VERA User's Meeting (2007年 11月12-13日)

VERA共同利用觀測結果報告:

Flares in Microquasar Cygnus X-3

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Kim, Jeong-Sook (慶熙大學校)
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Sasao, Tetsuo (亞州大學校, KVN)

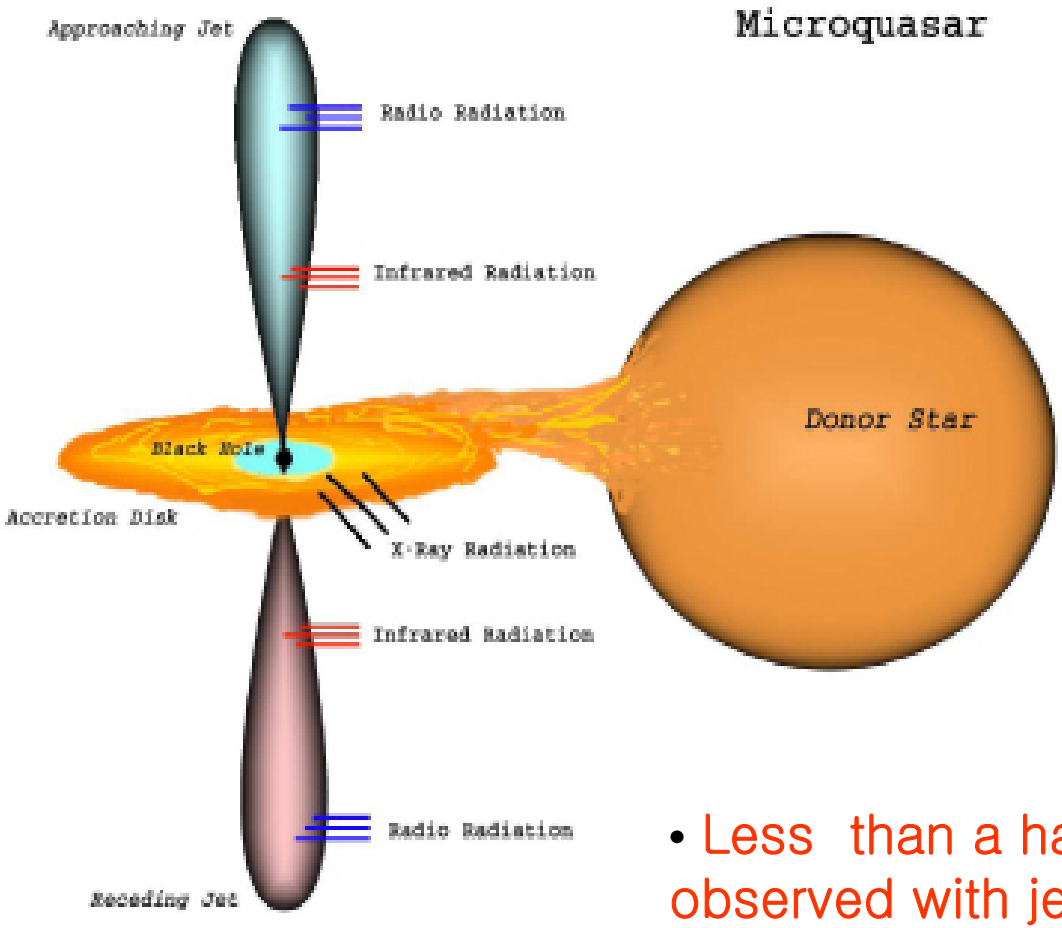
Common Use

List of accepted proposals for 2006/07 common use

Number of proposed observations : 9
Number of accepted proposals : 6
Total observing time for 2006/07 common use : 342

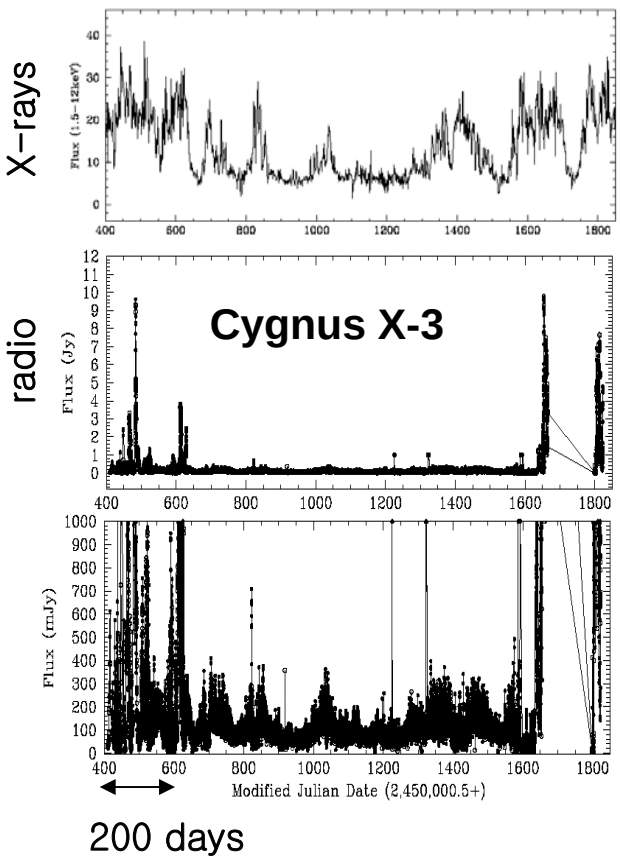
No.	Proposal Title	Person	affiliation	total observing time	
				VERA+NRO /NiCT	VERA only
1	Revealing the nature of the compact star in X-ray binary LSI+61 303 by orbit measurements	Mareki Honma	NAOJ	–	70
2	Monitoring Flares and Imaging Jets in Microquasar Cygnus X-3	Soon-Wook Kim	Korea Astronomy and Space Science Institute	–	40
4	Parsec-scale radio emission, accretion disk, and broad-line region in 3C390.3	A.P.Lobanov	MPIfR	80	–
6	A Search for Supermassive Black-Hole Binaries in Twin-Jet AGNs	Seiji Kameno	Kagoshima University	–	120
8	Multi-line obserations of H2O and CH3OH masers for studying formation mechanism of massive stars	Koichiro Sugiyama	Yamaguchi University	–	0*
9	Phase-referencing observations of semi-regular variable VX Sgr and its mass loss mechanism	Ryuichi Kamohara	NAOJ	–	32
			total	80	262

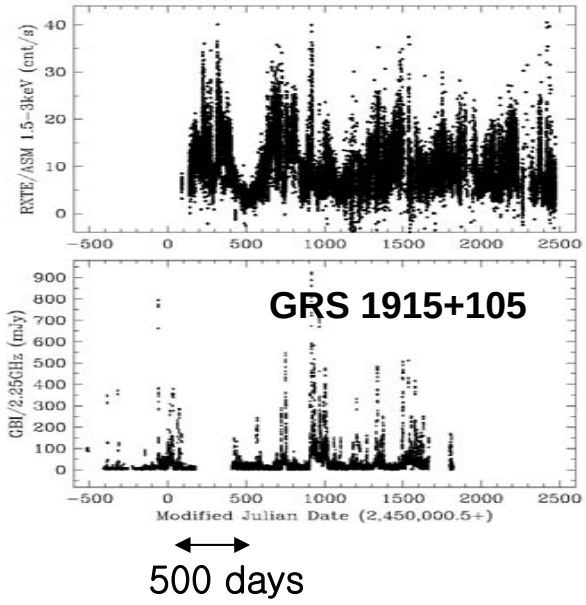
Microquasars



- Microquasar: Jet-ejecting X-ray binaires
- Basic components of a microquasar are a spinning BH/NS, an accretion disk around it, and a collimated relativistic (or superluminal) jets, together with normal companion star.
- Over fifty BH/NS transients known
- Less than a half sources have been observed with jets, presumably from instabilities associated with inner part of disk.

Cyg X-3: *Restless, Frequently Flaring* Microquasars (Jet-emitting XRBs)





- Difficulty for catching the radio jets ("microquasar phenomena") in BH/NS X-ray binaries is due to their *unpredictable*, transient nature with the recurrence time-scale of a few to hundred years, while they are undetectable in quiescence.

- Two radio-bright, frequently flaring microquasars: GRS 1915+105 & Cyg X-3.

- Numerous VLBI/array studies for GRS 1915+105.

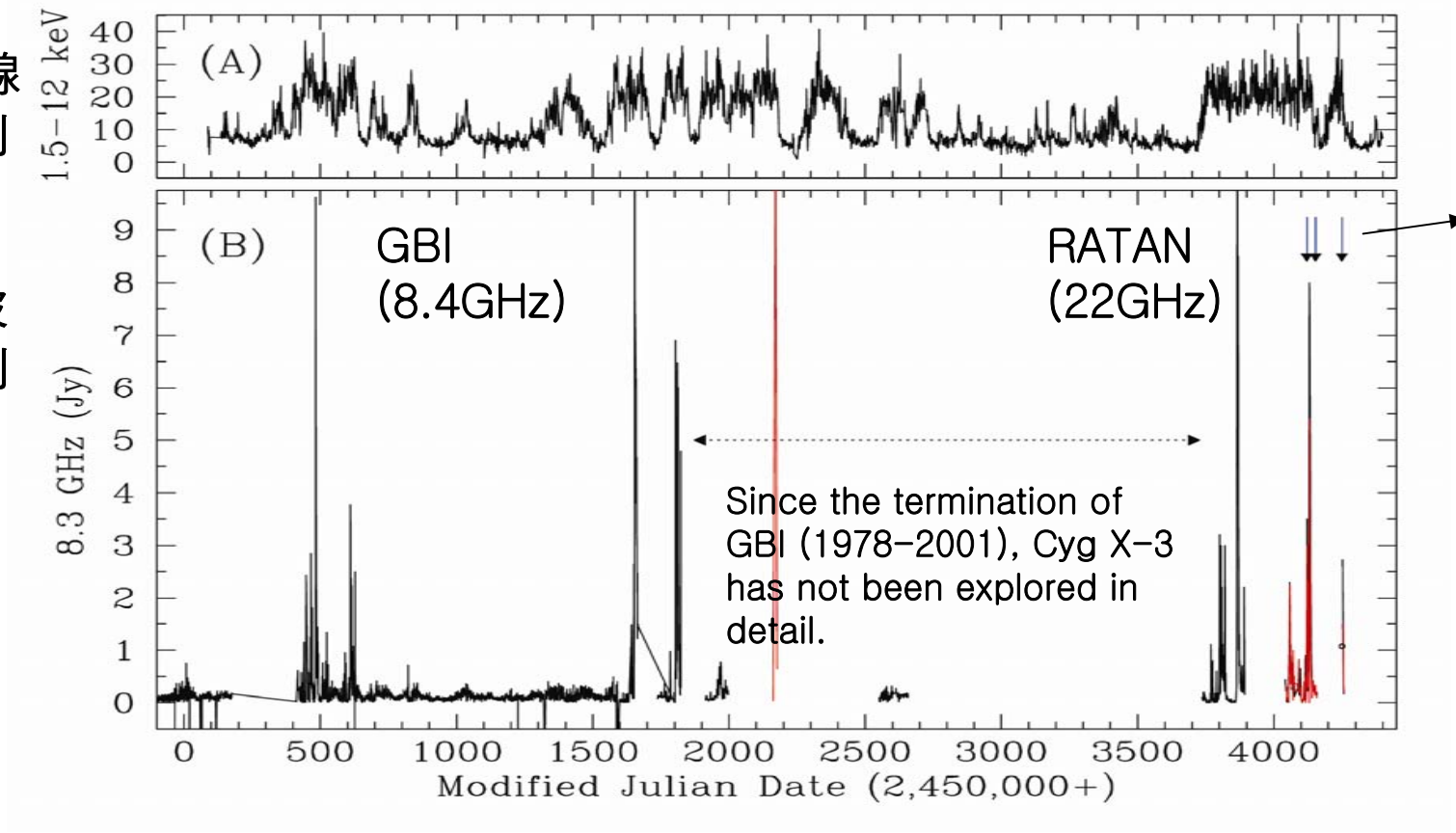
- Cyg X-3, the radio-brightest, has been poorly studied (only 2 VLBI for small flares & 3 for giant flares), in spite of long-term monitoring for two decades ⇒ motivation

- Goal: catching Variability (Flares) & Imaging (Jets) in Cyg X-3

X-ray & Radio Monitorings: Light Curve

X-線
觀測

電波
觀測

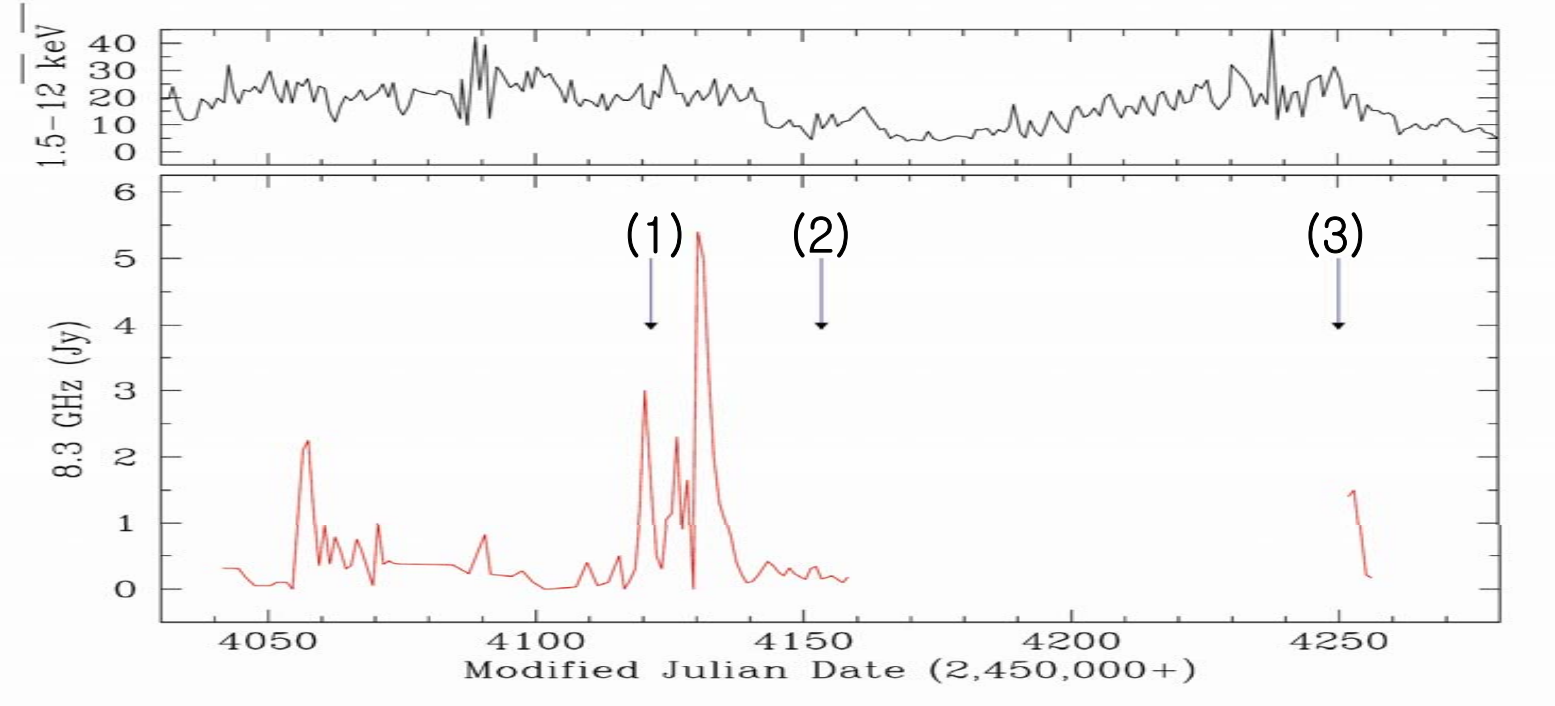


RXTE

2007
VERA
觀測

We picked up 3 dates by comparing other multiwavelength observations, together with our theoretical modelings

2007 VERA Observation (22 GHz)



Our predictions have been successful to match 2 flares out of 3 trials, e. g., by missing a half day from a peak !

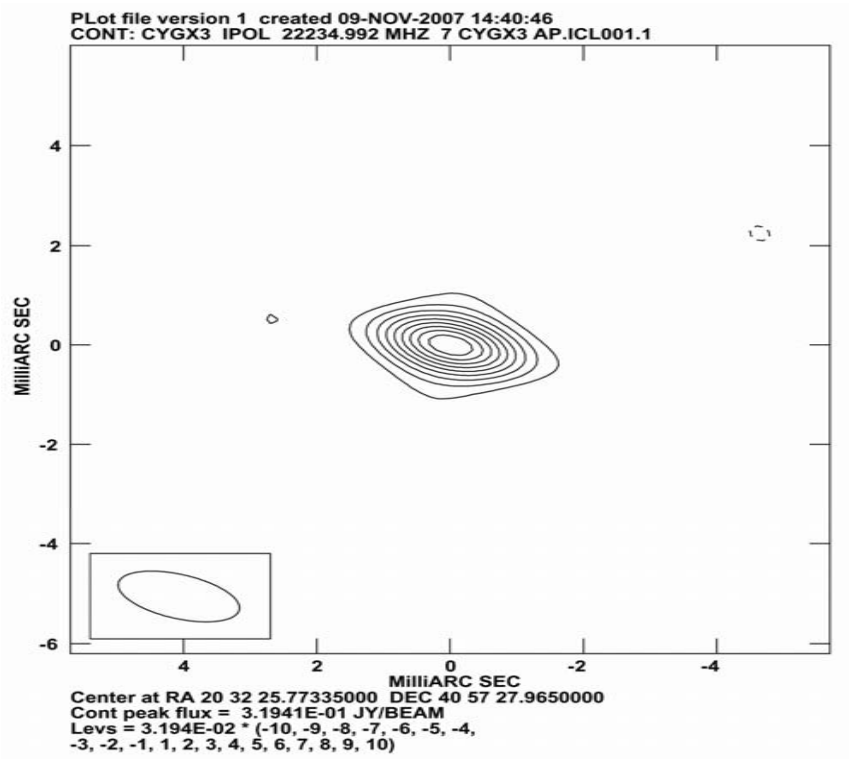
- Jan 20: in the early-decay of a radio flare
- Feb 21: during very small flaring states or near quiescence
- May 29: during X-ray-active state (probably during a radio flaring state)

観測 結果

1. Cyg X-3: 2007年 1月 20日 観測

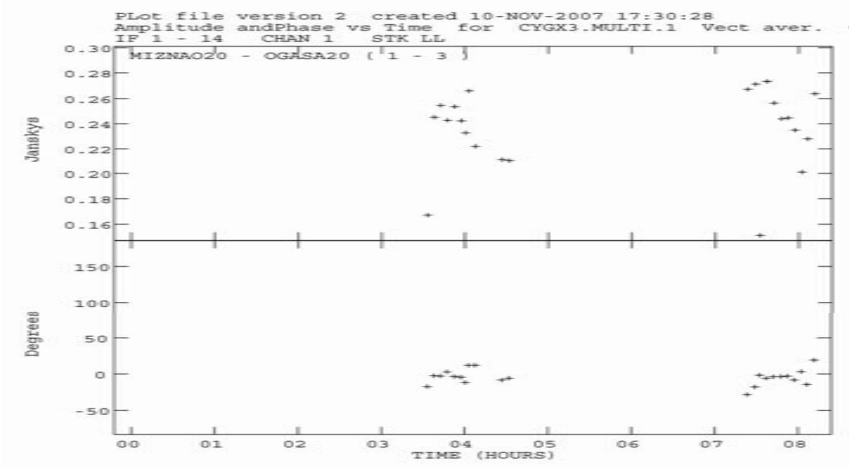
観測 20070120

SNR=5, solint=5min

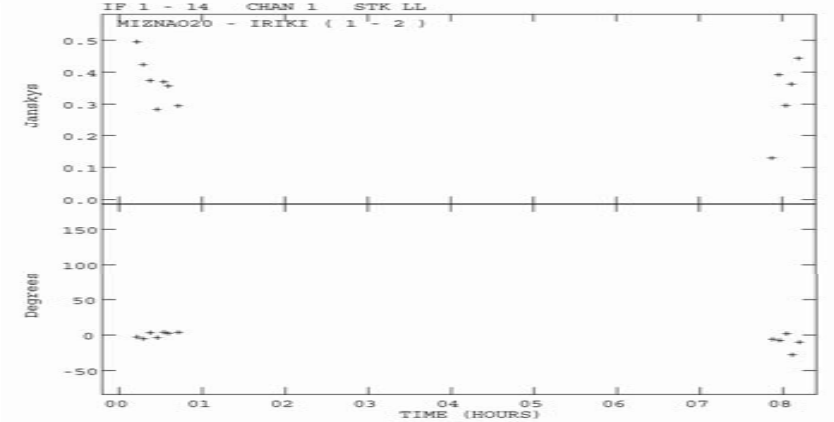


Beam Size = 1.895X0.867 mas^2
Position angle = +72.0 degree

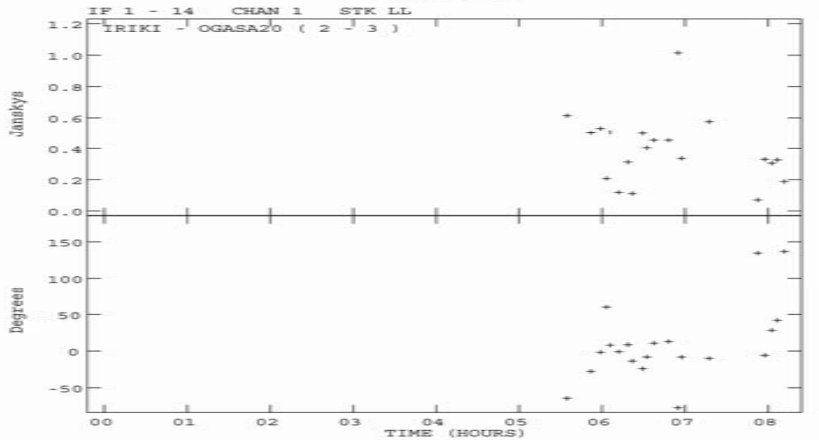
MIZ–OGA



IRI–MIZ



IRI–OGA



- Results of Fringe Search with AIPS
- Cyg X-3 flared up to ~ 500 mJy; plausibly at least 3 flares, lasting ≥ 2 hours; flares looks real with phase
- Image larger than the beam; probable structure due to jets

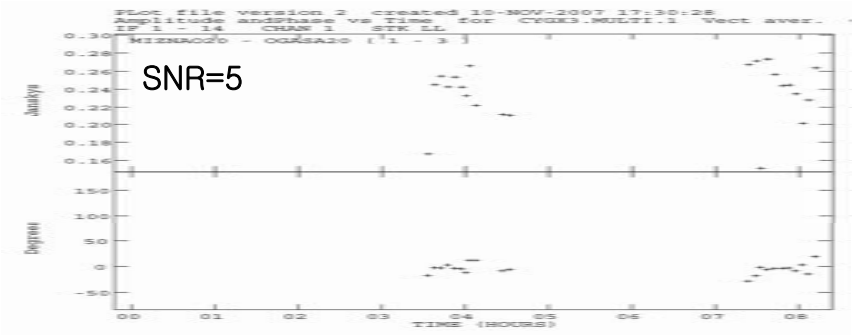
Baseline: Long-> short

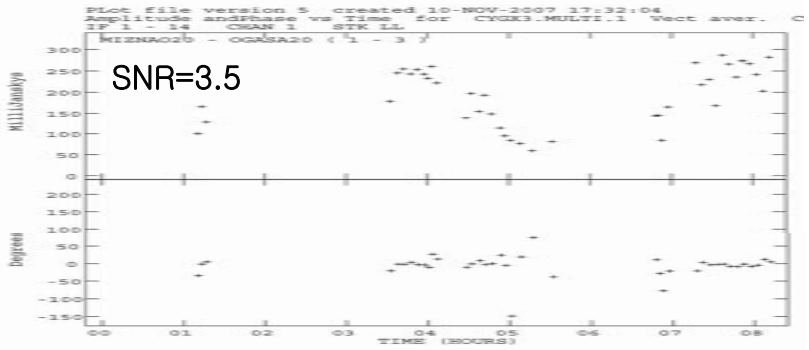
2007020 觀測: Amplitude & Phase for SNR=5 & 3.5, SOLINT=5min

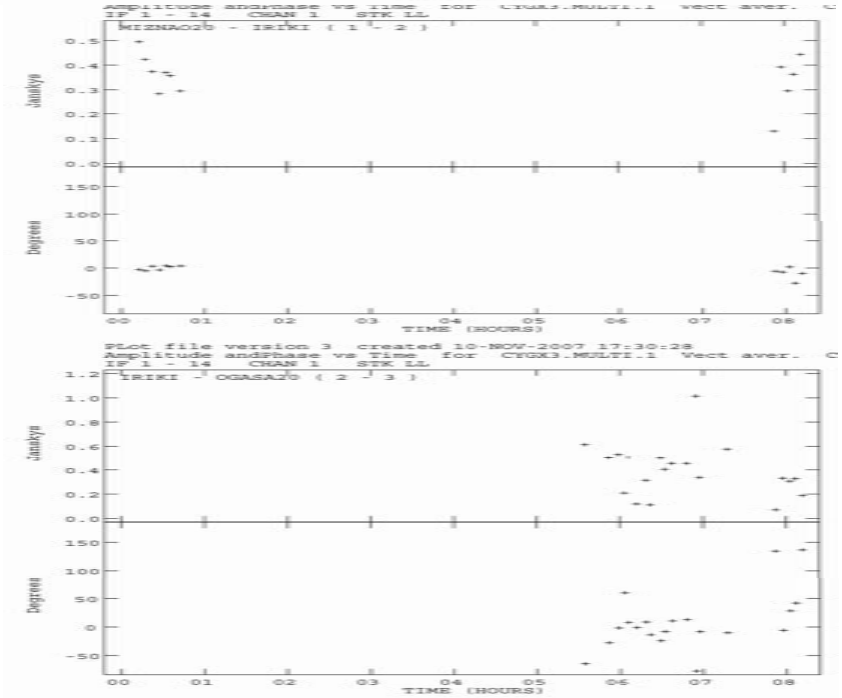
MIZ-OGA

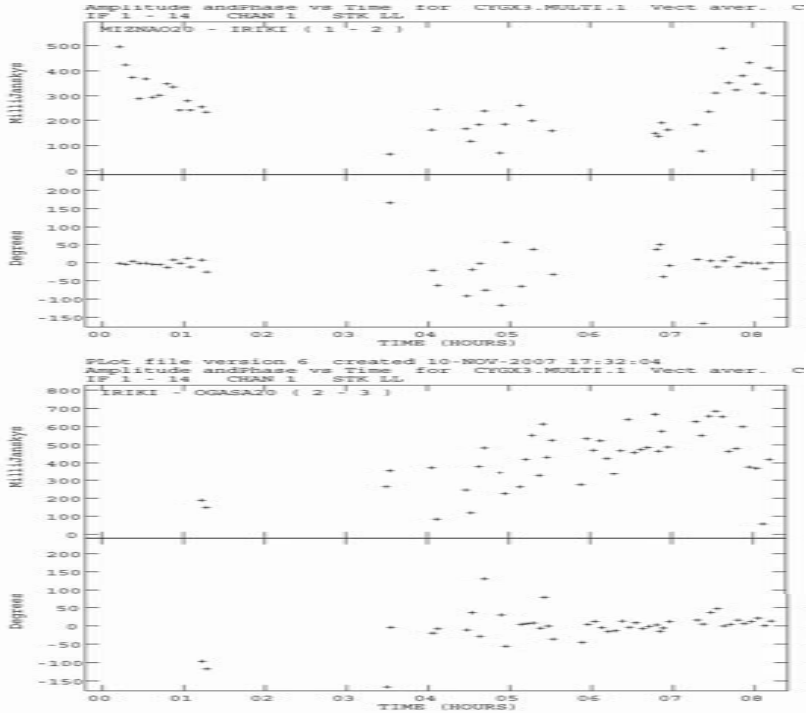
IRI-MIZ

IRI-OGA





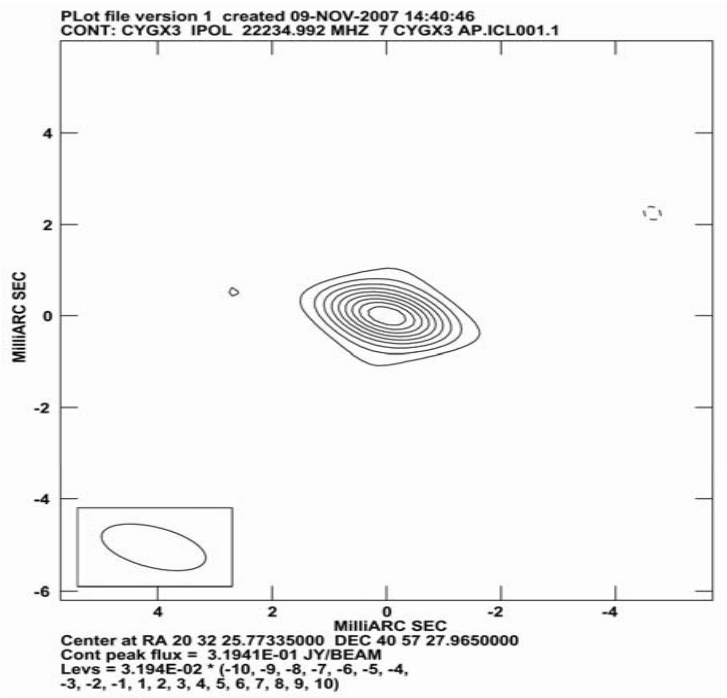




To check, SNR=5 is compared to SNR=3.5; Even with SNR=3.5, three flares looks real with phase presented.

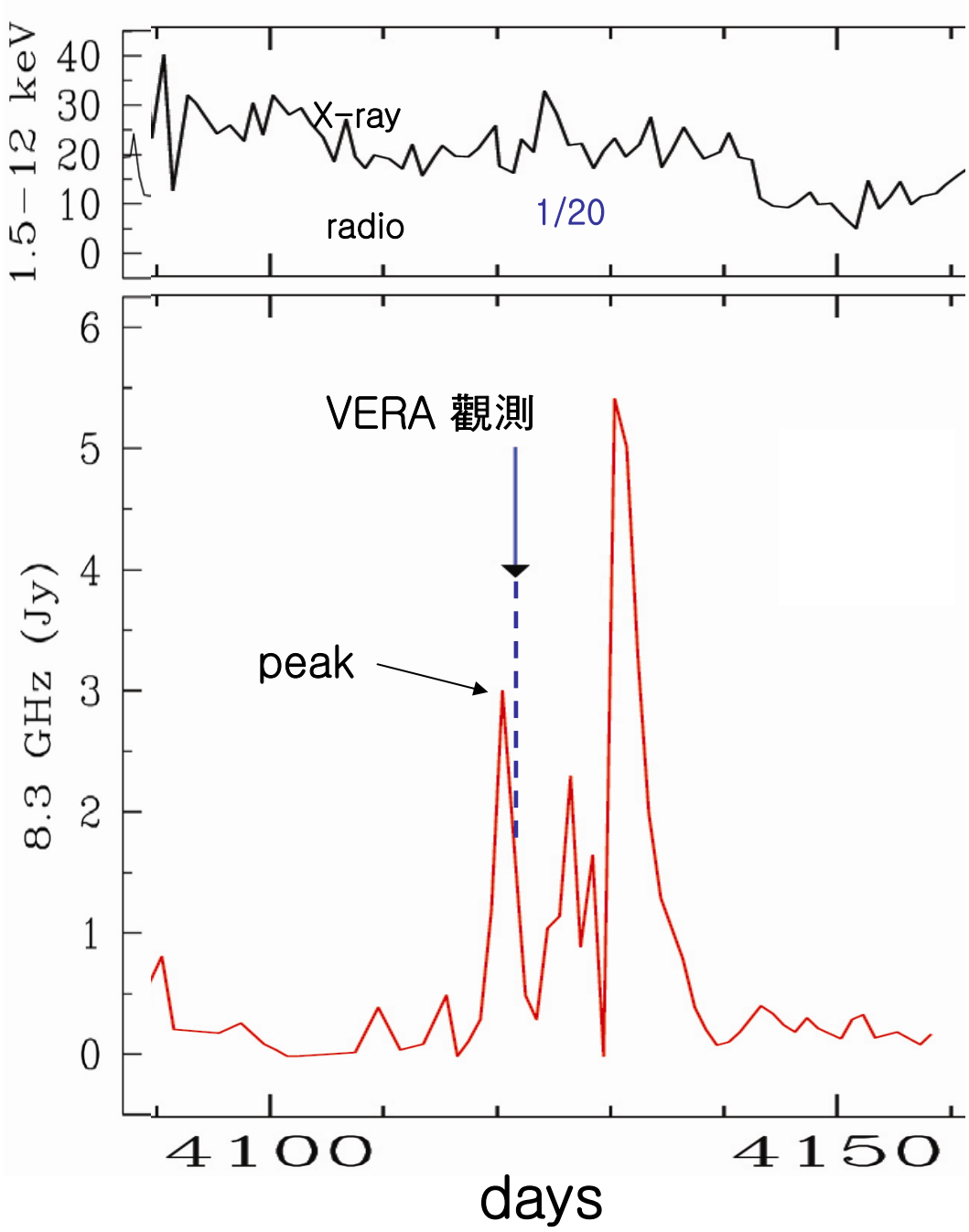
Baseline: Long-> short

20070120



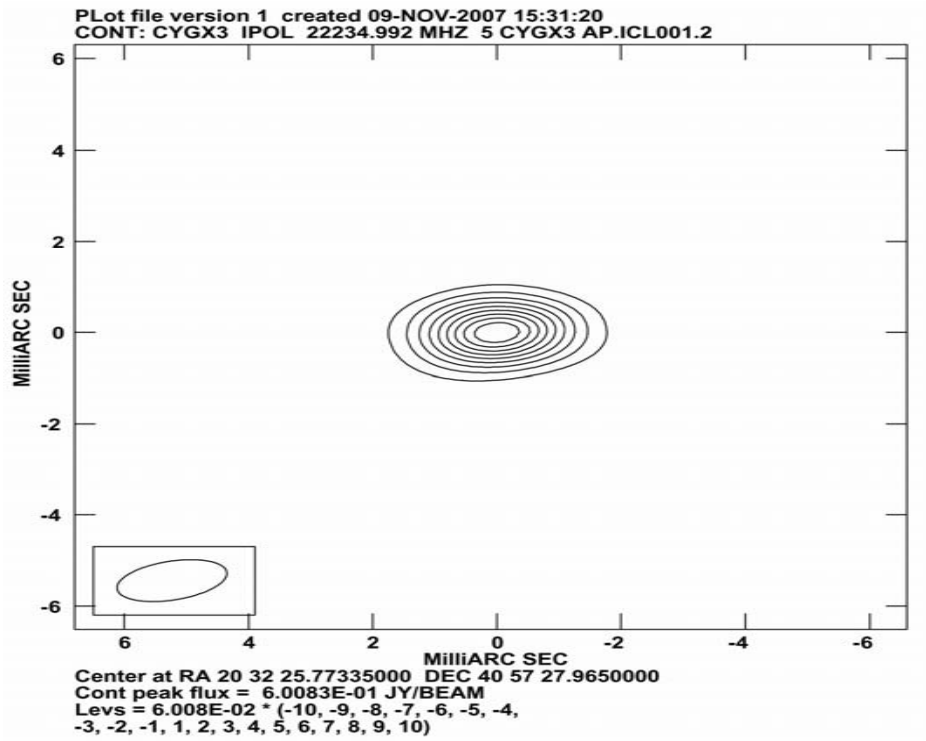
Beam Size = 1.895X0.867 mas^2
Position angle = +72.0 degree

- Origin of image detected ?
- If image is due to jet, it is possibly released at around the peak, within a day before VERA observation.



觀測 結果
2. Cyg X-3: 2007年 5月 29日 觀測

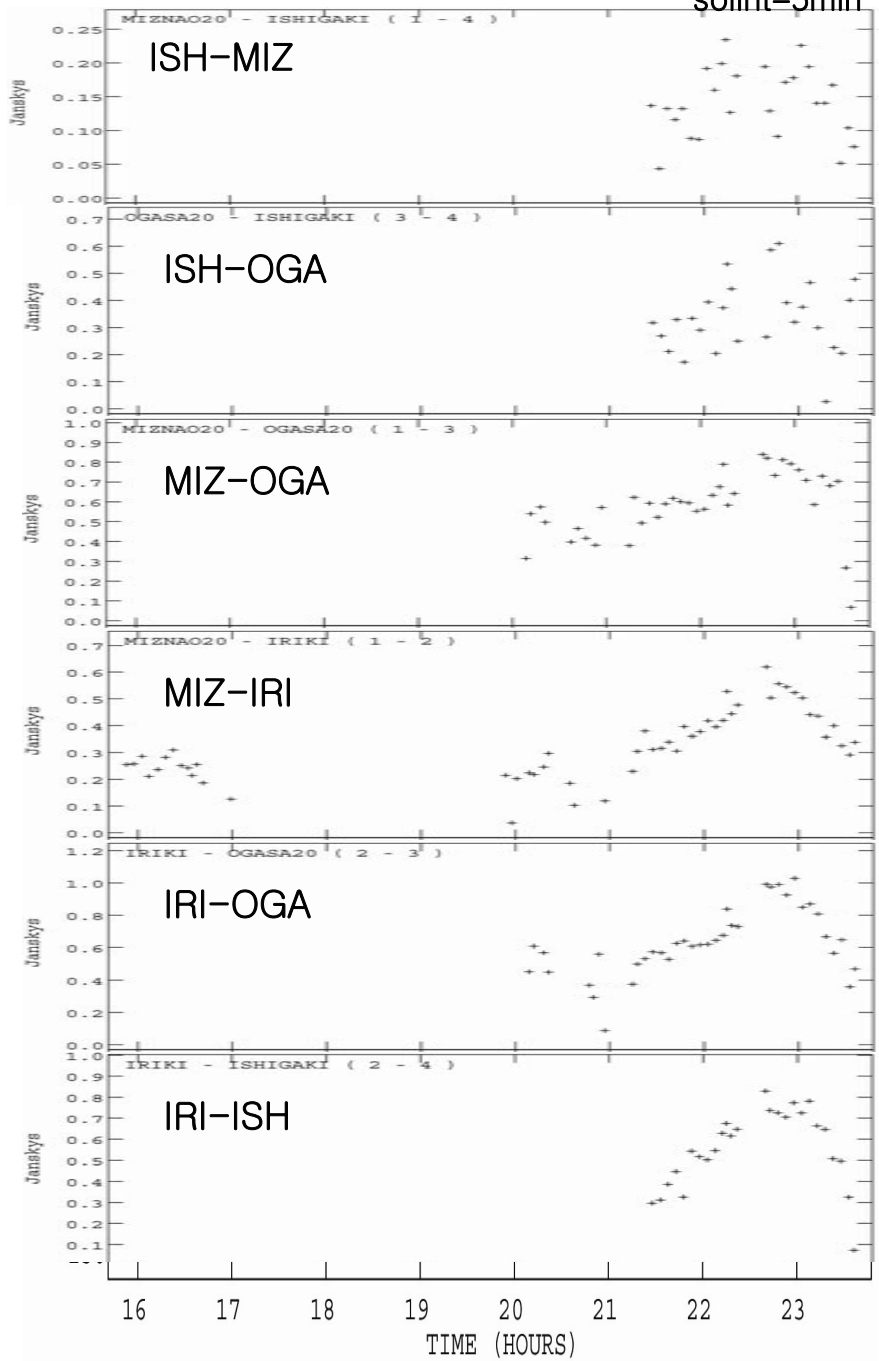
観測 20070529



Beam Size = 1.805X0.842 mas^2
Position angle = −76.9 degree

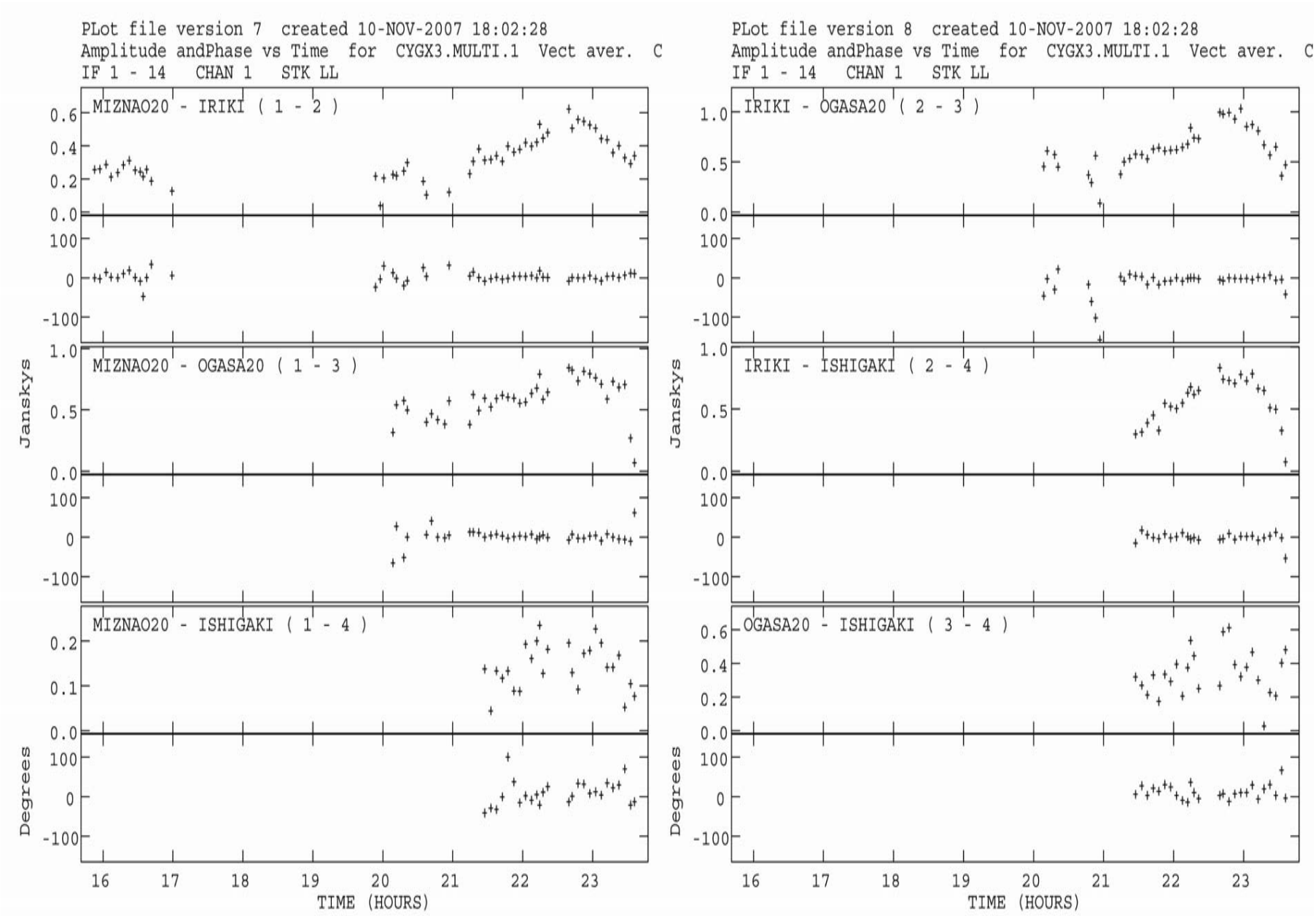
- Cyg X-3 flared up to ~ 500 mJy, lasting 3-4 hours; possible additional flare in the early epoch
- Image larger than the beam; probable structure due to jets.

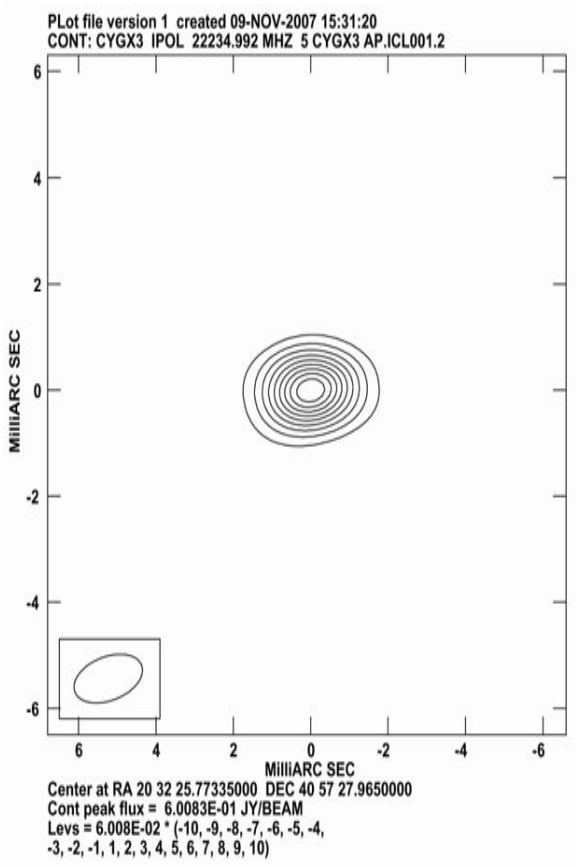
solint=5min

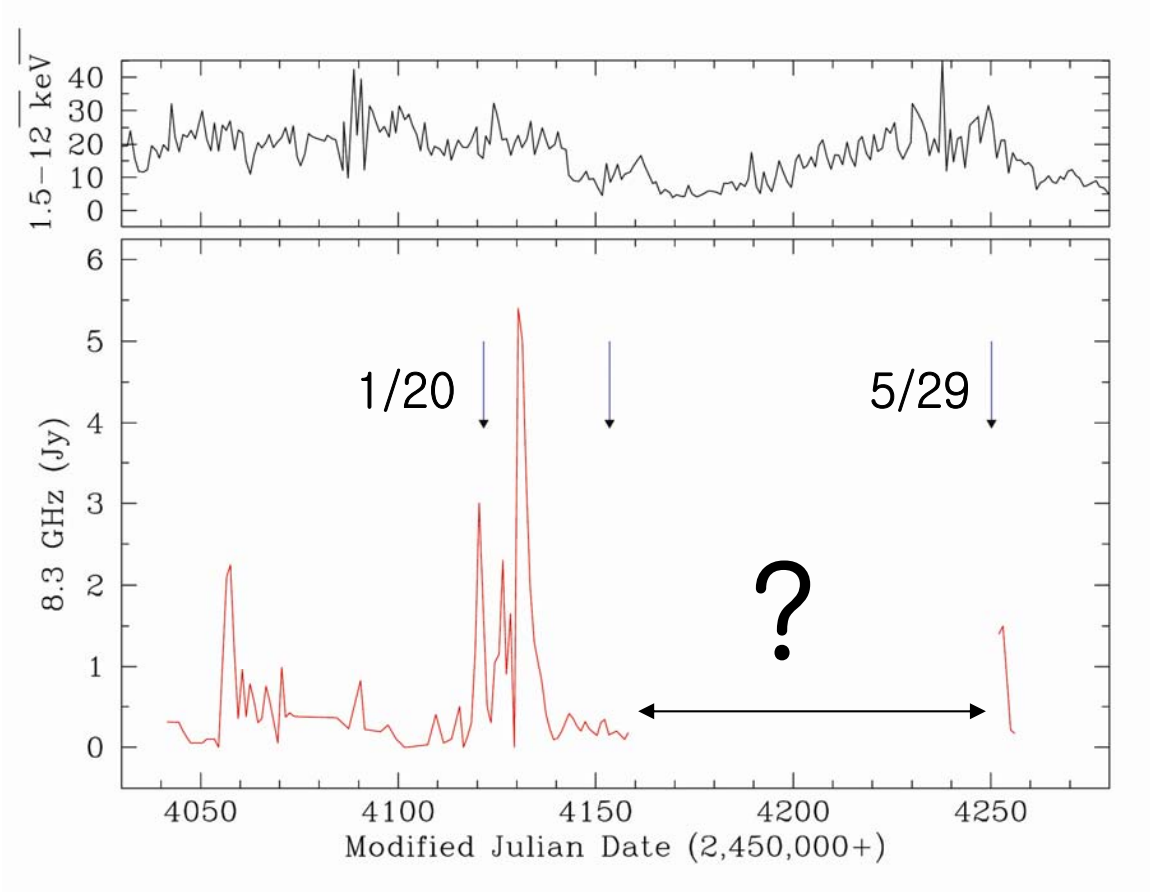


Baseline: Long-> short

20070120 (r07020): Amplitude & Phase for SNR=5, SOLINT=5min

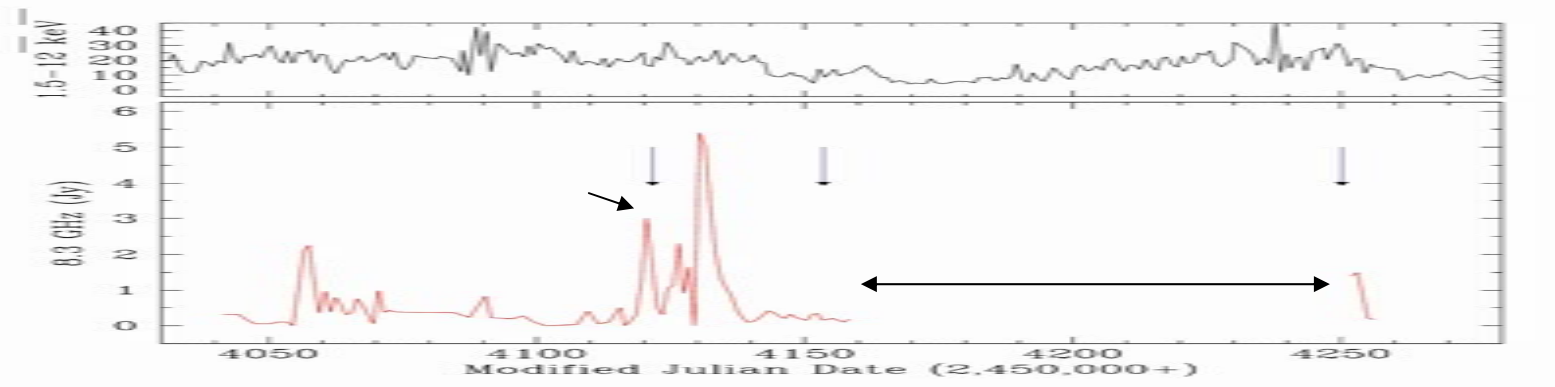






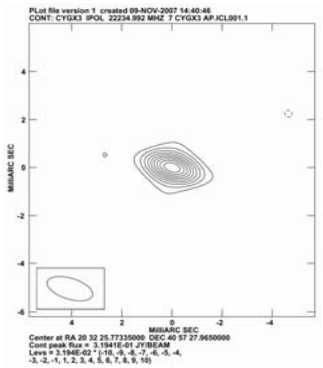
- Origin of Image Observed ?
- Unlike in the case of 20070120, no radio monitoring so far has been reported before our VERA observation; hard to tell what causes the image; further investigation is necessary to check up with other radio and multiwavelength observations.

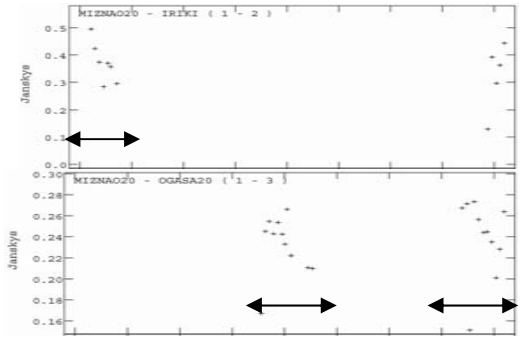
まとめと今後 (1)

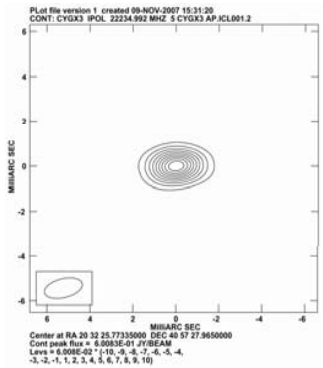


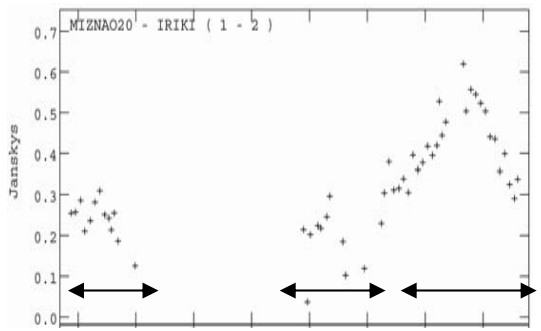
- VERA 觀測: 2007年 1月 20日, 2月 21日 & 5月 29日
- 1月 20日 & 5月 29日: visibility (flare) & image 獲得
- 1月 20日 觀測: origin of the image detected was plausible due to ~3 Jy peak of the flare, ≤ a half day before our VERA observation of a few hundred mJy
- 5月 29日 觀測: no radio observation has been reported prior to our VERA observation; origin of image structure cannot be conjectured at this moment. Further study is necessary to check up.

まとめと今後 (2)









Further studies will be done for

- Image for hour-long time scale; measurements of major/minor axis;
- Characteristic time-scales of variability for each flare;
- Correlation of variability to other multi-wavelengths are explored.

以上입니다.

感謝합니다.