Transition Observing and Science

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Atacama Large Millimeter/submillimeter Array
Expanded Very Large Array
Robert C. Byrd Green Bank Telescope
Very Long Baseline Array

NRAO

Transition Observing

- A primary requirement of the EVLA Project is to continue VLA operations throughout construction
- This we have achieved, with astronomical observations using ~60% of all available hours
- EVLA antennas included in general observing from August 1, 2006, onwards
- Two impacts:
  - New capabilities continuously provided to the user community
  - Some technical issues with the "transition" system that affect observing and data reduction procedures

General Capabilities: Receivers

- Currently 20 operating EVLA antennas
- Expanded tuning ranges
  - L-band: 1—2 GHz (interim receiver, limited by old OMTs)
  - C-band: 4—8 GHz (6 EVLA antennas; rest are interim receivers, polarization purity outside 4.5—5 GHz poor due to old OMTs)
  - K-band: 18—26.5 GHz (all EVLA antennas)
  - Ka-band: 26.5—40 GHz (8 EVLA antennas)
  - Q-band: 40—50 GHz (all EVLA antennas)
- New frequencies are available with standard VLA correlator set-ups; IFs separated by up to 10 GHz (Ka/Q-bands)

General Capabilities: Receivers

- Declining capability at 15 GHz, since the 15 GHz receivers will not be installed in the EVLA antennas until close to the end of the construction project, and the number of VLA antennas is steadily decreasing
  - Users requiring 2cm continuum are advised to consider using the low frequency end of K-band (18 GHz) instead during the transition
- Reduced 327 MHz capability due to an incompatibility of existing receivers with EVLA electronics

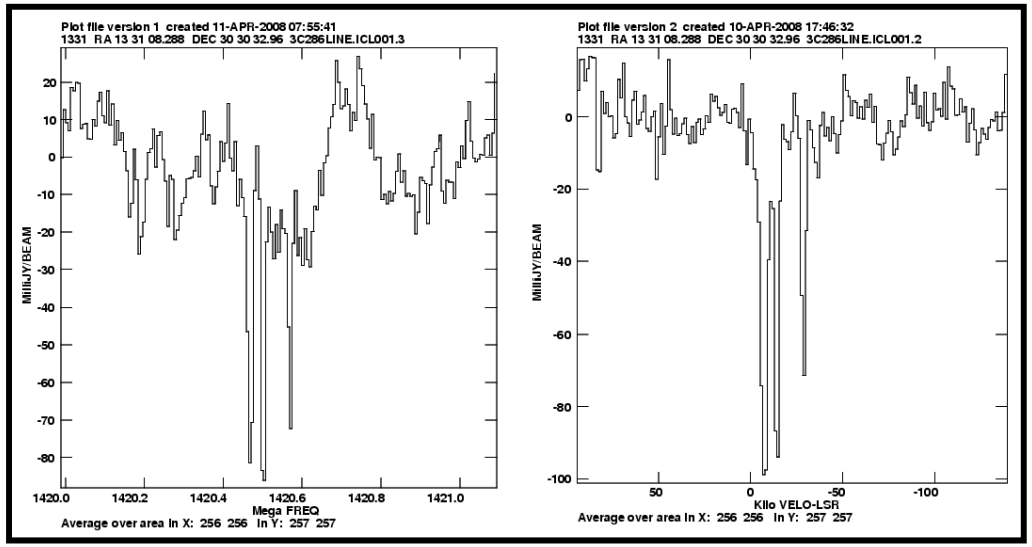
General Capabilities: Obs Prep

- Observation preparation:
  - An Observation Preparation Tool (OPT) is being developed for the EVLA and will be the sole means of setting up the WIDAR correlator
    - The OPT functionality has been expanded to cope with VLA correlator set-ups for Ka-band observations with EVLA antennas
    - Has been tested by outside users and is being used for current "exploratory" Ka-band observations
      - Initial feedback is very positive
  - JObserve remains the main tool for preparing VLA observations, but it cannot deal with the expanded tuning ranges available with the EVLA
    - Users contact NRAO staff for help with setting up non-standard observations during the VLA/EVLA transition
    - The EVLA OPT can be used for expanded tuning capability

Data Quality

- Large fraction of EVLA antenna hours (>70%) means that data quality is an extremely important issue for transition observing
  - amplitude and phase stability excellent
  - bandpasses are much better than VLA

VLA



EVLA: HI absorption line with peak $\tau \sim 10^{-3}$

Availability of Observing Modes

- All commonly-used observing modes are available
  - standard interferometer
  - reference pointing
  - raster modes (mosaicing, holography, fast switching)
  - planets
  - VLBI modes (phased array, single-dish VLBI)
  - multiple subarrays
  - tipping scans
- Might work but hasn't been fully tested
  - solar

Temporary Transition-Specific Issues

- Continuum observations: amplitude closure errors due to bandpass mismatch between VLA and EVLA antennas
  - *requires revised observing and data reduction procedures to calibrate closure error*
- Doppler tracking for spectral line observations: phase jumps on VLA-EVLA baselines caused by VLA fine tuning Fluke synthesizers on change of frequency or bandwidth
  - *requires revised observing and data reduction procedures for projects requiring VLA-EVLA baselines to apply Doppler corrections in post-processing*
- Aliasing: affects bottom ~0.5 MHz of baseband, caused by digital-to-analog hardware that enables use of EVLA antennas with VLA correlator
  - *very narrow bands compromised, especially for EVLA-only transition observations; revised observing and data reduction procedures required; additional time allocated to projects affected*

Notifying the Users of Transition Issues

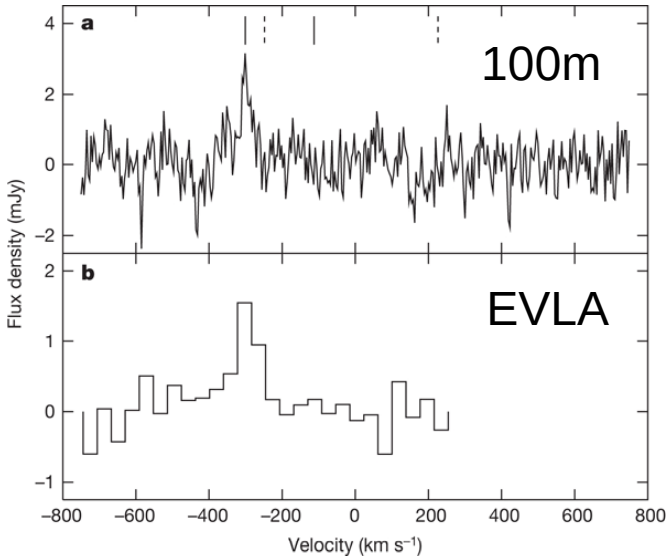
- "News for Proposers" ahead of each proposal deadline
  - includes current observing capabilities, transition issues, impact of EVLA construction project and commissioning, future plans (e.g., change in direction of configuration cycle)
    - http://www.vla.nrao.edu/astro/guides/news/
- All proposals undergo EVLA technical review, sent to PIs along with referee reports
- "EVLA return" web page
  - gives details of all transition problems and advice on setting up observations and reducing data
    - http://www.vla.nrao.edu/astro/guides/evlareturn/

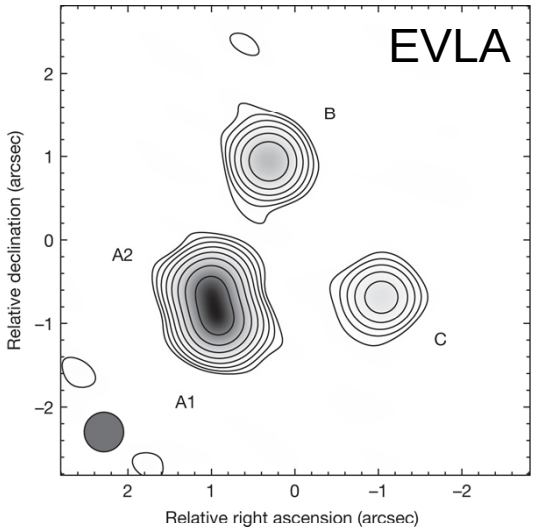
Archive integrity

- There will be a web page attached to the VLA archive interface outlining historical problems with data
- Prototype available at:
  - http://www.aoc.nrao.edu/~lsjouwer/archissue/

New EVLA/Transition Science

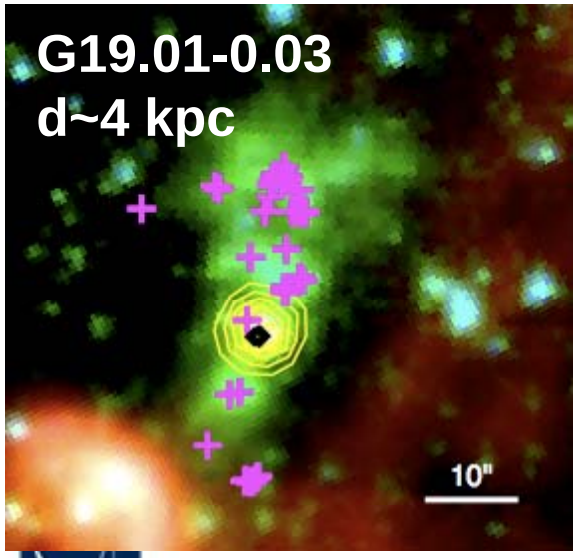
- Redshifted H_2O megamasers
  - Impellizzeri et al. 2008, Nature, 456, 927
    - z = 2.64 lensed quasar MG J0414+0534, H_2O line redshifted to 6.1 GHz
    - detected by Effelsberg 100m, imaged by EVLA

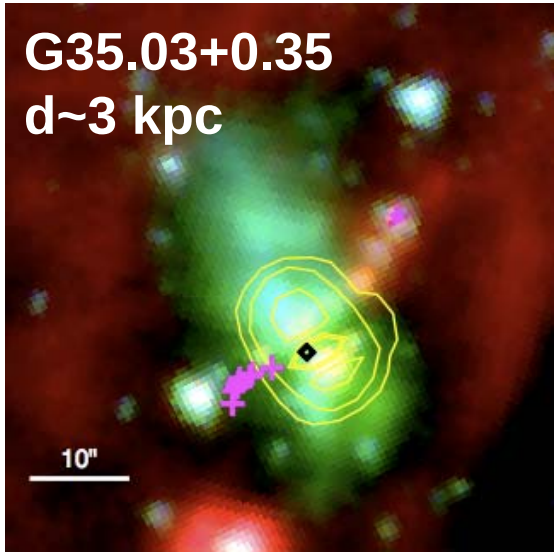


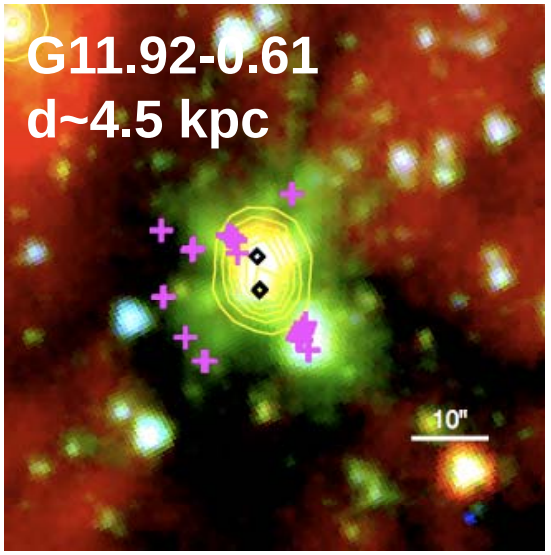


New EVLA/Transition Science

- 6.7 GHz type II CH_3OH masers as tracers of massive star formation
  - Cyganowski et al., in prep.
    - show that "extended green objects" in Spitzer/GLIMPSE are associated with massive protostars

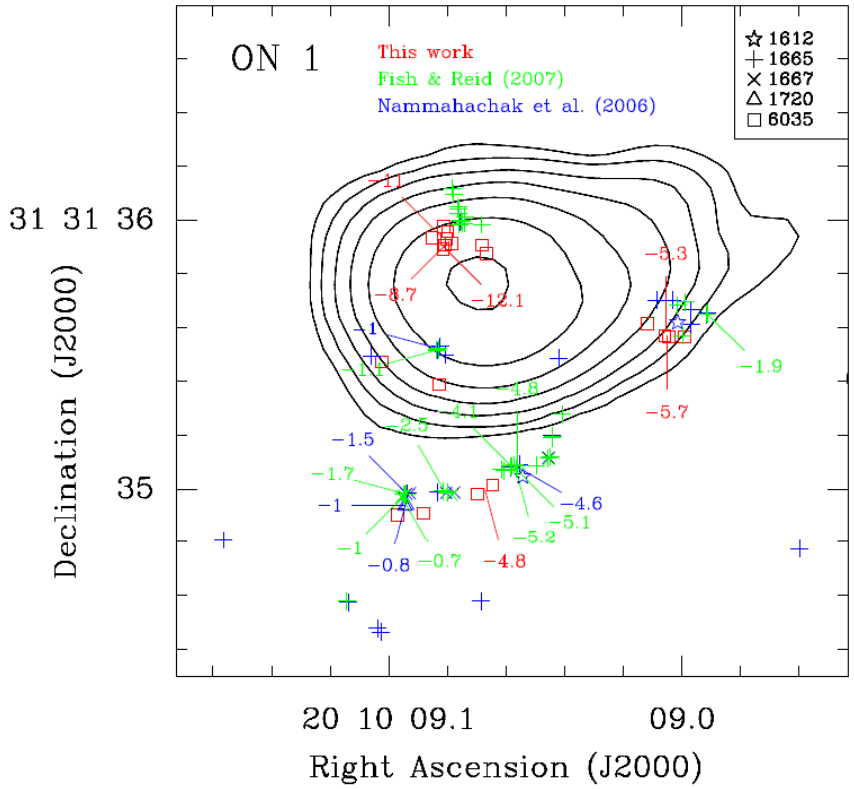






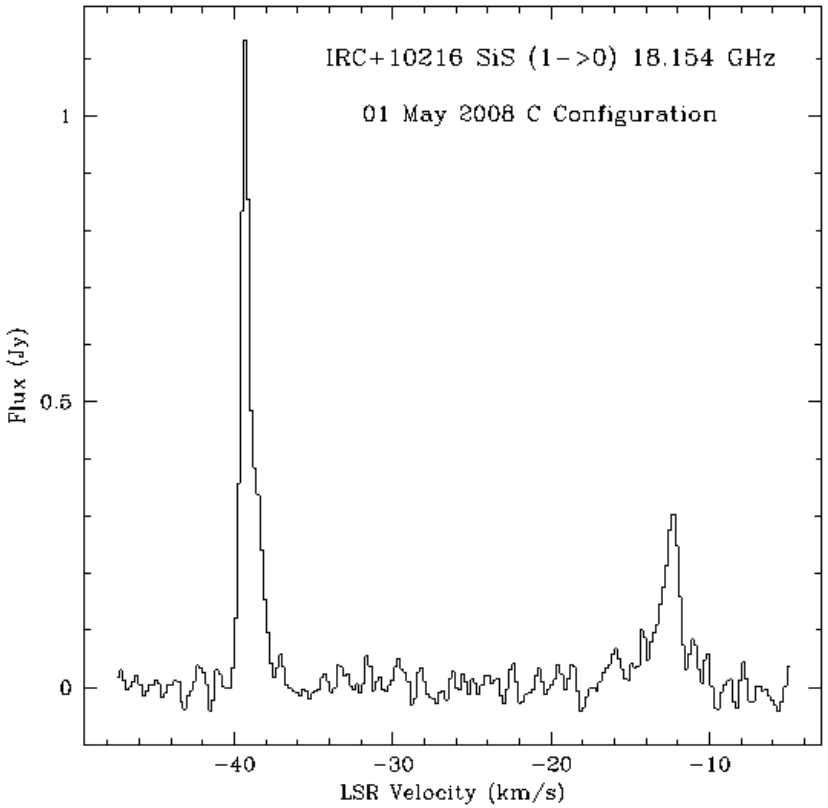
New EVLA/Transition Science

- Excited 6.030/6.035 GHz OH masers in stellar envelopes and star forming regions
  - Fish 2007, ApJ, 669, L81
    - Zeeman effect in OH 6.035 GHz masers in the massive star-forming region ON1 reveal line-of-sight magnetic field of ~10 mG
    - Linear polarization will need EVLA C-band receivers now available



A new maser in IRC+10216

- SiS(J=1–0) at 18.154 GHz
  - Claussen (in prep.)
    - Observed previously with single-dish telescopes; imaging in the A-configuration gives T_B~33,000 K⇒ must be a maser
    - Provides a new tool for tracing kinematics of circumstellar envelopes at high spatial resolution



Ka-band science

- Ka-band science proposed for special call for exploratory proposals (began March 2, 2009, ongoing)
  - 36 GHz methanol masers in the circumnuclear disk (7 hrs)
  - What sources are responsible for the observed very hot NH_3 in Orion BN/KL? (7 hrs)

Ka-band science

- Ka-band science proposed for Feb 1 deadline (CnB/C-configs)
  - Imaging CO(1–0) in lensed submm galaxies (60 hrs)
  - On the state and fate of molecular gas in IR-bright galaxies [redshifted CO(1–0)] (232 hrs)
  - Mapping CO(1–0) in the Cloverleaf and SMM J14011+0252 (36.5 hrs)
  - An EVLA study of CO J=1–0 line emission in gas-rich galaxies at $z \sim 2.5$ (15.5 hrs)
  - A confirmation of CO line emission in the most distant radio galaxy at $z = 5.2$ [redshifted CO(2–1)] (18 hrs)

Ka-band window covers: *CO(1–0) from z = 1.88 to 3.35*
CO(2–1) from z = 4.76 to 7.7

Ka-band science

- Ka-band science proposed for Feb 1 deadline (CnB/C-configs)
  - Dense gas excitation in nuclear starbursts at redshift 4 [redshifted HCN(2-1)] (24 hrs)
  - A search for molecular oxygen at z ~ 0.88582 (7 hrs)
  - The 36 GHz methanol maser Zeeman effect (2 hrs)

Ka-band window covers: *HCN(2–1) from z = 1.22 to 2.34*
O_2 (56.265 GHz) from z = 0.41 to 1.12