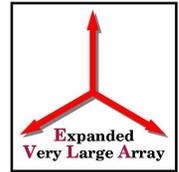




The EVLA: A North American Partnership



National Research
Council Canada

Conseil national
de recherches Canada



The EVLA Project on the Web
<http://www.aoc.nrao.edu/evla/>



New Science Impact of the EVLA Supercomputing Correlator

P. Dewdney

*Herzberg Institute of Astrophysics
National Research Council Canada*

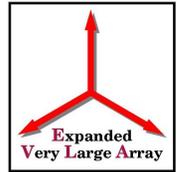
M. P. Rupen

National Radio Astronomy Observatory





Key EVLA Processing Capabilities



Deep Imaging
Polarization

- ✓ 8 GHz Bandwidth (dual polarization).
- ✓ Full polarization processing.
- ✓ Wide-field imaging.

Narrow spectral lines
Wideband searches

- ✓ 16,000 channels at max. bandwidth (BW).
- ✓ $>10^5$ channels at narrow BWs.
- ✓ Spectral resolution to match any linewidth.
- ✓ Spectral polarization (Zeeman Splitting).

Flexibility
Many resources

- ✓ 8 tunable 2 GHz wide bands.
- ✓ Each band - 16 tunable sub-bands.
- ✓ Sub-band – independent spectral resolution.
- ✓ Simultaneous line and continuum.

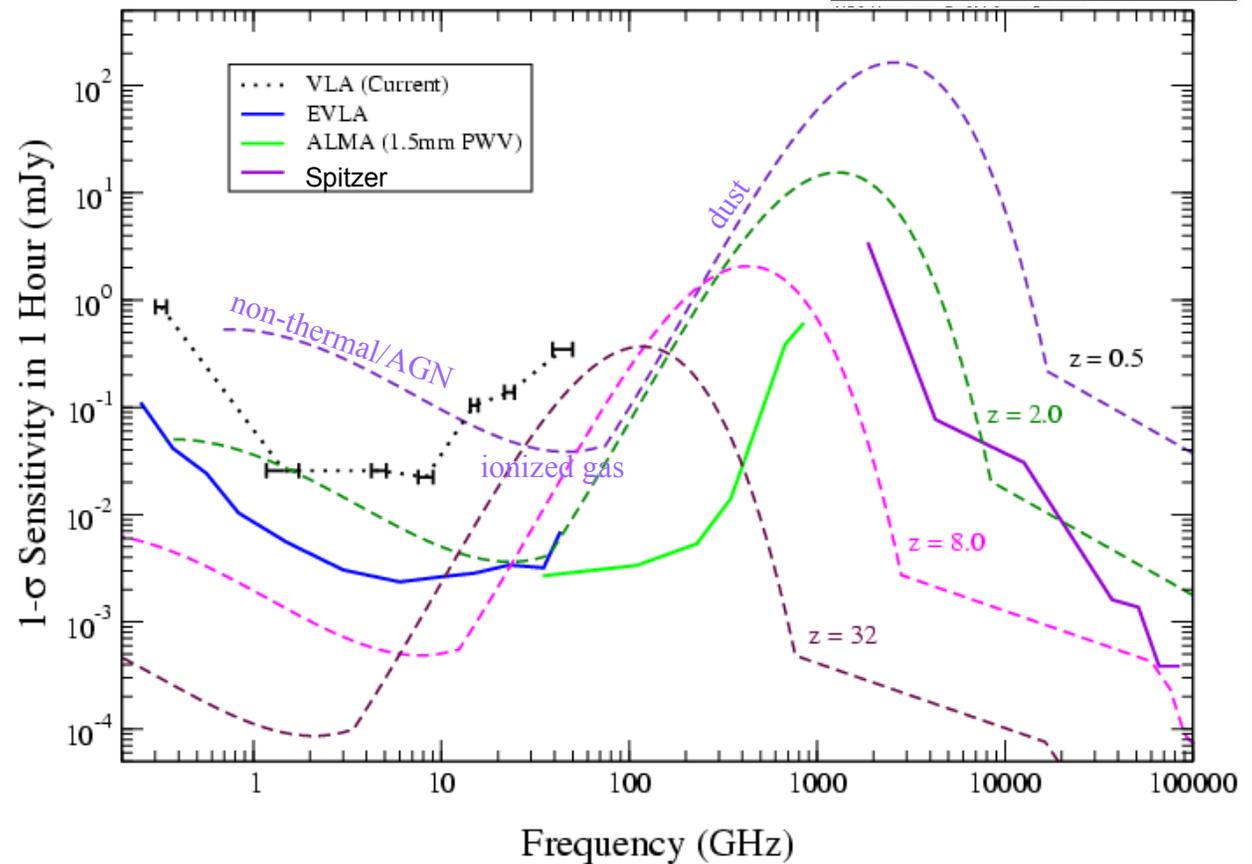
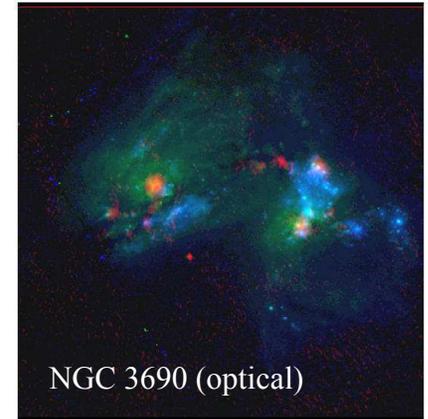
High time resolution

- ✓ 1000 pulsar “phase bins”.
- ✓ “Single-dish” data output to user instruments.
- ✓ Very fast time sampling (20 μ s).



Star-Forming Galaxies at High Redshift

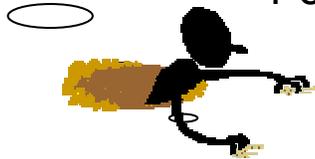
- Enabled by enhanced sensitivity of EVLA.
- Complementary to ALMA & Spitzer.
- K-correction compensates for z -losses in the 45 GHz band.
- Resolution 50 mas. (200 pc @ $z=10$).
- Imaging: 1 arcsec over 30 arcmin @ 1.5 GHz.
- EVLA/ALMA gives complete galaxy SED's:
 - 3 orders of magnitude of frequency,
 - Large range of redshift.



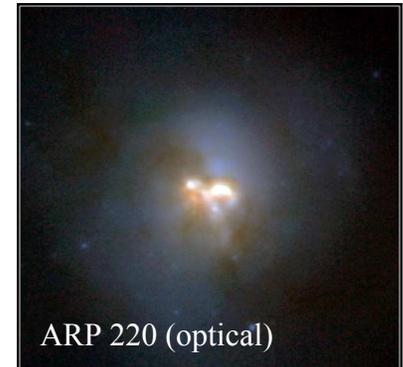
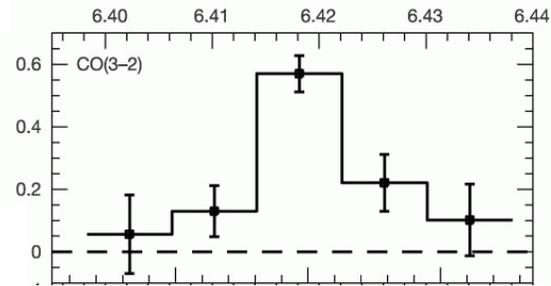
Arp220 SED scaled to high redshifts.

CO Surveys of High-z Star-Forming Galaxies

This is a struggle!



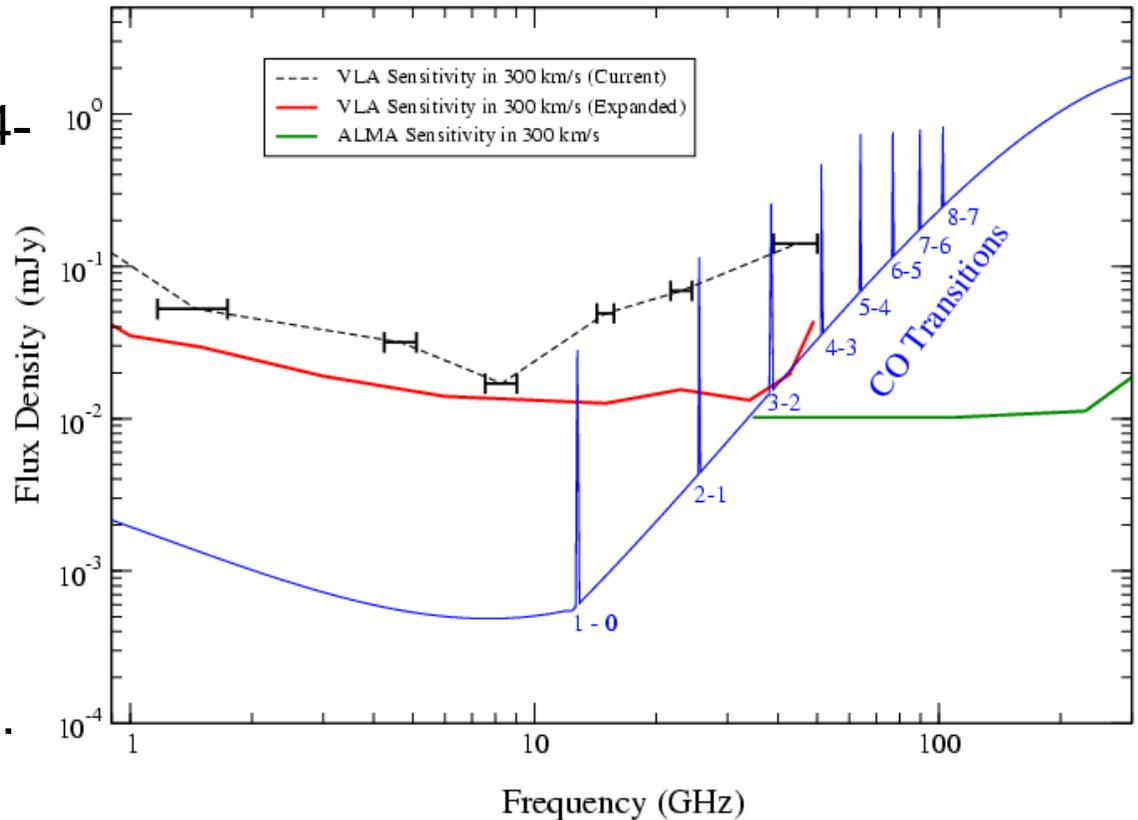
CO_{J=3-2}
 Z = 6.42
 Peak ~ 0.6 mJy



Spectral Line Sensitivity of the VLA

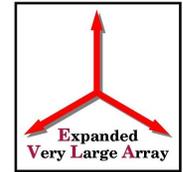
Arp 220 at z = 8, smoothed to 300 km/sec resolution

- EVLA sensitivity (red line) in 8 hrs (1 σ).
- Detects (J=1-0, 2-1, 3-2, 4-3).
- More transitions at high z.
- Precise redshift not necessary in advance.
- Spectral resolution will match channel to line-width.
- Other lines: HCN, HCO⁺...





Setup for CO Z-Search

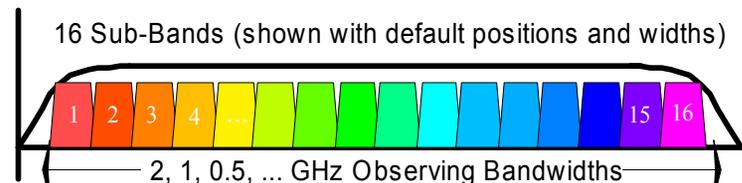
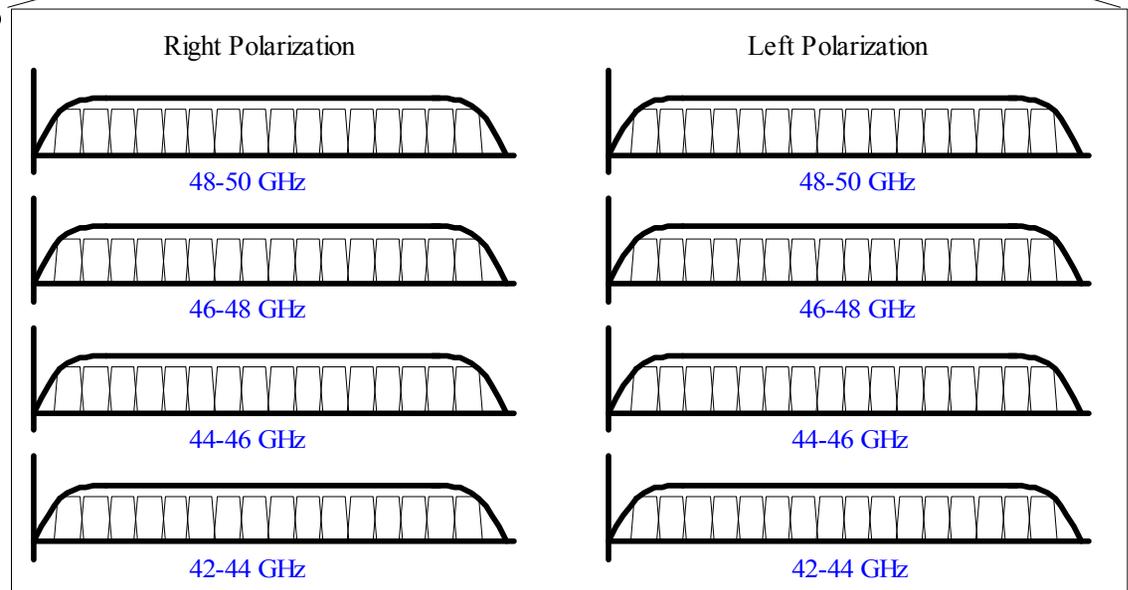


Sky Frequency Bands

1-2	2-4	4-8	8-12	12-18	18-27	27-40	40-50	GHz
L	S	C	X	U	K	Ka	Q	

8 tunable IF Bands

- 40-50 GHz band provides lowest redshift.
- $z = 1.4$ to 1.9 for $J=1-0$.
- $z = 3.8$ to 4.8 for $J=2-1$.
- $\Delta v \sim 5.0 \text{ km s}^{-1}$ (1 MHz).
- 200 km-s^{-1} galaxy would occupy ~ 40 channels.
- Interferometry
 - High resolution imaging.
 - Good spectral baselines.

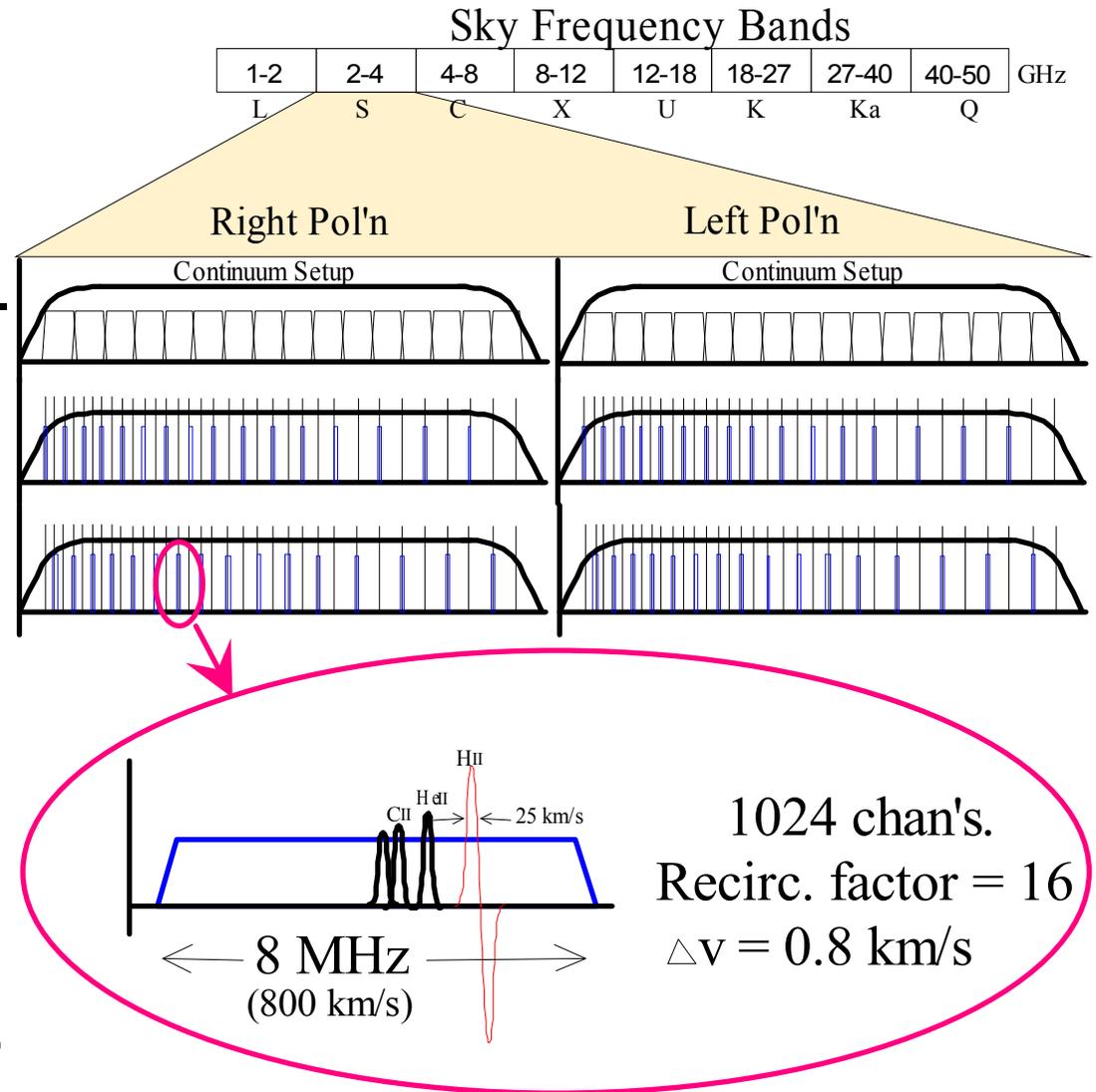


Note: Sub-bands can be seamlessly joined across each observing bandwidth.



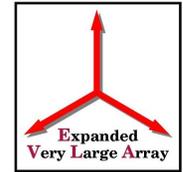
Magnetic Fields in Star-Forming Regions

- ~ 30 H⁺ radio recomb. lines in one observation.
- “Stack” lines to improve sensitivity.
- H⁺, He⁺, C⁺ recomb. lines.
- EVLA resolution provides images of:
 - gas density,
 - temperature,
 - metallicity,
 - B-fields (Zeeman).
- Sensitivity (12 hr, 5σ):
 - $\Delta S_{\text{line}} \sim 0.1$ mJy (stacked, integral)
 - $\Delta B \sim 150$ μ Gauss.
- Orion, W3, Gal. Center ...





Hundreds of Spectral Lines



- Kaifu, et al., TMC-1, 2004.
- Nobeyama spectral scan.
- 414 lines (8 to 50 GHz)
- 38 species.
- Some likely to show Zeeman splitting.
- “D-array” EVLA
 - Resolution,
 - Spectral baseline stability
 - Imaging.
- EVLA can observe **8 GHz** at one time – an average of 80 lines --- at **10 km/s** velocity res’n (30 GHz)
- EVLA Correlator can “target” many (~60) lines at once.

T_A^*

1-2	2-4	4-8	8-12	12-18	18-27	27-40	40-50	GHz
L	S	C	X	U	K	Ka	Q	

