

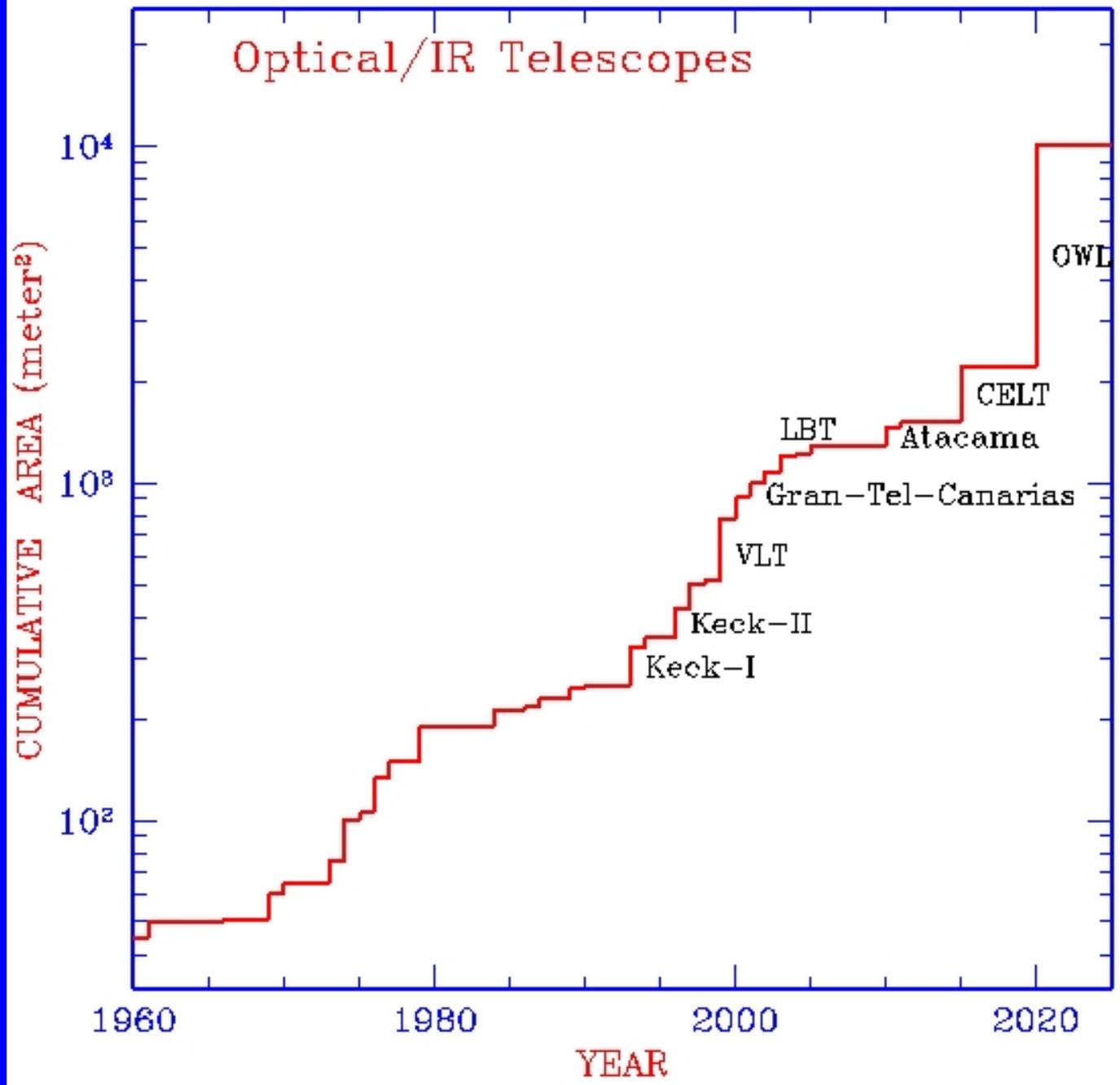
The SKA: Next Week, the Next 3 Years & Beyond

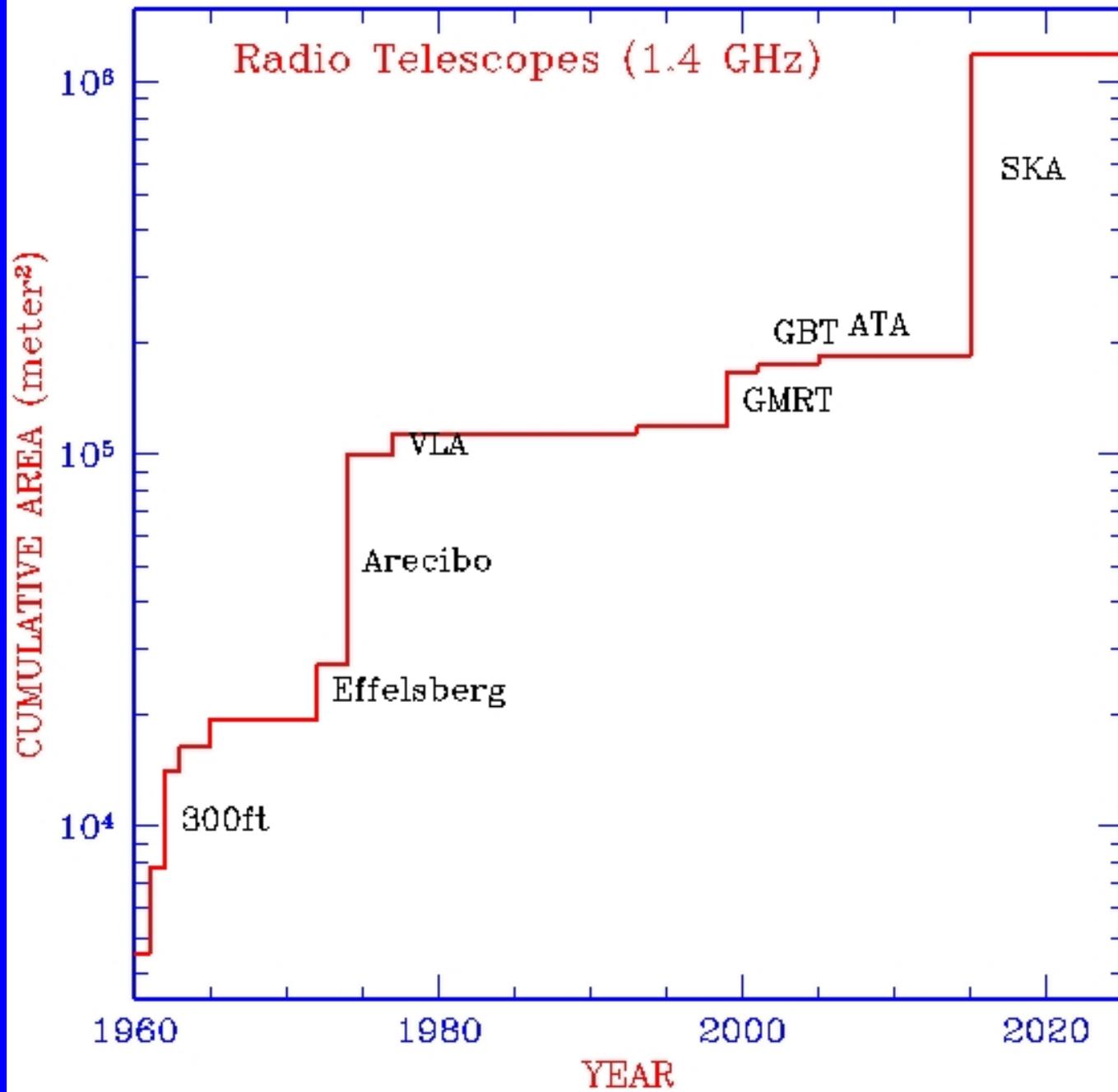
Jim Cordes, Cornell University
24 August 01

- Concepts
- Science Goals & Payoffs
- Configurations, Modes and Sites
- Development Plan (International, US)

 USKA
The US Square Kilometer Array Consortium

Optical/IR Telescopes





Key Science Areas

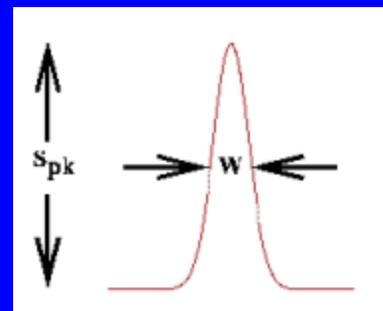
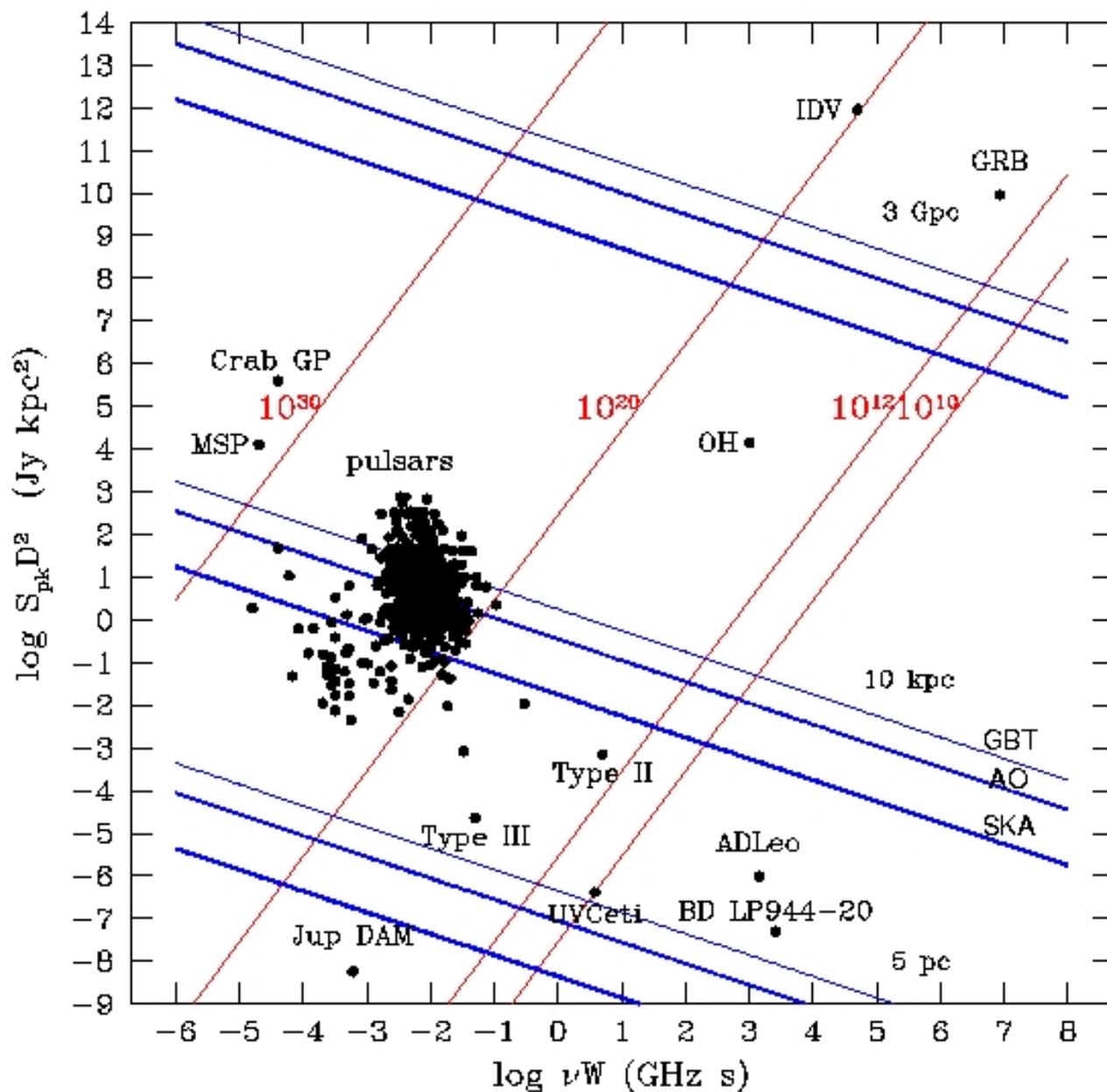
- **High Redshift Universe**
- **Transient Universe**
- **Galactic Census**
- **Solar System Inventories**

Science document (1999):

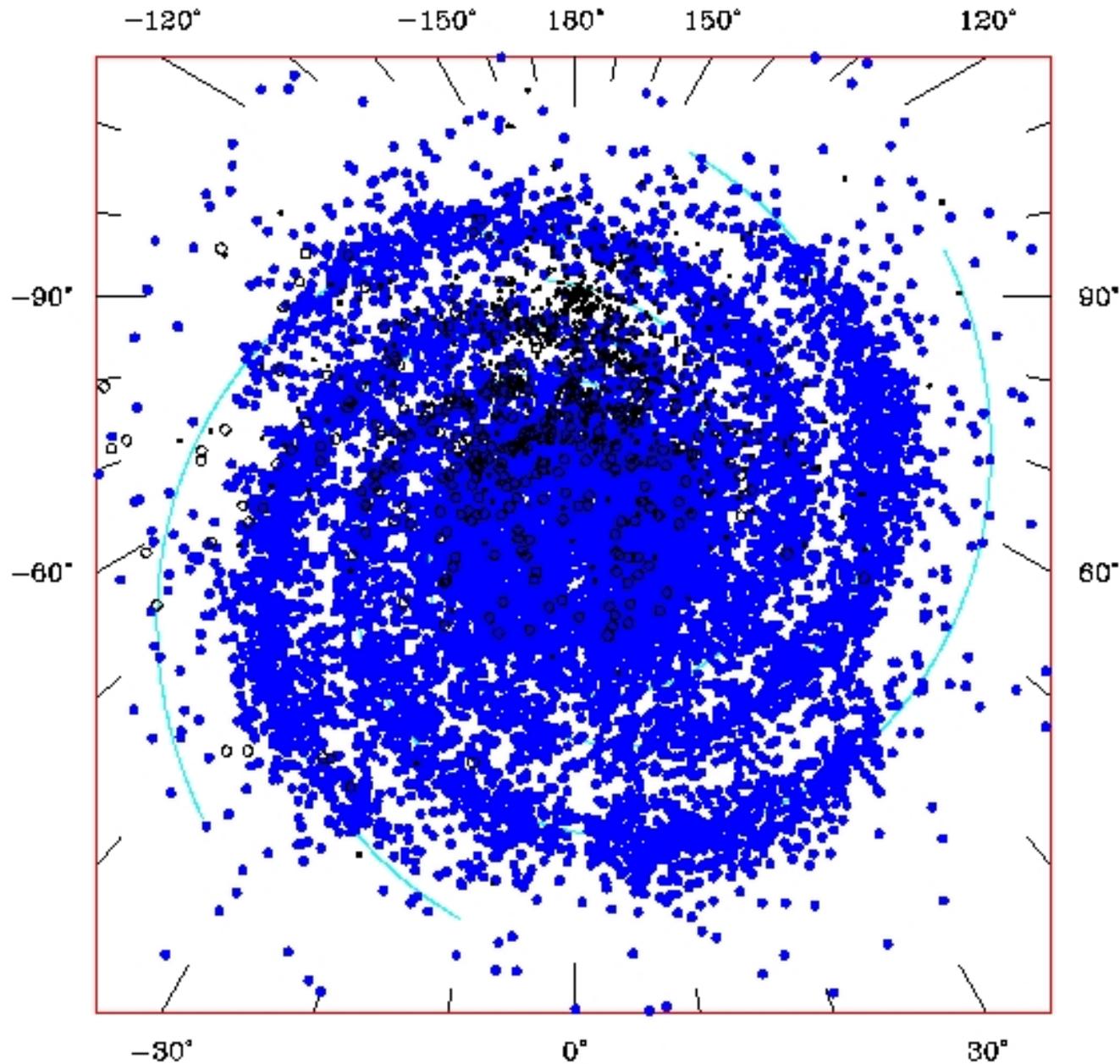
(AR Taylor, R Braun)

http://www.skatelescope.org/ska_science.shtml

Transient Detection



Known & Simulated Pulsars Projected onto the Galactic Plane



SKA: 1.4 GHz/400 MHz/1024 T/G = 0.25 Jy 600 s
PSR: $(\alpha, \beta, \gamma) = (-1.5, 0.5, 28.0)$ $\epsilon=0.001$ mod=2 n=2.5 $\tau_x=8$ Myr $t<50$ Myr

**SKA pulsar
survey**

**600 s per
beam**

$\sim 10^4$ psr's

Current Baseline Goals

Parameter	Design Goal	Comments
Sensitivity	$A/T = 2 \times 10^4 \text{ m}^2 / \text{K}$	20x Arecibo, 75x VLA
Surface brightness	1K at 0.1 arcsec (cont)	
Point sources	0.5 μJy	10 σ in 1 day, 100 MHz
Frequency range	0.15 – 22 GHz	
Redshift coverage	Z < 8.5 HI, Z > 4.2 CO (1 \rightarrow 0)	
L* galaxies	Z_{max} ~ 2 HI, ~ 20 CO	
FOV (imaging)	1 degree ² at 1.4 GHz	
Multibeams	> 100	
Ang. Resolution	40 mas at 1.4 GHz	VLBI: SKA enables all-sky phase referencing
Pixels	10 ⁸	
Instantaneous bandwidth	20% at high frequencies	
Spectra channels	10 ⁴	
Image Dynamic Range	10 ⁶ at 1.4 GHz	
Polarization isolation	-40 dB	



China KARST



**Canadian
aerostat**



US Large N

**(cf. Allen Telescope Array,
Extended VLA, also GMRT)**



**Australian
Luneburg
Lenses**

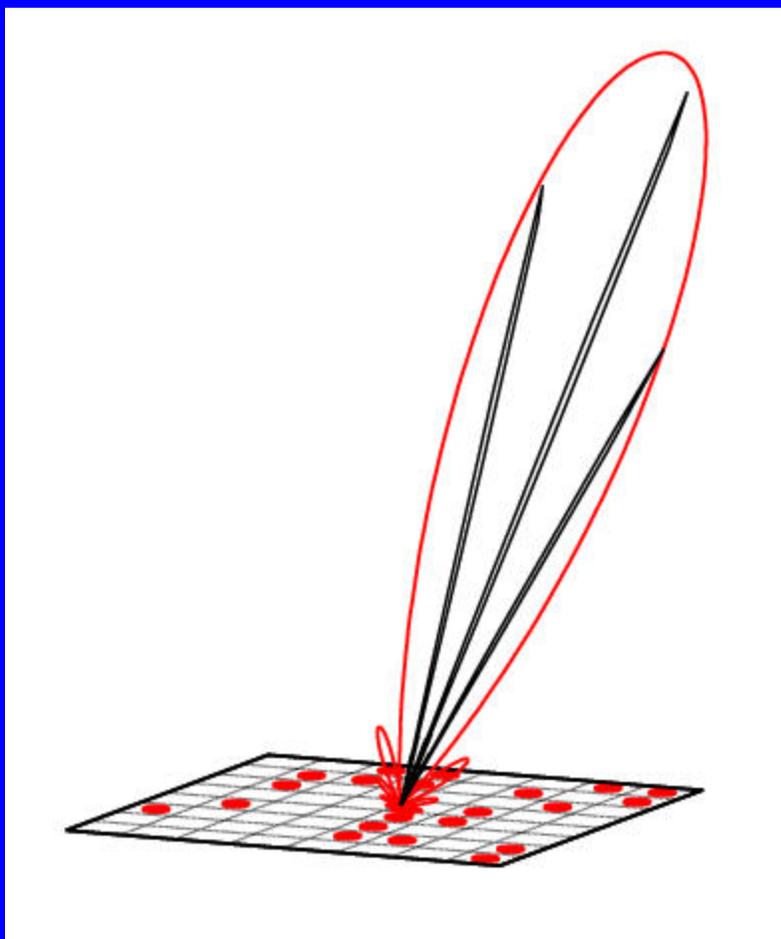


**Dutch fixed
planar array**

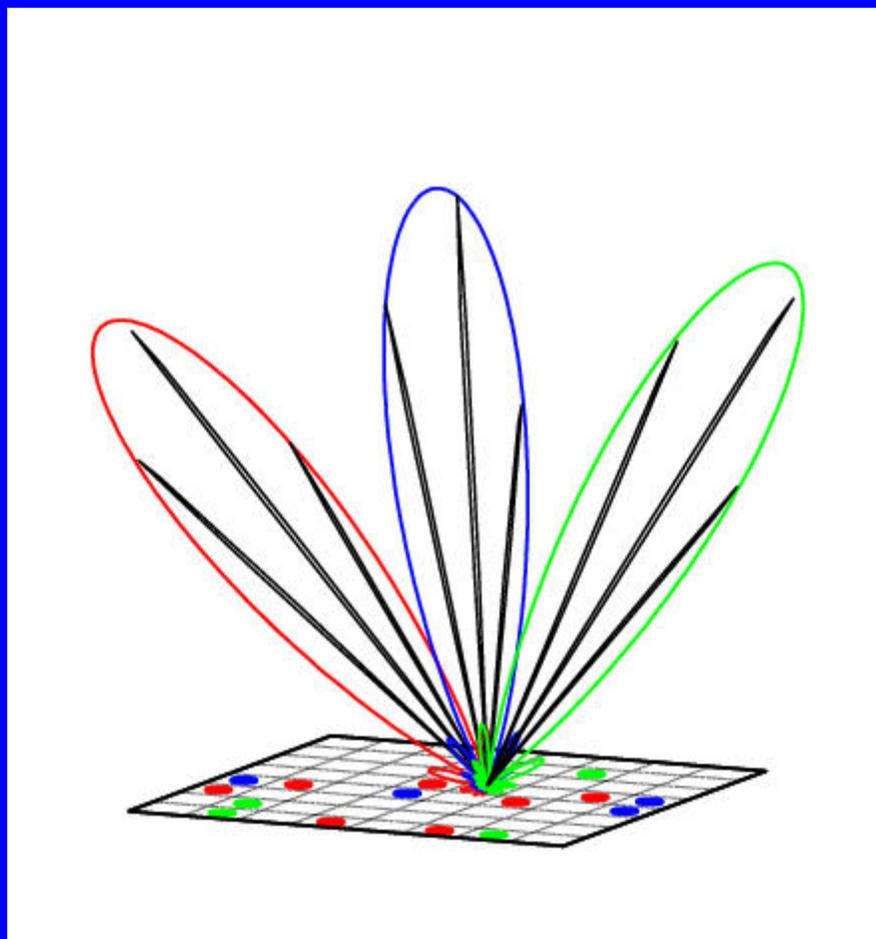
**(cf. LOFAR = Low Frequency
Array)**

Current Concepts

**Primary beam x station
synthesized beams**



Station subarrays



One station of ~ 1000 in SKA

International Timeline

- **2002** **Prioritized science goals (international)**
Design requirements
SKA Management Plan established
- **2003** **Strawman design concepts**
Site requirements
- **2005** **Choice of design concept**
Site selection
- **2006-2010:** **Prototype array(s)**
- **2010** **SKA construction begins**
- **2015** **Completion**

US Activity

- **2001** Roadmap submitted to NSF (April)
- **2001** NSF/ATI Proposal submitted
(next week!)
- **Now-2005** Development work from NSF funds
in parallel with ATA, EVLA, LOFAR,
eMERLIN activity
- **2003** Strawman US design
- **2005** Design to International Steering
Committee

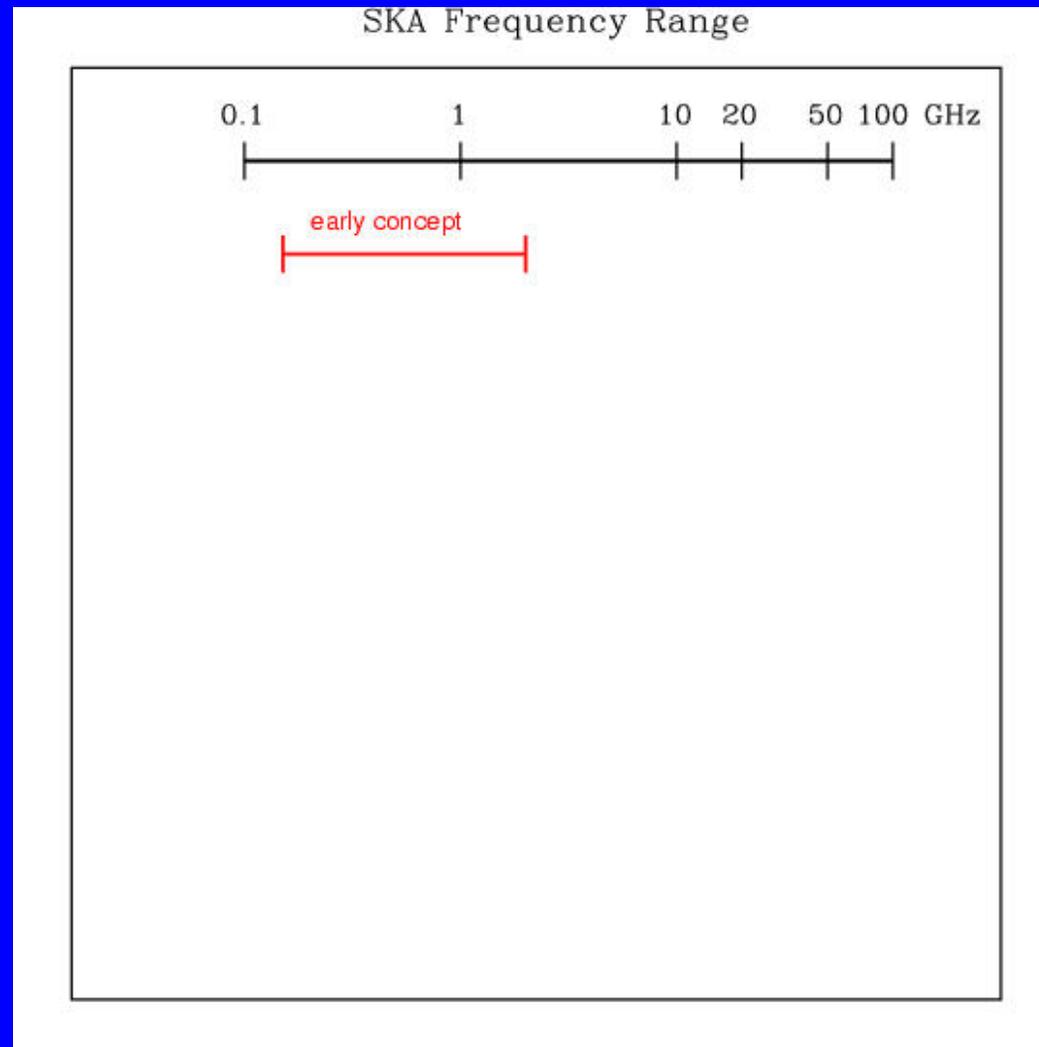
US NSF/ATI Proposal

- **3 year development proposal (\$1.5M/yr - \$2M/yr)**
- **Instrumentation and pilot observations (science return, RFI management algorithms)**
- **9 institutions (CIT, Cornell, Haystack, NAIC, OSU, SAO, SI, UCB,UMinn)**
- **Develop the US plan taking into account all tradeoffs**
 ⊆ design concept by 2005

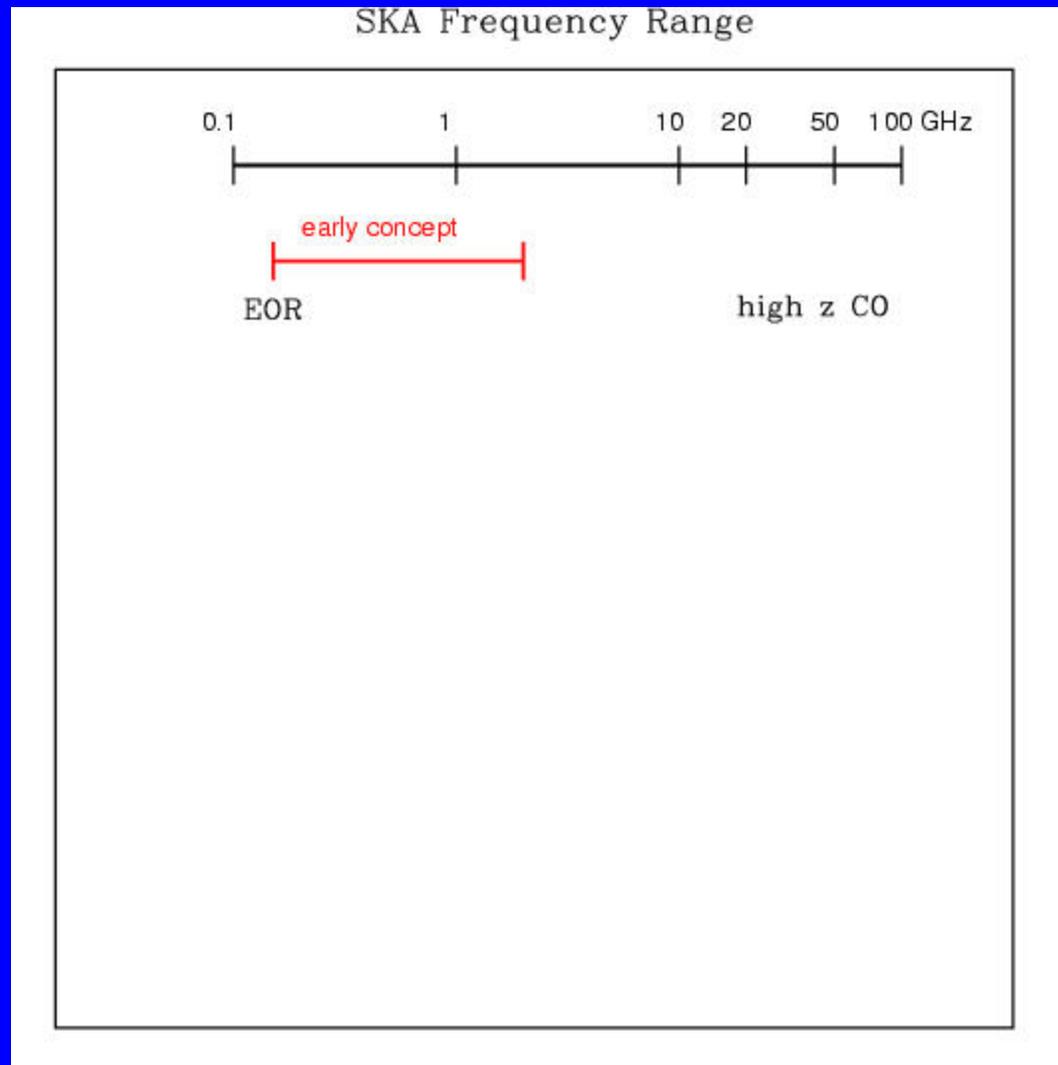
Why 2005?

- **We need a carrot in front of the horse**
- **Natural tie-ins to other projects (radio astronomy, NASA telemetry)**
- **Other countries (esp. Australia) are proceeding at similar dollar levels**
- **RFI management: avoid irreversible trends (loss of sites, spectrum, people)**

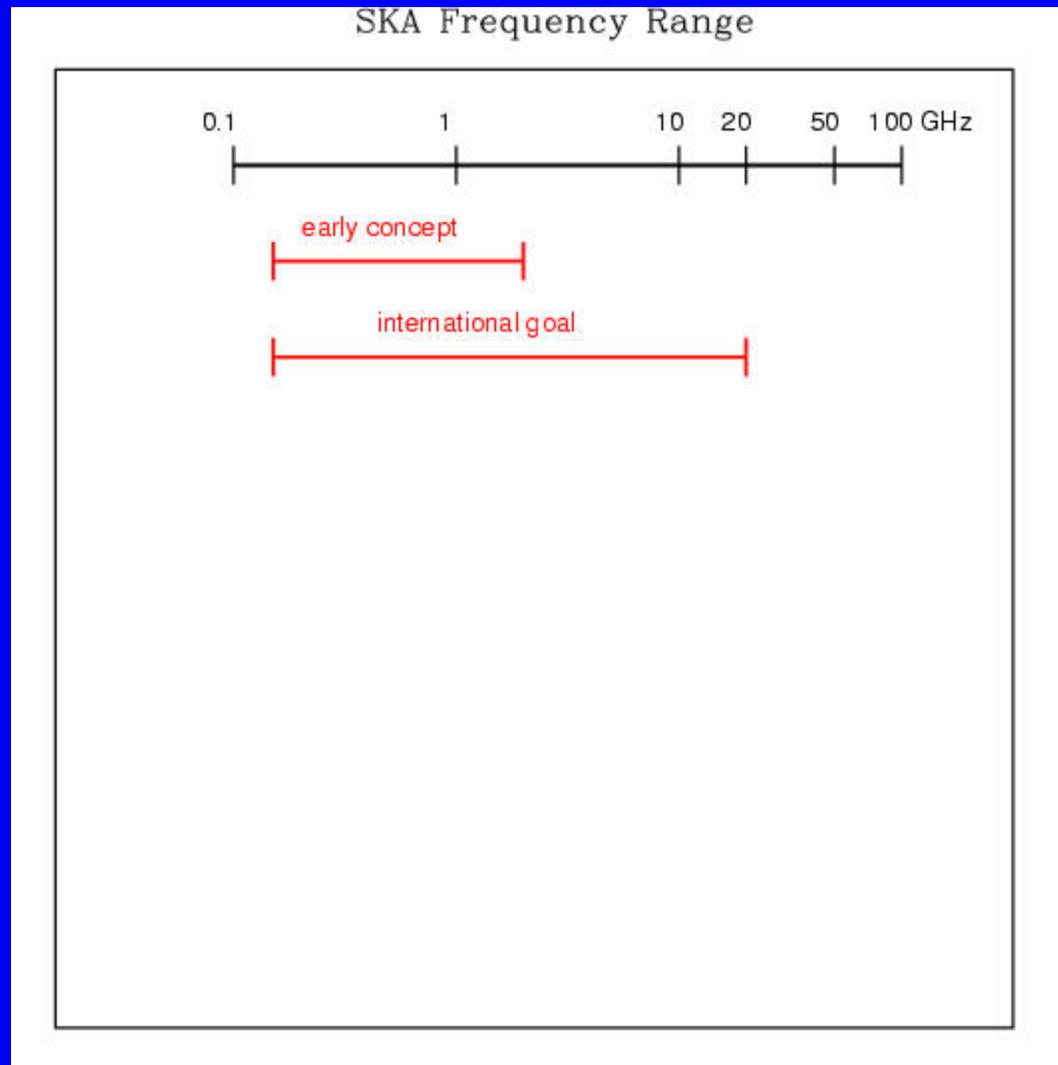
The SKA is a Fluid Concept: Frequency Range



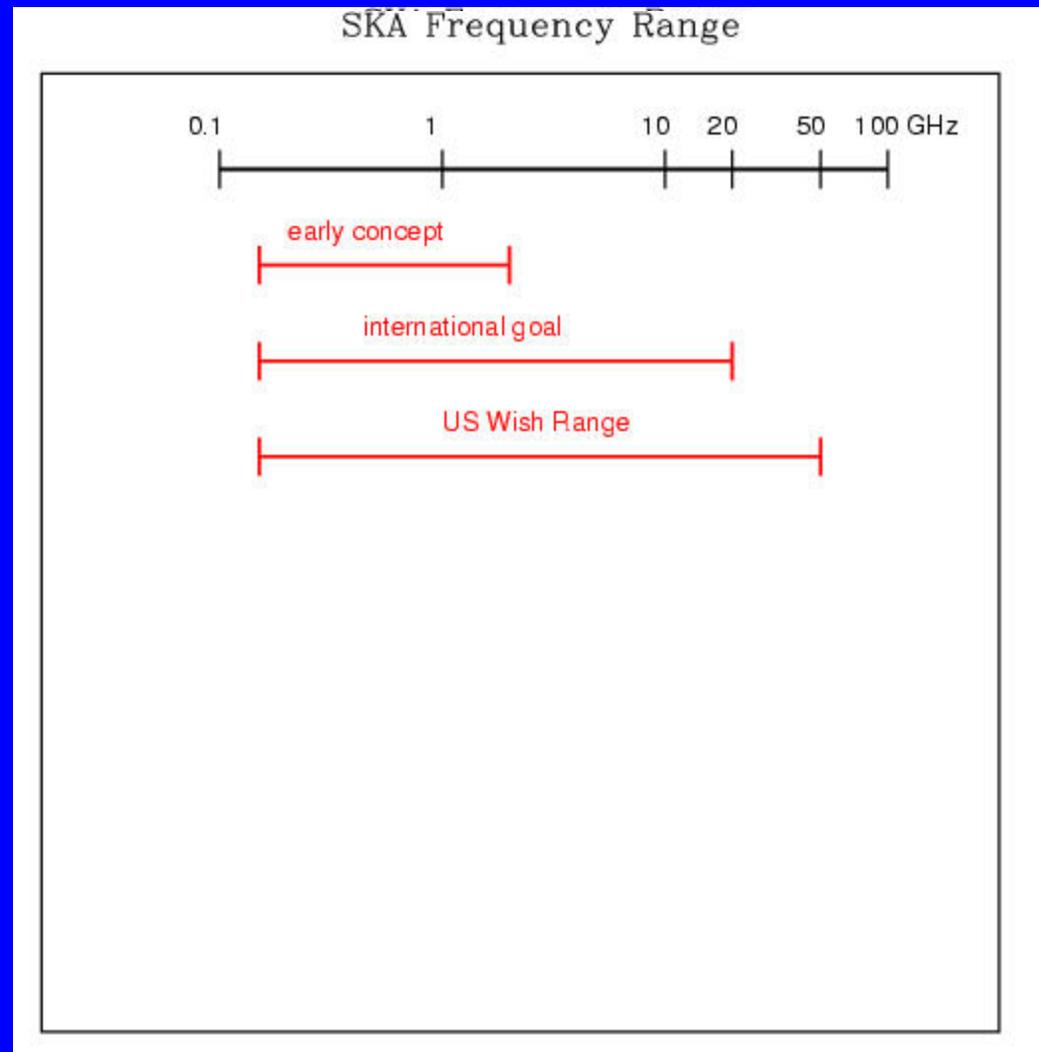
The SKA is a Fluid Concept: Frequency Range



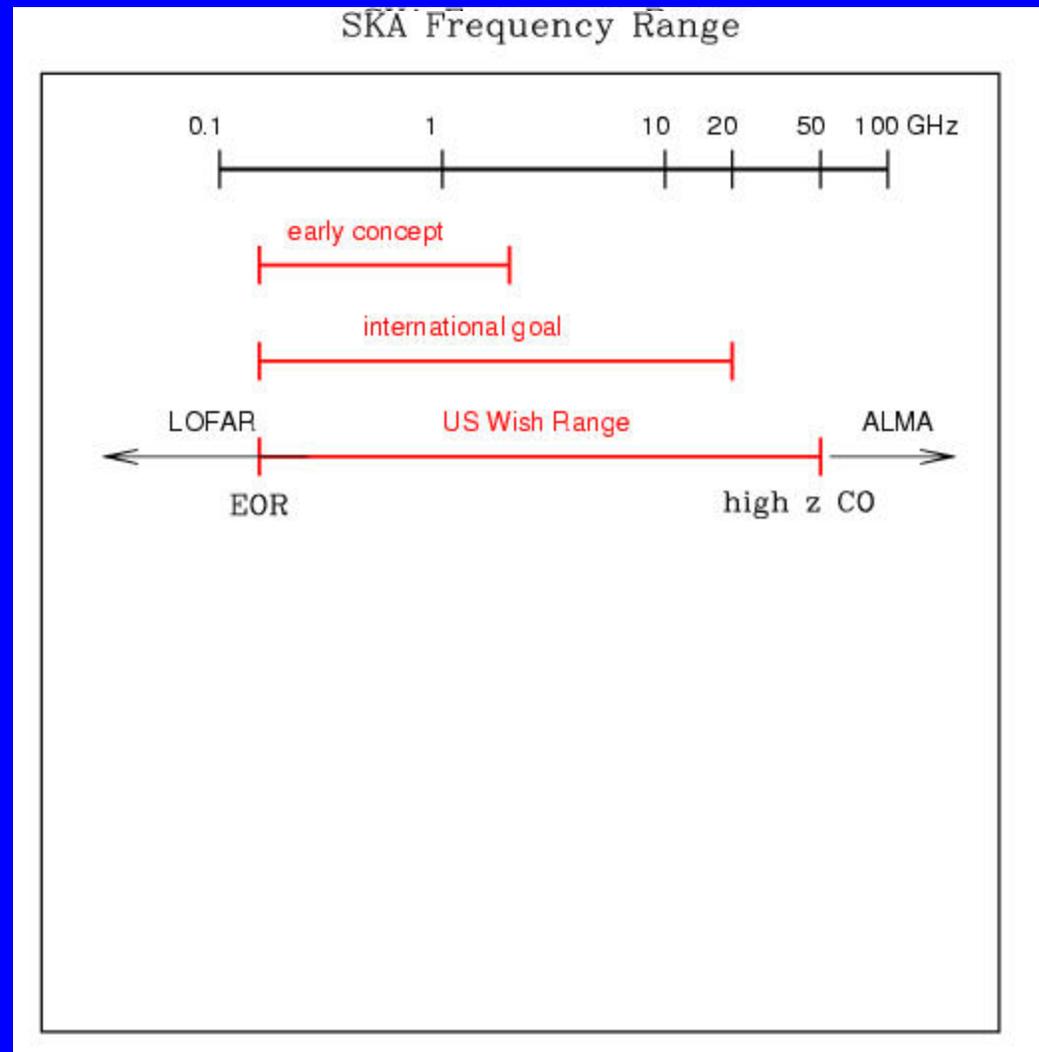
The SKA is a Fluid Concept: Frequency Range



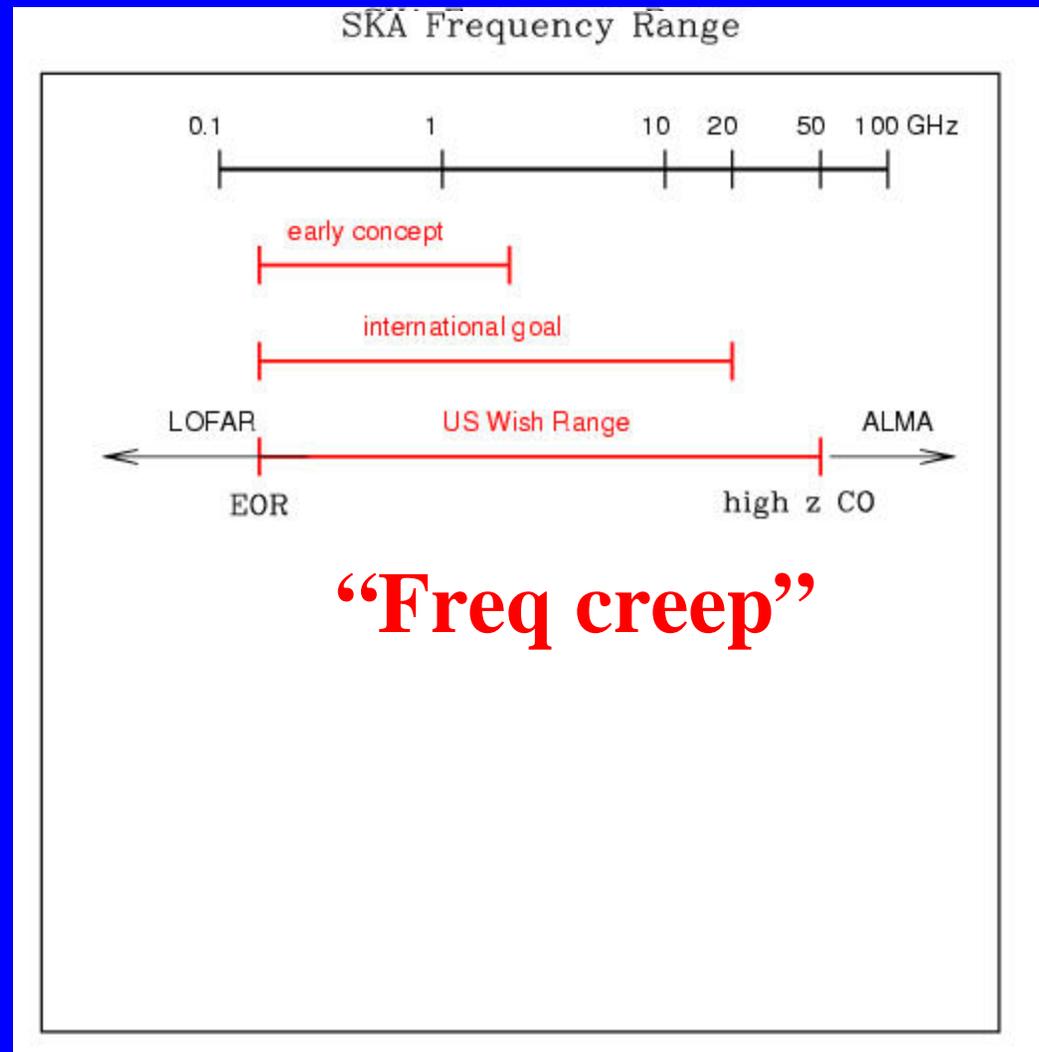
The SKA is a Fluid Concept: Frequency Range



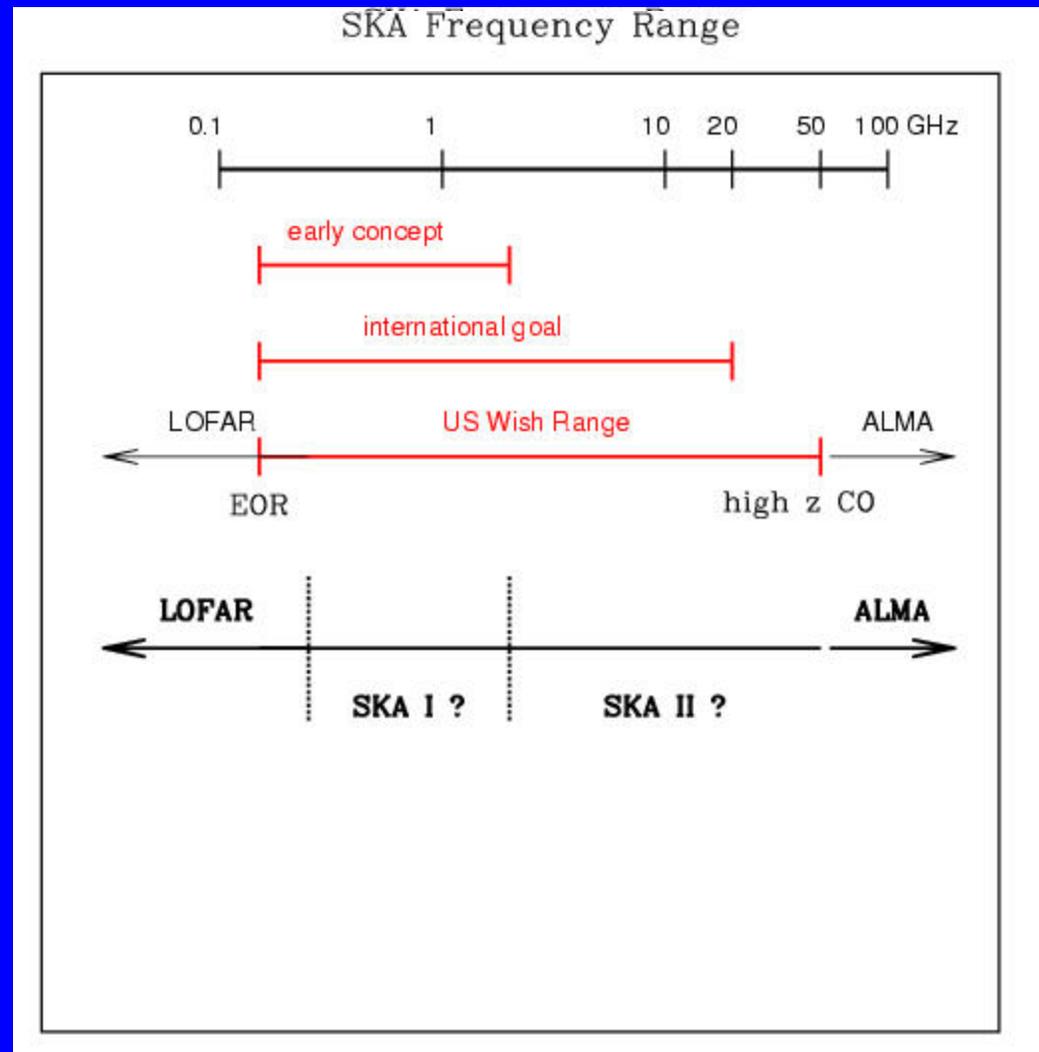
The SKA is a Fluid Concept: Frequency Range



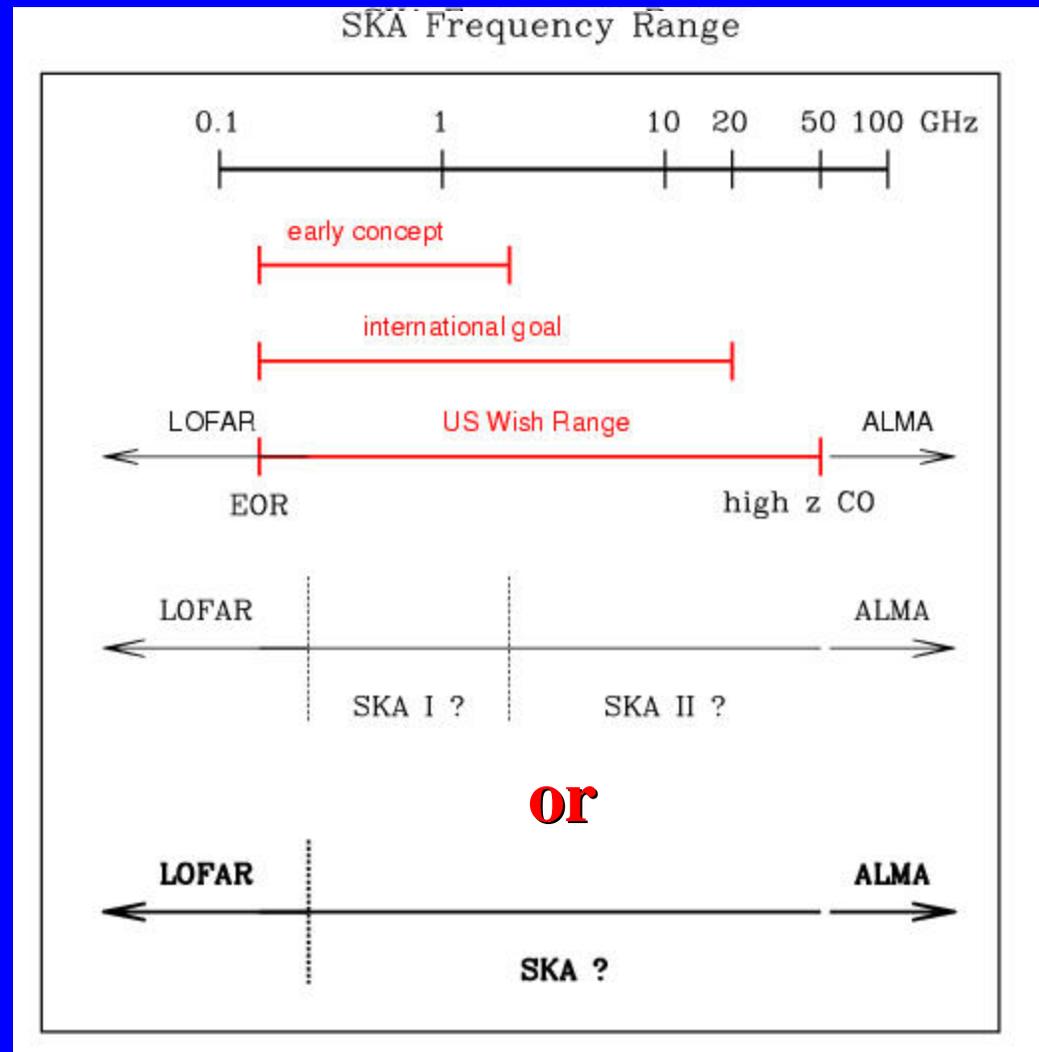
The SKA is a Fluid Concept: Frequency Range



The SKA is a Fluid Concept: Frequency Range



The SKA is a Fluid Concept: Frequency Range



The SKA is a Fluid Concept: Site(s)

Southwest US

- **80% of sky**
- **Available infrastructure**
- **Personnel**
- **Ties to VLA/VLBA**

Western Australia

- **80% of sky**
- **GC + more inner Galaxy**
- **Radio quiet zone (?)**
- **Land costs**

The SKA is a Fluid Concept: Site(s)

Advantages of 2 x (SKA/2):

- **Full sky coverage (entire Galactic plane)**
- **Best of both hemispheres**
- **Locks in radio astronomy presence**
- **Spacecraft tracking capability around the clock
("Dish" becomes "Array")**

The SKA is a Fluid Concept: Instantaneous Sky Coverage

- **Current design goal: FOV ~ 1 deg @ 1 GHz**
- **Difficult for some concepts**
- **Transient source surveys favor larger FOV
(as large as possible ... e.g. Dutch plan)**
- **Tradeoffs between science/tech./RFI/cost
w.r.t. FOV and imaging capability**
- **Subarray multiplexing can achieve large FOV**

Summary

- **The SKA is very much TBD**
- **It is a superset of the EVLA**
- **The next 3 years will test cost/
performance of arrays of small antennas**