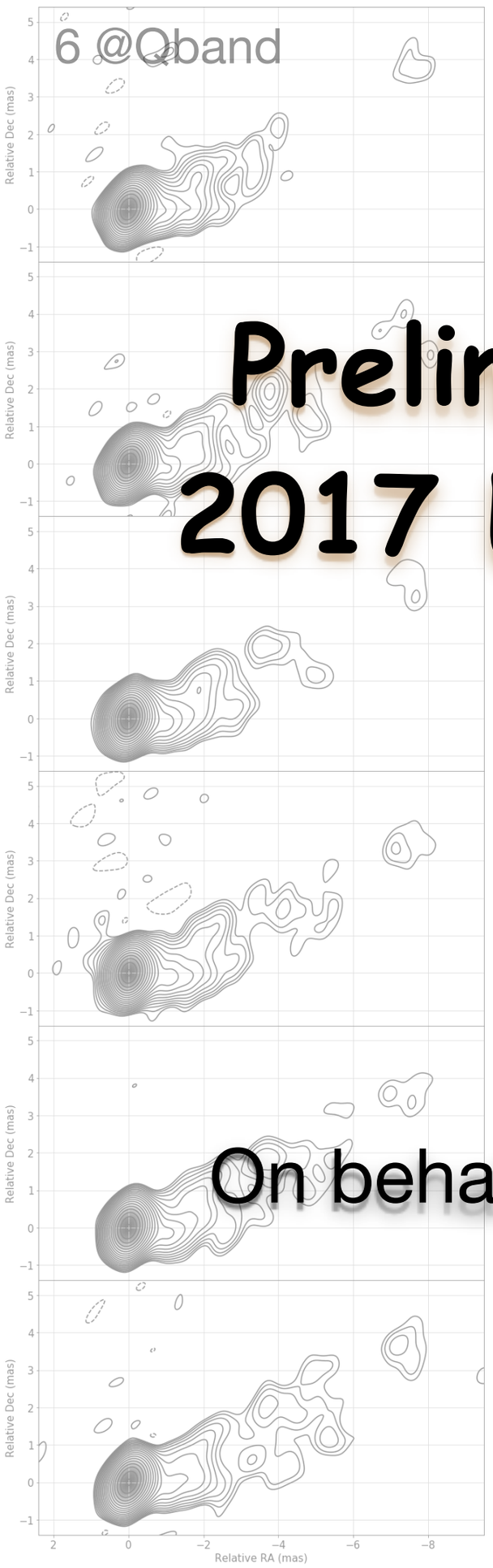

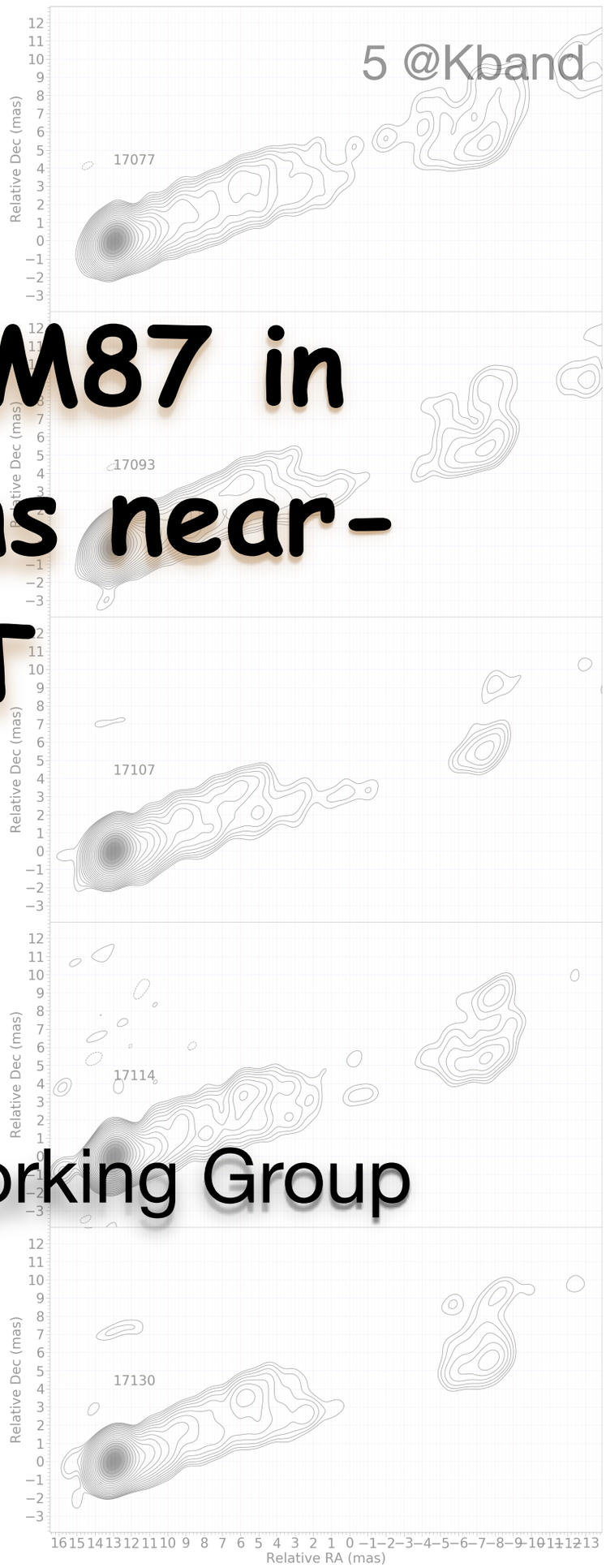

Preliminary results of M87 in 2017 EAVN observations near-in-time with EHT

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Kazuhiro, Hada
Mareki, Honma
On behalf of EAVN AGN Science Working Group
NAOJ / SOKENDAI

Content

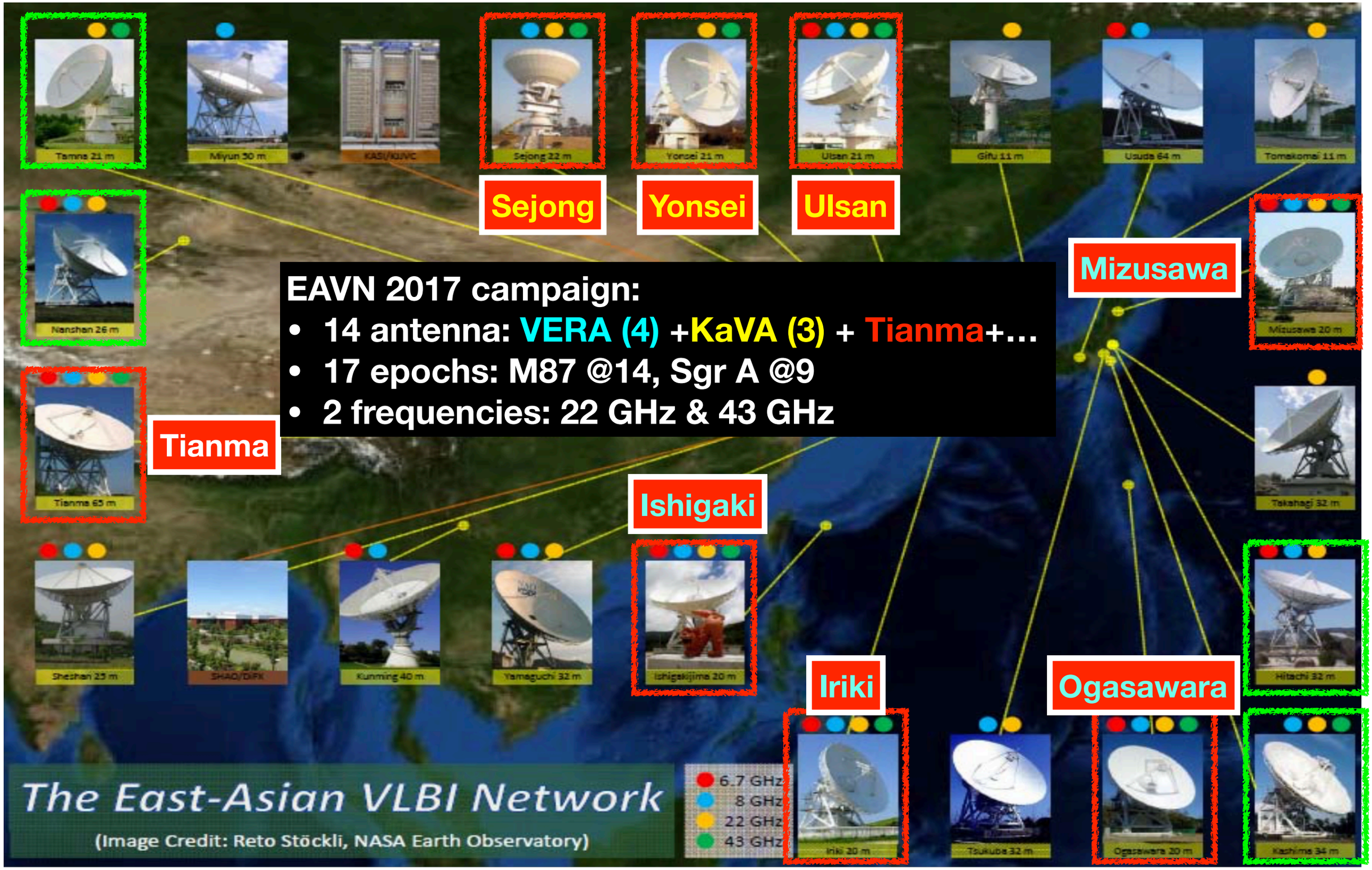
1. EAVN 2017 campaign;

2. EHT observation in 2017;

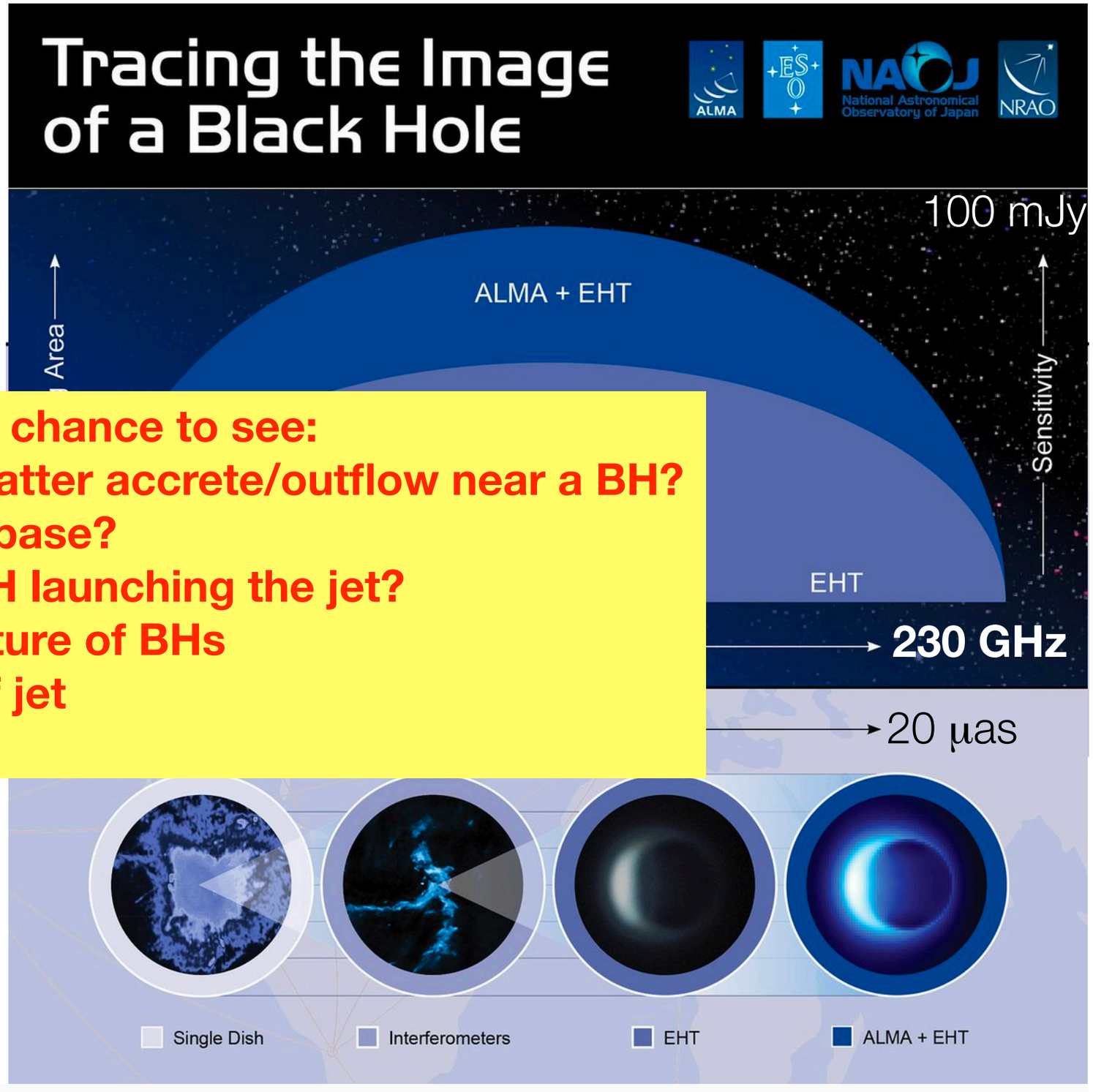
3. Possible connections between EAVN and EHT;

4. Future plan

From VERA to KaVA, then to EAVN



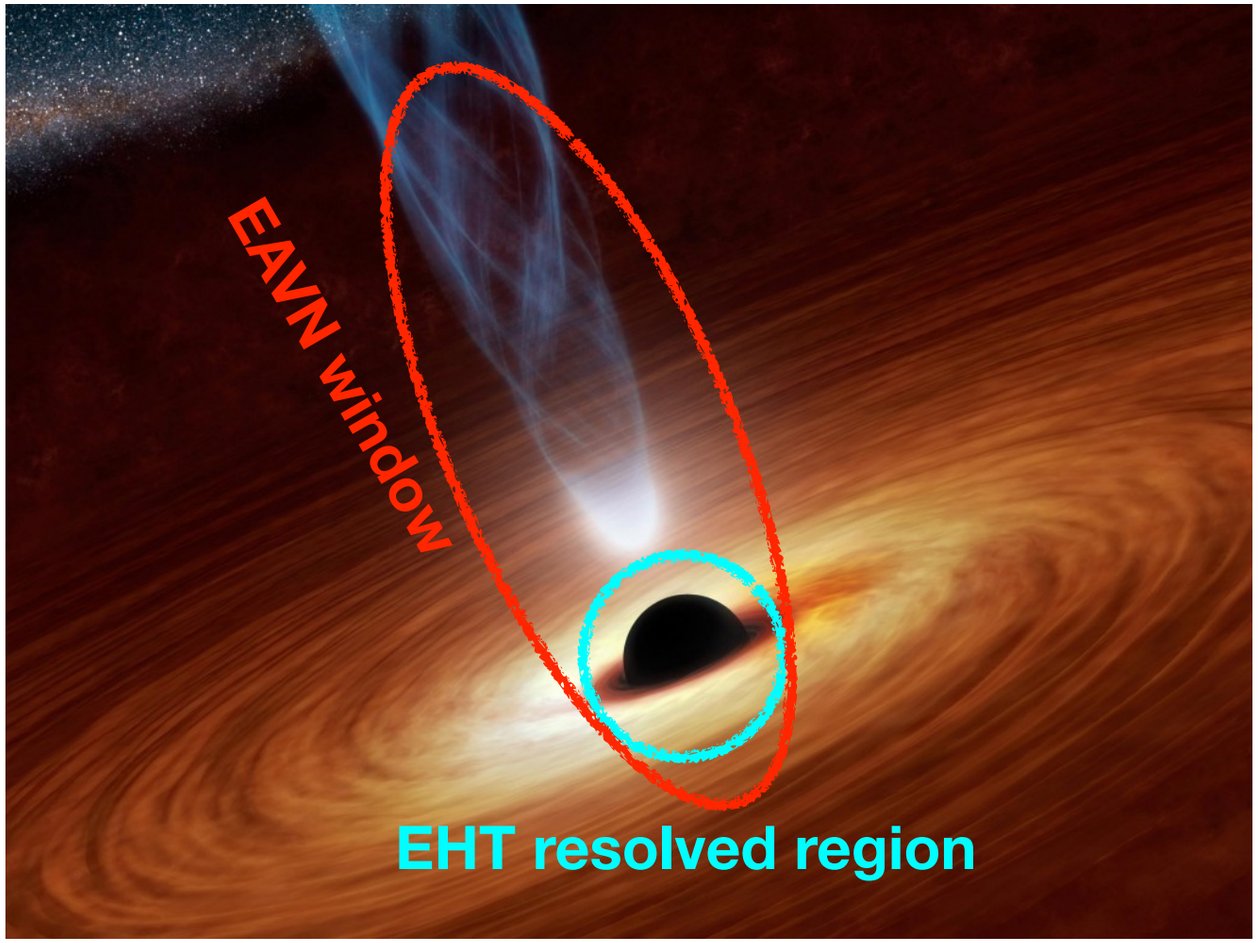
Event Horizon Telescope (EHT) observation in 2017



We may have a chance to see:

- **How does matter accrete/outflow near a BH?**
- **Where is jet base?**
- **How does BH launching the jet?**
- **Quantum nature of BHs**
- **Formation of jet**
- **…**

Comparison between EHT and EAVN



	EHT	EAVN
Frequency (GHz)	230	43
Angular resolution (μas)	20	700
Scale_M87 (Rs)	3	90

- **EHT :** imaging the BH shadow
- **EAVN:**
  - Over all jet structure;
  - Proper motion informations;
  - Position angle information;
  - Amplitude variance;
  - Spectrum index

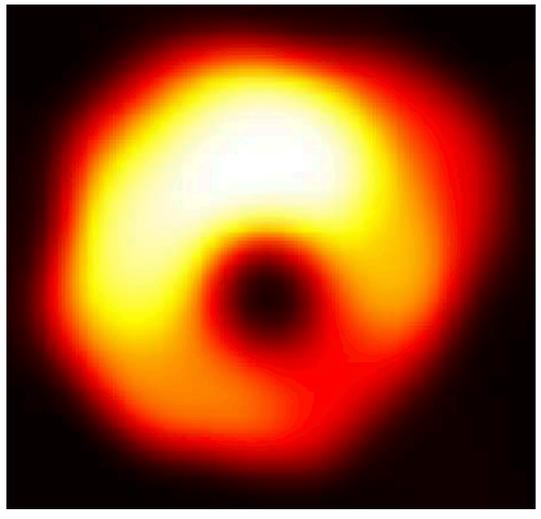
M87: $M_{BH} = 6.6 \times 10^9 M_{sun}$,
Rs = 7.79 μas; D = 15 Mpc

Will be very helpful supplements for each other !!!

Possible connection:

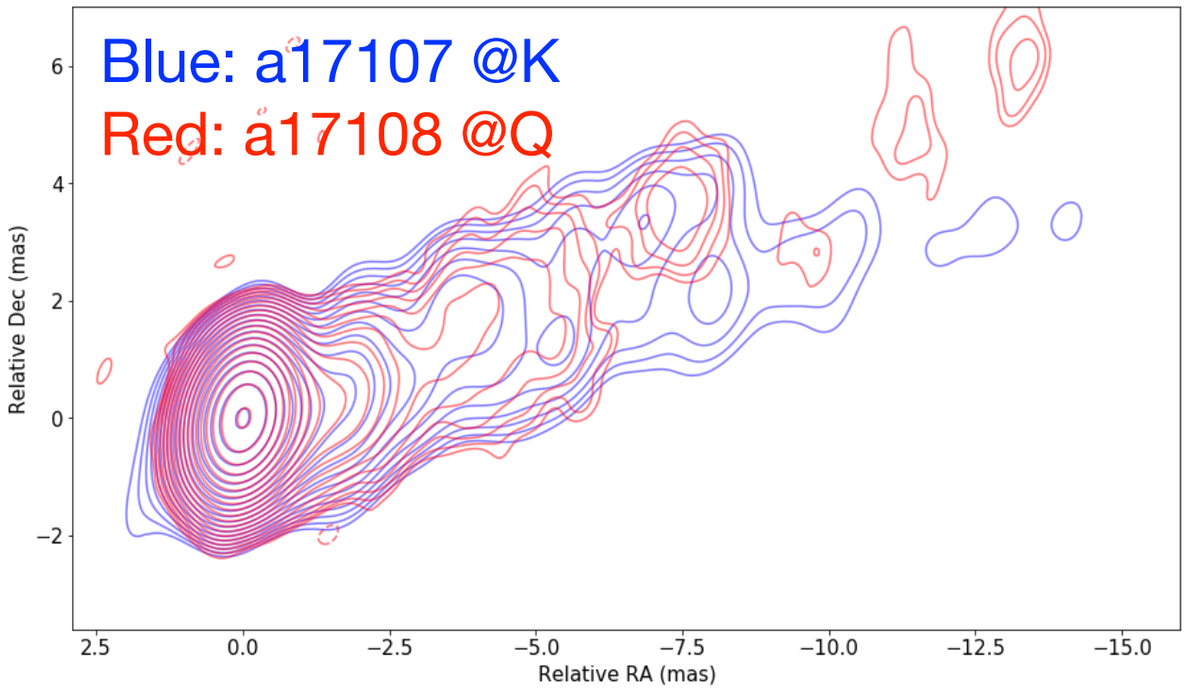
Expected flux density

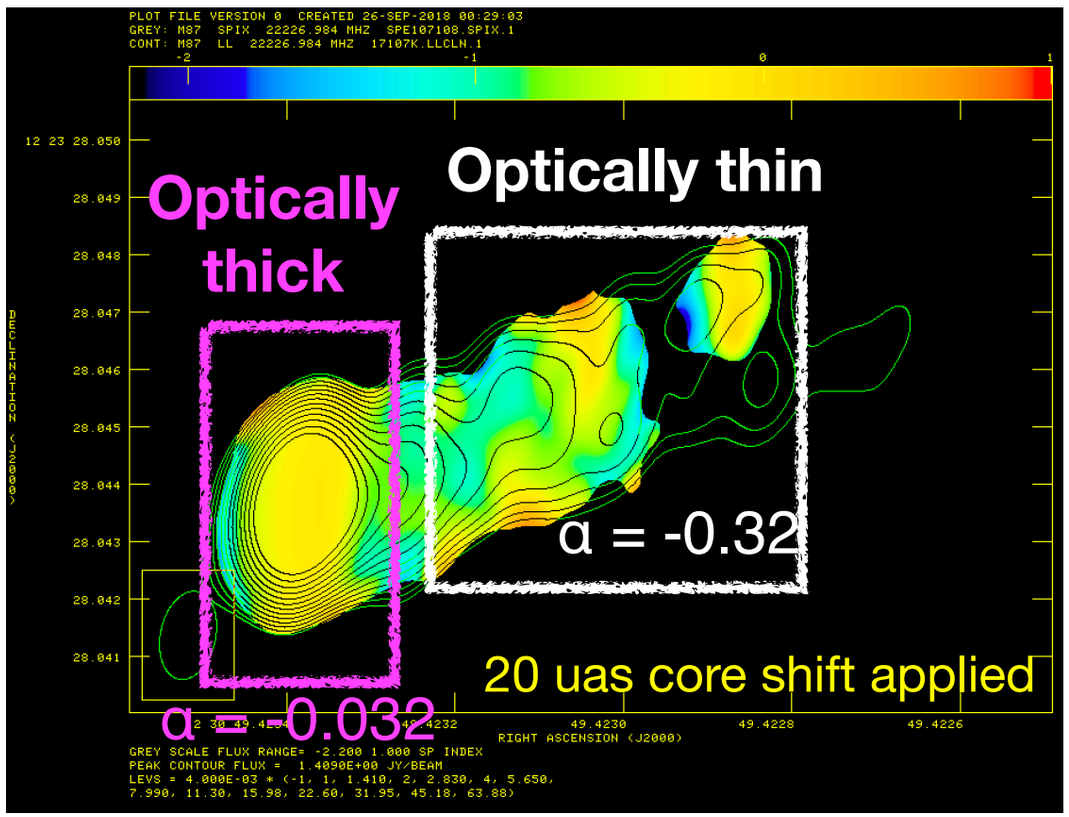
1. Can we detect the emission around the BH?



Simulation of M87, Akiyama+ 2017

Spectral Index Map ($S_\nu \propto \nu^\alpha$)





- **With the 22 GHz & 43 GHz data, we can get 4 pairs of spectral index maps to check the particle distribution of M87 by** $S_\nu \propto \nu^\alpha$

$$\frac{S_{\nu_1}}{S_{\nu_2}} = (\frac{\nu_1}{\nu_2})^\alpha$$

$$\log(\frac{S_{\nu_1}}{S_{\nu_2}}) = \alpha \log(\frac{\nu_1}{\nu_2})$$

$$\alpha = \frac{\log(\frac{S_{\nu_1}}{S_{\nu_2}})}{\log(\frac{\nu_1}{\nu_2})} = -0.32$$

Jet region

- **Assuming the particle distribution is same with the jet.** $S_{core,43GHz} = 586 mJy@VLBA$

$$\log(\frac{S_{core,230GHz}}{S_{core,43GHz}}) = \alpha \log(\frac{\nu_{230GHz}}{\nu_{43GHz}})$$

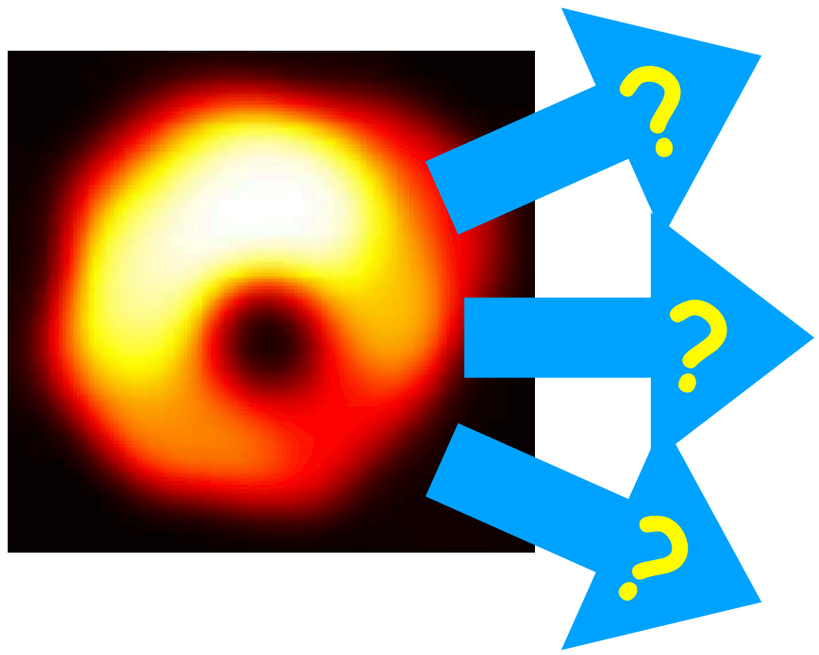
Core region

Detectable!

$$S_{core,230GHz} = 340 \ mJy@EHT$$

Expected position angle

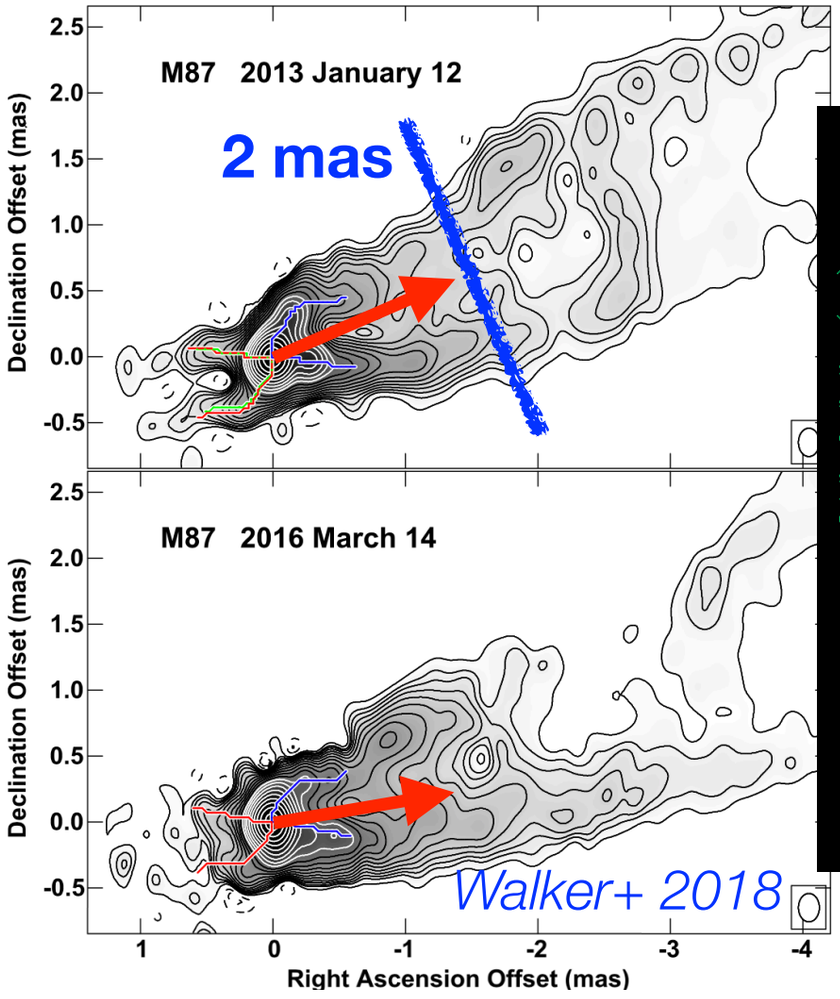
2. What is the direction of the emission?

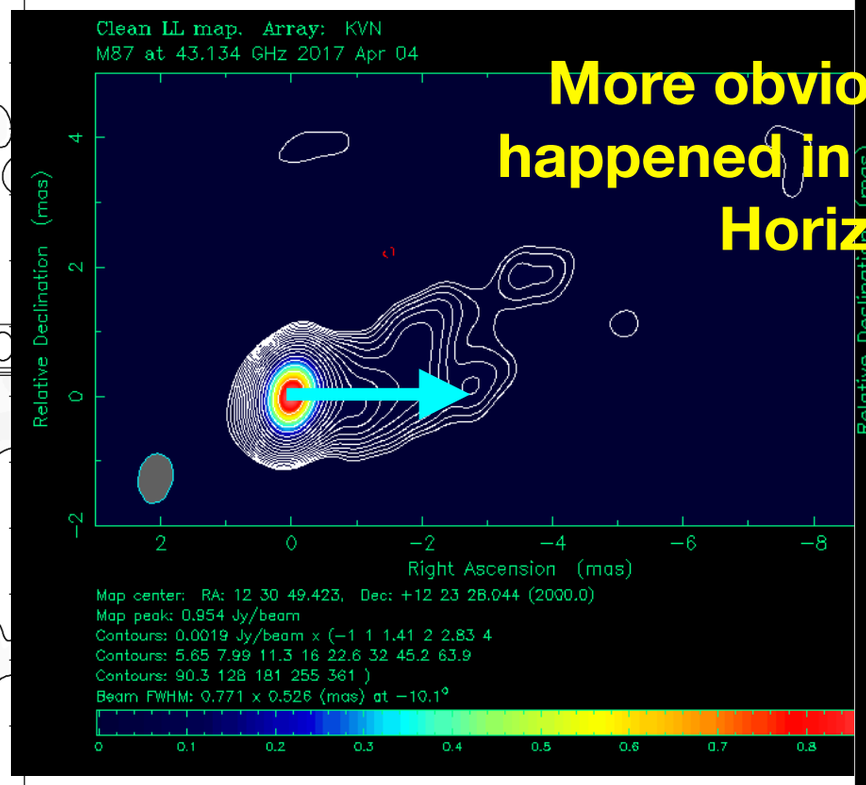


Simulation of M87, Akiyama+ 2017

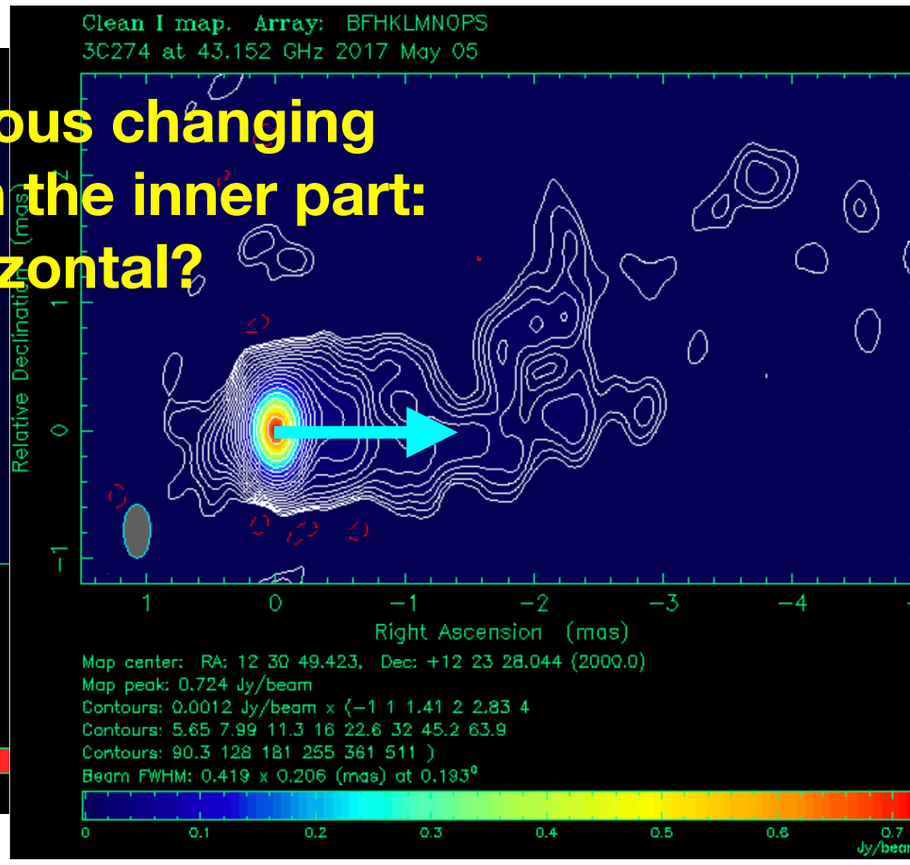
Position angle changing of M87

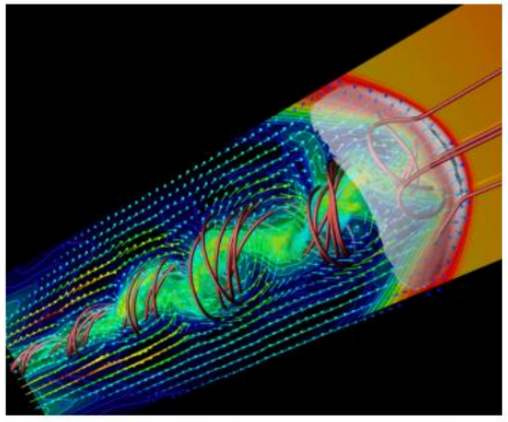
VLBA 2013/2016 **EAVN 2017** **VLBA 2017**



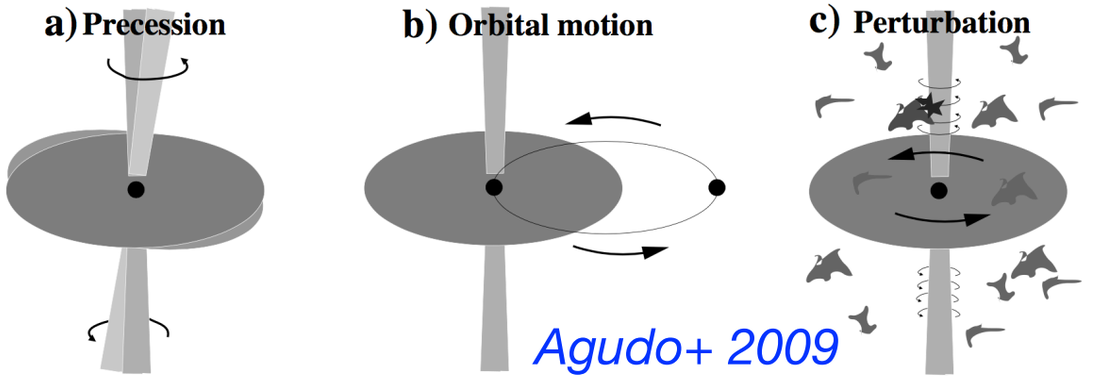


More obvious changing happened in the inner part: Horizontal?

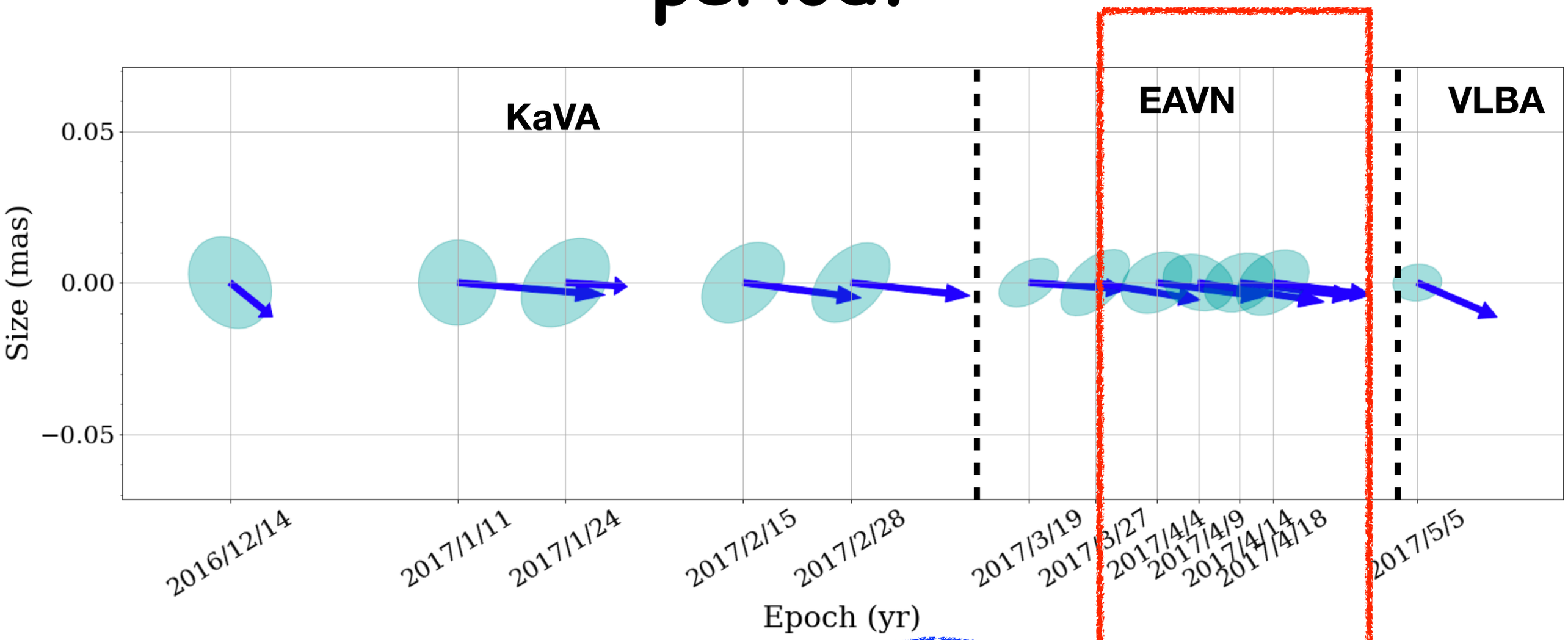




3D MHD simulation for propagating jet
(Nakamura & Meier 2004)

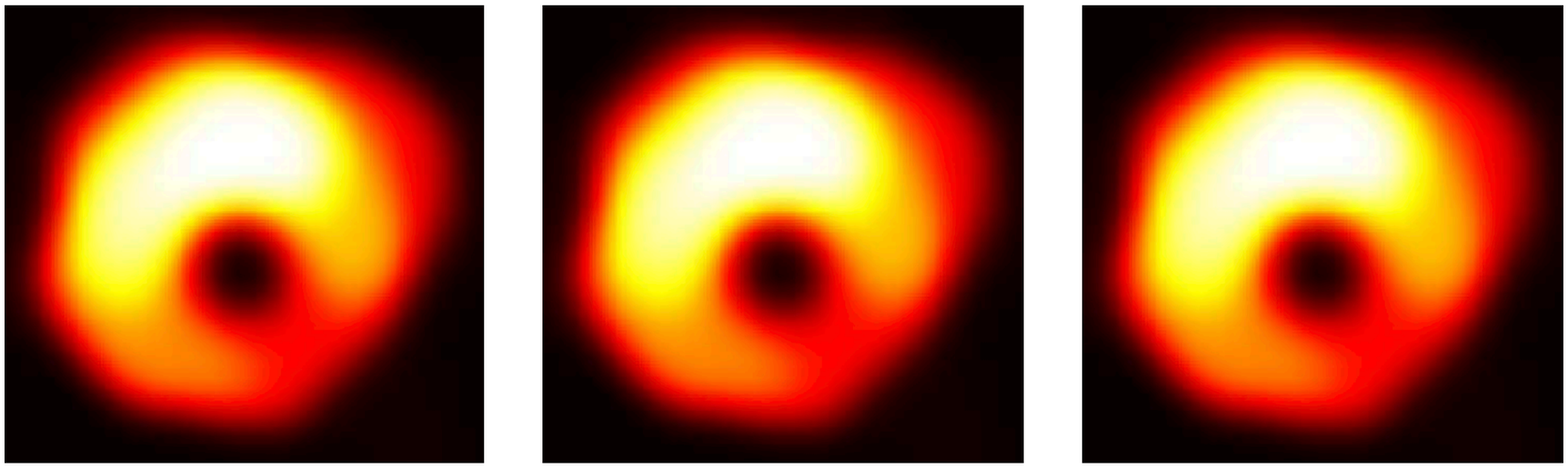


Initial Jet direction during EHT period?



Proper motion & new ejection

3. When was the new component ejected?



2017/04/05　　2017/04/10　　2017/04/15

✳ These dates are example

Simulation of M87, Akiyama+ 2017

Possible proper motion

Time interval:

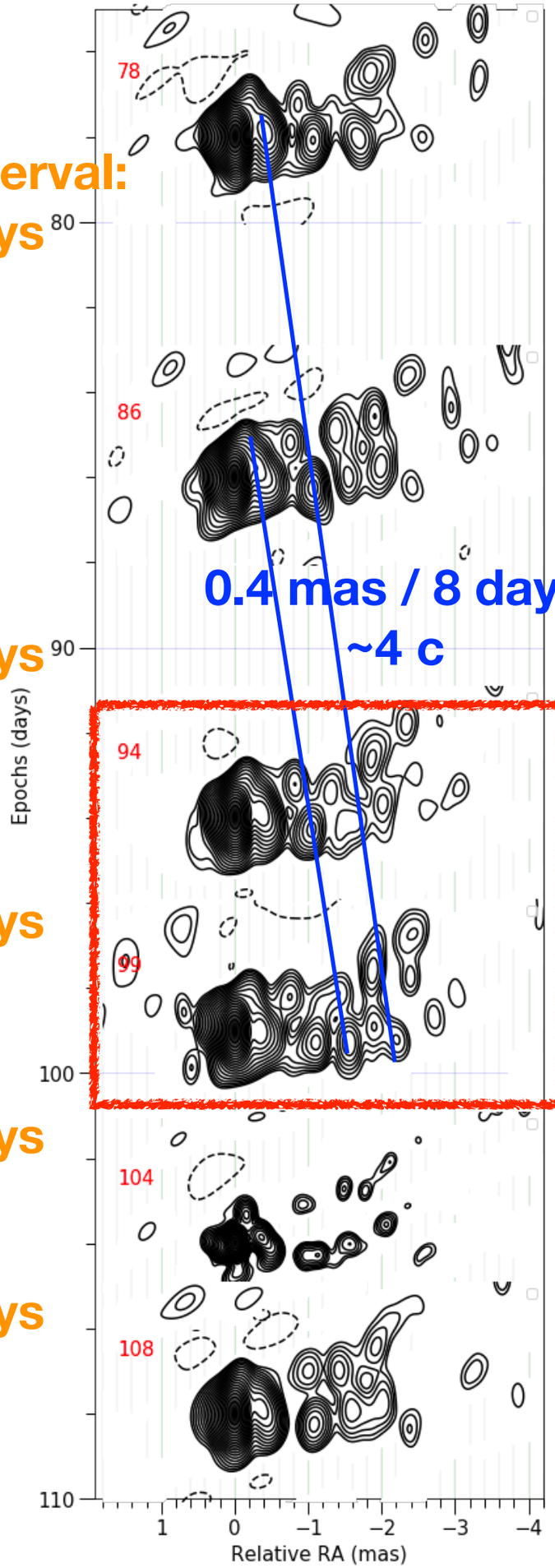
8 days

8 days

5 days

5 days

4 days

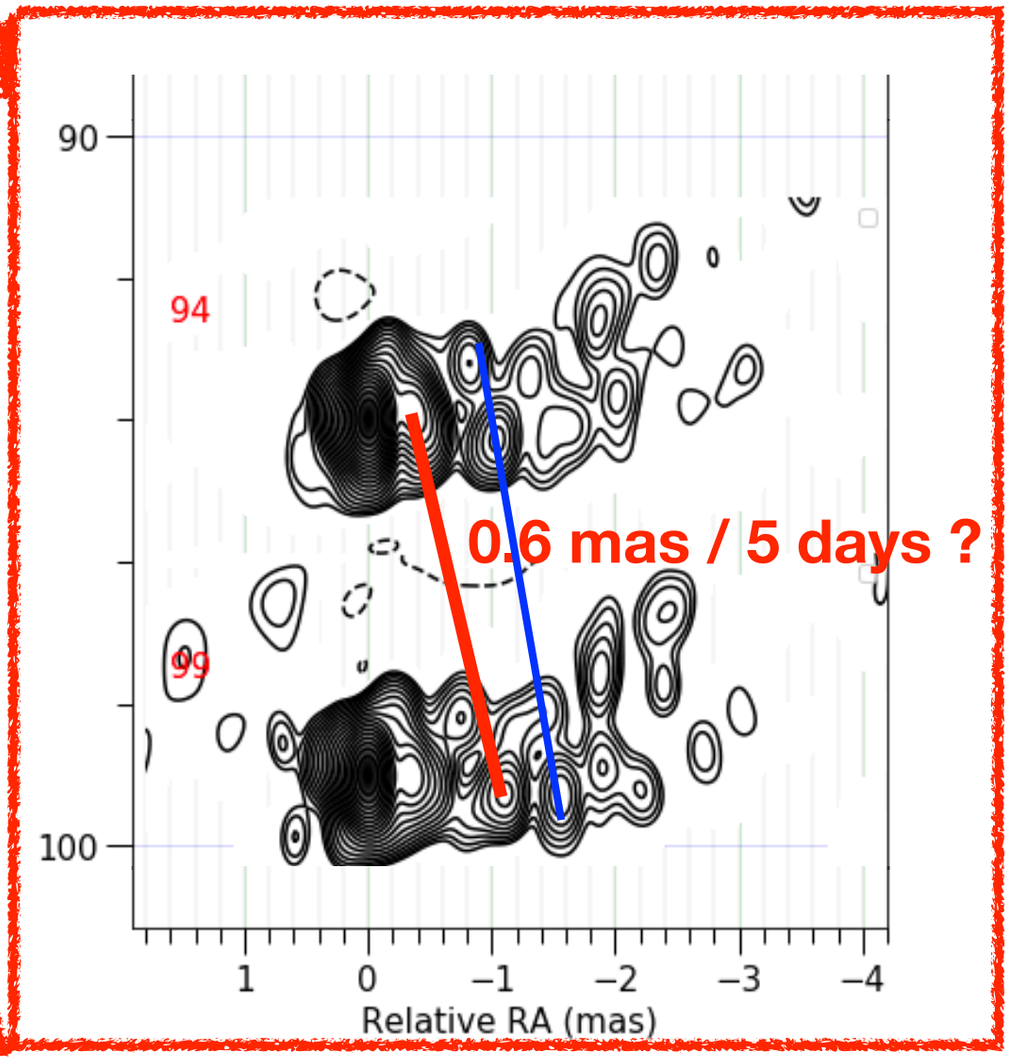


0.4 mas / 8 days

~4 c

Super resolution:

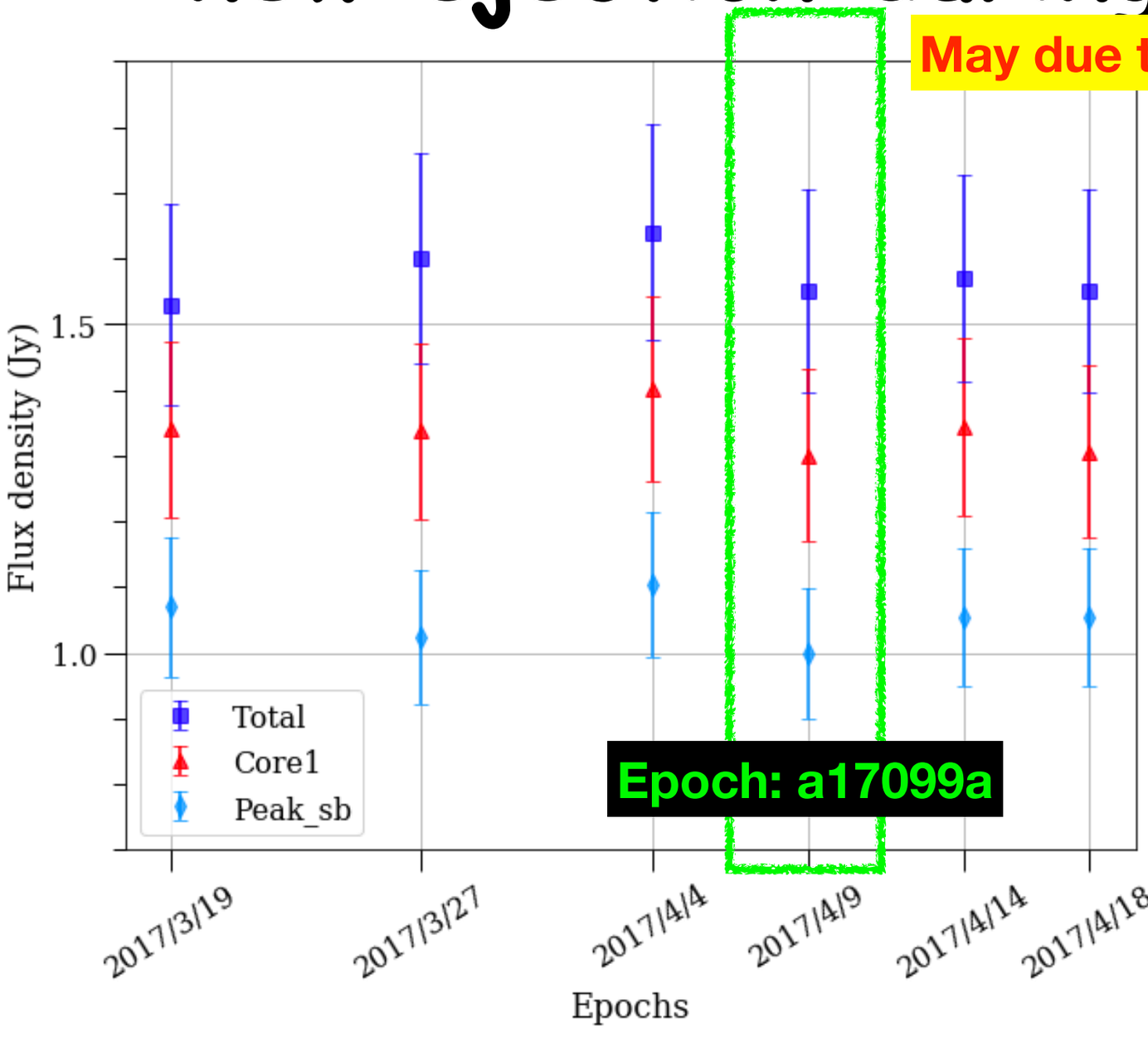
Beam size: 0.416 × 0.21 mas

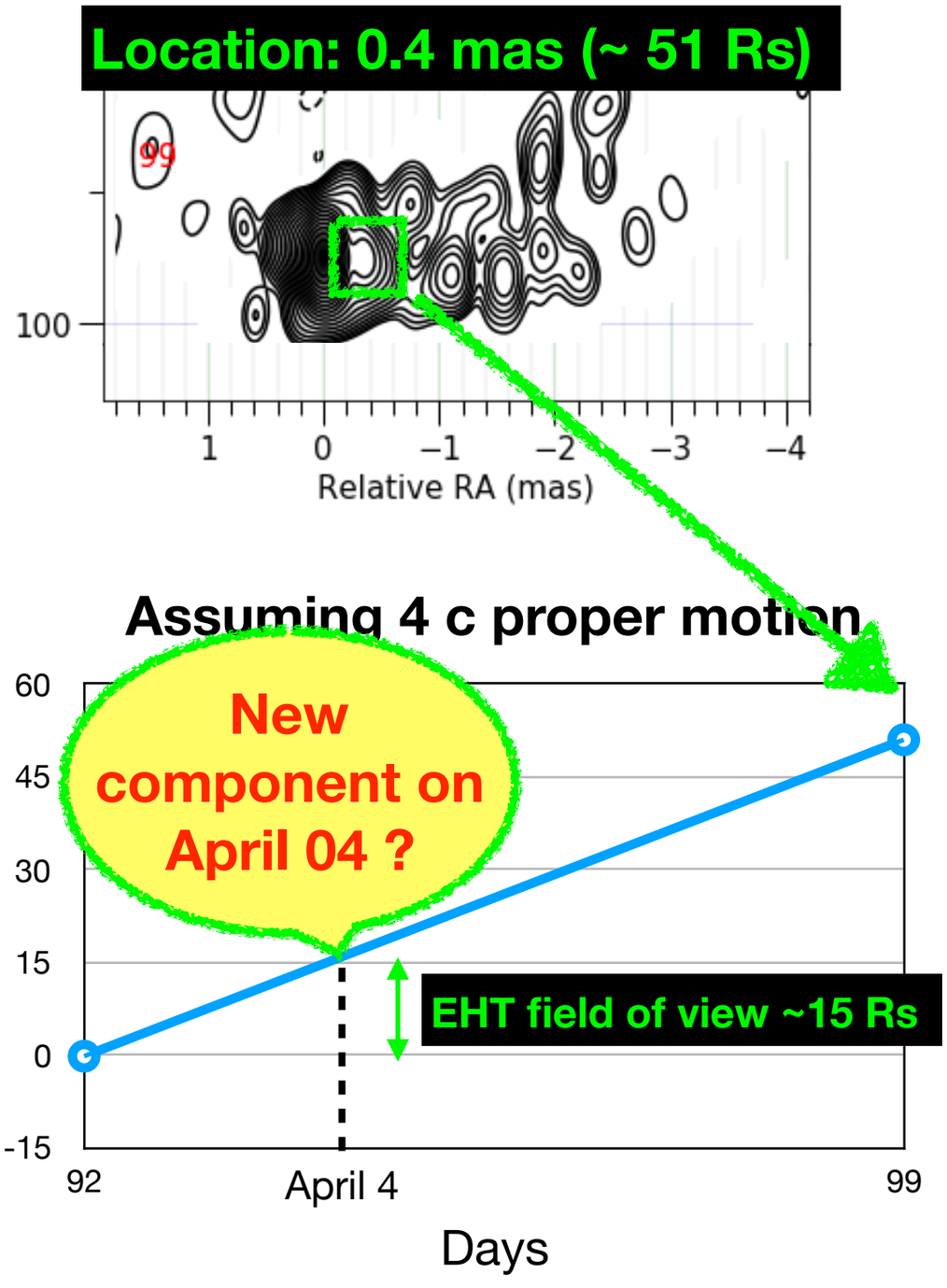


0.6 mas / 5 days ?

Rough estimation:
If we expect 1c motion, namely:
->1c = 4 mas / year
-> 0.1 mas / 7 days
-> 12.8 Rs / 7 days

Light curve (Q band)——
new ejection during EHT period?





M87: $M_{BH} = 6.6 \times 10^9 M_{sun}$, 4c~51.2 Rs /7 days

Rs = 7.79 μas; D = 15 Mpc

Future work

✤ **Technical part:**

- **Finish the evaluation of Tianma's performance;**
- **Double check the data;**
- **Finish the technical paper**

✤ **Scientific part:**

- **Spectral index of K band and Q band;**
- **Calculation of proper motion;**
- **Finish the scientific paper with EHT**