

# Nulling and Intermittent Pulsars

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*YERAC (20/07/2011)*

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1824

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of Manchester



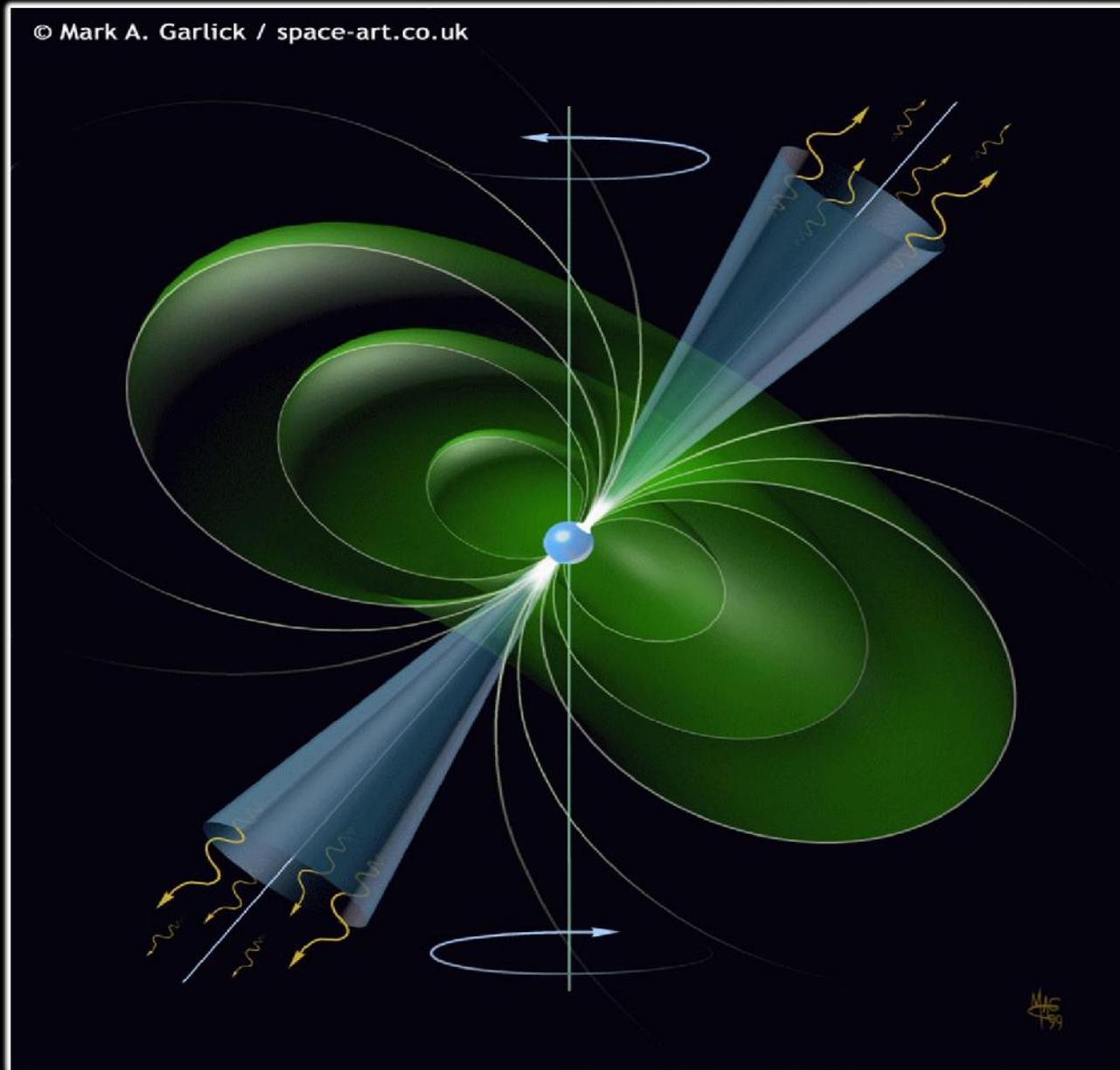
Science & Technology  
Facilities Council

# Outline

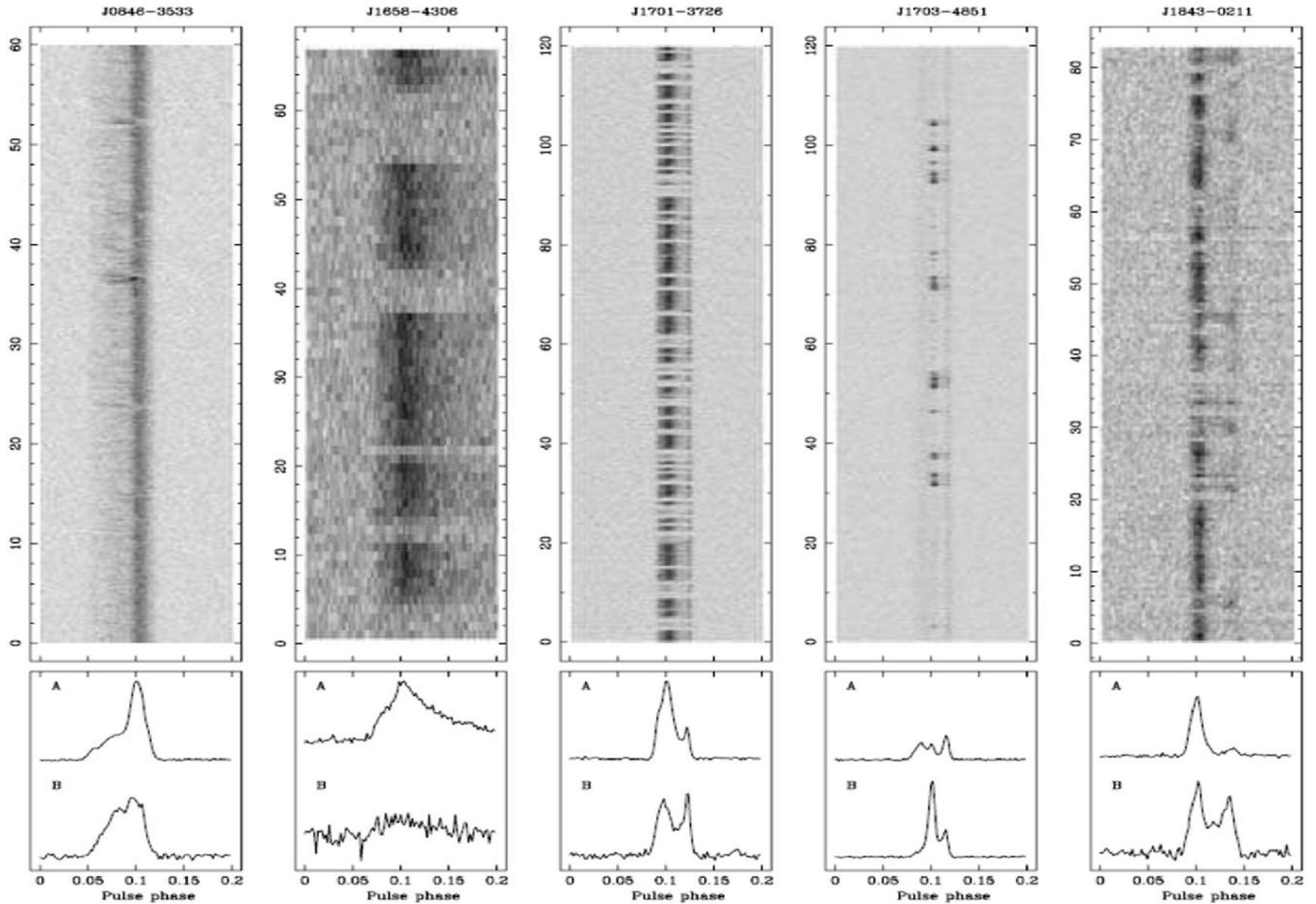
- **Radio Emission Physics**
- **Pulse Nulling**
- **Intermittent pulsars and state-switching**
- **Summary and Future Work**

# The Pulsar Magnetosphere

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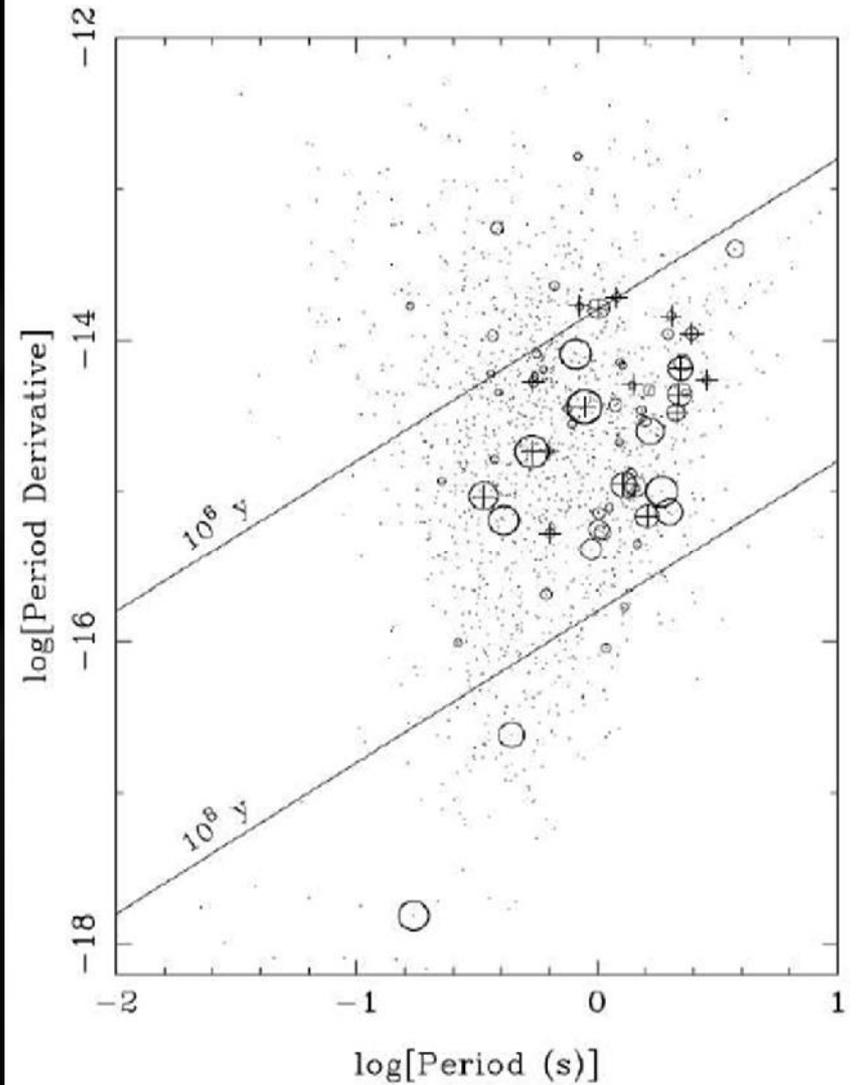
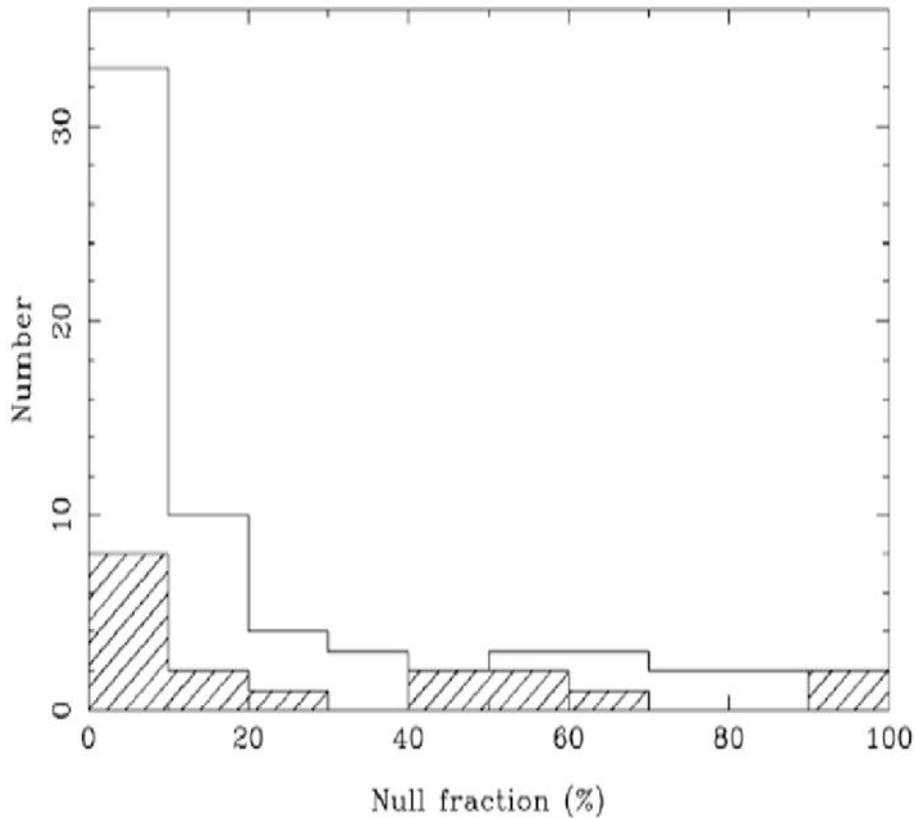
# Pulse Nulling



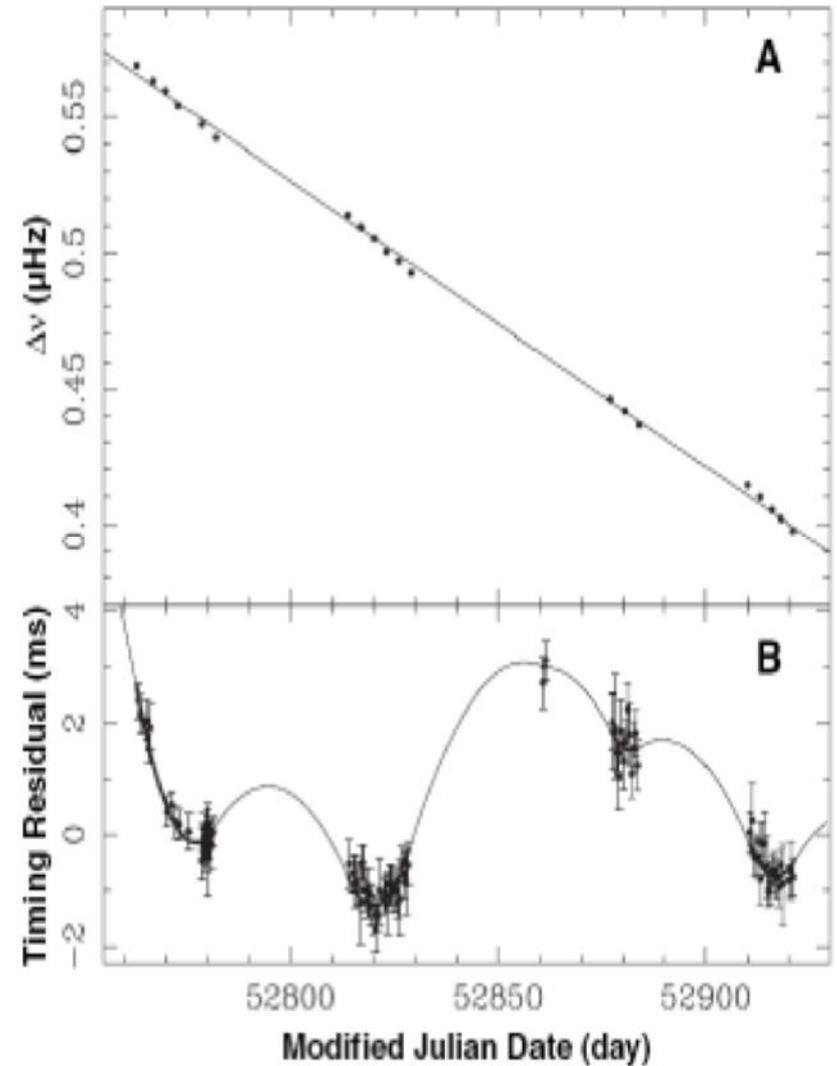
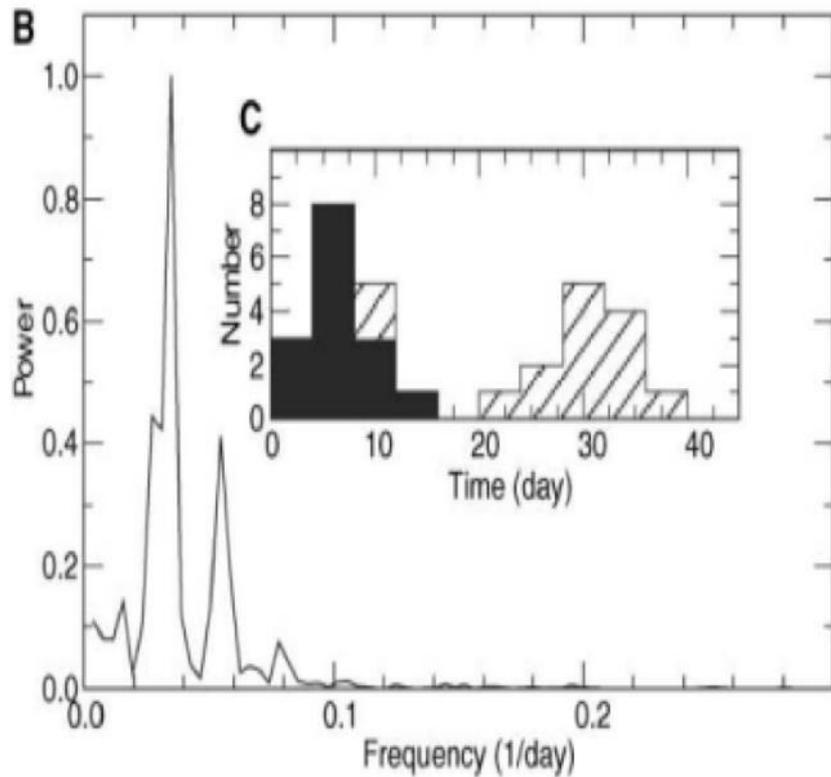
# Nulling Statistics I

- Null durations can last one or two pulses up to several days
- NF can vary from 1% - 95%
- NF is proposed to be correlated with spin-down age (Wang et al. 2007)
- No significant correlations found with other basic pulsar properties or geometry

# Nulling Statistics II



# PSR B1931+24 – The Intermittent Pulsar



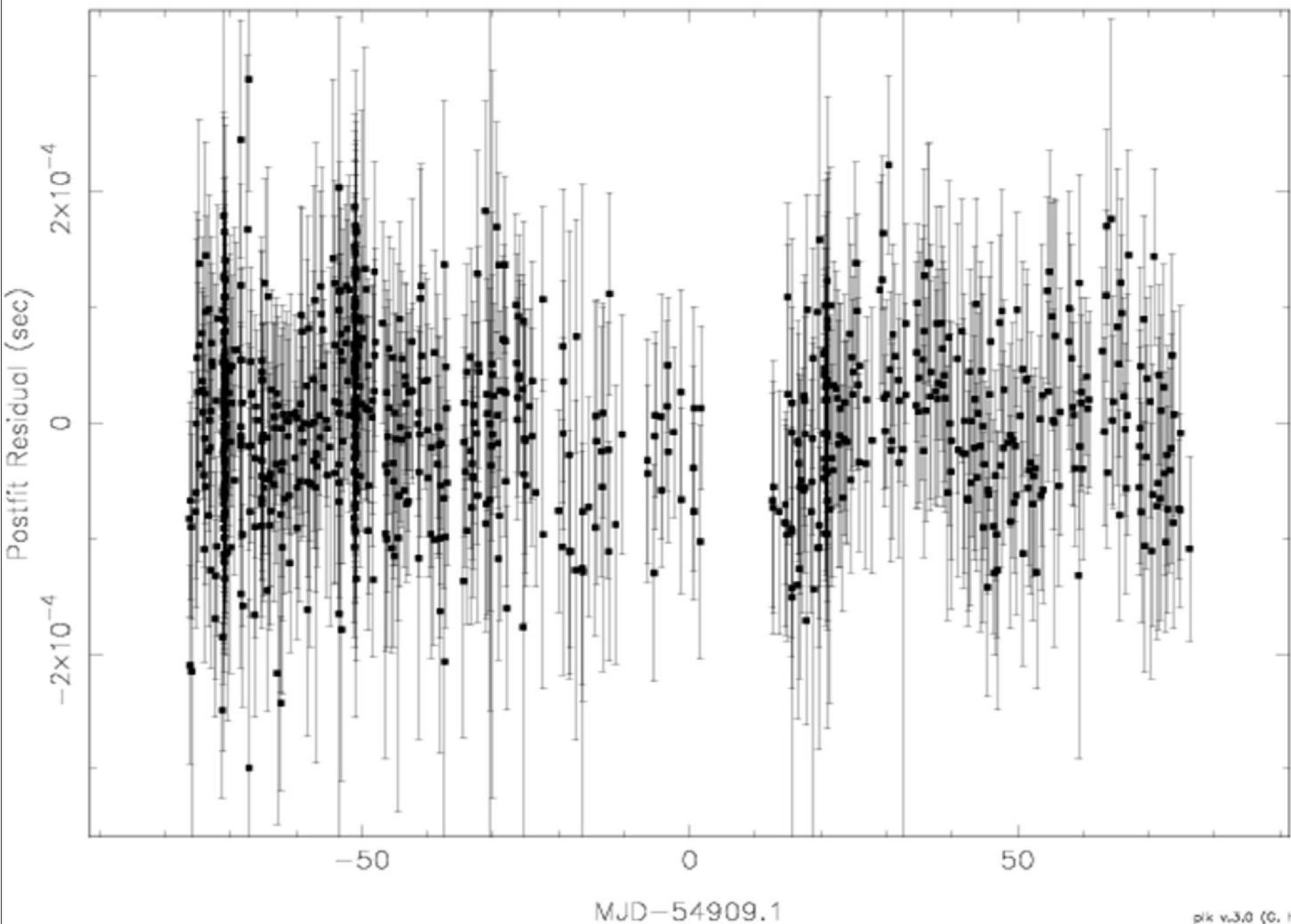
# Magnetospheric State-switching

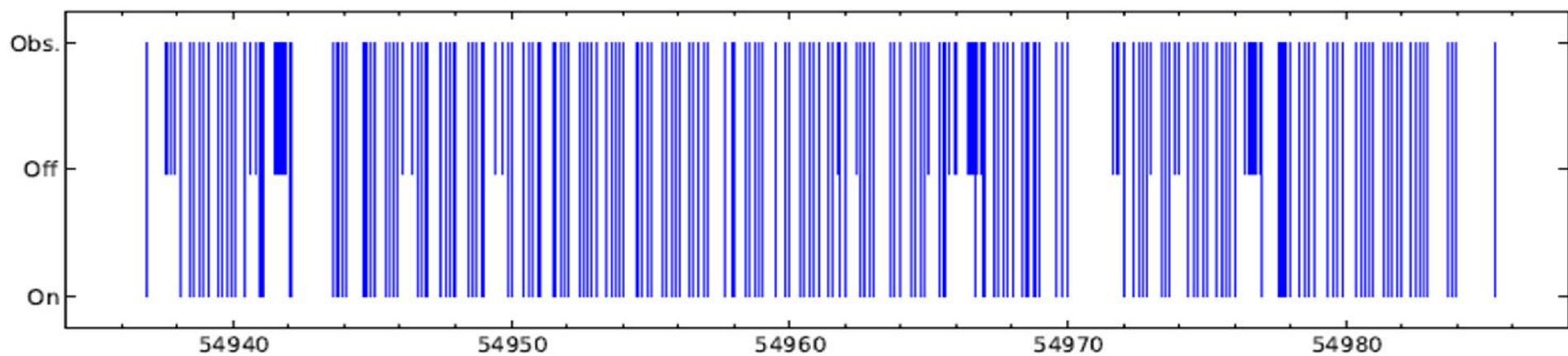
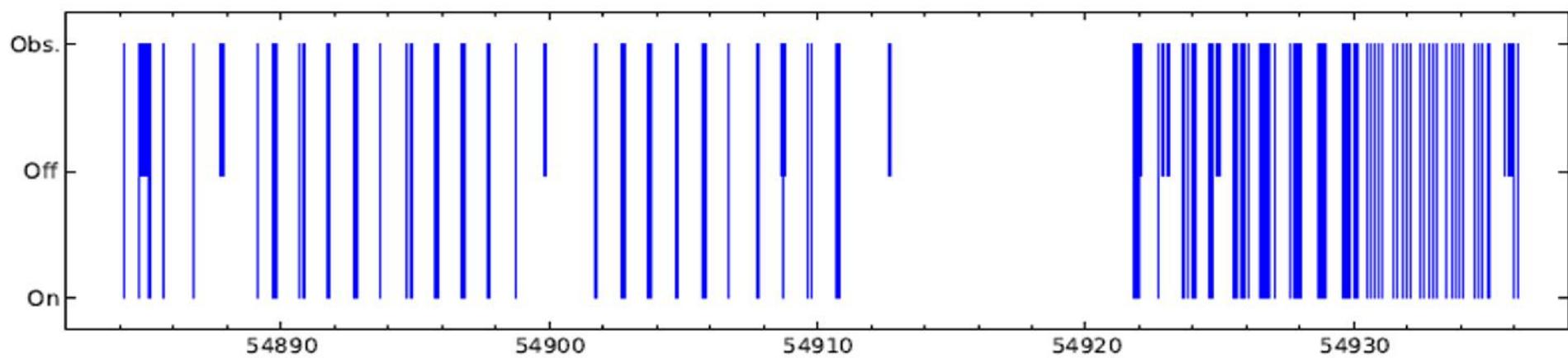
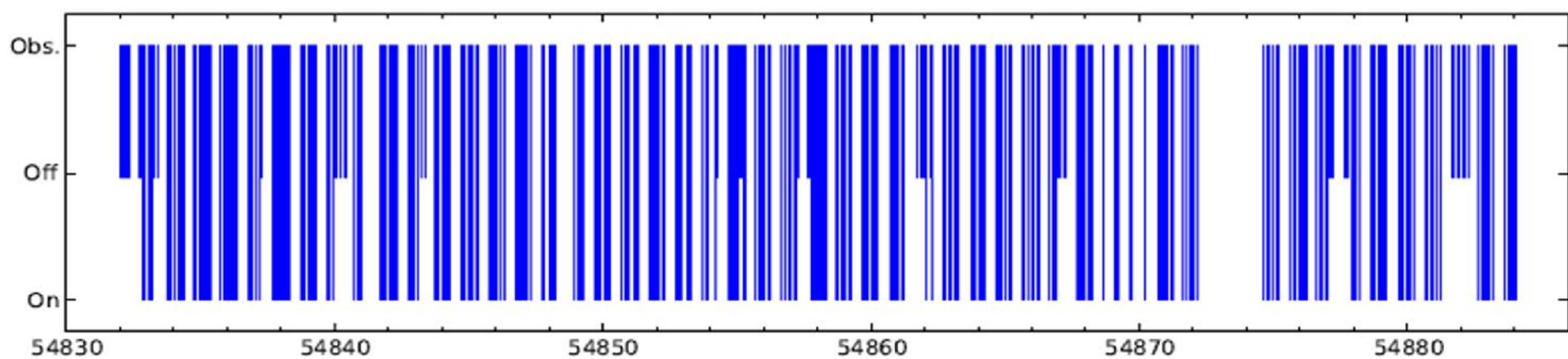
- Motivated by the findings of Kramer et al. (2006)
- Theory suggests the pulsar magnetosphere is highly dynamic and could possess numerous “stable” states (Contopoulos 2005)
- Changes in the charge density distribution will lead to dynamical changes in the co-rotation zone and emission beam geometry (Timokhin 2010)

# PSR B0823+26- Intermediate Variation

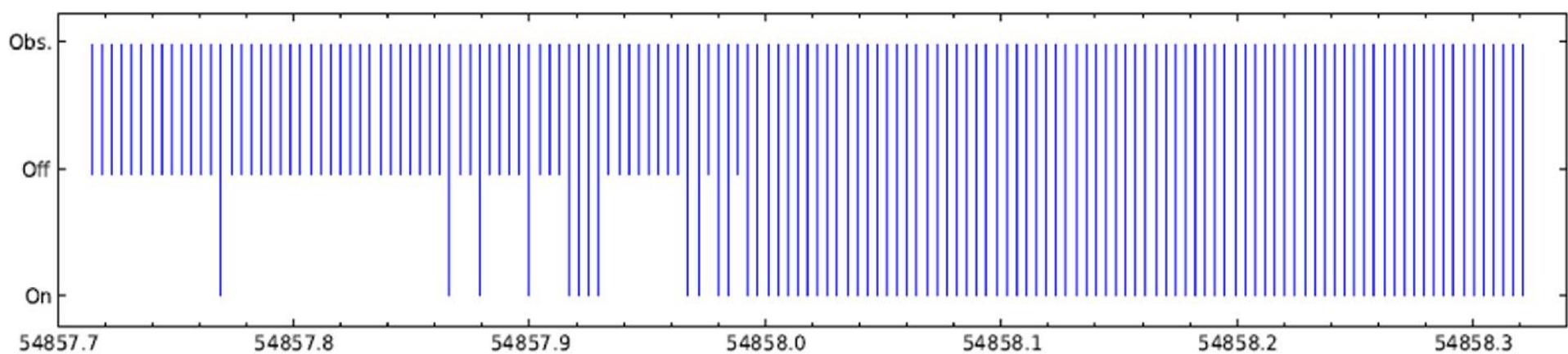
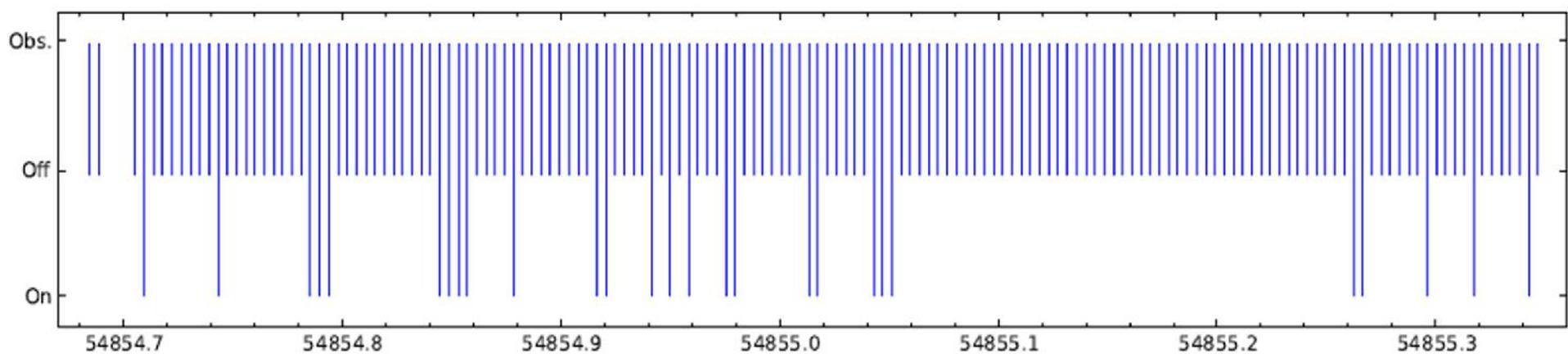
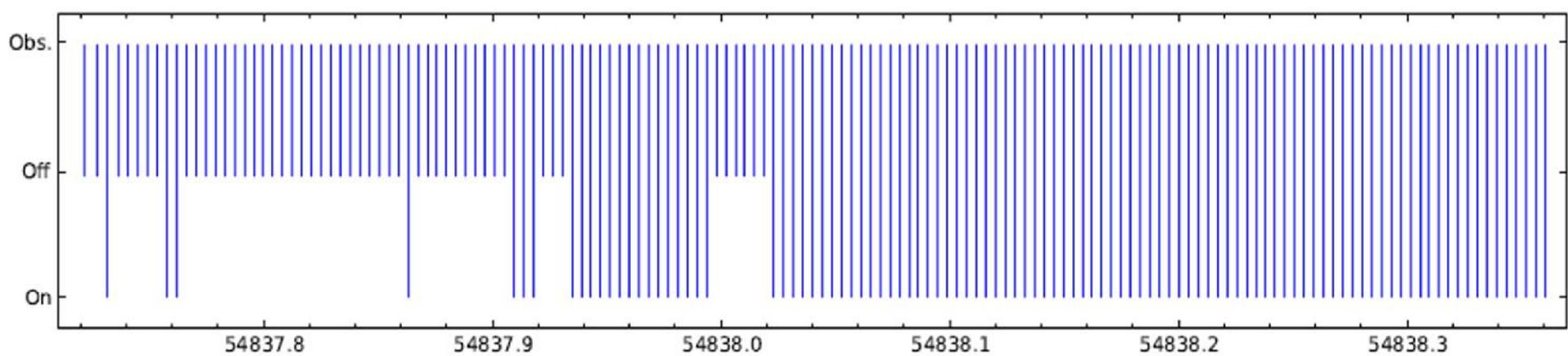
- Now starting to see effects over intermediate timescales (i.e. ~1000's of pulses – days)
- PSR B0823+26 undergoes both long (~days) and short (~1000's of pulses) timescale nulling
- Likely possesses information to unify short and long term nulling theories

0823+26 (rms = 75.641  $\mu$ s) post-fit





Modified Julian Date (day)



Modified Julian Date (day)

# Summary

- **B1931+24 is a quasi-periodic intermittent pulsar, which provides evidence for state-switching**
- **Bo823+26 exhibits both short and long-term nulling, but doesn't show concrete evidence for periodicity - it may possess a nulling distribution**
- **The radio emission moding in Bo823+26 implies that many other pulsars could exhibit this behaviour but haven't been observed yet**
- **Magnetospheric switching provides most favourable scenario for these phenomena, but does not have a definitive trigger determined**

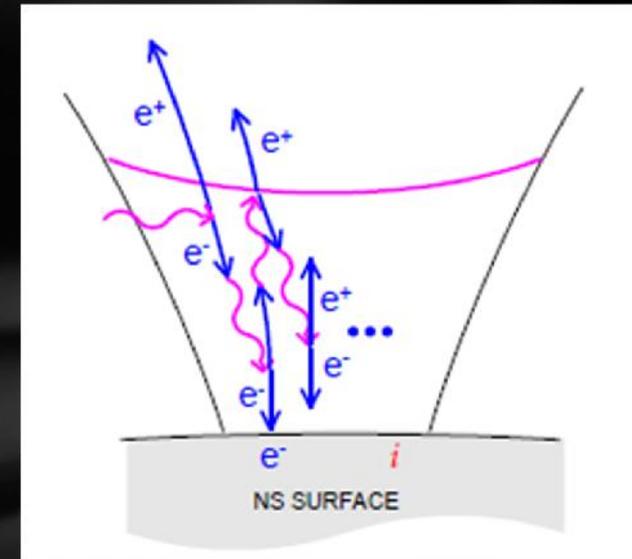
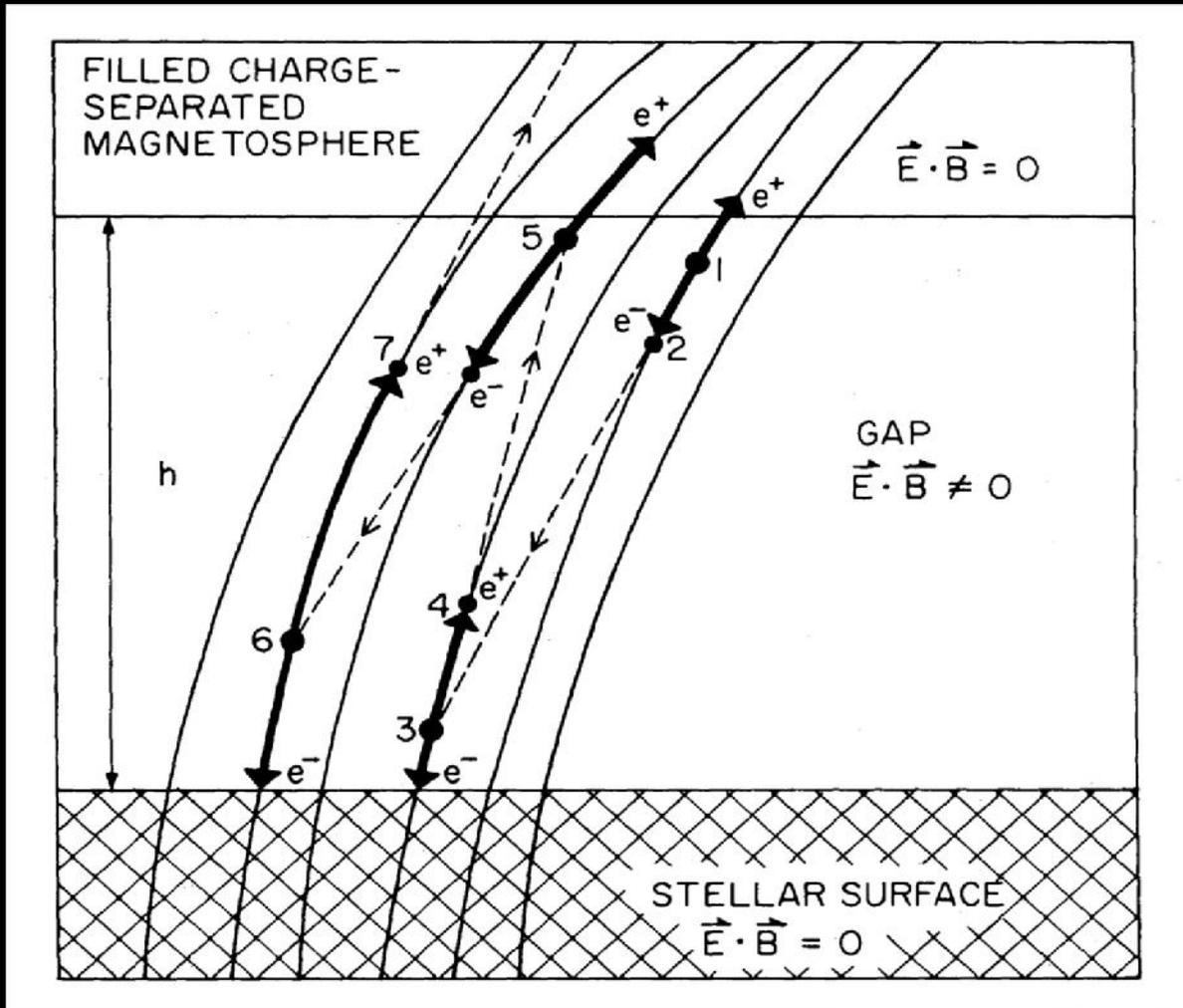
# Future Work

- Look into single pulse observations of B0823+26 in an effort to bridge the gap between timescales
- Examine B1931+24 spin-down rate evolution
- Studies of other intermittent pulsars
  - Apply same methodology to studies of radio emission activity
  - Study pulse profile changes in pulsars which exhibit moding in their spin-down rates

**Thanks for listening!**

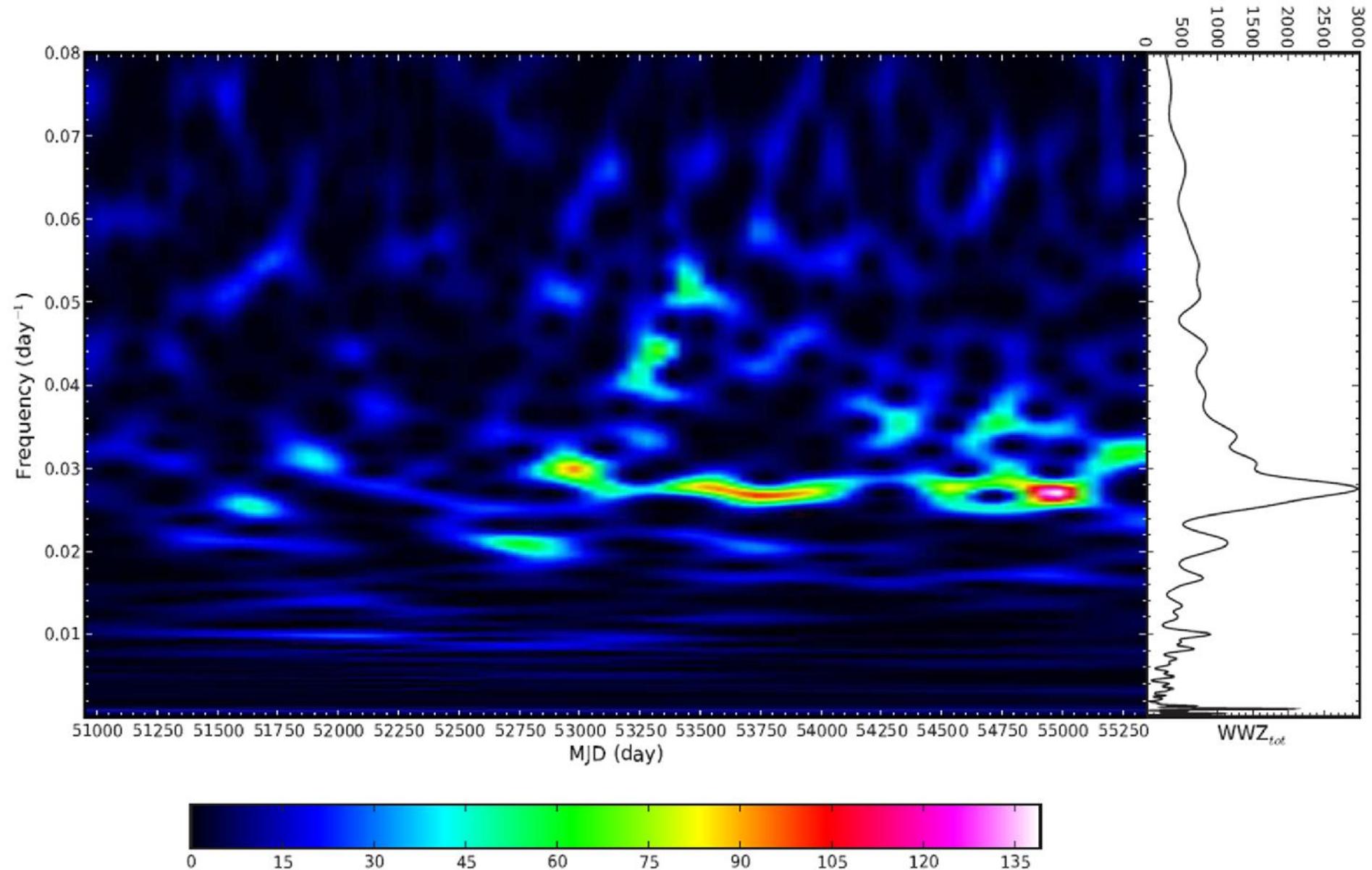
# Radio Emission Production

Harding (2007)



Ruderman & Sutherland (1975)

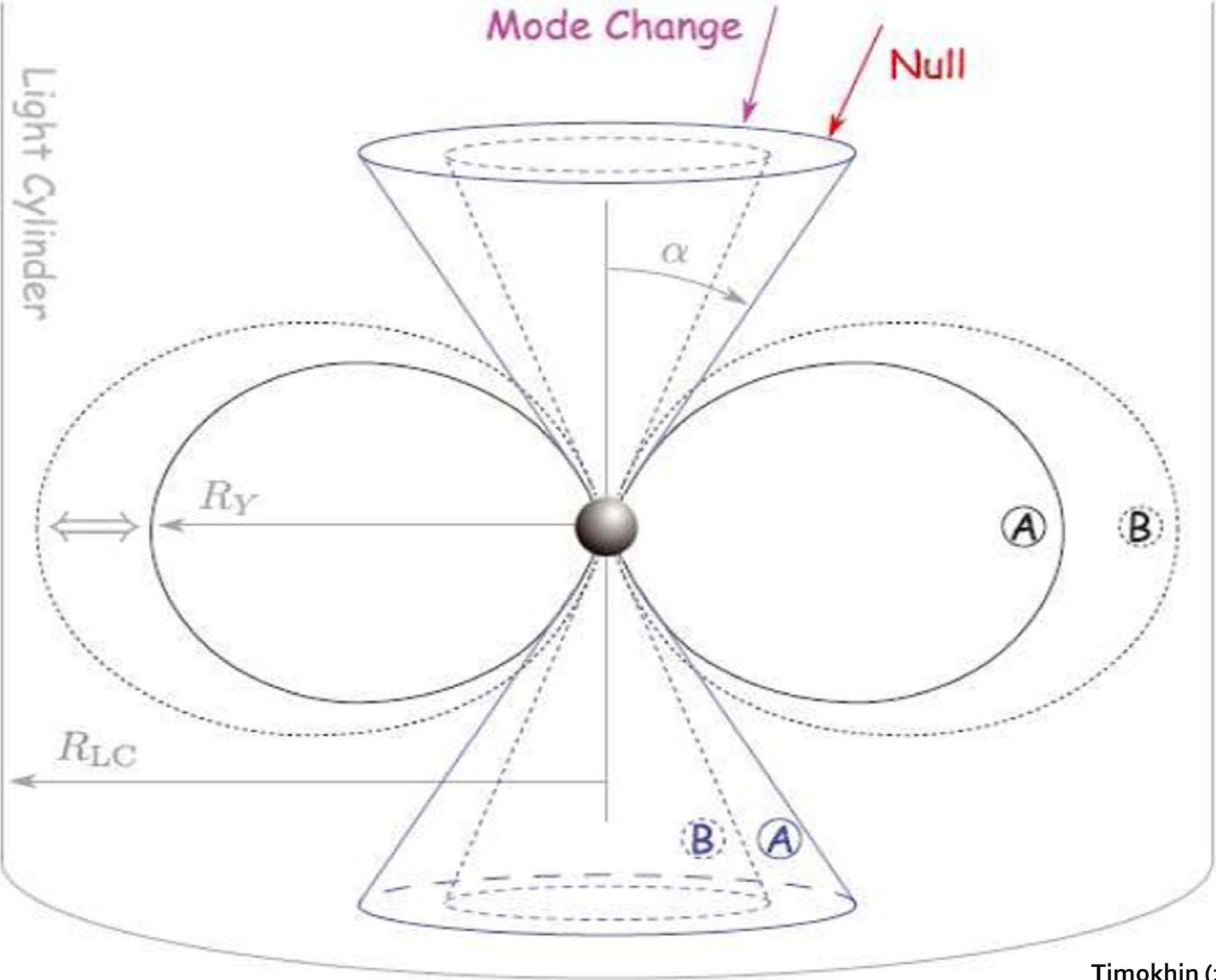
# PSR B1931+24 Periodicity Analysis

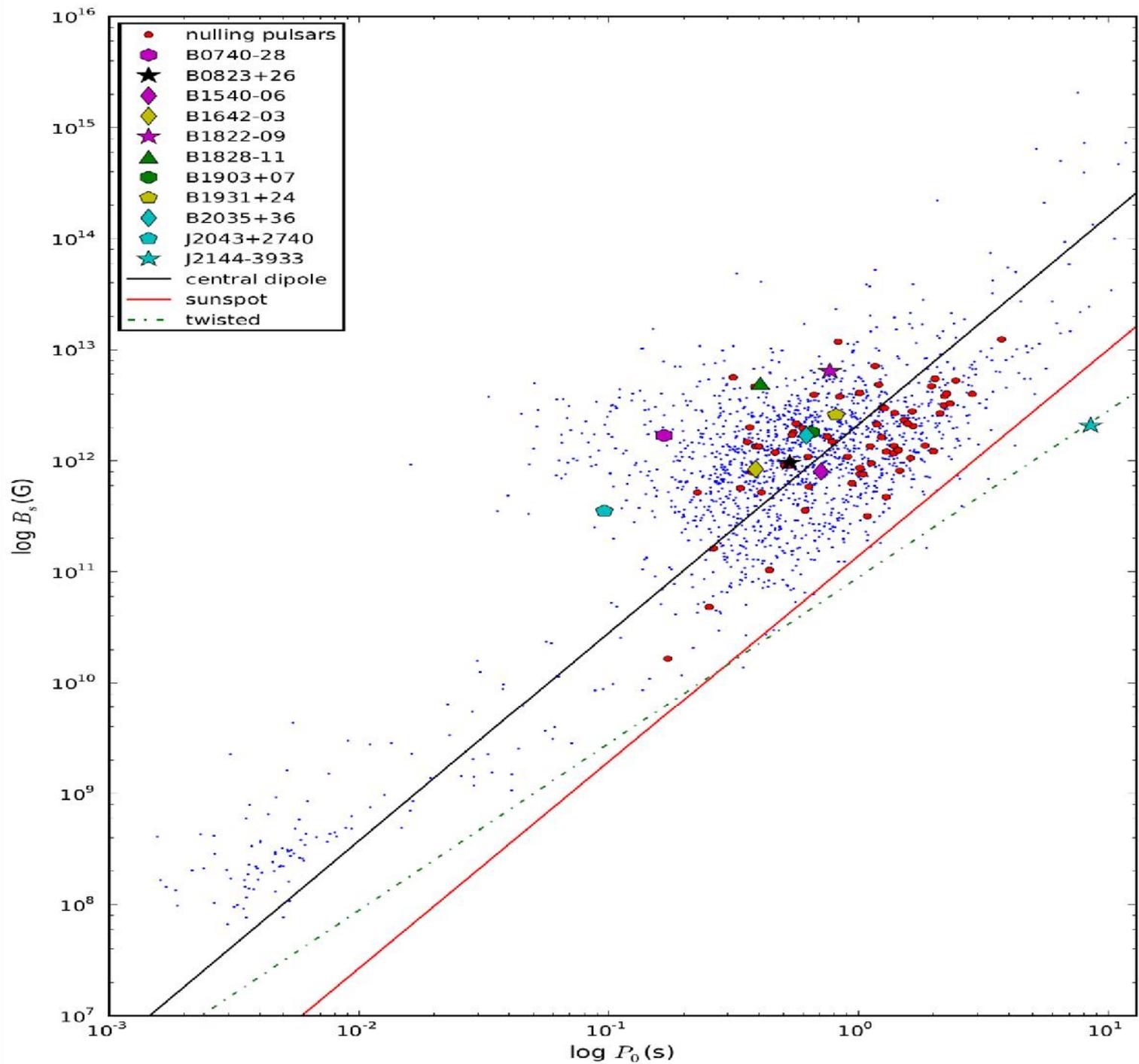


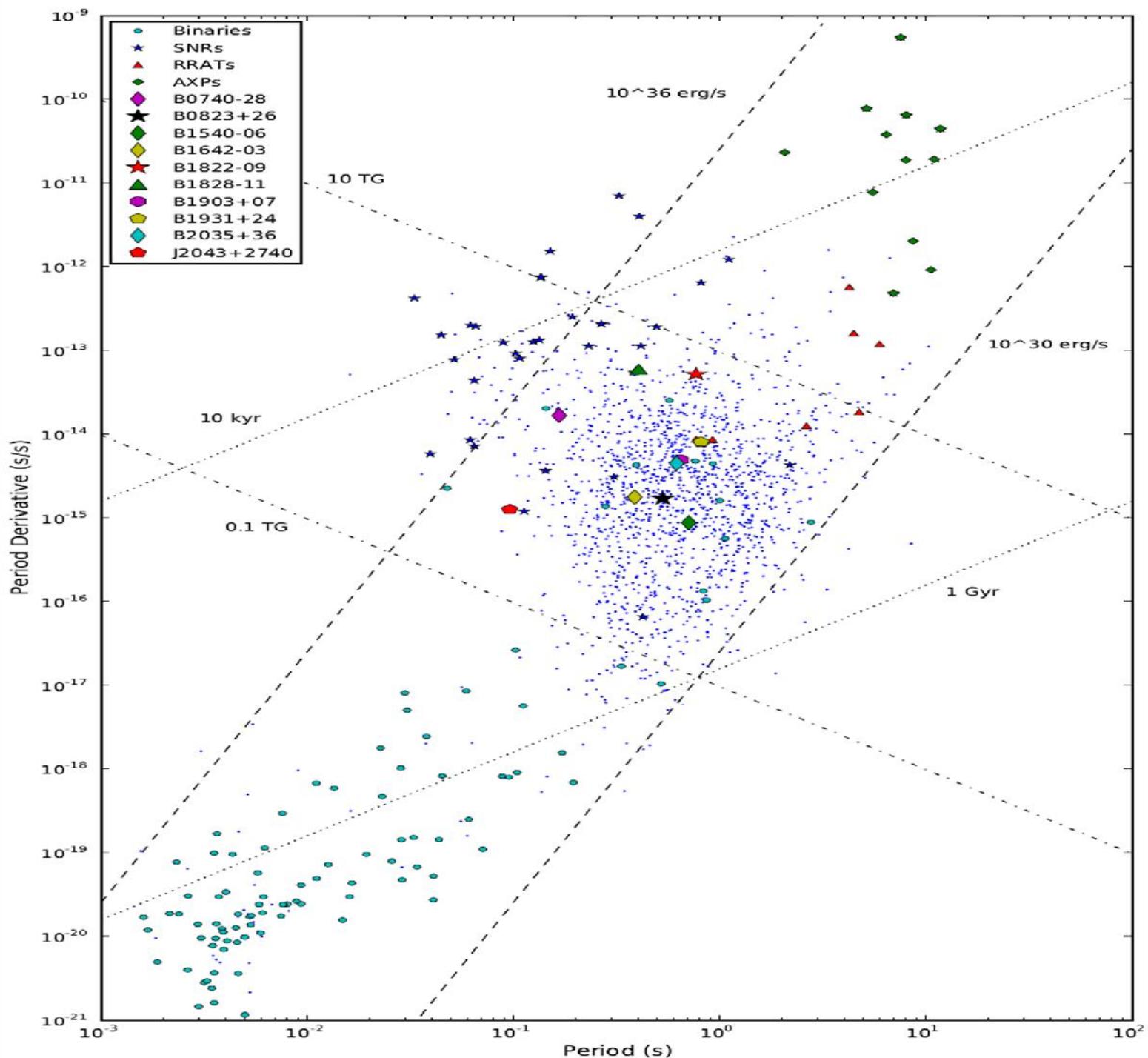
Mode Change

Null

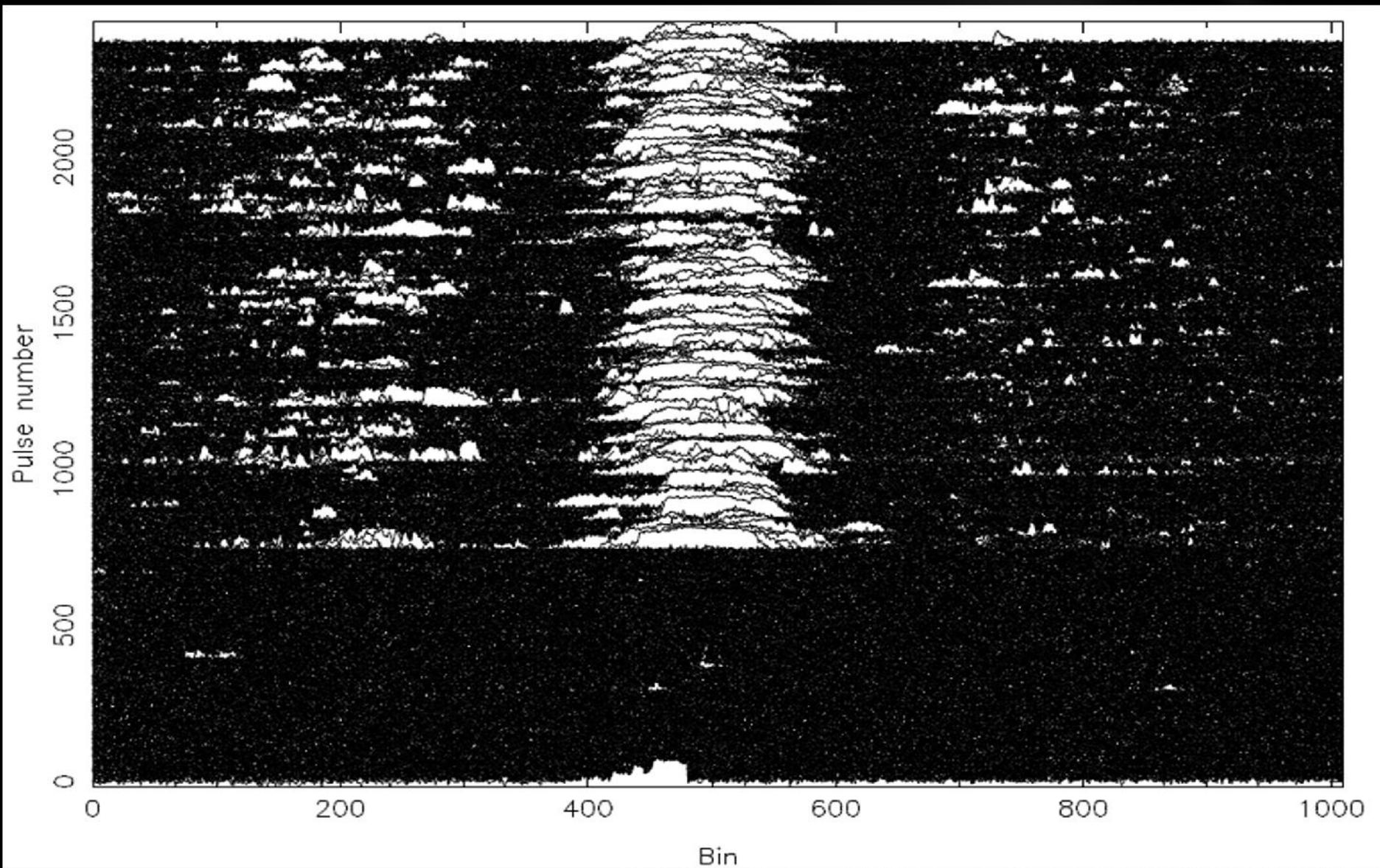
Light Cylinder



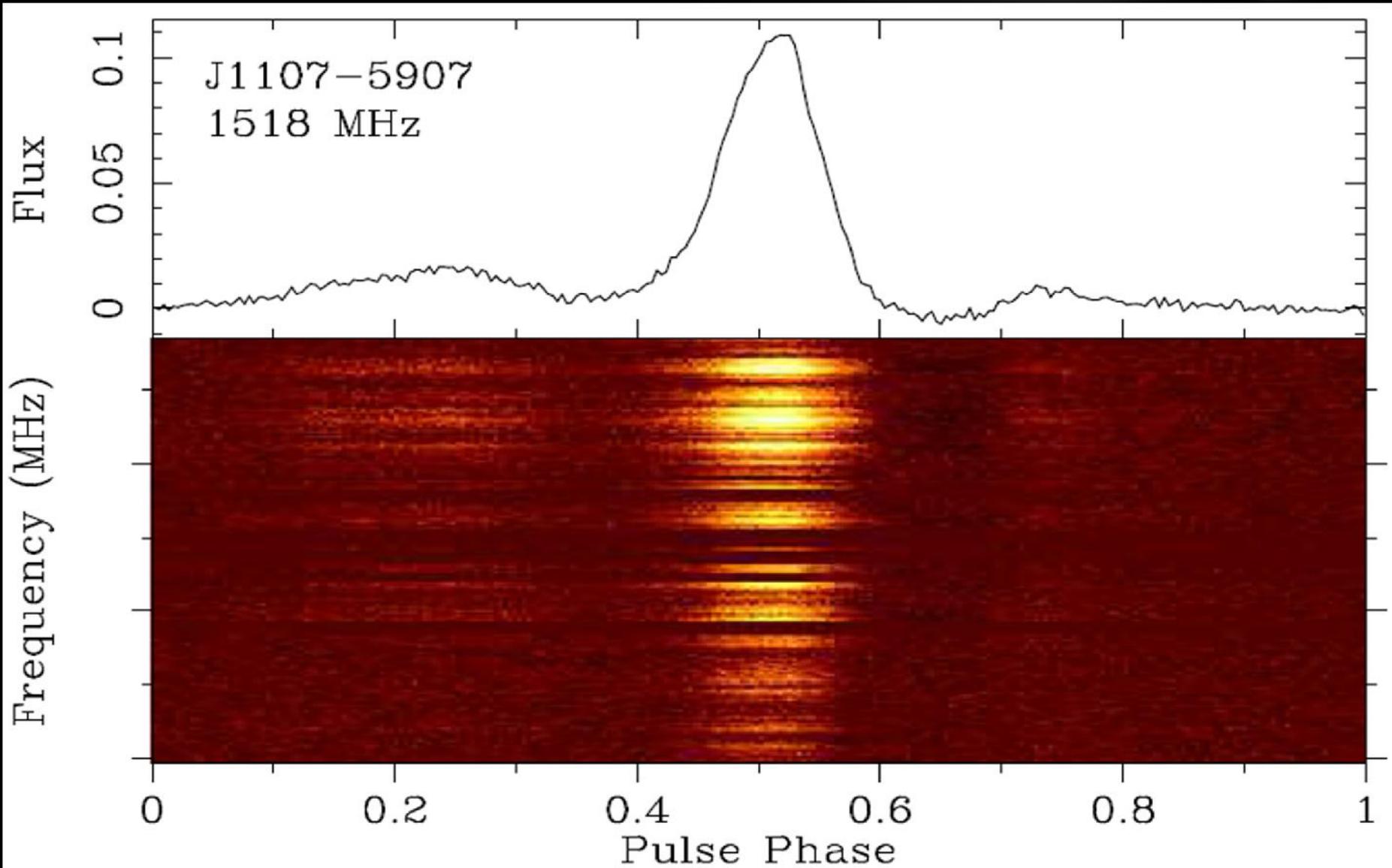




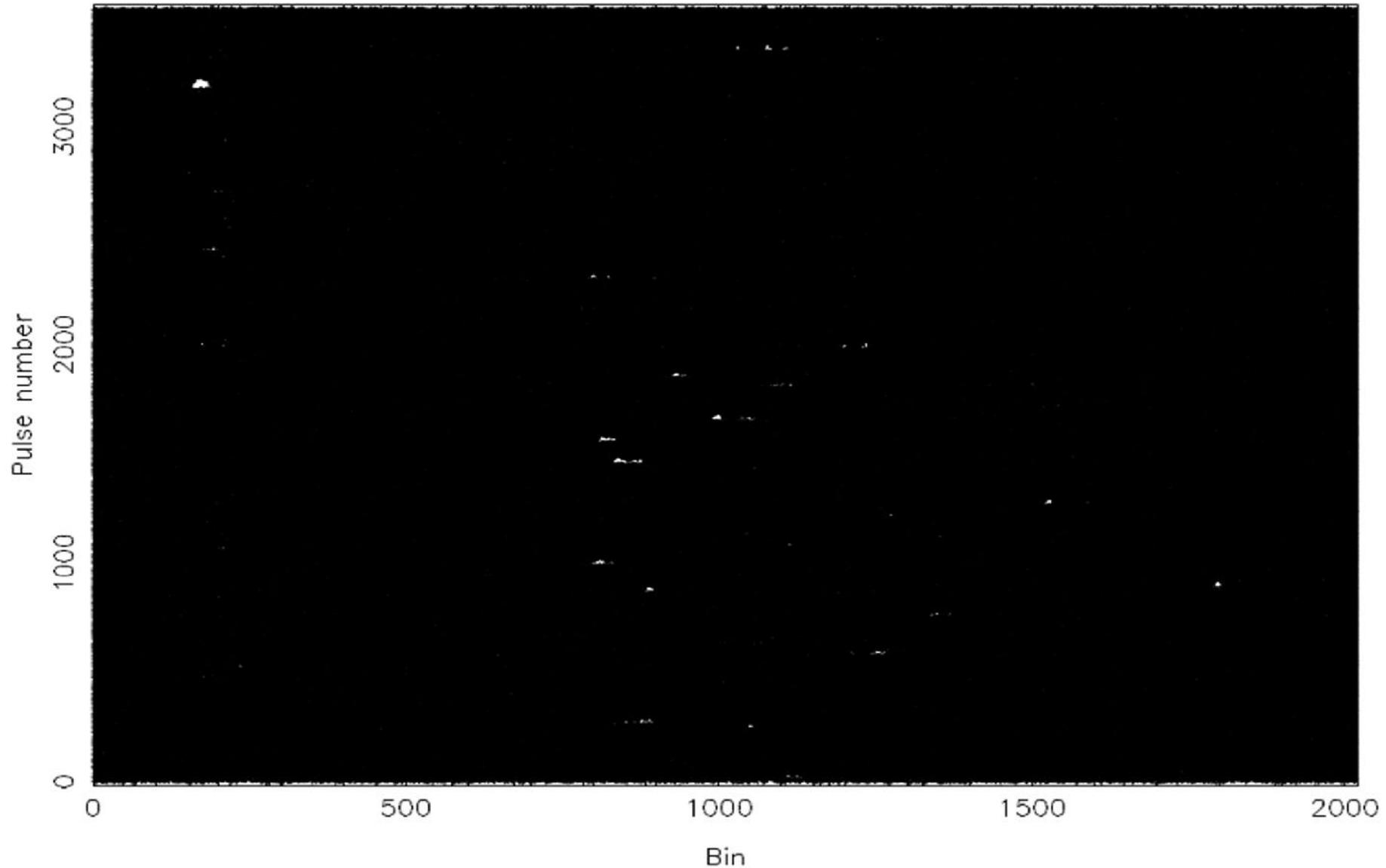
# J1107-5907 – Behaving Badly I



# J1107-5907 – Behaving Badly I



# J1107-5907 – Behaving Badly II



# J1107-5907 – Behaving Badly II

