

# The Radiation of Pulsars with Fall-back Disks

Xiong-Wei Liu 刘雄伟



西华师范大学

Xiongwliu@163.com

Background

The model

Observations

1. J1734-3333
2. J1622-4950

Discussion

# Background

## The model

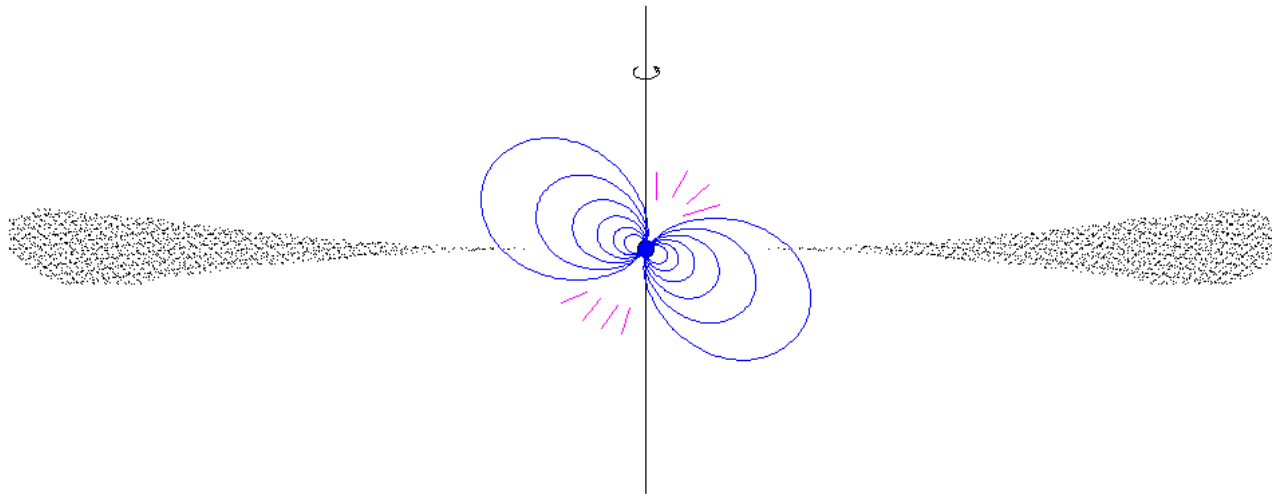
## Observations

1. J1734-3333
2. J1622-4950

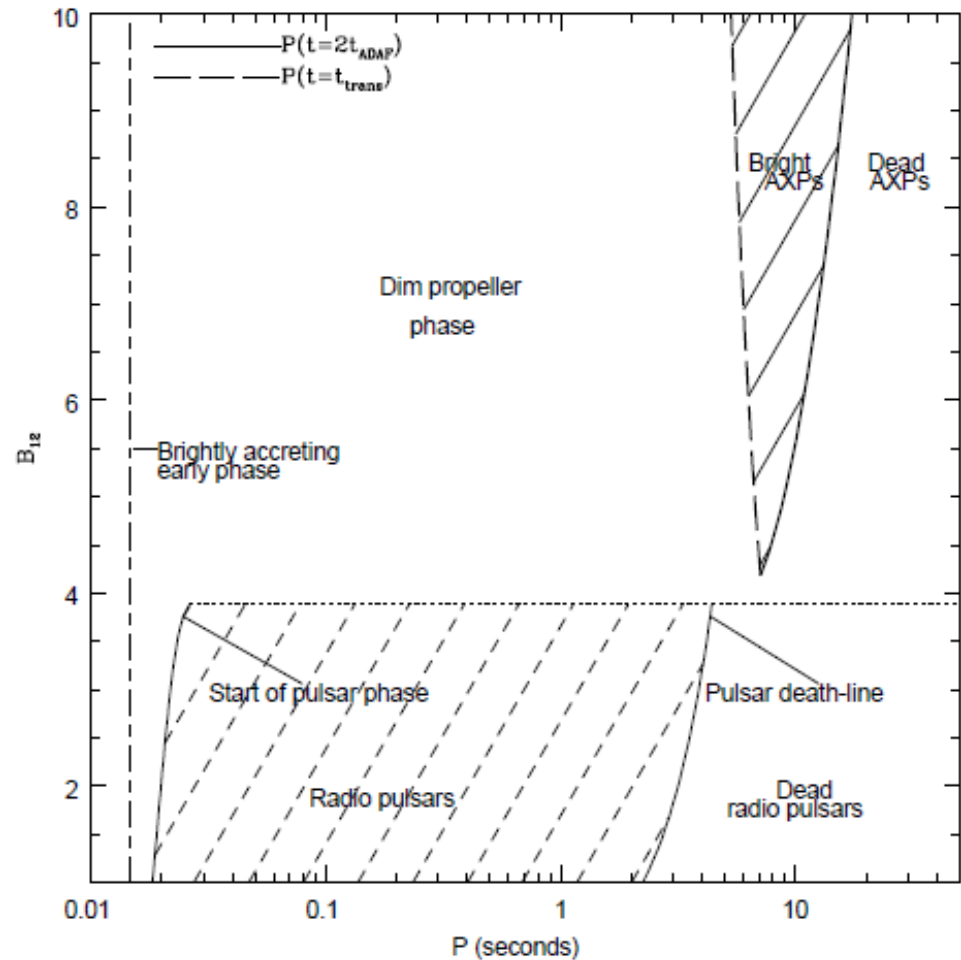
## Discussion

## fall-back disks

- Part of the fall-back material after supernova burst carries sufficient angular momentum and can rotate around the young neutron star, forming a fall-back disk.
- $M_d < 0.1 M_{\text{sun}}$  (Chevalier 1989; Lin et al. 1991)



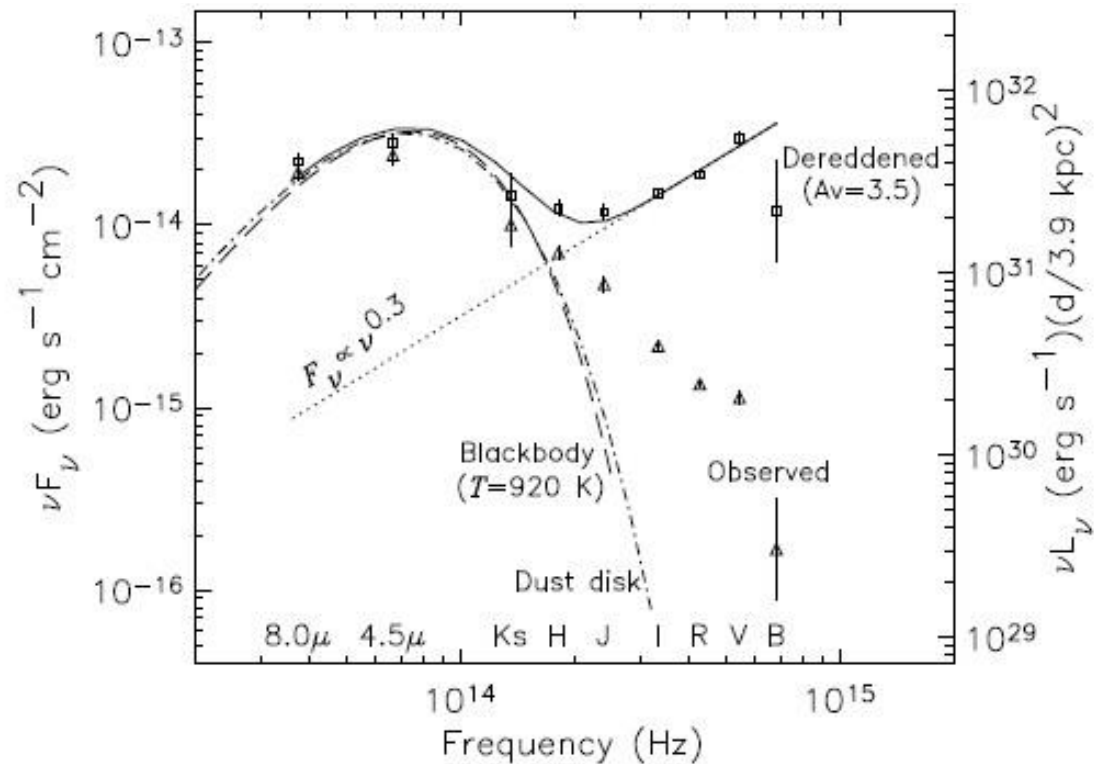
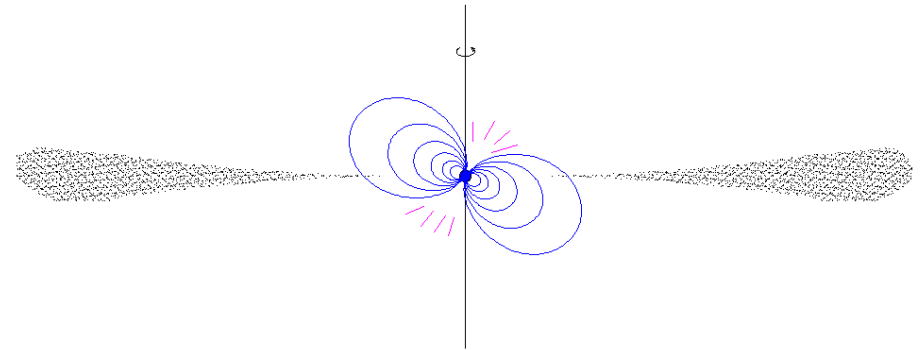
- Accretion model for anomalous x-ray pulsars  
(Chatterjee et al. 2000; Alpar, 2001)



(Chatterjee et al. 2000)

# Radiation of Pulsars with Fall-back Disks Background

- Found a debris disk around AXP 4U 0142+61 (Wang et al. 2006)

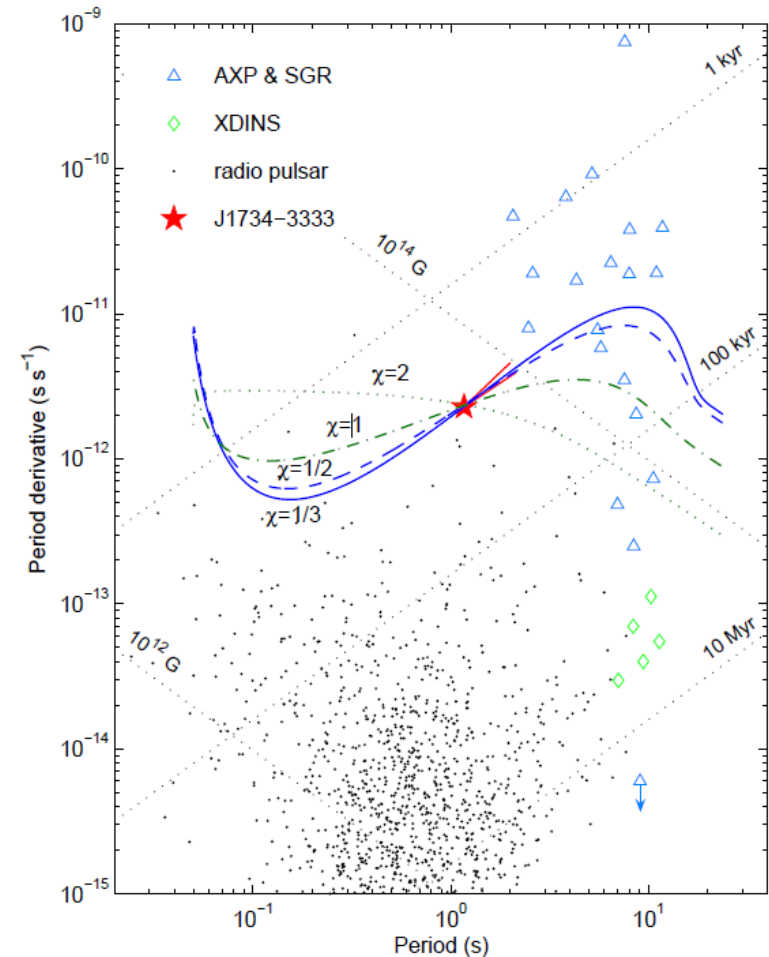


(Wang et al. 2006)

- SGR 0418+5729—how does a young neutron star spin down to a 9 s period with a dipole field less than  $10^{13}$  G? (Alpar et al. 2011)
- Braking the low braking index pulsar J1734–3333 with a fall-back disk (Caliskan et al. 2013, Liu et al. 2014)

.....

.....



(Liu et al. 2014)

## fall-back disks

- It seems they are not rare, even are general, around pulsars.
- And they should affect the manifestation of pulsars.

How to find them?

**Direct** VS **Indirect**  
(IR, sub-mm) (pulsar radiation)



Background

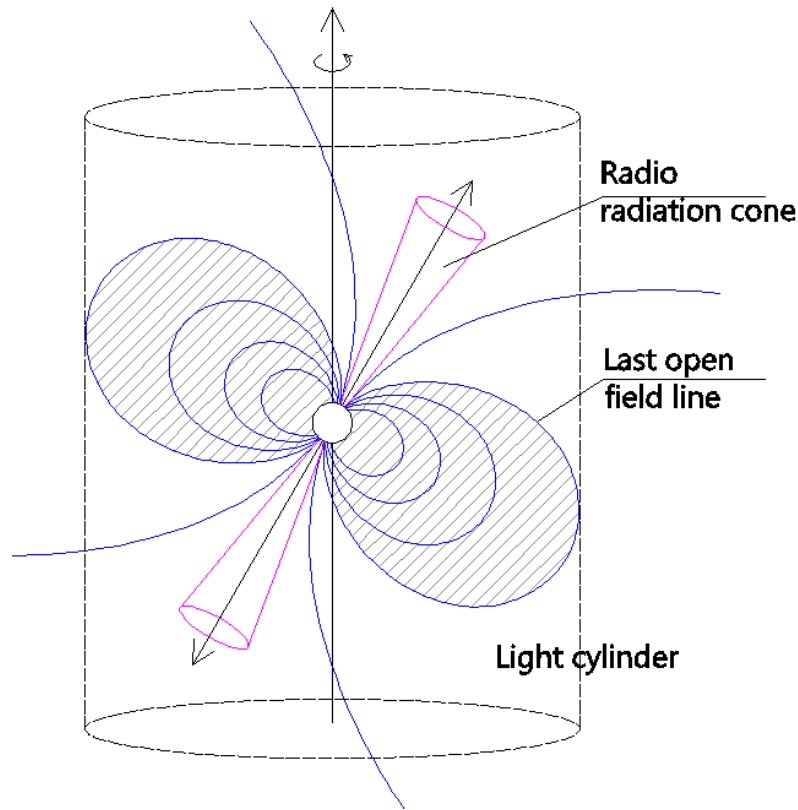
The model

Observations

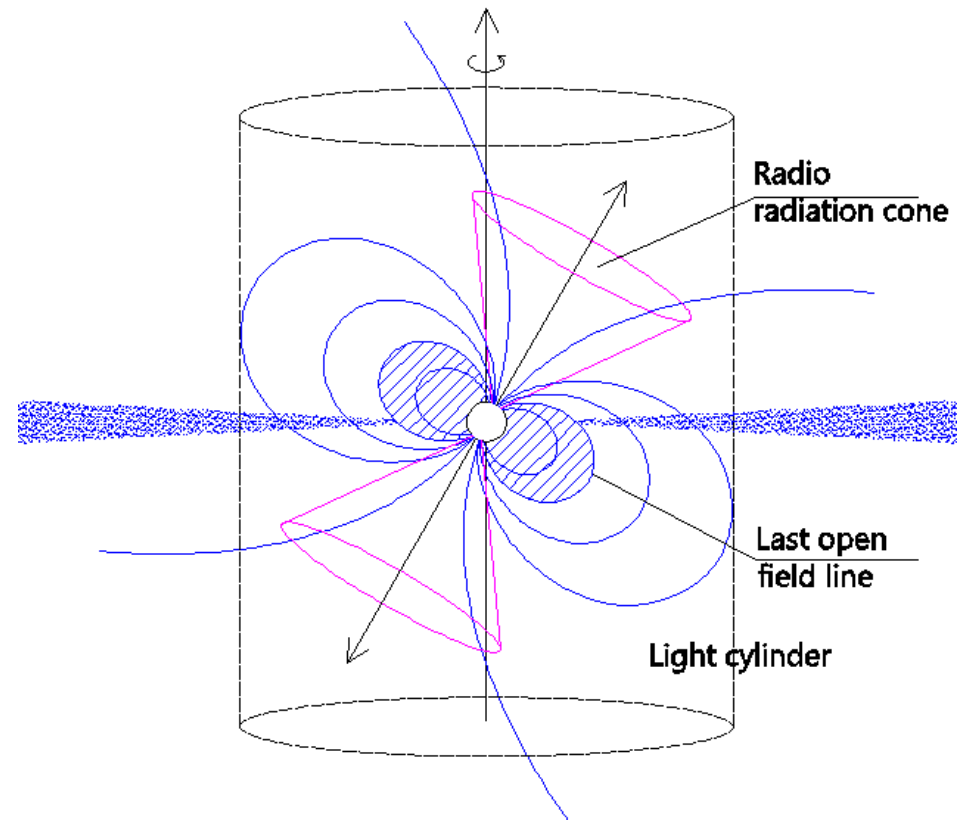
1. J1734-3333
2. J1622-4950

Discussion

## Isolated pulsar



## pulsar with fall-back disk (propeller phase)



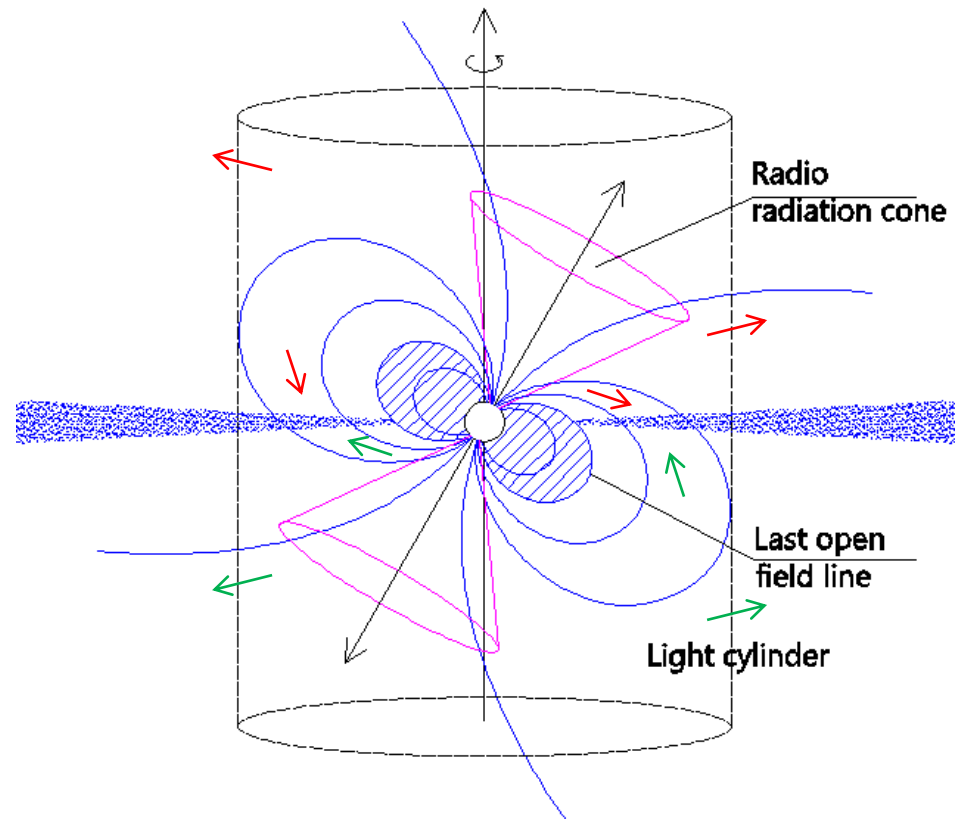
## Hypothesis:

No or only little disk matter goes towards the pulsar

## Results:

Radio radiation could survive, and should be distinctive!

## pulsar with fall-back disk (propeller phase)

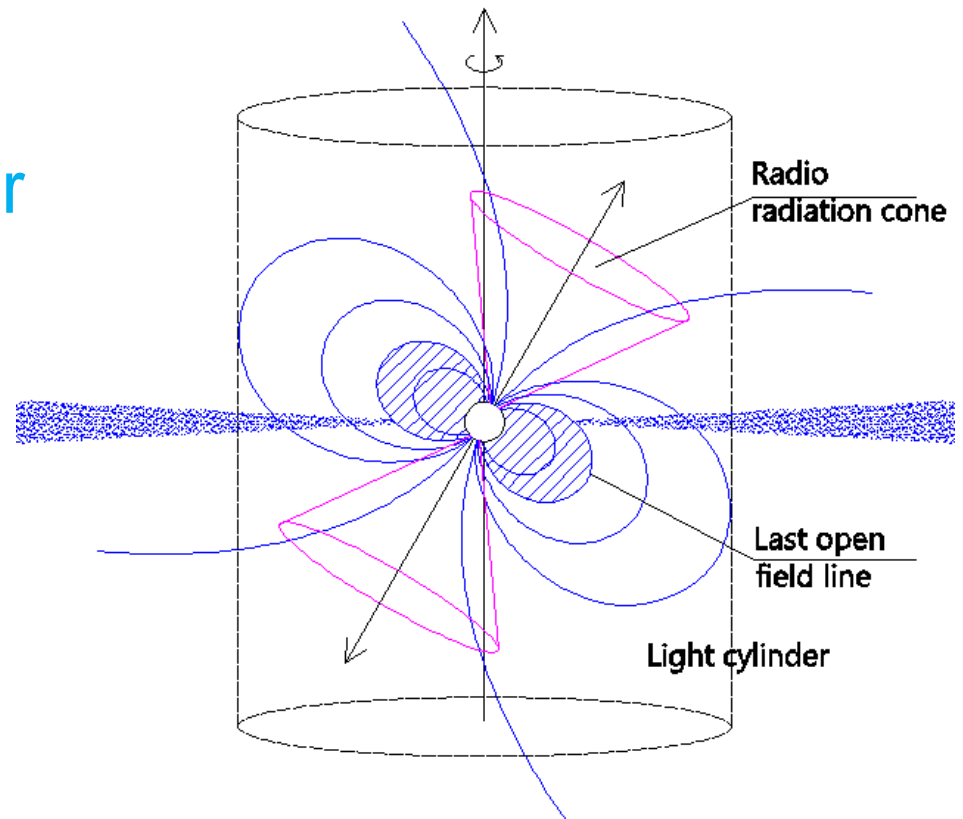


## Radiation features

1. Pulse width: wider
2. Profile: more annular component
3. Intensity: larger
4. Polarization: little different

.....

## pulsar with fall-back disk (propeller phase)



Background

The model

Observations

1. J1734-3333

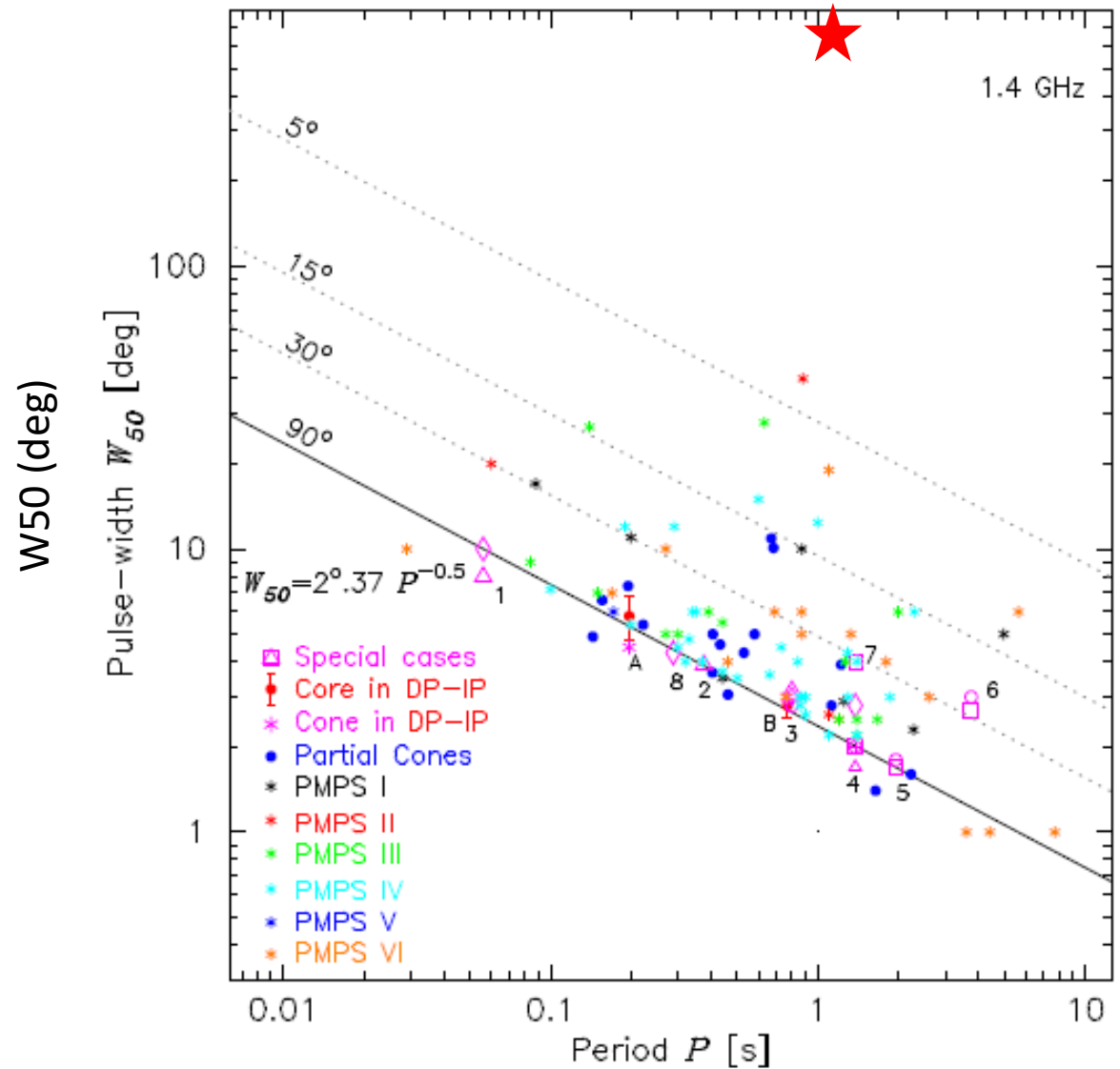
2. J1622-4950

Discussion

J1734-3333

 $W_{50} = 500\text{ms}$ 

(Espinoza et al. 2011)

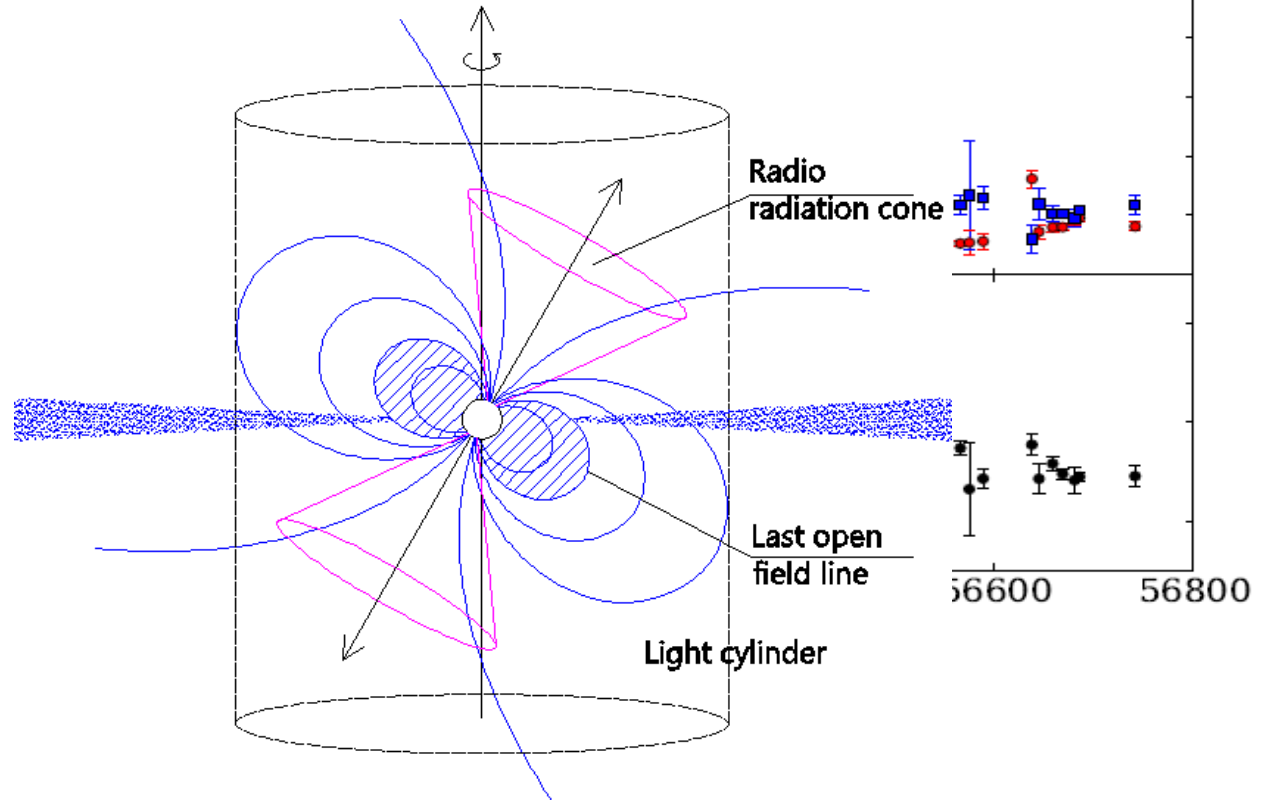
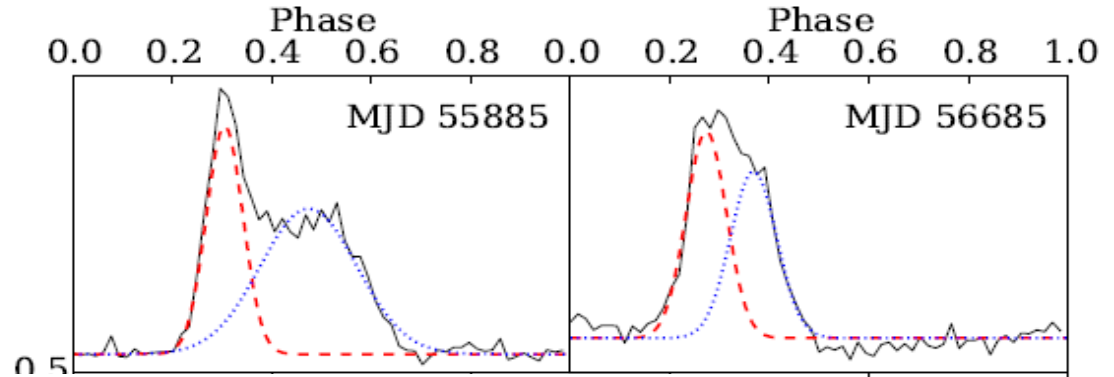
 $154^\circ$  !

(Maciesiak et al. 2011)

## J1622-4950

Variation of radio radiation after a burst.

Pulse-width was very wide and narrowed down.



Background

The model

Observations

1. J1734-3333

2. J1622-4950

Discussion



Disks around radio pulsars

Disks around Magnetars

Disks around IXDNs, CCOs, .....

Difficulties of identification

More pinpoint predictions and observations

*Thank you!*



China West Normal University