A Deep Survey for Gas Rich Galaxies with the uGMRT

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What, and Who?

- Key Science Goals:
  - To detect for gas rich galaxies at ($0 < z < 0.4$) with the uGMRT
  - To estimate HI mass of typical galaxies in this range using stacking
  - Study star formation using the continuum image

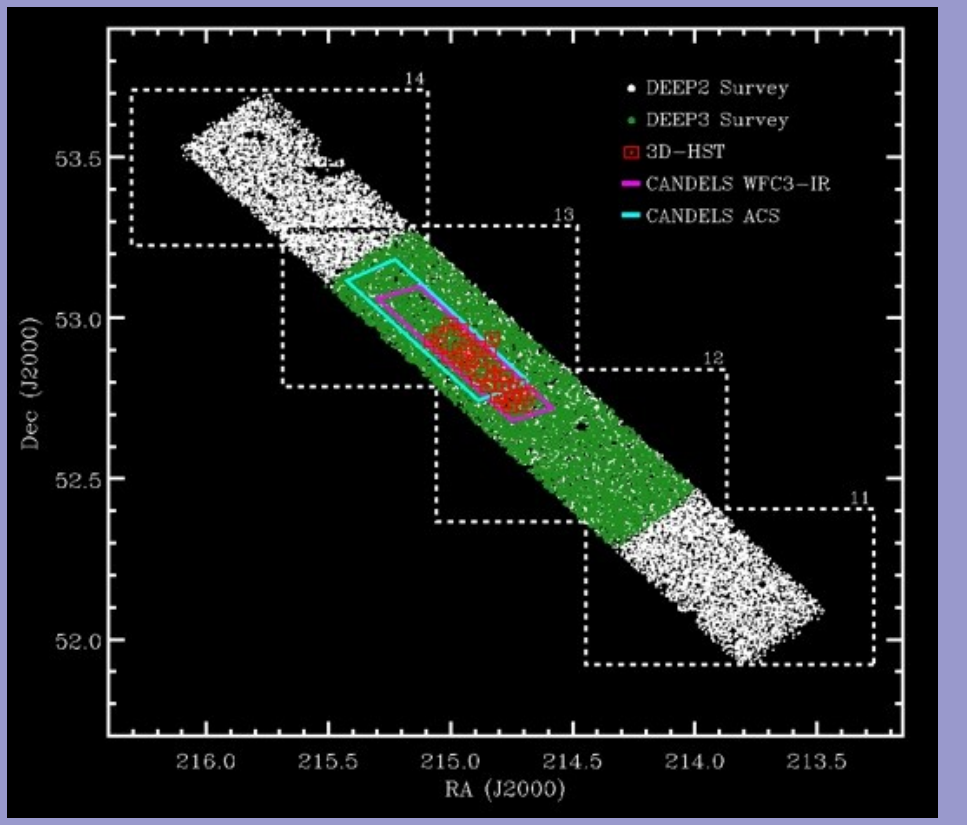
- The Team:
  - Jasjeet Singh Bagla (IISER Mohali)
  - Jayaram Chengalur (NCRA-TIFR)
  - Nissim Kanekar (NCRA-TIFR)
  - Sandeep Rana (IISER Mohali)

uGMRT
(see talk by Yashwant Gupta on Day 1)

- The relevant band is the 1000-1450 Mhz band.
- The dish is under-illuminated.
- The proposed survey targets the Extended Groth strip, where the DEEP3 galaxy redshift survey data is available.
- 125 hours have been allotted in the ongoing cycle for a pilot survey.

All wavelength Extended Groth strip International Survey (AEGIS)

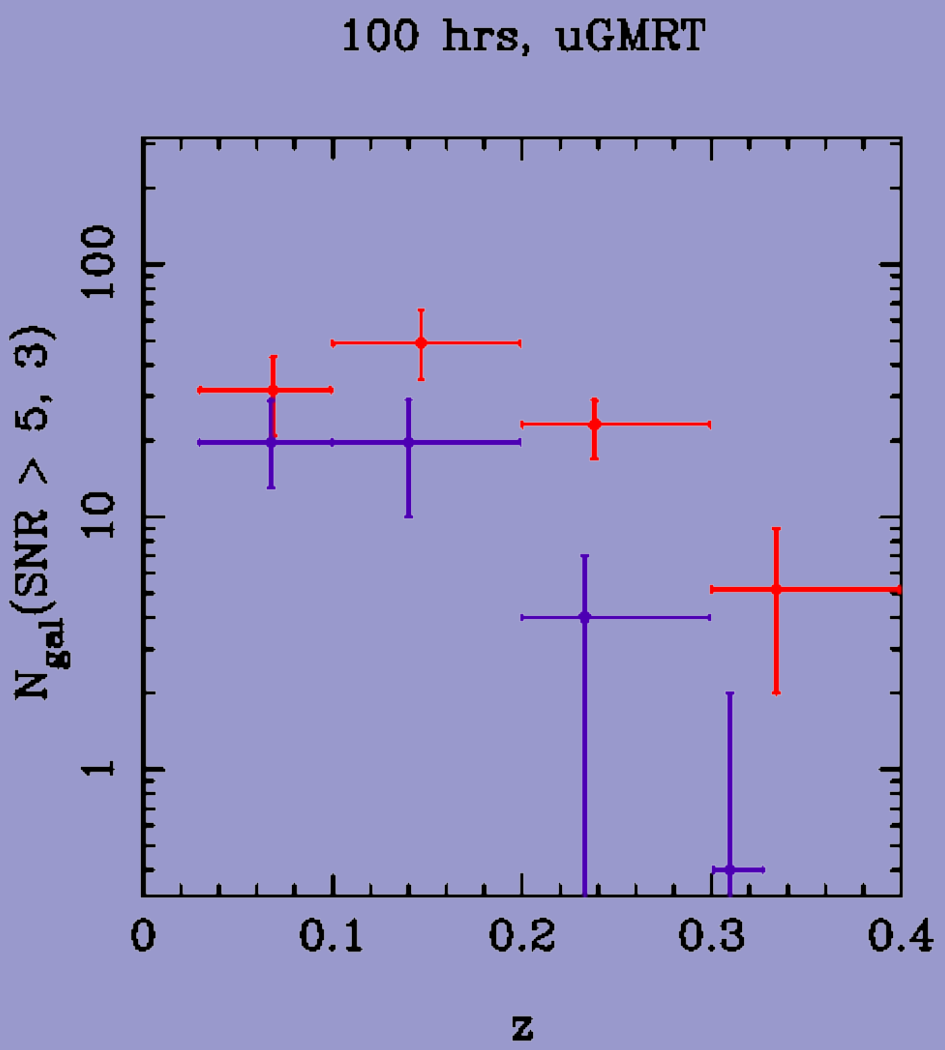
- Observations in the region available from X-ray to radio.
- Ideal target for the proposed survey.
- Plan to cover the entire strip over time.
- 3 pointings required for the Deep-3 regions, 6 for the full strip.
- Need to observe each pointing for 400 hrs to ensure detection of M* galaxies at z > 0.3.

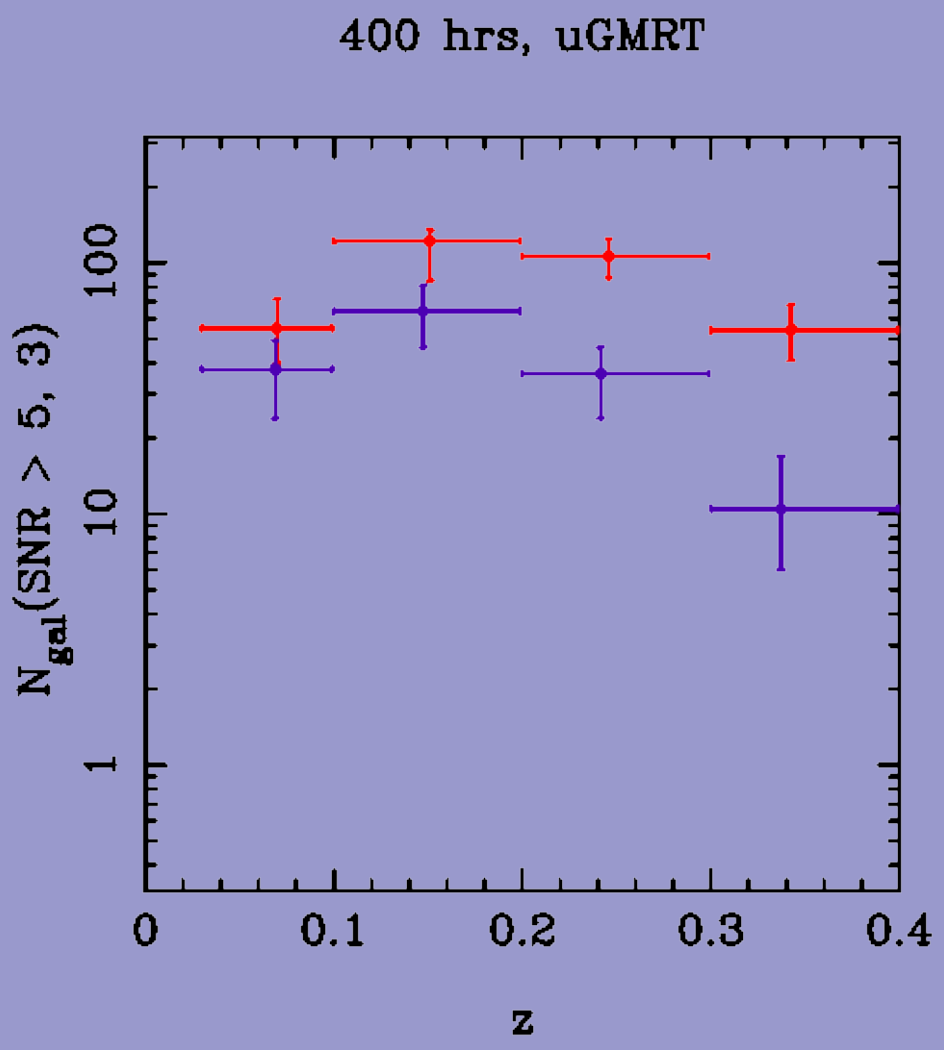


What to expect?

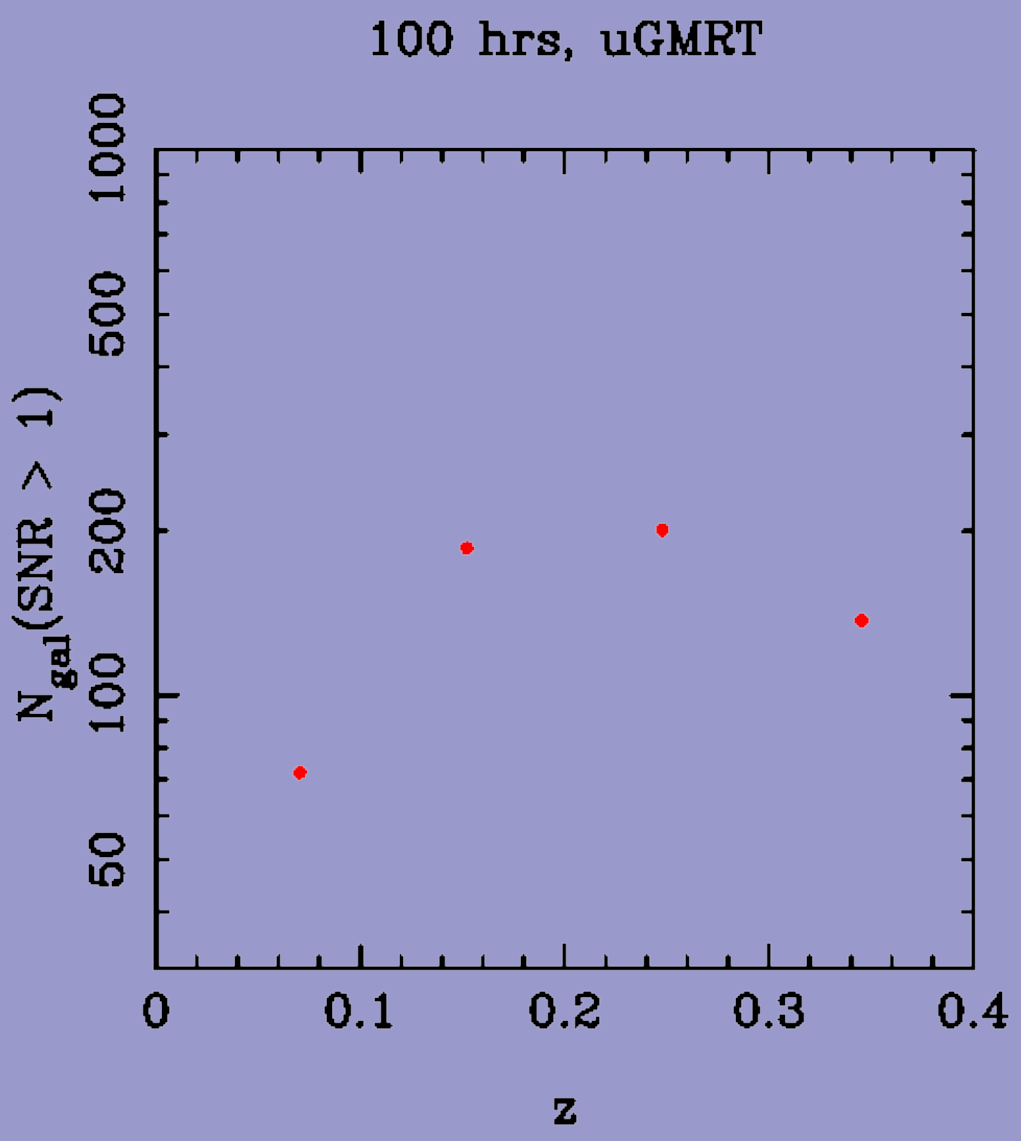
- We assume take the local HI mass function estimated from the ALFALFA survey (40% release) (Martin et al, 2010) is a good representation for the HI mass function in the full range of redshifts ($0 < z < 0.4$).
- We generate 20 mock catalogs to estimate the number of galaxies that can be detected by the GMRT in a blind survey.
- We also estimate the spread in numbers across mock catalogs.
- Unless the HI content of galaxies decreases as we go to higher redshifts, this gives us a conservative estimates on what to expect.

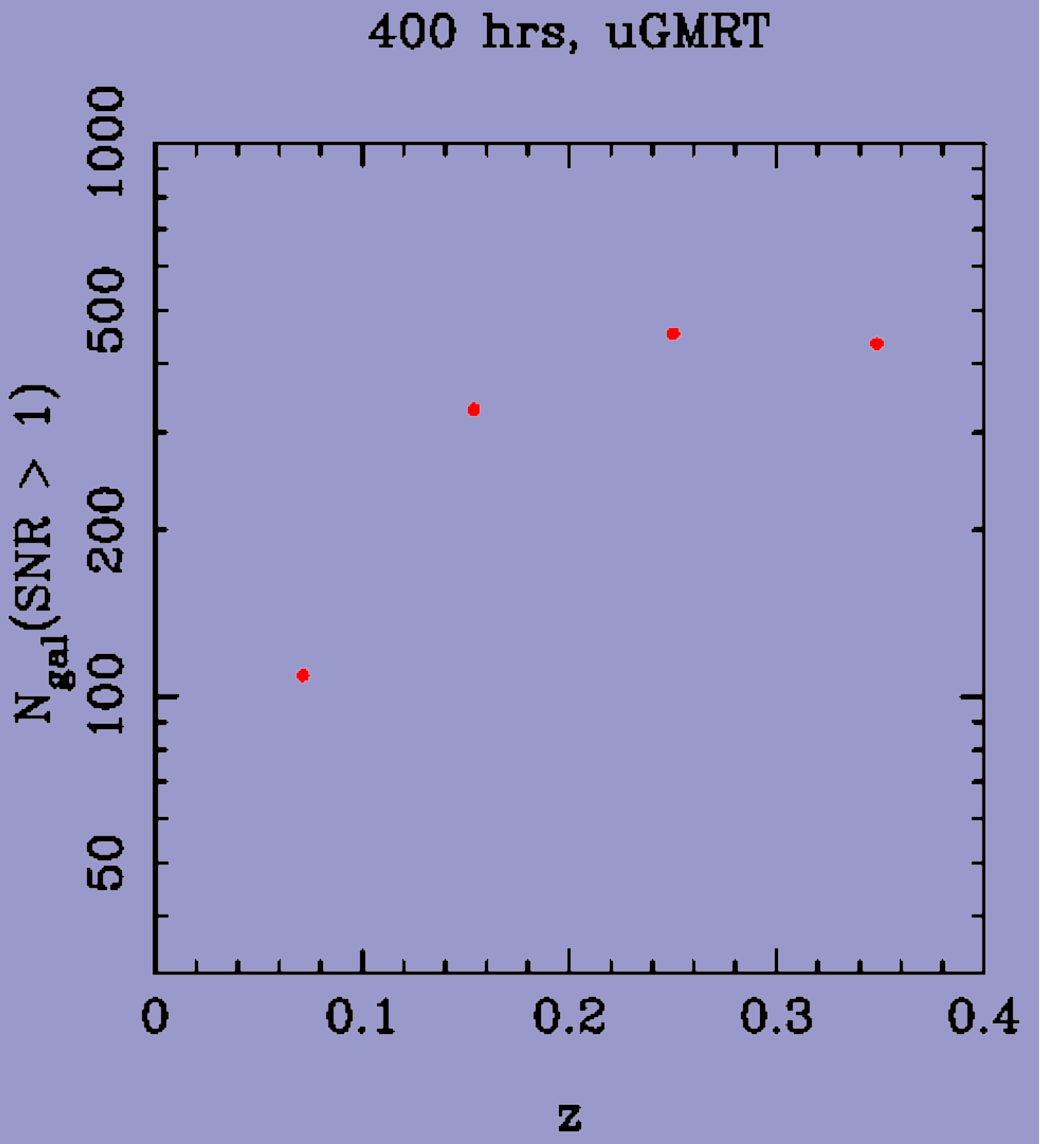
Expected Numbers of Galaxies





Numbers per field with SNR > 1





Optical redshifts and stacking of HI spectra

- Several thousand galaxies with secure spectroscopic redshifts are available in the Deep-2 + Deep-3 catalog in this redshift range.
- This allows us to attempt detection of these galaxies, and as we know the spectroscopic redshift, we can inspect spectra in the relevant part of the data cube.
- Prospects of stacking of spectra are also good, as we expect to have more than a hundred sources in the three bins at $z > 0.1$ with SNR > 1 in the pilot.
- This number increases significantly in the full survey per field, allowing us to slice the sets in different ways to analyse the variation of HI mass with other properties of galaxies.

Other Surveys

- Our survey is expected to start collecting data later this month. Data for the pilot will be collected before summer this year. Further observations will be proposed for late in the year. Coverage of the EGS will require 3-4 years.
- CHILES is an ongoing project (talk by Danielle Lucero earlier today) with 1000+ hrs on a single field. Data collections should be completed by the end of 2018(?).
- APERTIF has a very large field of view but is shallower.
- LADUMA is expected to start observing in later part of 2018. USP is the large field of view and redshift coverage.

Science Goals

- Direct detection of more than a hundred galaxies at ($0.1 < z < 0.4$) yielding direct estimate of HI mass.
- Constraining HI mass function at ($0.1 < z < 0.4$).
- Estimating Ω_{HI} at ($0.1 < z < 0.4$).
- Imaging of galaxies that are detected at high SNR.
- Studying evolution in the relation between HI mass, stellar mass, star formation and other properties of galaxies.
- Determining star formation rates from radio continuum in the EGS, comparison with other indicators of star formation. Nominally we will get to about 1 μJy/beam.