Unveiling the nature of the system of the TeV γ-ray binary LSI +61 303 with HDS observation

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1. γ-ray Binary and Two Competing Model

γ-ray Binaries

* emitting γ-rays, 7 sources discovered so far
* massive star (> 10 M_{sun}) + compact star
* TeV γ-ray emission from 5 γ-ray binaries
  … varies with orbital period

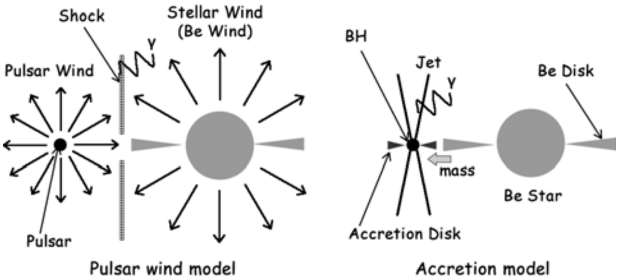
Two Competing Model

1) Pulsar Wind Model

Colliding wind region b/w a relativistic pulsar wind and a stellar wind (and/or a Be disk)
~> Acceleration of electrons
~> Inverse Compton (IC) ~> γ-rays

2) Accretion Model

High accretion rate
~> Relativistic jet
~> Leptonic model:
IC by relativistic electrons ~> γ-rays
Hadronic model:
pp interactions ~> neutral pions ~> γ-rays



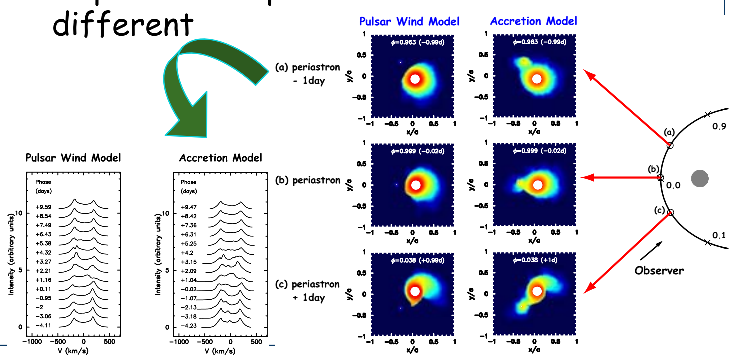
Only one source has been established to have a pulsar with a relativistic wind (PSR B1259-63)
~> which model is consistent with the rest of sources?

2. Distinguishing b/w two models

Previous approach
(both theoretical and observational)
… focusing mainly on compact star
(region emitting high-energy γ-rays)

Our strategy

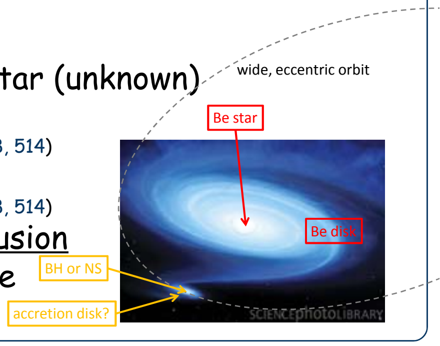
* focusing on the interaction b/w compact star and a massive star (Be star)
* SPH simulation based on two models
  ~> Different structure b/w two models
  ~> Expected line profile variabilities are hence different



3. Target

LS I +61° 303

* B0.5Ve + compact star (unknown)
* P_{orb} = 26.5 days
  (Aragona, C. et al. 2009, ApJ, 698, 514)
* e = 0.537
  (Aragona, C. et al. 2009, ApJ, 698, 514)
* No consensus conclusion on the nature of the compact object

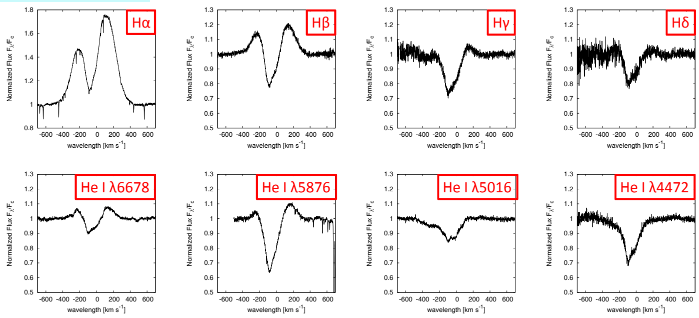


4. Observation

Subaru/HDS

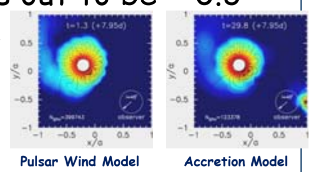
* 2011.09.29
* thanks to the serves program
* wavelength range 400 – 700 nm
* spectral resolution 100,000 @Hα
* exposure 3600 sec (1200 sec x 3)

5. Results



* Asymmetric emission line profile with the red peak stronger
* Small hump in the center?
* Unfortunately, the orbital phase which we thought was periastron turns out to be ~ 0.3

~> Expected Be disk structure is hardly distinguishable
Line profile variabilities already terminated



~> Monitor around periastron is necessity

6. Future Strategy

Observational Approach

*Monitor around periastron
*Constrain physical parameters of the Be star
+ inclination <~ spectro-polarimetry
+ optical depth <~ NIR spectroscopy

Theoretical Approach

*Improve SPH simulation
+ using more plausible physical parameter obtained by above observations
+ compute line profiles using 3-D radiation transfer code HDUST (Carciofi & Bjorkman 2006, ApJ, 639, 1081)

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