


Tianlai Simulation Working Group

A decorative horizontal flourish consisting of a central diamond shape with symmetrical, flowing lines extending outwards to the left and right.

June 2013

Goals / steps

- ✦ *Determine instrument raw sensitivity , or noise projection on 3D power spectrum*
- ✦ *Determine instrument response and capability to map the sky (3D maps)*
- ✦ *Explore foreground subtraction methods*
- ✦ *Compute reconstructed power spectrum and BAO scale*
- ✦ *Sensitivity to cosmological parameters & DE eq. state*

1- Sky model

21 cm signal model
Foreground model



3- Simulated observations

Visibilities computed from the
sky model and instrument
model / response



*(u,v) plane response,
synthesized beam, Noise
power spectrum*

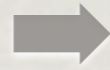


Receiver response, noise,
array configuration, survey
strategy
Polarization response
**Frequency response / standing
waves response**

2- Instrument model

3- Simulated observations

Simulated data set
 $\{V_{ij}(t)\}$



5- output sky maps

reconstructed
sky maps $\{I(\alpha, \delta, \nu)\}$



Quick map maker
optimal map making

4- map making tools

**6- Foreground
subtraction**



**6b - Polarization leakage /
farady rotation / instrument
spectral response**



8- Constraints on DE /
cosmological parameters

7- Power spectrum
 $P(k)$, $C(l)$ computation

- ✿ *Sky model : LSS 21 cm signal, radio foreground model*
- ✿ *Instrument model: noise, receiver beam, array layout*
 - ▣➔ *(u,v) plane response, beam, noise power spectrum ...*
- ✿ *Simulated data sets : $V_{ij}(\text{time})$*
- ✿ *3D map reconstruction, foreground subtraction, power spectrum estimate on the extracted 21 cm signal*
- ✿ *Direct signal power spectrum estimator*
- ✿ *Define instrument configuration to be compared*
 - ➔ *Dish array , dish size, number of dishes, feed+dish beam*
 - ➔ *Cylinders, width, number of cylinders, feed+cylinder beam*

Instrument configurations

★ *Dishes : 16 dishes, each $D=6$ meter in diameter*

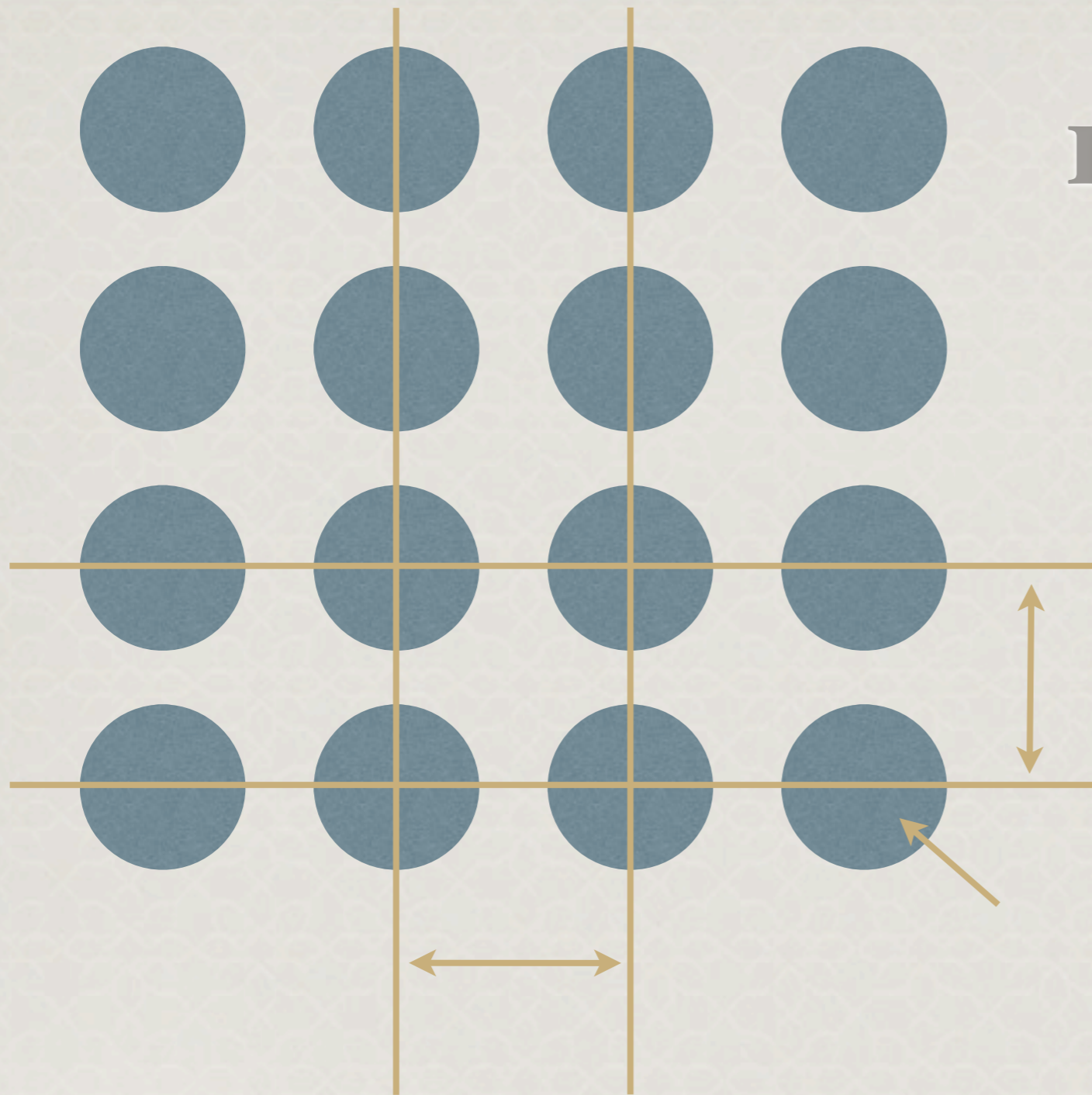
➔ *2 (polar) \times 16 = 32 digitization channels*

★ *Cylinders: 3 cyl \times ($w=15$ m $l=40$ m)*

➔ *2 (polar) \times 96 = 192 digitization channels*

★ *Frequency band : redshift $z=1$: 700-800 MHz, redshift $z=0.15$ 1200-1300 MHz or $z=0.05$ 1300-1400 MHz*

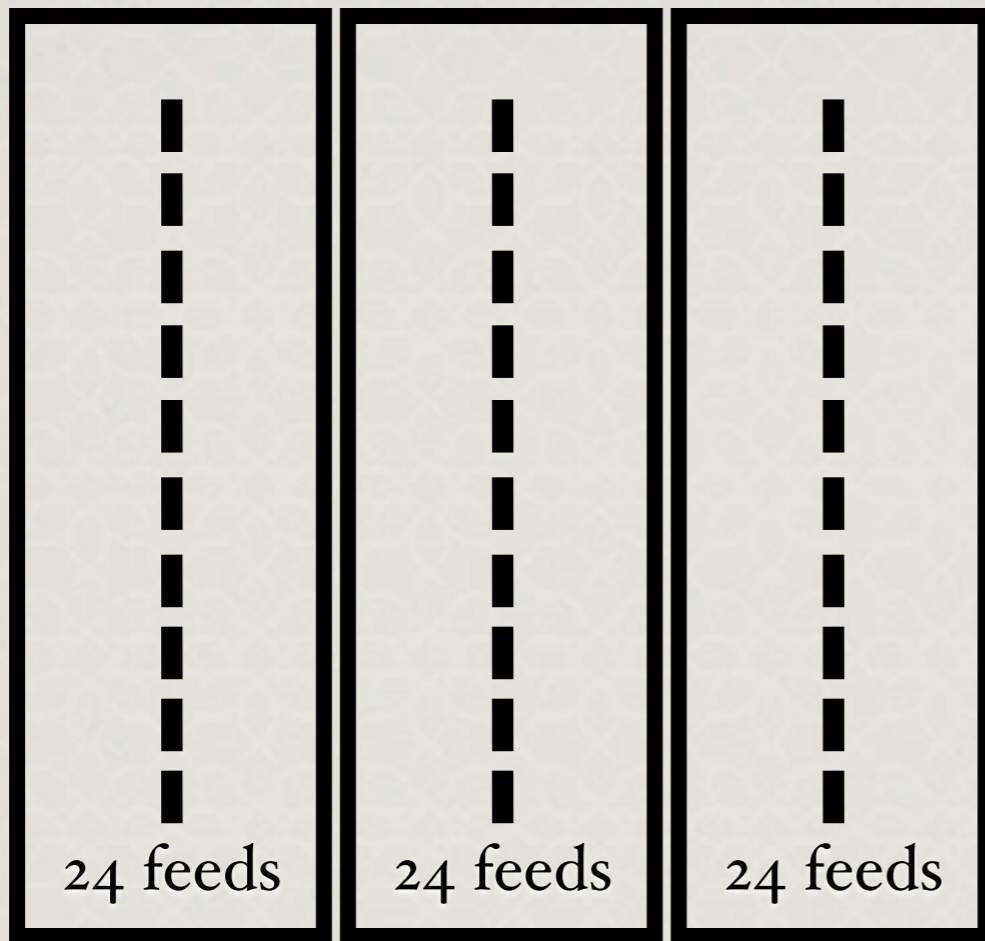
Dishes : 4×4 array



**7.5 m
(± 30 deg)**

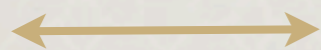
D=6 m

6.5 m



40 m

3 cylinders
15 m × 40 m
24 feeds (dual polarization) / cylinder



15 m

Config-1

each feed single dipole ~ 0.4-0.5 m separated by 1.6 m

Config-2

4 dipole sum packed feeds along the cylinder axis each feed ~ 1.6 m