EVLA Sensitivity & Survey Speed

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Sensitivity in 12 hours

Green shows deepest image ever made (as of 1999) -- 1.9 microJy/bm at 8.5 GHz (152 hrs; Richards et al.) -- 3 hours with the EVLA!

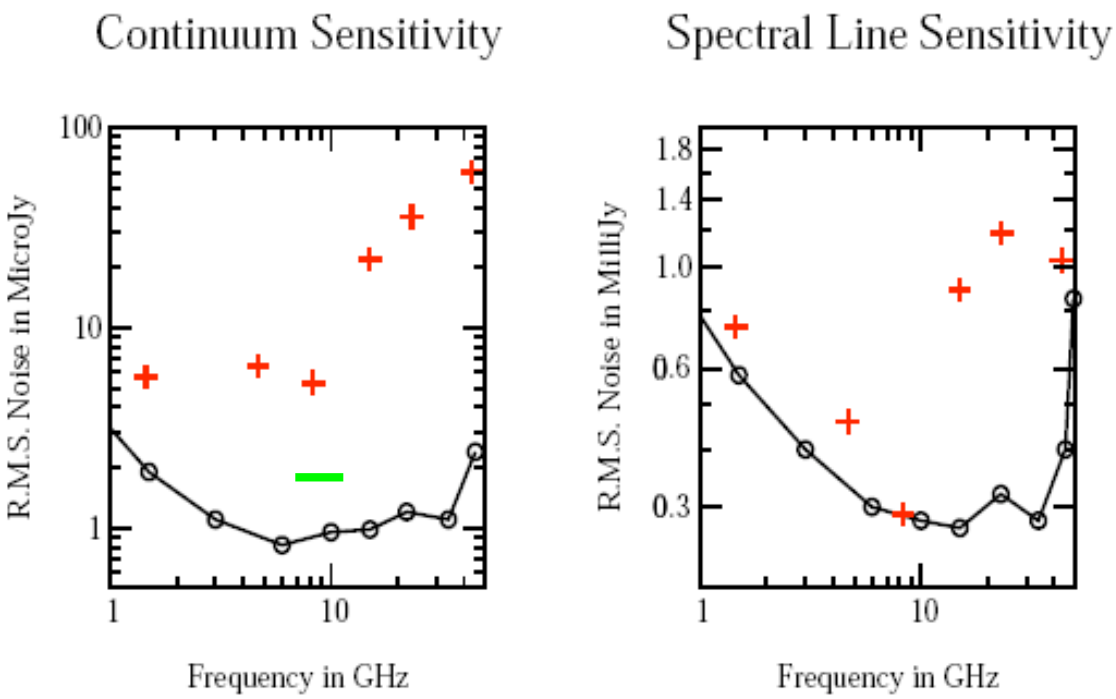


Figure 3.1: The current (+), and projected (o) continuum (left) and spectral line (right) point source sensitivity (1σ in 12 hours) of the VLA after the Ultrasensitive Array is completed. For the continuum plot, the bandwidths of Table 3.1 are assumed. For the spectral line plot, the assumed bandwidth corresponds to a velocity width of 1 km/sec. The width of the '+' symbols demonstrates the approximate range of tuning with the current VLA. The EVLA will be continuously tunable over the entire band.

Point source sensitivity in 2min/12hrs

Table 3.1: **Frequency Coverage and Point Source Sensitivity of the Ultrasensitive Array.** Assumes dual-polarization observations with 27 antennas.

Band	Freq. [GHz]	Freq. Range [GHz]	T_{sys} [K]	η	Continuum $\Delta\nu$ [GHz]	Continuum rms noise [μJy] 2 min	Continuum rms noise [μJy] 12 hr	Line (1 km/sec) $\Delta\nu$ [kHz]	Line (1 km/sec) rms noise [mJy] 2 min	Line (1 km/sec) rms noise [mJy] 12 hr
L	1.5	1.0– 2.0	26	0.50	0.5	36	1.9	5	11	0.58
S	3.0	2.0– 4.0	29	0.62	1.5	21	1.1	10	7.6	0.40
C	6.0	4.0– 8.0	31	0.60	3.0	16	0.82	20	5.7	0.30
X	10	8.0–12.0	34	0.56	3.0	18	0.95	33	5.1	0.28
U	15	12.0–18.0	39	0.54	4.0	19	0.98	50	5.1	0.27
K	22	18.0–26.5	54	0.51	6.0	23	1.2	74	6.1	0.32
K_a	33	26.5–40.0	45	0.39	8.0	21	1.1	111	5.3	0.28
Q	45	40.0–50.0	66	0.34	5.0	46	2.4	150	7.6	0.40

Explanation of Table Entries

η: a general efficiency factor, including both aperture efficiency and correlator losses. Assumes a two-bit, four-level correlator.

$\Delta\nu$: the frequency width, per polarization, used in calculating the noise. For the continuum case, the width assumed is limited by the RFI environment at low frequencies, and by atmospheric opacity at the highest frequencies; for the spectral line case, this width corresponds to 1 km/sec at the central frequency of the band.

rms noise: the root-mean-square (1σ) thermal noise, assuming dual-polarization observations and a data weighting scheme chosen to give low noise with a reasonably small beam size (Briggs' robustness R = 0).

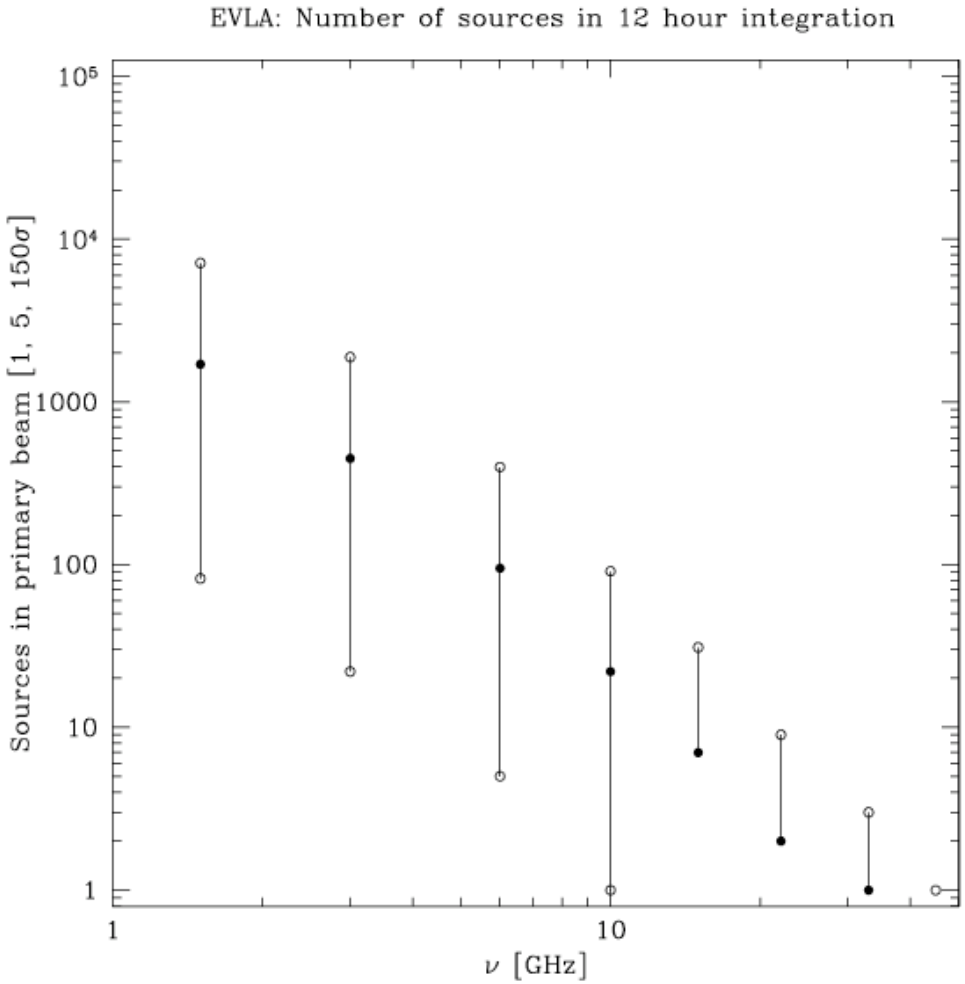
Surface brightness sensitivity in 2min/12hrs

Table 3.2: **Surface Brightness Sensitivity of the Ultrasensitive Array: A-Configuration.** For the **B**, **C**, and **D** configurations, multiply the beam size by 3.2, 10, and 32, and divide the rms noise by 10, 100, and 1000, respectively.

Freq. Range [GHz]	Synthesized Beam size [arcsec]	Continuum rms noise [K]		Line (1 km/sec) rms noise [K]	
		2 min	12 hr	2 min	12 hr
1.0- 2.0	1.6	11	0.57	3,300	170
2.0– 4.0	0.80	6.3	0.33	2,300	120
4.0– 8.0	0.40	4.8	0.25	1,700	90
8.0–12.0	0.25	5.4	0.30	1,500	84
12.0–18.0	0.17	5.7	0.30	1,500	81
18.0–26.5	0.12	6.9	0.36	1,800	96
26.5–40.0	0.08	6.3	0.33	1,600	84
40.0–50.0	0.06	14	0.72	2,300	120

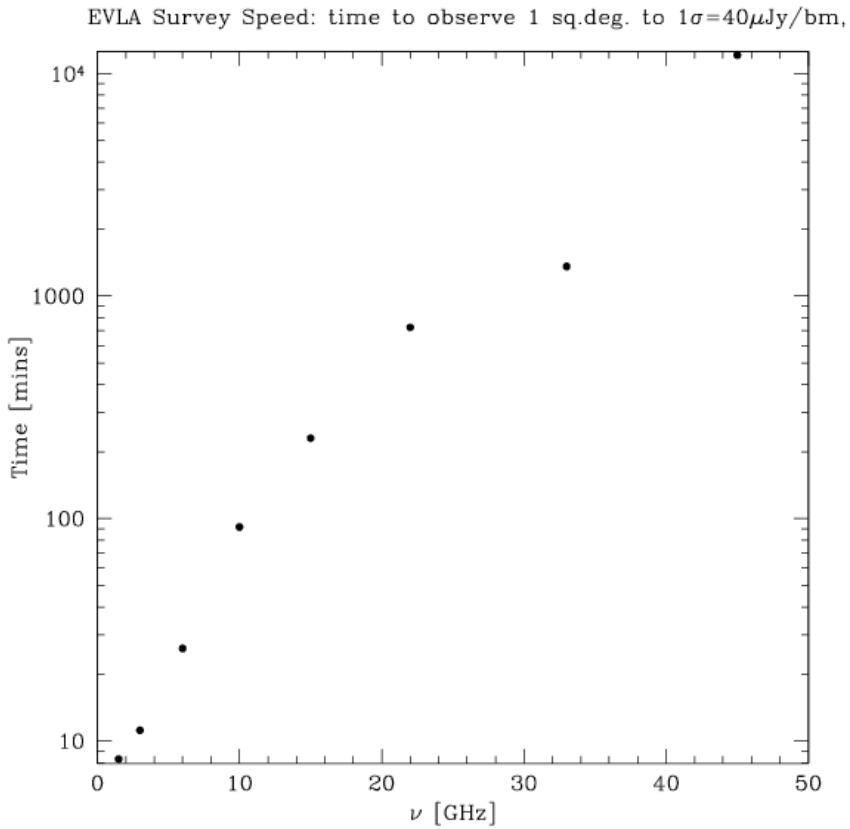
Assumes the same parameters as in Table 3.1.
Beam size: full width at half maximum for the frequency at the center of the band, assuming the same data weighting as in Table 3.1.
rms noise: the root-mean-square (1σ) thermal noise as in Table 3.1, converted to the surface brightness sensitivity assuming a source whose size is equal to the beam size.

Number of background sources in 12 hours



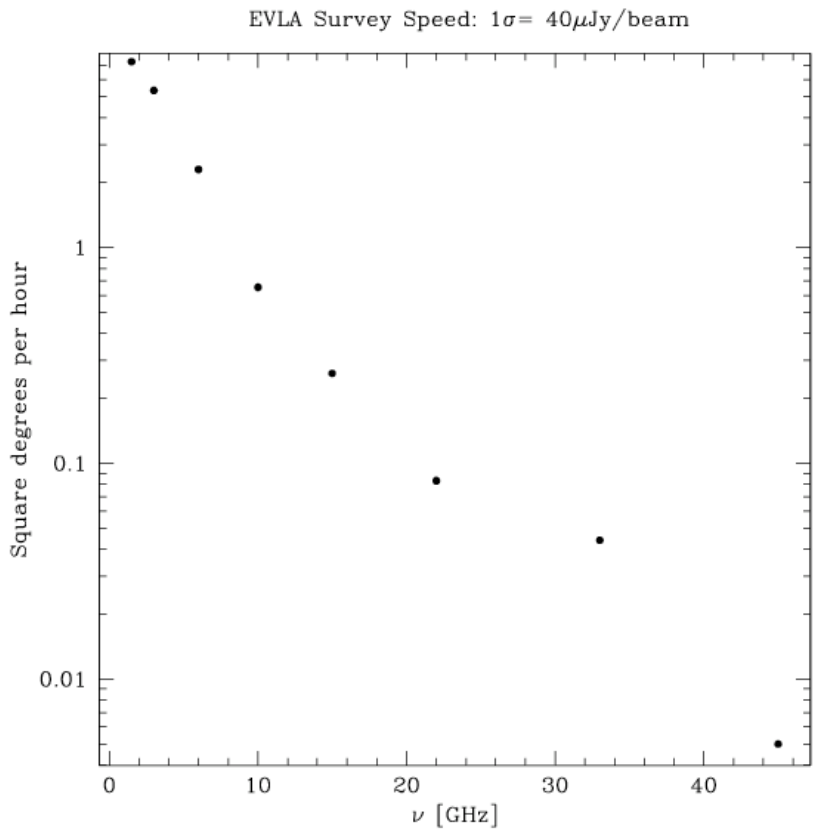
Number of background sources in the primary beam in a 12-hour integration

Survey Speed I



- Time to observe 1 square degree to 40 microJy/beam rms
  - doesn't include overhead (--> x1.5, from NVSS)
  - Rms chosen to ensure at least 20s/ptg (NVSS: 30s with 23.3s on-source)
- Note uv-coverage issues
- Assumes no overlap

Survey Speed II



- Square degrees observed per hour as a function of frequency, to an rms of 40 microJy/bm
- Assumptions as in last slide