on the observatory
- The timing model for the pulsar, another key ingredient, is loaded from a .par file

Source : https://github.com/nanograv/PINT/wiki/Code-Architecture

Still on-going development

A comparison between Tempo2 and PINT on Fermi data on Vela shows that PINT is today still under construction

PINT and Tempo2 phasograms

PULSE_PHASE_TEMPO2 - PHASE_PINT
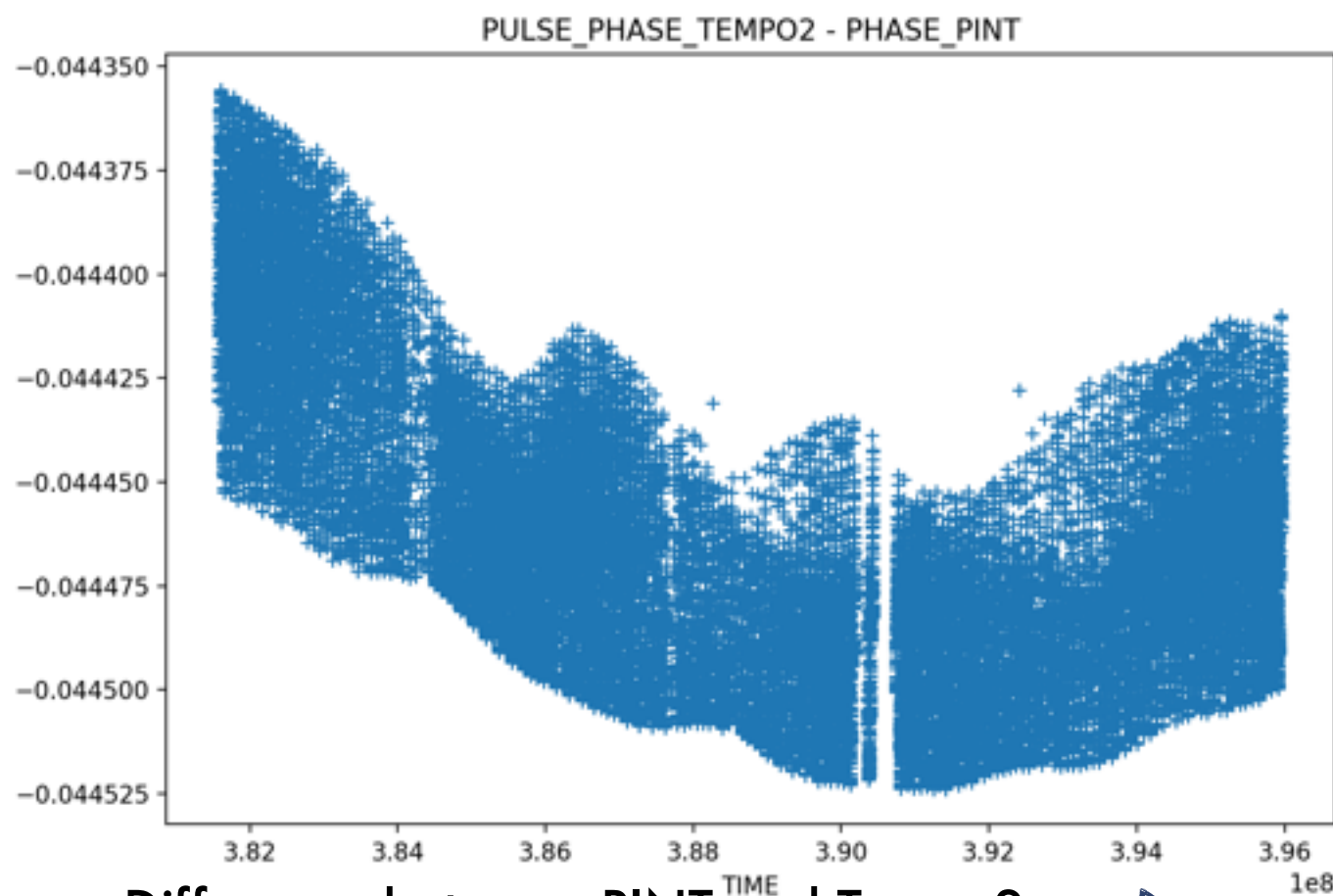
Difference between PINT and Tempo2 phases as a function of the time
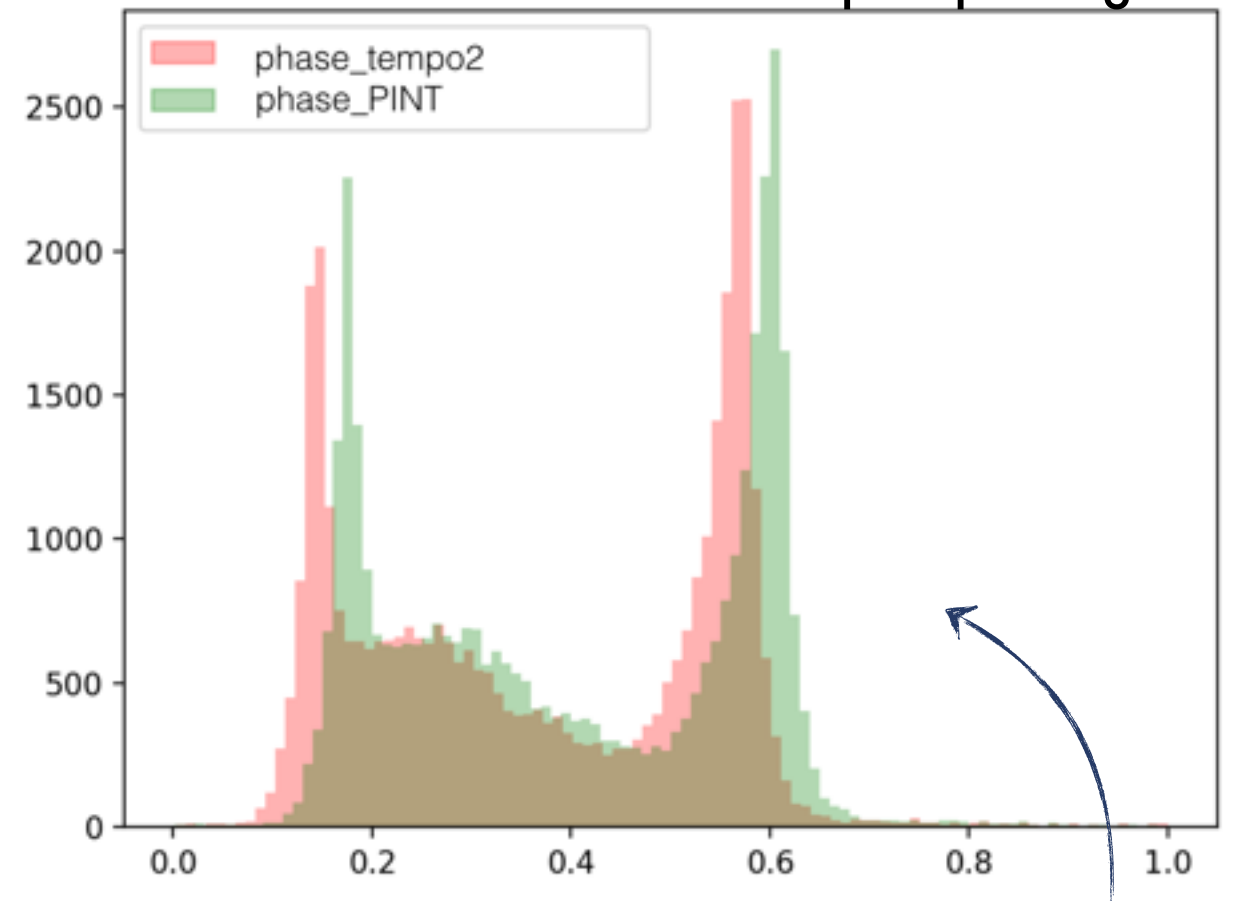
Same data, same ephemerides : there is a 0.04 offset (TZRMJD) which is easy to fix, and a missing wave correction (order of magnitude 10^{-4}) as a function of the time which isn't in PINT yet

PINT cannot be used for the CTA DC1

‣ In the DC1, the model for the pulsations doesn't have delay terms
   ➡ Unrealistic (position of observatory not taken into account)
   ➡ Very easy to compute the phases

$$\phi(t) = \phi_0 + f(t - t0) + \frac{1}{2}\dot{f}(t - t0)^2 + \frac{1}{6}\ddot{f}(t - t0)^3$$

‣ Ctools doesn't use Tempo2 (but a ctphase function that does this)

◉ However, to see an example of PINT usage applied to CTA data, it's on the part 5 of the tutoriel : https://github.com/gammasky/cta-analyses/blob/master/pulsar/pulsar_phase_cta_dc1.ipynb
◉ It doesn't work of course, it's just for the sake of having one example (which might be flawed, it's hard to guarantee an absence of bug before having obtained the phasogram)

Thank you !