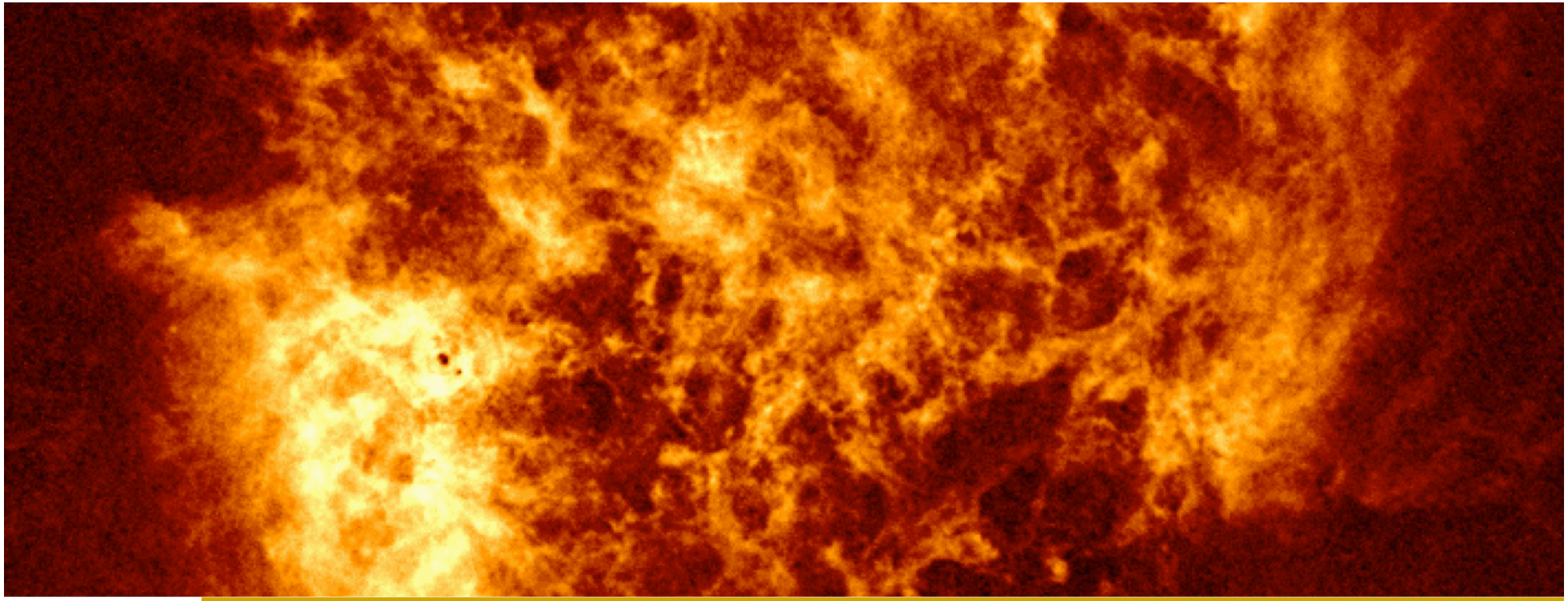

The Challenge of High Redshifts: SKA Pathfinders

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HI Science Drivers for SKA Pathfinders

Galaxy Population

- Cosmic density of the lowest-mass galaxies
- Host galaxies of absorption-line systems
- The HI mass function in different environments
- Low surface brightness gas and the cosmic web

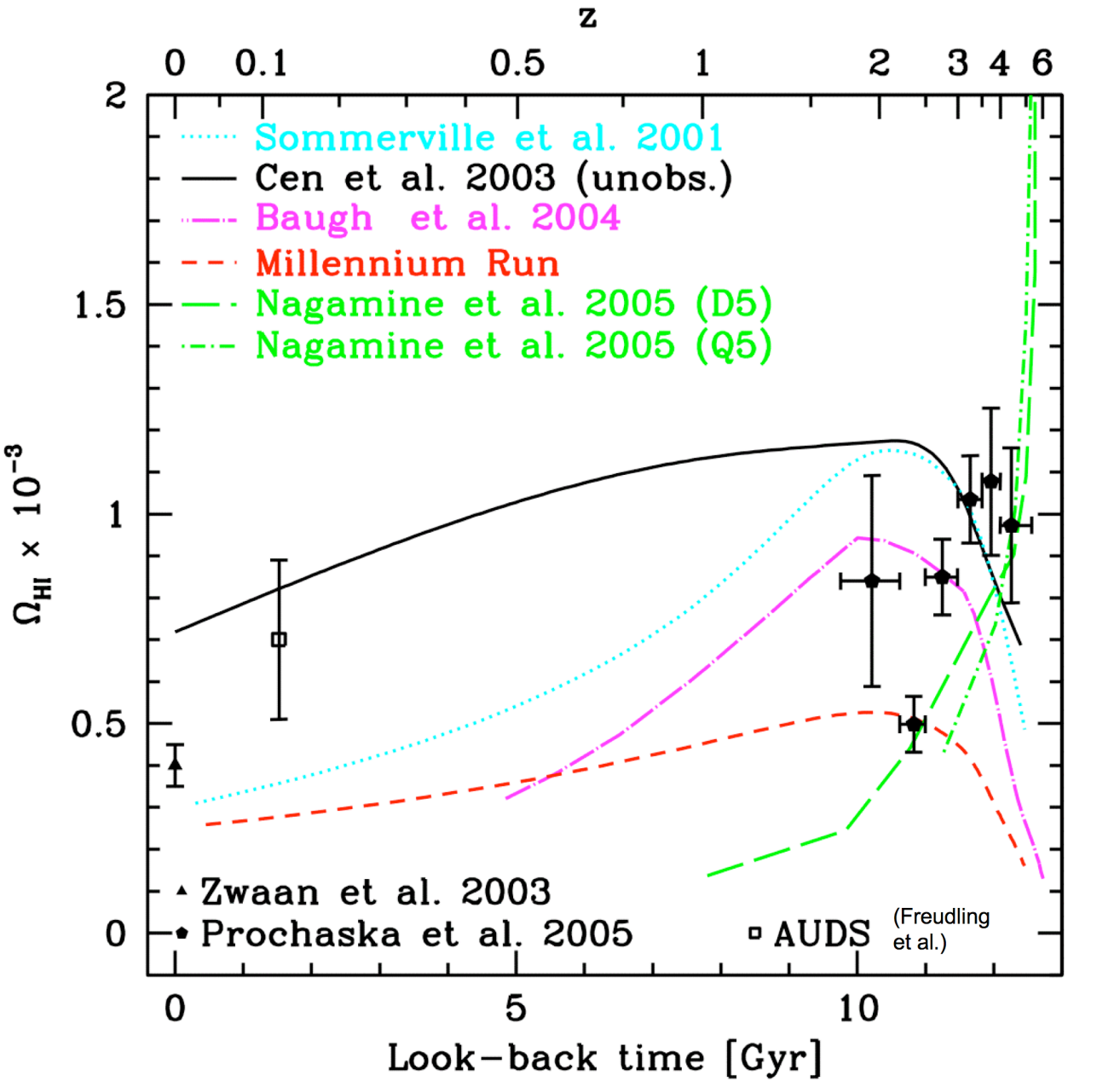
Galaxy Evolution

- Evolution of cosmic gas density
- Halo Occupancy of Gas-Rich galaxies

Cosmology

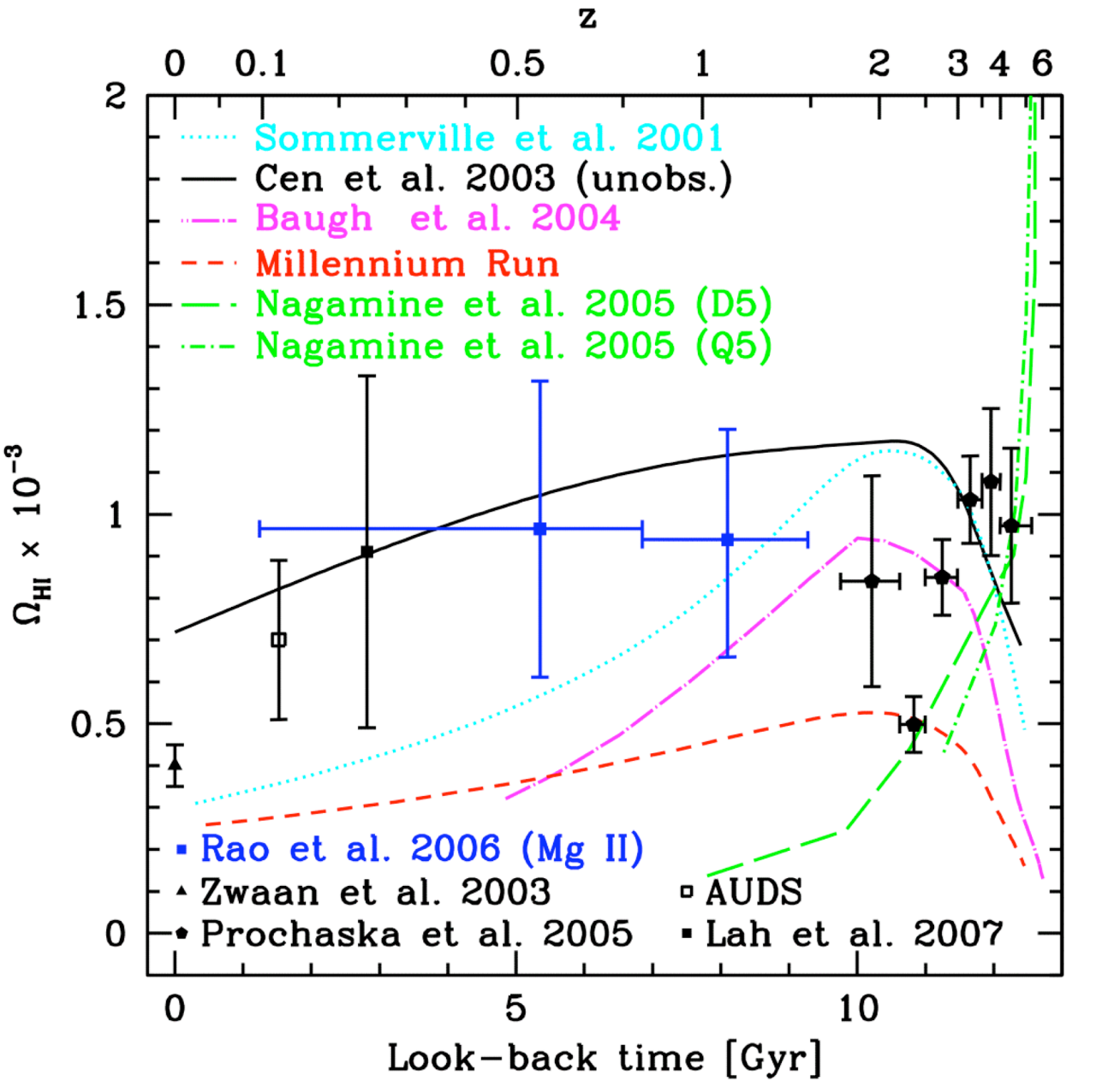
- Biasing in gas-rich galaxies
- Baryon Acoustic Oscillations/Dark Energy

Neutral hydrogen density v. redshift



Neutral hydrogen density v. redshift

(AUDS: Freudling et al.)



Distant HI with Existing Large Telescopes

Arecibo:

- SF-selected SDSS galaxies up to z=0.28 (Catinella et al.).
- Blind ultra-deep survey (AUDS) up to z=0.15 (Freudling et al.).

WSRT:

- A2218 galaxy at z=0.18 (Zwaan et al. 2001).
- A963 and A2192 at z=0.2 (Verheijen et al. 2007).

GMRT:

- Co-added Subaru/A370 galaxies at z=0.24,0.37 (Lah et al. 2007).

All required many days of observing time!

The SKA (Pathfinder) Advantage

Mapping speed for a radio telescope:

- $S = (A/T)^2 \Omega$

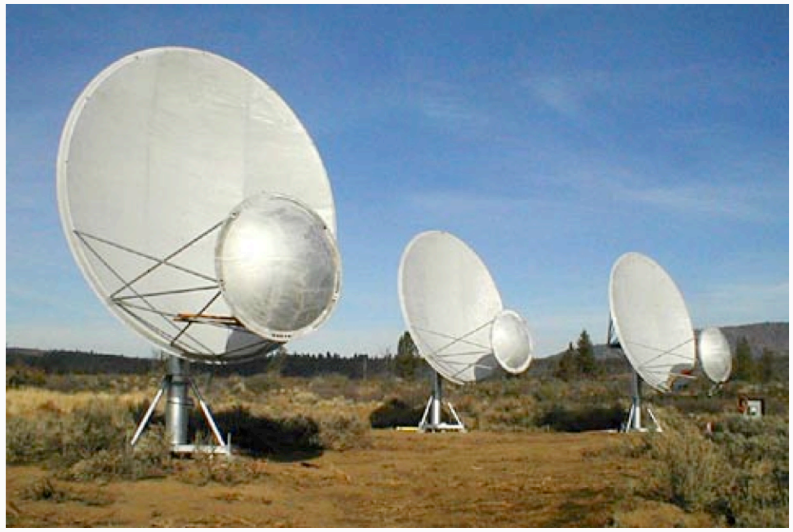
Parkes multibeam (1 GHz)

- S=1

SKA (1 GHz)

- $S=5x10^6$

SKA Pathfinders



Allen Telescope Array (Blitz talk)

Australian SKA Pathfinder (ASKAP=MIRANdA=xN
MeerKAT (S.Africa)

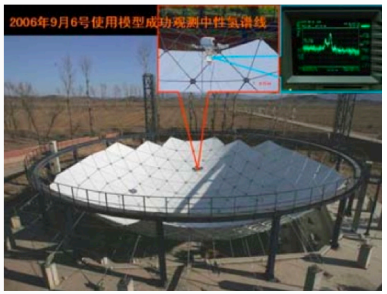
Apertif WSRT

MWA (Lonsdale)

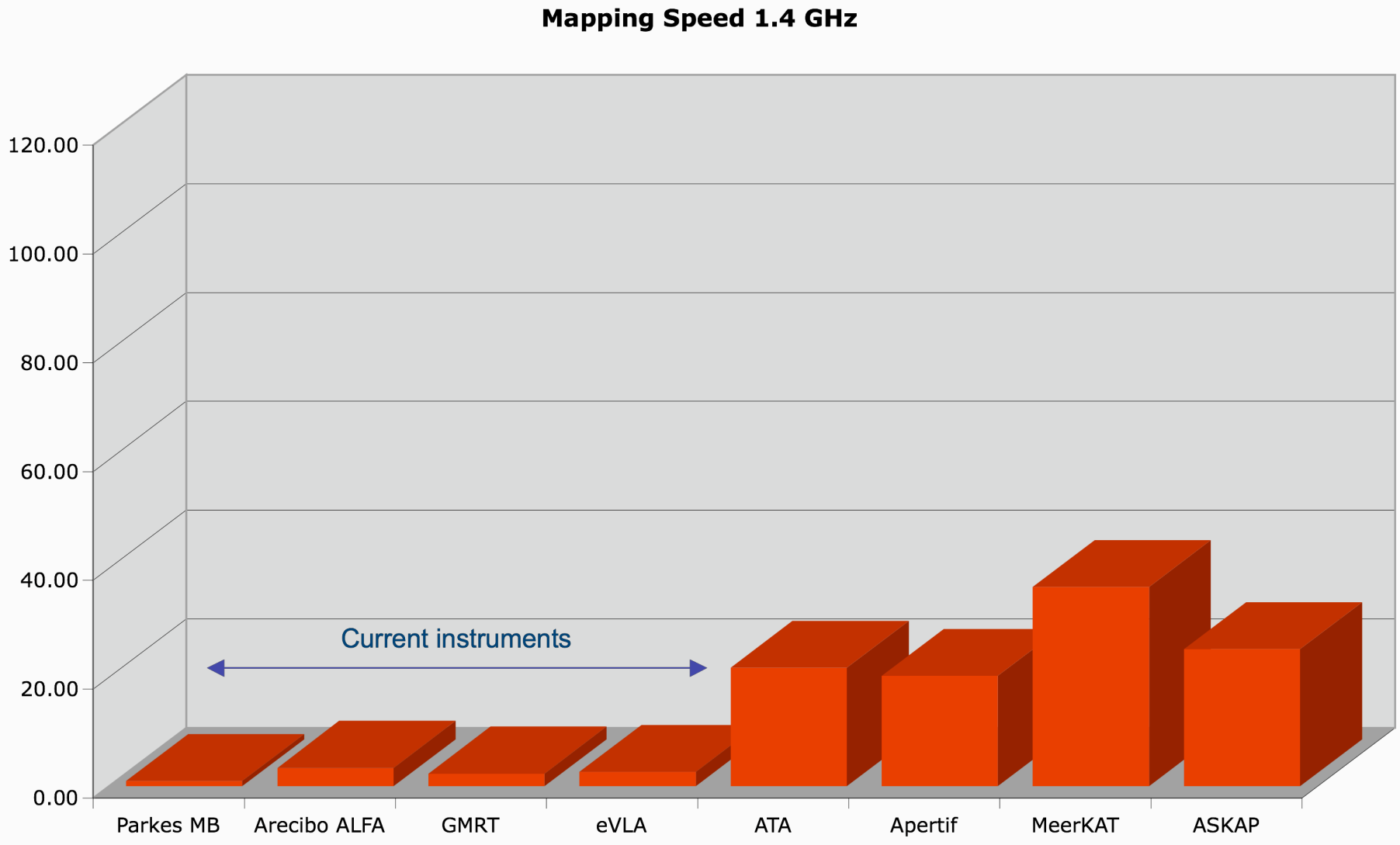
Hubble Hydrogen Array
(Peterson)

LOFAR
(de Bruyn)

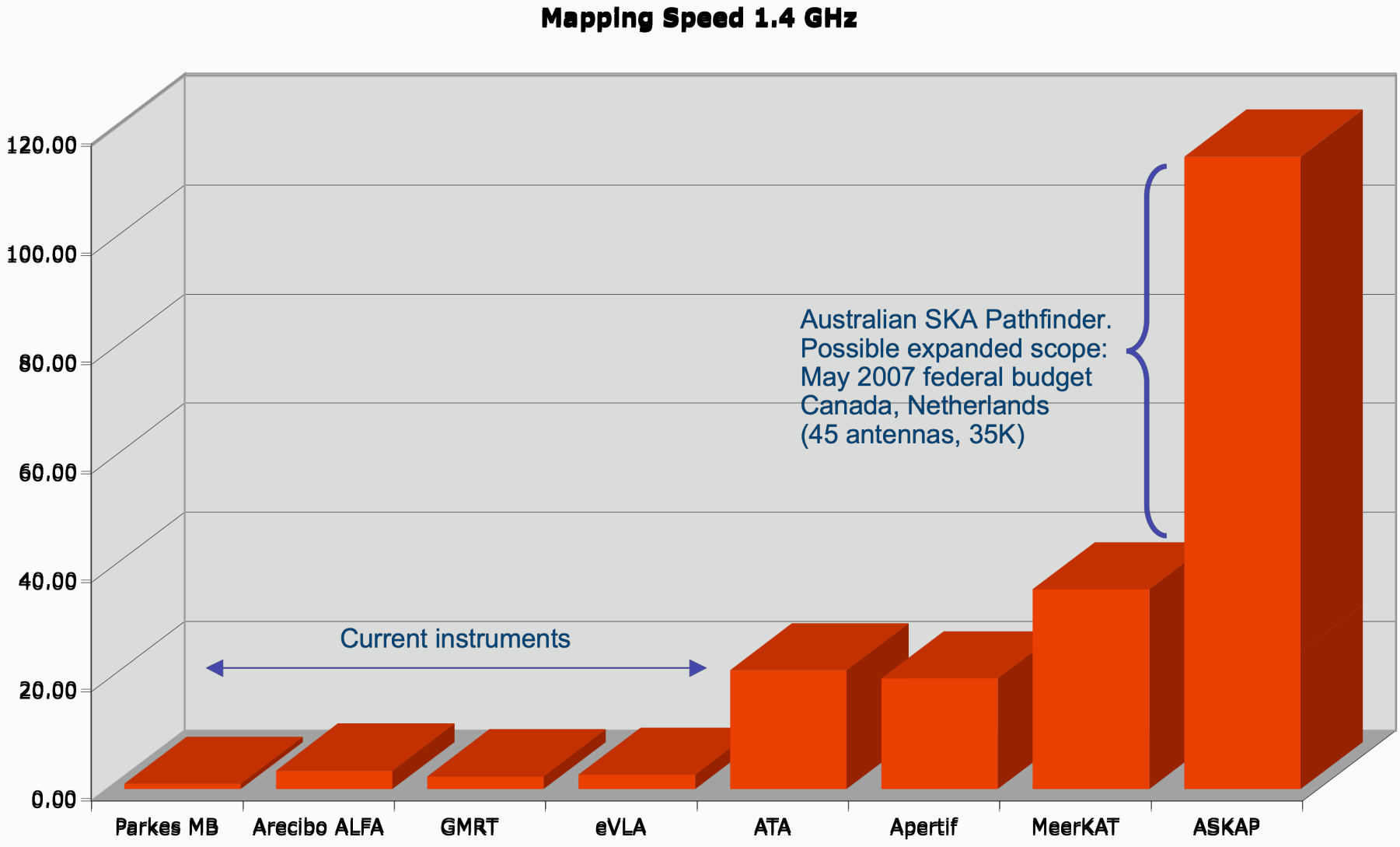
FAST (China)



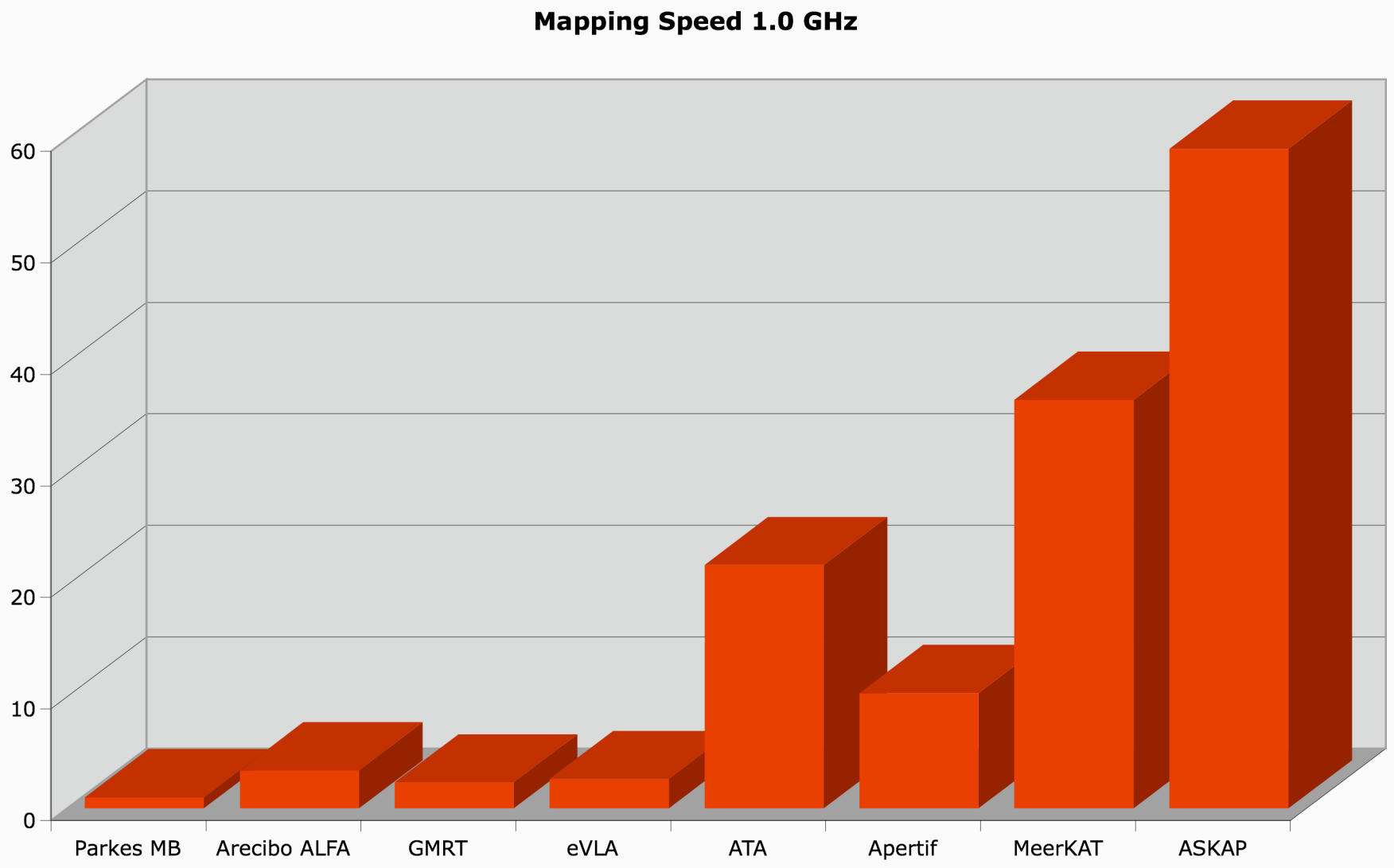
Current Instruments and SKA Pathfinders
(Parkes multibeam=1)



Current Instruments and SKA Pathfinders
(Parkes multibeam=1)

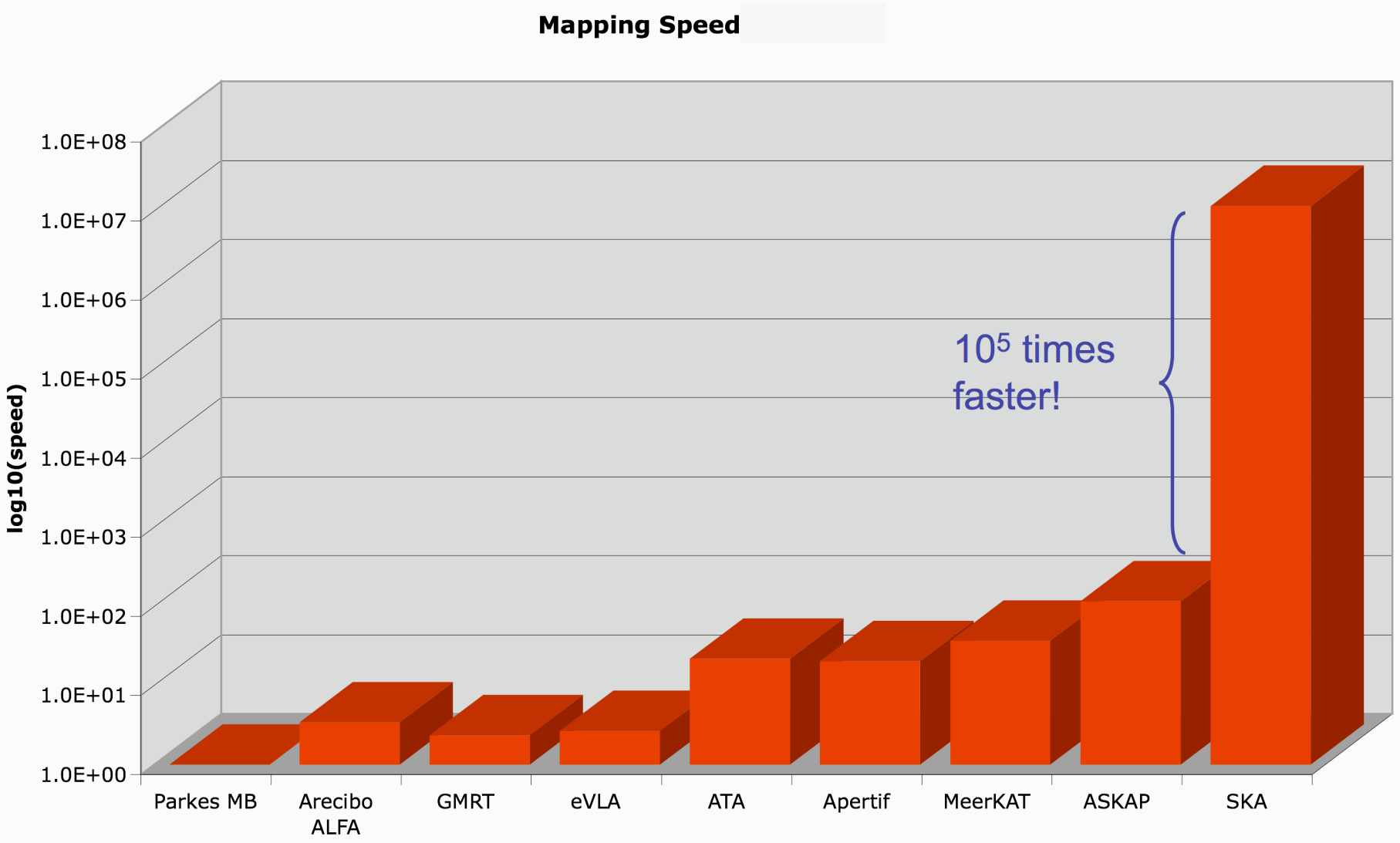


Effect of observing frequency (z=0.4)

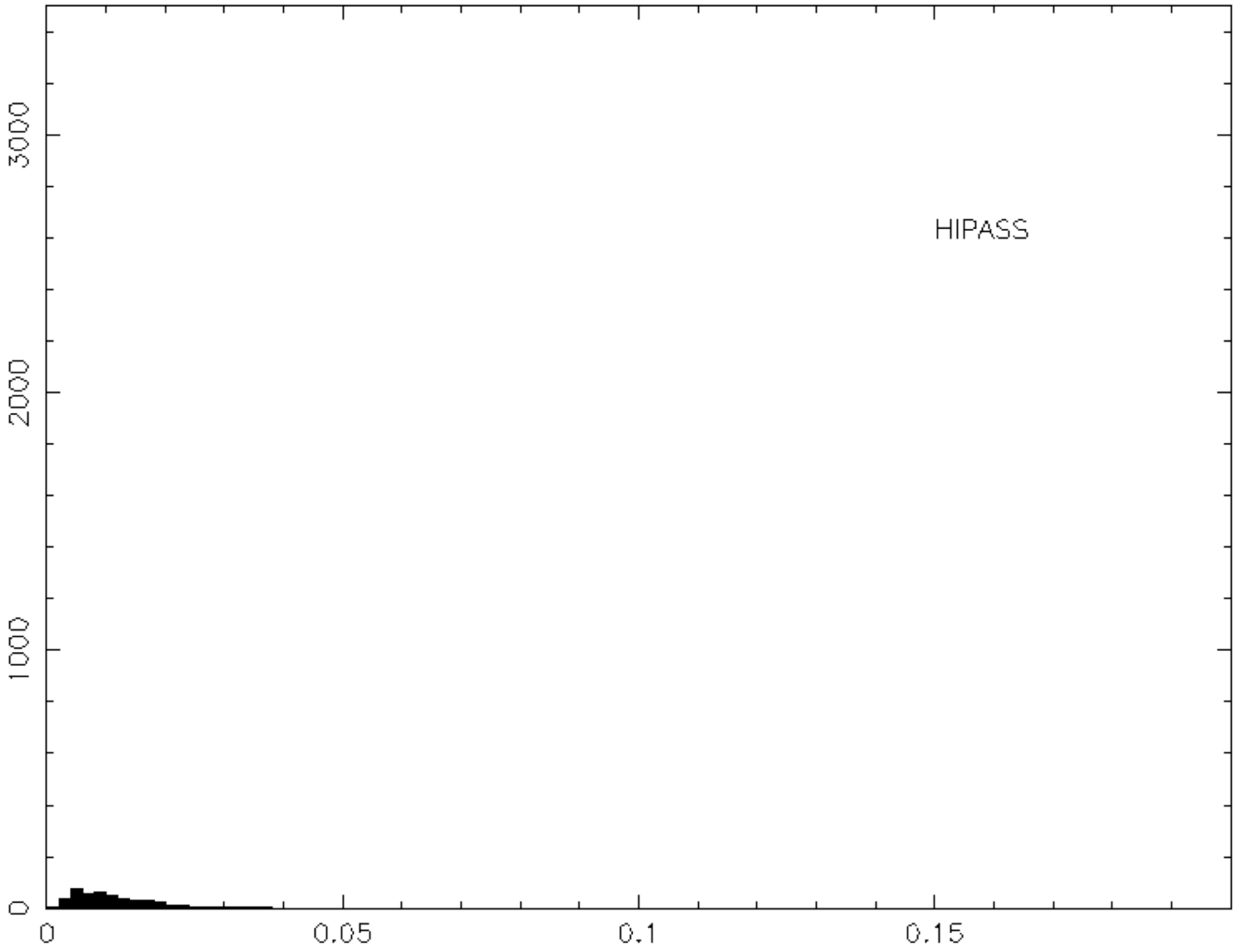


Projected Mapping Speed of the SKA

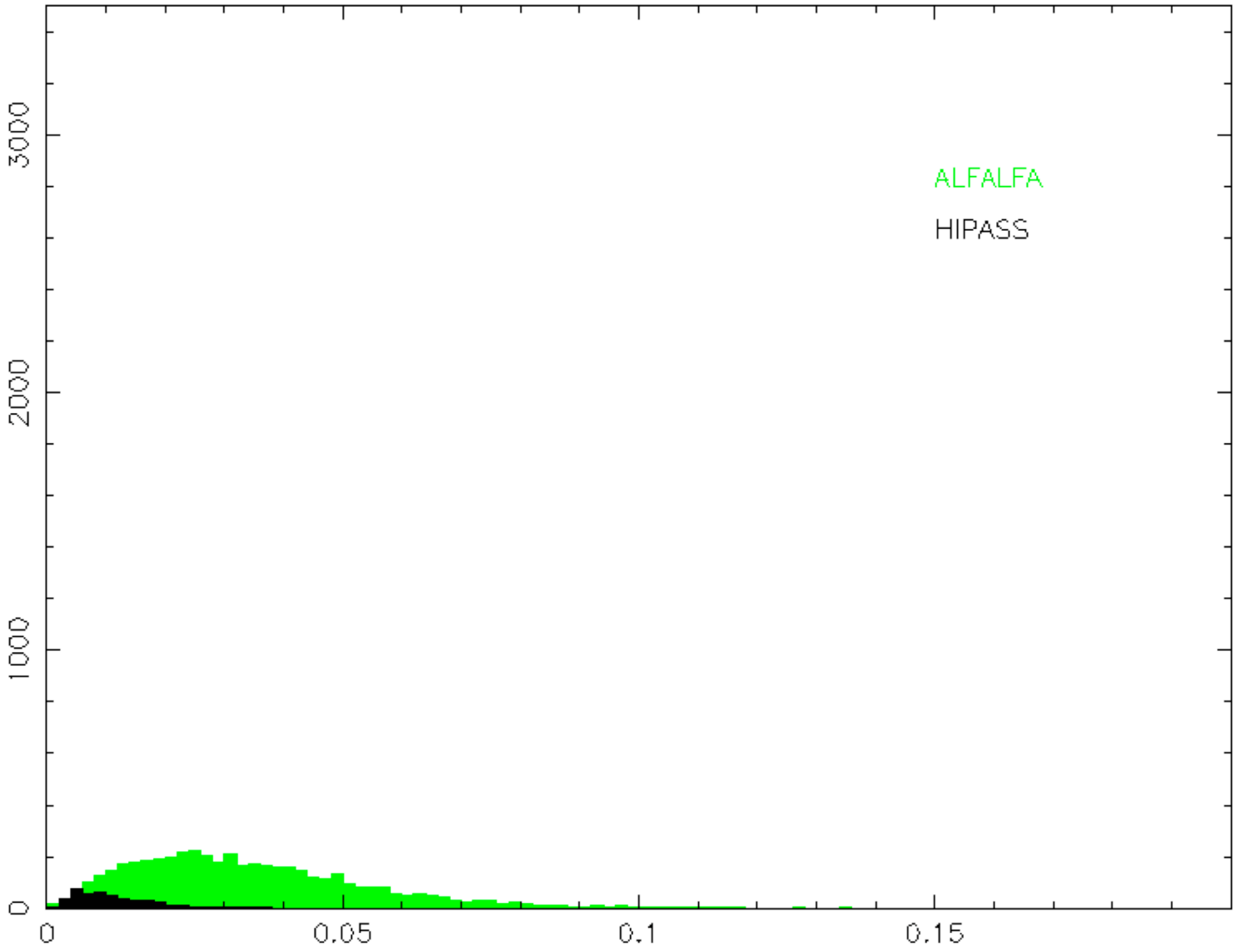
log scale!



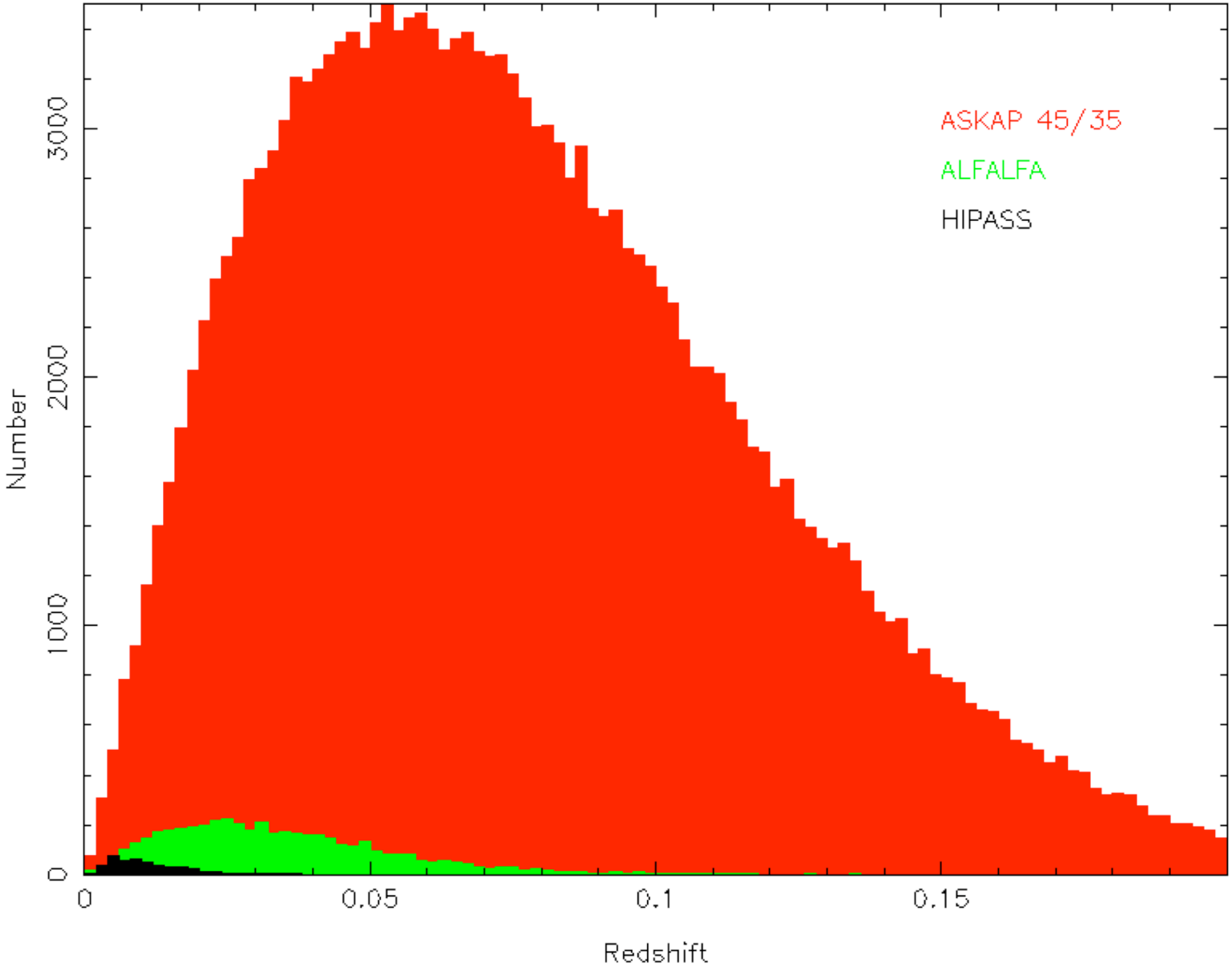
All-Sky Surveys (detections v redshift)



All-Sky Surveys (detections v redshift)

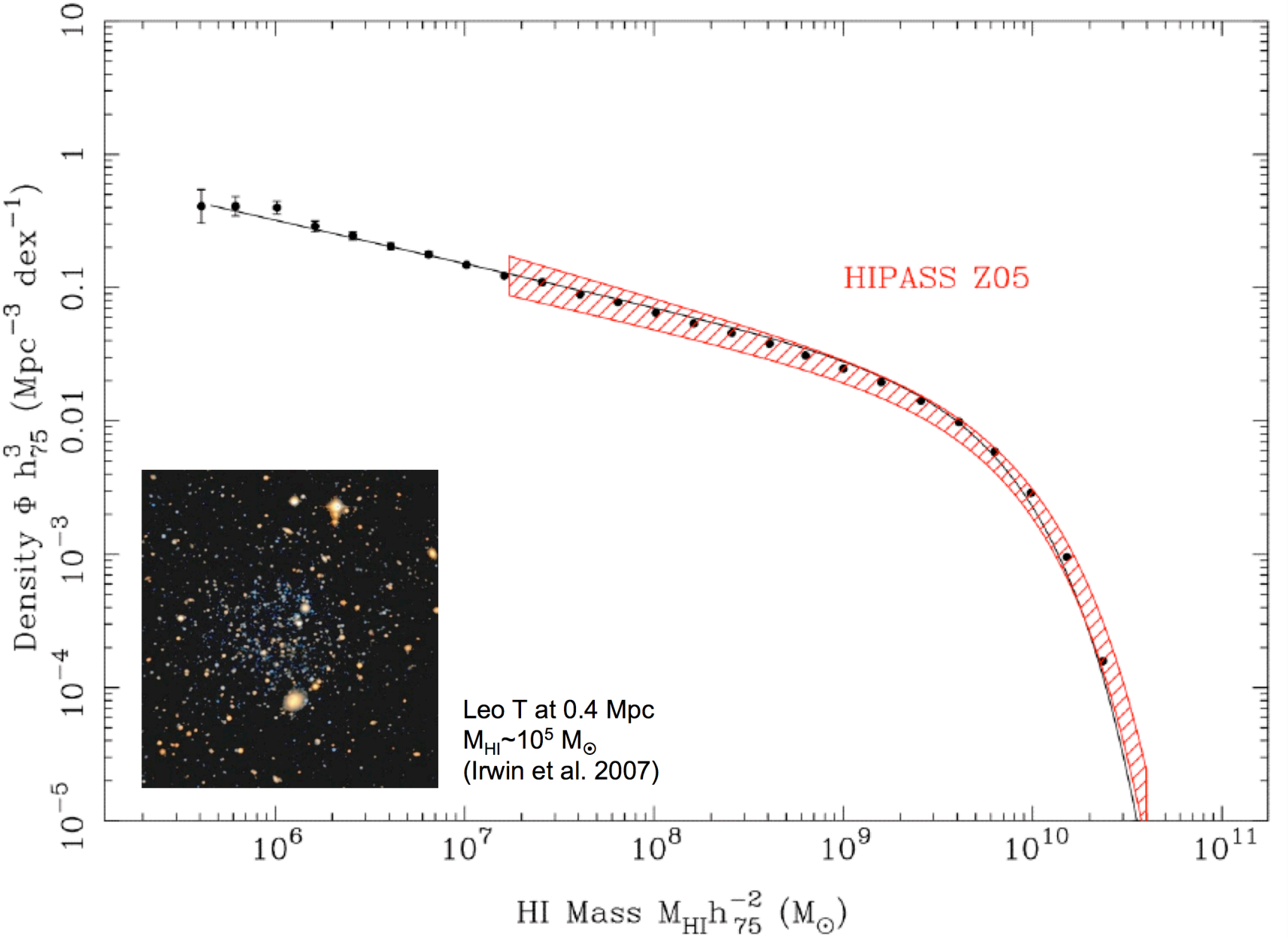


All-Sky Surveys

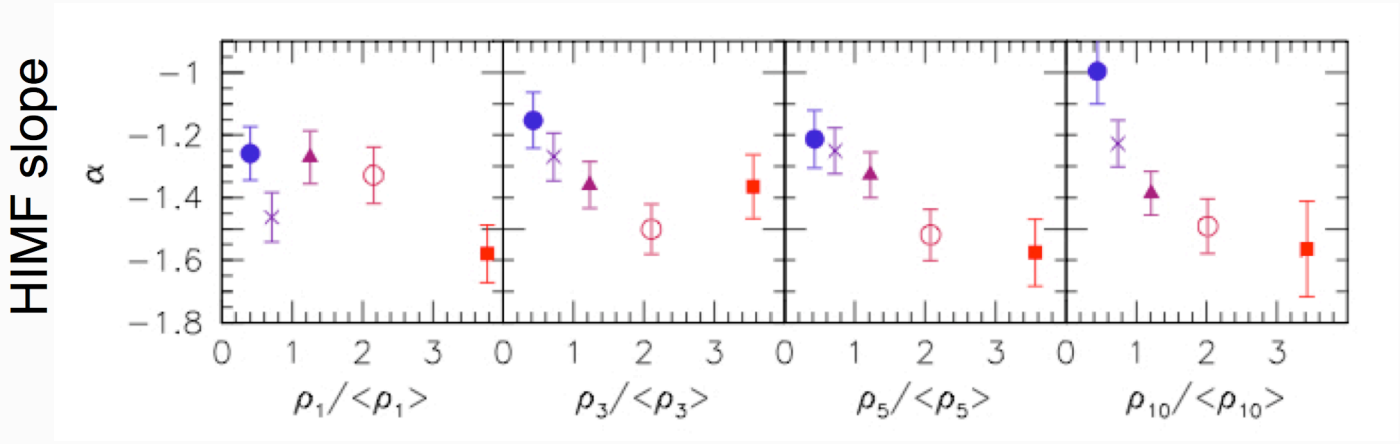


HI Mass Function beyond Local Group

ASKAP 30/50 All-Sky Survey



The effect of environment on the HIMF?

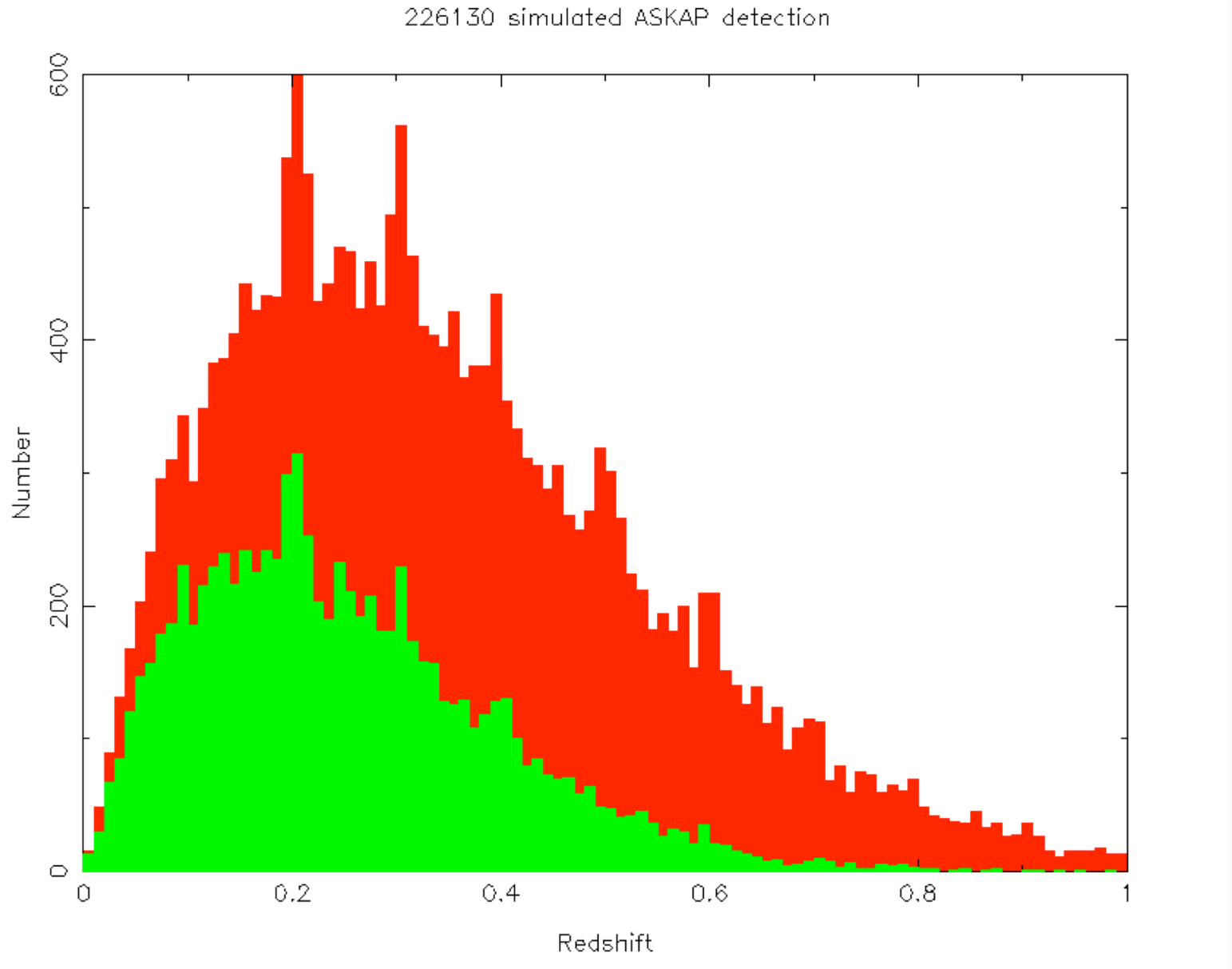


Less faint galaxies

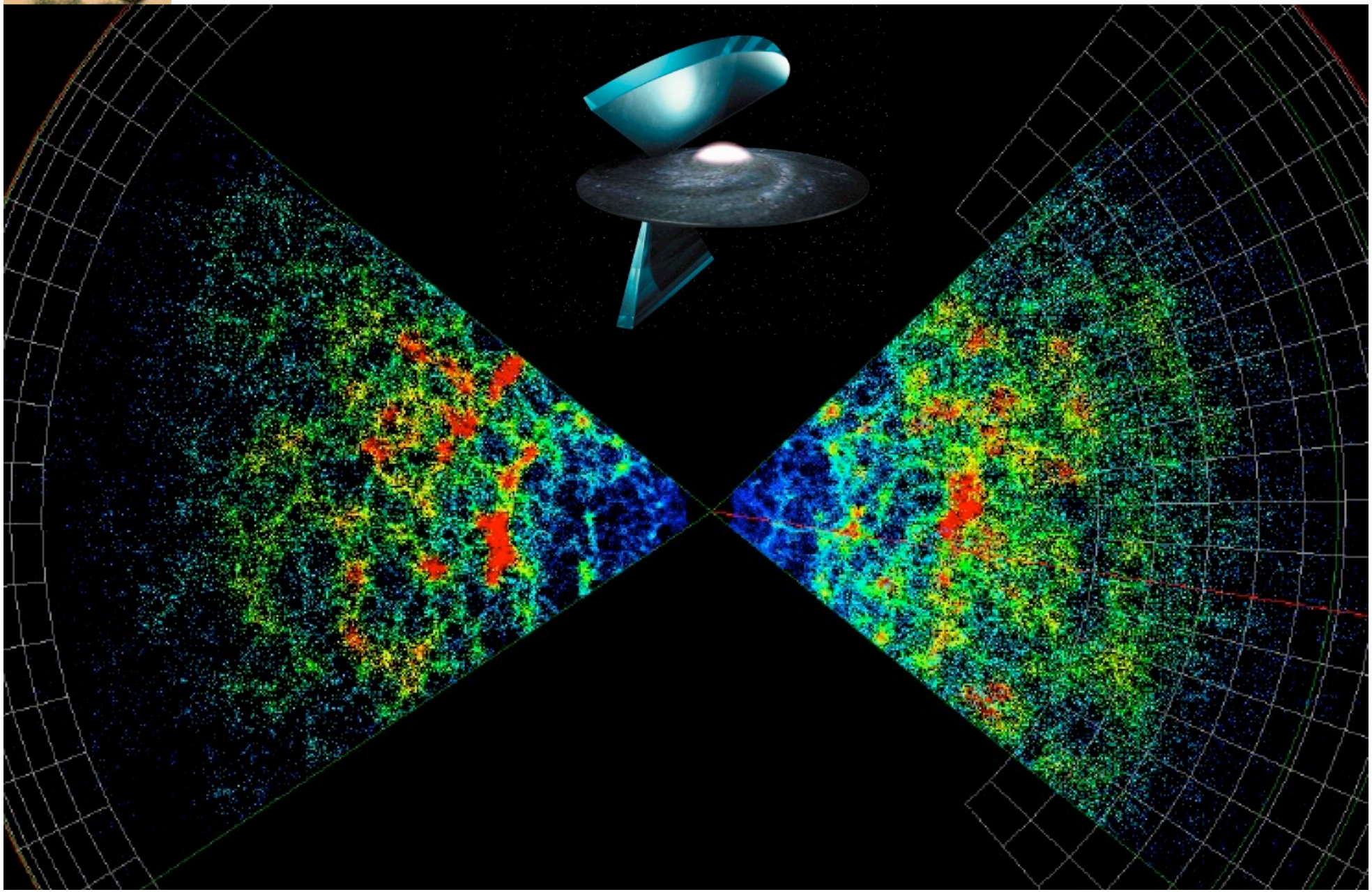
More faint galaxies

- HIPASS suggests the HIMF *steepens* in high-density environments (Zwaan et al. 2005)
- Group HIMFs suggest differently (Verheijen et al., Oosterloo et al., Kilborn et al.)

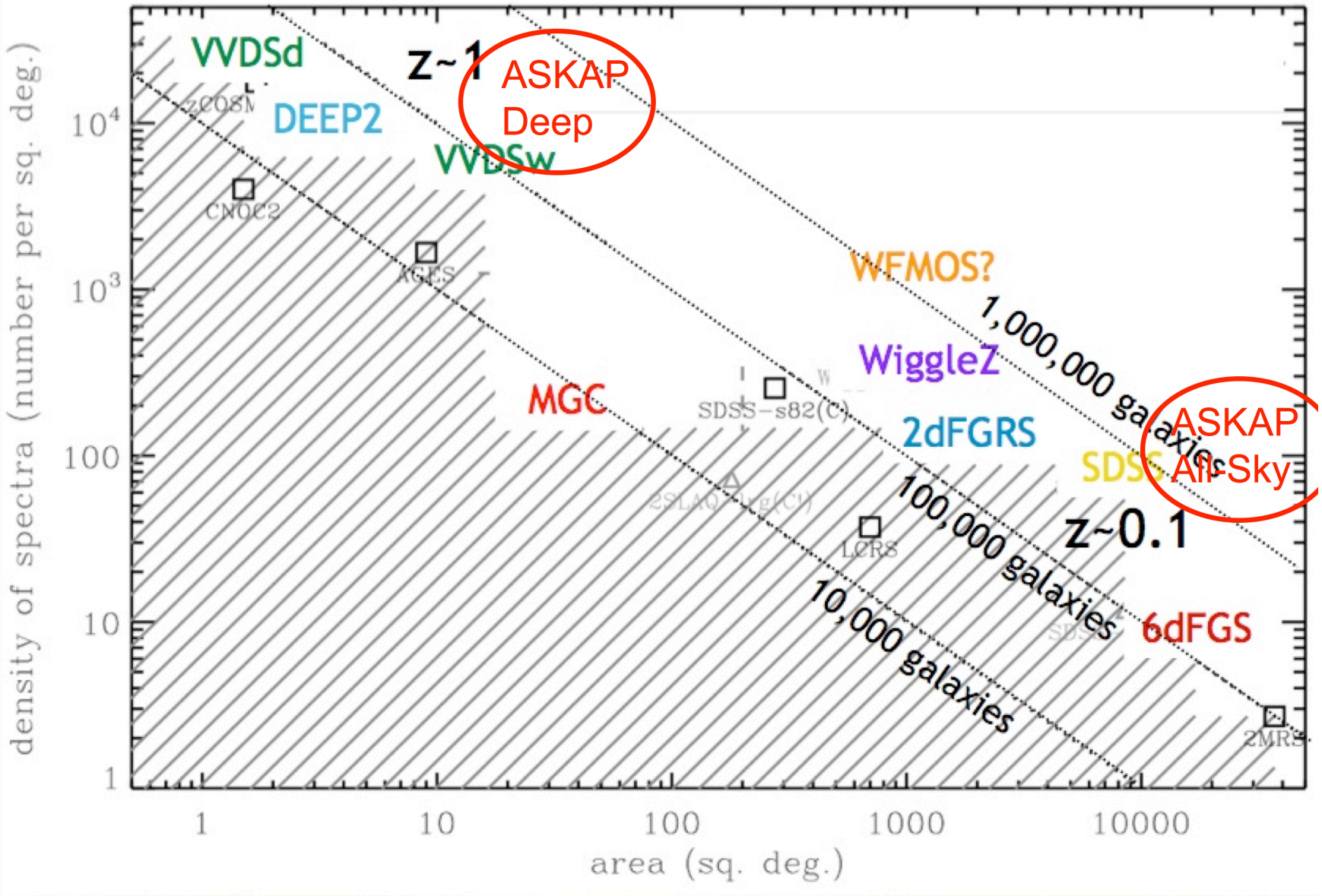
Deep HI ASKAP survey (1 year)



2dFGRS (Colless et al. 2001)

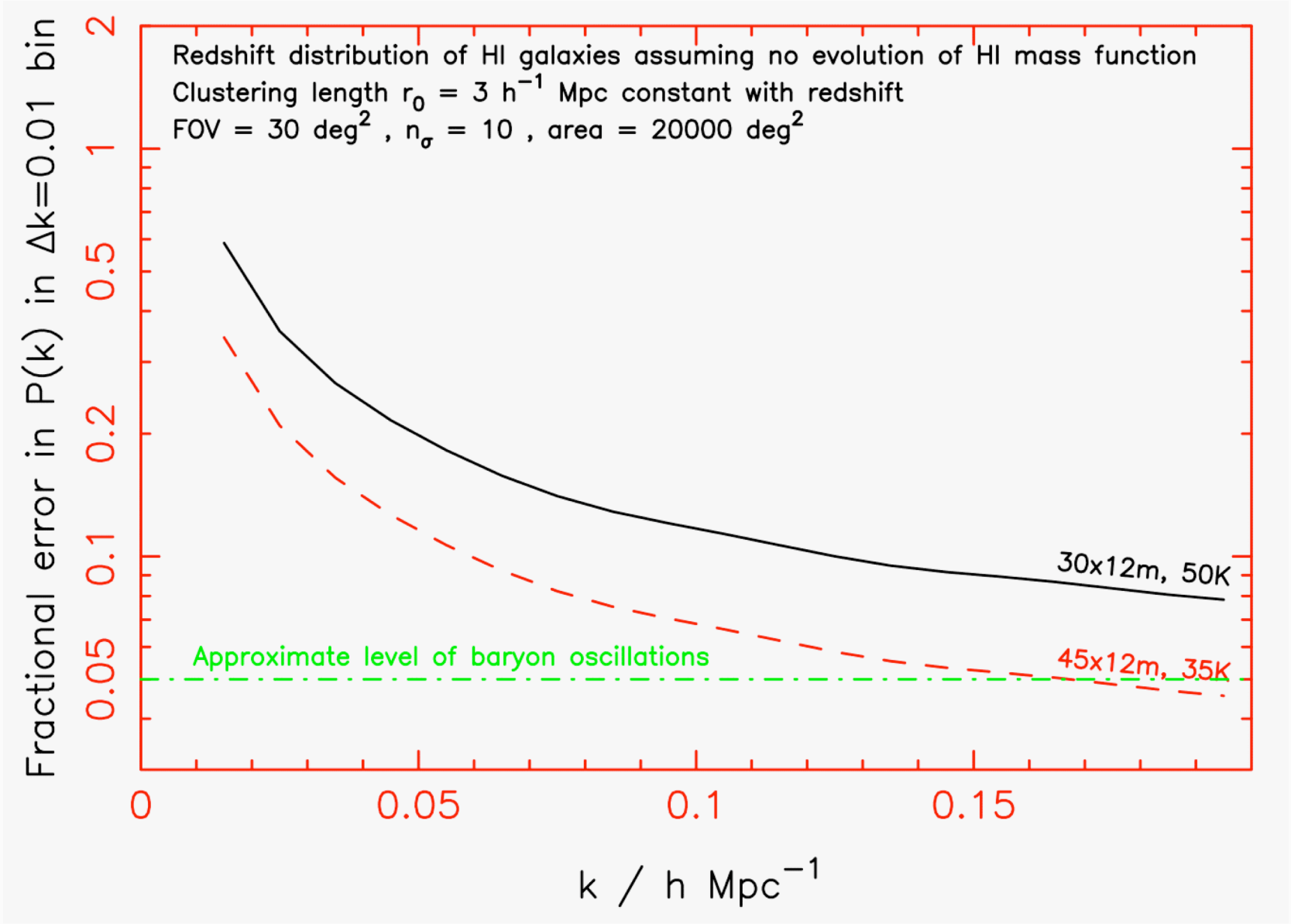


Optical Redshift Surveys



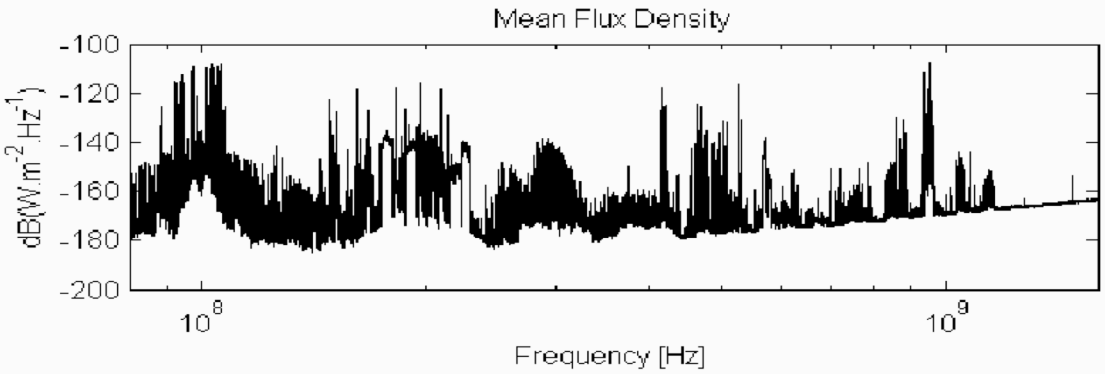
M.Colles

Baryon Oscillations weakly detectable
(Blake)

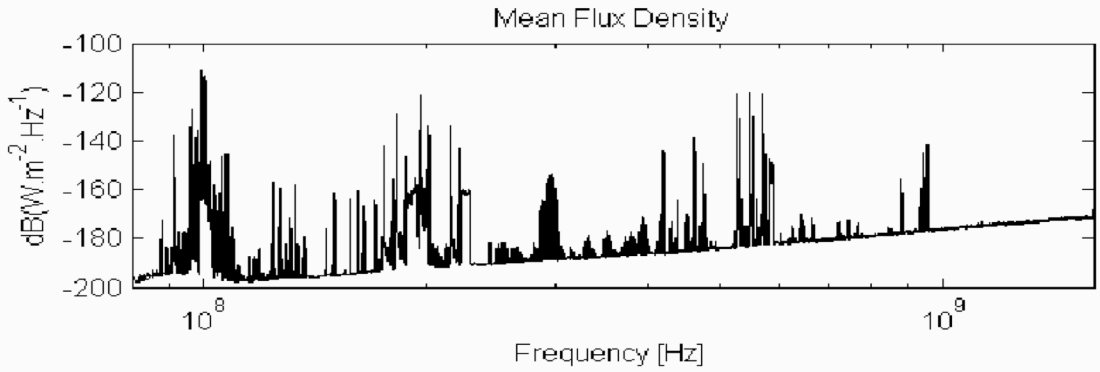


Comparison of radio interference levels

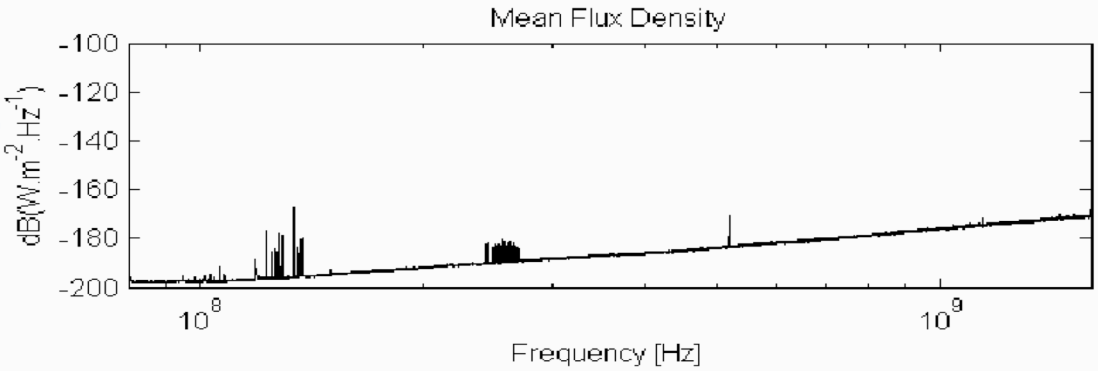
Sydney - population 4M



Narrabri (site of Compact Array) - Population 7000



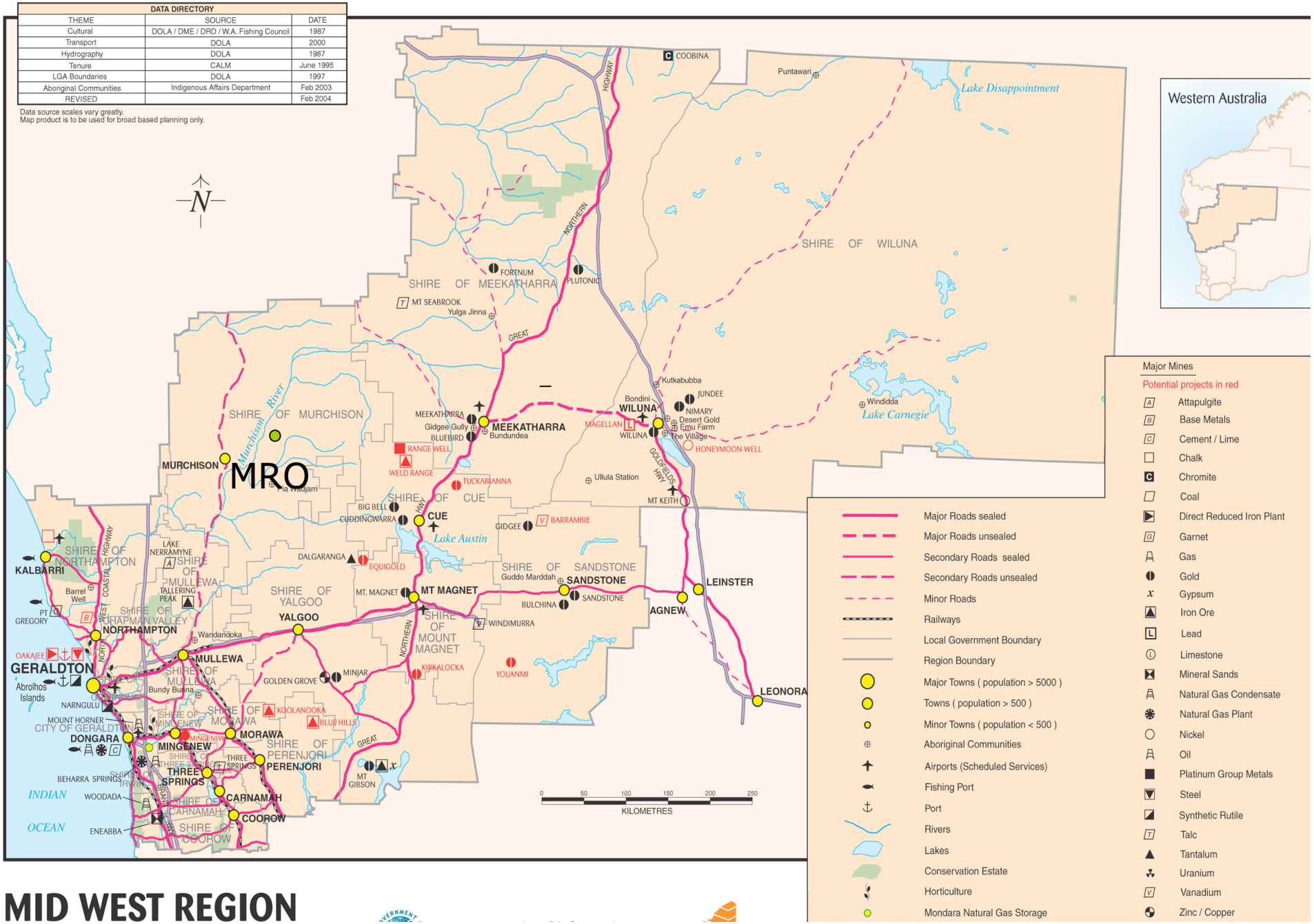
Murchison Shire WA - Population 160



WA Midwest

DATA DIRECTORY		
THEME	SOURCE	DATE
Cultural	DOLA / DME / DRD / W.A. Fishing Council	1987
Transport	DOLA	2000
Hydrography	DOLA	1987
Tenure	CALM	June 1995
LGA Boundaries	DOLA	1997
Aboriginal Communities	Indigenous Affairs Department	Feb 2003
REVISED		Feb 2004

Data source scales vary greatly.
Map product is to be used for broad based planning only.



MID WEST REGION

WA Midwest

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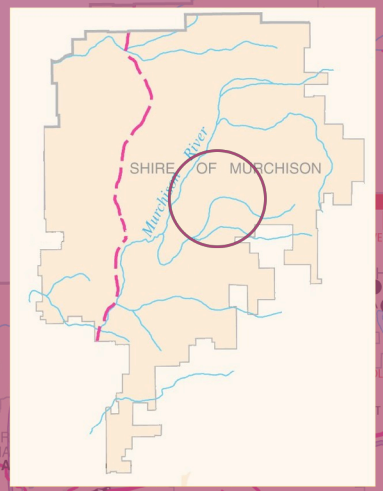

=Venice-Rome

Major Mines
Potential projects in red

- Attapulgite
- Base Metals
- Cement / Lime
- Chalk
- Chromite
- Coal
- Direct Reduced Iron Plant
- Garnet
- Gas
- Gold
- Gypsum
- Iron Ore
- Lead
- Limestone
- Mineral Sands
- Natural Gas Condensate
- Natural Gas Plant
- Nickel
- Oil
- Platinum Group Metals
- Steel
- Synthetic Rutile
- Talc
- Tantalum
- Uranium
- Vanadium
- Zinc / Copper

- Major Roads sealed
- Major Roads unsealed
- Secondary Roads sealed
- Secondary Roads unsealed
- Minor Roads
- Railways
- Local Government Boundary
- Region Boundary
- Major Towns (population > 5000)
- Towns (population > 500)
- Minor Towns (population < 500)
- Aboriginal Communities
- Airports (Scheduled Services)
- Fishing Port
- Port
- Rivers
- Lakes
- Conservation Estate
- Horticulture
- Mondara Natural Gas Storage

MID WEST REGION

WA Midwest

gazetted towns: 0

population: "up to 160"

=Venice-Rome

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THEME	SOURCE	DATE
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Oil
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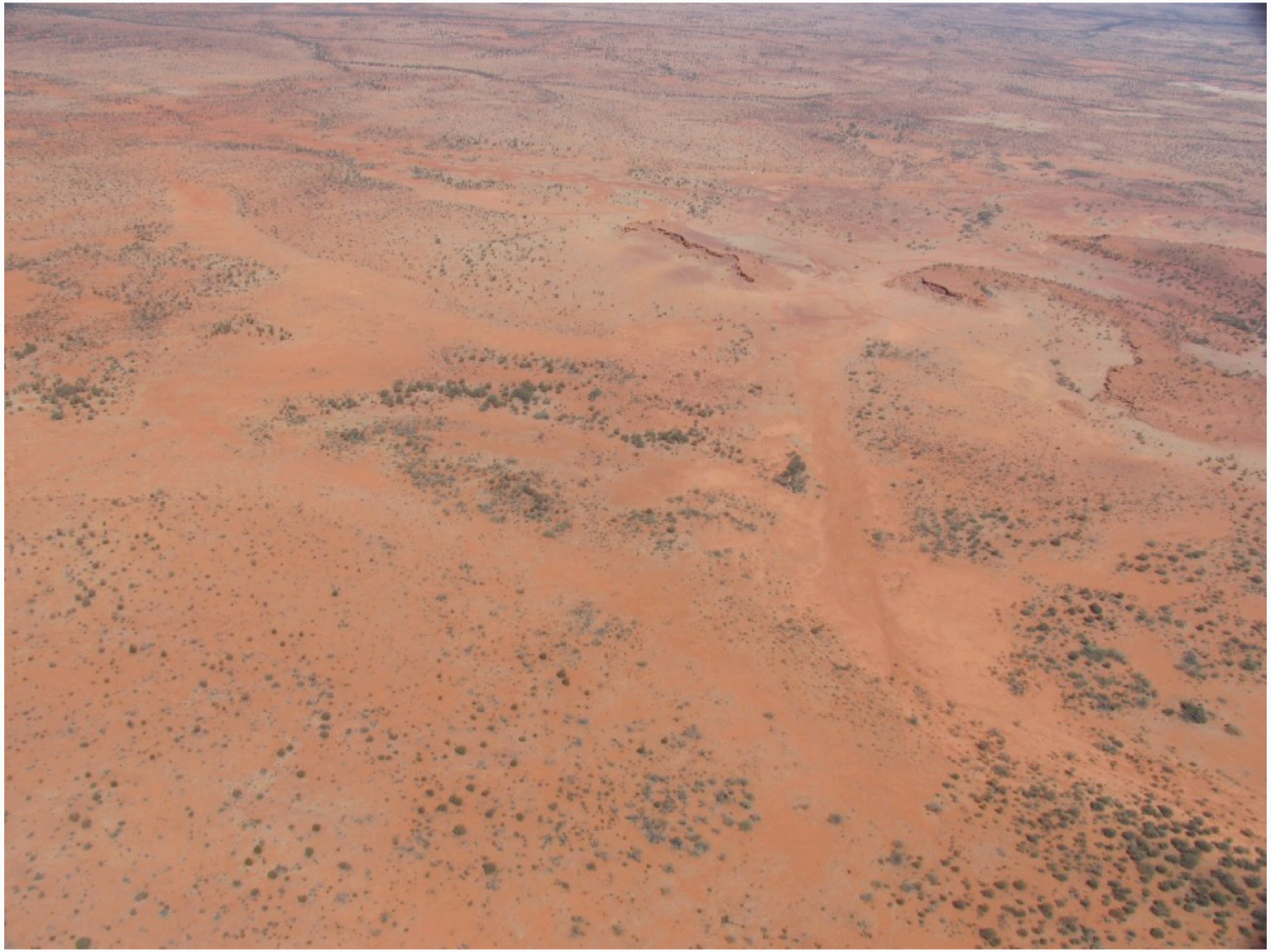
Steel
Synthetic Rutile
Talc
Tantalum
Uranium
Vanadium
Zinc / Copper

MID WEST REGION

Murchison Radio Observatory - Boolardy Station



Murchison Radio Observatory - Boolardy Station

Murchison Radio Observatory

Summary

SKA Pathfinders (ASKAP/Apertif/ATA/MeerKAT) will be powerful facilities capable of large-scale HI surveys:

- Gas evolution beyond z~0.5 (5 Gyr look-back time)
- HI mass function of galaxies in different environments
- Halo Occupation Distribution of gas rich galaxies
- Scale-dependent ‘bias’
- Examine complete 3D structure of Universe to z~0.1

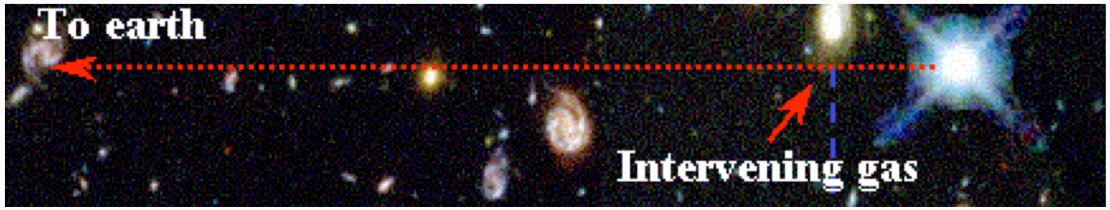
ASKAP Timescales

- 6 antennas commissioned 2009
- ASKAP commissioned 2010

Ambiguities in Interpretation of MgII/Damped Ly-α sightlines

A. GRB spectra have higher HI column densities than QSO spectra (Berger et al. 2005)

- Dust obscuration biases QSO determinations of absorber incidence?



B. GRB spectra have 4x the number of strong MgII absorption-line systems than QSOs (Prochter et al. 2006)

- Dust obscuration?
- Non-cosmological absorbers?
- GRBs gravitationally lensed (Porciani et al. 2007)?
- Intrinsic size of GRBs and QSOs?