VLA/VLBA Large Projects

Jim Ulvestad
Assistant Director, NRAO

NRAO Large Proposals (VLA/VLBA)

- Large Projects defined to be ≥ 200 hr of observing (720 ksec, or ~133 HST orbits)
  - Lower limit used to be 250-300 hr
  - Length of scientific justification is unlimited
  - “Survey” or “Large Project”
- Proposal Submission/Review
  - Deadline once per configuration cycle (16 months)
    - Next deadline is October 2, 2006
  - Anonymous referee reports from 8 “normal” VLA/VLBA referees
  - Large Proposal Review Committee (non-NRAO) meets face-to-face to evaluate proposals
  - NRAO has always followed LPRC recommendations

Large Proposal Evaluation

- Evaluation Criteria
  - Broad scientific interest
  - Data reduction plan
  - Data products from surveys; data-release plan
- Constraints on Evaluation Panel
  - Soft limit of 10%-20% of observing time to Large Proposals
    - VLA and VLBA observe 6000 and 4500 hr/yr, respectively
    - Chandra: 18% > 1 Msec; 18% in 0.3-1 Msec range
    - LPRC and Users Committee have not recommended “intermediate” category for NRAO
  - No more than 50% of observing time at one Local Sidereal Time in one VLA configuration

Past Large Proposals (see www.vla.nrao.edu/astro/)

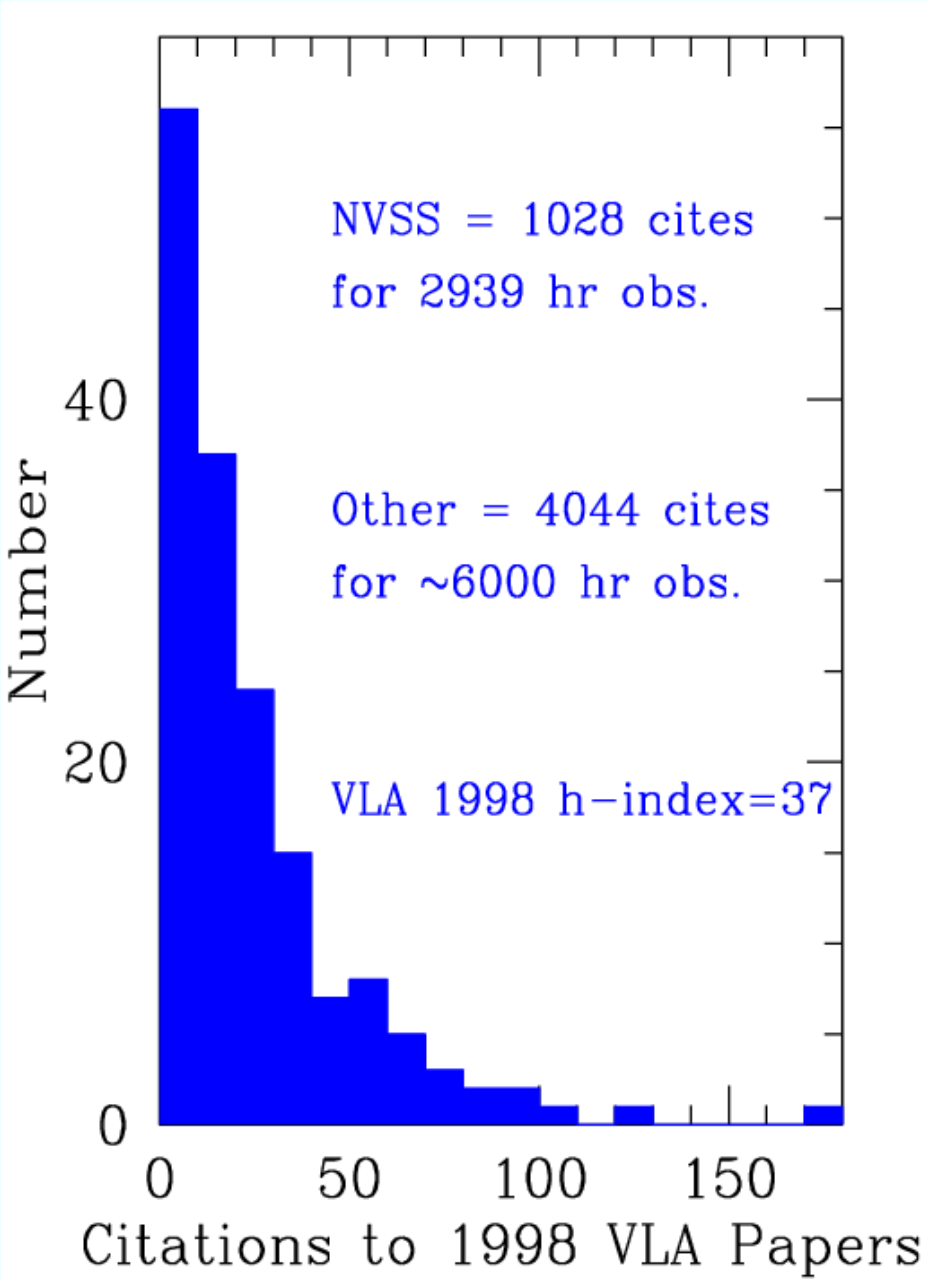
AS801	VLA COSMOS	VLA A,C	2004-2005	264 hr	E.Schinnerer
AK563	Virgo: A Laboratory for Studying Galaxy Evolution	VLA C	2004-2005	240 hr	J. Kenney
BL123	MOJAVE: Monitoring of Jets in Active galaxies with VLBA Experiments	VLBA	2004-2005	14 x24 hr	M. Lister
AW605	THINGS: The HI Nearby Galaxy Survey	VLA B,C,D	2003-2005	293 hr	F. Walter
AH810	Coordinated Radio and Infrared Survey for High-Mass Star Formation	VLA B	2005	40 hr pilot	M. Hoare
BL111	MOJAVE: Monitoring of Jets in Active galaxies with VLBA Experiments	VLBA	2002-2004	17 x 24 hr	M. Lister
AK509	Cosmic Explosions	VLA	2000-2003	30 hr/month	S. Kulkarni
BC120	Pulsar Astrometry with the VLBA	VLBA	2002-2004	300 hr	S. Chatterjee
AS687	A Deep Radio Survey of the SIRTF First-look Survey	VLA B	2001-2002	240 hr	T. Soifer
AB628, AB879, AB950	FIRST Survey	VLA B	1993-2002	3209 hr	R. Becker
AG592	HI Survey of Clusters in the Local Universe	VLA C	2001-2002	360 hr	J. van Gorkom
AP397	A 4-meter All-sky Survey	VLA BnA,B	2001	70 hr pilot	R. Perley
AT245	A Global, High Resolution HI Survey of the Milky Way	VLA D	2000	260 hr	R. Taylor
AC308	NRAO VLA Sky Survey	VLA D,DnC	1993-1996	2939 hr	J. Condon

Active Large Proposals

AH884	The Coordinated Radio and Infraed Survey for High-Mass Star Formation (The CORNISH Survey)	VLA B, BnA	2006-2007	360 hr	M. Hoare
BL137	MOJAVE II: Monitoring of Jets in Active galaxies with VLBA Experiments II. Entering the GLAST Era	VLBA	2006-2007	384 hr	M. Lister
BT085	The VLBA Imaging and Polarimetry Survey (VIPS)	VLBA	2006	195 hr	G. Taylor
BR100	The Spiral Structure and Kinematics of the Milky Way	VLBA	2005-2007	270 hr	M. Reid
AK583	Cosmic Explosions	VLA	2005-2006	20 hr/month	S. Kulkarni
AP452	VLA Low-frequency Sky Survey	VLA BnA, B	2003-2006	690 hr	R. Perley

- Two of the presently active large proposals followed from previous proposals that were given “pilot” time
- VLA (imaging) Large Proposals have tended to be in intermediate (B or C) configurations
- Approved VLA Large Proposals in 2004-2005 took a bit more than 10% of VLA time (~1300 hours observing)

Citation Rates of Large and Normal Proposals



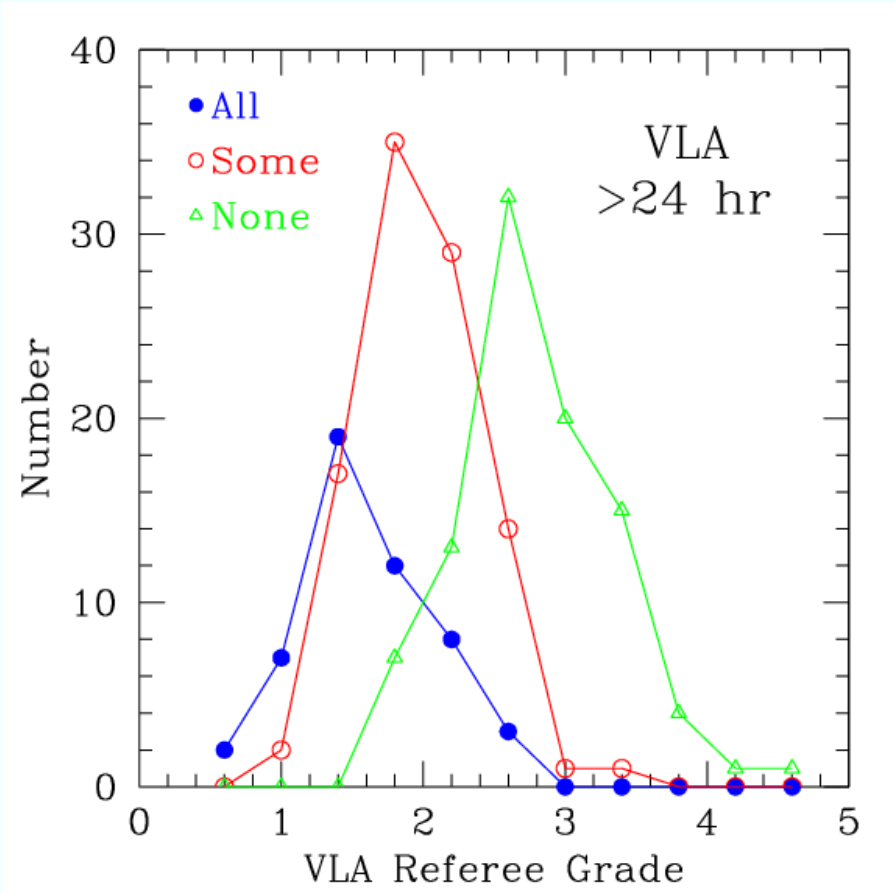
- FIRST and NVSS each have about 1000 citations for 3000 observing hours
- Typical VLA paper has higher citation rate per hour of observing
  - Chandra also has more citations/ksec for observations shorter than 100 ksec
- However, citation rate may not be a good measure of scientific impact of large projects

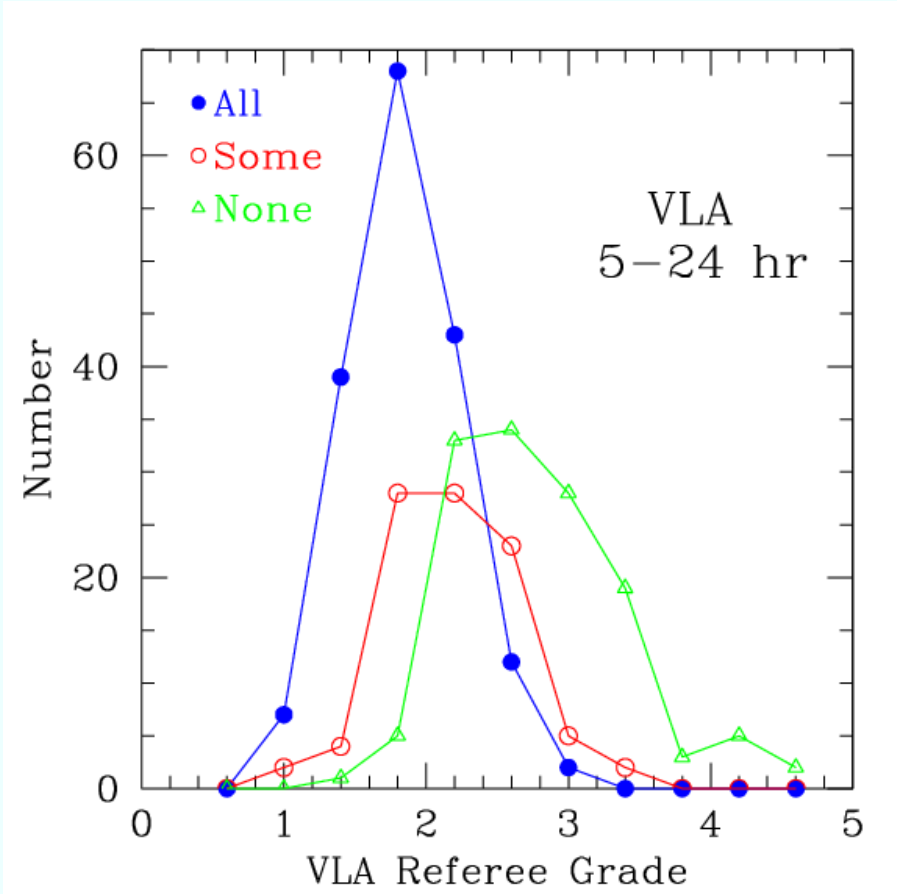
Extragalactic “Blank Field” Proposal Call

- VLA is the telescope of choice for deep radio integrations of various extragalactic fields
- Made a special proposal call for current VLA cycle, for 40-200 hr proposals
  - External evaluation, allocated time for 4/8 proposals

AM857	A Deep & Unbiased Probe of Star Formation in the GOODS Northern Field	VLA A	2006	77 hr	G. Morrison
AO201	The SWIRE Deep Field at 90cm: A Steep Spectrum MicroJy Radio Population?	VLA A,C	2006	66 hr	F. Owen
AS859	Follow-up of the COSMOS 1.4 GHz Imaging Survey: Identification of Dusty Massive Starforming Systems	VLA A	2006	60 hr	E. Schinnerer
AY164	An In-depth Investigation of the Nature of the Faint 24 Micron Spitzer Sources and 1100 Micron AzTEC Sources in the FLS Verification Strip	VLA A,B	2006	96 hr	M. Yun

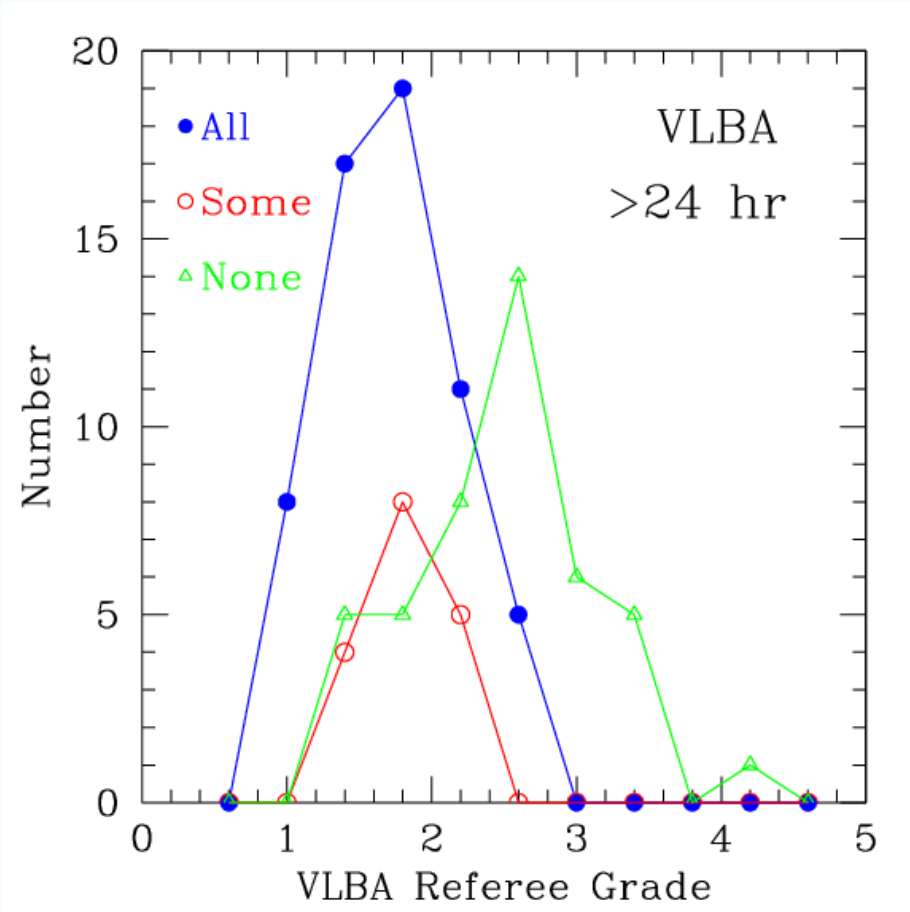
VLA Time Allocation-1

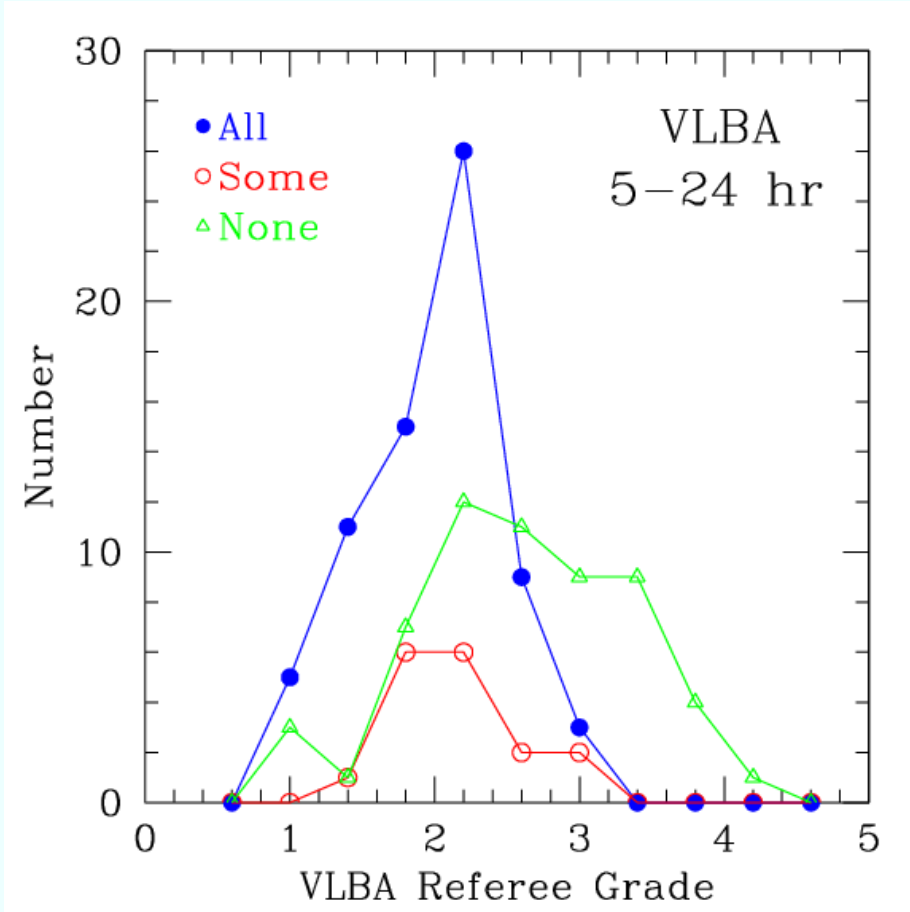




- All/Some/None: Received All/Some/None of time requested
- Some highly ranked proposals are not finished yet, others are large proposals, and others are Known Transient Proposals that were not triggered (more applicable for VLBA than for VLA)

VLBA Time Allocation





- Very few VLBA proposals request fewer than 5 hours

VLA/EVLA/VLBA Capabilities

Jim Ulvestad

VLA Frequency Coverage and Sensitivity

Wavelength (cm)	*Freq. Range (GHz)*	*Image RMS (12 hr)*	*Maximum Resolution*
400	0.073-0.0745	15 mJy	24 arcsec
90	0.305-0.337	0.17 mJy	6 arcsec
18-21	1.24-1.70	6.6 μJy	1.4 arcsec
6	4.50-5.00	6.4 μJy	0.4 arcsec
4	8.08-8.75	5.3 μJy	0.24 arcsec
2	14.65-15.32	>30 μJy	0.14 arcsec
1.3	21.20-25.20	12 μJy	0.08 arcsec
0.7	40.50-44.50	30 μJy	0.05 arcsec

- Sensitivity degrades slightly due to EVLA antennas undergoing retrofit
  - 2 cm receivers will not be replaced until after 2010

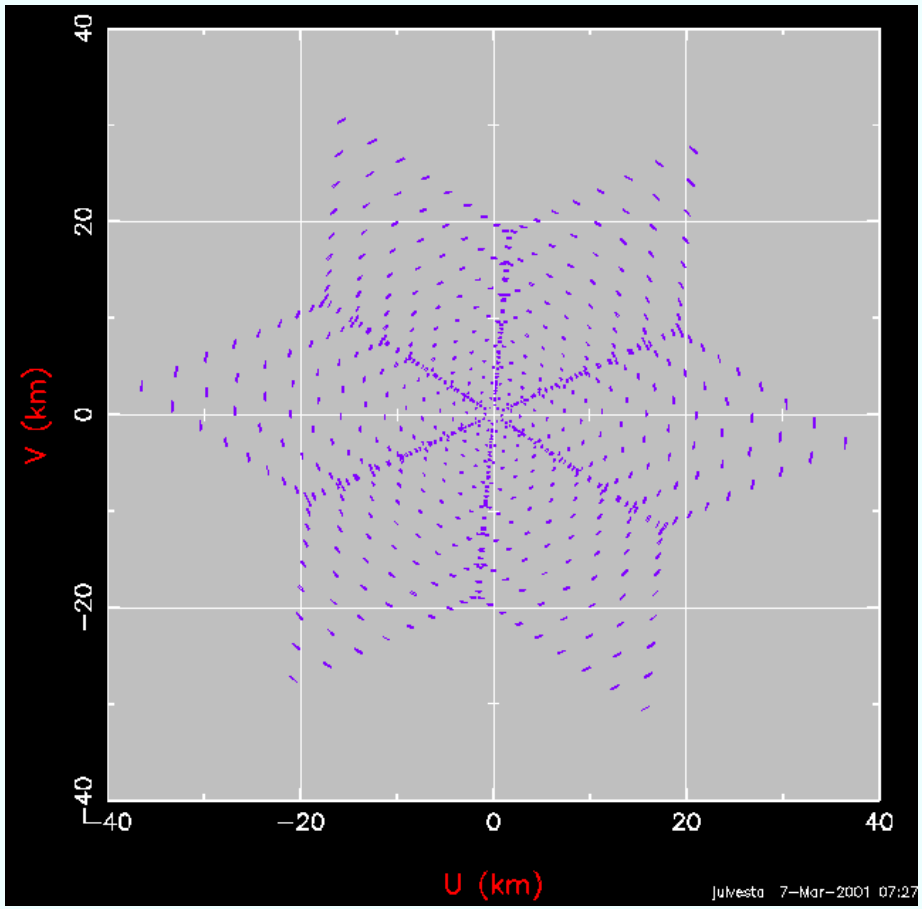
Angular Resolution and Continuum Sensitivity in B/C Configurations

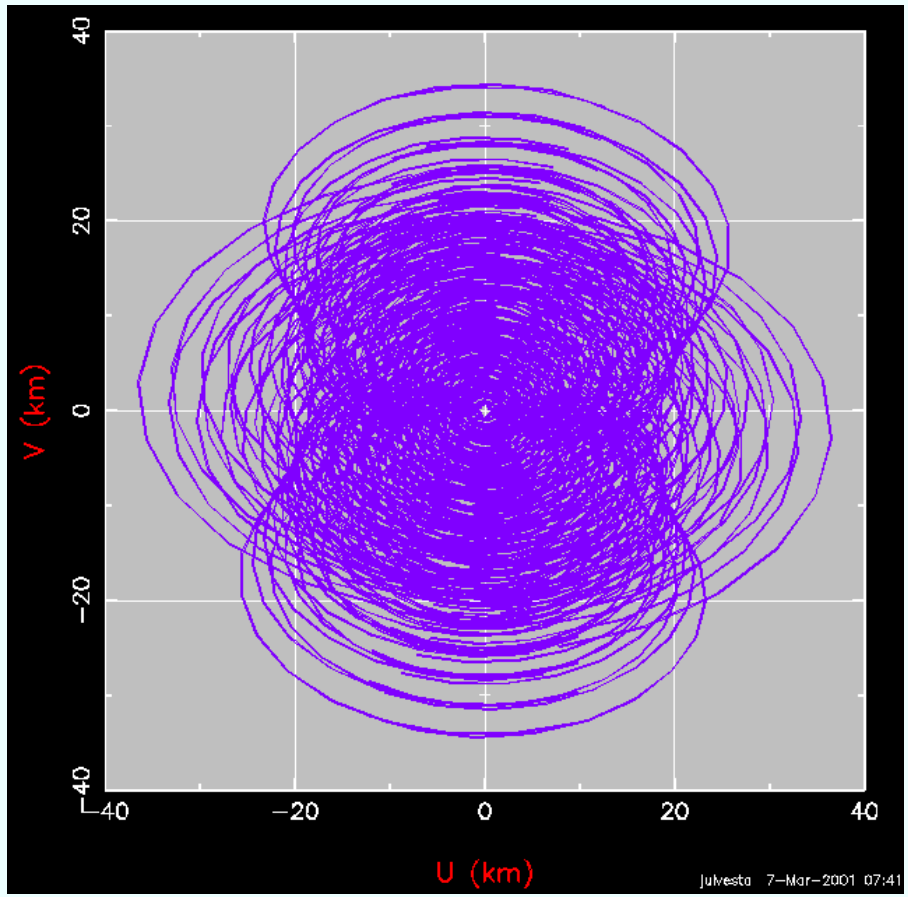
Wavelength (cm)	Beam (arcsec) B	C	T_b rms (mK) B	C
400	80	260	30,000	3,000
90	17	56	4600	460
18-21	3.9	12.5	200	20
6	1.2	3.9	190	19
4	0.7	2.3	160	16
1.3	0.3	0.9	350	35
0.7	0.15	0.47	870	87

- Beams scale by factors of 3, and T_b by factors of 10, for A and D configurations

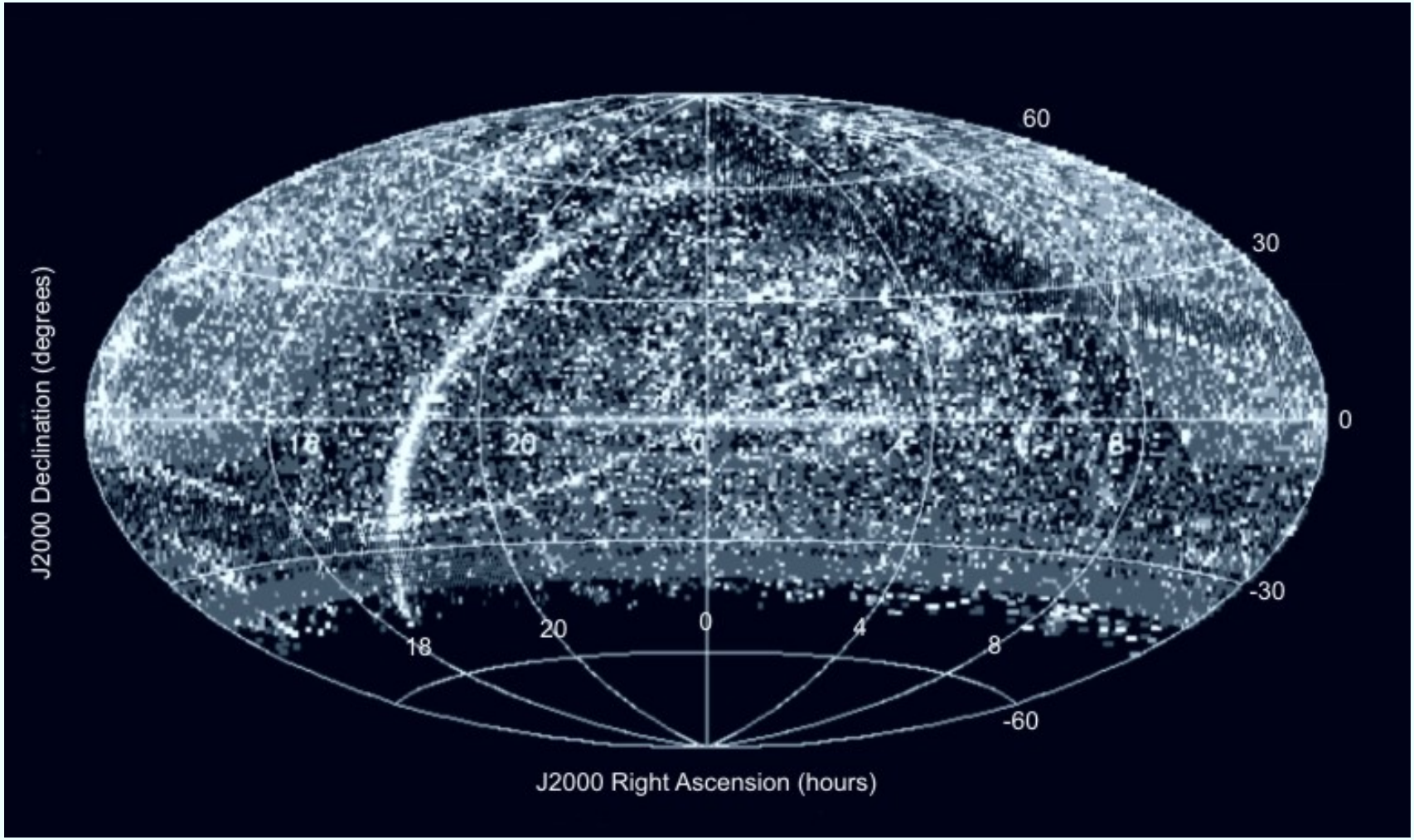
VLA Synthesized Aperture

- Snapshot Observation
- 12-hr Synthesis

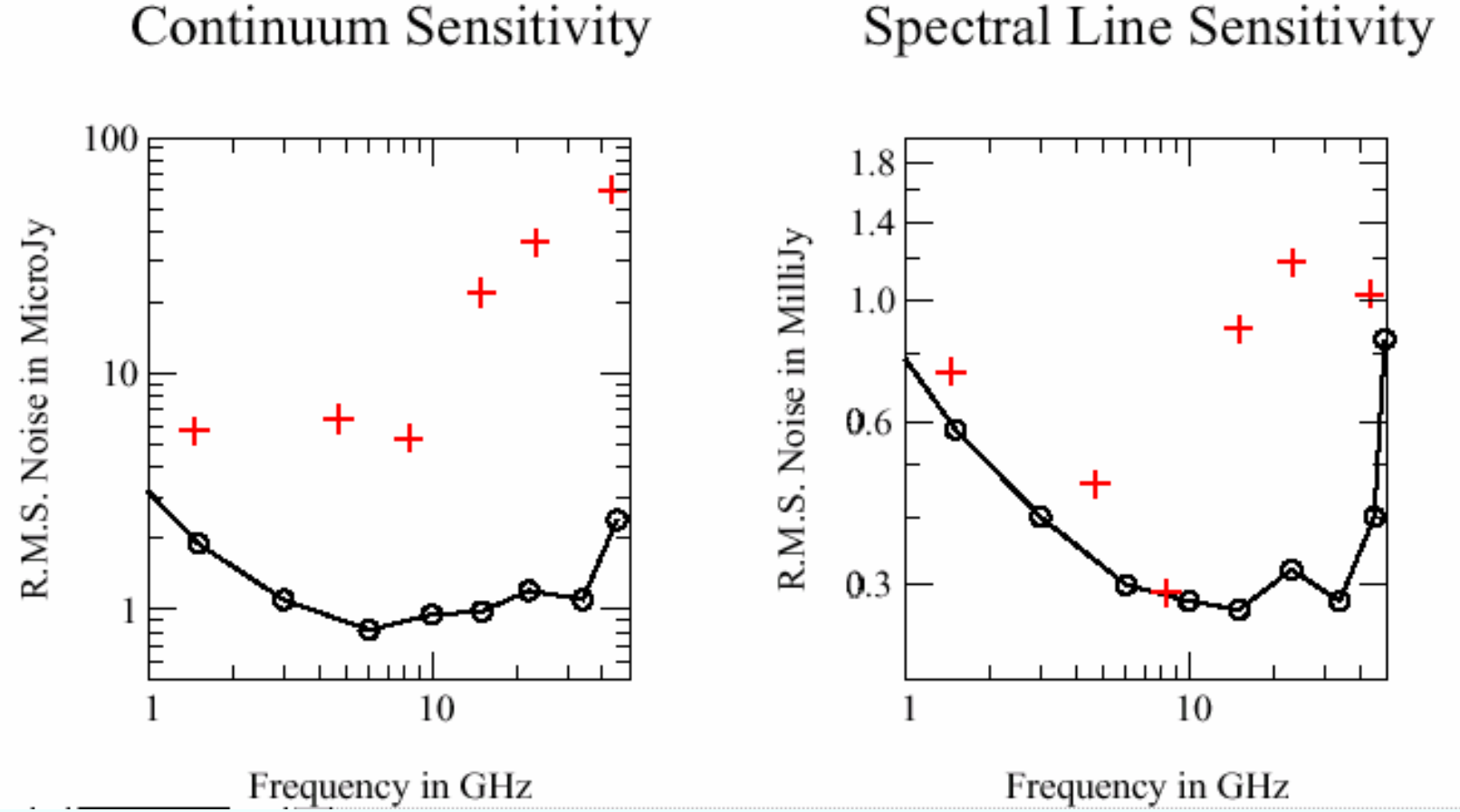




28 Years of VLA Observations



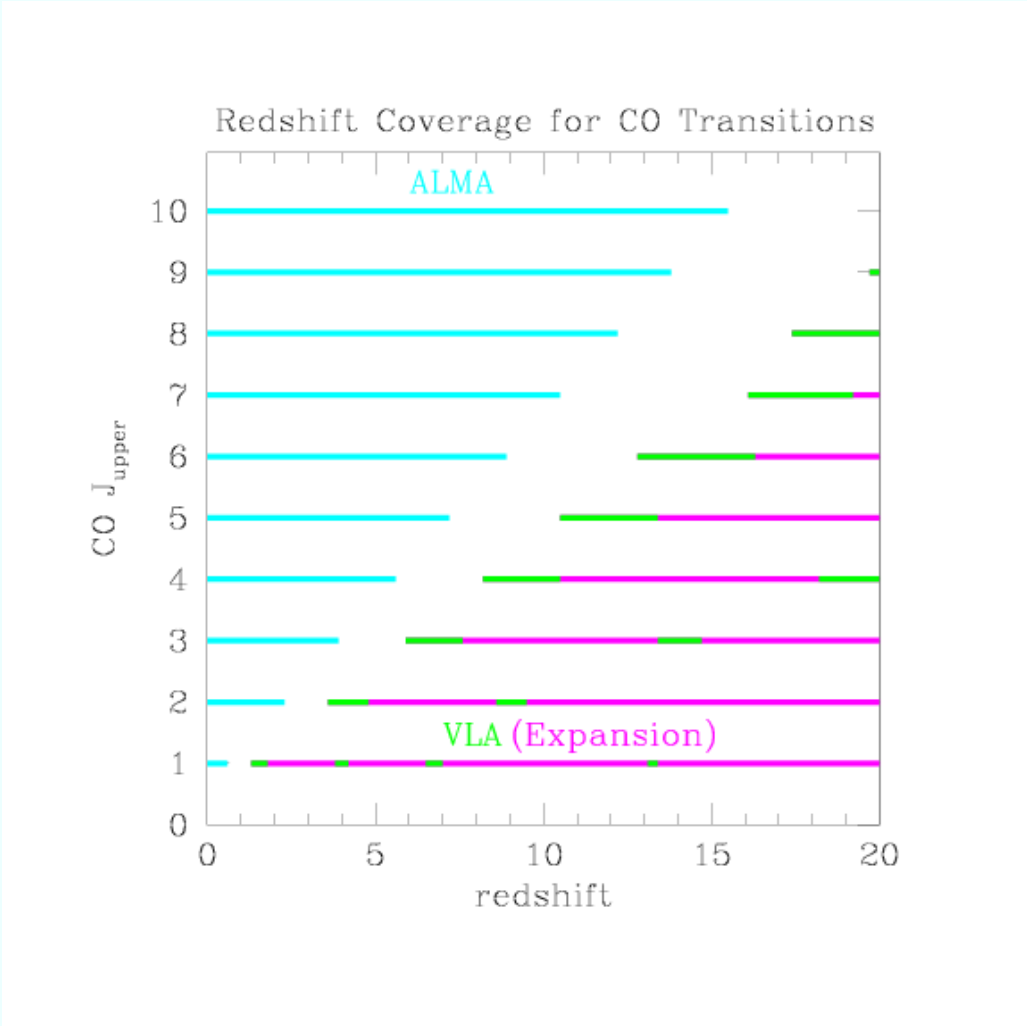
EVLA Point-Source Sensitivity Improvements : 1-σ, 12-hours



Red: Current VLA, Black: EVLA Goals

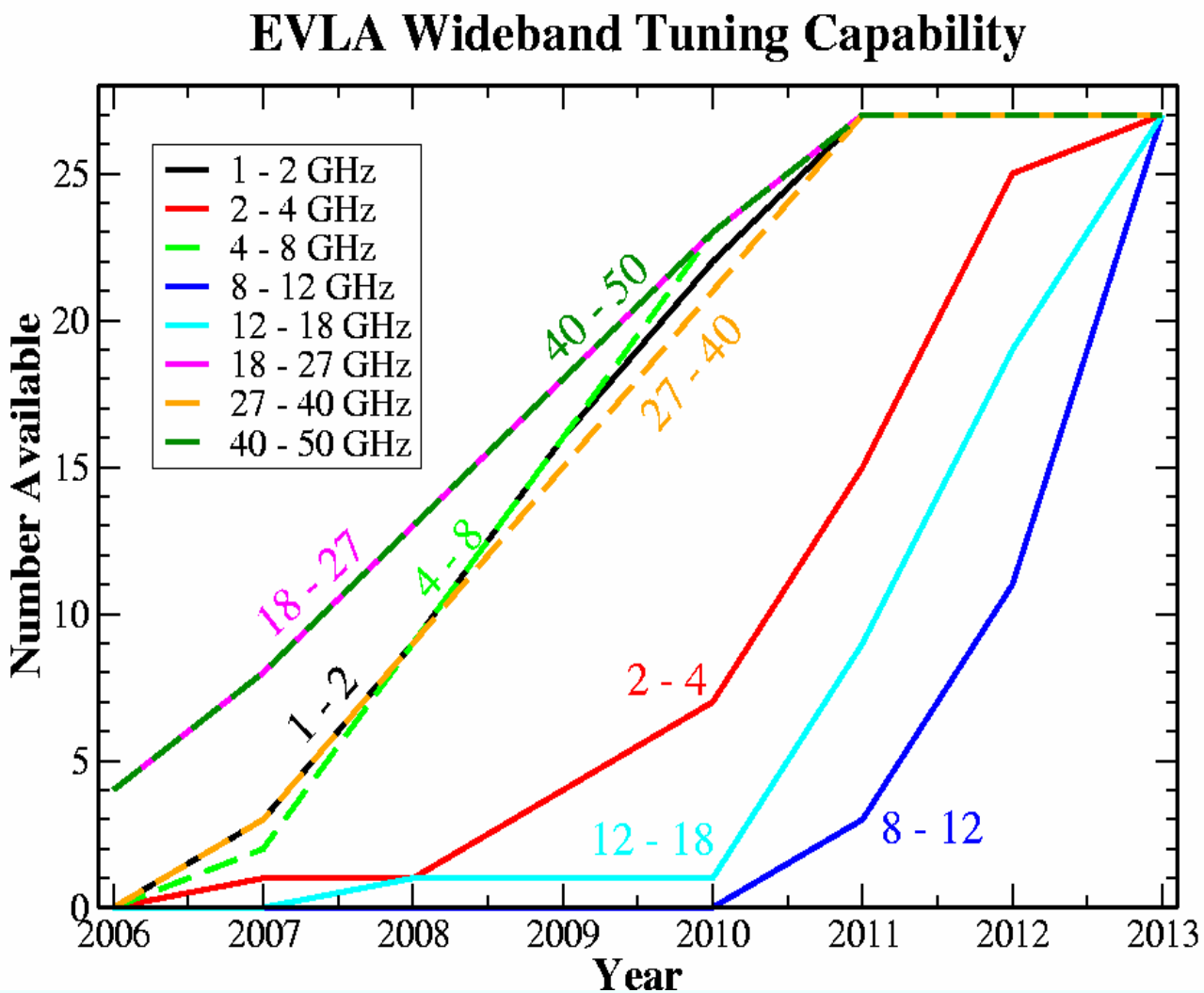
EVLA Access to Redshifted CO

- Continuous frequency coverage from 1 GHz to 50 GHz
- Detect CO at almost any redshift



EVLA New Capabilities Timescale

- The old correlator will be employed until the new correlator achieves full capability
  - User availability in 2010
- Full band tuning available sooner, on schedule shown here.



VLBA Frequency Coverage and Sensitivity

Wavelength (cm)	*Freq. Range (GHz)*	*Image RMS (8 hr)*
90	0.312-0.342	2 mJy/beam
50	0.596-0.626	2 mJy/beam
18-21	1.35-1.75	46 μJy/beam
13	2.15-2.35	50 μJy/beam
6	4.6-5.1	45 μJy/beam
4	8.0-8.8	46 μJy/beam
2	12.0-15.4	84 μJy/beam
1.3	21.7-24.1	151 μJy/beam
0.7	41.0-45.0	237 μJy/beam
0.3	80-96	>1 mJy/beam

VLBA Angular Resolution

Wavelength (cm)	*Beam FWHM (mas)*	*Beam (at z=1) (H_0=65, q_0=0.5)*
90	21	140 pc
50	12	80 pc
18-21	5	33 pc
13	3	20 pc
6	1.4	9 pc
4	0.8	5 pc
2	0.5	3.3 pc
1.3	0.3	2.0 pc
0.7	0.2	1.3 pc
0.3	0.1	0.7 pc

- Improved resolution by factor of 500 compared to VLA A configuration
  - Implies loss factor of 250,000 in brightness sensitivity

Some Details on VLBA Capabilities

- Sub-milliarcsecond resolution
- Repeated observations possible with identical aperture-plane coverage
- Accurate geometric models, and model accountability, enable astrometric accuracy of tens of microarcseconds
- Pulsar gating possible in correlator
- Brightness temperature sensitivity above 10^6 K
  - Nonthermal emission, masers are viable targets
  - Sensitivity may be improved by factors of up to 10 using High Sensitivity Array (add VLA, GBT, Ar, Eb)
- Most programs are scheduled dynamically

Common VLA/EVLA/VLBA Attributes

- Excellent aperture-plane coverage
- Well-calibrated arrays of identical antennas
- Mature operational systems
- Reliability above 95%
- Excellent astrometric capabilities based on inertial reference frame
- Full suite of exportable data-analysis software
  - AIPS now
  - CASA under development
- NRAO scientific support available as needed for Large Proposals