Monitoring of EPIC-pn Timing

Jacobo Ebrero

Epic Calibration Meeting, 15 March 2018

Outline

- Report on routine calibration observations of the Crab
  - Relative timing
  - Absolute timing
- On the differences between Timing and Burst modes

Relative and absolute timing monitoring

- *Absolute timing*: locating events in time with reference to standard time defined by atomic clocks or other satellites.

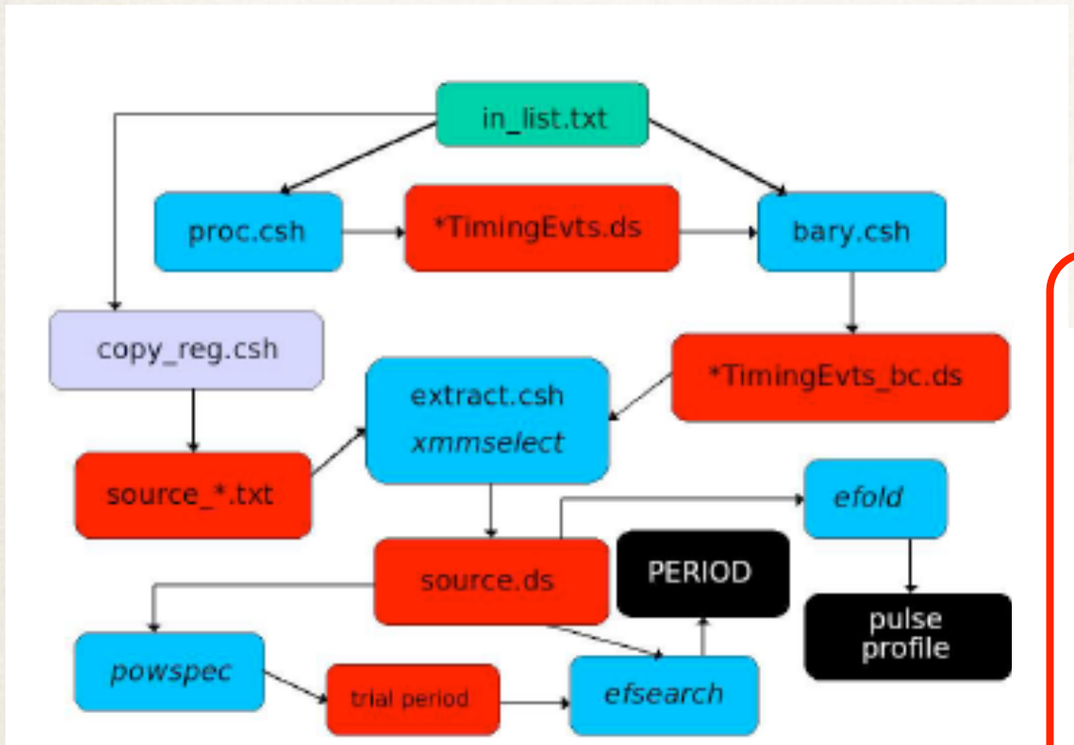
- *Relative timing*: the capacity to measure time intervals and periodicity reliably.

- Crab observed twice per semester (spring, autumn).

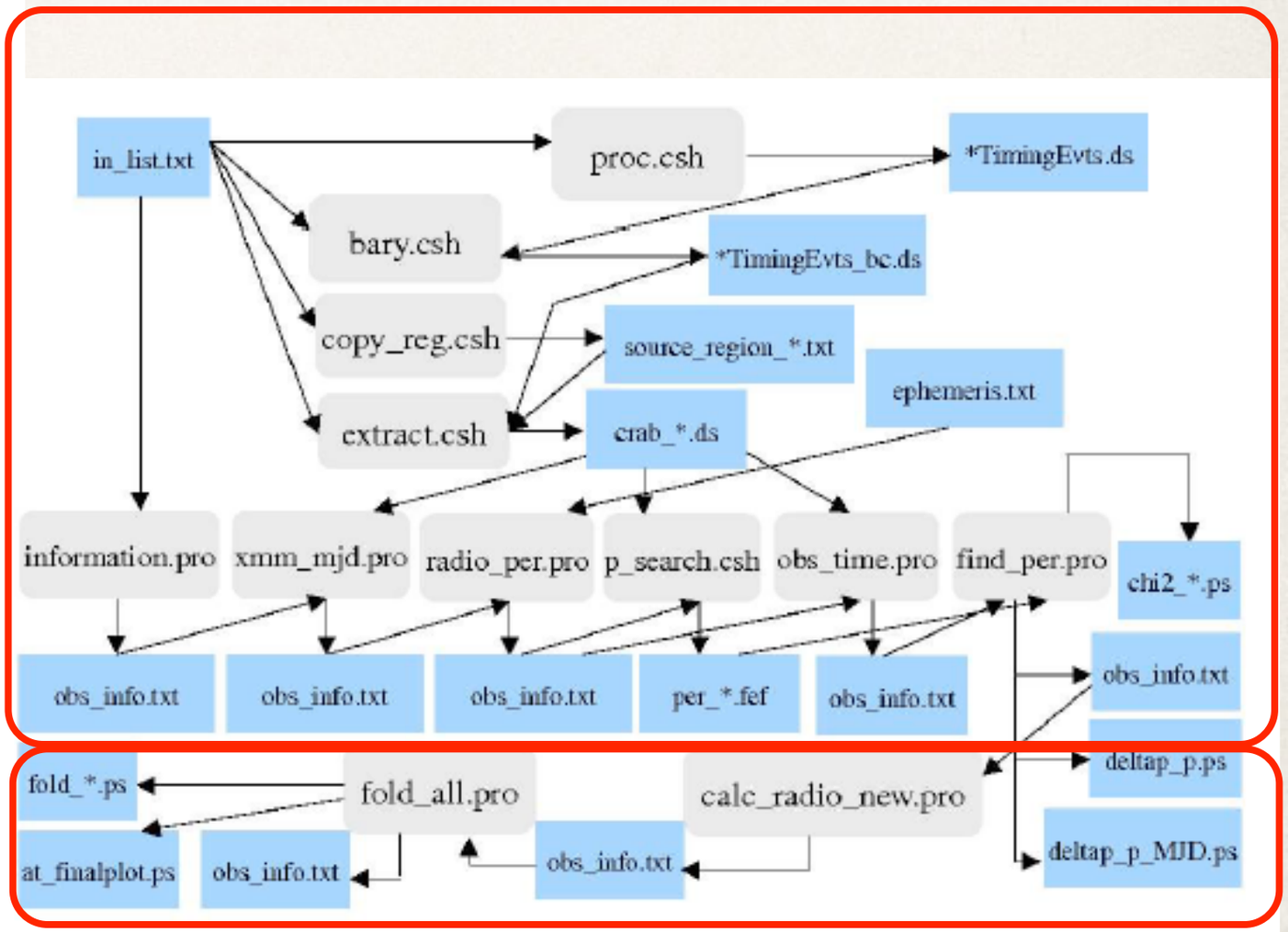
- T_{exp} at least 10 ks, half in Timing and half in Burst mode.

- Scheduled at different phases of a single orbit to cover different time delays and G/S data links.

An automated process

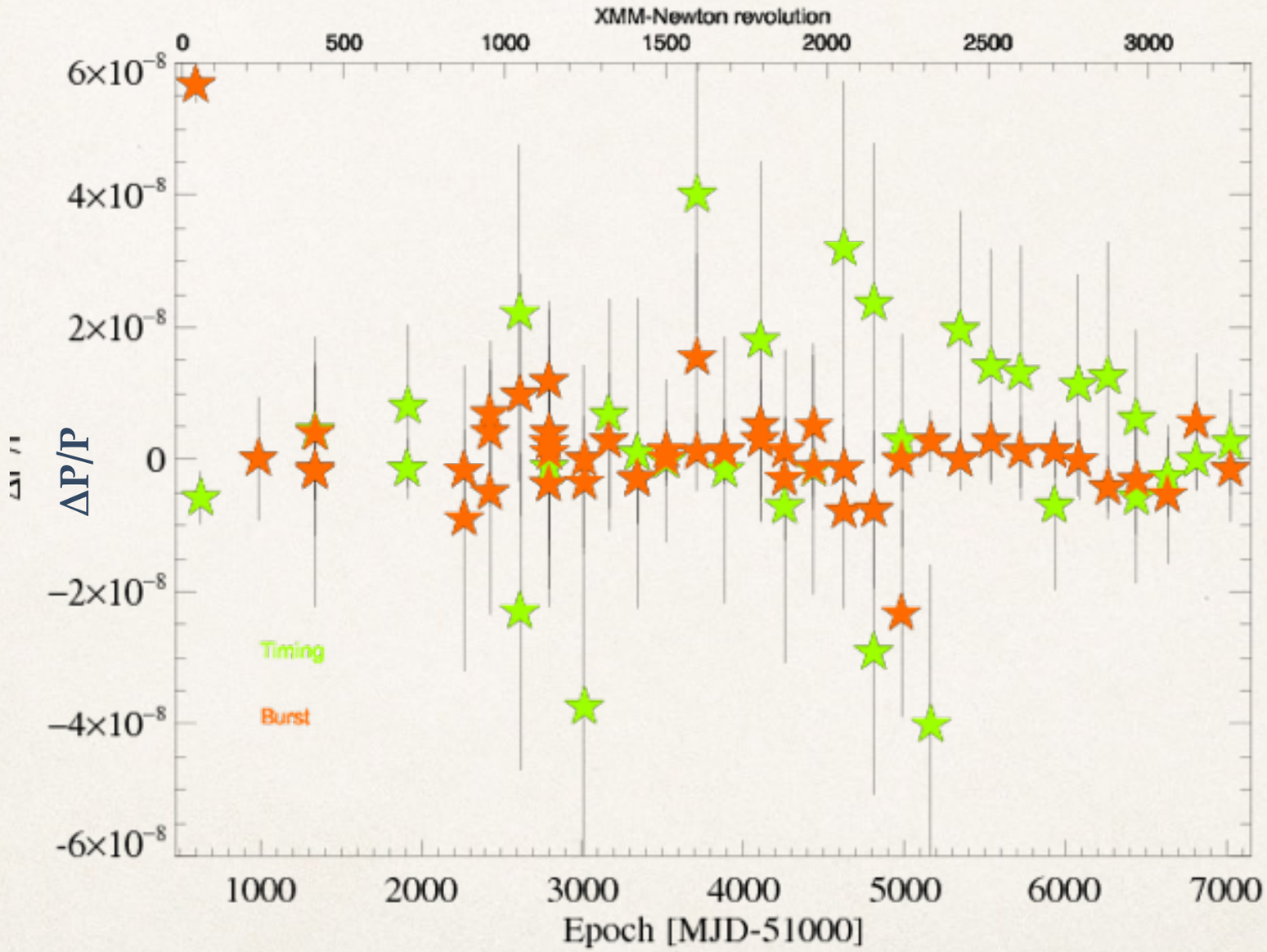


Relative timing



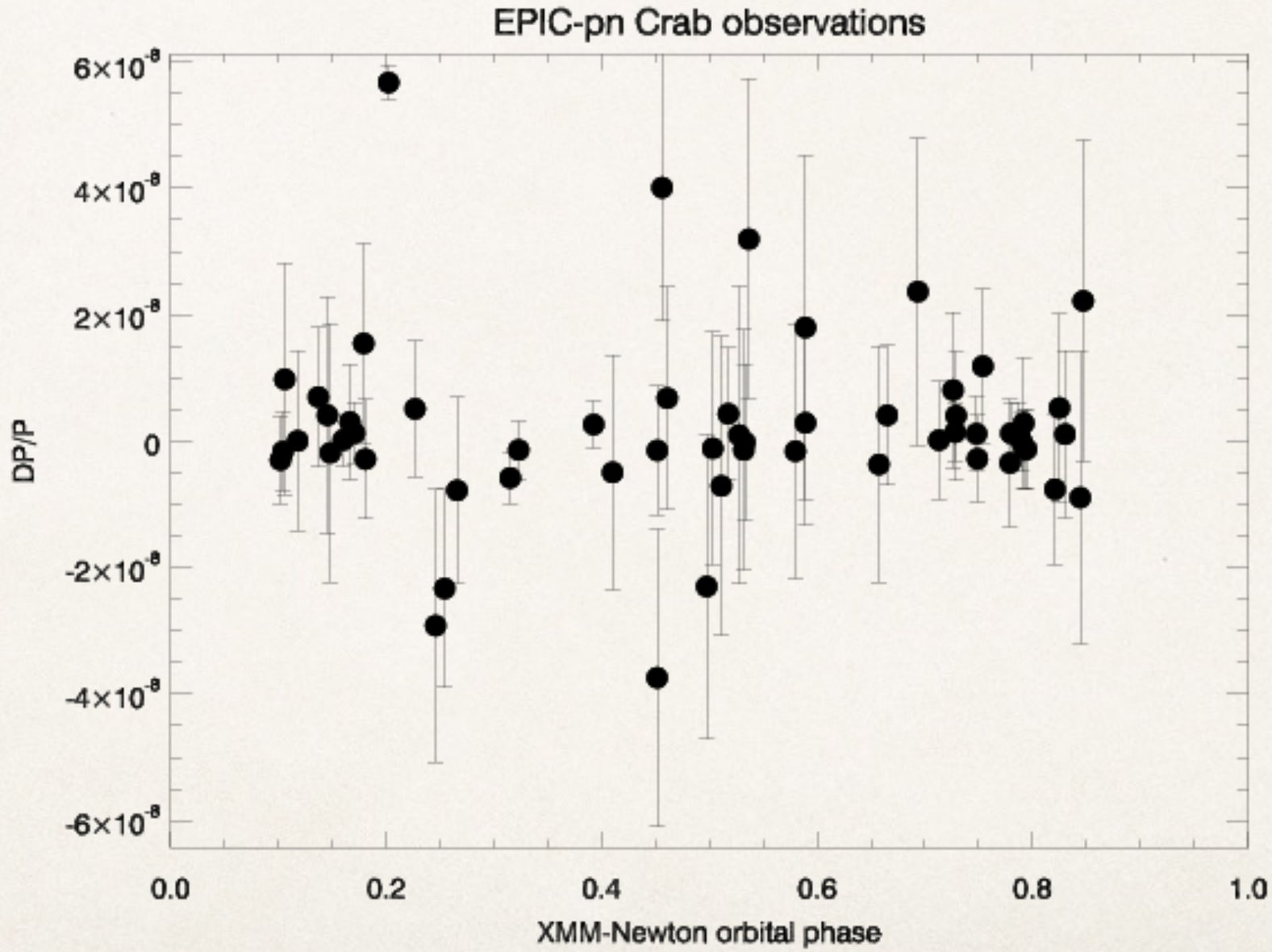
Absolute timing

Relative Timing

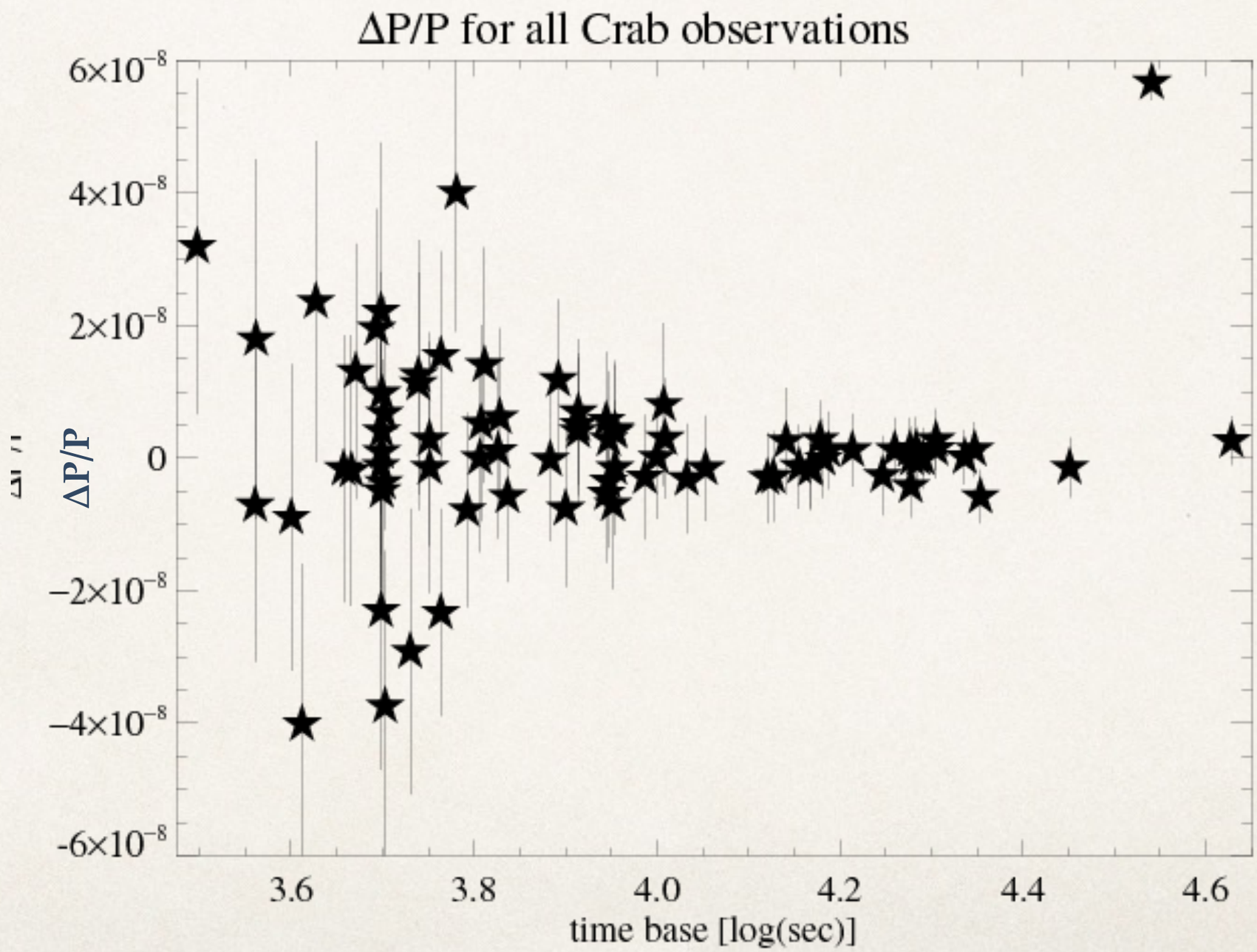


- Relative deviation of the observed pulse period with respect to the most accurate radio data (Crab ephemeris from Jodrell Bank) is $< 3 \times 10^{-8}$.

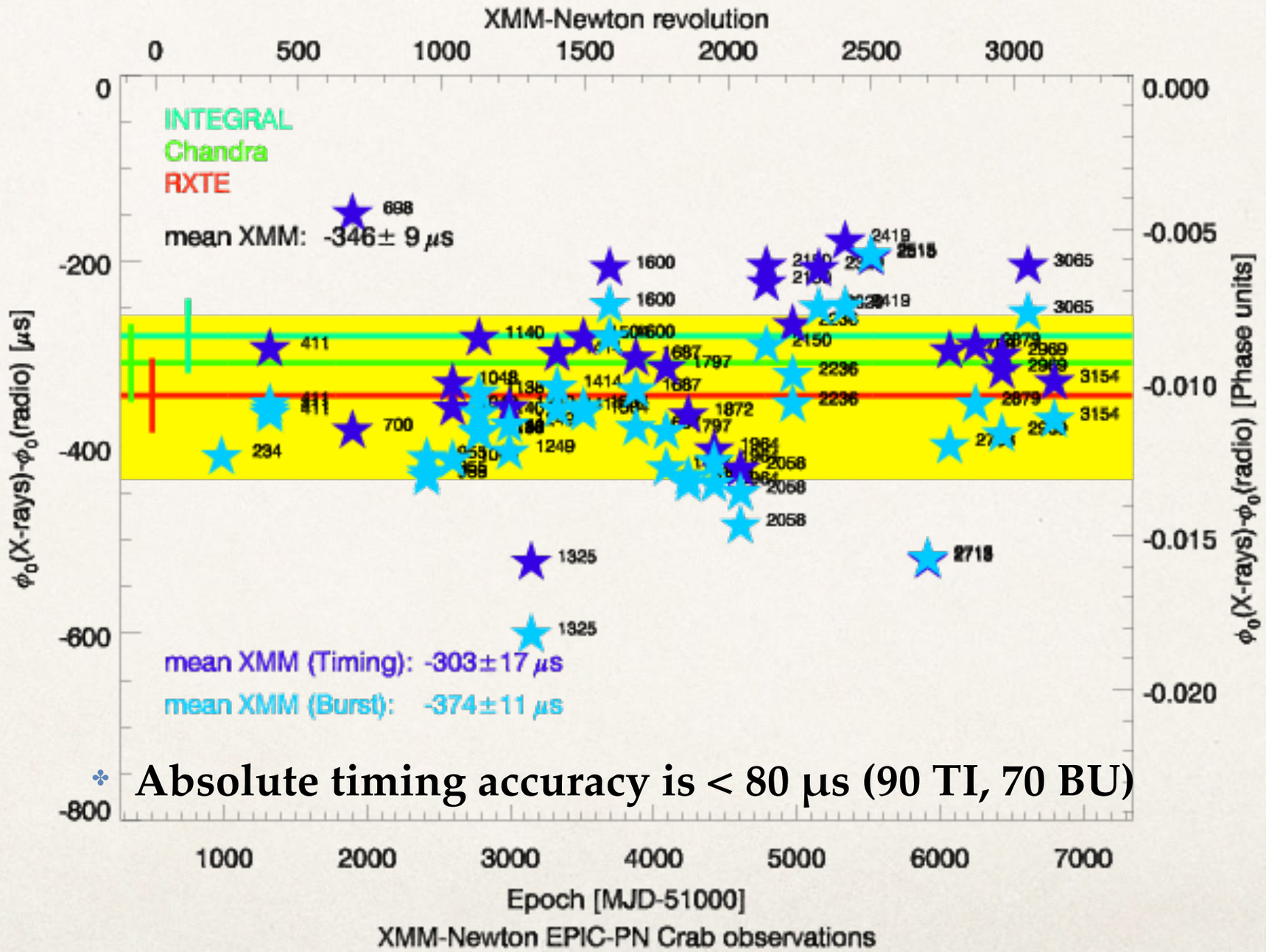
Relative Timing



Relative Timing

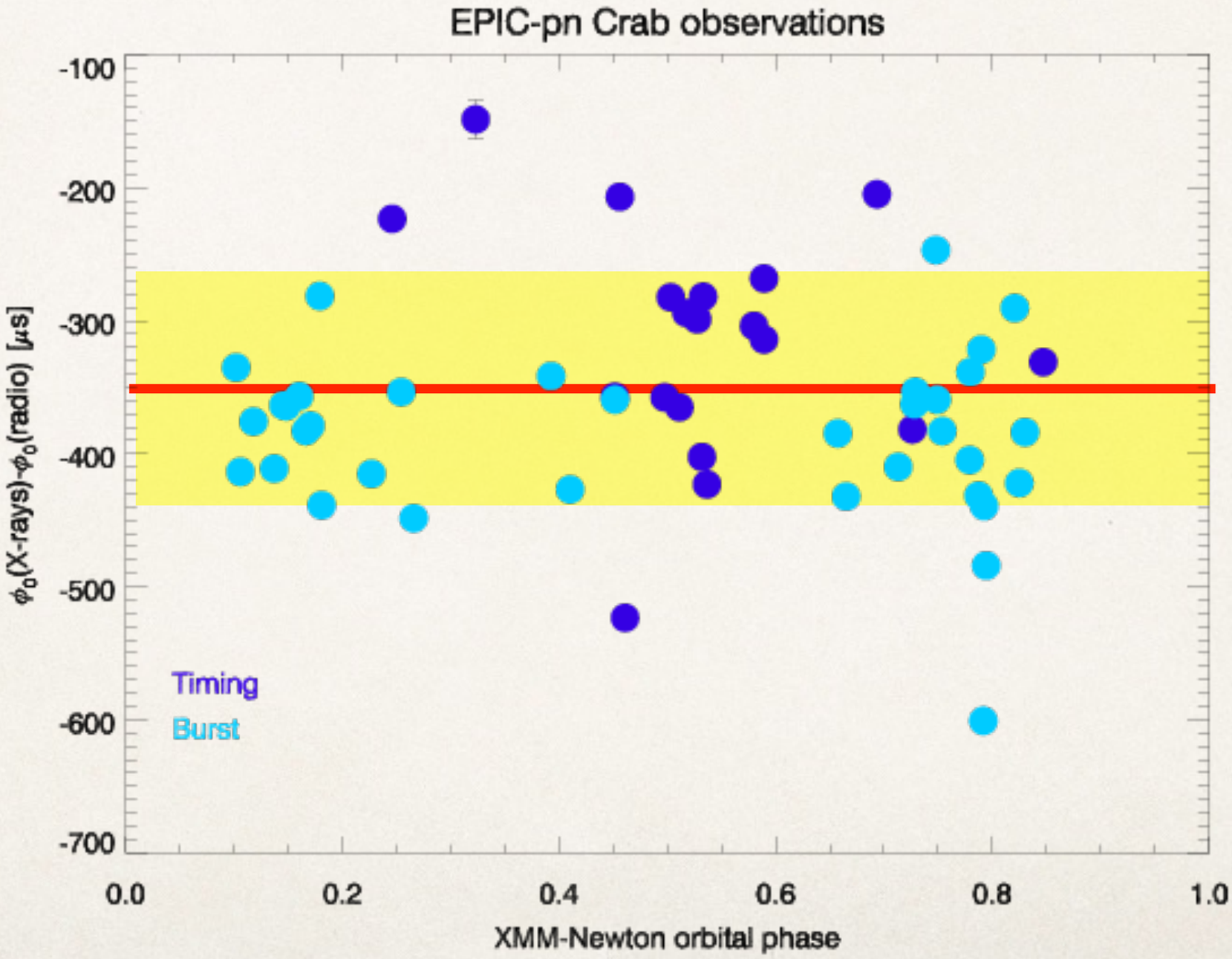


Absolute Timing



Absolute timing accuracy is < 80 μs (90 TI, 70 BU)

Absolute Timing



The TI vs BU discrepancies

- Seasonal pulse profile distortions (CAL-TN-0211)
- Main conclusions:
  - FIFO overflows cause a loss of counts at different phases of the Crab pulse profile.
  - Seasonal dependence is due to the different number of counts gathered on-board because of the different coverage of the nebula.
  - For very bright sources do not use TI, but rather BU.

The TI vs BU discrepancies

- Delay with respect to the radio pulse is systematically different:
  - TI: -303 ± 17 μs
  - BU: -374 ± 11 μs
- Only seen in the absolute timing analysis, not in the relative.
- Possible explanation: FIFO again?
- Any thoughts?