

Three kinds of science with Dual Beam: masers in star-forming regions and flaring activity in a microquasar[†]

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“べつべつの そして いっしょの けんきゅう”

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VERA Obs. of Water Masers in a Star-forming Region W75N (beam A)

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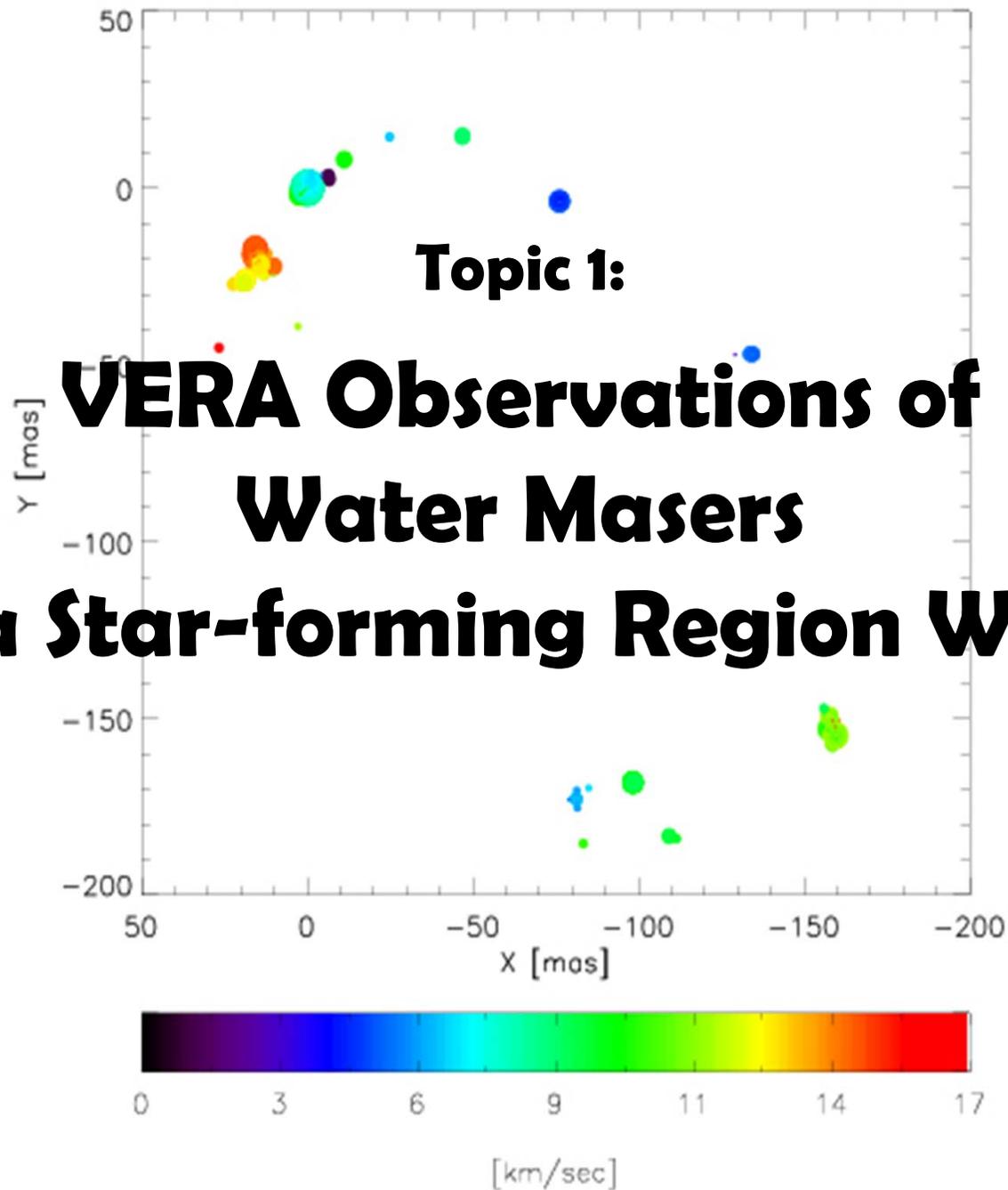


Topic 3:

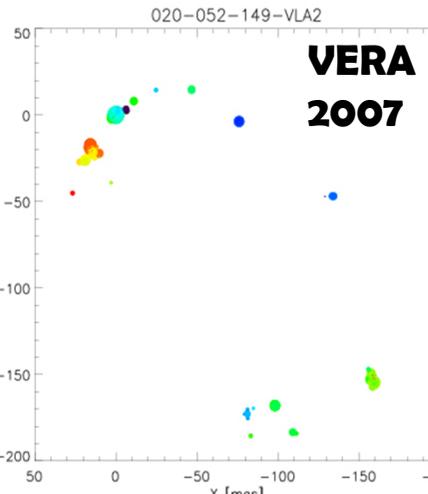
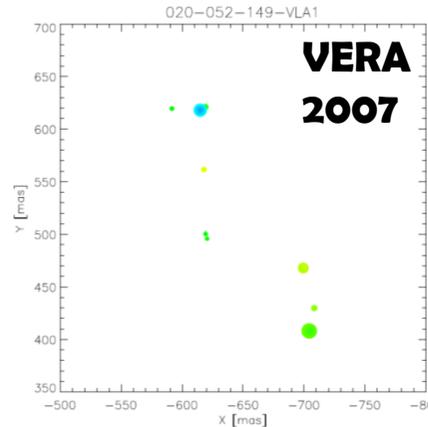
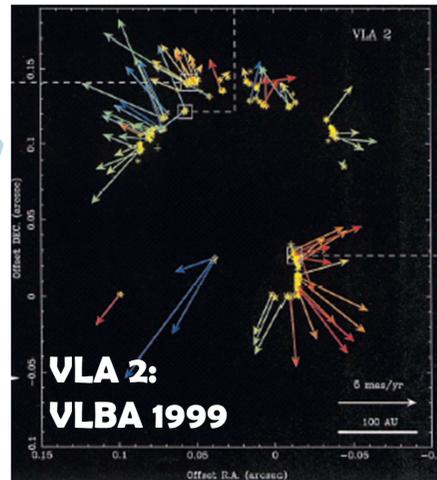
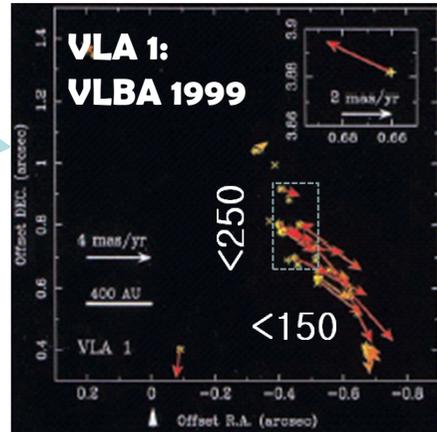
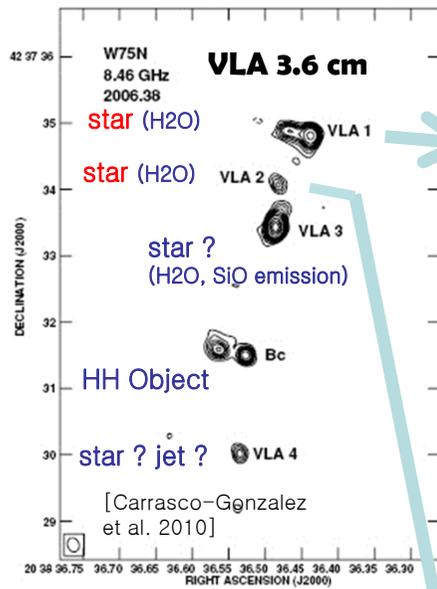
Proper Motion of a Microquasar Cygnus X-3 with respect to a star-forming region W75N of the Dual Beam

Topic 1:

VERA Observations of Water Masers in a Star-forming Region W75N



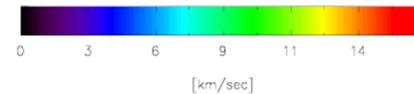
Water Masers in W75N



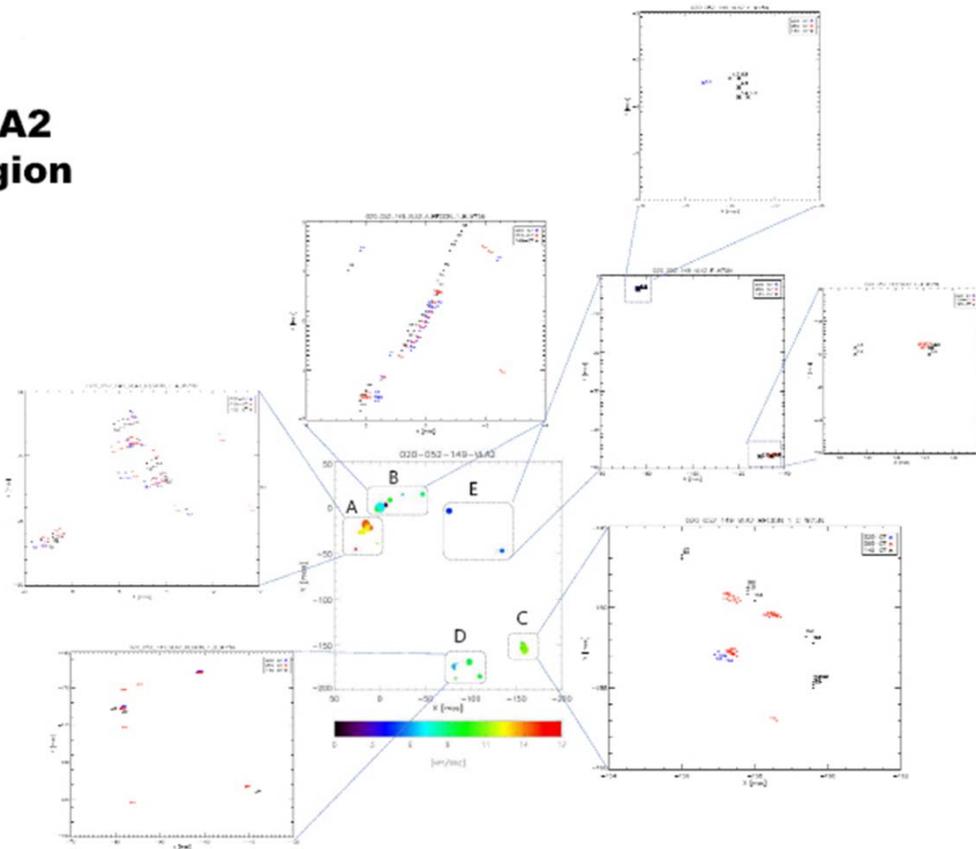
VLA 1: a structure of linear, well-collimated, jet-like outflow in both observations.
→ for details, please see **Poster #15**

VLA 2: expanding shell, consistent to VLBA '99

- Geometrical distribution of masers: **elliptical**, contrast to **circular** in VLBA 1999
- Check out other observations ...



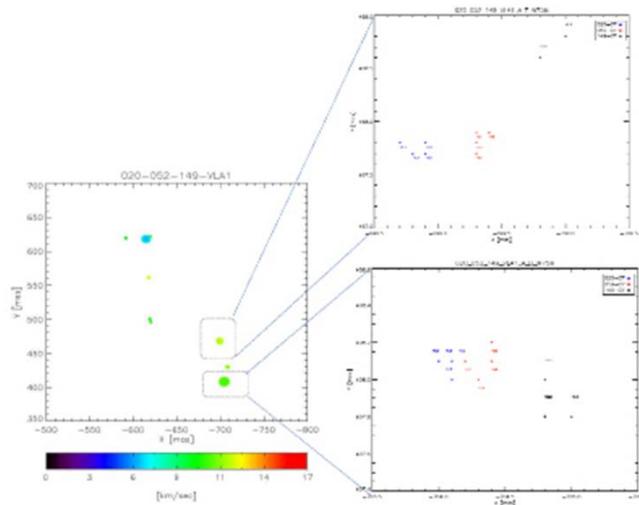
**VLA2
region**



**Microstructures of Water
Masers in VLA 1 and VLA 2
regions of W75N**

**Please see
Poster #15**

**VLA1
region**



relativistic jet

**corona ?
hot flow ?**

**accretion
disk**

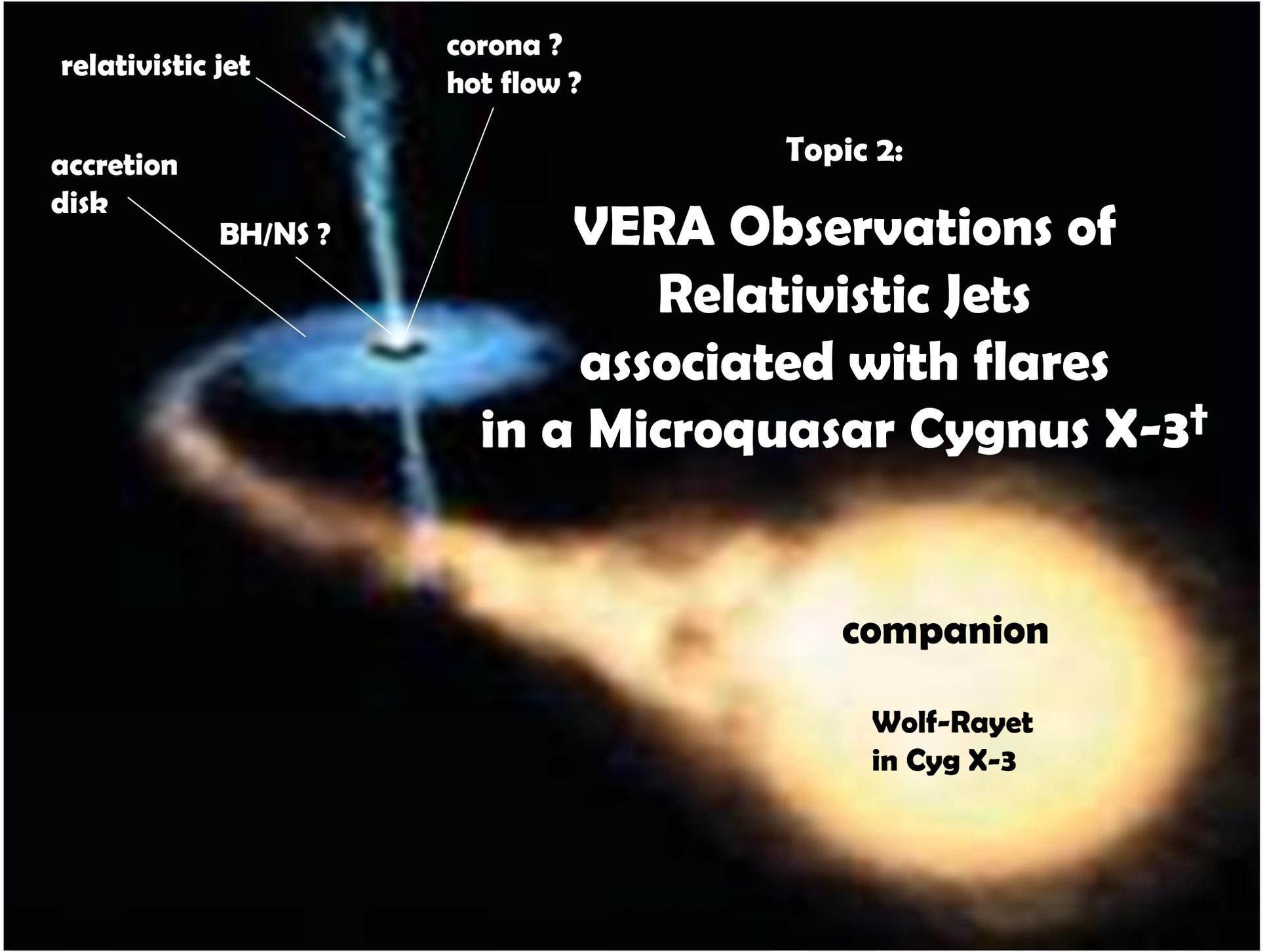
BH/NS ?

Topic 2:

**VERA Observations of
Relativistic Jets
associated with flares
in a Microquasar Cygnus X-3†**

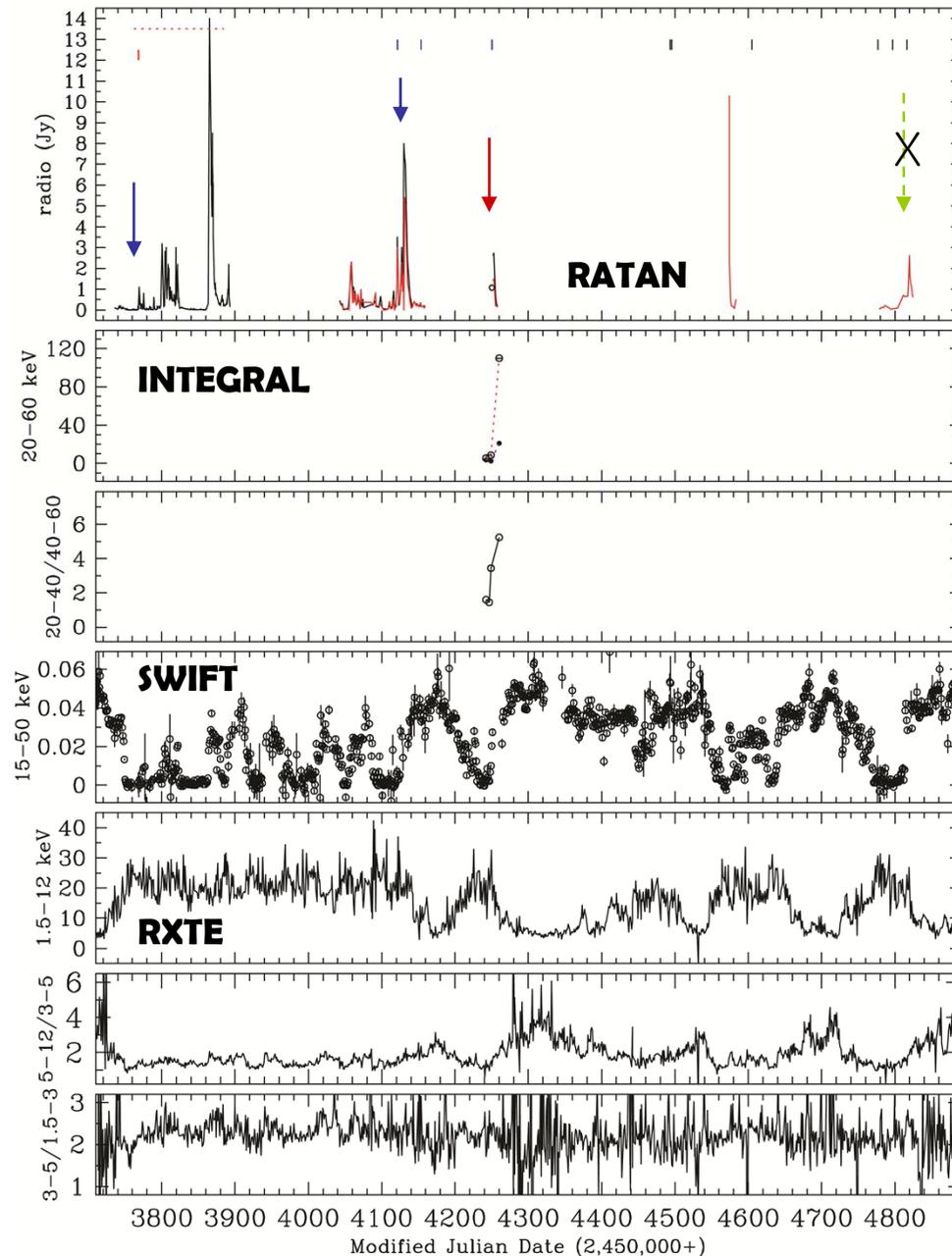
companion

**Wolf-Rayet
in Cyg X-3**



VERA Obs. of Cyg X-3

Typical microquasars are flaring up with a time scale of a few to tens of years. Cyg X-3 is the brightest, and has been shown *rapid, restless flaring* activities with a variety of time scale.

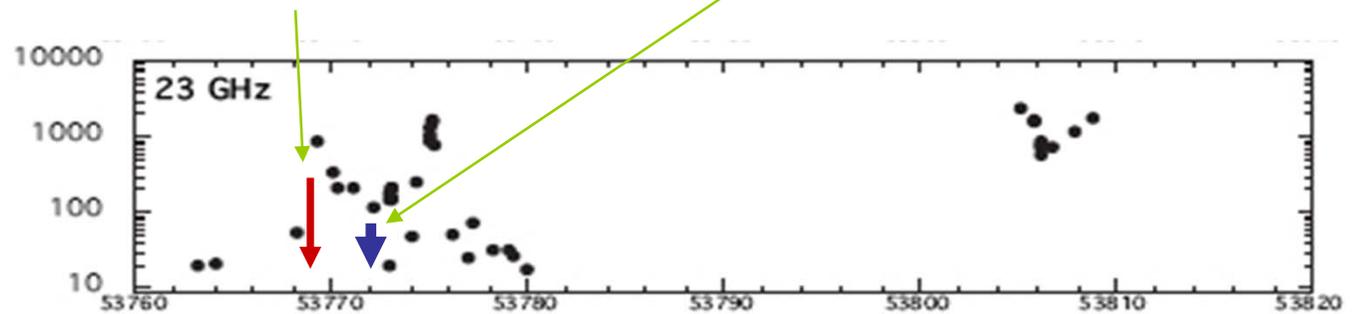
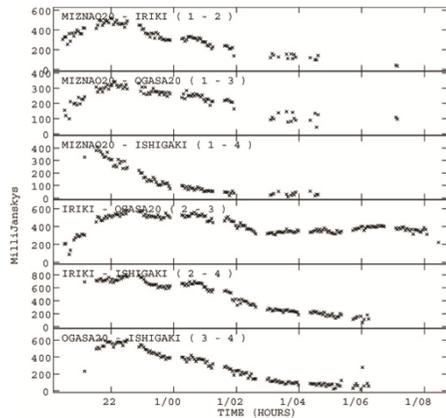
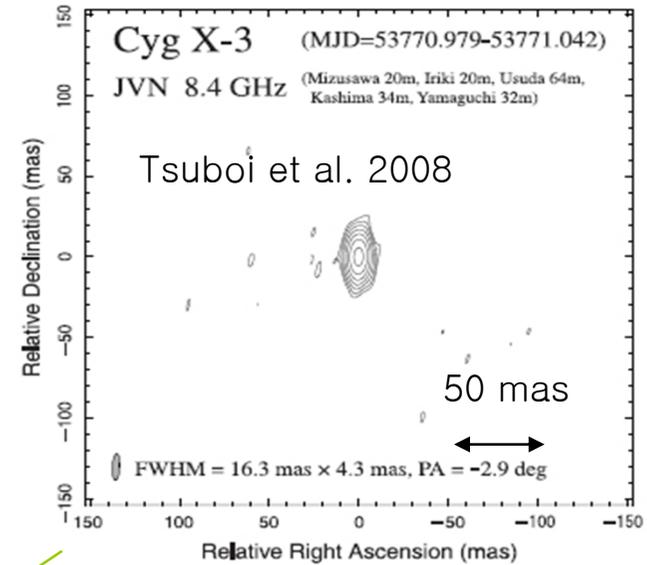
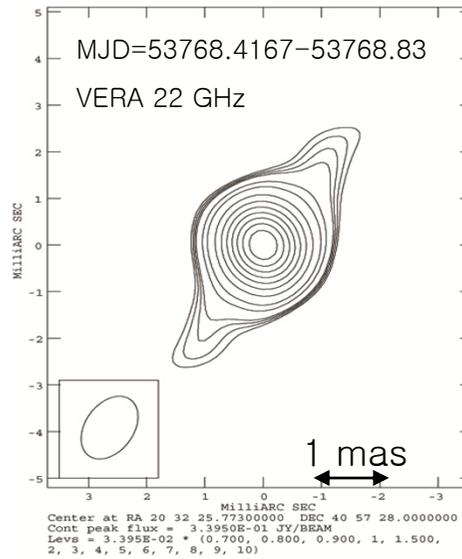
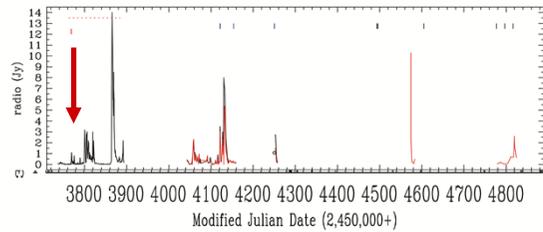


Detected flares in

- 2006 Feb
- 2007 Jan
- 2007 May
- 2008 Dec (1-baseline only)

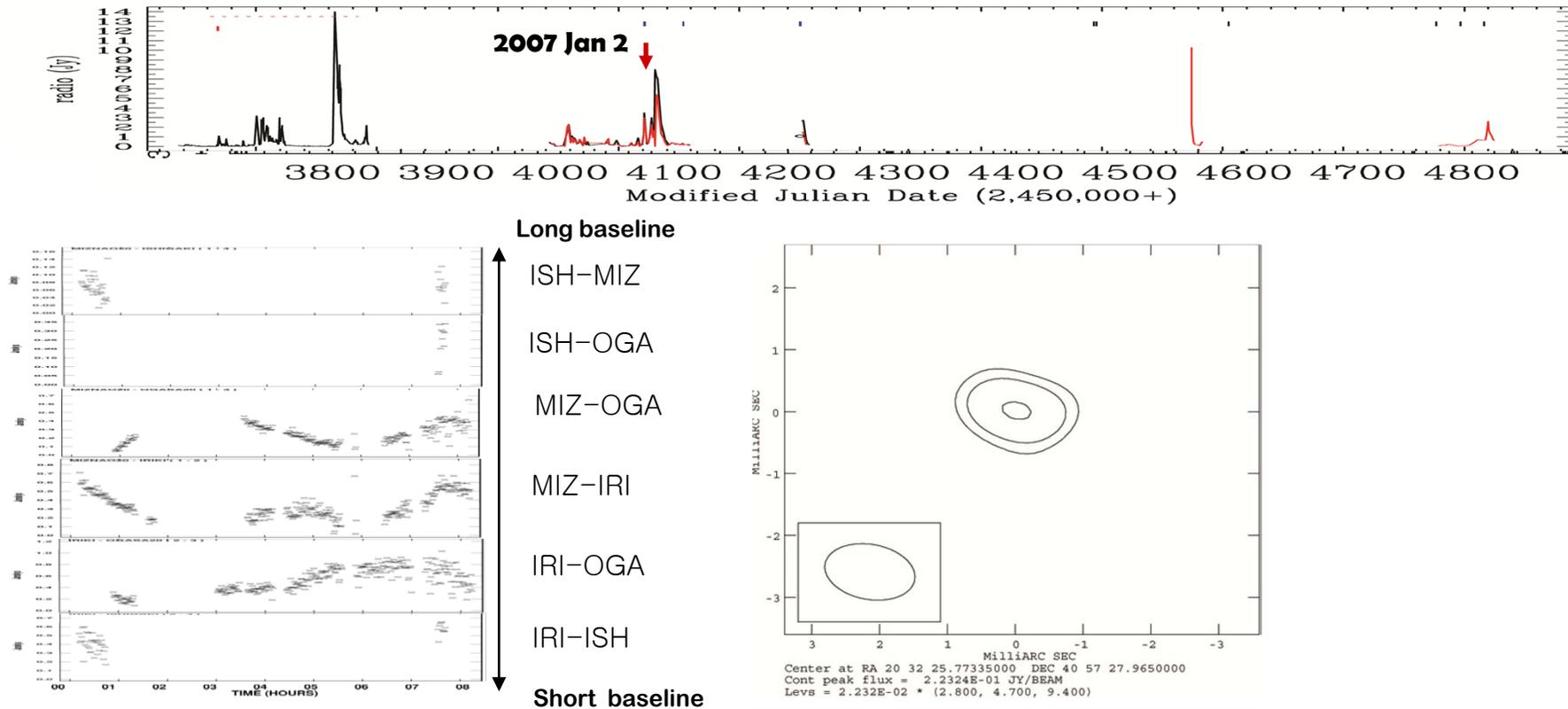
VERA Obs. of Cyg X-3:

1. 2006 Feb. on the Rise



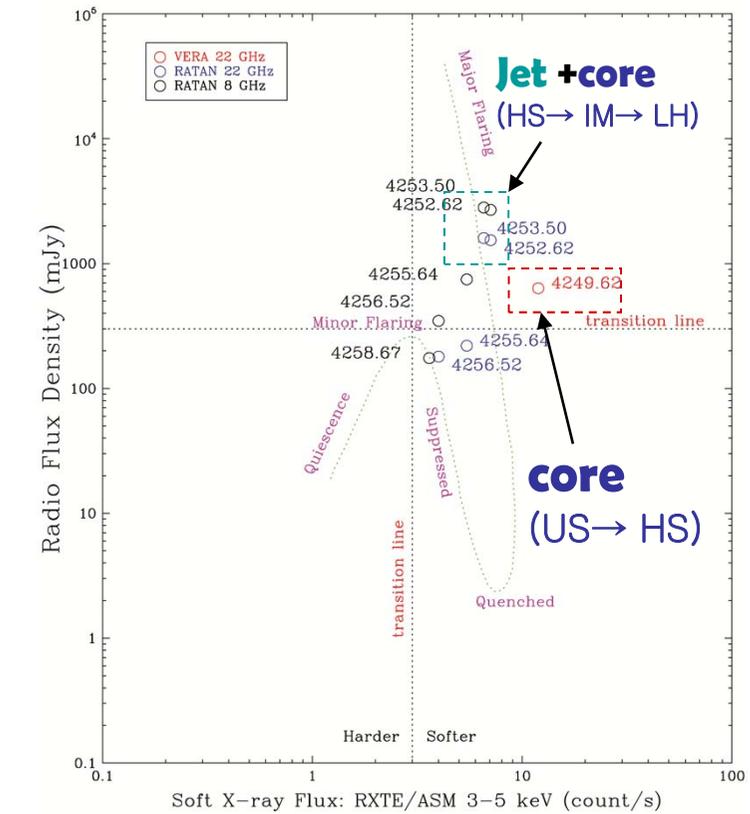
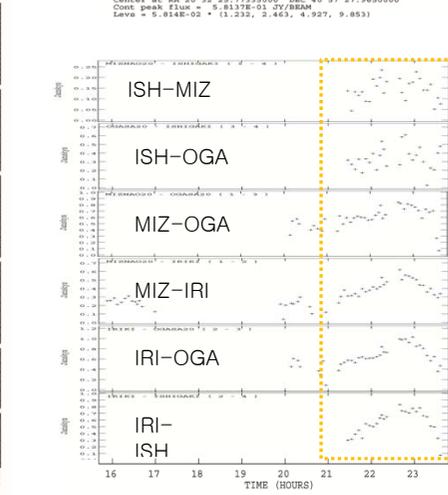
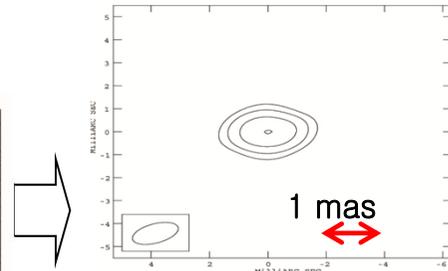
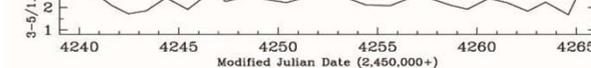
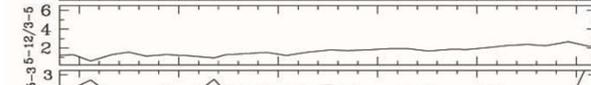
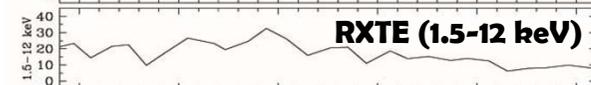
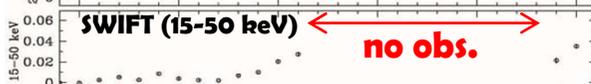
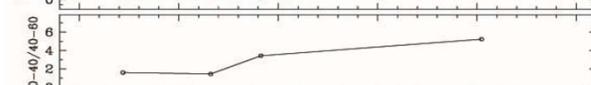
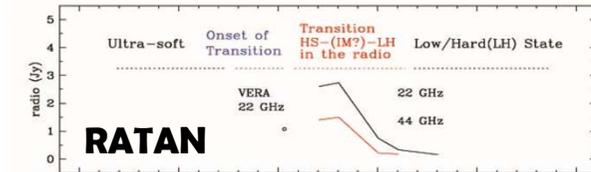
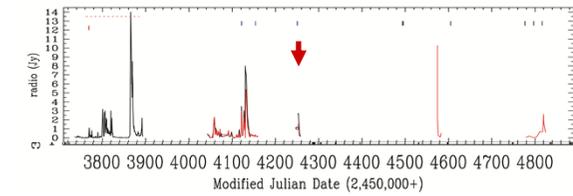
- On its **rise**, a few mas jet @22 GHz with a structure detected on Feb 1-2, while a larger, ten of mas, extended jet detected @8.4 GHz on the way of its **decay** phase, on Feb 4 by JVN (Tsuboi et al. 2006)
- Are two jets from the same origin? Separate jets?
- Multiwavelength modeling is on-going ...
- Please visit our **Poster #16** for a further discussion ...

VERA Observations of Cygnus X-3: 2. 2007 Jan., on the Rise



- Cyg X-3 flared up to ~ 1 Jy; at least 2 or 3 rapid mini-flares were plausible, with different flux variation for each baseline.
- **The jet looks stable, but the flux variation with baselines is not ...**
accretion process associated with flare/jet might be very complicated...
- Please visit our **Poster #16** for a further discussion.

VERA Observations of Cygnus X-3: 3. 2007 May



• No radio monitoring before/after, no hard X-ray obs. during transition: only VLBI ob. during an X-ray state transition from US to HS states, when Cyg X-3 probably eject core-jet. Presumably, 2 or 3 days later when RATAN detected Cyg X-3, the VLBI imaging could reveal separate components of jet and core if there were observation(s)...

• Please visit our **Poster #16** for further discussion ...

Topic 3: Proper Motion of a Microquasar Cyg X-3 with respect to a Star-forming region W75N of the Dual Beam

Proper Motion & Formation of Relativistic Objects of in Microquasars

Source	Mass (M_{\odot})	Proper motion (mas/yr)	Peculiar velocity (km/sec)	
GRO J1655-40	6.0-6.6	5.2 ± 0.6	113 ± 20	SN explosion, runaway
XTE J1118+480	6.5-7.3	18.4 ± 2.0	160 ± 25	SN explosion, runaway
Cygnus X-1	6.9-13.2	8.3 ± 0.3	31 ± 26	without natal kick
V404 Cygni	10.1-13.4	9.1 ± 0.1	43 ± 7	energetic SN explosion with fall-back of NS
GRS 1915+105	10.0-18.0	6.8 ± 0.1	30 ± 7	without natal kick
LS 5039	2.7-4.0 ?	?	150	SN explosion
CygX-3	2-30 ?	$4.62 ?$	$9-250 ?$?

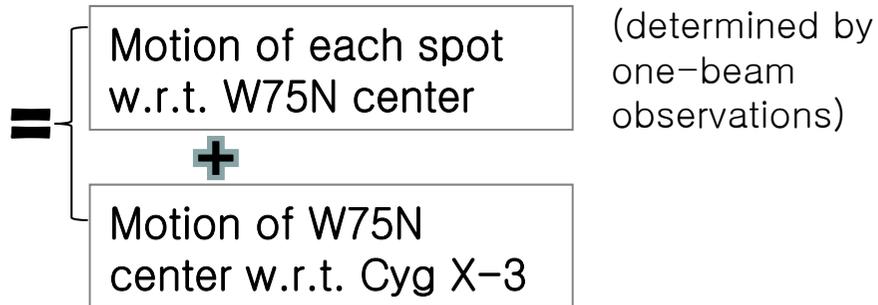
(adopted and modified from Miller-Jones' presentation)

- BH/NS formation via SN explosion with the natal kick
- BH formation by direct collapse from the most massive progenitors ($25-35 M_{\odot}$), no explosion (e.g., Cygnus X-1)

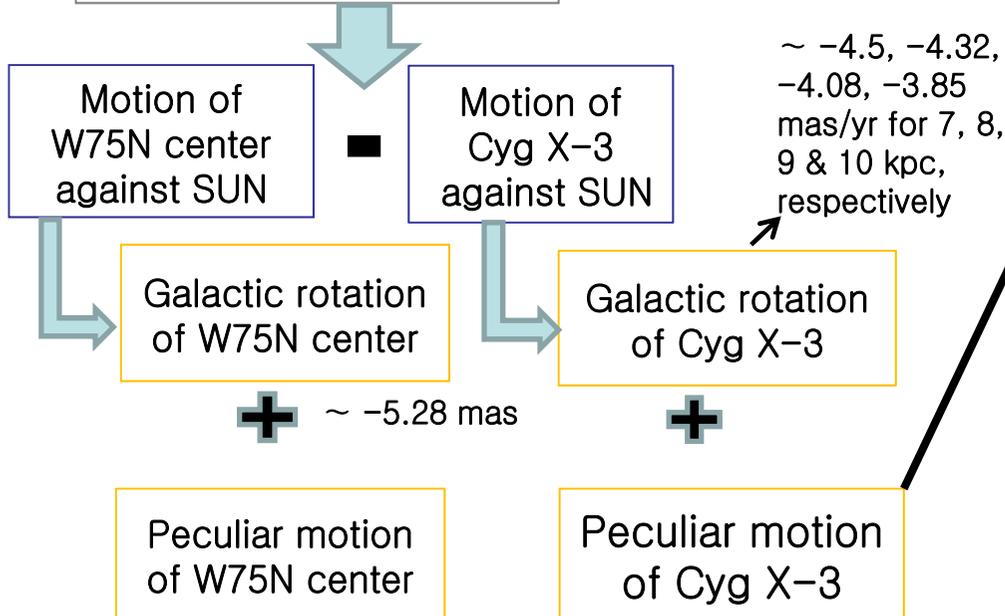
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Proper Motion of Cyg X-3 with respect to W75N

(determined by phase-referencing with dual beam)



	Cyg X-3 distance from the Sun			
	7kpc	8kpc	9kpc	10kpc
peculiar velocity of Cyg X-3	250-290 (km/s)	270-300 (km/s)	290-340 (km/s)	310-370 (km/s)



250–370 km/s:
250 km/s corresponding to the upper limit of previous study (Miller-Jones et al. 2009: 9–250 km/s)

- A few hundred km/s for the proper motion indicates that it may be formed from a direct SN explosion, or through a fall-back from a neutron star core.
- On the contrary, with the peculiar velocity of about ten km/s, it is also probable that a similar implosion might happened to that in Cygnus X-1.

↓ unavailable, assumed to be zero

• Please see **Poster #17**

END

感謝합니다