

SKA2 Science Drivers

- Emerging from the Dark Ages and the Epoch of Reionization
 - Exoplanet studies**
 - EoR and Possibly Reaching to Cosmic Dawn in Phase 2**
- Galaxy Evolution, Cosmology, & Dark Energy
 - Cutting edge contributions in non-Gaussianity and Dark Energy**
 - Complementarity to Euclid, LSST in Phase 1 (reduced systematics)**
 - Unmatched performance in Phase 2 (Billion Galaxy HI Surveys)**
- Strong-field Tests of Gravity with Pulsars and Black Holes
 - Unique GR constraints, major contributions in Phase 1 and Phase 2**
- The Cradle of Life & Astrobiology
 - Studies of thermal emission from protoplanetary disks enabled by sensitivity increase at frequencies >10 GHz**
- The Origin and Evolution of Cosmic Magnetism

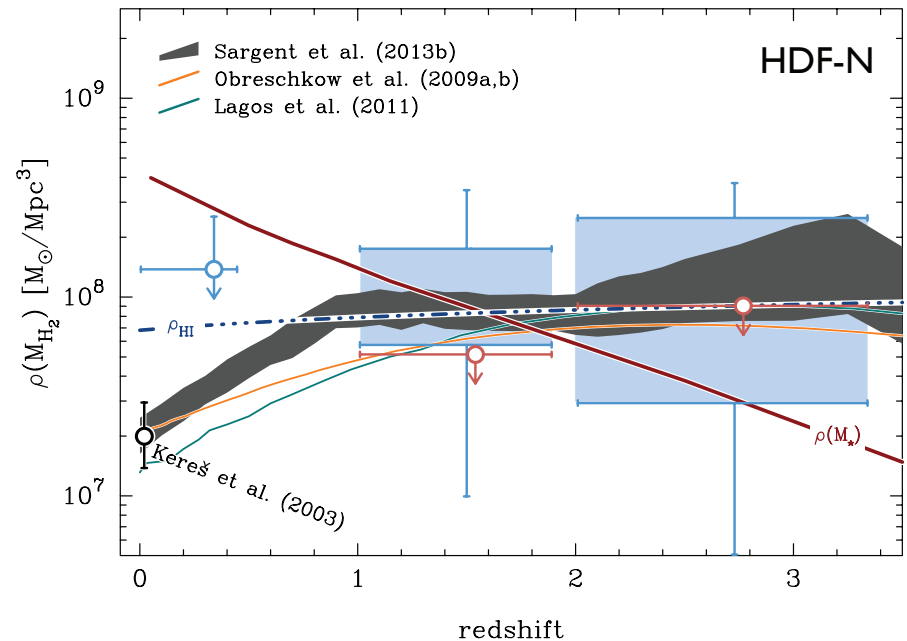
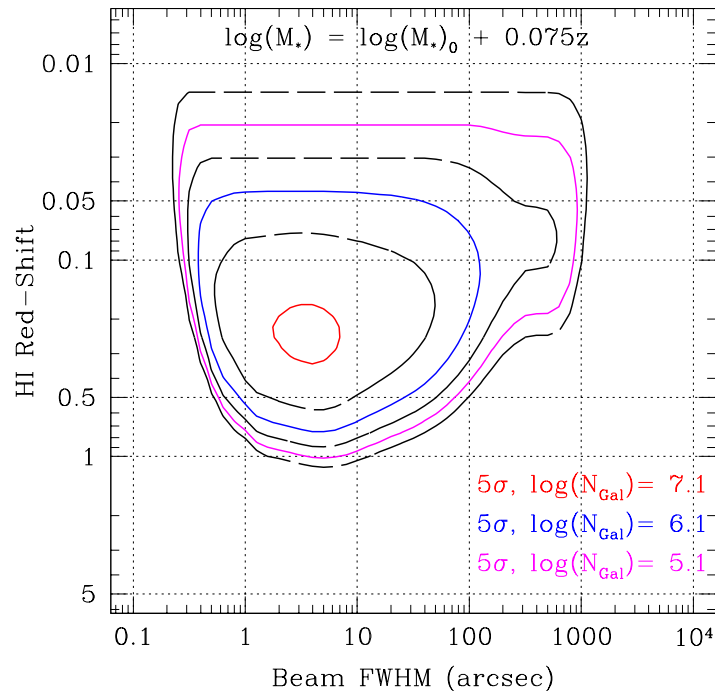
With design philosophy of *Exploration of the Unknown*

Unmatched prospects (complement to LSST) in Phase 1 and Phase 2

A wide-field HI emission survey to measure $\Omega_{\text{HI}}(z)$ and BAOs



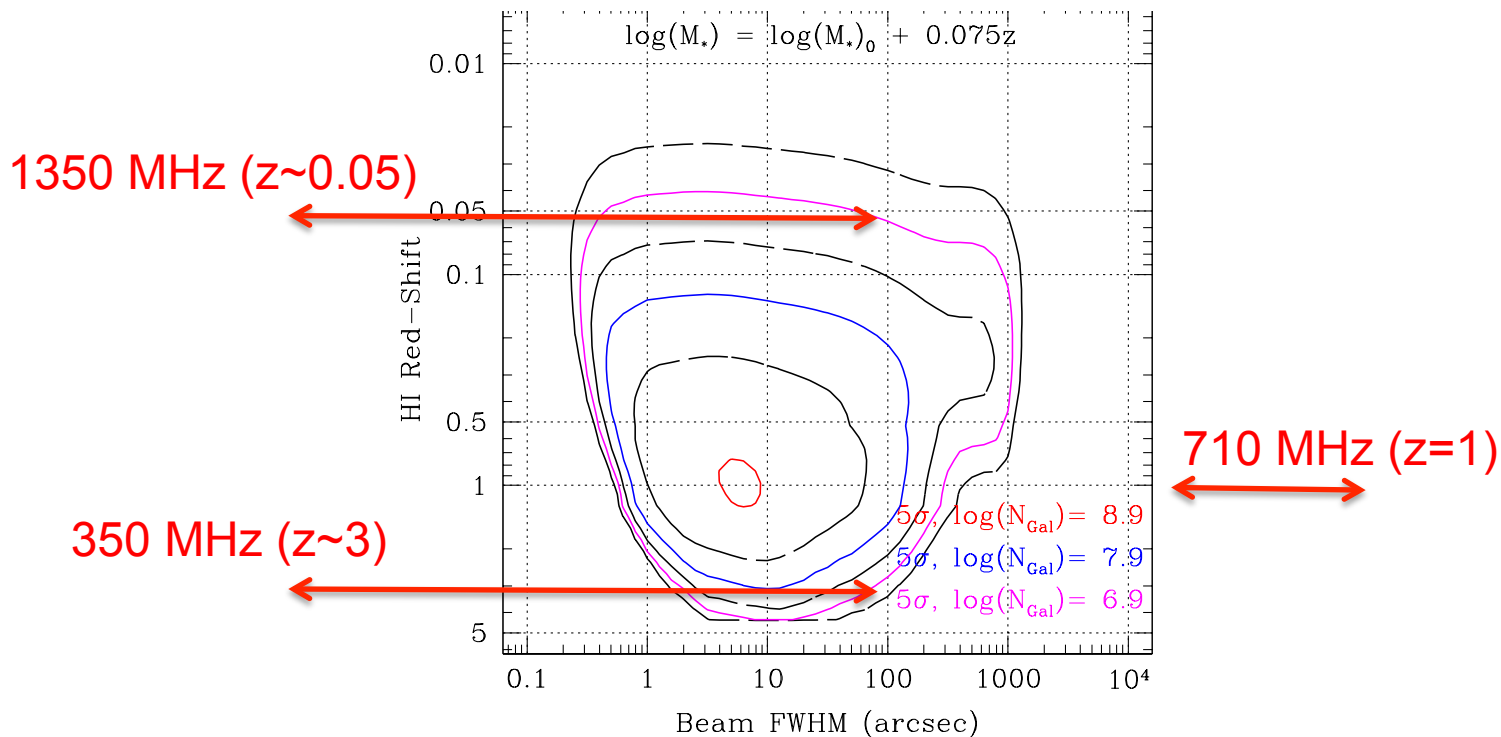
SKA1-SUR Line Survey (100 km/s, 5000 deg², 2yr)



Walter et al. 2013

- Detect $10^{7.1}$ galaxies $\langle z \rangle \approx 0.3$, $10^{5.1}$ galaxies $\langle z \rangle \approx 1$
- Density ≈ 2500 galaxies deg⁻², 1 arcmin⁻²
- Compare SDSS: $10^{6.2}$ galaxies with $\langle z \rangle \approx 0.1$ over 15,000 deg²
- Compare WigglesZ $10^{5.2}$ galaxies with $\langle z \rangle \approx 0.6$
- **Major contribution to BAO science, complementary systematics versus Opt/IR**

An SKA2 HI emission survey for precision Cosmology



- Detect $10^{8.9}$ galaxies with $\langle z \rangle \approx 1$, $10^{7.9}$ with $\langle z \rangle \approx 2$
- Compare Euclid target of 10^8 spectra with $\langle z \rangle \approx 1$

Summary of SKA2 sensitivity requirements

- 4x SKA1 sensitivity 50-350 MHz
- 10x SKA1 sensitivity 350 MHz - 24 GHz (including deployment of high frequency bands on MID)
- 50% of the "natural" sensitivity of the facility over a wide range of beam size
- ~20x SKA1 FoV 350 MHz - 1.5 GHz (compared to SKA1 MID)
- ~20x SKA1 maximum angular resolution 50 MHz - 24 GHz (better than 0.5 arcsec at 600 MHz, >250 km baselines)

- Match performance for SKA2-Mid
 - 2500 antennas + PAFs + beam former
(PAF band 1: 350-900 MHz, band 2: 650-1670 MHz)
- **Goal: Sensitivity** $8000 \text{ m}^2/\text{K}$ @ $T=50\text{K}$, 600MHz
 - 400,000 m^2 of tile
- **Goal: Survey speed** $3 \times 10^9 \text{ m}^4/\text{K}^2 \text{ deg}^2$ @ $T=50\text{K}$,
 $\sim 144 \text{ deg}^2$ FOV, 600MHz
- Frequency range: 350 MHz up to ~ 1420 MHz