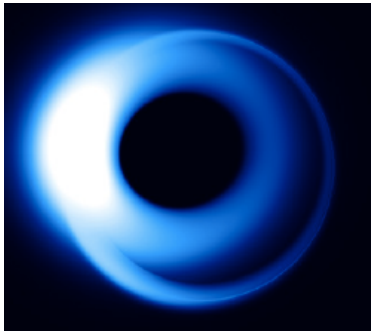
Summary of KaVA/EAVN AGN SWG activities

M. Kino (NAOJ/Kogakuin Univ) & BW Sohn (KASI)
on behalf of EAVN AGN SWG

Science driver

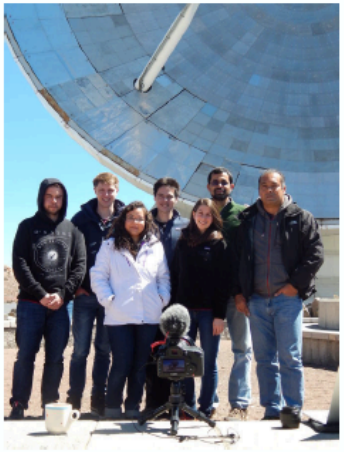
- What happens in the vicinity of black holes (BHs)?
- M87 and Sgr A* are the best two targets for looking into the vicinity of Black holes!
- KaVA-EAVN AGN SWG has focused on M87 and Sgr A* since 2013~.



Tight collaboration with EHT-C via M87 and Sg r A*

Members of the EHT team at Telescopes






Event Horizon Telescope

Publications using KaVA AGN LP (1st phase) data

1. Performance evaluation of KaVA array with bright AGNs (2011 data) (Niinuma et al. 2014, PASJ).
2. Early result of KaVA pilot monitoring (during 2013-2014) at 22 GHz confirmed superluminal motions at sub-pc scale (Hada et al. 2017, PASJ).
3. Kinematics of 4C21.35 (during 2013-2014) (Lee T et al. 2018, MNRAS).
4. Scattering kernel of Sgr A* (one epoch in 2014) (Johnson et al. 2018, ApJ)

5. Detailed profile of the velocity field of M87 based on KaVA AGN LP (2015-2016 (Park et al. *in prep*).
6. The radial profile of the spectral index map of M87 between 22 and 43 GHz with KaVA AGN LP data (2015-2016) is investigated (Ro et al. *in prep*).
7. Performance evaluation of EAVN (KaVA+Tia) w/ M87 data (Cui, Hada et al. *in prep*).
8. **M87 kinematics during 2017 EAVN-EHT campaign data (Cui, Hada et al. *in prep*).**
9. Performance evaluation of EAVN (KaVA+Tia) w/ Sgr A* data (Zhao et al. *in prep*).
10. **Sgr A* long term monitoring (2013-2015) (Zhao et al. *in prep*)**
11. etc

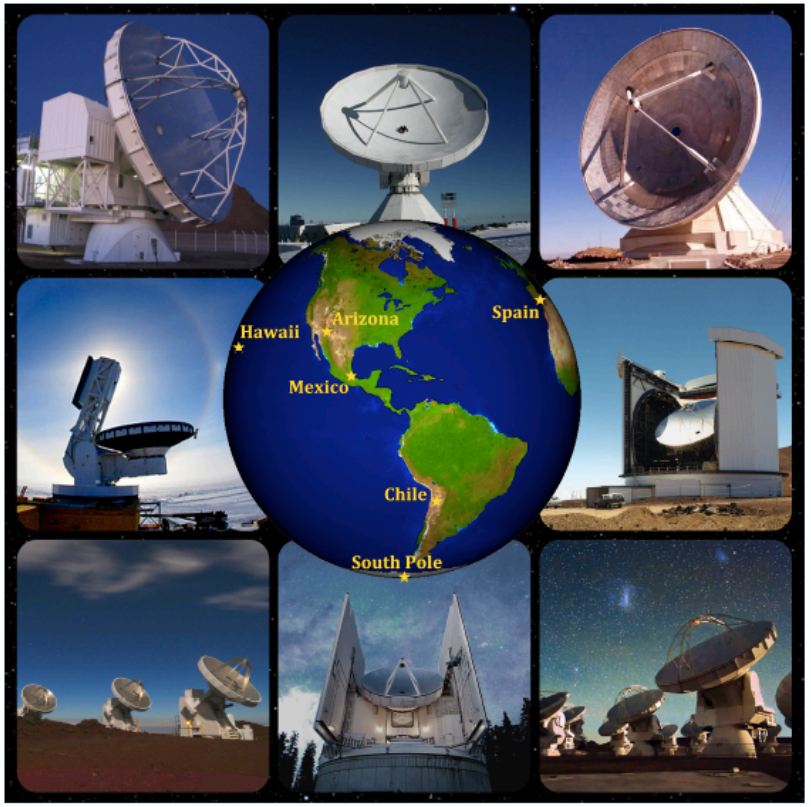
VERA UM 2018

News on 2017 EAVN-EHT campaign

M87 (1 mas = 140 Rs) is the best source for this study.

Event Horizon Telescope in 2017

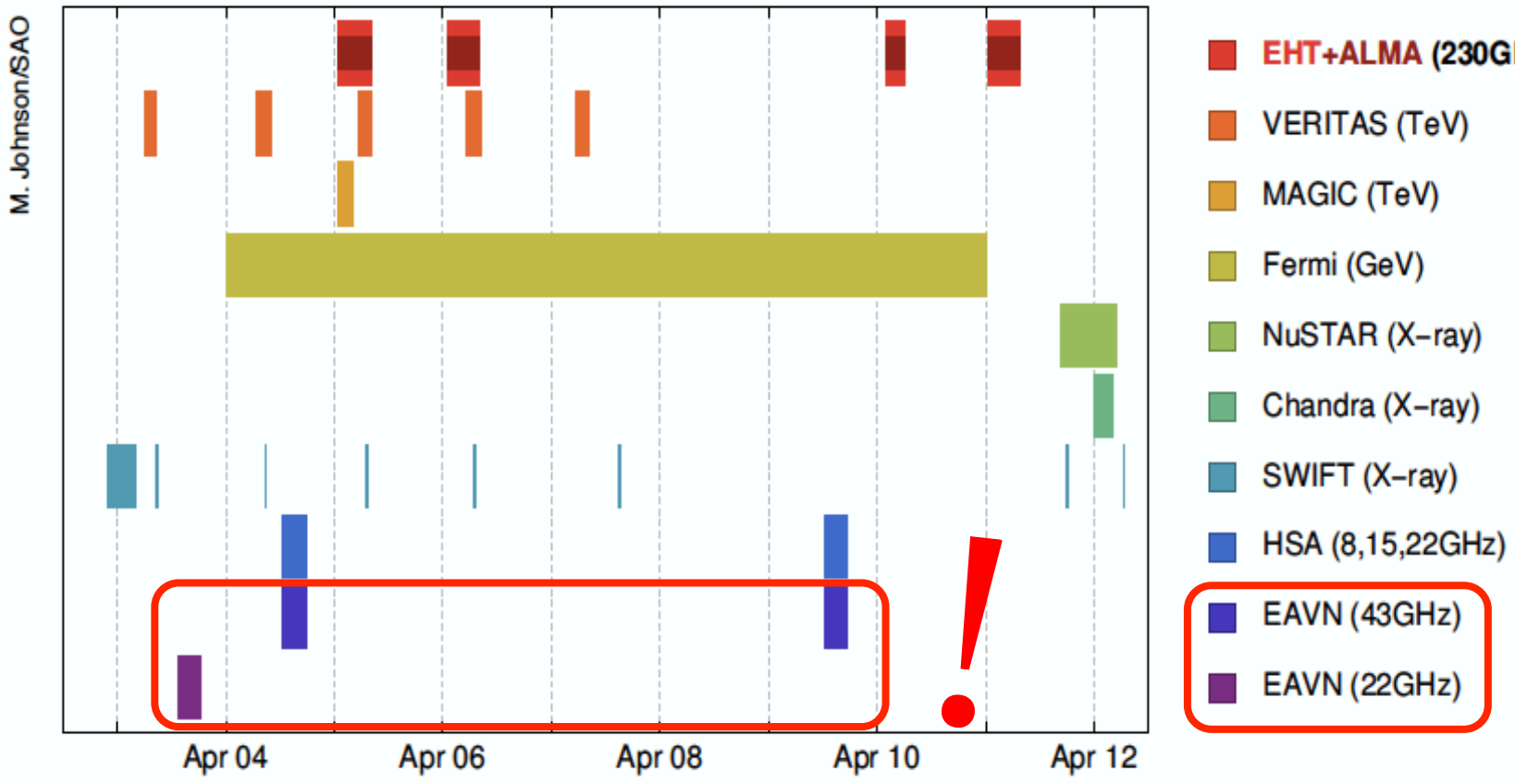
- Atacama Large Millimeter Array (ALMA), Chile
- ALMA Pathfinder Experiment (APEX), Chile
- James Clerk Maxwell Telescope (JCMT), Hawaii
- Large Millimeter Telescope (LMT), Mexico
- IRAM 30-meter Telescope, Spain
- South Pole Telescope (SPT), South Pole
- Submillimeter Array (SMA), Hawaii
- Submillimeter Telescope (SMT), Arizona



M. Johnson/SAO

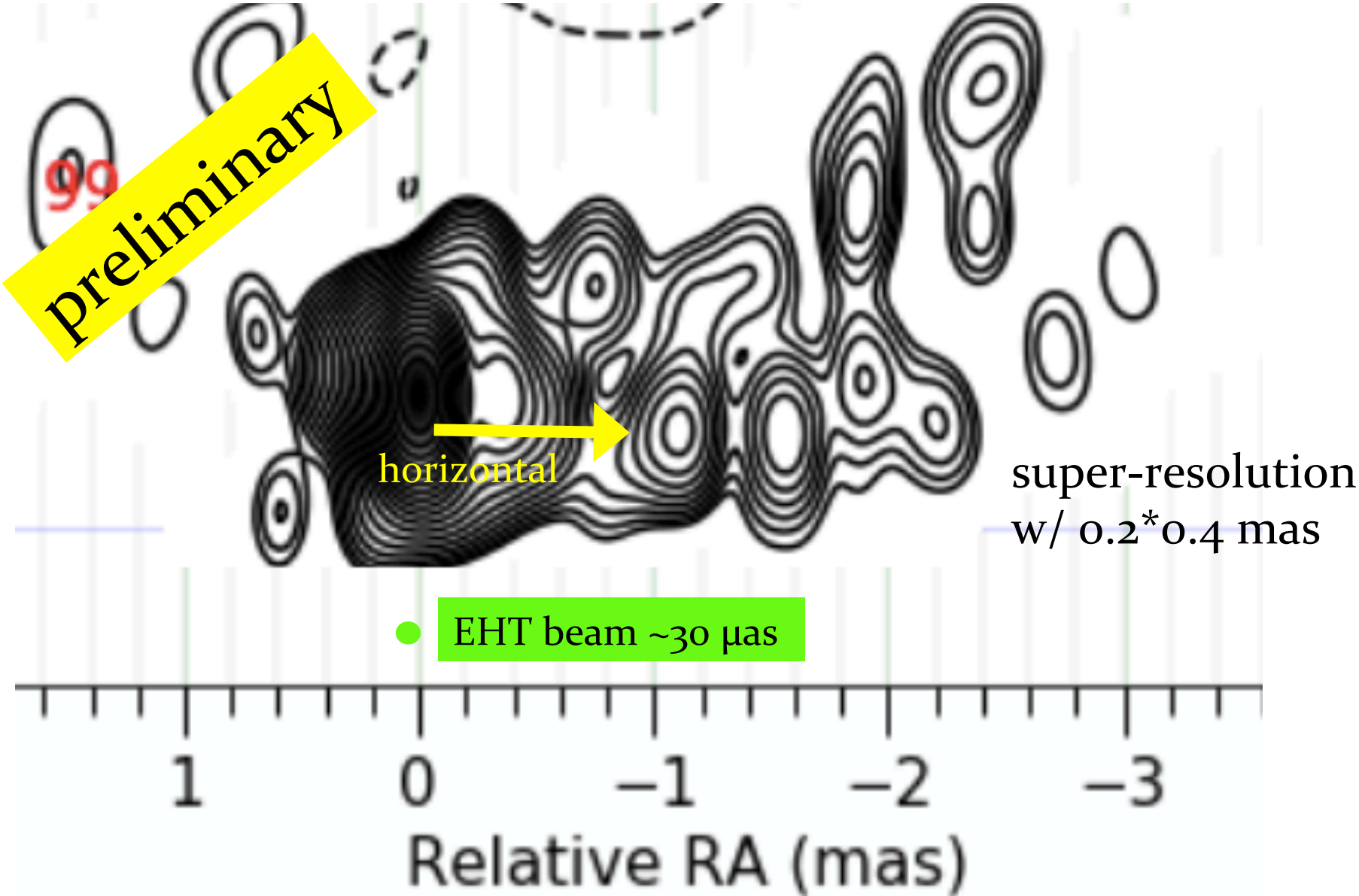
Event Horizon Telescope

Multi-Wavelength Coverage: M87 in April 2017



Cui, Hada+ *in prep*

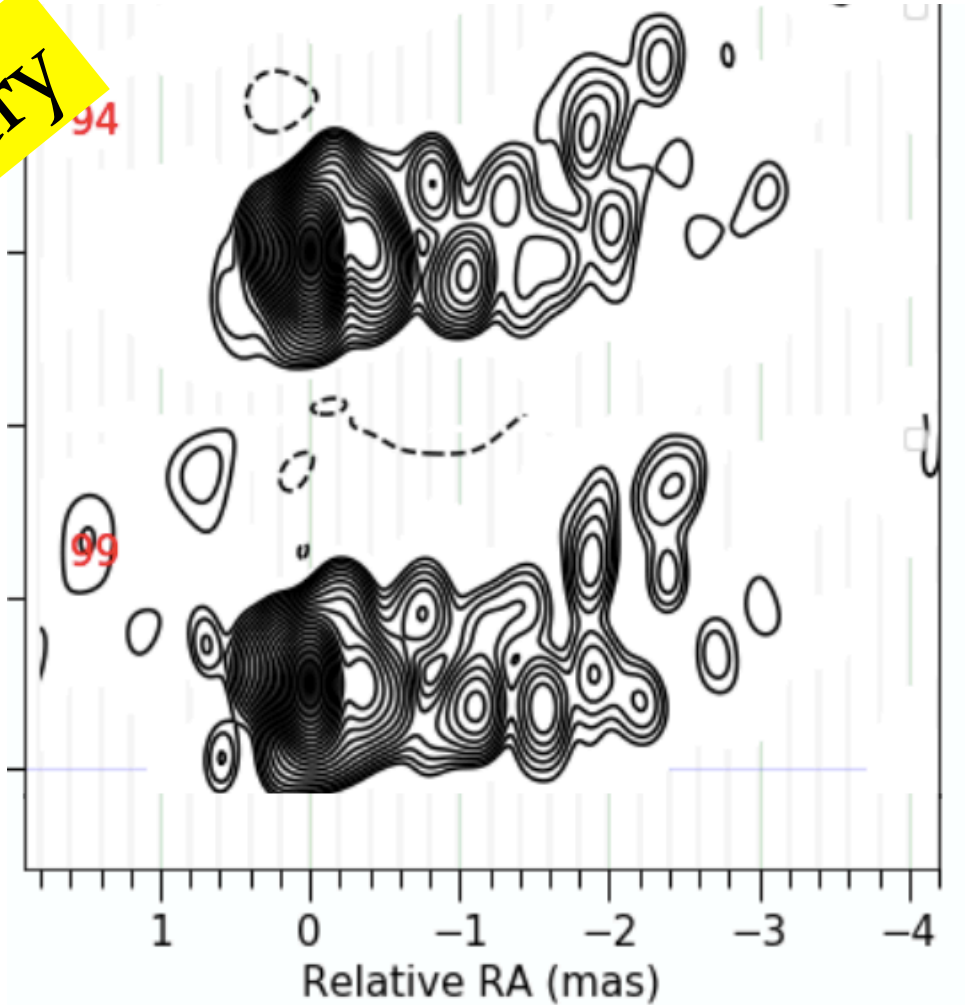
Closer look at April 9th 2017



Cui, Hada+ *in prep*

Shortest interval (Apr 5th and 9th 2017)

preliminary



Don’t miss the next talk by Y. Cui san!

VERA UM 2018

Persuade of non-Gaussianity in Sgr A*

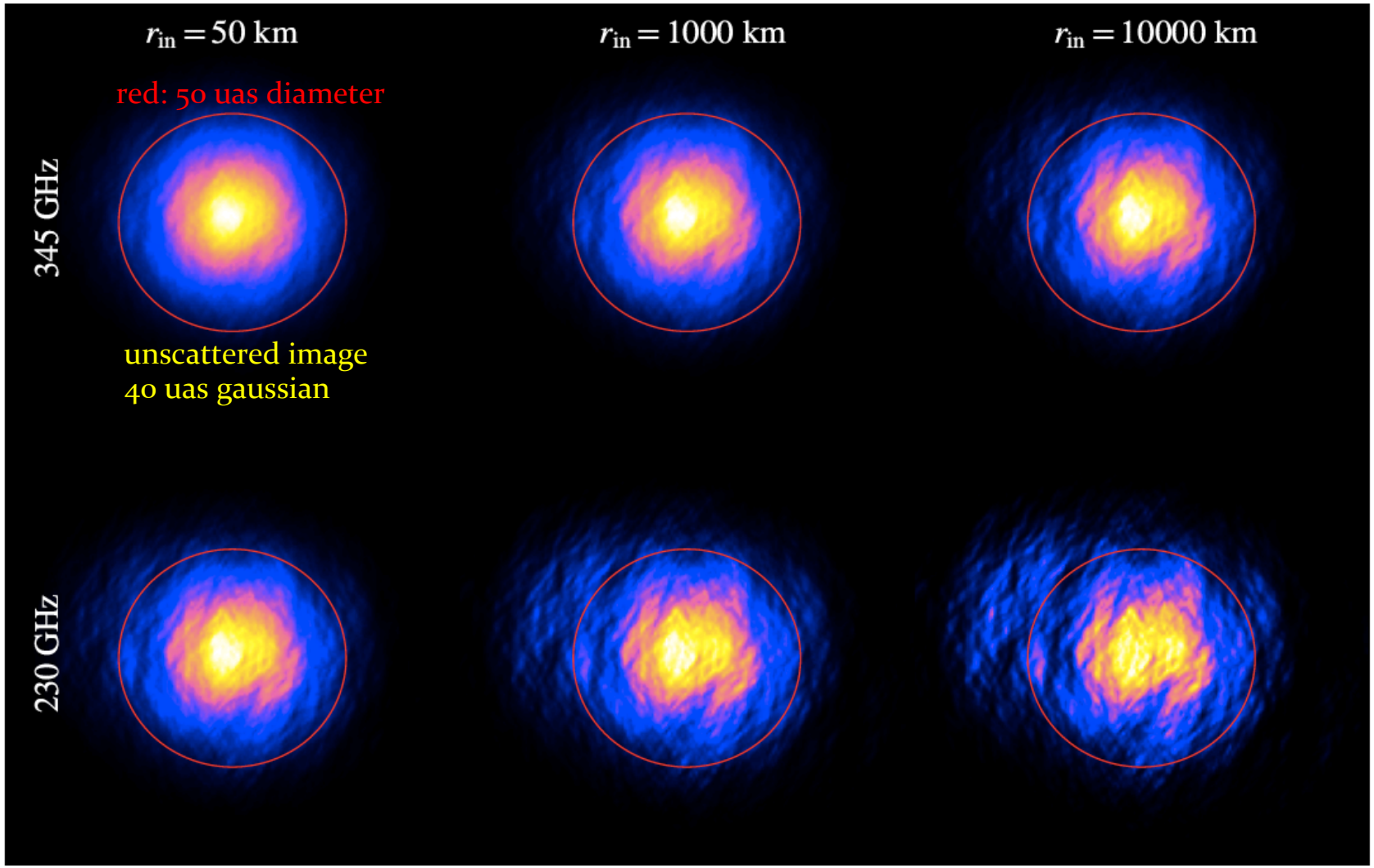
Sgr A*(1 mas = 100 Rs) is the unique source for this study.

Long standing problem:

"Observed radio images of Sgr A* is dominated by interstellar scattering. So, an inference of Sgr A* image is sensitive to an assumed scattering model."

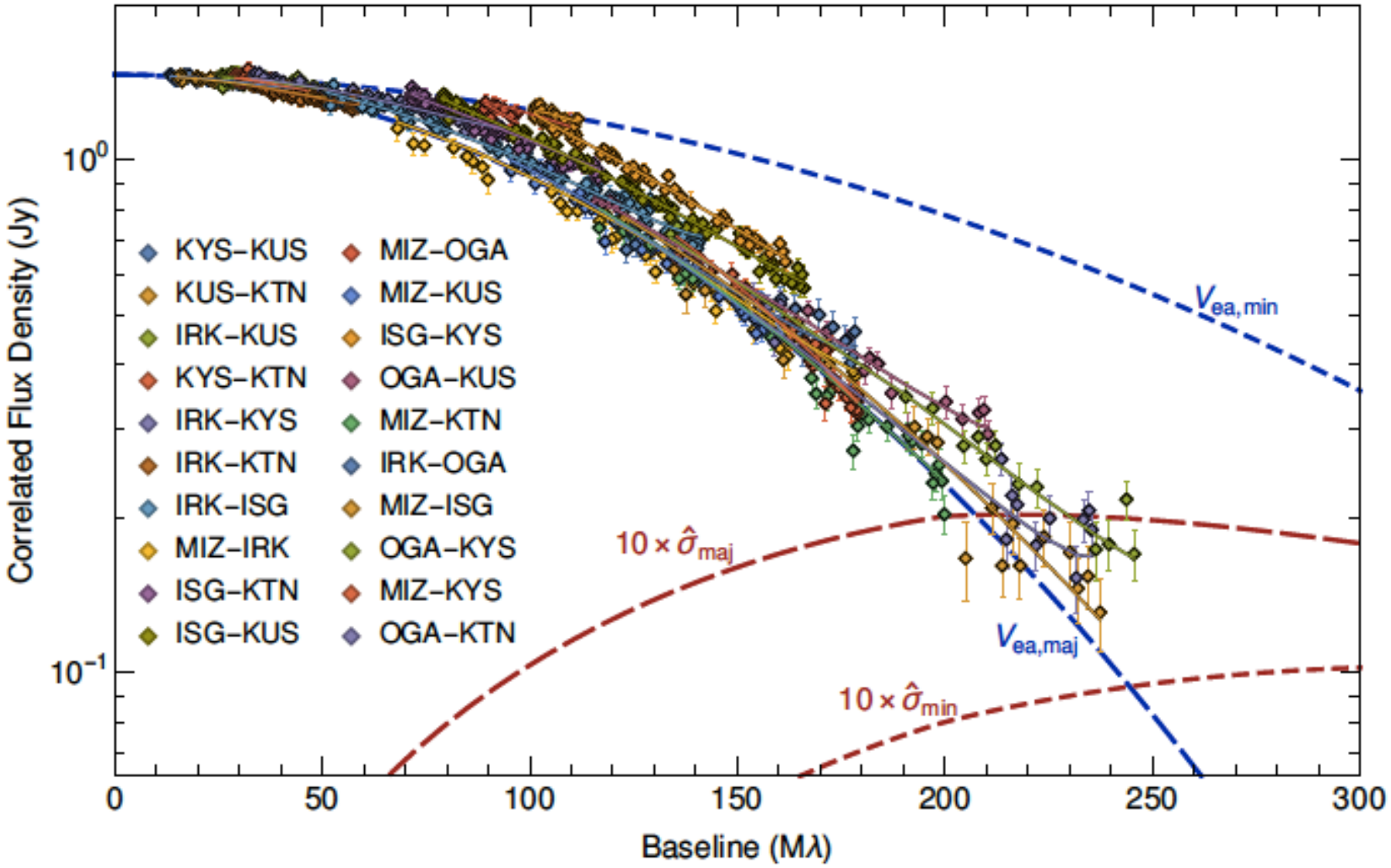
Psaltis, Johnson+ 2018

Progress:
a physically motivated model of interstellar scattering



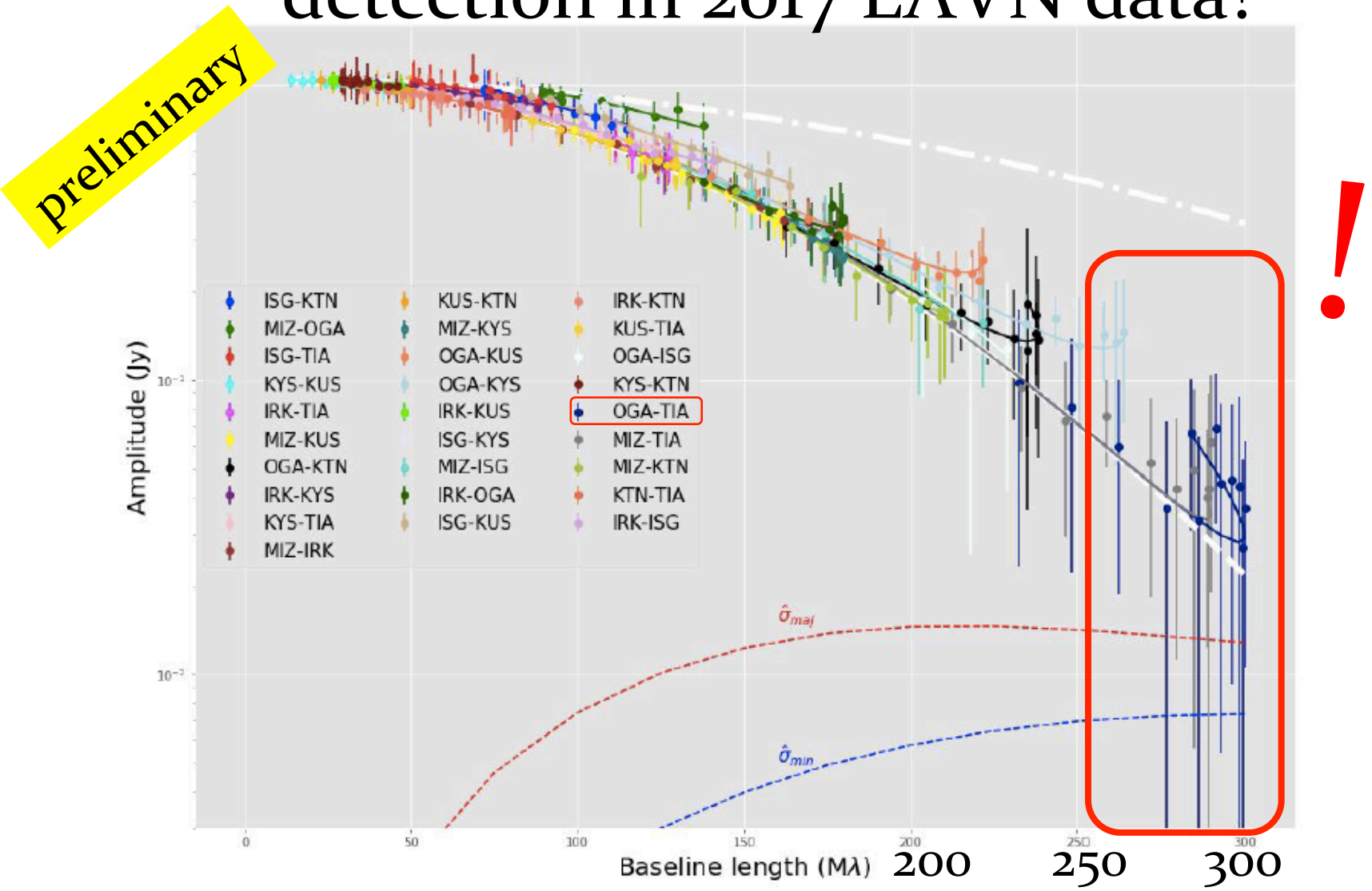
Johnson+ 2018

KaVA 7mm data (2014 Nov) significantly contributes to constrain scattering kernel.



Zhao+ *in prep*

Longest baseline (OGA-TIA 300Mλ) detection in 2017 EAVN data!



VERA UM 2018

Further upgrade of EAVN

EAVN-high @ 3.5 mm

EAVN white paper

White Paper on East Asian Vision for mm/submm VLBI:

Toward Black Hole Astrophysics down to Angular Resolution of 1 R_S

Editors

Asada, K.[1], Kino, M.[2,3], Honma, M.[3], Hirota, T.[3], Lu, R.-S.[4,5], Inoue, M.[1], Sohn, B.-W.[2,6], Shen, Z.-Q.[4], and Ho, P. T. P.[1,7]

Authors

Akiyama, K.[3,8], Algaba, J-C.[2], An, T.[4], Bower, G.[1], Byun, D-Y.[2], Dodson, R.[9], Doi, A.[10], Edwards, P.G.[11], Fujisawa, K.[12], Gu, M-F.[4], Hada, K.[3], Hagiwara, Y.[13], Jaroenjittichai, P.[15], Jung, T.[2,6], Kawashima, T.[3], Koyama, S.[1,5], Lee, S-S.[2], Matsushita, S.[1], Nagai, H.[3], Nakamura, M.[1], Niinuma, K.[12], Phillips, C.[11], Park, J-H.[15], Pu, H-Y.[1], Ro, H-W.[2,6], Stevens, J.[11], Trippe, S.[15], Wajima, K.[2], Zhao, G-Y.[2]

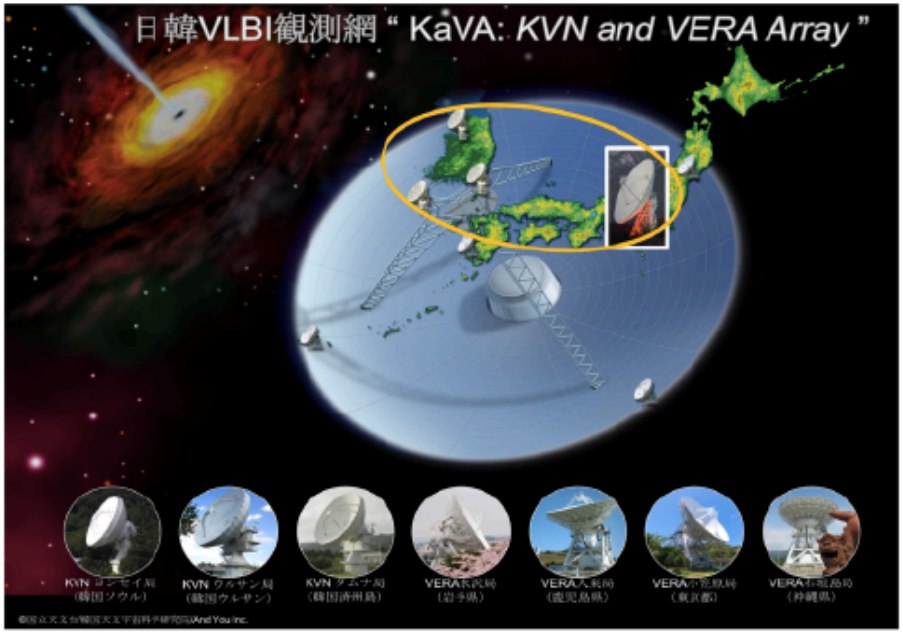
arXiv:1705.04776v1 [astro-ph.HE] 13 May 2017

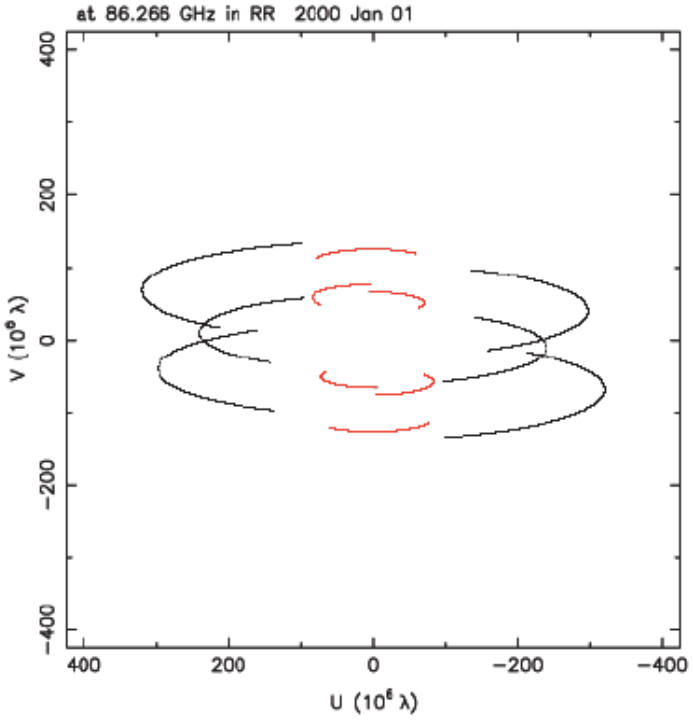
What’s next?

86GHz!

Which array?

KVN + NRO45@86 GHz



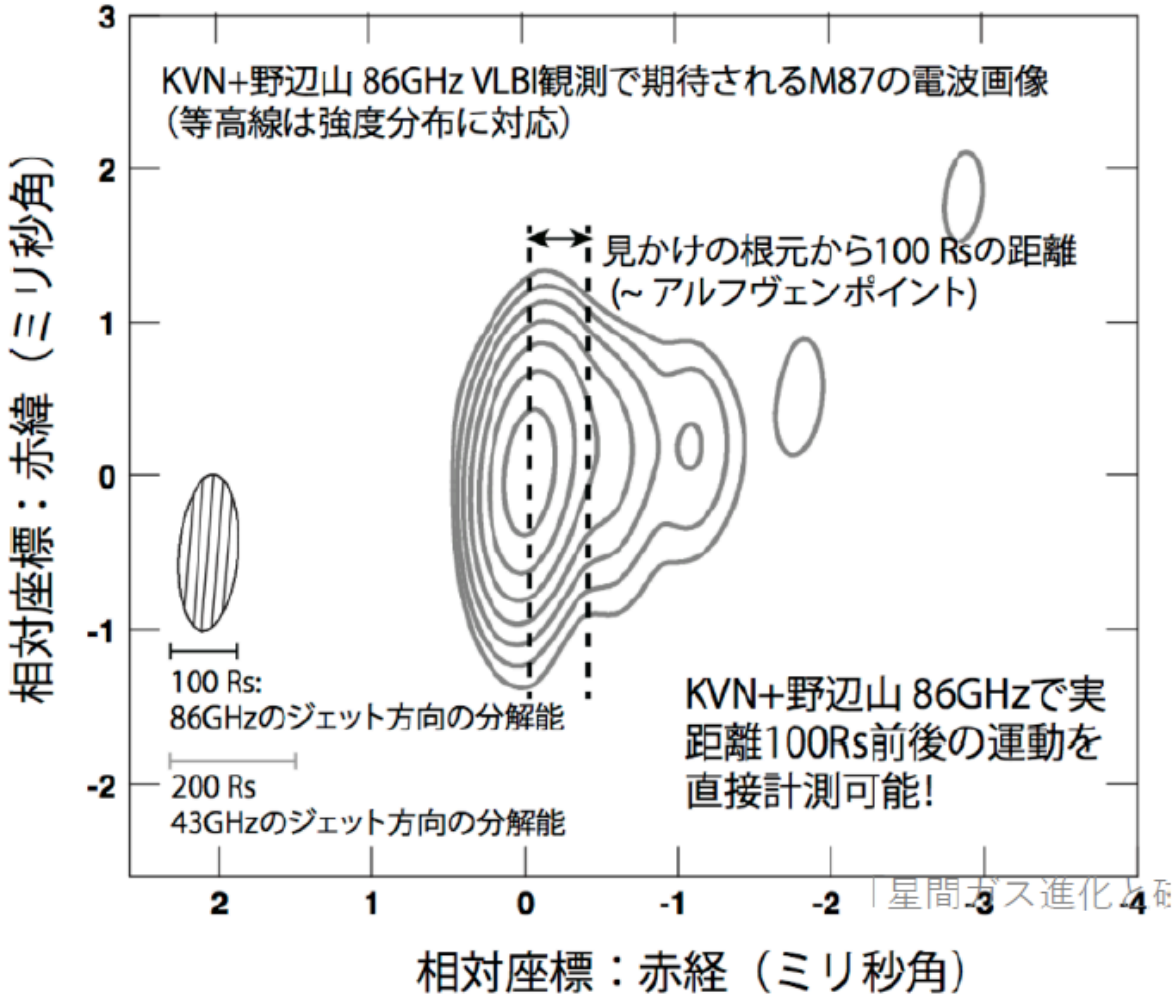


M87ジェットに沿って、基線長が３倍に！

Why KVN+NRO45? Cadence!

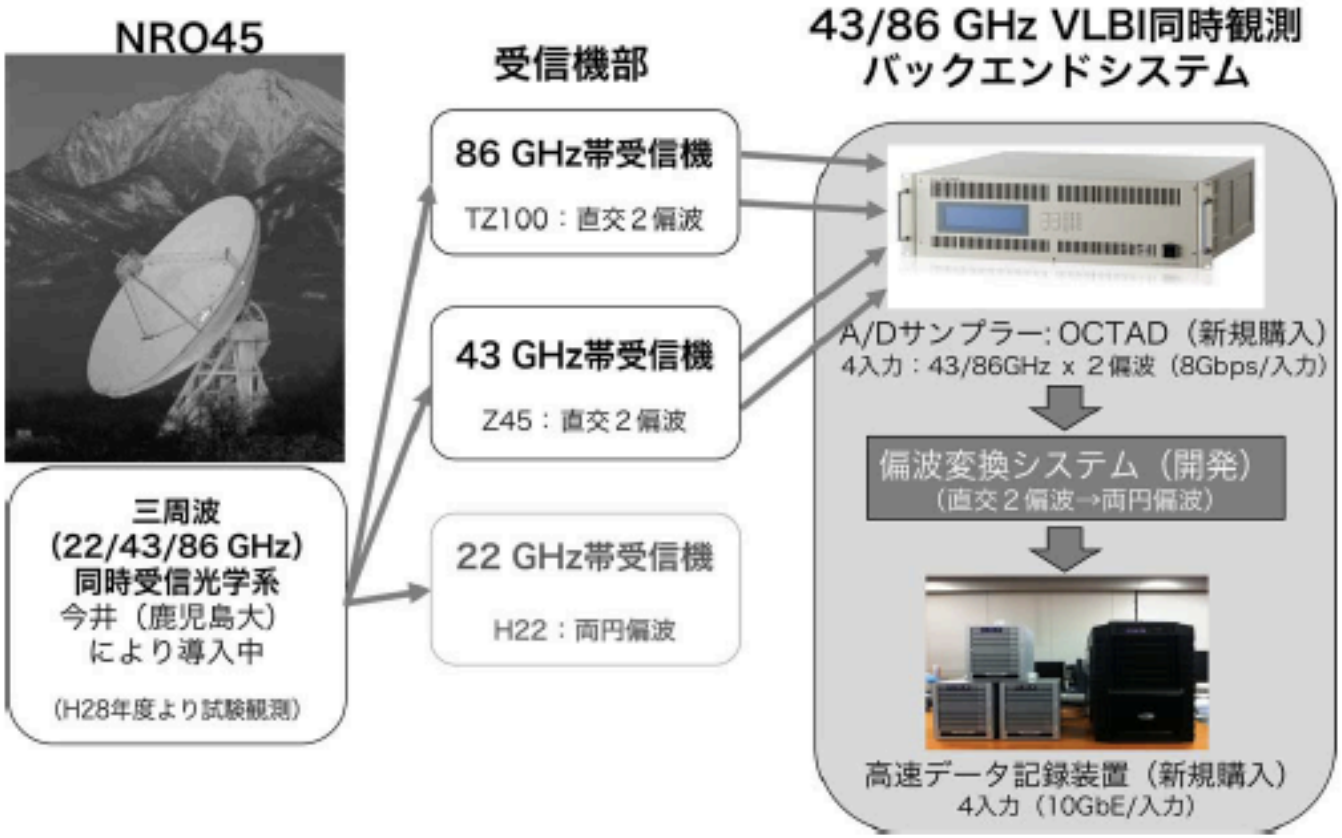
世界のミリ波 VLBIアレイ (> 86GHz)	空間分解能 (1)	撮像感度 (2)	モニター頻度 (3)
Event Horizon Telescope (230GHz)	◎ ~6Rs	×	× (年数回のみ)
Global mm-VLBI Array (86GHz)	◎ ~14Rs	◎ >10σ	× (年数回のみ)
KVN+NRO45 (86GHz：本研究)	◎ **88Rs**	◎ **~10σ**	◎ **(2週間に1回)**

VLBA+GBT 86 GHz image (Hada+16) restored w/ KVN-NRO45 beam



JSPS Grant-in-Aid for Scientific Research (A) Projects

Upgrade of NRO45m: VLBI backend system (PI: Niinuma-san) & Quasi-Optics (PI Imai-san)



Don’t miss the relevant talk by Okada-san!

JSPS Grant-in-Aid for Scientific Research (A) Projects

研究統括：新沼（代表）

日韓短ミリ波VLBI観測網構築

図１- 項目①

Ⅰ：広帯域記録システム整備
新沼(代表)、河野*、藤澤

Ⅱ：偏波変換システム開発
新沼(代表) 、科研費研究員

Ⅲ： VLBI性能評価
新沼(代表) 、科研費研究員、秦*、小林、今井、小川、Jung(協力)

図１- 項目②

観測運用調整/運用ソフト改修
秦*、本間、南谷、Byun(協力) 、Roh(協力)

高頻度モニター観測実施

観測と数値実験の密な連携体制構築

図１- 項目③

Ⅰ：科学観測実施
新沼(代表) 、秦*、紀*

Ⅱ：データ解析・考察
新沼(代表) 、秦*、萩原、Zhao(協力)

図１- 項目④

M87低周波モニター
紀*、Zhao(協力)

相補的観測
観測連携

図１- 項目⑤

Ⅰ：数値実験コード最適化
Ⅱ：数値実験の実施
紀*、川島、高橋

Ⅲ：数値実験結果と観測結果の比較
新沼(代表) 、秦*、紀*

*は分担者、無印は連携研究者、
(協力)は研究協力者を表す

ご支援のほどどうぞよろしくお願い申し上げます

Summary of EAVN AGN SWG activities

- Wrapping up papers w/ 1st phase KaVA LP data 2016-2017
  - ✓both EAVN performance-evaluation of and KaVA LP science
- Development/Upgrade of EAVN
  - ✓https://radio.kasi.re.kr/eavn/main_eavn.php
  - ✓EAVN-high, NRO45

Timeline for W-band VLBI at NRO