# Tianlai NCP

## Paper plan

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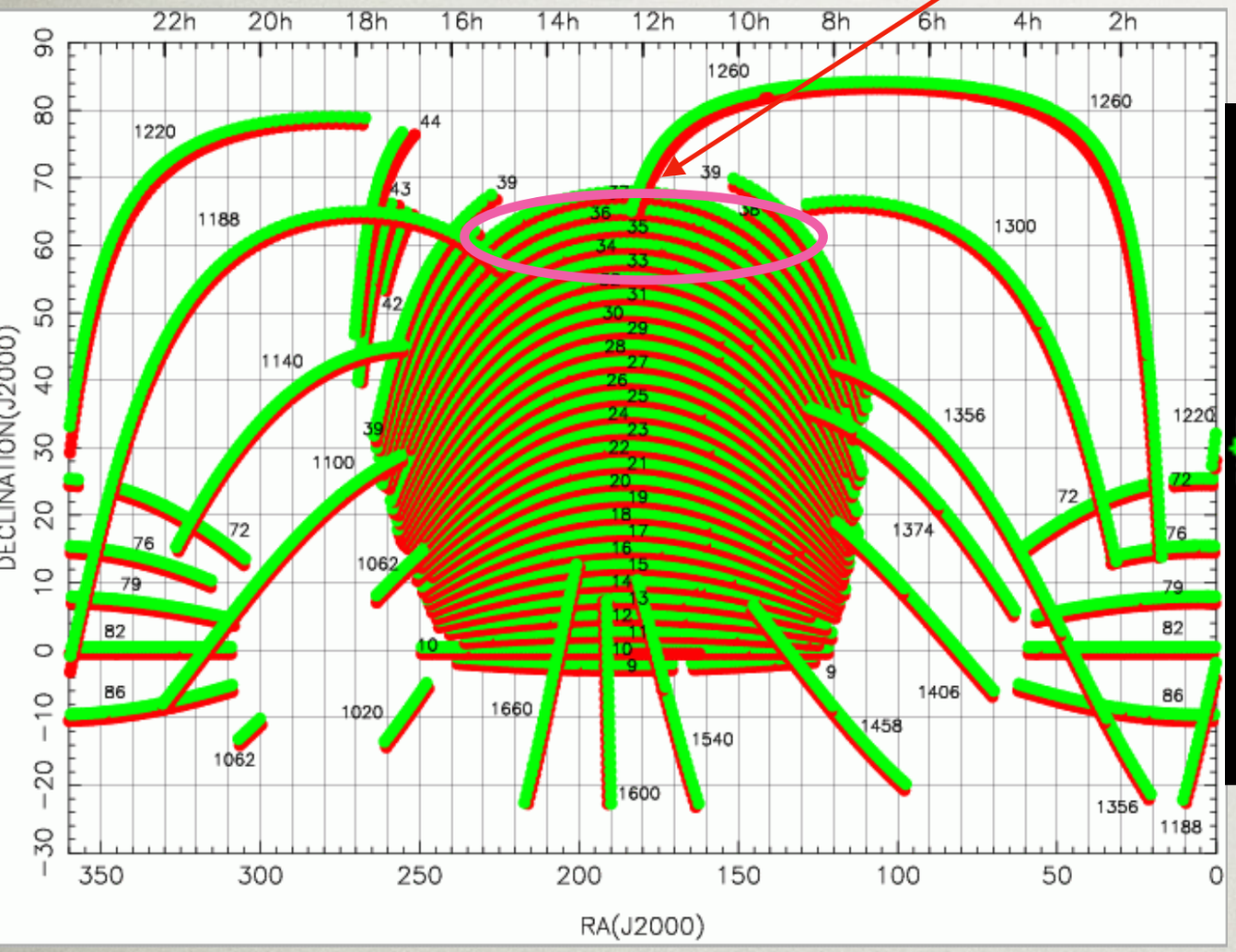
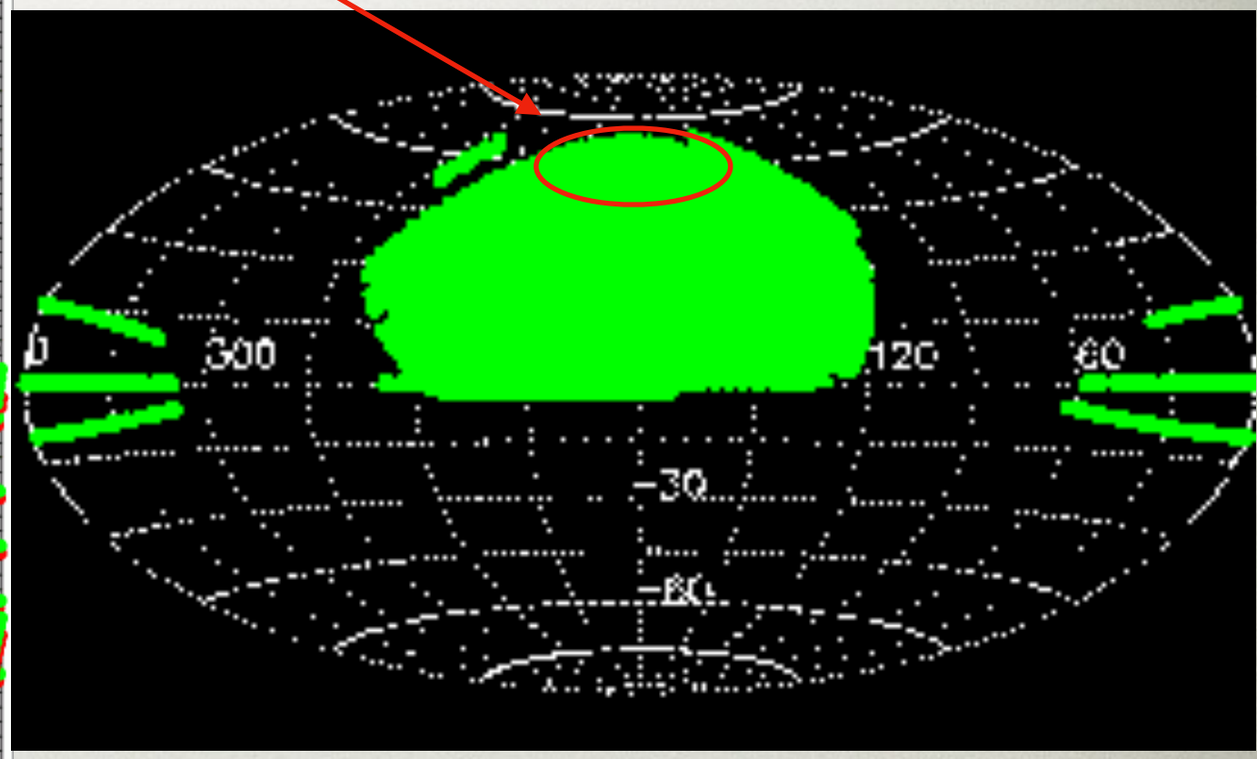
17 Sep 2020

- Science reach of Tianlai dish array surveys, at low (z ~ 0.1) and medium (z ~ 0.3-0.5) redshifts, targeted toward restricted area
- NCP region , 5-100 deg^2 area ,  2-5 mK visibilities noise level (1MHz x 30” sampling, ~1 month observation per declination )
- Mid-latitude (near CasA declination, to overlap with SDSS legacy spectroscopic surver , 1000-2000 deg^2 area , 100-200 deg^2 overlap with SDSS
- Detection of nearby (z <~ 0.05 ) HI clumps : reliable estimates of number of detectable clumps (mass & redshift distribution)
- Detection of LSS in cross-correlation with optical survey
- Possible detection of LSS as excess auto-correlation signal ?

# SDSS legacy survey coverage (spectroscopy)

Target area for Tianlai mid-latitude low resdhift survey




https://classic.sdss.org/dr7/coverage/

# Paper plan (preliminary)

1. Introduction
2. Low redshift surveys : a path to prove Intensity mapping and transit observations - discuss the way instrument noise project on sky (varying with reshift, as well as the accessible k (wave-number range) - The three signals
3. From instrument noise to visibilities and maps : per pixel noise level (visibility space and map space) - Impact of imperfect calibration - NCP and mi-latitude case
4. HI clump detection : mass distribution and effective detection thresholds (based on simulation including foregrounds and radio-sources , followed by map-making , or in visibility space)
5. Cross correlation detection : effect of incomplete spectroscopic catalogs , and redshift errors - NCP case and mi-latitude case
6. Auto-correlation detection ?
7. Discussion / Optimal strategy : NCP area coverage and redshift ranges, mi-latitude  coverage and redshift ranges

# Some work items

- Produce foreground visibilities - specify the foreground model ( Haslam map + spectral indices / direction + (bright source catalog with spectral indices) - JSkyMap can then produce the set of ra-binned visibilities
- Create a **random catalog of nearby HI clumps** (following mass the observed mass distribution) and compute associated visibilities ( -> Section 4)
- For part/section 5 : start from the SDSS spectroscopic catalog , extend it to include missing sources , associate HI mass based on optical magnitude & colors and HI mass → **Consolidated Optical+HI source catalog** covering an area of few hundred degrees, up to z <~ 0.3 . Compute correlation 21cmxOptical in a simple model , But compute also the visibilities for the HI from these sources , perform map making and compute cross-correlations - we can try to do it in the visibility space
- For part 6 : Either start from some available cosmological simulations, providing either an optical galaxy catalog, then assign HI mass using the same procedure as above, or directly use an HI clump catalog from the simulation if available (this should cover an area of a few hundred degrees at least and z <~ 0.5) . → Either **a 3D distribution of cosmological HI sources or 3D cosmological box with the HI content in each cell.** Compute the associated visibilities.
- Alternatively, we can use the simple simulations procedure that we used in :
  - https://arxiv.org/pdf/1902.03004.pdf

# Comments - suggestion

- Consider cross-correlation with ALFALFA or FAST HI survey → survey at low latitude to have overlap with theses surveys (Peter)
- There are frequency bands unusable due to strong RFI (from satellites) , around 1380 MHz for example - We should blank these frequency bands which will decrease the statistical significance (Olivier)
- For section 3, evaluate the impact of going from analytical smooth beams to realistic beams from simulations - Peter hopes to have the computed beams soon
- Check whether the stripes observed by SDSS at the highest declinations (~80 deg) could be a target area (Albert)
- Start an overleaf document (Peter)