M2O Newsletter, No. 20

Website: Updated with the latest publications, members list and a link to the MaserDB, take a look here.

Maser flares: G33.641 has become active again (Y. Yonekura, see SamePage). Its short flare duration makes it a tricky target, however we have ample observing resources. Considering this, I would like to encourage discussion on SamePage about the best way to conduct follow-up observations of this maser in order to image the active flaring feature.

Collaboration: The terms of an M2O-JCMT Transients collaboration are being clarified (See Reports).

Cumulative M2O source list: Source lists haven now been provided by 7 single-dish observatories, enabling cross-check with eachother, with the MaserDB and with other projects (see Reports).

EAVN workshop in March: 2-5th March. I will be presenting a poster on the general M2O operations and a presentation on the G358 VLBI full data set. Documents will go up on SamePage.

SamePage: The app seems to have undergone an aesthetic refurbishment. No issues otherwise.

---

1 Activity since the previous Telecom

- **SamePage:** +1 (Cristina Garcia-Miro (SKA?), total 73 members.
- **Papers accepted:** +0; Total: 16
- **Papers in revision:**
- **Updates on papers in prep:**
  - Bayandina et al., VLA masers in G358, first draft ready
  - Burns et al., 6.7 GHz VLBI movie in G358. Drafting and further analyses (see Telecom18 Report)
  - Burns et al., VLBI maps of rare maser lines in G358. (See Telecom15 Report)
  - Orosz et al., 7.6 and 7.8 GHz methanol masers in G358, aiming for ApJL
  - Hirota et al., G24.33+0.14 ALMA follow-up; pre- and post- maser flare phases. (see Reports)
  - Olech et al., VLBI images of G24.33 during its maser flare.
  - Gray et al., Two additions to the maser flare series: compression and skyplane overlap scenarios.

- **M2O targets:**

Name	Maser [GHz]	Pre-burst Flux [Jy]	Max Flux [Jy]	Current Flux [Jy]	Reported by	Reobserved by	Status
G359.617-0.251	6.7	120	200	100	Yonekura	Ib, Hh,	stable
Orion S6	6.7	3.1	9	2	Yonekura	Ib, Tr, Sz, Hh	variable
G85.411+0.002	6.7	12	95	95	Yonekura	Ib, Ef, Sz, Tr, Hh, Ky, Vs	decreasing
G33.641-0.228	6.7	-	236	43	Bringfried	Hh, Ib, Vs	eruptive
IRAS 16293-2422	22	-	30k	-	Sunada, Mc	Vr, Mc, Hh, Sz, Ib	-
NGC2071	22	1k	7k	920	Sunada, Hh	Vr, Hh, Sz, Ib	post-burst
G53.22-0.08	22	3	800	30	Sunada	Vr, Hh, Ib	post-burst
G358.93-0.03	6.7	5	1000	20	Yonekura	Hh, Ib	decreasing
G24.33+0.14	6.7	-	800	7	Torun	Hh, Ib, Vs	post-burst
G25.65+1.05	22	-	60k	2150	Volvach	Hh, Sz	post-burst
G034.196-0.592	22	-	120	120	Ladeyschikov	Sz, Oa, Hh	?
G35.200.74	22	600	4k	4k	Volvach	Sz, Hh, Ib	?

(Ib = Ibaraki) (Tr = Torun) (Sz = Simeiz) (Hh = HartRAO) (Ef = Effelsberg) (Ky = KVN Yonsei) (Vs = Ventspil) (Vr = VERA stations) (Mc = Medicina) (Ps = Puschino) (Oa = OAO-WFC)

- **New observing proposals:**
  EVN Post-burst follow-up imaging (Burns; submitted)
  VLBA Triggerable ToO (Burns; submitted)
- **Active trigger proposals:**

Array	Code	Grade	Hours granted target x epoch x hour	Hours remaining	Active period	Resubmit deadline
EVN	EB083	1.2 / 5.0 (0 is best)	(3x2x8)x2 bands = 96	96	15/SEP/20 - 15/SEP/21	1/JUN/21
KaVA	EAVN21A-213	7.6 / 10.0 (10 is best)	2 x 1 x 8 = 16	16	01/FEB/21 - 01/SEP/21	1/JUN/21
EAVN	EAVN21A-214	8.3 / 10.0 (10 is best)	1 x 2 x 8 = 16	16	01/FEB/21 - 01/SEP/21	1/JUN/21
LBA	V581	4.1 / 5.0 (5 is best)	96	88	01/OCT/20 - 01/OCT/21	16/JUN/21
VLBA	BB418	1.82 / 10.0 (0 is best)	48	48	01/AUG/20 - 01/AUG/21	01/FEB/21
Subaru	S20B0051N	accepted	0.5*2 or 1 night	0.5*2 or 1 night	01/AUG/20 - 01/JAN/21	-

- **Follow-up observations conducted this month (see Record Keeping):**
  KaVA K band, and KVN KQWD of G034.196-0.592 3rd epoch, with G35.200.74 2nd epoch piggy-back, both are 22 GHz maser flare sources [obs: 18FEB21, code a21d1b].

2 Reports

Short reports on specific activities, please send me an email (ross.burns@nao.ac.jp) in advance if you have something to report in an upcoming telecom.

JCMT Transient program collaboration (R. Burns)

In recent discussions with the JCMT Transients team we have reached agreements on what would be the terms of an M2O-JCMT collaboration. Generally, as discussed in Telecom19, the idea of providing burst alerts to eachother is seen as beneficial to both teams. Regarding this, we have began joint-drafting a policy document on protecting the interestes of both sides. I began by sending a copy of the policy that we have co-written for the M2O, which was seen as perfectly agreeable on their side, and the same courtesies (crediting flare event finders with co-authorship of subsequent related proposals/publications) should be extended to the JCMT team in cases where they alert us to new flare events. They ask that their main data reduction pipeline developer, Steve Mairs, be included in such cases, along with their selection of JCMT members. As mentioned, we are now co-drafting a document outlining the conditions of this collaboration which will need to be approved by their project coordinators. On our side I will be sure to provide M2O members with ample chance to see, discuss and comment on the document once it is drafted. This will be sometime in March.

In the meantime, cross-checking the JCMT transient survey regions with the MaserDB and the full M2O monitoring source list (see below) is progressing along and I will present the outcome of those efforts in the next Telecom (No21, March 31st).

M2O Cumulative source list (R. Burns)

As we have attracted more and more attention in the past years, several projects have approached us wanting to know what is the extent of our monitoring coverage and new radio telescopes coming online are keen to know which maser targets would be good to monitor. Toward this effort I restarted yet again the efforts to establish the full M2O source list. This has been quite successful and most M2O monitoring stations have provided the coordinates of their monitoring campaigns. I am now crosschecking these lists to estimate the total number of unique sources being monitored. Basic estimates on the stats right now are that we cover about 800 unique maser sources across all frequency bands. However, this precedes a proper coordinate cross-check.

Chatting with Dmitry, this is about 10% of the known masers in the Galaxy. This is great news because it shows we have a lot of optimising to do. Furthermore, any new stations wanting to join the M2O will immediately be able to help raise us above 10% coverage. This will naturally move us into more science involving SiO, water and OH masers, and evolved stars, which I have been partially involved for several years. This will come in addition to our efforts in star forming regions.

Progress on the ALMA G24.33 paper (T. Hirota)

As for G24.33, most of the relatively minor comments were taken into account in the revised manuscript, but major comments were not yet considered. ALMA cycle3 and cycle 6 data for G24.33 are now being reanalyzed to correct phase center and resolution in order to measure flux ratios more accurately.

I'm planning to submit an ALMA Cycle 8 ToO proposal to study the next H2O maser burst which is expected within a few year. This will be a modified version of the Cycle 0 proposal to observe continuum emission and some submillimeter H2O maser lines.

VLBI Data reduction (R. Burns and N Shakhvorostova)

In February we began piloting a series of one-to-one zoom data reduction sessions starting with a lecture on the fundamental basics of each step in VLBI data reduction (what we calibrate, why we need to calibrate it, and how to check if the calibration was successfully completed). The aim is to get more VLBI 'data reducers' in the M2O in order to support eachother's science and accelerate publication of our growing data backlog. Please let me know if you or others are interested in joining such activities. If there is a demand I would be happy to regularise such sessions. We have VLBI data for all major arrays, each needing their own specific tasks and approaches, but all following the same general calibration scheme.

Next Newsletter / Telecom: 31st March 2021, 18:00 JST

Record keeping

3 M2O Publications

No.	Target	Facility	Author	Frequency (GHz)	Status	Ref	Journal
1	W49N	Sm, Tr	Volvach+	22.2	Published	(1)	MNRAS_L
2	W49N	Sm, Tr, Mc, Ef	Volvach+	22.2	Published	(2)	A&A
3	W49N	Sm, Tr, Mc, Ef, Kvazar	Volvach+	22.2	Published	(3)	Ast.Rep.
4	W49N	Sm	Volvach+	22.2	Published	(4)	MNRAS
5	G25	VLA	Bayandina+	6.7, 12.2, 22	Published	(5)	ApJ
6	G25	Sim/Hh/Tr	Volvach+	22	Published	(6)	MNRAS_L
7	G25	KVASAR	Volvach+	22	Published	(7)	Ast.Rep.
8	G25	EVN	Burns+	22	Published	(8)	MNRAS
9	G25		Aberfelds+	6.7	in prep		-
10	G25		Bayandina+	12.2, 23.1	in prep		-
11	G25		MacCleod+	6.7, 22	in prep		-
12	G358	ATCA	Breen+	mm	Published	(9)	ApJ
13	G358	ALMA-SMA	Brogan+	mm	Published	(10)	ApJL
14	G358	Hh	MacCleod+	New Methanol masers	Published	(11)	MNRAS
15	G358	LBA	Burns+	6.7	Published	(12)	Nat.Ast.
16	G358	Various VLBI	Burns+	6.7 movie	in prep		-
17	G358	Various VLBI	Burns+	Maps of rare masers	in prep		
18	G358	VLBA	Burns+	6.7 and 12.18	in prep		
19	G358	Asia-Pacific VLBI	Orosz+	7.6, 7.8	in prep.		ApJL
20	G358	VLA	Chen+	multiple lines methanol	Published	(13)	ApJL
21	G358	VLA	Chen+	New lines + Methanol	Published	(14)	Nat. Ast.
22	G358		MacCleod+	6.7 GHz monitoring	in prep		
23	G358		MacCleod+	6.2, 12.2, 20.3, 20.9	in prep		-
24	G358	VLA	Bayandina+	6.7, 12.2, 22.2	in prep		-
25	G358	SOFIA	Stecklum+	FIR	published	(15)	A&A
26	G358	Sm and Hh	Volvach+	19.9, 20.9	Published	(16)	MNRASL
27	G358	ATCA	Breen+	Rare transitions	in prep		-
28	G24.33	EVN, VLBA	Olech+	6.7, 12.2, 22.2	in prep		-
29	G24.33	Tr	Olech+	OH, Meth	in prep		-
30	G24.33	Hh	v. d. Heever+		in prep		-
31	G24.33	ALMA	Hirota+	Thermal and maser	in prep		-

References

[1] Volvach, L. N., Volvach, A. E., Larionov, M. G., MacLeod, G. C. & Wolak, P. Unusual flare activity in the extreme-velocity 81 kms1 water-maser feature in W49N. *Monthly Notices of the Royal Astronomical Society: Letters* **487**, L77–L80 (2019). URL https://doi.org/10.1093/mnrasl/slz088.

[2] Volvach, L. N. *et al.* Flaring water masers associated with W49N. A&A **628**, A89 (2019).

[3] Volvach, L. N. *et al.* An unusually powerful water-maser flare in the galactic source w49n. *Astronomy Reports* **63**, 652–665 (2019). URL https://doi.org/10.1134/S1063772919080067.

[4] Volvach, A. E., Volvach, L. N. & Larionov, M. G. Unusually powerful flare activity of the H_2O maser feature near a velocity of -60 km s^{-1} in W49N. MNRAS **496**, L147–L151 (2020).

[5] Bayandina, O. S., Burns, R. A., Kurtz, S. E., Shakhvorostova, N. N. & Val'tts, I. E. JVLA overview of the bursting H$_2$O maser source G25.65+1.05. *arXiv e-prints* arXiv:1812.11353 (2018).

[6] Volvach, L. N. *et al.* Powerful bursts of water masers towards G25.65+1.05. MNRAS **482**, L90–L92 (2019).

[7] Vol'vach, L. N. *et al.* A Giant Water Maser Flare in the Galactic Source IRAS 18316-0602. *Astronomy Reports* **63**, 49–65 (2019).

[8] Burns, R. A. *et al.* VLBI observations of the G25.65+1.05 water maser superburst. MNRAS **491**, 4069–4075 (2020).

[9] Breen, S. L. *et al.* Discovery of Six New Class II Methanol Maser Transitions, Including the Unambiguous Detection of Three Torsionally Excited Lines toward G 358.9310.030. ApJ **876**, L25 (2019).

[10] Brogan, C. L. *et al.* Sub-arcsecond (Sub)millimeter Imaging of the Massive Protocluster G358.93−0.03: Discovery of 14 New Methanol Maser Lines Associated with a Hot Core. ApJL **881**, L39 (2019).

[11] MacLeod, G. C. *et al.* Detection of new methanol maser transitions associated with G358.93-0.03. MNRAS **489**, 3981–3989 (2019).

[12] Burns, R. A. *et al.* A heatwave of accretion energy traced by masers in the G358-MM1 high-mass protostar. *Nature Astronomy* 10 (2020). URL https://ui.adsabs.harvard.edu/abs/2020NatAs.tmp...10B.

[13] Chen, X. *et al.* $^{13}CH_3OH$ Masers Associated With a Transient Phenomenon in a High-mass Young Stellar Object. ApJL **890**, L22 (2020). URL https://ui.adsabs.harvard.edu/abs/2020ApJ...890L..22C.

[14] Chen, X. *et al.* New maser species tracing spiral-arm accretion flows in a high-mass young stellar object. *Nature Astronomy* (2020). URL https://ui.adsabs.harvard.edu/abs/2020NatAs.tmp..144C.

[15] Stecklum, B. *et al.* Infrared observations of the flaring maser source G358.93-0.03 – SOFIA confirms an accretion burst from a massive young stellar object. *arXiv e-prints* arXiv:2101.01812 (2021). URL https://ui.adsabs.harvard.edu/abs/2021arXiv210101812S.

[16] Volvach, A. E. *et al.* Monitoring a methanol maser flare associated with the massive star-forming region G358.93-0.03. MNRAS **494**, L59–L63 (2020).

M2O follow-up data

No.	Target	Facility	Date	Frequency (GHz)	Code	PI/comment
1	G25	VLA	Oct 2017	6.7, 12.2, 22	17B-408	OB / Reduced
2	G25+W49N	EVN	Oct 2017	22	RB004	RB / Reduced
3	G25+W49N	KaVA	Oct 2017	22	K17RB01A	RB / Reduced
4	G25+W49N	VLBA	Oct 2017	22	BO058	GO / Reduced
5	G25	VERA	2007-2013	22, 16 x epochs	[archival]	K. Motogi / Processing
6	G358	VERA	31 Jan 2019	6.7	-	SY / Reduced
7	G358	VERA	3 Mar 2019	6.7	-	SY / Reduced
8	G358	VERA	1 Apr 2019	6.7	-	SY / Reduced
9	G358	VERA	3 May 2019	6.7	-	SY / Reduced
10	G358	LBA	2 Feb 2019	6.7	vc026a	RB / Reduced
11	G358	LBA	3 Feb 2019	23.1	vc026b	GO / Abandoned
12	G358	LBA	28 Feb 2019	6.7	vc026c	RB / Reduced
13	G358	EVN	13 Mar 2019	6.7, 6.18	RB005	RB / Reduced
14	G358	KVN	25 Mar 2019	22, 44, 95, 120	n19rb01a	RB / Reduced
15	G358	VLBA	19 May 2019	6.7, 12.2, 23.1	BB414	RB / QuickLook
16	G358	VLBA	7 Jun 2019	6.7, 12.2, 20.7	BB412	RB / Reduced
17	G358	LBA+E.Asia	17 May 2019	7.6, 7.8	vx028a	GO,SE / QuickLook
18	G358	LBA+AusSCOPE	28 Sep 2019	6.7	v581a	RB / Reduced
19	G358	LBA+AusSCOPE	18 Aug 2020	6.7	v581b	RB / Reduced
20	G358	SOFIA	30 April 2019	50...120 μm		BS,JE
21	G358	GROND	8 Feb 2019	NIR		HL,BS,AC
22	G358	SMA	several 2019	mm		THunter,CB
23	G358	ALMA	several 2019	Bands 5,6,7		CB
24	G358	VLA	2019	GHz	-	OB
25	G358	VLA	2019	GHz	-	OB
26	G358	VLA	2019	HNCO	-	XC,AS
27	G24	LBA	8 Sep 2019	6.7	vx026d	RB,MO / Correlated
28	G24	LBA	13 Sep 2019	6.7	s002a	RB,MO / Correlated
29	G24	LBA	28 Sep 2019	6.7	v581a	RB,MO / Correlated
30	G24	EVN	22 Sep 2019	22	RB006A	RB,MO / QuickLook
31	G24	EVN+Merlin	7 Oct 2019	6.7	RB006B	RB,MO / QuickLook
32	G24	EVN+Merlin	17 Nov 2019	1.667	RB007	RB,MO / correlated
33	G24	VLBA	27 Sep 2019	6.7, 12.2, 22	BB416A	RB,MO / QuickLook
34	G24	VLBA	27 Oct 2019	6.7, 12.2, 22	BB416B	RB,MO / correlated
35	G24	VLBA	02 Dec 2019	6.7, 12.2, 22	BB416C	RB,MO / correlated
36	G24	ALMA	26 Sep 2019	Band6	-	THirota / QuickLook
37	G24	SOFIA	25 Oct 2019	FIR		BS,JE
38	G24	ATCA	26 Nov 2019	K-band	C3321	GO,SB
39	G24	ATCA	27 Nov 2019	C-band	C3321	GO,SB
40	NGC2071, Ori-S6	KaVA	13 Mar 2020	22/44/95/130	a20d3a	RB / QuickLook
41	NGC2071, Ori-S6	KaVA	16 Apr 2020	22/44/95/130	a20d3b	RB / QuickLook
42	NGC2071, Ori-S6	KaVA	11 May 2020	22/44/95/130	a20d3c	RB / Correlated
43	G85	VLBA	24/Apr/2020	L/C/Ku/K	BB421B	RB / QuickLook
44	G85	VLBA	22/May/2020	L/C/Ku/K	BB421A	RB / QuickLook
45	G85	VLBA	22/June/2020	L/C/Ku/K	BB421C	RB / correlated
46	G359.617-0.251	LBA	18/Aug/2020	6.7	V581B	RB / Observed
47	G359.617-0.251	VLBA	21/Aug/2020	6.7 / 12.2 / 22	BB418A	RB / Correlated
48	G359.617-0.251	ATCA	25-26/July/2020	6-10 GHz	C3321	GO / Processing
49	G034.196-0.592	VLA	19/NOV/2020	C	VLA/20B-441	DL / Processing
50	G034.196-0.592	VLA	29/NOV/2020	K	VLA/20B-441	DL / Processing
51	G034.196-0.592	KaVA	12/DEC/2020	K(QWD)	a20d4a	RB / Quick Look
52	G034.196-0.592	KaVA	23/JAN/2021	K(QWD)	a21d1a	RB / Correlating
53	G034.196-0.592	KaVA	18/FEB/2021	K(QWD)	a21d1b	RB / Observed
54	G35.200.74	KaVA	23/JAN/2021	K(QWD)	a21d1a	RB / Correlating
55	G35.200.74	KaVA	18/FEB/2021	K(QWD)	a21d1b	RB / Observed

Reminders:
All G25.65+0.15 papers should include a member from the Volvach et al. in the author list and an acknowledgement of their funding.
All G358 papers should include a member from the Ibaraki team in the author list and an acknowledgement of their funding.
All G24.33 papers should include a member from the Torun team in the author list and an acknowledgement of their funding.
All Orion-S6 papers should include a member from the Ibaraki team in the author list and an acknowledgement of their funding.
All NGC2071 papers should include a member from the VERA / Sunada team in the author list and an acknowledgement of their funding.
All G53.22-0.08 papers should include a member from the VERA / Sunada team in the author list and an acknowledgement of their funding.
All G85 papers should include a member from the Ibaraki team in the author list and an acknowledgement of their funding.
All G359 papers should include a member from the Ibaraki team in the author list and an acknowledgement of their funding.
All G034.196-0.592 papers should include a member from the Ladeyschikov et al. in the author list and an acknowledgement of their funding.
All G35.200.74 papers should include a member from the Volvach et al. in the author list and an acknowledgement of their funding.