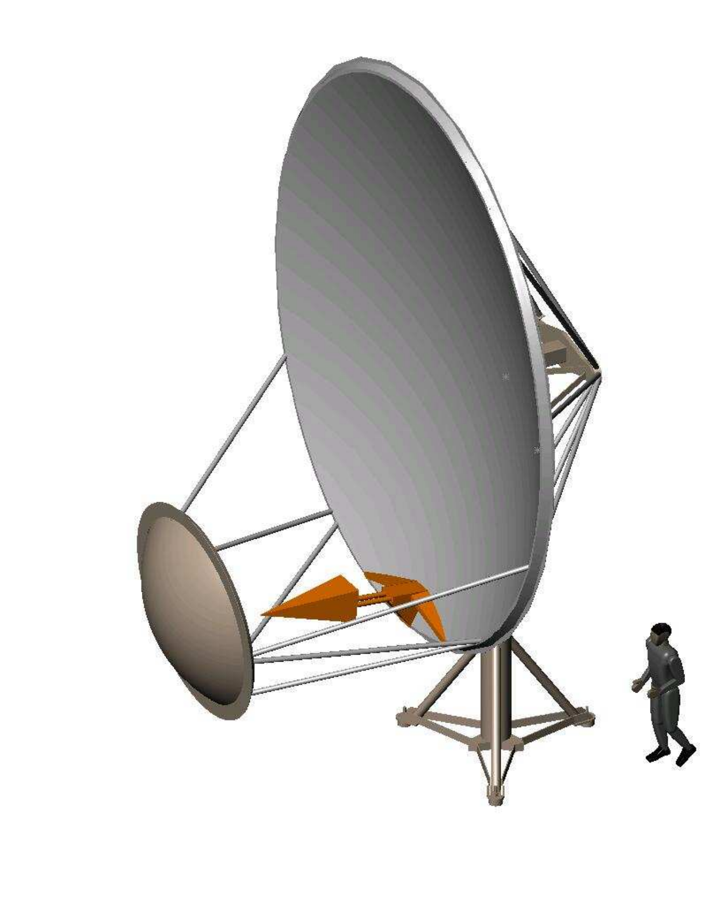
The Antenna Configuration of the Allen Telescope Array



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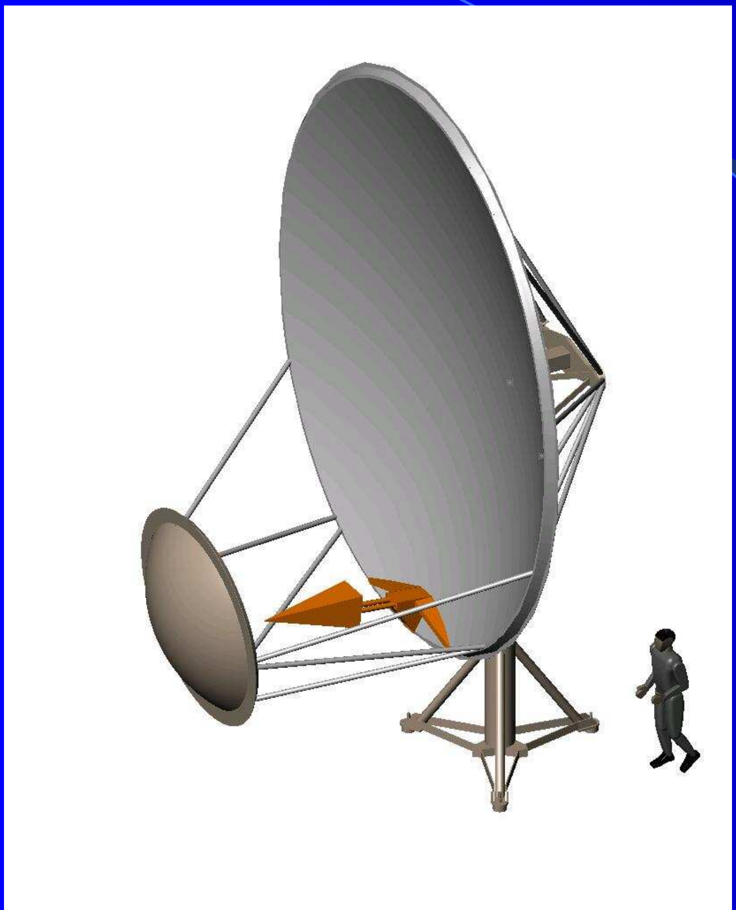


Outline:

- Science goals
- Configuration design

Unique features of the ATA

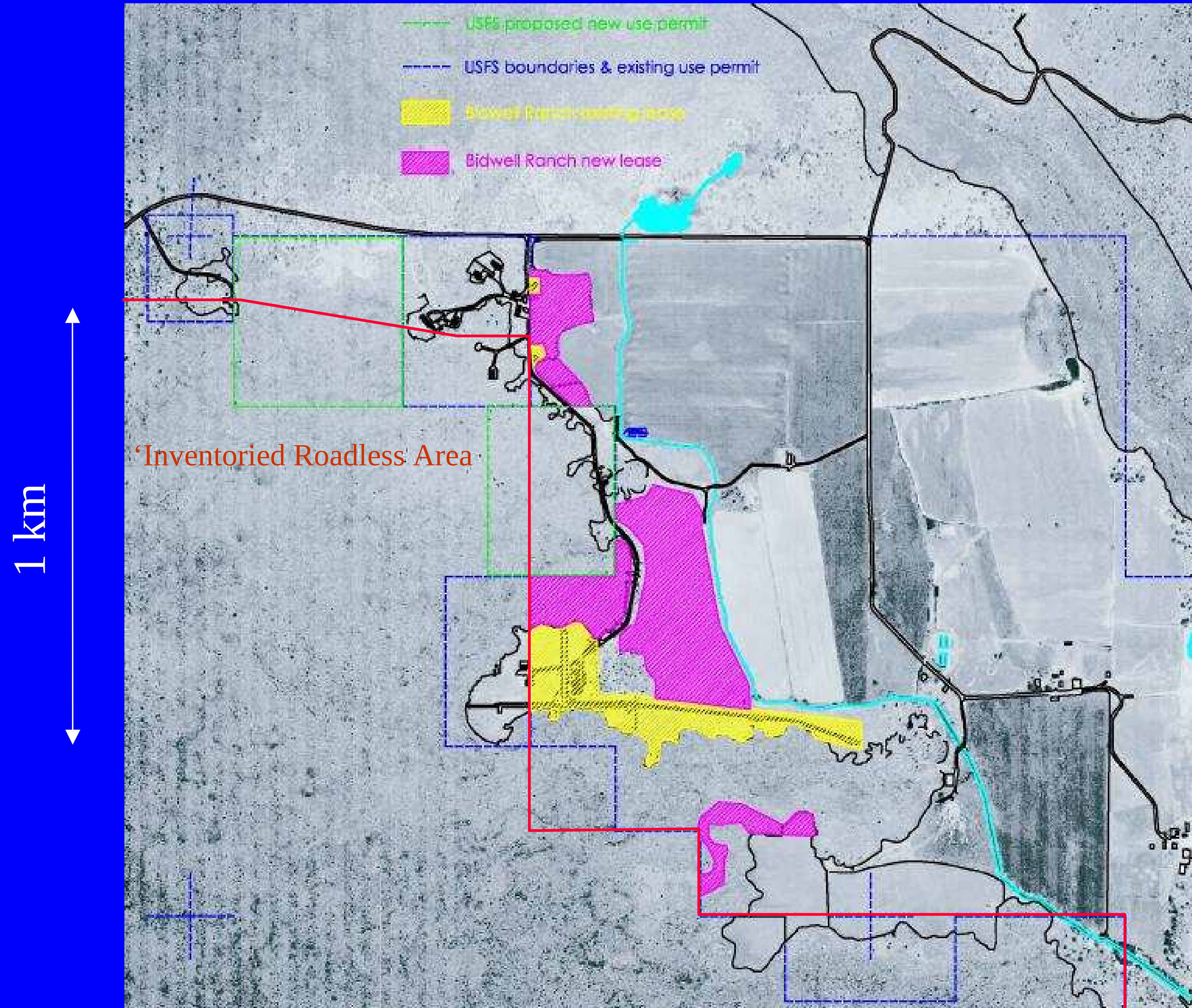
- Wide field of view (2.5° @ 1.4 GHz)
- Large-*N* design (*N*=350, D=6.1 m)
- Instantaneous frequency coverage (0.5–11.2 GHz)
- Ability to conduct several simultaneous observing programs

Key science drivers for the ATA

- SETI
- Pulsars (gravitational waves)
- Transient and variable sources
- Extragalactic HI (z = 0.2, cf. SDSS; HI in IGM)
- Magnetic fields

Impact on the Configuration

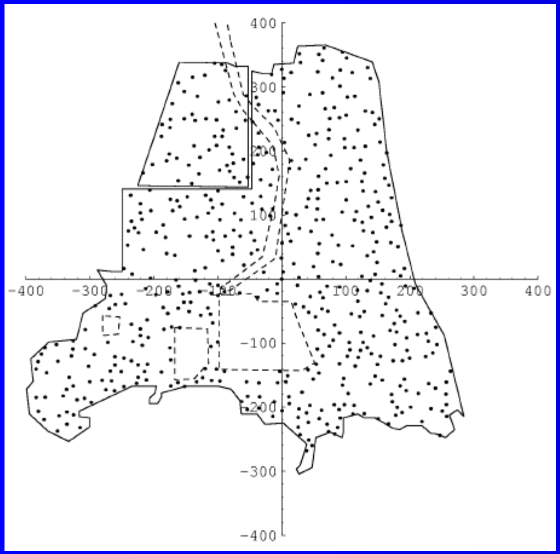
- SETI and pulsars/transients
  - low sidelobes
  - minimum shadowing
  - image southern sources
  - minimum confusion
- Imaging projects — snapshots!
  - low sidelobes
  - sufficient resolution but good sensitivity to extended structure (for HI, best resolution which matches T_b sensitivity to z-sensitivity)



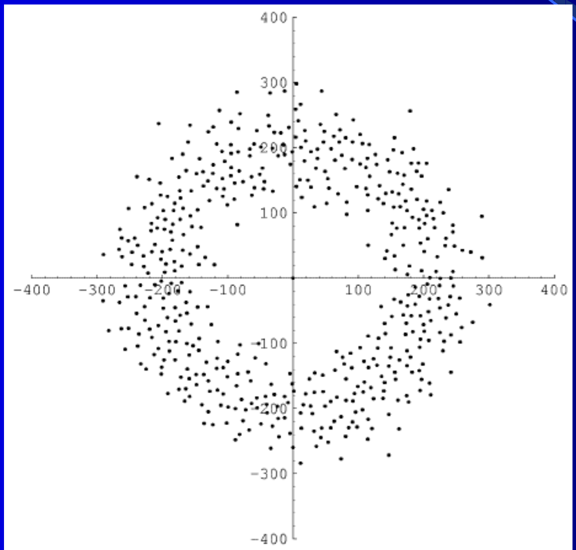
USFS proposed new use permit
USFS boundaries & existing use permit
Bidwell Ranch new lease
'Inventoried Roadless Area
1 km


7 19 '00

Sample Configurations

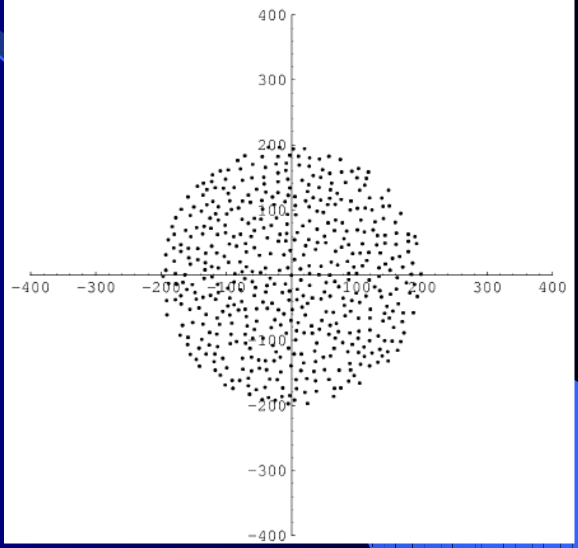


Uniform, larger
Beam: 72″ × 69″
(zenith, 1.4 GHz)
Sidelobes: 5%



Doughnut
72″ × 69″

13%

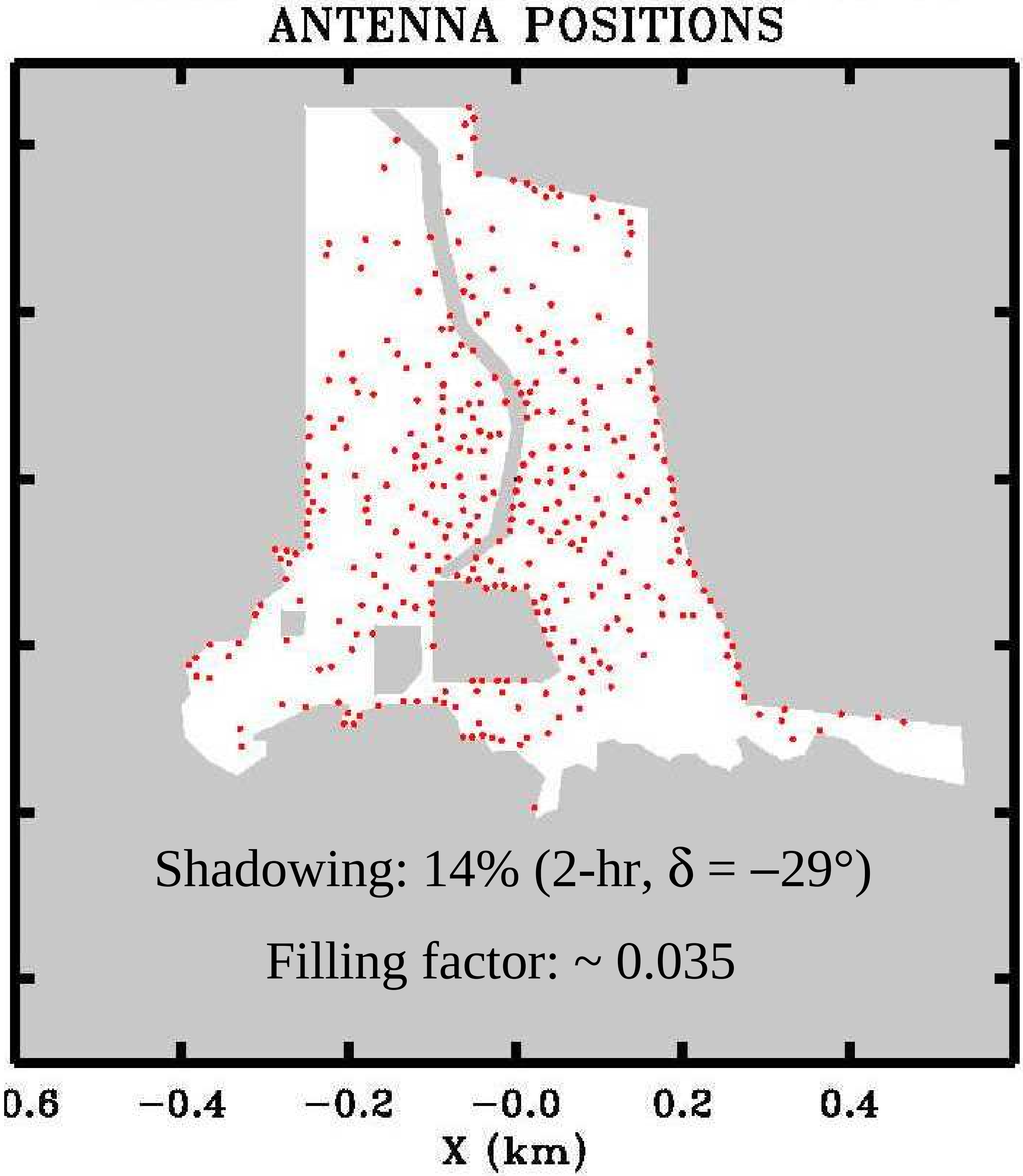


Uniform, minimal
111″ × 108″

5%

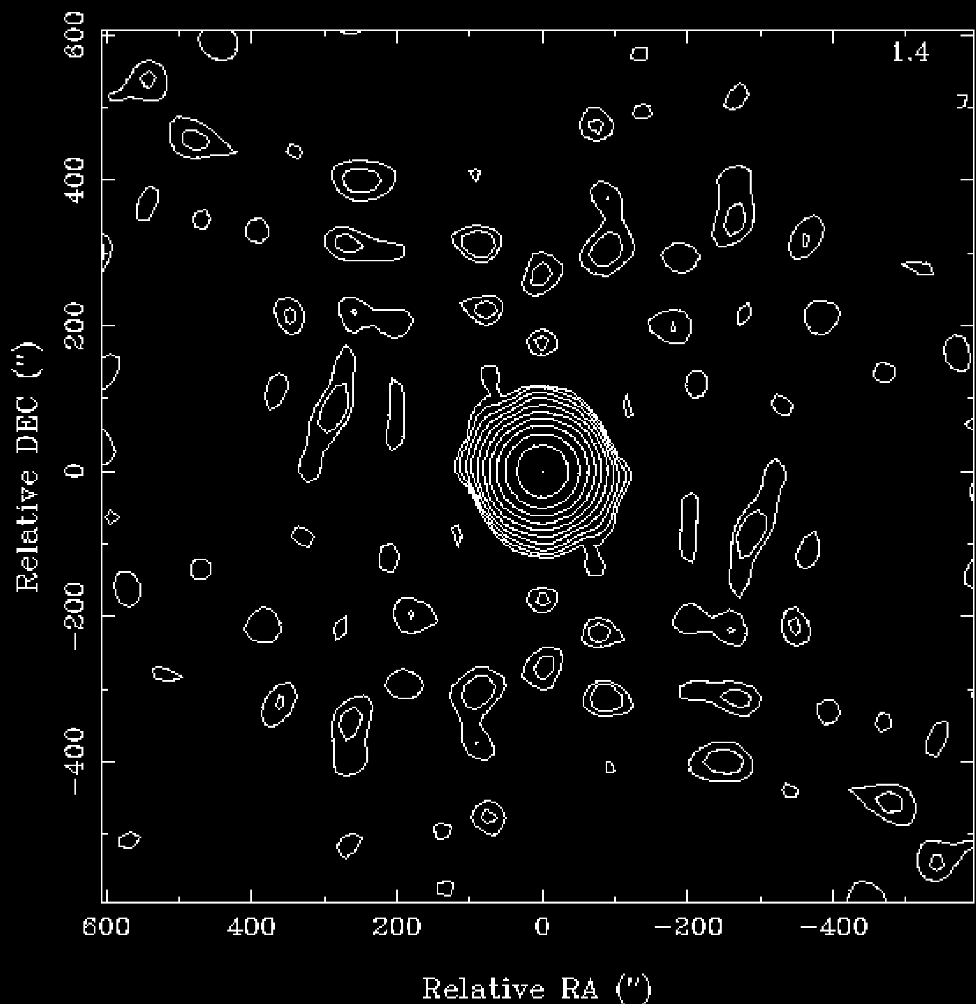
Optimizing *uv* Coverage

- Fit *uv* coverage to a Gaussian model
  (F. Boone 2001a,b; A&A submitted and in prep.)
- Model minimizes near sidelobes and forces a round beam (at chosen declination)
- Maintains ‘complete’ *uv* coverage (to 440 m baselines)
- Far sidelobes 1/*N* (rms)

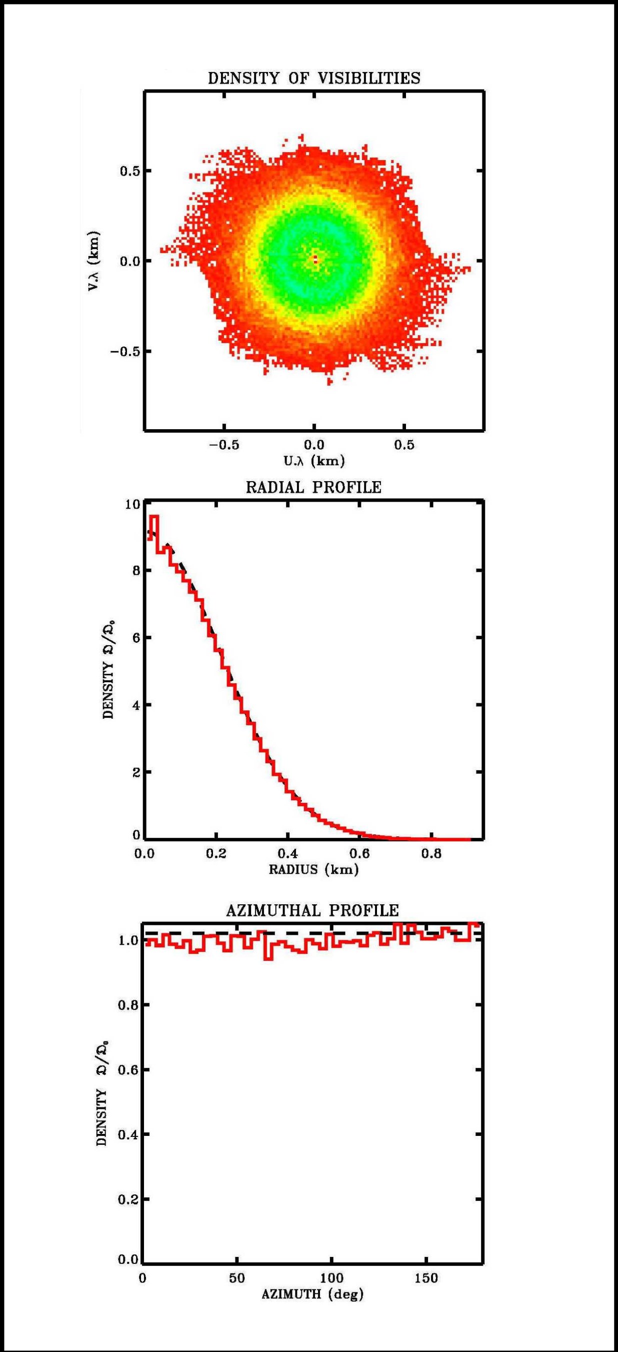

ANTENNA POSITIONS
Shadowing: 14% (2-hr, δ = –29°)
Filling factor: ~ 0.035
0.6
−0.4
−0.2
−0.0
0.2
0.4
X (km)

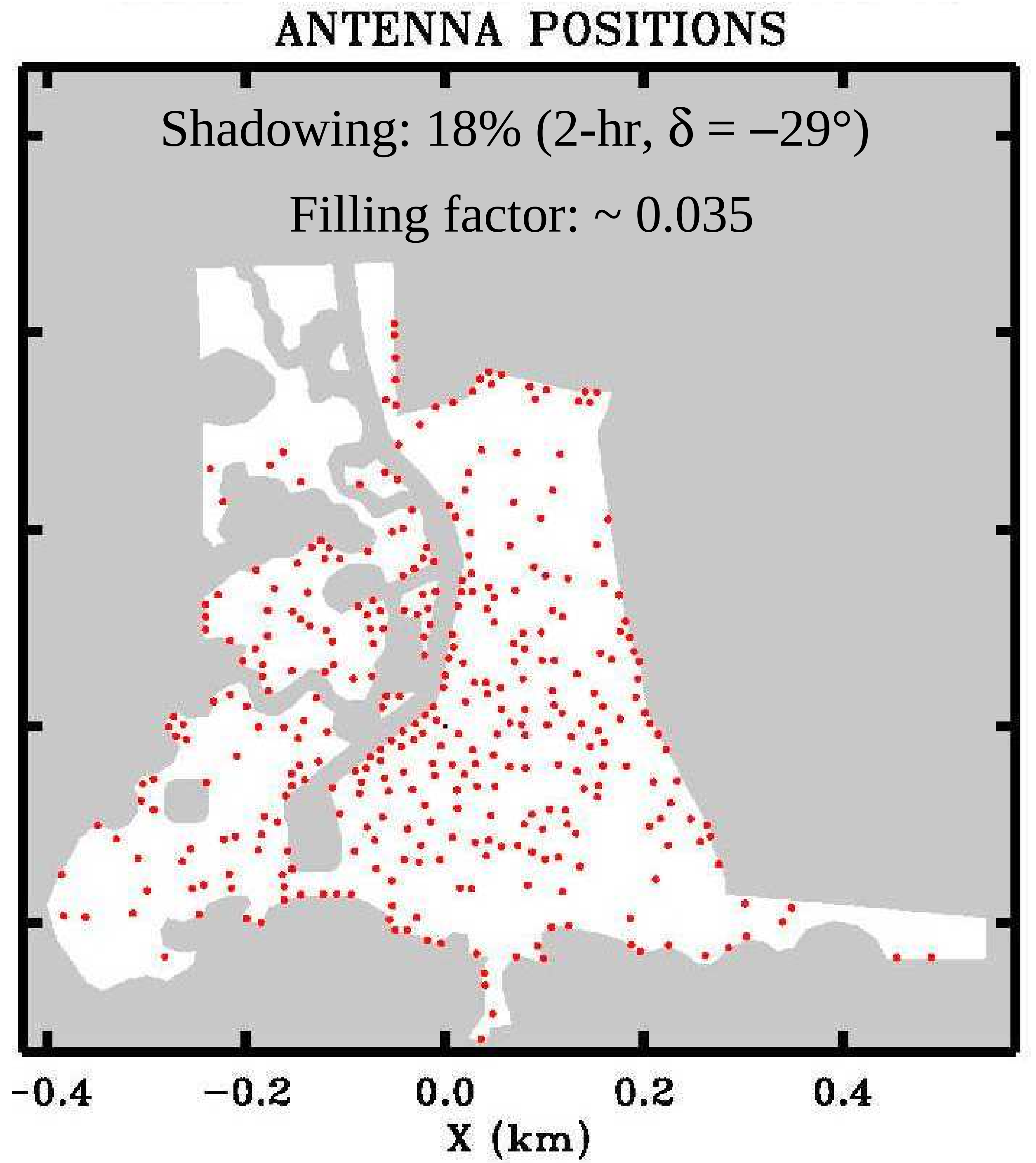
Nat. weighted beam 78″ × 78″ at δ = 5° (ν = 1.4 GHz)

Sidelobes: near 0.9% peak; far 0.3% rms



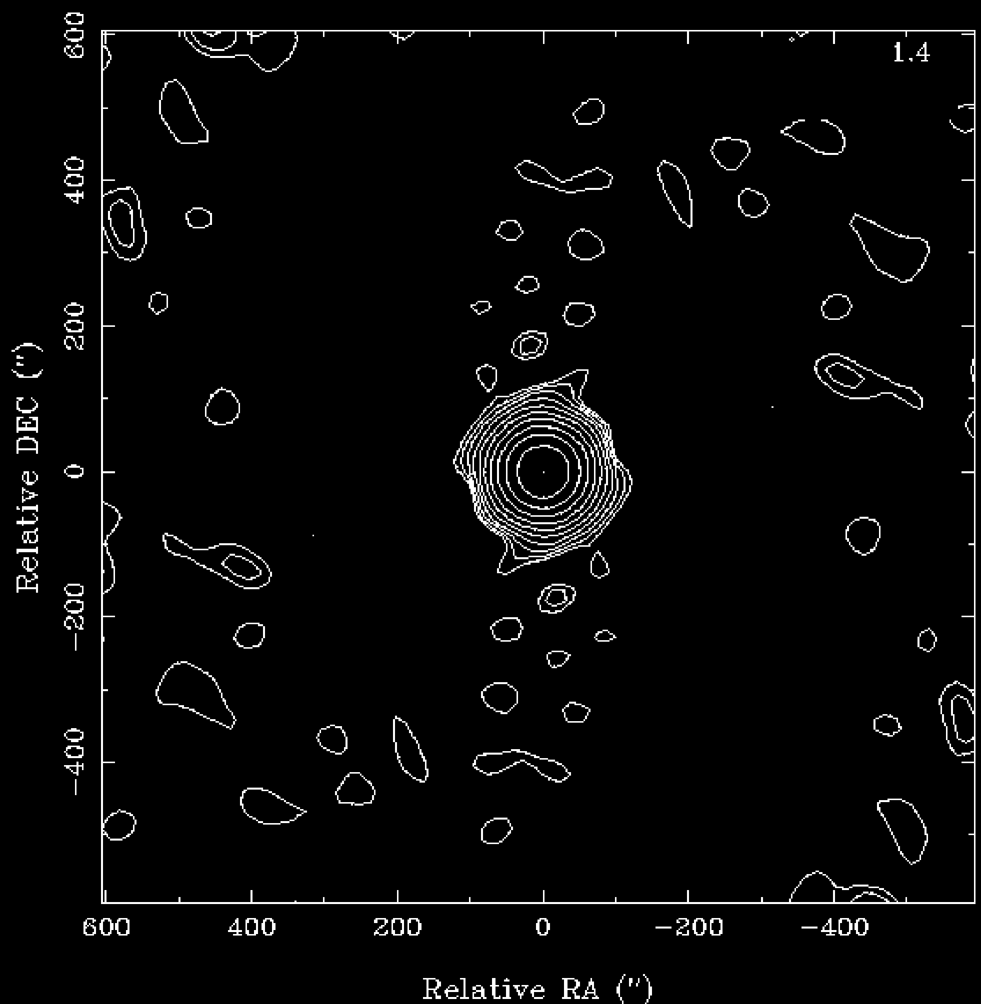
Contours: 0.3, 0.5, 0.9 … %



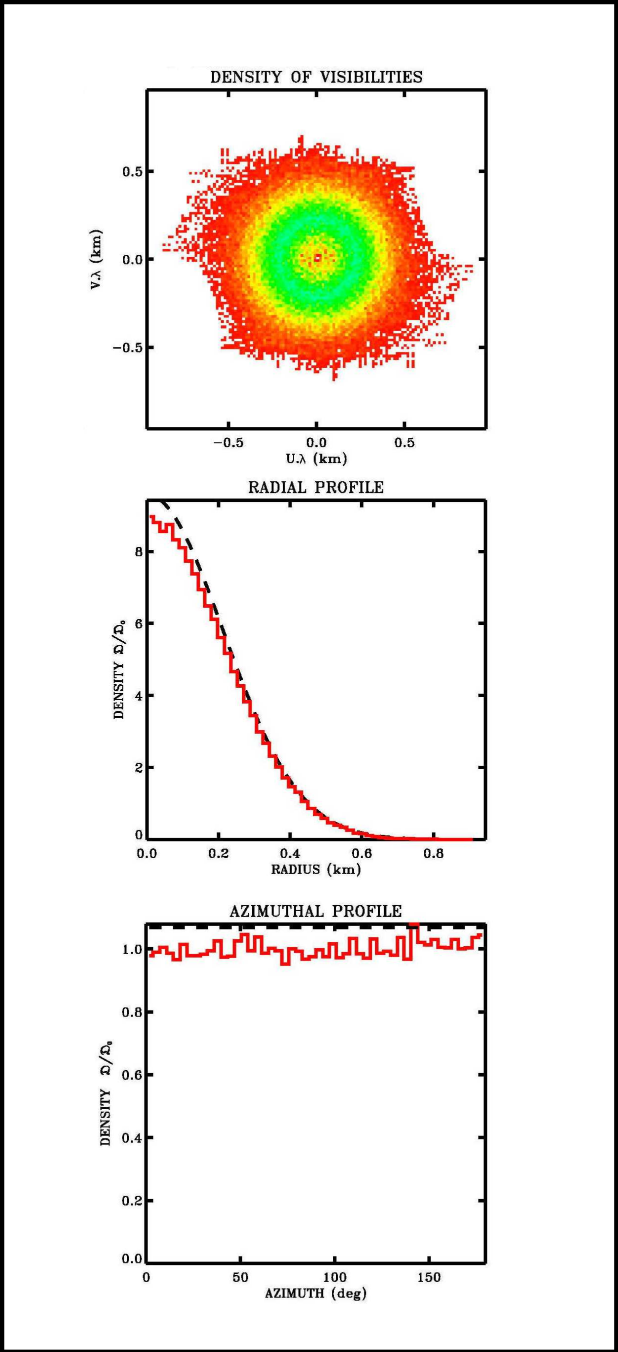

ANTENNA POSITIONS
Shadowing: 18% (2-hr, δ = –29°)
Filling factor: ~ 0.035
−0.4
−0.2
0.0
0.2
0.4
X (km)

Nat. weighted beam 78″ × 78″ at δ = 23°
(ν = 1.4 GHz)

Sidelobes: near 0.7% peak; far 0.3% rms

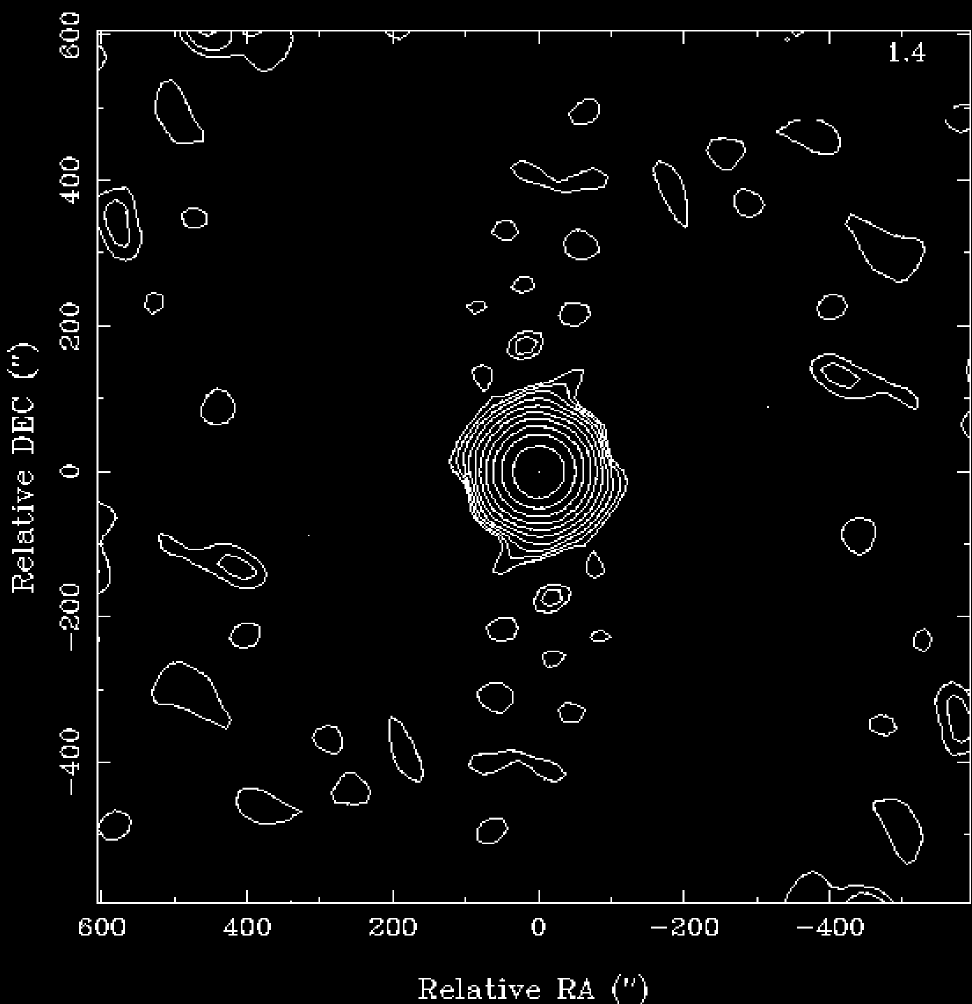


Contours: 0.3, 0.5, 0.9 … %



Nat. weighted beam 78″ × 78″ at $\delta = 23°$
(ν = 1.4 GHz)

Sidelobes: near 0.7% peak; far 0.3% rms



Contours: 0.3, 0.5, 0.9 … %

Re-weight for rounder beam and sidelobes < 0.1%
→ < 10% loss in sensitivity

Truncate at B_{max} = 440 m
(limit of complete *uv* coverage)
→ 84″ beam, sidelobes 1.5%

Put antennas in the road
→ sidelobes 0.5%

Lose 10% of antennas
→ sidelobes ∈2%

Random position error (1 m)
→ no effect

cf. the most compact configuration possible

- Antennas within 280 m diameter (filling factor 0.15) [0.035]
- Antennas still random (0.3% rms far sidelobes)
- Uniform distribution (5% near sidelobes [0.7%])
- Transit beam 150″ [78″]
- Shadowing 59% (2-hr, $\delta = -29°$) [18%]

Where are we now?

- Trying to save some trees
- Geological survey of the lava (impacts foundation design and antenna placement — a cost issue)
- Need to obtain US Forest Service approval for the final configuration