



# The Relationship Between X-ray and Radio Emission in the Vela Pulsar

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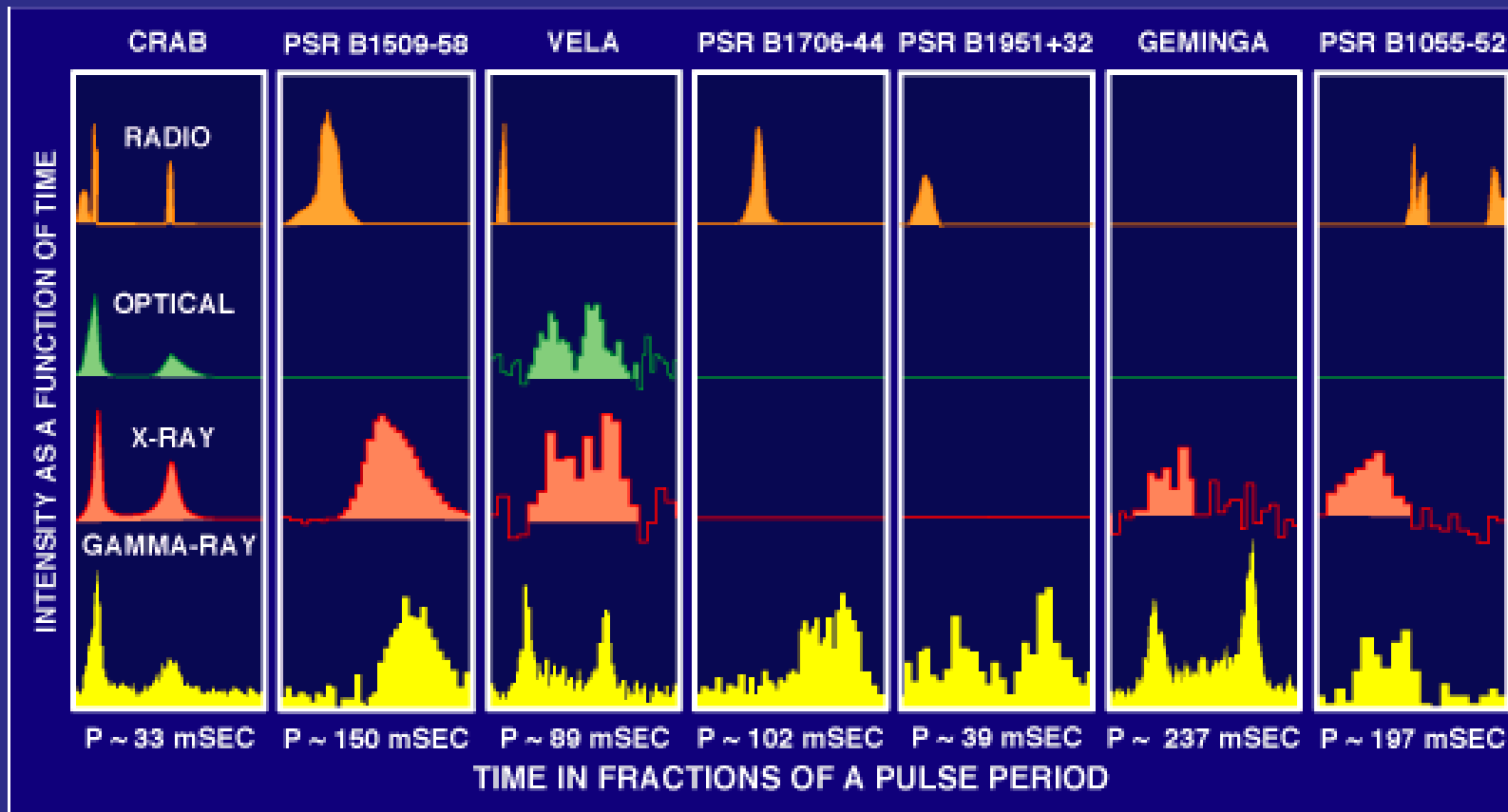
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# What's the relationship between high energy emission and radio emission in general?

From a talk  
on GLAST  
given by  
Lynn  
Cominsky  
of Sonoma  
State  
University



# Brief Review of the Vela Pulsar

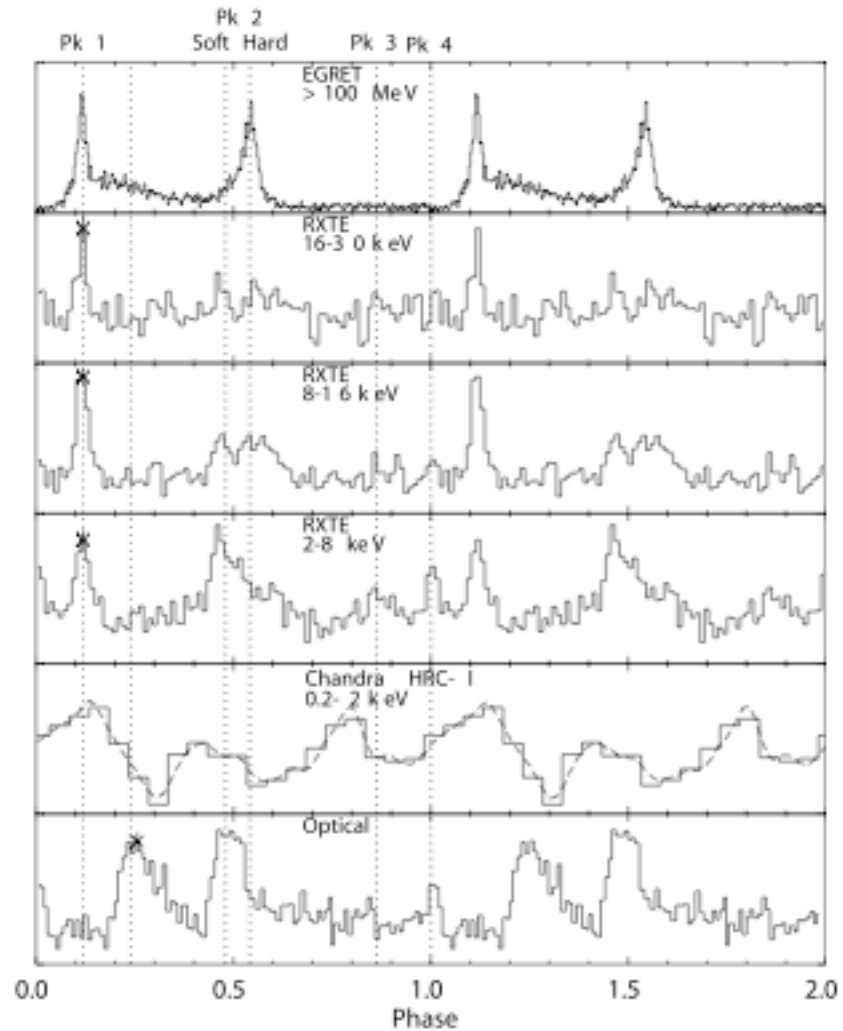


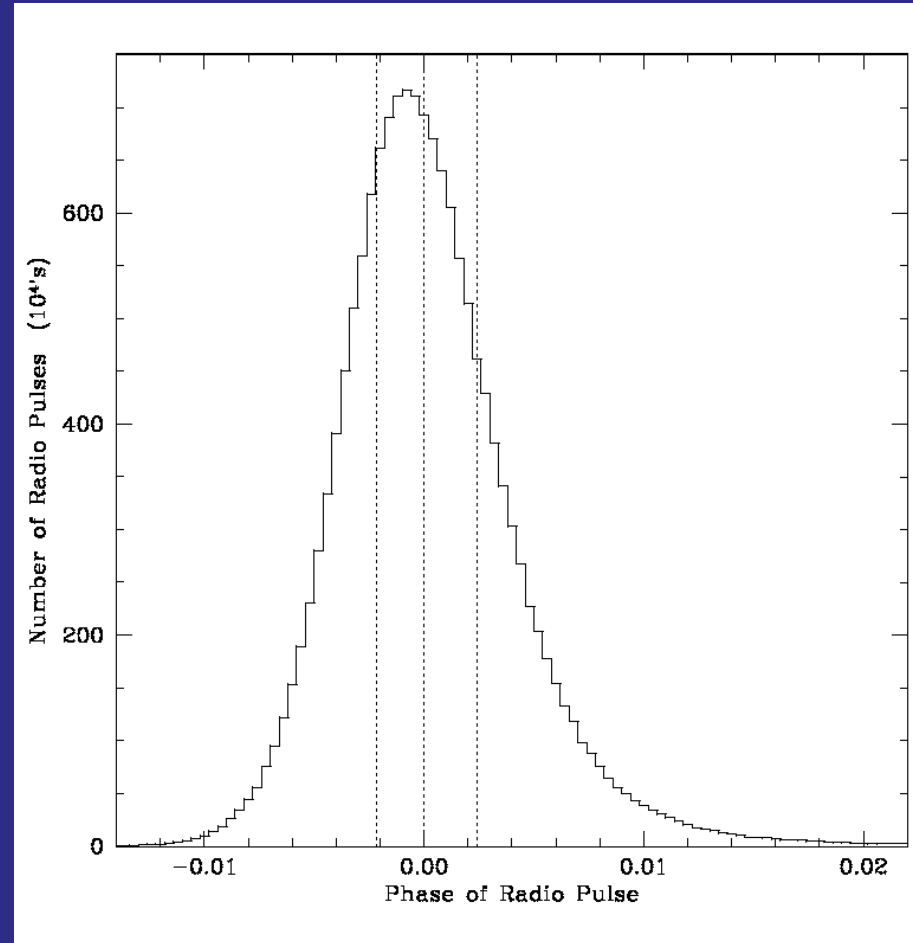
FIG. 1.—Vela Cycle 3 RXTE pulsed emission-phase histograms in three broad energy bands, averaged over the entire observation. Also shown are pulse profiles in EGRET (Kasburh et al. 1994), Chandra (Sanwal et al. 2002), and optical (Gioffrè 1998) bands.

# Our data

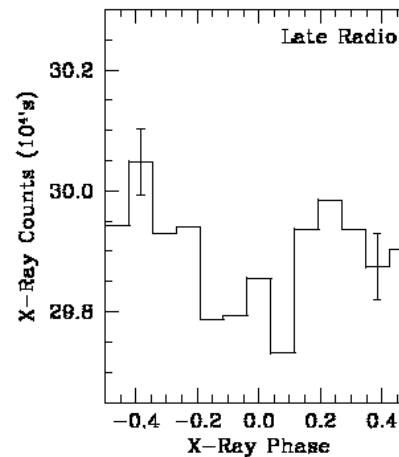
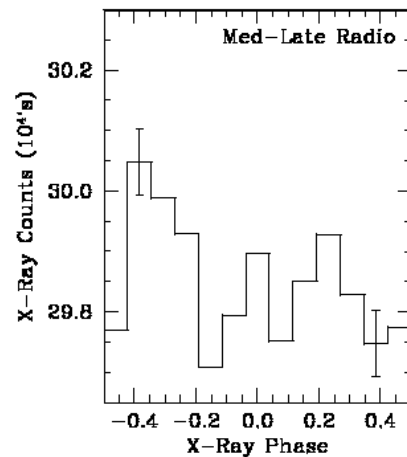
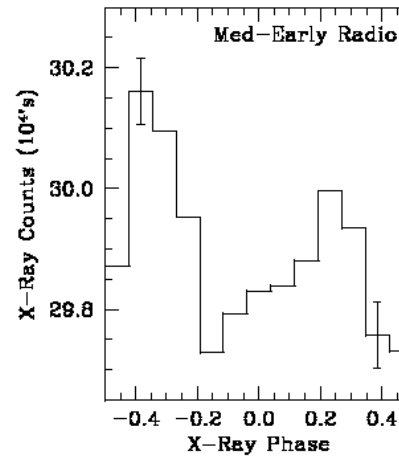
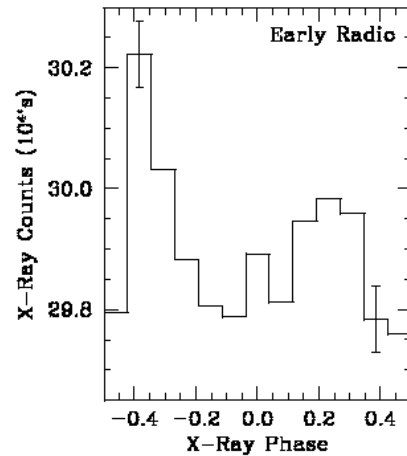
- 74 hours of simultaneous xray and radio observations
  - Mt. Pleasant Radio Observatory, Tasmania
    - 990 MHz, 6.4 MHz bandwidth
  - RXTE
    - 265 ks of usable data

# Binning by Residual Arrival Time

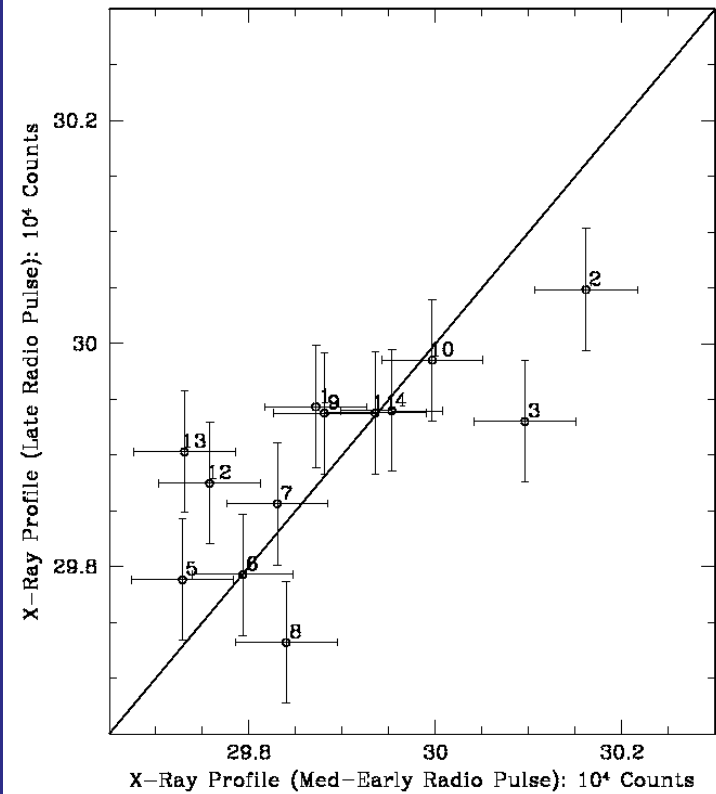
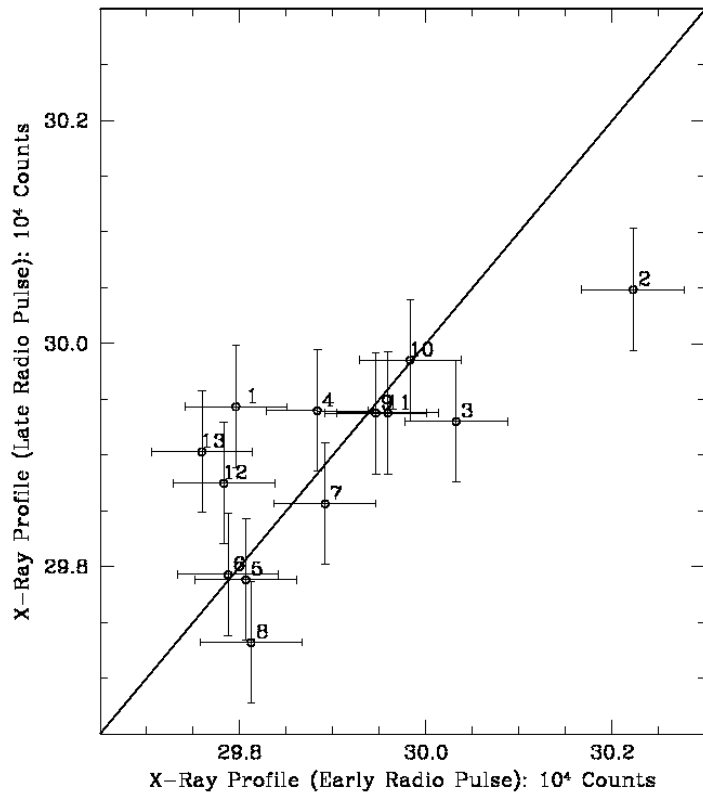
- Figure shows number of radio pulses vs residual arrival time
- Four bins were created



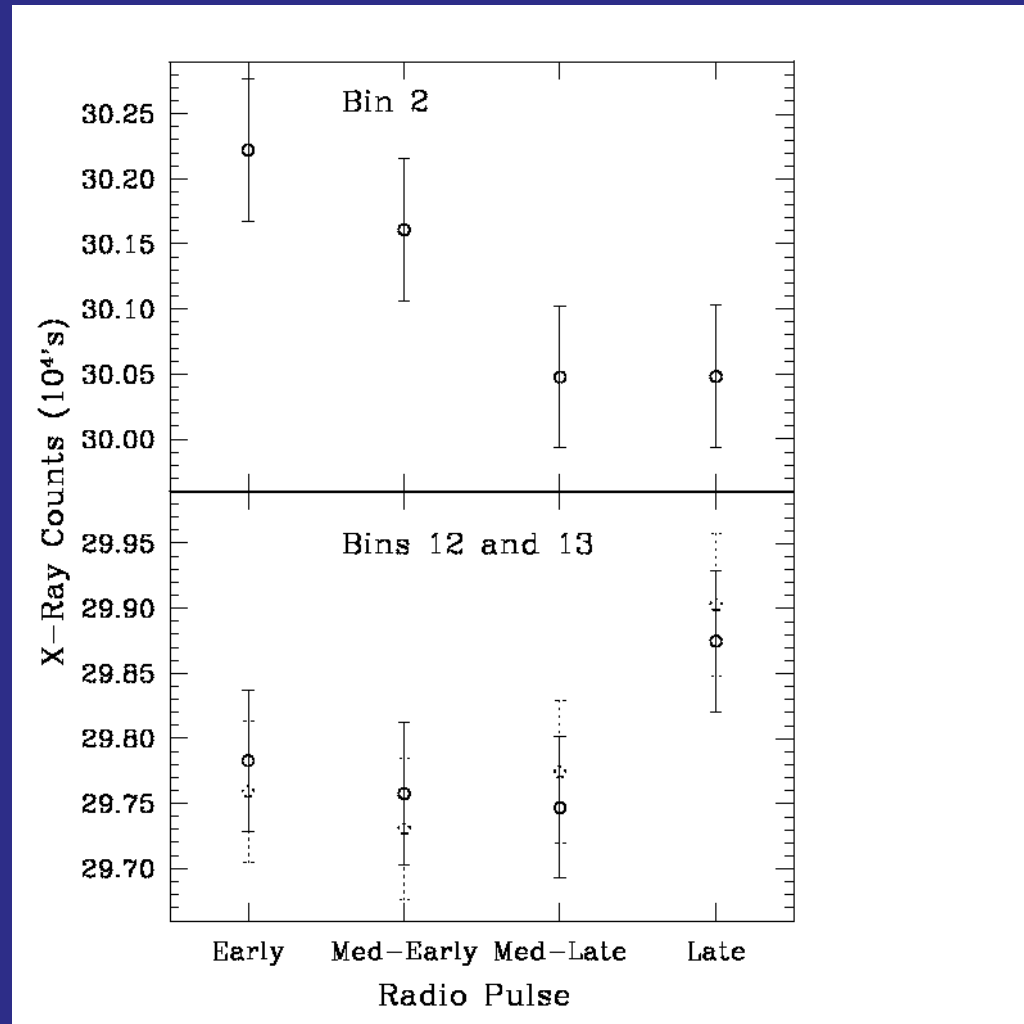
# Four x-ray profiles corresponding to radio arrival time binning



# Are the differences significant?

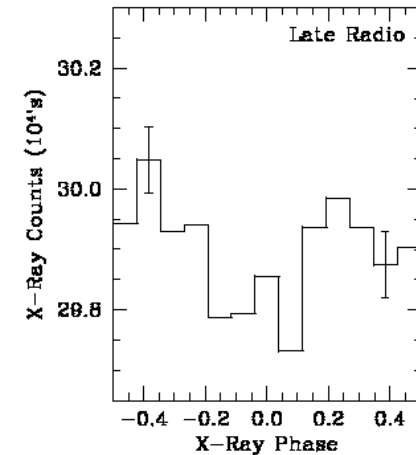
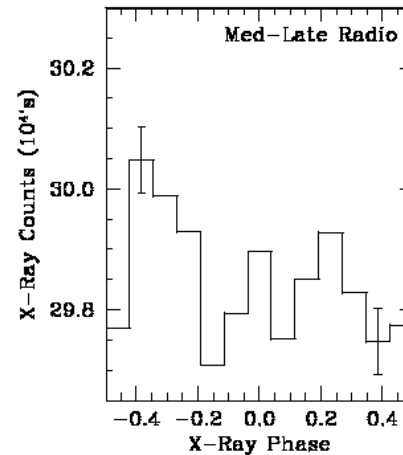
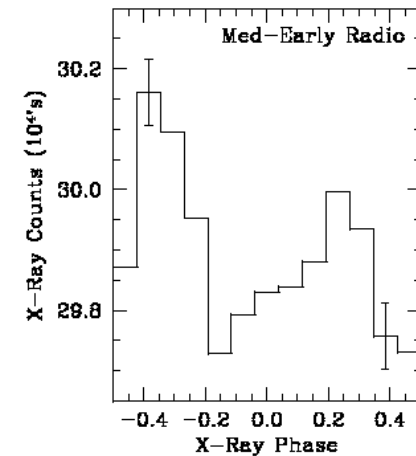
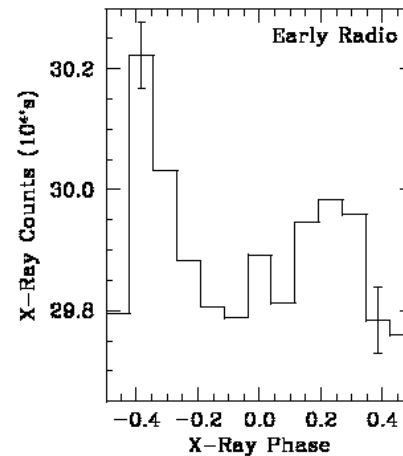


# Are the differences significant?



# Yes, well then what does it mean?

- Late radio emission corresponds to increased xray emission at the radio peak location



# Conclusions

- Xray pulses associated with early radio pulses show stronger emission at the main xray peak (the sharper one)
- Xray pulses associated with later radio pulses show stronger x-ray emission near the location of the radio peak.
- Suggests perhaps that different xray components are emitted at different heights in the magnetosphere (just like radio components)
- Suggests a close relationship between xray and radio emission

# The slide where I get myself in trouble

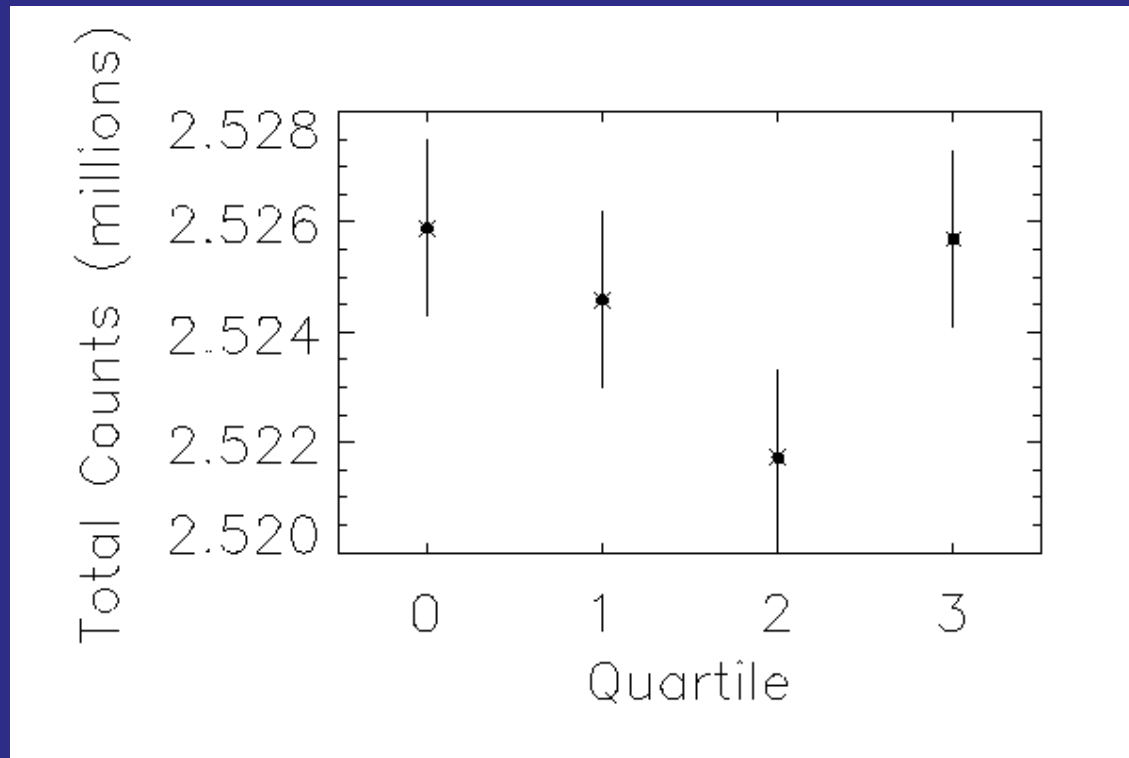
- The data are consistent with Petrova '03 model.
  - Resonant absorption of radio emission leads to optical and higher energy emission by spontaneous synchrotron emission.
- The observation I have presented here is not consistent with outer gap models.
  - In outer gap models the high energy emission comes from a gap connection to the OPPOSITE pole from the one producing the radio emission.

# Additional Slides

# Scintillation concerns

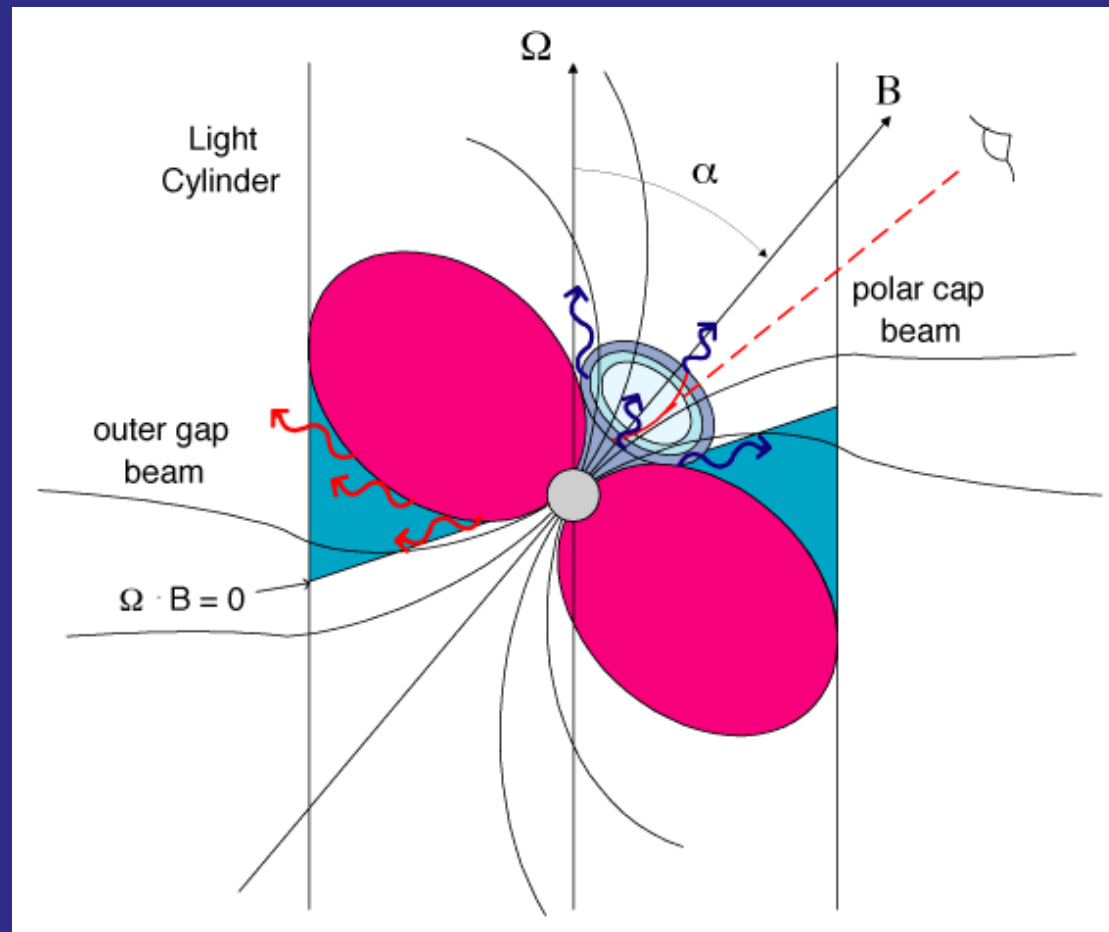
- Vela properties
  - Diffractive bandwidth      2 kHz
  - Refractive timescale      25 days
- Observation properties
  - 6.4 MHz
  - 12 epochs of several hours each

# Somewhat bizarre flux binning result



# Outer gap vs polar gap

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# Yadigaroglu and Romani Model 1995

