

(Expanded Study on Stellar Masers)

East-west offset (mas)

25

20

15

10

5

0

-10

North-south offset (mas)

SiO v=1, J=1-0 SiO v=2, J=1-0

_Yun et al. 2016

Hiroshi Imai

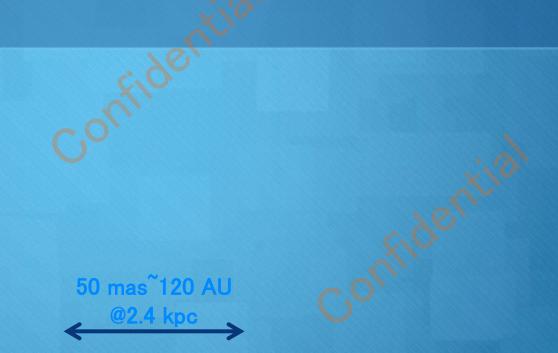
(Kagoshima University) On behalf of the KaVA ESTEMA Team

Results of KaVA commissioning observations

Red supergiant S Per (Asaki et al. in prep.)

Band-to-band transfer of phase calibration Solutions

Continuous tracing of mass loss flows from stellar surface to accelerated zone of circumstellar envelope Episodic mass ejection on decade scale?



 H_2O (22GHz) SiO J=1→0 v=1 (43GHz) SiO J=1→0 v=2 (43GHz) SiO J=2→1 (86GHz, one KVN baseline)

KaVA ESTEMA (2015-2016)

First stage of KaVA Large Program on circumstellar H₂O and SiO masers
Snapshot imaging or ~80 stars in H₂O and SiO masers
~200 hr project during 2015 October-2016 Autumn

Finally selecting 20 stars for the one-decade intensive monitoring project in the KaVA second stage Large Program

Yielding maps of 40 stars in H₂O and/or SiO masers

 Statistical view of circumstellar maser on microscopic (maser spots) to macroscopic (circumstellar envelopes) scale

KaVA ESTEMA team

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*co-PI

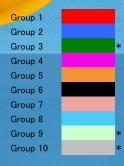
¹Kagoshima U.; ²KASI; ³NAOJ/ALMA; ⁴ICRAR/UWA; ⁵NAOJ/VERA; ⁶SNU; ⁷Yonsei U.; ⁸U. Nigeria; ⁹Ural Fed. U.; ¹⁰JIVE; ¹¹SHAO

Target 80 stars in KaVA ESTEMA

See KaVA HP

ESTEMA source list (1st year)

| Г | | | | / | (() = = = =) | |
|---|-----|-----------------------|----------|--------------|-------------------------|--------|
| H | No. | Maser source (Type) | Priority | R.A. (J2000) | Dec. (J2000) | Vstar |
| L | | | | | | (km/s) |
| | 41 | RS Vir (Mi*) | А | 14 27 16.39 | +04 40 41.1 | -14 |
| | 46 | U Her (Mi*) | А | 16 25 47.47 | +18 53 32.9 | -15 |
| | 51 | AH Sco (SG) | А | 17 11 17.02 | -32 19 30.7 | -13 |
| | 53 | RW Sco (Mi*) | Α | 17 14 51.68 | -33 25 54.6 | -70 |
| | 86 | V1111 Oph (Mi*) | А | 18 37 19.26 | +10 25 42.2 | -30 |
| | 99 | RT Aql (Mi*) | А | 19 38 01.60 | +11 43 18.2 | -33 |
| ŀ | 111 | OH83.42-0.89 (OH*) | А | 20 50 58.60 | +42 48 11.0 | -39 |
| ŀ | 116 | IRC+60370 (Mi*) | А | 22 49 59.20 | +60 17 55.0 | -54 |
| ŀ | 118 | MY Cep (SG) | А | 22 54 31.71 | +60 49 38.9 | -50 |
| ŀ | 119 | V627 Cas (Sy*) | А | 22 57 40.99 | +58 49 12.5 | -52 |
| | 1 | Y Cas (Mi*) | А | 00 03 21.47 | +55 40 51.8 | -17 |
| | 34 | R UMa (Mi*) | А | 10 44 38.47 | +68 46 32.7 | 38 |
| | 122 | R Cas (Mi*) | А | 23 58 24.87 | +51 23 19.7 | 21 |
| | 32 | R Leo (Mi*) | А | 09 47 33.49 | +11 25 43.7 | -1 |
| | 57 | OH358.23+0.11 (OH*) | А | 17 40 53.40 | -30 23 09.0 | -10 |
| | 70 | V4201 Sgr (sr*) | А | 17 53 18.80 | - 26 56 37.0 | -4 |
| ŀ | 103 | IRAS 19422+3506 (OH*) | А | 19 44 07.00 | +35 14 08.2 | -49 |
| | 79 | V5102 Sgr (sr*) | А | 18 16 26.03 | - 16 39 56.4 | 48 |
| | 88 | IRC+00363 (Mi*) | А | 18 41 25.00 | -04 20 36.0 | 55 |
| | 93 | OH38.10-0.13 (pA*) | А | 19 01 20.05 | +04 32 31.6 | 53 |
| • | 100 | IRAS 19371+2855 (OH*) | А | 19 39 07.77 | +29 02 38.6 | 24 |
| | 52 | V2108 Oph (Mi*) | А | 17 14 19.39 | +08 56 02.6 | 16 |
| | 56 | IRC-30308 (OH*) | А | 17 38 40.49 | -31 57 18.2 | 5 |
| | 71 | V4120 Sgr (Mi*) | А | 18 03 56.54 | -20 19 00.4 | 15 |
| | 80 | OH16.1-0.3 (pA*) | А | 18 21 06.44 | -15 03 29.8 | 22 |
| | 16 | U Ori (Mi*) | А | 05 55 49.17 | +20 10 30.7 | -45 |
| | 22 | Z Pup (Mi*) | А | 07 32 38.06 | -20 39 29.1 | 3 |
| | 27 | R Cnc (Mi*) | А | 08 16 33.83 | +11 43 34.6 | 18 |
| | 42 | S CrB (Mi*) | А | 15 21 23.93 | +31 22 02.4 | -1 |
| | 4 | 0 Cet (Mi*) | А | 02 19 20.79 | -02 58 37.4 | 47 |
| | 15 | S Col (Mi*) | А | 05 46 56.31 | -31 41 28.4 | 65 |
| L | 24 | QX Pup (pA*) | А | 07 42 17.16 | -14 42 49.9 | 29 |
| ŀ | 120 | R Peg (Mi*) | А | 23 06 39.17 | +10 32 36.1 | 23 |
| | 25 | V353 Pup (sr*) | А | 07 46 34.15 | - 32 18 16.3 | 28 |
| | 26 | HU Pup (sr*) | А | 07 55 40.16 | -28 38 54.8 | 44 |
| | 30 | IW Hya (Mi*) | А | 09 45 15.24 | -22 01 45.3 | 46 |
| | 20 | IRC-10151 (OH*) | А | 07 07 49.38 | -10 44 05.9 | 45 |
| | 36 | R Crt (sr*) | А | 11 00 33.85 | -18 19 29.6 | 11 |
| | 37 | RT Vir (sr*) | А | 13 02 37.98 | +05 11 08.4 | 15 |
| | 40 | RX Boo (sr*) | А | 14 24 11.84 | +25 42 21.1 | 1 |

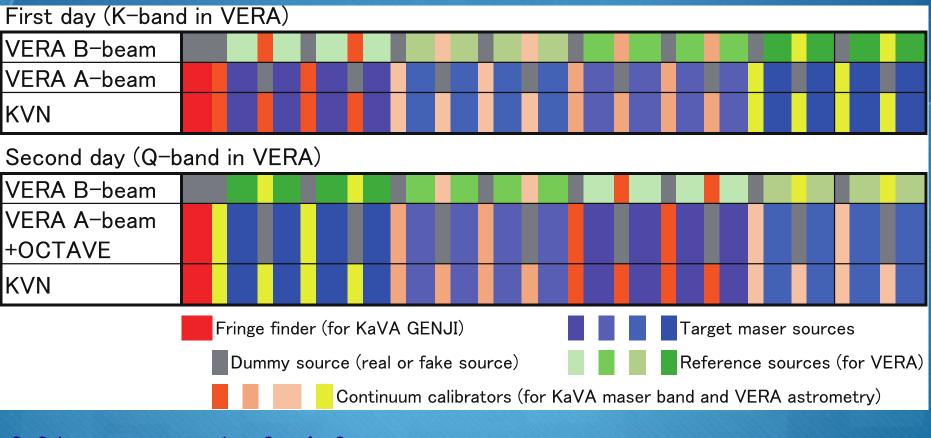


* Group 3, 9, 10 can be grouped together in a 2x15h session ESTEMA source list (2nd semester, Priority B)

| UUU <th< th=""><th>Group</th><th>No.</th><th>Maser source (Type)</th><th>Priority</th><th>R.A. (J2000)</th><th>Dec. (J2000)</th><th>Vstar</th></th<> | Group | No. | Maser source (Type) | Priority | R.A. (J2000) | Dec. (J2000) | Vstar |
|--|-------|-----|-----------------------|----------|--------------|--------------|--------|
| B1 11 BW Cam (Mi*) B 05 19 52.56 +63 15 55.8 50 B1 19 GX Mon (Mi*) B 06 52 47.04 +08 25 19.2 -8 B1 23 OZ Gem(Mi*) B 07 33 57.75 +30 30 37.8 7 B2 109 IRAS 20381+5001 (Mi*) B 20 39 39.60 +50 12 15.0 -38 B2 115 AM Cep (Mi*) B 21 41 27.08 +76 23 11.3 -50 B2 117 V386 Cep (sr*) B 26 53 12.33 +61 70 04 -49 B3 17 AP Lyn (Mi*) B 06 64 46.49 +59 52 01.6 -16 B3 29 X Hya (Mi*) B 00 21 09.11 -34 47 18.7 -18 B4 40 RX Boo (sr*) B 10 55 93.8 +71 52 09.8 -50 B4 40 RX Boo (sr*) B 10 53 43.34 -16 07 54.3 -33 B5 66 MHSOM100 B 17 48 18.11 -28 07 38.9 111 B5 76 OH10.1-0.1 (pA*) B 18 02 61.33 <td< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th>(km/s)</th></td<> | | | | | | | (km/s) |
| B1 19 GX Mon (Mi*) B 06 52 47.04 +08 25 19.2 -8 B1 23 OZ Gem(Mi*) B 07 33 57.75 +30 30 37.8 7 B2 2 V524 Cas (Mi*) B 00 46 00.12 +69 10 53.4 -27 B2 109 IRAS 20381+5001 (Mi*) B 20 39 39.60 +50 12 15.0 -38 B2 115 AM Cep (Mi*) B 21 41 27.08 +76 23 11.3 -50 B2 117 V386 Cep (sr*) B 20 63 4 33.92 +60 56 26.2 -23 B3 17 AP Lyn (Mi*) B 06 40 46.49 +59 52 01.6 -16 B3 29 X Hya (Mi*) B 00 21 09.11 -34 47 18.7 -18 B4 35 VX UMa (Mi*) B 10 52 39.88 +71 52 09.8 -50 B4 40 RX Boo (sr*) B 16 33 43.54 -16 07 54.3 -33 B5 66 MHSOM100 B 174 48 18.11 -28 07 38.9 1111 B5 77 V438 Sct (Mi*) B 18 03 46.33 | B1 | 6 | RR Per (Mi*) | В | 02 28 29.40 | +51 16 17.3 | 9 |
| BI 23 OZ Gem(Mi*) B 07 33 57.75 +30 30 37.8 7 B2 2 V524 Cas (Mi*) B 00 46 00.12 +69 10 53.4 -27 B2 109 IRAS 20381+5001 (Mi*) B 20 39 39.60 +50 12 15.0 -38 B2 115 AM Cep (Mi*) B 21 41 27.08 +76 23 11.3 -50 B2 117 V386 Cep (sr*) B 22 53 12.33 +61 17 00.4 -49 B3 17 AP Lyn (Mi*) B 06 40 46.49 +59 52 01.6 -16 B3 29 X Hya (Mi*) B 10 21 09.11 -34 47 18.7 -18 B4 35 VX UMa (Mi*) B 10 55 39.88 +71 52 09.8 -50 B4 40 RX Boo (sr*) B 116 33 43.54 -16 07 54.3 -33 B5 66 MHSOM100 B 174 48 18.11 -28 07 38.9 -111 B5 76 OH10.1-0.1 (pA*) B 18 08 16.38 -02 15 15.4 50 B6 49 V446 Oph (sr*) B 16 46 39.11 | B1 | 11 | BW Cam (Mi*) | В | 05 19 52.56 | +63 15 55.8 | 50 |
| B2 2 V524 Cas (Mi*) B 00 46 00.12 +69 10 53.4 -27 B2 109 IRAS 20381+5001 (Mi*) B 20 39 39.60 +50 12 15.0 -38 B2 115 AM Cep (Mi*) B 21 41 27.08 +76 23 11.3 -50 B2 117 V386 Cep (sr*) B 22 53 12.33 +61 17 00.4 -49 B3 17 AP Lyn (Mi*) B 06 34 33.92 +60 55 26.2 -23 B3 18 U Lyn (Mi*) B 09 35 30.27 -11 41 28.6 -118 B4 35 VX UMa (Mi*) B 10 25 39.88 +71 52 09.8 -50 B4 40 RX Boo (sr*) B 14 24 11.84 +25 42 21.1 1 B4 44 WX Ser (Mi*) B 15 27 47.38 +19 33 42.9 -7 B4 47 T Oph (Mi*) B 16 33 43.54 -16 07 54.3 -33 B5 66 MHSOM100 B 17 48 18.11 -28 07 38.9 111 B5 76 OH10.1-0.1 (pA*) B 18 42 08.43 | B1 | 19 | GX Mon (Mi*) | В | 06 52 47.04 | +08 25 19.2 | -8 |
| B2 109 IRAS 20381+5001 (Mi*) B 20 39 39.60 +50 12 15.0 -38 B2 115 AM Cep (Mi*) B 21 41 27.08 +76 23 11.3 -50 B2 117 V386 Cep (sr*) B 22 53 12.33 +61 17 00.4 -49 B3 17 AP Lyn (Mi*) B 06 40 46.49 +59 52 01.6 -16 B3 29 X Hya (Mi*) B 09 35 30.27 -14 41 28.6 27 B3 33 V Ant (Mi*) B 10 21 09.11 -34 47 18.7 -18 B4 40 RX Boo (sr*) B 114 24 11.84 +25 42 21.1 1 B4 44 WX Ser (Mi*) B 15 27 47.38 +19 33 42.9 -7 B4 47 T Oph (Mi*) B 16 33 43.54 -16 07 54.3 -33 B5 66 MHSOM100 B 17 48 18.11 -28 07 38.9 111 B5 74 38 Sct (Mi*) B 18 04 16.33 -06 15.0 7.11 B5 87 V438 Sct (Mi*) B 17 21 1.20 -37 53 13.0 | B1 | 23 | OZ Gem(Mi*) | В | 07 33 57.75 | +30 30 37.8 | 7 |
| B2 115 AM Cep (Mi*) B 21 41 27.08 +76 23 11.3 -50 B2 117 V386 Cep (sr*) B 22 53 12.33 +61 17 00.4 -49 B3 17 AP Lyn (Mi*) B 06 34 33.92 +60 56 26.2 -23 B3 18 U Lyn (Mi*) B 06 40 46.49 +59 52 01.6 -16 B3 29 X Hya (Mi*) B 00 21 09.11 -34 47 18.7 -18 B4 35 VX UMa (Mi*) B 10 21 09.11 -34 47 18.7 -18 B4 40 RX Boo (sr*) B 14 24 11.84 +25 42 21.1 1 B4 44 WX Ser (Mi*) B 15 27 47.38 +19 33 42.9 -7 B4 47 T Oph (Mi*) B 16 33 43.54 -16 07 54.3 -33 B5 66 MHSOM100 B 17 48 18.11 -28 07 38.9 111 B5 87 V438 Sct (Mi*) B 18 08 16.38 -20 16 11.6 52 B5 87 V438 Sct (Mi*) B 17 42 11.20 -37 53 | B2 | 2 | V524 Cas (Mi*) | В | 00 46 00.12 | +69 10 53.4 | -27 |
| B2 117 V386 Cep (sr*) B 22 53 12.33 +61 17 0.04 -49 B3 17 AP Lyn (Mi*) B 06 34 33.92 +60 56 26.2 -23 B3 18 U Lyn (Mi*) B 06 40 46.49 +59 52 01.6 -16 B3 29 X Hya (Mi*) B 09 35 30.27 -14 41 28.6 27 B3 33 V Ant (Mi*) B 10 21 09.11 -34 47 18.7 -18 B4 35 VX UMa (Mi*) B 10 55 39.88 +71 52 09.8 -50 B4 40 RX Boo (sr*) B 14 24 11.84 +25 42 21.1 1 B4 44 WX Ser (Mi*) B 16 33 43.54 -16 07 54.3 -33 B5 66 MHSOM100 B 17 48 18.11 -28 07 38.9 111 B5 7 V438 Sct (Mi*) B 18 08 16.38 -20 16 11.6 52 B5 87 V438 Sct (Mi*) B 18 41 14.33 -06 15 00.7 71 B5 89 IRC+00364 (IR) B 18 42 08.43 -02 45 1 | B2 | 109 | IRAS 20381+5001 (Mi*) | В | 20 39 39.60 | +50 12 15.0 | -38 |
| B3 17 AP Lyn (Mi*) B 06 34 33.92 +60 56 26.2 -23 B3 18 U Lyn (Mi*) B 06 40 46.49 +59 52 01.6 -16 B3 29 X Hya (Mi*) B 09 35 30.27 -14 41 28.6 27 B3 33 V Ant (Mi*) B 10 21 09.11 -34 47 18.7 -18 B4 35 VX UMa (Mi*) B 10 55 39.88 +71 52 09.8 -50 B4 40 RX Boo (sr*) B 14 24 11.84 +25 42 21.1 1 B4 44 WX Ser (Mi*) B 16 33 43.54 -16 07 54.3 -33 B5 66 MHSOM100 B 17 48 18.11 -28 07 38.9 111 B5 7 V438 Sct (Mi*) B 18 08 16.38 -20 16 11.6 52 B5 87 V438 Sct (Mi*) B 18 41 14.33 -06 15 00.7 71 B5 89 IRC+00364 (IR) B 18 42 08.43 -02 45 15.4 50 B6 49 V446 Oph (sr*) B 18 27 36.53 -12 27 58. | B2 | 115 | AM Cep (Mi*) | В | 21 41 27.08 | +76 23 11.3 | -50 |
| B3 18 U Lyn (Mi*) B 06 40 46.49 +59 52 01.6 -16 B3 29 X Hya (Mi*) B 09 35 30.27 -14 41 28.6 27 B3 33 V Ant (Mi*) B 10 21 09.11 -34 47 18.7 -18 B4 35 VX UMa (Mi*) B 10 55 39.88 +71 52 09.8 -50 B4 40 RX Boo (sr*) B 14 24 11.84 +25 42 21.1 1 B4 44 WX Ser (Mi*) B 15 27 47.38 +19 33 42.9 -7 B4 47 T Oph (Mi*) B 16 33 43.54 -16 07 54.3 -33 B5 66 MHSOM100 B 17 48 18.11 -28 07 38.9 111 B5 76 OH10.1-0.1 (pA*) B 18 08 16.38 -20 16 11.6 52 B5 87 V438 Sct (Mi*) B 18 41 14.33 -06 15 00.7 71 B5 89 IRC+00364 (IR) B 18 42 08.43 -02 45 15.4 50 B6 49 V446 Oph (sr*) B 16 46 39.11 -11 3 8 5 | B2 | 117 | V386 Cep (sr*) | В | 22 53 12.33 | +61 17 00.4 | -49 |
| B3 29 X Hya (Mi*) B 09 35 30.27 -14 41 28.6 27 B3 33 V Ant (Mi*) B 10 21 09.11 -34 47 18.7 -18 B4 35 VX UMa (Mi*) B 10 55 39.88 +71 52 09.8 -50 B4 40 RX Boo (sr*) B 14 24 11.84 +25 42 21.1 1 B4 44 WX Ser (Mi*) B 15 27 47.38 +19 33 42.9 7 B4 47 T Oph (Mi*) B 16 33 43.54 -16 07 54.3 -33 B5 66 MHSOM100 B 17 48 18.11 -28 07 38.9 111 B5 76 OH10.1-0.1 (pA*) B 18 08 16.38 -20 16 11.6 52 B5 87 V438 Sct (Mi*) B 18 41 14.33 -06 15 00.7 71 B5 89 IRC+00364 (IR) B 18 42 08.43 -02 45 15.4 50 B6 49 V446 Oph (sr*) B 17 21 1.20 -37 53 13.0 -26 B6 102 V1415 Aql (Mi*) B 18 27 36.53 -12 7 | B3 | 17 | AP Lyn (Mi*) | В | 06 34 33.92 | +60 56 26.2 | -23 |
| B3 33 V Ant (Mi*) B 10 21 09.11 -34 47 18.7 -18 B4 35 VX UMa (Mi*) B 10 55 39.88 +71 52 09.8 -50 B4 40 RX Boo (sr*) B 14 24 11.84 +25 42 21.1 1 B4 44 WX Ser (Mi*) B 15 27 47.38 +19 33 42.9 7 B4 47 T Oph (Mi*) B 16 33 43.54 -16 07 54.3 -33 B5 66 MHSOM100 B 17 48 18.11 -28 07 38.9 111 B5 76 OH10.1-0.1 (pA*) B 18 08 16.38 -20 16 11.6 52 B5 87 V438 Sct (Mi*) B 18 41 14.33 -06 15 00.7 71 B5 89 IRC+00364 (IR) B 18 42 08.43 -02 45 15.4 50 B6 49 V446 Oph (sr*) B 16 46 39.11 -11 38 53.1 10 B6 54 IRAS 17187-3750 (IR) B 17 22 11.20 -37 53 13.0 -26 B6 102 V1415 Aql (Mi*) B 17 4 10.80 < | B3 | 18 | U Lyn (Mi*) | В | 06 40 46.49 | +59 52 01.6 | -16 |
| B4 35 VX UMa (Mi*) B 10 55 39.88 +71 52 92 11 B4 40 RX Boo (sr*) B 14 24 11.84 +25 42 21.1 1 B4 44 WX Ser (Mi*) B 15 27 47.38 +19 33 42.9 7 B4 47 T Oph (Mi*) B 16 33 43.54 -16 07 54.3 -33 B5 66 MHSOM100 B 17 48 18.11 -28 07 38.9 111 B5 76 OH10.1-0.1 (pA*) B 18 81 14.33 -06 15 0.7 71 B5 89 IRC+00364 (IR) B 18 42 04.45 31.0 -26 B6 49 V446 Oph (sr*) B 17 22 11.20 -37 53 13.0 -26 B6 102 V1415 Aql (Mi*) B 18 27 53 0.20 -31 </td <td>B3</td> <td>29</td> <td>X Hya (Mi*)</td> <td>В</td> <td>09 35 30.27</td> <td>-14 41 28.6</td> <td>27</td> | B3 | 29 | X Hya (Mi*) | В | 09 35 30.27 | -14 41 28.6 | 27 |
| B4 40 RX Boo (sr*) B 14 24 11.84 +25 42 21.1 1 B4 44 WX Ser (Mi*) B 15 27 47.38 +19 33 42.9 7 B4 47 T Oph (Mi*) B 16 33 43.54 -16 07 54.3 -33 B5 66 MHSOM100 B 17 48 18.11 -28 07 38.9 111 B5 76 OH10.1-0.1 (pA*) B 18 08 16.38 -20 16 11.6 52 B5 87 V438 Sct (Mi*) B 18 41 14.33 -06 15 00.7 71 B5 89 IRC+00364 (IR) B 18 42 08.43 -02 45 15.4 50 B6 49 V446 Oph (sr*) B 16 46 39.11 -11 38 53.1 10 B6 54 IRAS 17187-3750 (IR) B 17 22 11.20 -37 53 13.0 -26 B6 102 V1415 Aql (Mi*) B 18 27 36.53 -12 27 58.9 26 B7 62 MHSOM75 B 17 46 12.46 -28 07 05.3 -39 B7 68 V2211 Oph (Mi*) B 18 05 36.47 <t< td=""><td>B3</td><td>33</td><td>V Ant (Mi*)</td><td>В</td><td>10 21 09.11</td><td>-34 47 18.7</td><td>-18</td></t<> | B3 | 33 | V Ant (Mi*) | В | 10 21 09.11 | -34 47 18.7 | -18 |
| B4 44 WX Ser (Mi*) B 15 27 47.38 +19 33 42.9 7 B4 47 T Oph (Mi*) B 16 33 43.54 -16 07 54.3 -33 B5 66 MHSOM100 B 17 48 18.11 -28 07 38.9 111 B5 76 OH10.1-0.1 (pA*) B 18 08 16.38 -20 16 11.6 52 B5 87 V438 Sct (Mi*) B 18 41 14.33 -06 15 00.7 71 B5 89 IRC+00364 (IR) B 18 42 08.43 -02 45 15.4 50 B6 49 V446 Oph (sr*) B 16 46 39.11 -11 38 53.1 10 B6 54 IRAS 17187-3750 (IR) B 17 22 11.20 -37 53 13.0 -26 B6 102 V1415 Aql (Mi*) B 18 27 36.53 -12 27 58.9 26 B6 102 V1415 Aql (Mi*) B 17 41 0.80 -15 33 02.0 -49 B7 62 MHSOM75 B 17 46 12.46 -28 07 05.3 -39 B7 68 V2211 Oph (Mi*) B 18 43 36.47 | B4 | 35 | VX UMa (Mi*) | В | 10 55 39.88 | +71 52 09.8 | -50 |
| B4 47 T Oph (Mi*) B 16 33 43.54 -16 07 54.3 -33 B5 66 MHSOM100 B 17 48 18.11 -28 07 38.9 111 B5 76 OH10.1-0.1 (pA*) B 18 08 16.38 -20 16 11.6 52 B5 87 V438 Sct (Mi*) B 18 41 14.33 -06 15 00.7 71 B5 89 IRC+00364 (IR) B 18 42 08.43 -02 45 15.4 50 B6 49 V446 Oph (sr*) B 16 46 39.11 -11 38 53.1 10 B6 54 IRAS 17187-3750 (IR) B 17 22 11.20 -37 53 13.0 -26 B6 102 V1415 Aql (Mi*) B 19 43 45.29 +03 44 30.4 -31 B7 55 IRAS17313-1531 B 17 46 12.46 -28 07 05.3 -39 B7 68 V2211 Oph (Mi*) B 18 43 36.47 +13 57 22.8 -9 B8 72 IRC-20427 (Mas) B 18 43 36.47 +13 57 22.8 <td>B4</td> <td>40</td> <td>RX Boo (sr*)</td> <td>В</td> <td>14 24 11.84</td> <td>+25 42 21.1</td> <td>1</td> | B4 | 40 | RX Boo (sr*) | В | 14 24 11.84 | +25 42 21.1 | 1 |
| B5 66 MHSOM100 B 17 48 18.11 -28 07 38.9 111 B5 76 OH10.1-0.1 (pA*) B 18 08 16.38 -20 16 11.6 52 B5 87 V438 Set (Mi*) B 18 41 14.33 -06 15 00.7 71 B5 89 IRC+00364 (IR) B 18 42 08.43 -02 45 15.4 50 B6 49 V446 Oph (sr*) B 16 46 39.11 -11 38 53.1 10 B6 54 IRAS 17187-3750 (IR) B 17 22 11.20 -37 53 13.0 -26 B6 82 UY Set (sr*) B 18 27 36.53 -12 27 58.9 26 B6 102 V1415 Aql (Mi*) B 19 43 45.29 +03 44 30.4 -31 B7 55 IRAS17313-1531 B 17 46 12.46 -28 07 05.3 -39 B7 62 MHSOM75 B 17 46 12.46 -28 07 05.3 -39 B7 68 V2211 Oph (Mi*) B 18 05 35.49 -21 13 42.2 17 B8 72 IRC-20427 (Mas) B 18 06 42.88 | B4 | 44 | WX Ser (Mi*) | В | 15 27 47.38 | +19 33 42.9 | 7 |
| B5 76 OH10.1-0.1 (pA*) B 18 08 16.38 -20 16 11.6 52 B5 87 V438 Sot (Mi*) B 18 41 14.33 -06 15 00.7 71 B5 89 IRC+00364 (IR) B 18 42 08.43 -02 45 15.4 50 B6 49 V446 Oph (sr*) B 16 46 39.11 -11 38 53.1 10 B6 54 IRAS 17187-3750 (IR) B 17 22 11.20 -37 53 13.0 -26 B6 82 UY Sct (sr*) B 18 42 45.29 +03 44 30.4 -31 B7 55 IRAS17313-1531 B 17 34 10.80 -15 33 02.0 -49 B7 62 MHSOM75 B 17 46 12.46 -28 07 05.3 -39 B7 68 V2211 Oph (Mi*) B 175 109.95 -08 01 21.3 -20 B7 90 V837 Her (Mi*) B 18 05 35.49 -21 13 42.2 17 B8 72 IRC-20427 (Mas) B 18 06 42.88 -08 13 12.0 20 B8 73 IRC-10395 (IR) B 18 05 35.49 </td <td>B4</td> <td>47</td> <td>T Oph (Mi*)</td> <td>В</td> <td>16 33 43.54</td> <td>-16 07 54.3</td> <td>-33</td> | B4 | 47 | T Oph (Mi*) | В | 16 33 43.54 | -16 07 54.3 | -33 |
| B5 87 V438 Sct (Mi*) B 18 41 14.33 -06 15 00.7 71 B5 89 IRC+00364 (IR) B 18 42 08.43 -02 45 15.4 50 B6 49 V446 Oph (sr*) B 16 46 39.11 -11 38 53.1 10 B6 54 IRAS 17187-3750 (IR) B 17 22 11.20 -37 53 13.0 -26 B6 82 UY Sct (sr*) B 18 27 36.53 -12 27 58.9 26 B6 102 V1415 Aql (Mi*) B 19 43 45.29 +03 44 30.4 -31 B7 55 IRAS17313-1531 B 17 46 12.46 -28 07 05.3 -39 B7 62 MHSOM75 B 17 51 09.95 -08 01 21.3 -20 B7 90 V837 Her (Mi*) B 18 43 36.47 +13 57 22.8 -9 B8 72 IRC-20427 (Mas) B 18 06 42.88 -08 13 12.0 20 B7 90 V837 Her (Mi*) B 18 05 35.49 -21 13 42.2 17 B8 72 IRC-10395 (IR B 18 06 42.88 <td>B5</td> <td>66</td> <td>MHSOM100</td> <td>В</td> <td>17 48 18.11</td> <td>-28 07 38.9</td> <td>111</td> | B5 | 66 | MHSOM100 | В | 17 48 18.11 | -28 07 38.9 | 111 |
| B5 89 IRC+00364 (IR) B 18 42 08.43 -02 45 15.4 50 B6 49 V446 Oph (sr*) B 16 46 39.11 -11 38 53.1 10 B6 54 IRAS 17187-3750 (IR) B 17 22 11.20 -37 53 13.0 -26 B6 82 UY Sct (sr*) B 18 27 36.53 -12 27 58.9 26 B6 102 V1415 Aql (Mi*) B 19 43 45.29 +03 44 30.4 -31 B7 55 IRAS17313-1531 B 17 46 12.46 -28 07 05.3 -39 B7 62 MHSOM75 B 17 51 09.95 -08 01 21.3 -20 B7 90 V837 Her (Mi*) B 18 43 36.47 +13 57 22.8 -9 B8 72 IRC-20427 (Mas) B 18 06 42.88 -08 13 12.0 20 B8 73 IRC-10395 (IR) B 18 06 42.88 -08 13 12.0 20 B8 77 V2302 Oph (Mi*) B 18 35 29.20 -07 13 08.0 | B5 | 76 | OH10.1-0.1 (pA*) | в | 18 08 16.38 | -20 16 11.6 | 52 |
| B6 49 V446 Oph (sr*) B 16 46 39.11 -11 38 53.1 10 B6 54 IRAS 17187-3750 (IR) B 17 22 11.20 -37 53 13.0 -26 B6 82 UY Sct (sr*) B 18 27 36.53 -12 27 58.9 26 B6 102 V1415 Aql (Mi*) B 19 43 45.29 +03 44 30.4 -31 B7 55 IRAS17313-1531 B 17 46 12.46 -28 07 05.3 -39 B7 62 MHSOM75 B 17 46 12.46 -28 07 05.3 -39 B7 68 V2211 Oph (Mi*) B 17 51 09.95 -08 01 21.3 -20 B7 90 V837 Her (Mi*) B 18 43 36.47 +13 57 22.8 -9 B8 72 IRC-20427 (Mas) B 18 05 35.49 -21 13 42.2 17 B8 73 IRC-10395 (IR) B 18 06 42.88 -08 13 12.0 20 B8 77 V2302 Oph (Mi*) B 18 35 29.20 -07 13 08.0 | B5 | 87 | V438 Sct (Mi*) | в | 18 41 14.33 | -06 15 00.7 | 71 |
| B6 54 IRAS 17187-3750 (IR) B 17 22 11.20 -37 53 13.0 -26 B6 82 UY Set (sr*) B 18 27 36.53 -12 27 58.9 26 B6 102 V1415 Aql (Mi*) B 19 43 45.29 +03 44 30.4 -31 B7 55 IRAS17313-1531 B 17 34 10.80 -15 33 02.0 -49 B7 62 MHSOM75 B 17 46 12.46 -28 07 05.3 -39 B7 68 V2211 Oph (Mi*) B 17 51 09.95 -08 01 21.3 -20 B7 90 V337 Her (Mi*) B 18 43 36.47 +13 57 22.8 -9 B8 72 IRC-20427 (Mas) B 18 05 35.49 -21 13 42.2 17 B8 73 IRC-10395 (IR) B 18 06 42.88 -08 13 12.0 20 B8 77 V2302 Oph (Mi*) B 18 35 29.20 -07 13 08.0 42 B9 92 V1366 Aql (Mi*) B 18 35 83 0.09 +06 42 57.8 </td <td>B5</td> <td>89</td> <td>IRC+00364 (IR)</td> <td>в</td> <td>18 42 08.43</td> <td>-02 45 15.4</td> <td>50</td> | B5 | 89 | IRC+00364 (IR) | в | 18 42 08.43 | -02 45 15.4 | 50 |
| B6 82 UY Sct (sr*) B 18 27 36.53 -12 27 58.9 26 B6 102 V1415 Aql (Mi*) B 19 43 45.29 +03 44 30.4 -31 B7 55 IRAS17313-1531 B 17 34 10.80 -15 33 02.0 -49 B7 62 MHSOM75 B 17 46 12.46 -28 07 05.3 -39 B7 68 V2211 Oph (Mi*) B 17 51 09.95 -08 01 21.3 -20 B7 90 V837 Her (Mi*) B 18 43 36.47 +13 57 22.8 -9 B8 72 IRC-20427 (Mas) B 18 06 42.88 -08 13 12.0 20 B8 73 IRC-10395 (IR) B 18 09 18.55 +09 12 15.6 -13 B8 84 OH24.7+0.2 (OH*) B 18 35 29.20 -07 13 08.0 42 B9 92 V1366 Aql (Mi*) B 18 35 83 0.09 +06 42 57.8 20 B9 94 UV Cyg (sr*) B 19 31 13.28 +43 38 13.6 | B6 | 49 | V446 Oph (sr*) | В | 16 46 39.11 | -11 38 53.1 | 10 |
| B6 102 V1415 Aql (Mi*) B 19 43 45.29 +03 44 30.4 -31 B7 55 IRAS17313-1531 B 17 34 10.80 -15 33 02.0 -49 B7 62 MHSOM75 B 17 46 12.46 -28 07 05.3 -39 B7 68 V2211 Oph (Mi*) B 17 51 09.95 -08 01 21.3 -20 B7 90 V337 Her (Mi*) B 18 43 36.47 +13 57 22.8 -9 B8 72 IRC-20427 (Mas) B 18 05 35.49 -21 13 42.2 17 B8 73 IRC-10395 (IR) B 18 06 42.88 -08 13 12.0 20 B8 77 V2302 Oph (Mi*) B 18 35 29.20 -07 13 08.0 42 B9 92 V1366 Aql (Mi*) B 18 35 29.20 -07 13 08.0 42 B9 92 V1366 Aql (Mi*) B 19 31 13.28 +43 88 13.6 33 B9 105 OH65.4+1.3 (OH*) B 19 51 21.20 +29 13 01.3 | B6 | 54 | IRAS 17187–3750 (IR) | В | 17 22 11.20 | -37 53 13.0 | -26 |
| B7 55 IRAS17313-1531 B 17 34 10.80 -15 33 02.0 -49 B7 62 MHSOM75 B 17 46 12.46 -28 07 05.3 -39 B7 68 V2211 Oph (Mi*) B 17 51 09.95 -08 01 21.3 -20 B7 90 V837 Her (Mi*) B 18 43 36.47 +13 57 22.8 -9 B8 72 IRC-20427 (Mas) B 18 05 35.49 -21 13 42.2 17 B8 73 IRC-10395 (IR) B 18 06 42.88 -08 13 12.0 20 B8 77 V2302 Oph (Mi*) B 18 35 29.20 -07 13 08.0 42 B9 92 V1366 Aql (Mi*) B 18 58 30.09 +06 42 57.8 20 B9 92 V1366 Aql (Mi*) B 19 31 13.28 +43 38 13.6 33 B9 105 OH65.4+1.3 (OH*) B 19 51 21.20 +29 13 01.3 -21 B9 108 V1282 Cyg (Mi*) B 20 36 57.04 +37 52 33.9 -22 B10 101 V391 Cyg (Mi*) B 19 40 52 | B6 | 82 | UY Sct (sr*) | В | 18 27 36.53 | -12 27 58.9 | 26 |
| B7 62 MHSOM75 B 17 46 12.46 -28 07 05.3 -39 B7 68 V2211 Oph (Mi*) B 17 51 09.95 -08 01 21.3 -20 B7 90 V837 Her (Mi*) B 18 43 36.47 +13 57 22.8 -9 B8 72 IRC-20427 (Mas) B 18 05 35.49 -21 13 42.2 17 B8 73 IRC-10395 (IR) B 18 06 42.88 -08 13 12.0 20 B8 77 V2302 Oph (Mi*) B 18 35 29.20 -07 13 08.0 42 B9 92 V1366 Aql (Mi*) B 18 58 30.09 +06 42 57.8 20 B9 92 V1366 Aql (Mi*) B 19 31 13.28 +43 38 13.6 33 B9 105 OH65.4+1.3 (OH*) B 19 51 21.20 +29 13 01.3 -21 B9 108 V1282 Cyg (Mi*) B 20 36 57.04 +37 52 33.9 -22 B10 101 V391 Cyg (Mi*) B 19 40 52.39 +48 47 41.5 -200 B10 106 V468 Cyg (Mi*) B 19 55 | B6 | 102 | V1415 Aql (Mi*) | В | 19 43 45.29 | +03 44 30.4 | -31 |
| B7 68 V2211 Oph (Mi*) B 17 51 09.95 -08 01 21.3 -20 B7 90 V837 Her (Mi*) B 18 43 36.47 +13 57 22.8 -9 B8 72 IRC-20427 (Mas) B 18 05 35.49 -21 13 42.2 17 B8 73 IRC-10395 (IR) B 18 06 42.88 -08 13 12.0 20 B8 77 V2302 Oph (Mi*) B 18 09 18.55 +09 12 15.6 -13 B8 84 OH24.7+0.2 (OH*) B 18 35 29.20 -07 13 08.0 42 B9 92 V1366 Aql (Mi*) B 18 58 30.09 +06 42 57.8 20 B9 98 UV Cyg (sr*) B 19 31 13.28 +43 38 13.6 33 B9 105 OH65.4+1.3 (OH*) B 19 51 21.20 +29 13 01.3 -21 B9 108 V1828 Cyg (Mi*) B 20 36 57.04 +37 52 33.9 -22 B10 101 V391 Cyg (Mi*) B 19 40 52.39 +48 47 41.5 -200 B10 106 V468 Cyg (Mi*) B <th< td=""><td>B7</td><td>55</td><td>IRAS17313-1531</td><td>В</td><td>17 34 10.80</td><td>-15 33 02.0</td><td>-49</td></th<> | B7 | 55 | IRAS17313-1531 | В | 17 34 10.80 | -15 33 02.0 | -49 |
| B7 68 V2211 Oph (Mi*) B 17 51 09.95 -08 01 21.3 -20 B7 90 V837 Her (Mi*) B 18 43 36.47 +13 57 22.8 -9 B8 72 IRC-20427 (Mas) B 18 05 35.49 -21 13 42.2 17 B8 73 IRC-10395 (IR) B 18 06 42.88 -08 13 12.0 20 B8 77 V2302 Oph (Mi*) B 18 09 18.55 +09 12 15.6 -13 B8 84 OH24.7+0.2 (OH*) B 18 35 29.20 -07 13 08.0 42 B9 92 V1366 Aql (Mi*) B 18 58 30.09 +06 42 57.8 20 B9 98 UV Cyg (sr*) B 19 31 13.28 +43 38 13.6 33 B9 105 OH65.4+1.3 (OH*) B 19 51 21.20 +29 13 01.3 -21 B9 108 V1828 Cyg (Mi*) B 20 36 57.04 +37 52 33.9 -22 B10 101 V391 Cyg (Mi*) B 19 40 52.39 +48 47 41.5 -200 B10 106 V468 Cyg (Mi*) B <th< td=""><td>B7</td><td>62</td><td>MHSOM75</td><td>В</td><td>17 46 12.46</td><td>-28 07 05.3</td><td>-39</td></th<> | B7 | 62 | MHSOM75 | В | 17 46 12.46 | -28 07 05.3 | -39 |
| B7 90 V837 Her (Mi*) B 18 43 36.47 +13 57 22.8 -9 B8 72 IRC-20427 (Mas) B 18 05 35.49 -21 13 42.2 17 B8 73 IRC-10395 (IR) B 18 06 42.88 -08 13 12.0 20 B8 77 V2302 Oph (Mi*) B 18 09 18.55 +09 12 15.6 -13 B8 84 OH24.7+0.2 (OH*) B 18 35 29.20 -07 13 08.0 42 B9 92 V1366 Aql (Mi*) B 18 58 30.09 +06 42 57.8 20 B9 98 UV Cyg (sr*) B 19 31 13.28 +43 38 13.6 33 B9 105 OH65.4+1.3 (OH*) B 19 51 21.20 +29 13 01.3 -21 B9 108 V1828 Cyg (Mi*) B 20 36 57.04 +37 52 33.9 -22 B10 101 V391 Cyg (Mi*) B 19 40 52.39 +48 47 41.5 -20 B10 106 V468 Cyg (Mi*) B 19 55 38.15 +32 45 | | 68 | | | | | |
| B8 72 IRC-20427 (Mas) B 18 05 35.49 -21 13 42.2 17 B8 73 IRC-10395 (IR) B 18 06 42.88 -08 13 12.0 20 B8 77 V2302 Oph (Mi*) B 18 09 18.55 +09 12 15.6 -13 B8 84 OH24.7+0.2 (OH*) B 18 35 29.20 -07 13 08.0 42 B9 92 V1366 Aql (Mi*) B 18 58 30.09 +06 42 57.8 20 B9 98 UV Cyg (sr*) B 19 31 13.28 +43 38 13.6 33 B9 105 OH65.4+1.3 (OH*) B 19 51 21.20 +29 13 01.3 -21 B9 108 V1828 Cyg (Mi*) B 20 36 57.04 +37 52 33.9 -2 B10 101 V391 Cyg (Mi*) B 19 40 52.39 +48 47 41.5 -20 B10 106 V468 Cyg (Mi*) B 19 55 38.15 +32 45 33.8 -45 B10 112 UX Cyg (Mi*) B 20 55 05.52 +30 24 | | 90 | | В | | | |
| B8 73 IRC-10395 (IR) B 18 06 42.88 -08 13 12.0 20 B8 77 V2302 Oph (Mi*) B 18 09 18.55 +09 12 15.6 -13 B8 84 OH24.7+0.2 (OH*) B 18 35 29.20 -07 13 08.0 42 B9 92 V1366 Aql (Mi*) B 18 58 30.09 +06 42 57.8 20 B9 98 UV Cyg (sr*) B 19 31 13.28 +43 38 13.6 33 B9 105 OH65.4+1.3 (OH*) B 19 51 21.20 +29 13 01.3 -21 B9 108 V1828 Cyg (Mi*) B 20 36 57.04 +37 52 33.9 -2 B10 101 V391 Cyg (Mi*) B 19 40 52.39 +48 47 41.5 -20 B10 106 V468 Cyg (Mi*) B 19 55 38.15 +32 45 33.8 -45 B10 112 UX Cyg (Mi*) B 20 55 05.52 +30 24 52.1 2 | | 72 | | В | | | 17 |
| B8 77 V2302 Oph (Mi*) B 18 09 18.55 +09 12 15.6 -13 B8 84 OH24.7+0.2 (OH*) B 18 35 29.20 -07 13 08.0 42 B9 92 V1366 Aql (Mi*) B 18 58 30.09 +06 42 57.8 20 B9 98 UV Cyg (sr*) B 19 31 13.28 +43 38 13.6 33 B9 105 OH65.4+1.3 (OH*) B 19 51 21.20 +29 13 01.3 -21 B9 108 V1828 Oyg (Mi*) B 20 36 57.04 +37 52 33.9 -2 B10 101 V391 Cyg (Mi*) B 19 40 52.39 +48 47 41.5 -20 B10 106 V468 Cyg (Mi*) B 19 55 38.15 +32 45 33.8 -45 B10 112 UX Cyg (Mi*) B 20 55 05.52 +30 24 52.1 2 | | | | | | | |
| B8 84 OH24.7+0.2 (OH*) B 18 35 29.20 -07 13 08.0 42 B9 92 V1366 Aql (Mi*) B 18 58 30.09 +06 42 57.8 20 B9 98 UV Cyg (sr*) B 19 31 13.28 +43 38 13.6 33 B9 105 OH65.4+1.3 (OH*) B 19 51 21.20 +29 13 01.3 -21 B9 108 V1828 Cyg (Mi*) B 20 36 57.04 +37 52 33.9 -2 B10 101 V391 Cyg (Mi*) B 19 40 52.39 +48 47 41.5 -20 B10 106 V468 Cyg (Mi*) B 19 55 38.15 +32 45 33.8 -45 B10 112 UX Cyg (Mi*) B 20 55 05.52 +30 24 52.1 2 | | 77 | | в | | | |
| B9 92 V1366 Aql (Mi*) B 18 58 30.09 +06 42 57.8 20 B9 98 UV Cyg (sr*) B 19 31 13.28 +43 38 13.6 33 B9 105 OH65.4+1.3 (OH*) B 19 51 21.20 +29 13 01.3 -21 B9 108 V1828 Cyg (Mi*) B 20 36 57.04 +37 52 33.9 -2 B10 101 V391 Cyg (Mi*) B 19 40 52.39 +48 47 41.5 -20 B10 106 V468 Cyg (Mi*) B 19 55 38.15 +32 45 33.8 -45 B10 112 UX Cyg (Mi*) B 20 55 05.52 +30 24 52.1 2 | | 84 | | в | 18 35 29.20 | | |
| B9 105 OH65.4+1.3 (OH*) B 19 51 21.20 +29 13 01.3 -21 B9 108 V1828 Cyg (Mi*) B 20 36 57.04 +37 52 33.9 -2 B10 101 V391 Cyg (Mi*) B 19 40 52.39 +48 47 41.5 -20 B10 106 V468 Cyg (Mi*) B 19 55 38.15 +32 45 33.8 -45 B10 112 UX Cyg (Mi*) B 20 55 05.52 +30 24 52.1 2 | B9 | 92 | | В | 18 58 30.09 | +06 42 57.8 | 20 |
| B9 105 OH65.4+1.3 (OH*) B 19 51 21.20 +29 13 01.3 -21 B9 108 V1828 Cyg (Mi*) B 20 36 57.04 +37 52 33.9 -2 B10 101 V391 Cyg (Mi*) B 19 40 52.39 +48 47 41.5 -20 B10 106 V468 Cyg (Mi*) B 19 55 38.15 +32 45 33.8 -45 B10 112 UX Cyg (Mi*) B 20 55 05.52 +30 24 52.1 2 | В9 | 98 | UV Cvg (sr*) | в | 19 31 13.28 | +43 38 13.6 | 33 |
| B9 108 V1828 Cyg (Mi*) B 20 36 57.04 +37 52 33.9 -2 B10 101 V391 Cyg (Mi*) B 19 40 52.39 +48 47 41.5 -20 B10 106 V468 Cyg (Mi*) B 19 55 38.15 +32 45 33.8 -45 B10 112 UX Cyg (Mi*) B 20 55 05.52 +30 24 52.1 2 | | 105 | • - | | | | |
| B10 101 V391 Cyg (Mi*) B 19 40 52.39 +48 47 41.5 -20 B10 106 V468 Cyg (Mi*) B 19 55 38.15 +32 45 33.8 -45 B10 112 UX Cyg (Mi*) B 20 55 05.52 +30 24 52.1 2 | | 108 | | в | | | |
| B10 106 V468 Cyg (Mi*) B 19 55 38.15 +32 45 33.8 -45 B10 112 UX Cyg (Mi*) B 20 55 05.52 +30 24 52.1 2 | | | | | | | |
| B10 112 UX Cyg (Mi*) B 20 55 05.52 +30 24 52.1 2 | | | | | | | |
| | | | | | | | |
| | B10 | 121 | R Aqr (Sy*) | | 23 43 49.46 | -15 17 04.1 | -21 |

Scan pattern in KaVA/ESTEMA observations

First two hours of observation block



6-9 hours per session for 4-6 sources 20 pairs of K/Q-band sessions with VERA

ESTEMA results as to 2016 September

Observations and data handling

- O 95% of observations scheduled as to 2016 October
- 0 85% of observations complete
- ⊘ 80% of correlation complete
- 70% of inspection complete
- O Ingest processing ongoing
- Calibration pipeline in development/tested
- Ingest pipeline script still in development
- Ø Basic data calibration pipeline tested
 - O Tools for scientific analysis tools in design discussion

ESTEMA fringe inspection

 O H₂O masers: 19/44 fringe detections
2⁸SiO J=1→0 v=1&2 masers: 17/40 fringe detections
7 stars simultaneously detectable in H₂O and ²⁸SiO J=1→0 v=1&2 masers
2⁹SiO J=1→0 v=0 masers: not yet inspected (KVN or VERA/OCTAVE wide only)
2⁸SiO J=2→1 and 3→2 v=1 masers: not yet inspected (KVN orly)

O ²⁸SiO J=1→0 v=3 masers:

not yet inspected (VERA/OCTAVE wide only)

Fringe detection rates slightly lower than planned in proposal submission

Future perspectives

Proposing one of KaVA "legacy" projects
Targeting 20 stars for one decade monitoring
biweelky—quarter monthly maser mapping
light curve phase spacing: Δ φ 1/20
Observations for <500 hours/year

OProposing by the middle of 2017

O Final goals

O Detecting pulsation-driven shock waves and/or periodic behaviors in circumstellar envelopes

O Finding evolution of inhomogeneity in CSEs

O Synergies with

★ALMA (thermal/sub-mm masers)
★VLTI (star images)
★JASMINE (stellar astrometry)
★SKA-VLBI (OH masers)