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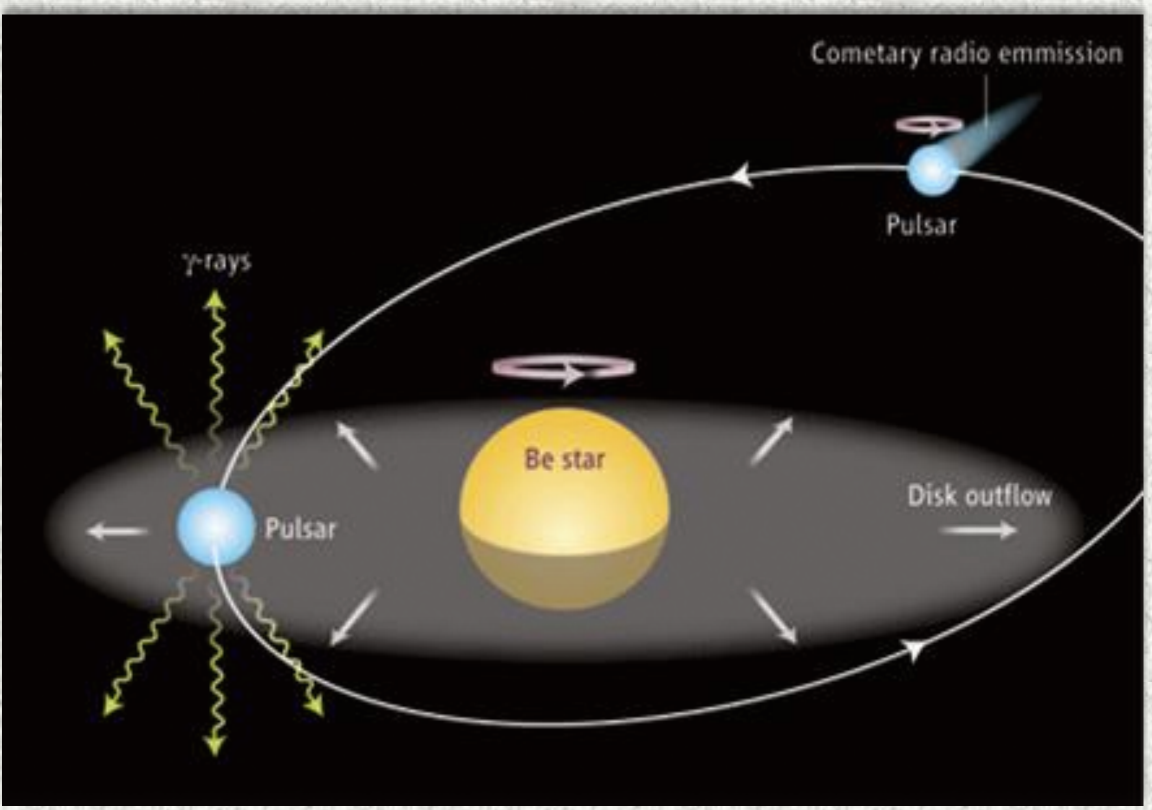
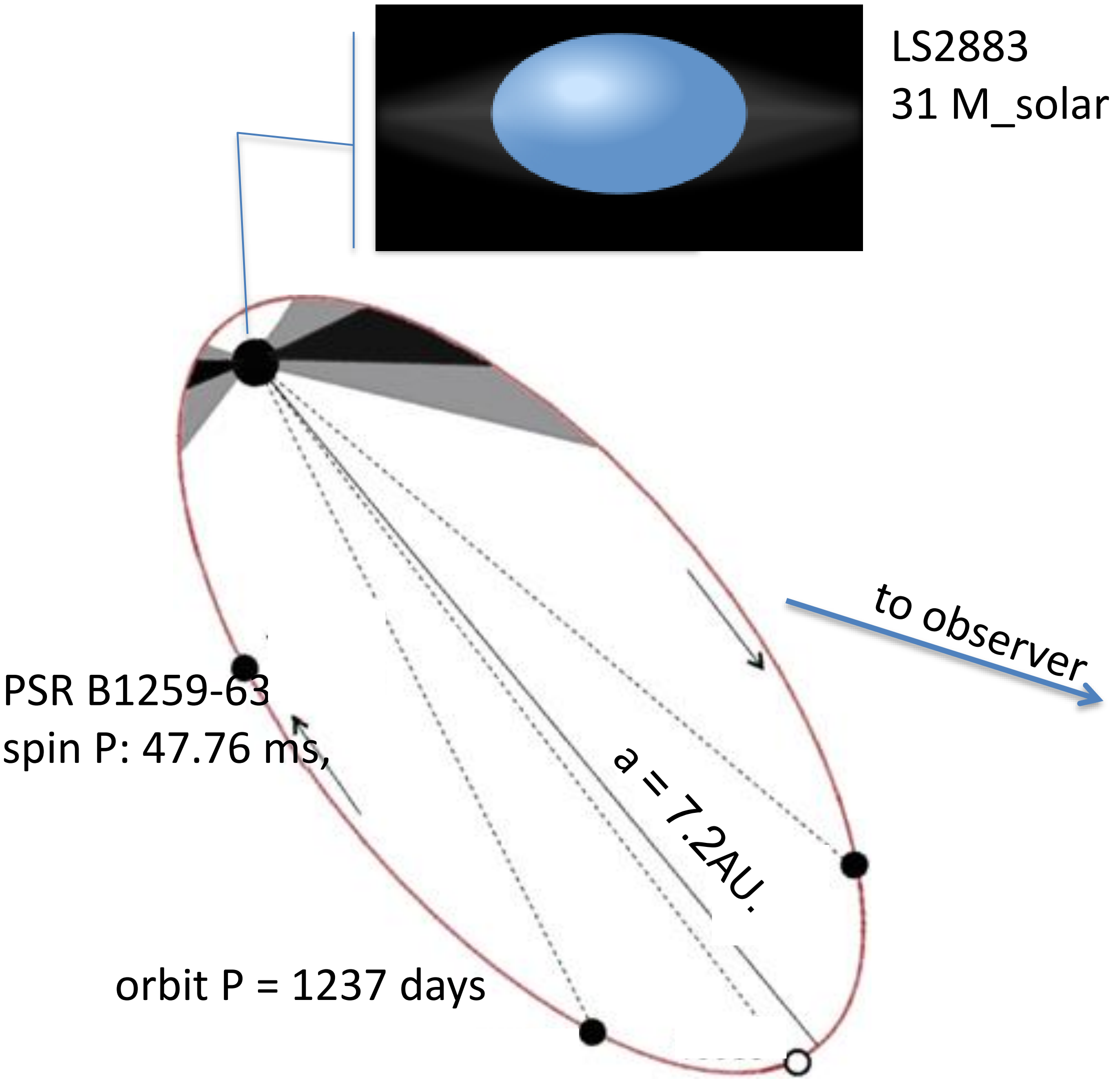
THE UNIVERSITY OF HONG KONG

# A NEW APPROACH TO THE GeV FLARE OF PSR B1259-63/LS2883



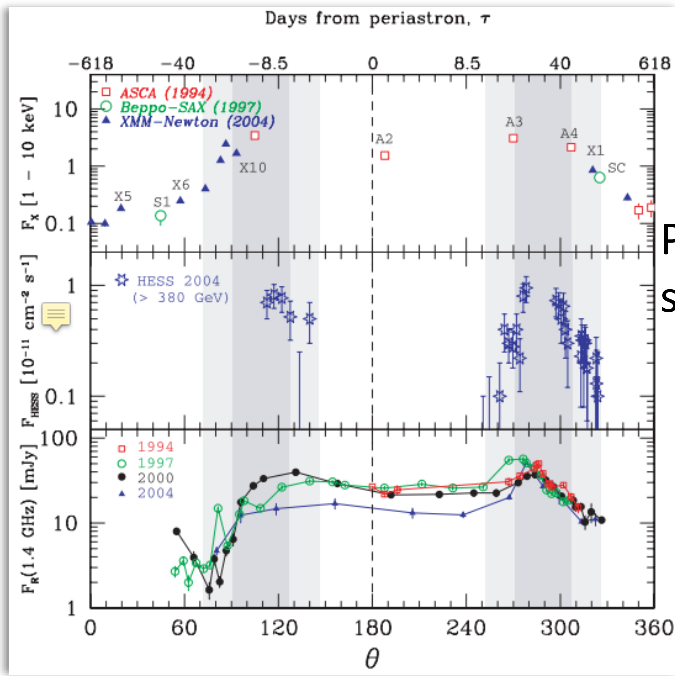

*Yi Shu-Xu (易疏序), K-S Cheng*
Department of Physics
University of Hong Kong
FPS6 @ Wuhan

# Introduction of the system

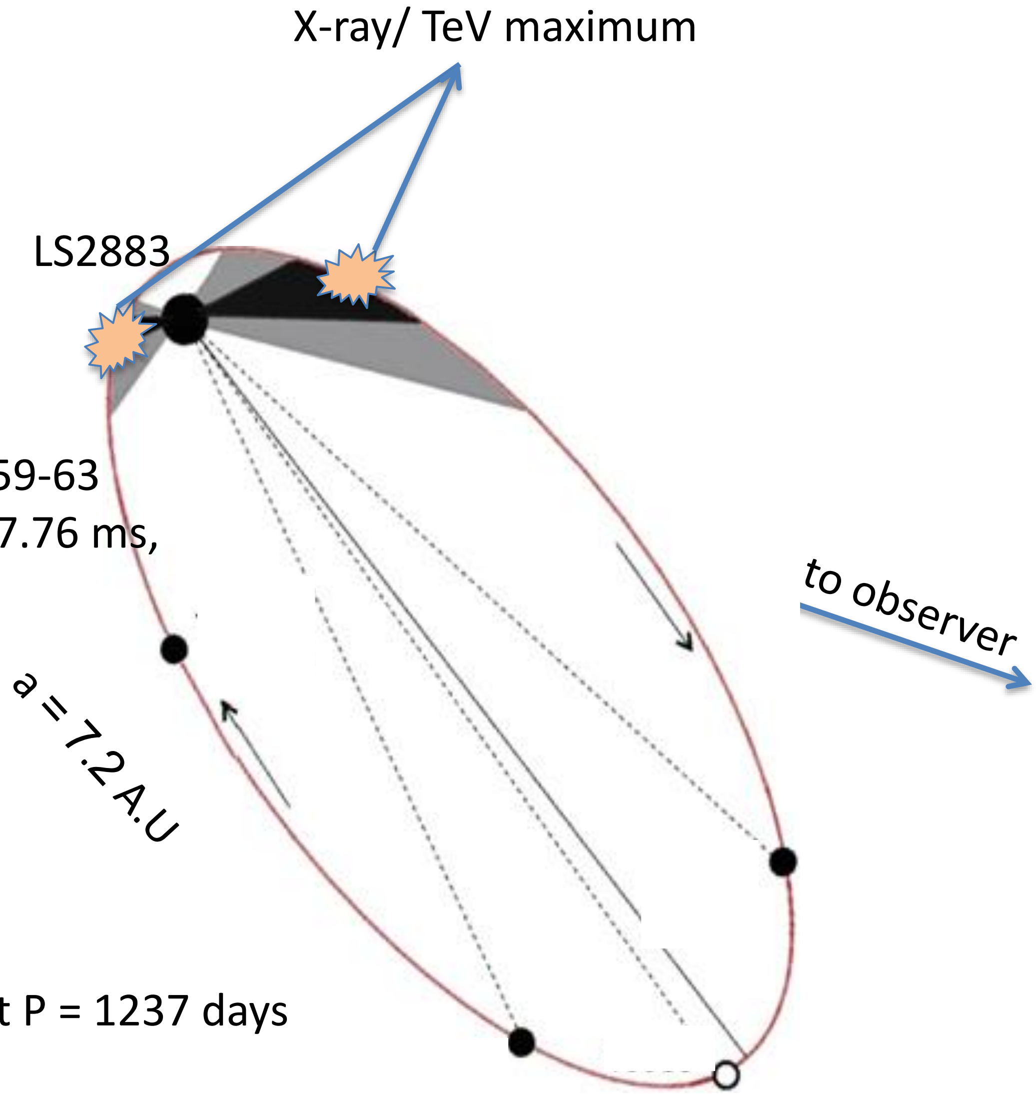



George G. Pavlov et al. 2015

# X-ray/TeV emission



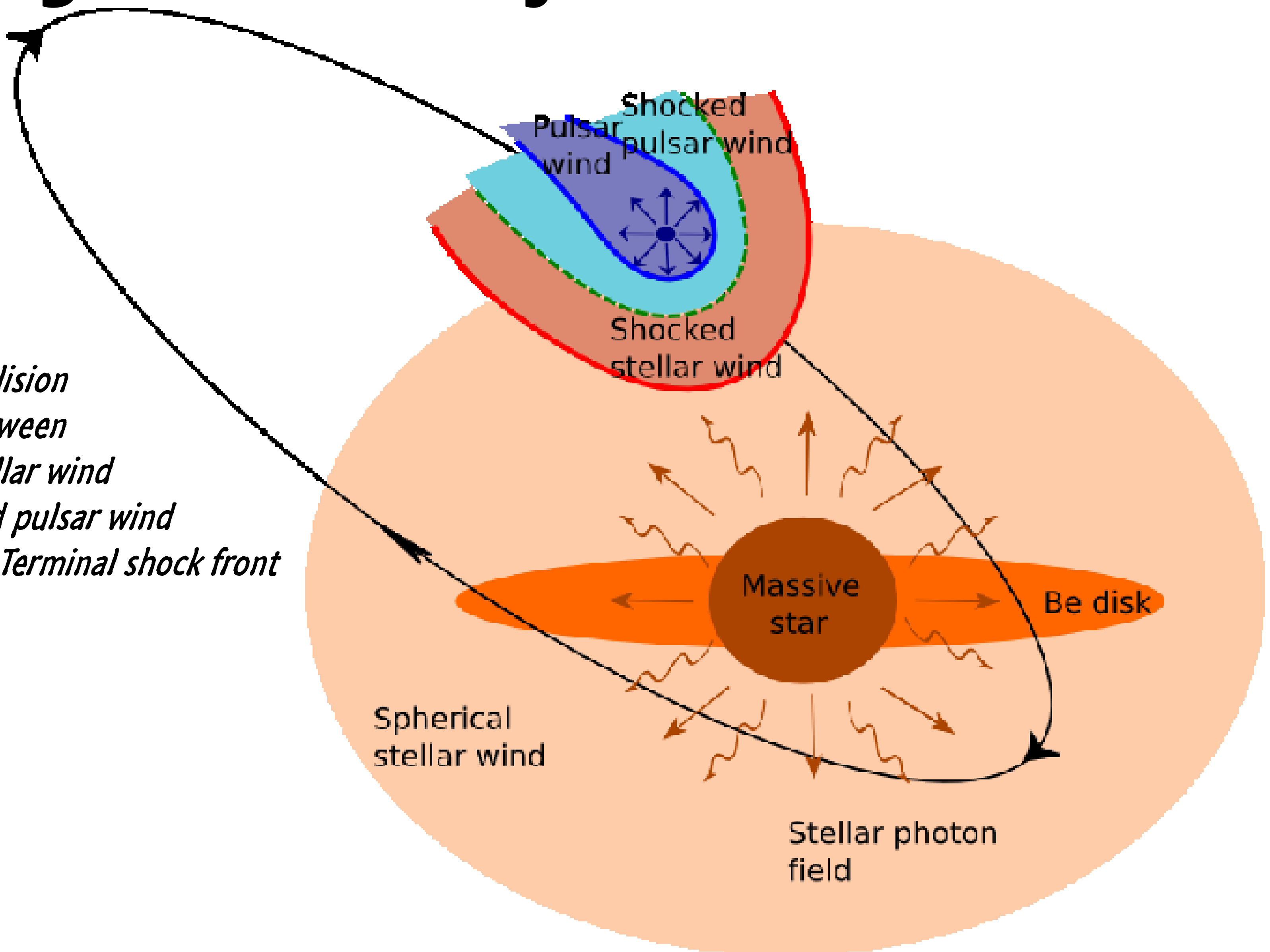

PSR B1259-63
spin P: 47.76 ms,



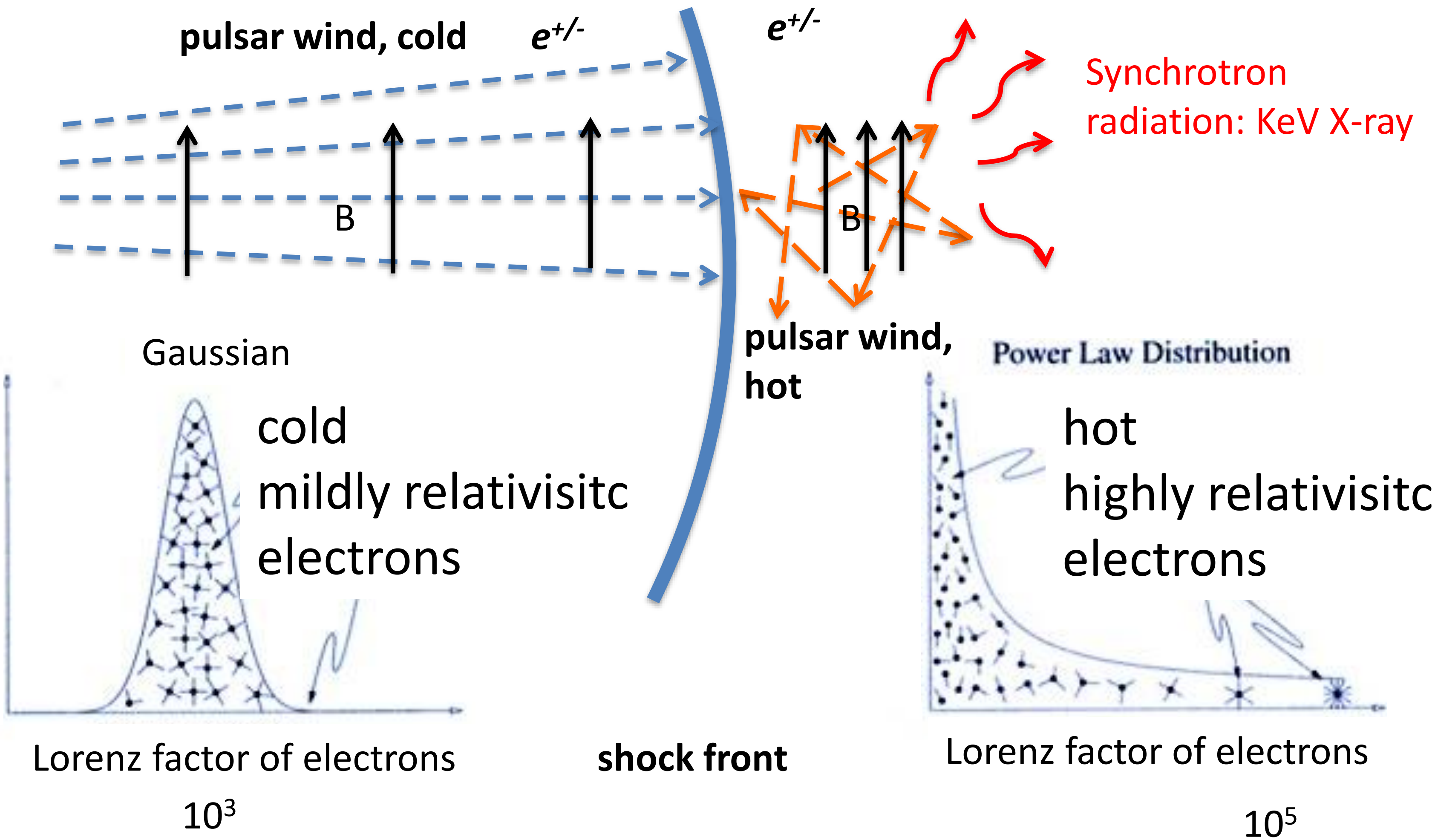

orbit P = 1237 days

# Origin of the X-ray/TeV emission

*Collision*
*Between*
*Stellar wind*
*And pulsar wind*
*→ Terminal shock front*

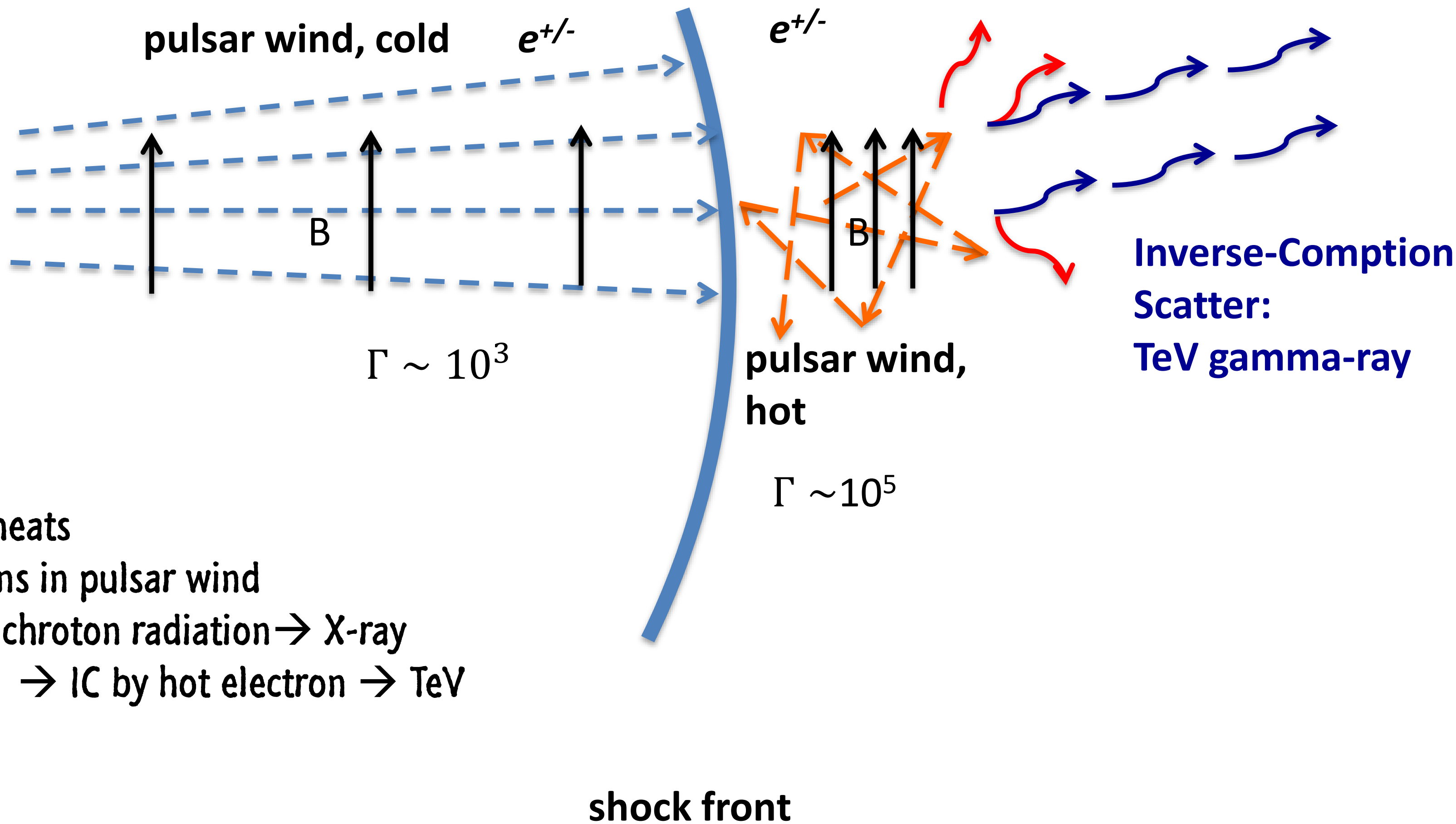


# Origin of the X-ray/TeV emission




Kong et al. 2011

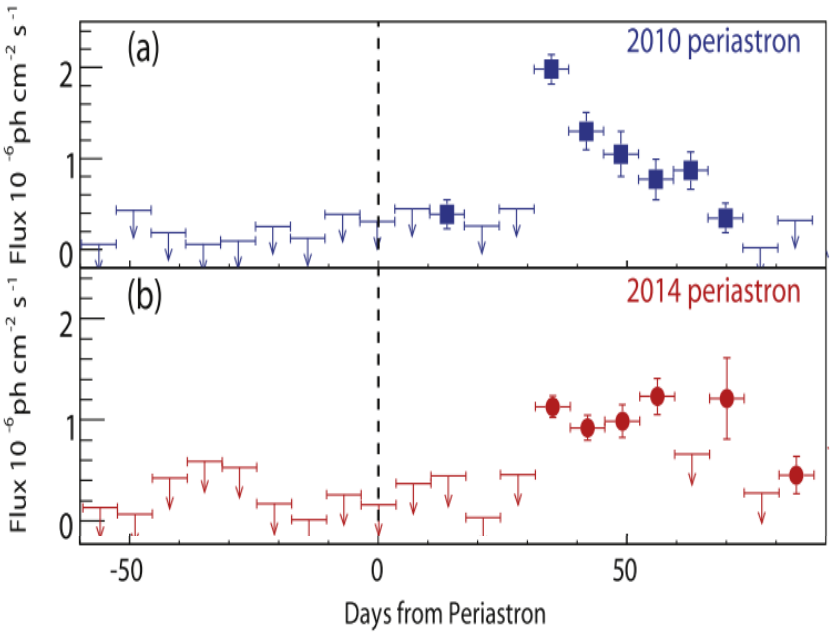
# Origin of the X-ray/TeV emission

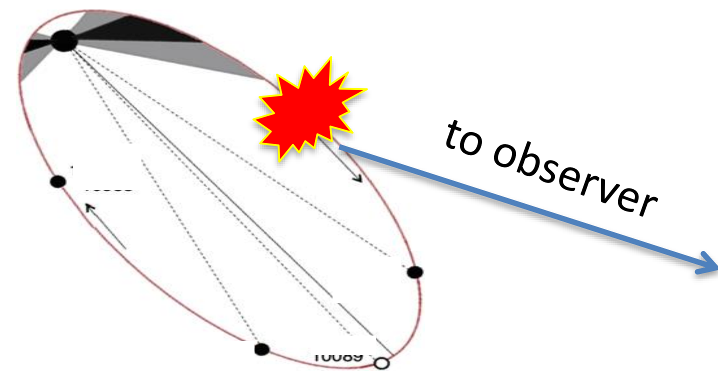



Shock heats
Electrons in pulsar wind
→ synchroton radiation → X-ray
→ IC by hot electron → TeV

Kong et al. 2011

# Emission in 100 MeV-100 GeV



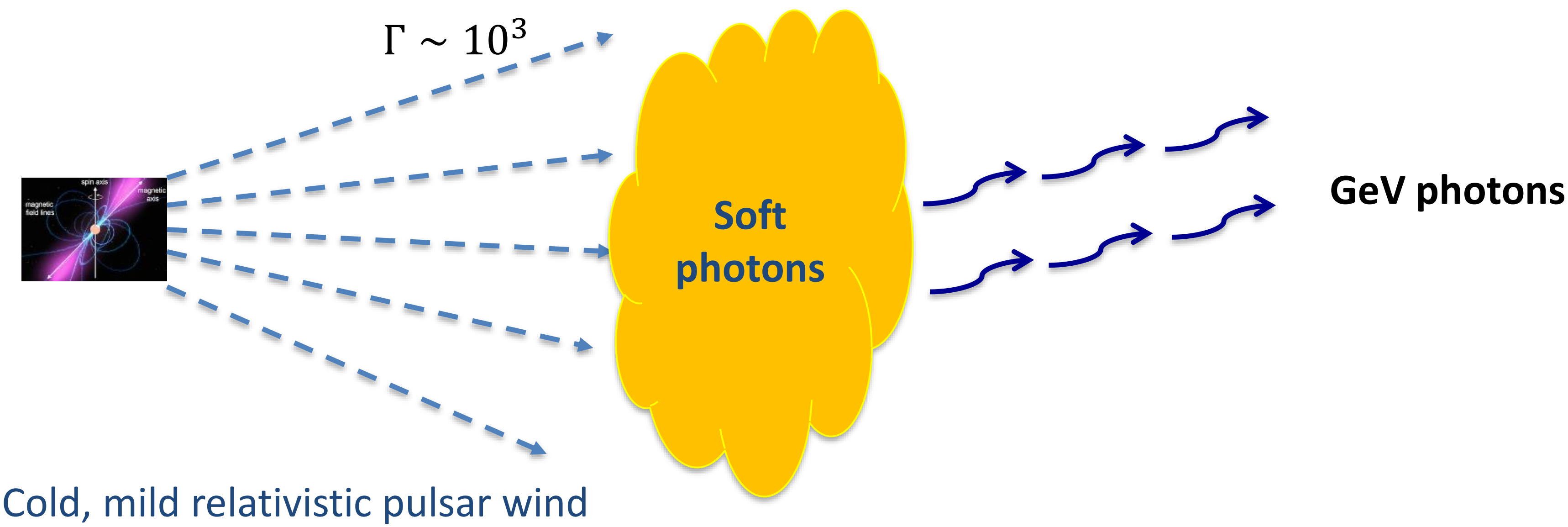




*GeV flare at un-expected orbital phase*

Tam 2011, Abdo 2011, Caliandro 2015

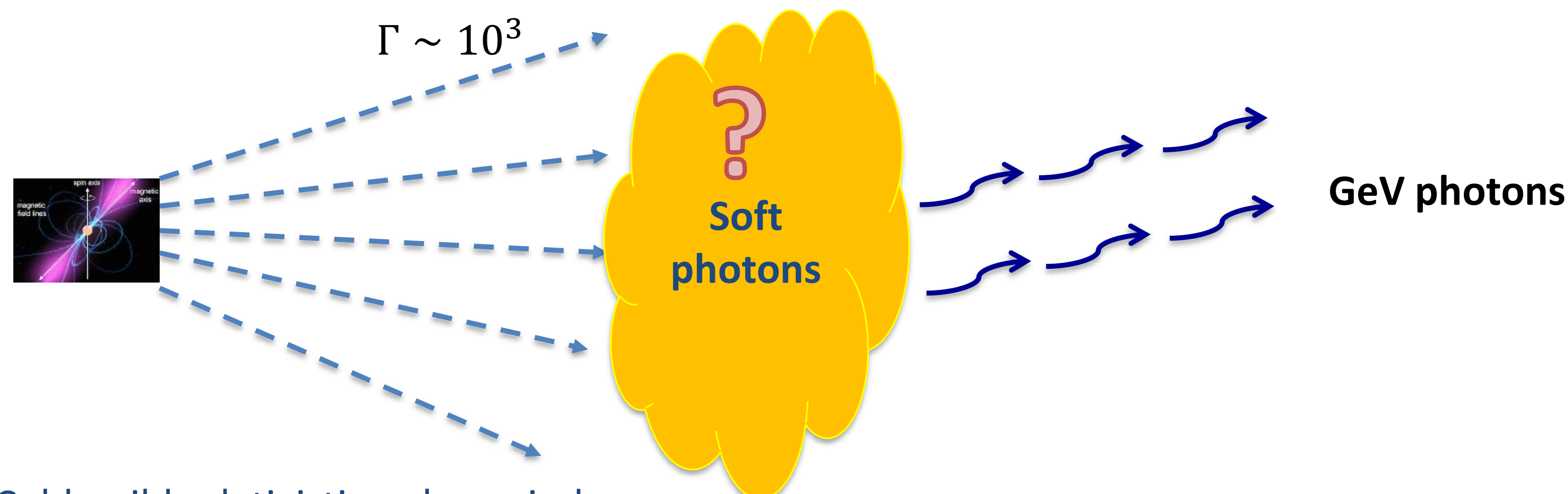
# Models for GeV emission

- Inverse Compton scattering: first come-to-mind mechanism for GeV emission



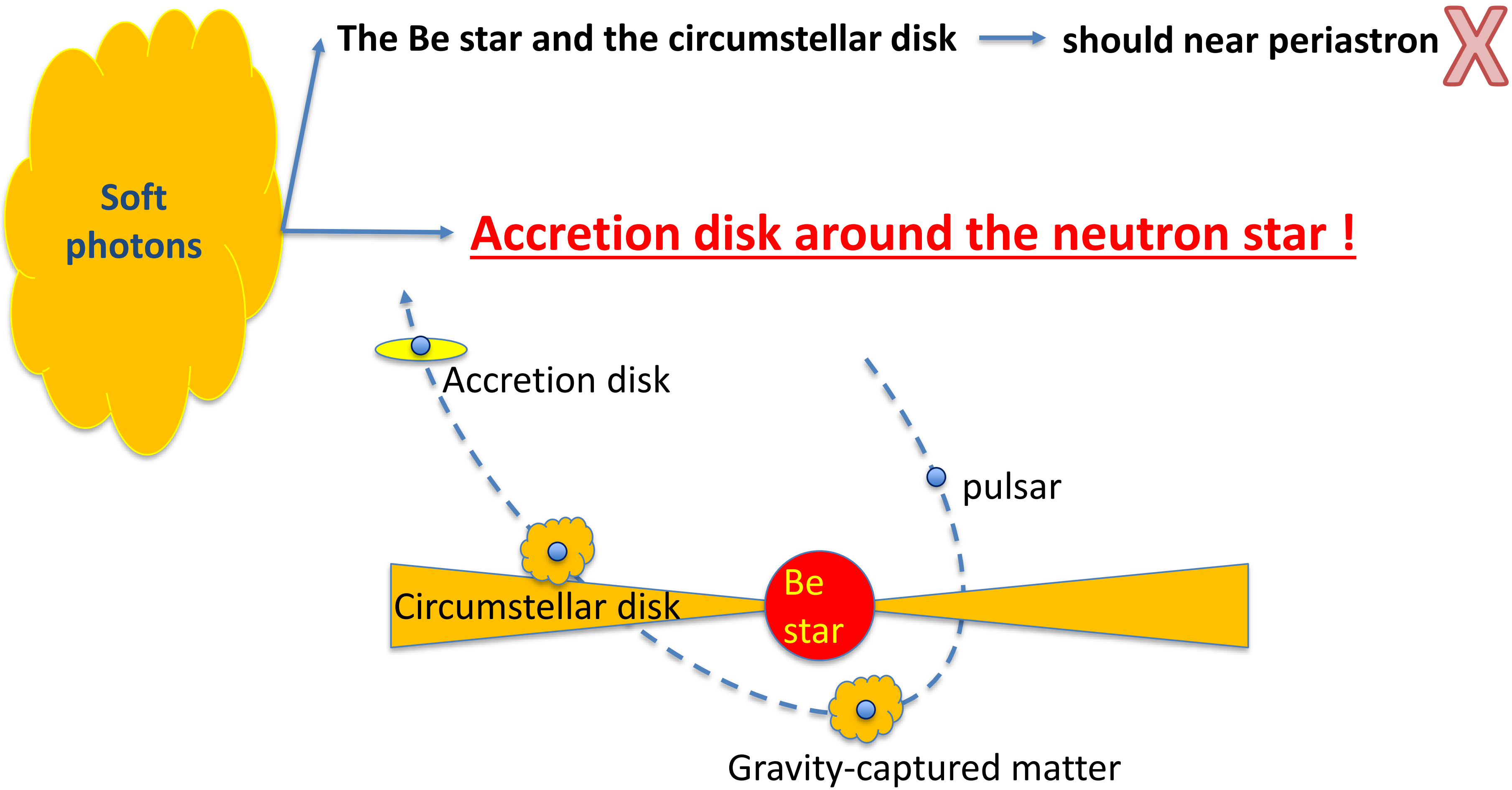
# Models for GeV emission

- Inverse Compton scattering
- Problem: where comes the soft photons (target)?




Cold, mild relativistic pulsar wind

# Models for GeV emission

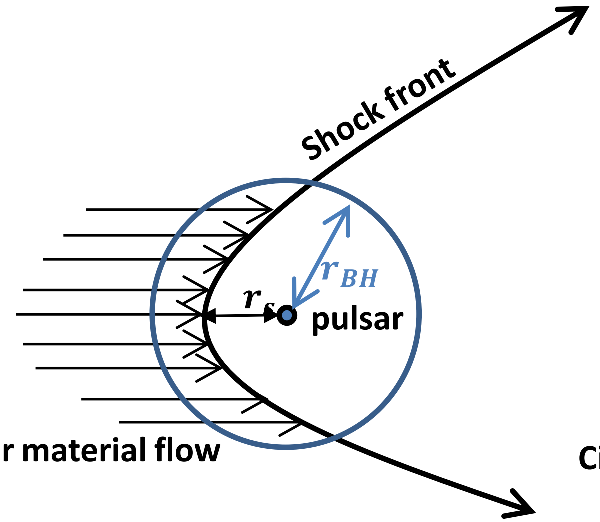


# Condition of mass transfer from optical companion

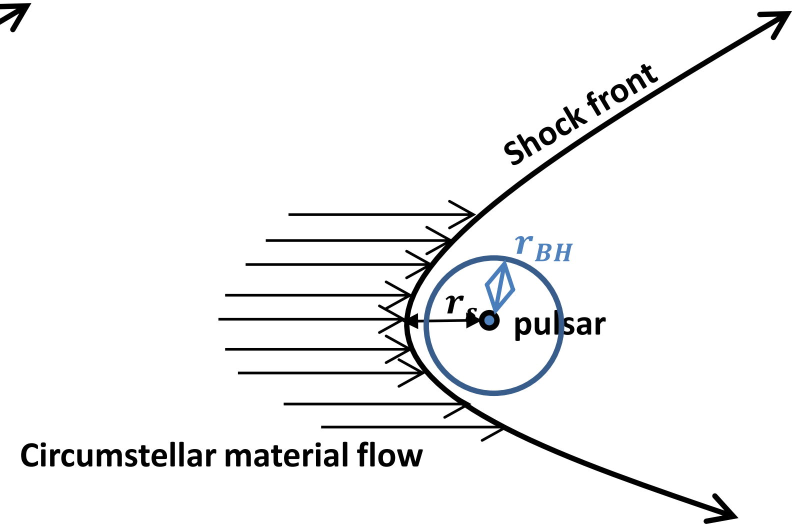
**Shock from should inside the Bondi-Hoyle sphere**

$$r_{\rm BH} = \frac{2GM_{\rm p}}{v_{\rm rel}^2},$$

$$r_{\rm s} = \sqrt{\frac{L_{\rm spin}}{4\pi\rho_{\rm cd}v_{\rm vel}^2 c}},$$

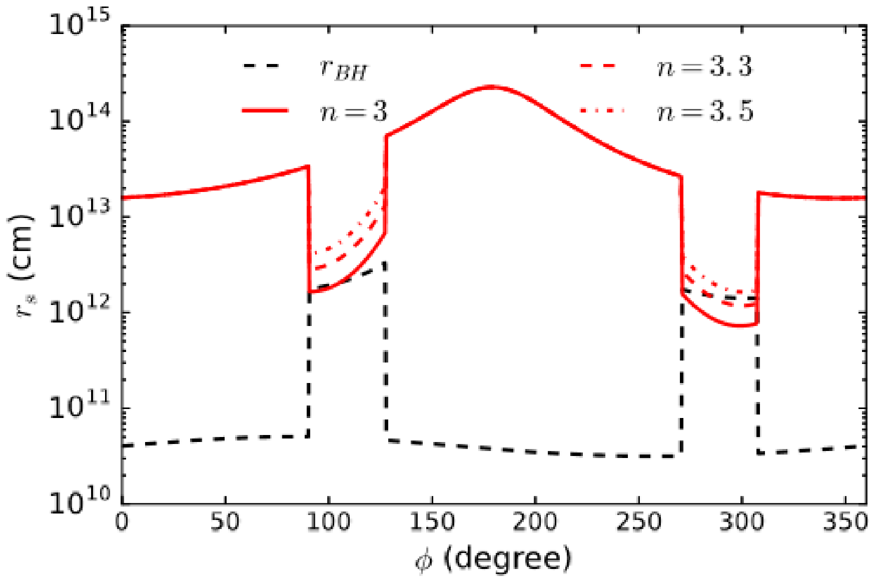


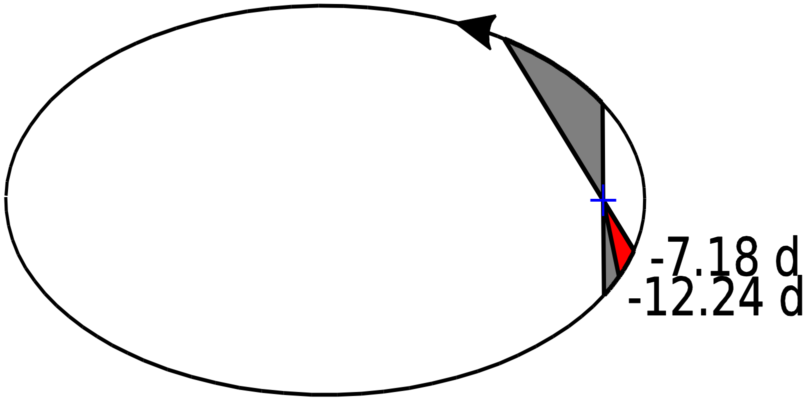

Mass can transfer




Mass can NOT transfer

# Location of the circumstellar disk, and phases of mass transfer



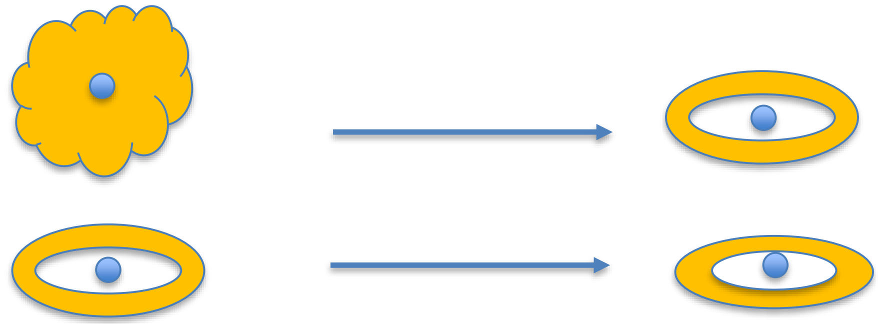
# Condition of the formation of accretion disk

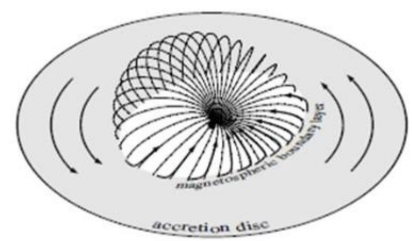
- The transferred material should have enough specific angular momenta: $r_{circ} > r_{lc}$
- $r_{circ} = \frac{l^2}{GM_p}$
- The angular momenta of the transferred material are due to the density and velocity gradient of the circumstellar disk.

$$l(t) = \frac{(GM_{\rm p})^2}{v_{\rm rel}^3}\left(\frac{|\nabla v_{\rm vel}|}{v_{\rm rel}} + \frac{|\nabla \rho_{\rm cd}|}{\rho_{\rm cd}}\right).$$

# Formation of the accretion disk

- Phase I: matter kinetic energy redistribution → torus
- Phase II: torus → accretion disk
- Phase III: inner edge of accretion disk decrease until it reaches the inner most radius
- Phase IV: mass and accretion rate decrease



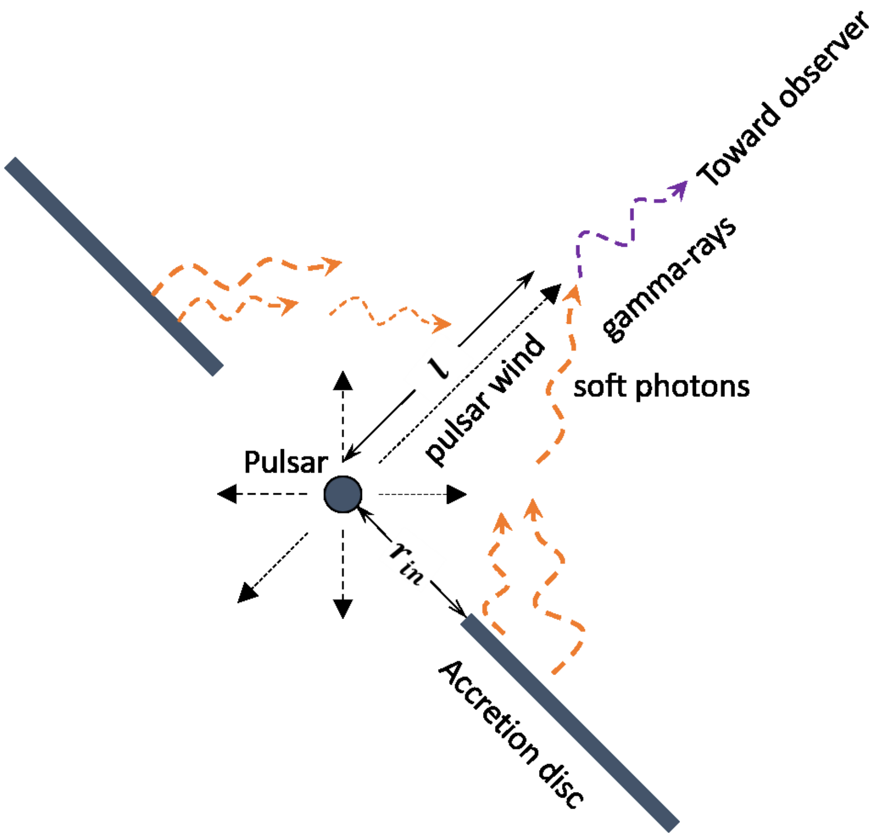



Viscosity time scale

$$\tau \approx \frac{R_{\rm circ}}{v_r} \approx \frac{1}{2.7}\alpha^{-4/5}\dot{M}_{\rm acc,16}^{-3/10} m_{\rm p}^{1/4} R_{\rm circ}^{5/4} \times 10^6\ {\rm s.}$$

# Evolution of the accretion disk

$$T = 1.4 \times 10^4 \alpha^{-1/5} \dot{M}_{\mathrm{acc},16}^{3/10} m_{\mathrm{p}}^{1/4} r_{\mathrm{in},10}^{-3/4}\,\mathrm{K},$$



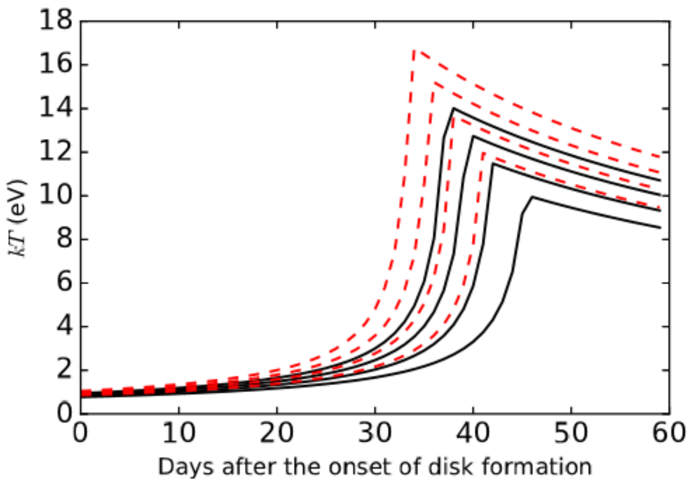




**Figure 3.** **The temperature of the inner most region of the accretion disk, as a function of the time after the formation of the accretion disk:** From left to right correspond to

# Evolution of SED

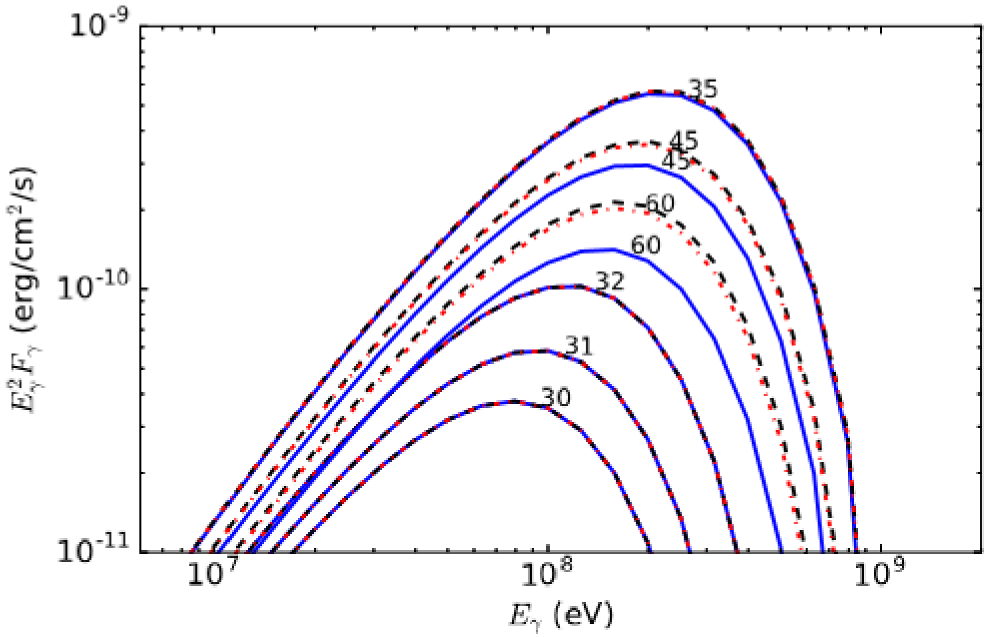
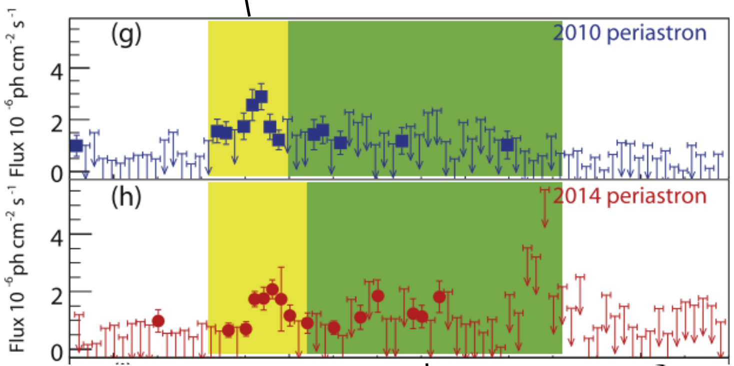
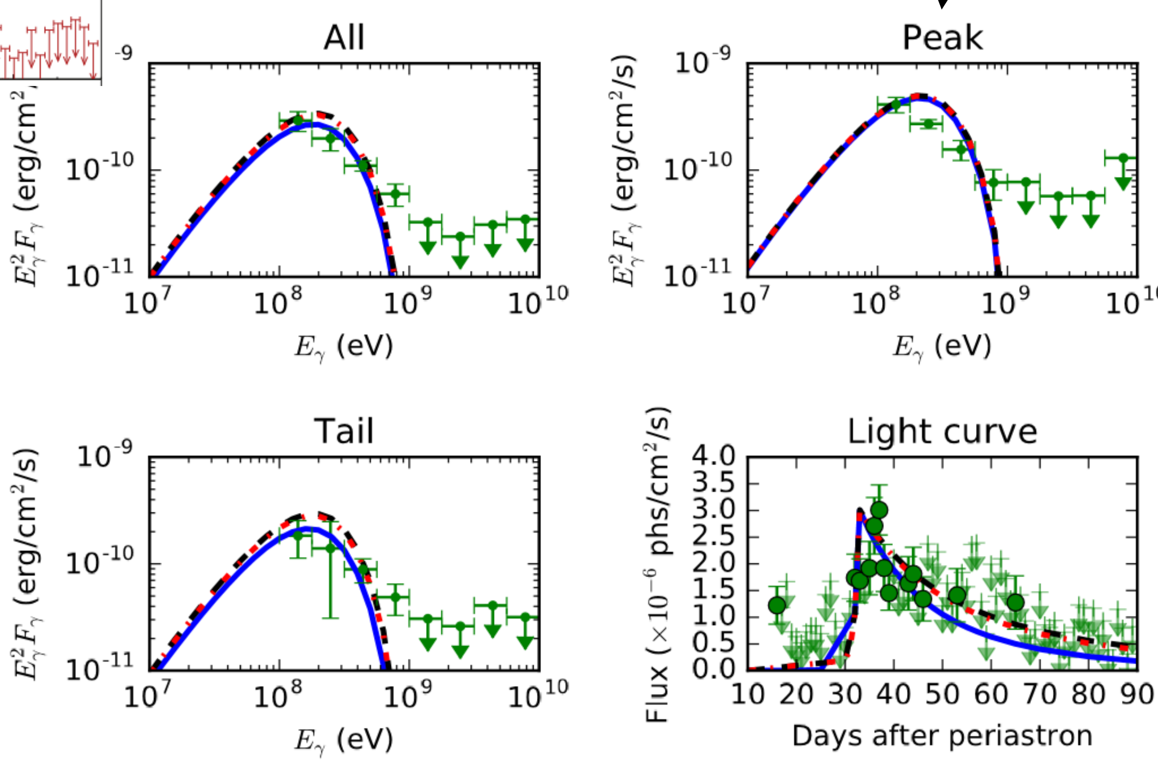



**Figure 5. The evolution of the SED of IC:**

# Evolution of SED and light curve



# Predication

*UV excess from the accretion disk*

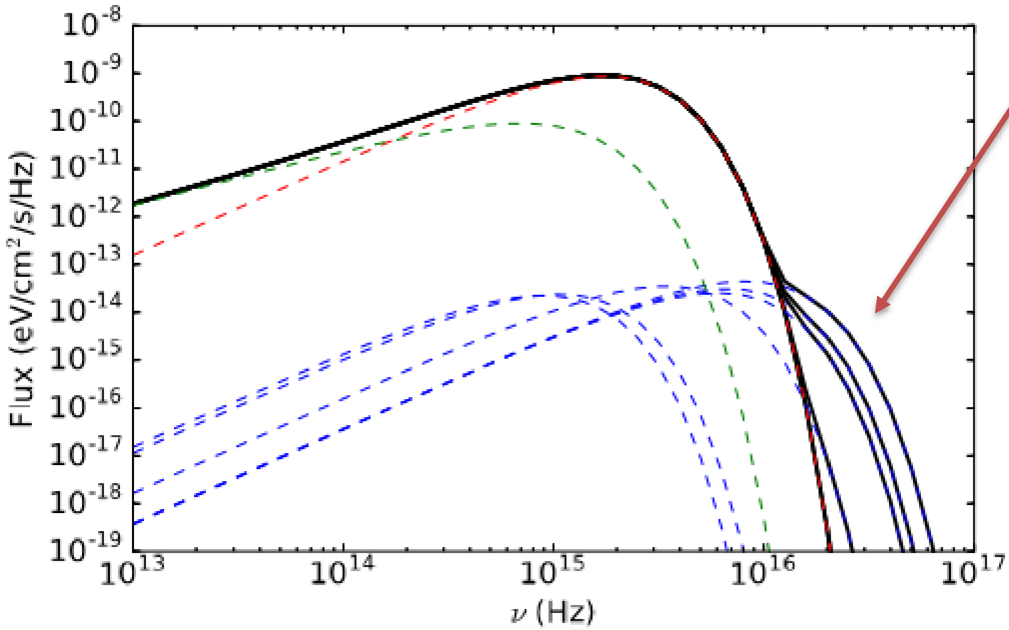



Figure 8. IR/Optical/UV SED from the sys-

# Summary of the model

- Matter from circumstellar disk captured by gravity of pulsar
- An accretion disk forms.
- Pulsar wind inverse-Compton scatter the soft photon from accretion disk