Promoting EAVN: current status

Mizusawa VLBI Observatory

Kazuhiro Hada

Tamna 21 m
Miyun 50 m
KASI/KJJVC
Sejong 22 m
Yonsei 21 m
Ulsan 21 m
Gifu 11 m
Usuda 64 m
Mizusawa 20 m
Nanshan 26 m
Takahagi 32 m
Tianma 65 m
Hitachi 32 m
Sheshan 25 m
SHAO/DiFX
Kunming 40 m
Yamaguchi 32 m
Ishigakijima 20 m
Kashima 34 m
Iriki 20 m
Tsukuba 32 m
Ogasawara 20 m

The East-Asian VLBI Network

(Image Credit: Reto Stöckli, NASA Earth Observatory)

6.7 GHz
8 GHz
22 GHz
43 GHz
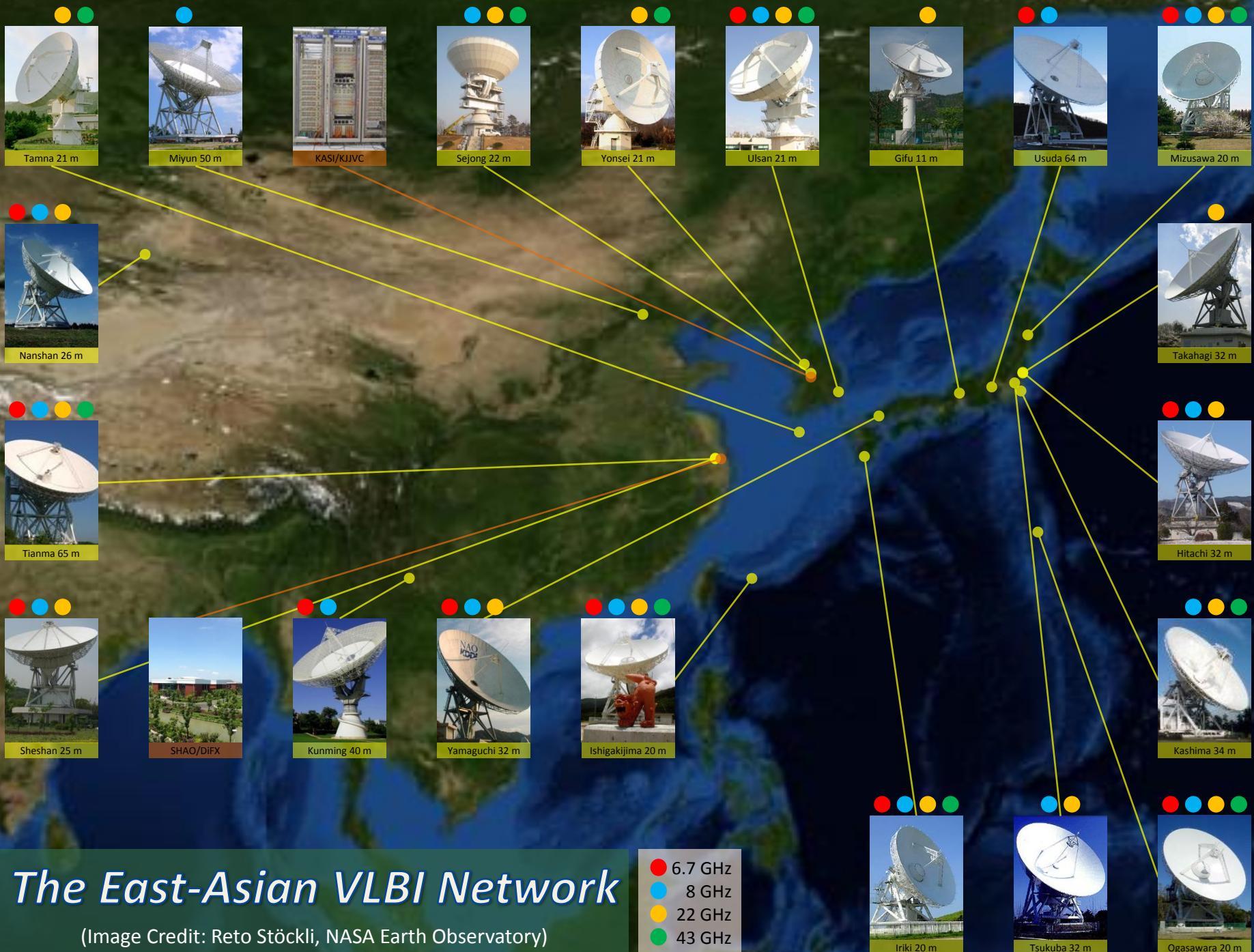
Tiger Team 2016

- Promote EAVN commissioning
  - test observations, scheduling, array performance evaluation, technical/engineering etc. towards the realization of open-use
- China (8)
  - SHAO (Shanghai): Wu Jiang, Bo Xia, Tao An, Willem A. Baan, Noriyuki Kawaguchi
  - XAO (Urumqi): Ming Zhang
  - YAO (Kunming): Longfei Hao, Min Wang
- Korea (5)
  - KASI: Taehyun Jung, Jongsoo Kim, Se-jin Oh, Duk-Gyoo Roh, Kiyoaki Wajima (Chair)
- Japan (5)
  - NAOJ: Hideyuki Kobayashi, Yuanwei Wu, Kazuihro Hada
  - Toyo U: Yoshiaki Hagiwara
  - Yamaguchi U: Kenta Fujisawa
- Regular Skype meeting (active participants)

Timeline (as of 2016/Mar, Wajima-san's slide)

Year	2014	2015	2016	2017	2018
Actions	・5-time fringe tests done ・FTP data transfer test	・Further fringe tests ・Imaging tests, performance evaluation	・Imaging tests ・Science commissioning observations at 8/22 GHz ・Fringe tests at 6.7/43 GHz	・(Late 2017) Risk-shared open-use at 8/22 GHz ・Performance evaluation and science commissioning at 6.7/43 GHz	・(Late 2017) Risk-shared open-use at 6.7/8/22/43 GHz ・Performance evaluation for extending observation modes (2-pol., wide-band, etc.)
Freq.	8/22 GHz	8/22 GHz	6.7/8/22/43 GHz	6.7/8/22/43 GHz	6.7/8/22/43 GHz
Purposes	・Fringe detection from some telescopes in EAVN	・Evaluation of array performance and imaging capability	・Evaluation of array performance and array operation commissioning ・Performance evaluation at 6.7/43 GHz	・Initial scientific outputs from EAVN ・Confirmation of performance at 6.7/43 GHz	・Regular operation of EAVN ・Conformation of performance for various observation modes

Goals of EAVN commissioning FY2016

(black: as of 2016/Mar, red: later redefinition)

- Promote test observations at 6.7(/8)/22/43GHz
- Obtain ~~1Gbps~~2Gbps fringes at 6.7/8/22/43GHz
- Obtain 1Gbps images at 6.7/8/22/43GHz
- Obtain 2Gbps images at 6.7/22/43GHz(best effort)
- EAVN status table
- Evaluate amplitude calibration performance via multiple methods (a-priori, maser template)
- Fix key/vex templates at each station
- Perform a joint observation with LBA?

Test observations in 2016

- **(2015/Dec/13: 1st imaging test)**
  - **X-band**, 1Gbps (16MHz x 16ch), RHCP, 4C39.25
  - VERA3, Ulsan, Yamaguchi, Hitachi, Tsukuba, Tianma, Kunming
- **2016/Mar/20: 2nd imaging test** **(A)**
  - **Q-band**, 1Gbps (32MHz x 8ch), M87
  - KaVA, Tianma, ATCA
- **2016/Mar/21: 3rd imaging test**
  - **K band**, 1Gbps (32MHz x 8ch), M87
  - KaVA, Takahagi
- **2016/Sep/13: 1st fringe test at 2Gbps** **(B)**
  - **Q-band**, 2Gbps, 3C345
  - KaVA, Tianma
- **2016/Sep/26: 4th imaging test** **(C)**
  - **K-band**, 1Gbps (32MHz x 8ch), LHCP, M87/RT-Vir etc.
 - KaVA7, Takahagi, Urumqi
- **2016/Sep/26: 5th imaging test**
  - **Q-band**, 1Gbps (32MHz x 8ch), LHCP, BLLac/R-Cas etc.
  - KaVA6 (no ISG), Tianma

# (A) First (0th?) EAVN image?

KaVA
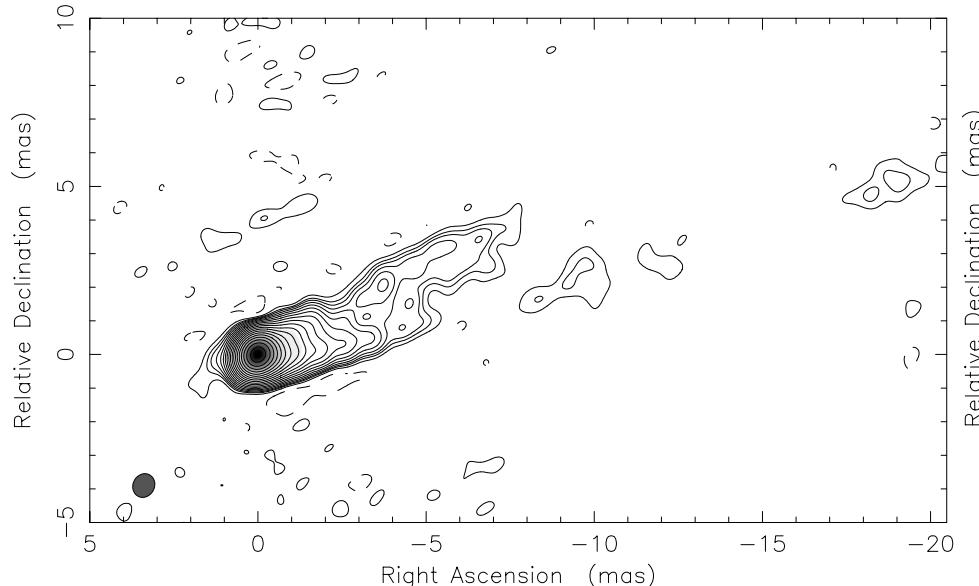
Map center: RA: 12 30 49.423, Dec: +12 23 28.044 (2000.0)
Map peak: 0.777 Jy/beam
Contours: 0.000834 Jy/beam x (−1 1 2 2.83 4 5.66
Contours: 8 11.3 16 22.7 32 45.3 64 90.5 128 181
Contours: 256 362 512 724)
Beam FWHM: 0.723 x 0.638 (mas) at −28.6°
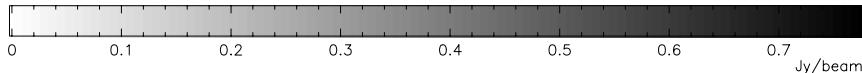
KaVA+Tianma
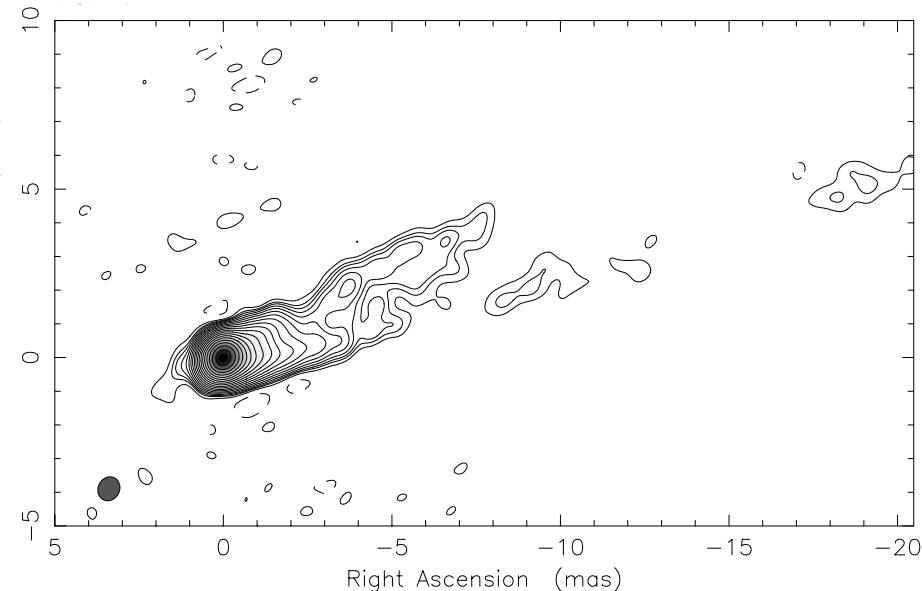
Map center: RA: 12 30 49.423, Dec: +12 23 28.044 (2000.0)
Map peak: 0.779 Jy/beam
Contours: 0.000834 Jy/beam x (−1 1 2 2.83 4 5.66
Contours: 8 11.3 16 22.7 32 45.3 64 90.5 128 181
Contours: 256 362 512 724)
Beam FWHM: 0.727 x 0.636 (mas) at −26.9°
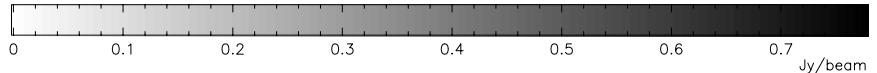
- 2016/Mar/20 UT 11:00-19:40
- Issues at Tianma
  – Not cooled Q-band receiver
  – Tsys measurement failure
 – IF-dependent artificial offset in amplitude

Image performance on M87

| UV weighting	M87	KaVA	KaVA+Tianma
Natural weight	Beam size (mas x mas, PA)	0.72 x 0.64, -29	0.73 x 0.64, -27
	Peak intensity (mJy/b)	777	779
	Near-core rms (mJy/b)	0.33	0.28
	Off-center rms (mJy/b)	0.24	0.22
	Dynamic range (peak/off-center rms)	3238	3540
	Theoretical thermal (mJy/b)	0.20	0.20
Uniform weight	Beam size	0.61 x 0.56, -46	0.61 x 0.55, -34
	Peak intensity (mJy/b)	747	749
	Near-core rms (mJy/b)	0.64	0.63
	Off-center rms (mJy/b)	0.55	0.57
	Dynamic range (peak/off-center rms)	1358	1314
	Theoretical thermal (mJy/b)	0.61	0.65

(B) 1st EAVN fringe test at 2Gbps

- 2016/Sep/13
- Q-band, 3C345
- KVN, Tianma, (VERA)
- Quick correlation with DiFX Shanghai
- Fringes detected!
  – SNR~50@KVN-KVN
  – SNR~175@KVN-Tm
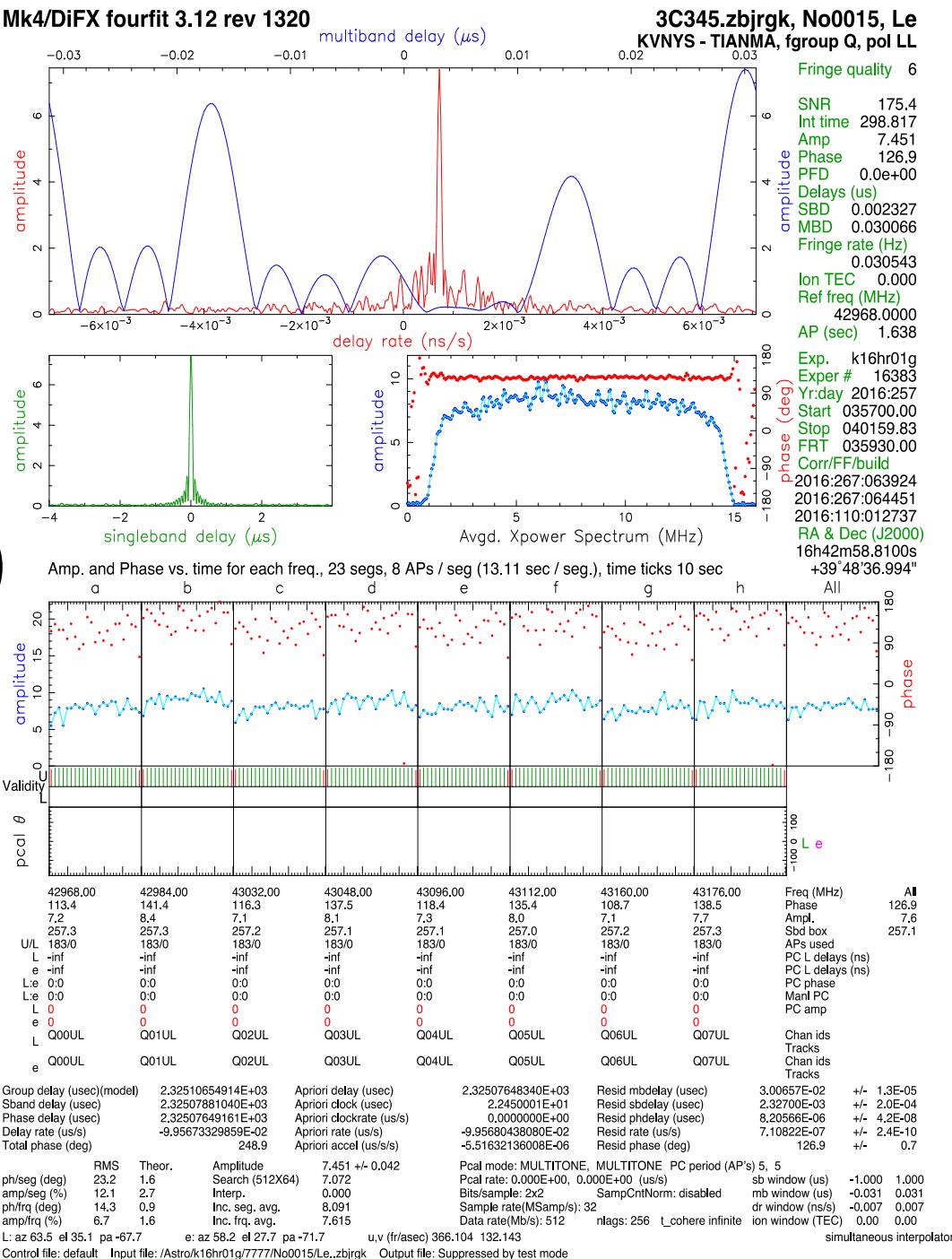
(c) 1st EAVN imaging run with Urumqi

UV Coverage for a16270aU

KVNYS
KVNUS
KVNTN
VERAISGK
VERAMZSW
VERAOGSW
VERAIRIK
URUNQI

M87

V (Km)

U (Km)
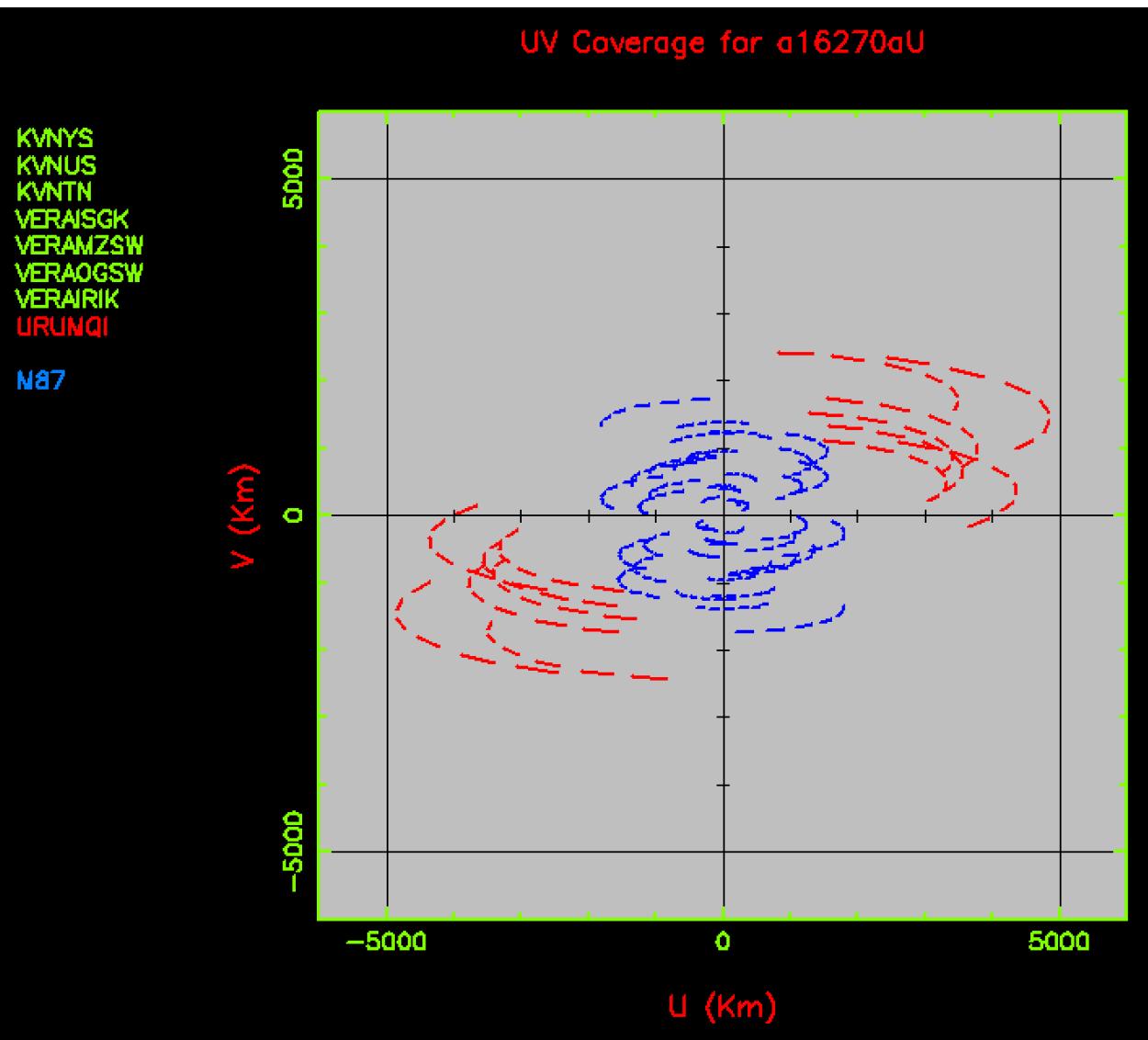
- 2016/Sep/26 UT 1:00-7:00
- K band
- KaVA, Takahagi, Urumqi
- M87, 3C273
- 2300km => 5500km

Goals of EAVN commissioning FY2016

- Promote test observations at 6.7(/8)/22/43GHz
- Obtain 2Gbps fringes at 6.7/8/22/43GHz
- Obtain 1Gbps images at 6.7/8/22/43GHz
- Obtain 2Gbps images at 6.7/22/43GHz(best effort)
- EAVN status table
- Evaluate amplitude calibration performance via multiple methods (a-priori, maser template)
- Fix key/vex templates at each station
- Perform a joint observation with LBA?

In the next 1-2years

- Array capability: continuing expansion
  - wideband (>2Gbps), dual pol, phase-ref, more stations (EA, LBA, EU)
  - low frequencies? (<2GHz)
- Towards open-use / regular operation
  - 2Gbps by default
  - Allocate "EAVN session" blocks?
  - "Extended KaVA"-like operation at K/Q
  - what about C-band operation?
- Website, status table, EAVN calculator, simplify schedule file preparation

To accelerate EAVN activities…

- Active contribution from China is critical
- "Fascinate" the Chinese community at Guiyang EAVN Workshop
- From KaVA SWG to EAVN SWG
  - Invite Chinese collaborators to each KaVA SWG
- More f2f communication with Non-Shanghai people
- Unique science cases

Summary

- Accelerating EAVN commissioning
- 1st EAVN images coming out
- FY2016: obtain 1(2)Gbps images at C/X/K/Q
- Late FY2017: common use open
- More interaction with Chinese collaborators

EAVNをこれから本当に盛り上げていくためには
（やる気を維持するためには）

- 夢と希望を与えてくれる望遠鏡でなければならない

- EAVNが本気を出したときにどんな夢が見られるか
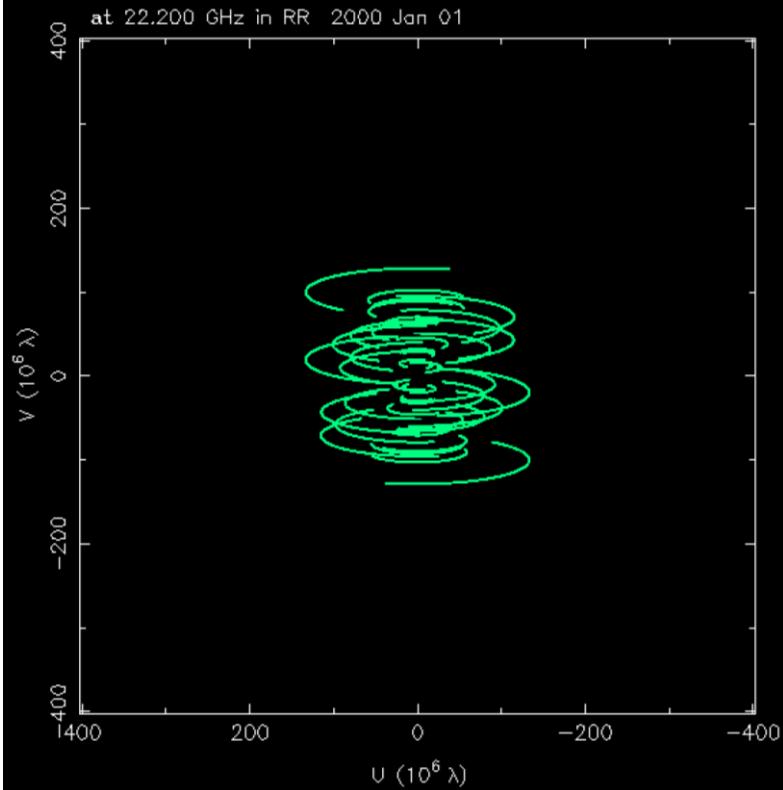
M87 simulation
22GHz 1Gbps
KaVA
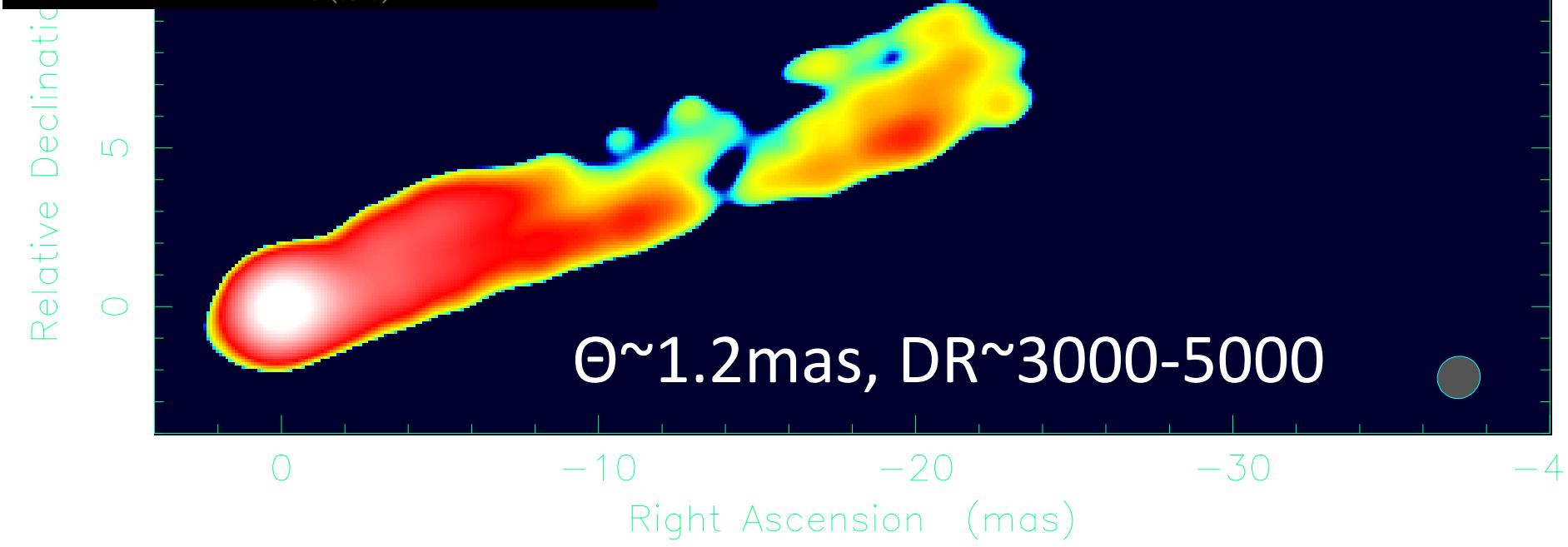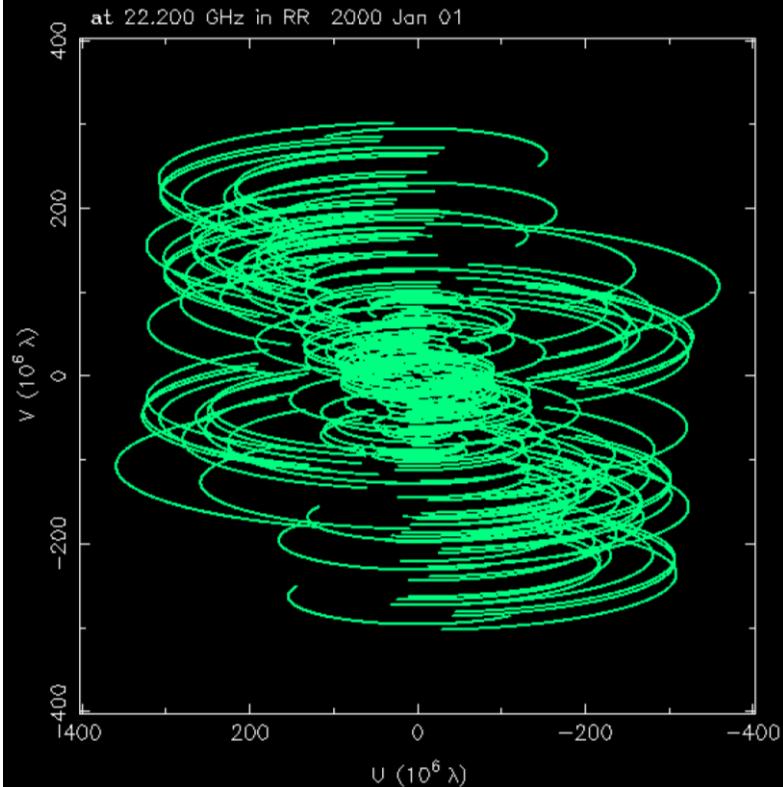
Θ~1.2mas, DR~3000-5000

M87 simulation
22GHz 1Gbps
KaVA+Sj+Tia+Ur+Tk+Ks+Gf
+TVN

Θ~0.5mas, DR~15000-20000

M87 simulation
22GHz 1Gbps
KaVA+Sj+Tia+Ur+Tk+Ks+Gf+TVN+LBA+IVN

Θ~0.16mas, DR~15000-28000
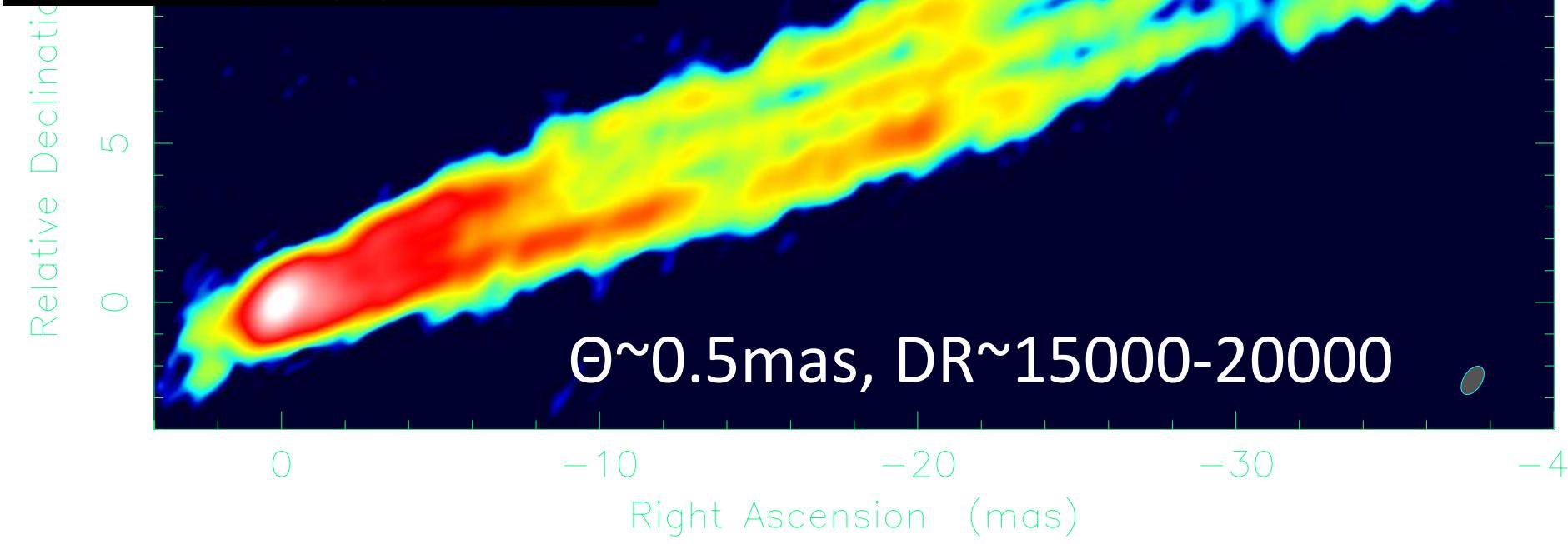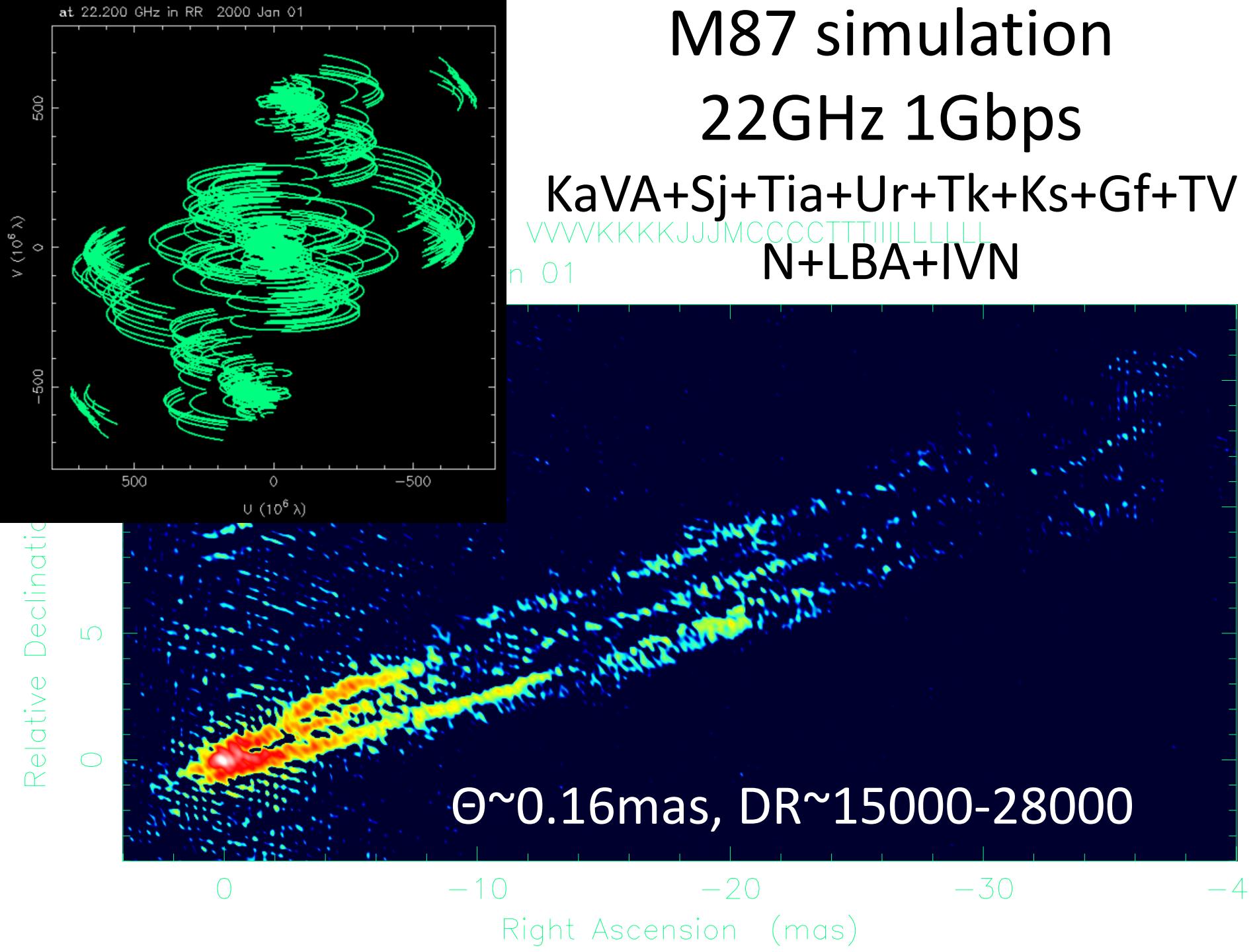
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- 今年12月号を予定
- 原稿期限内提出にご協力おねがいします
- 最終締め切り　10/14(金)