The MeerKAT Survey of Fornax

An Update

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Overview

- Survey Overview
- Recent Progress
  - Funding/Organization
  - Technical Requirements
  - Ancillary Data
- Moving Forward

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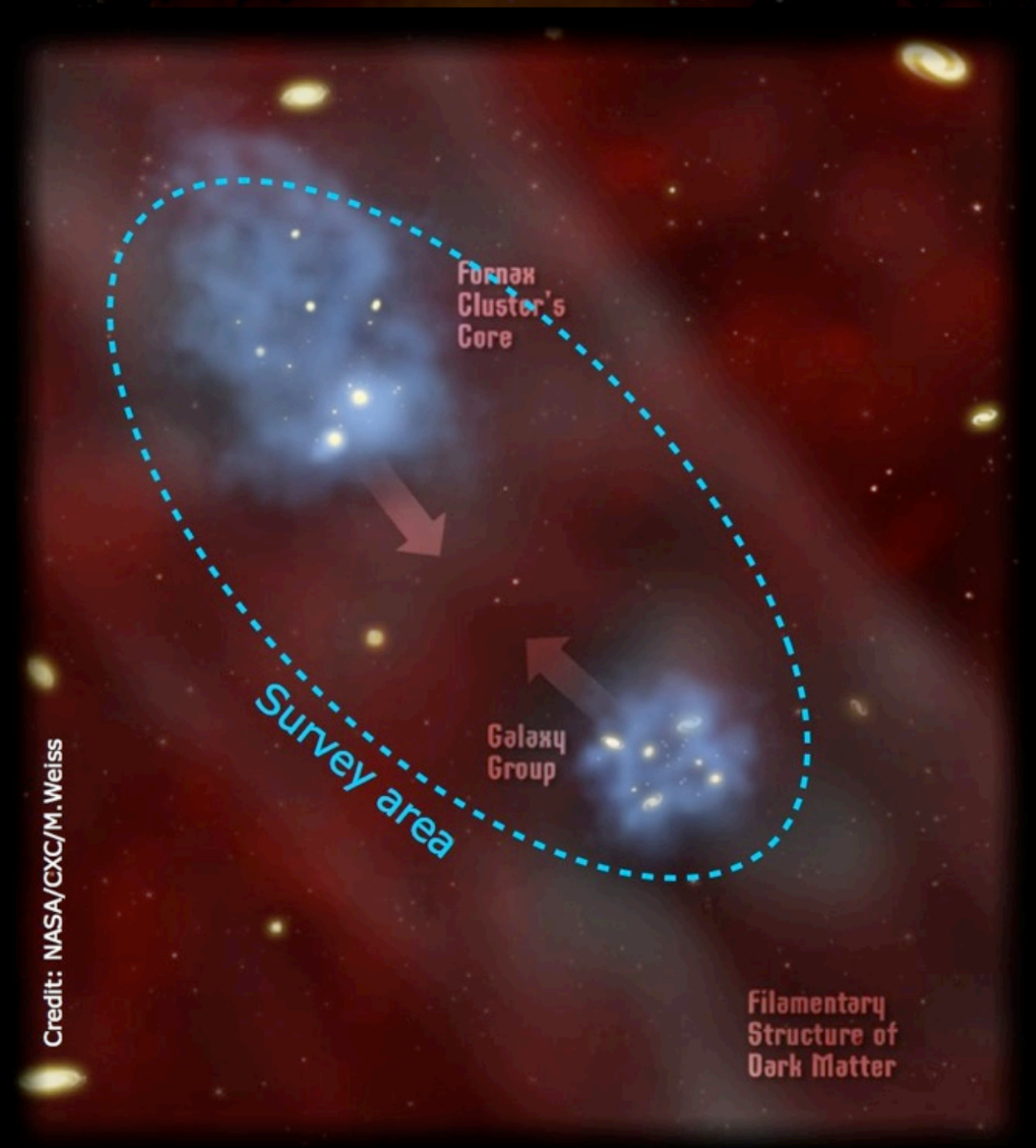
Scientific Goals

- Fornax Cluster - second most massive galaxy concentration with ~20Mpc, largest nearby cluster in Southern Hemisphere.
- Many multi-wavelength surveys.
  - Recent blind survey with ATCA.
  - Shallower, lower resolution.
- MeerKAT Fornax Survey will be the deepest and widest survey of HI in Fornax Cluster.
- 2,450hrs + calibration
  - 11 deg^2 strip from cluster core to outskirts
  - 0-3000 km/s range of galaxies in cluster.
  - *Natural* noise ~0.1mJy/beam in 5 km/s channel⚑.
  - 10^{18} cm-^{2} at low resolution
  - 10^{19} cm-^{2} at high resolution



⚑goes up by 1.4~2 when tapering for resolution 10~100''

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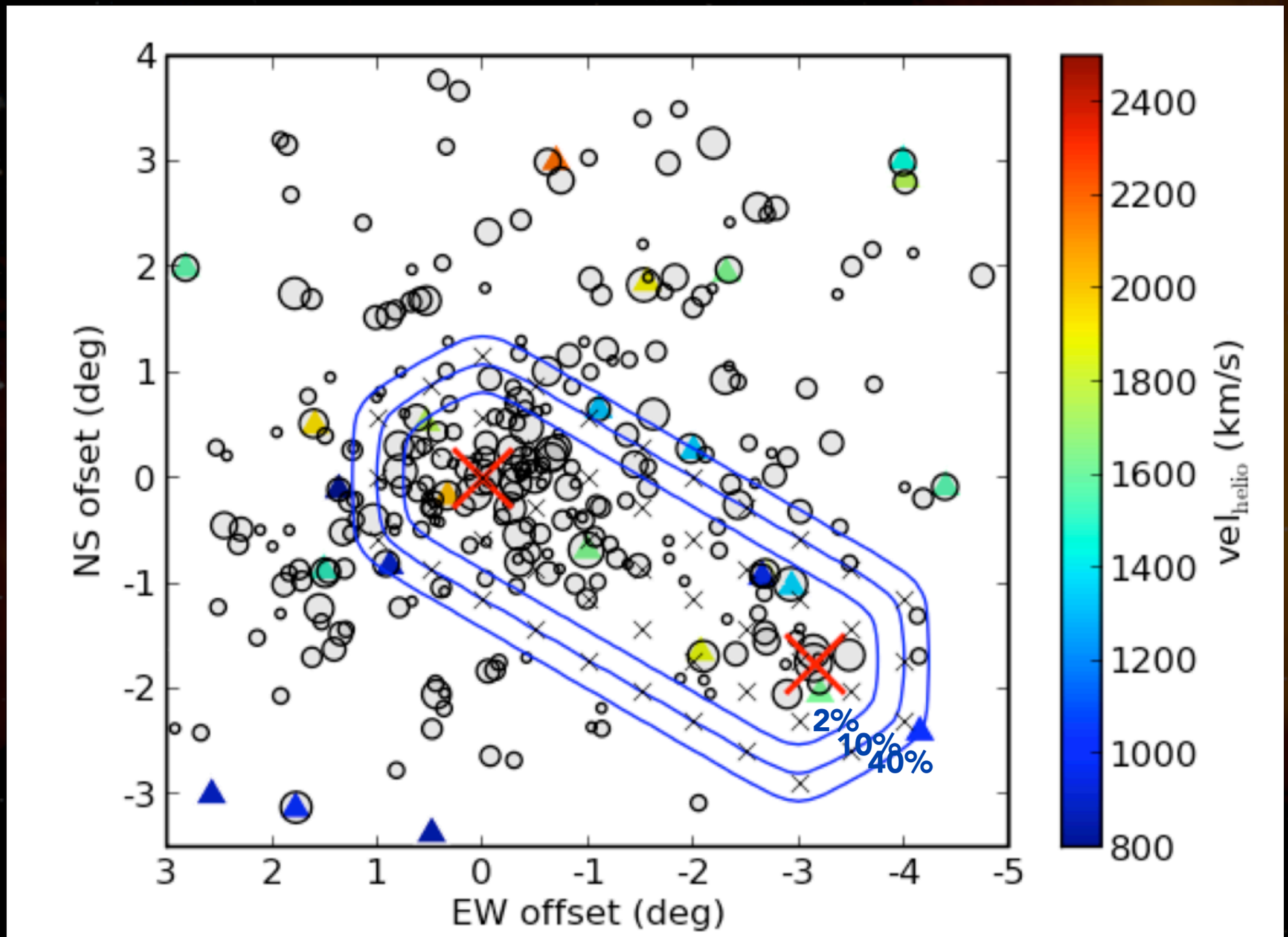
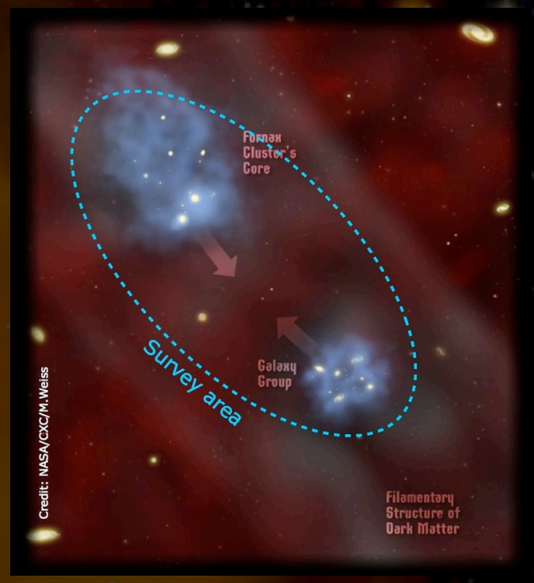
Scientific Goals





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Scientific Goals

Stripping of neutral hydrogen from galaxies

10^{19} cm^{-2} sensitivity @ 1 kpc resolution

Massive clusters: hydrodynamics

Fornax: gravity?

Slide Credit - Paolo Serra

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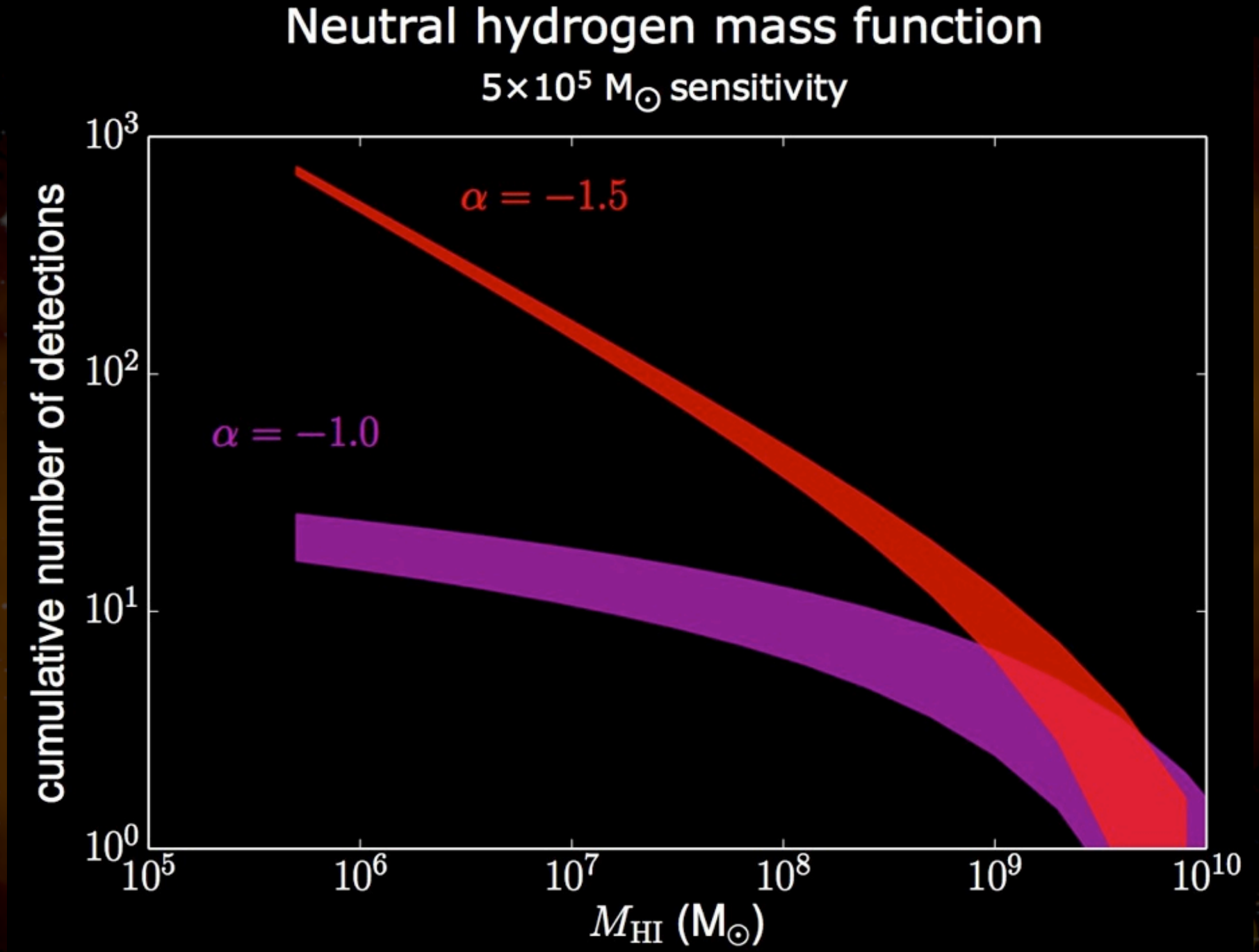
Scientific Goals



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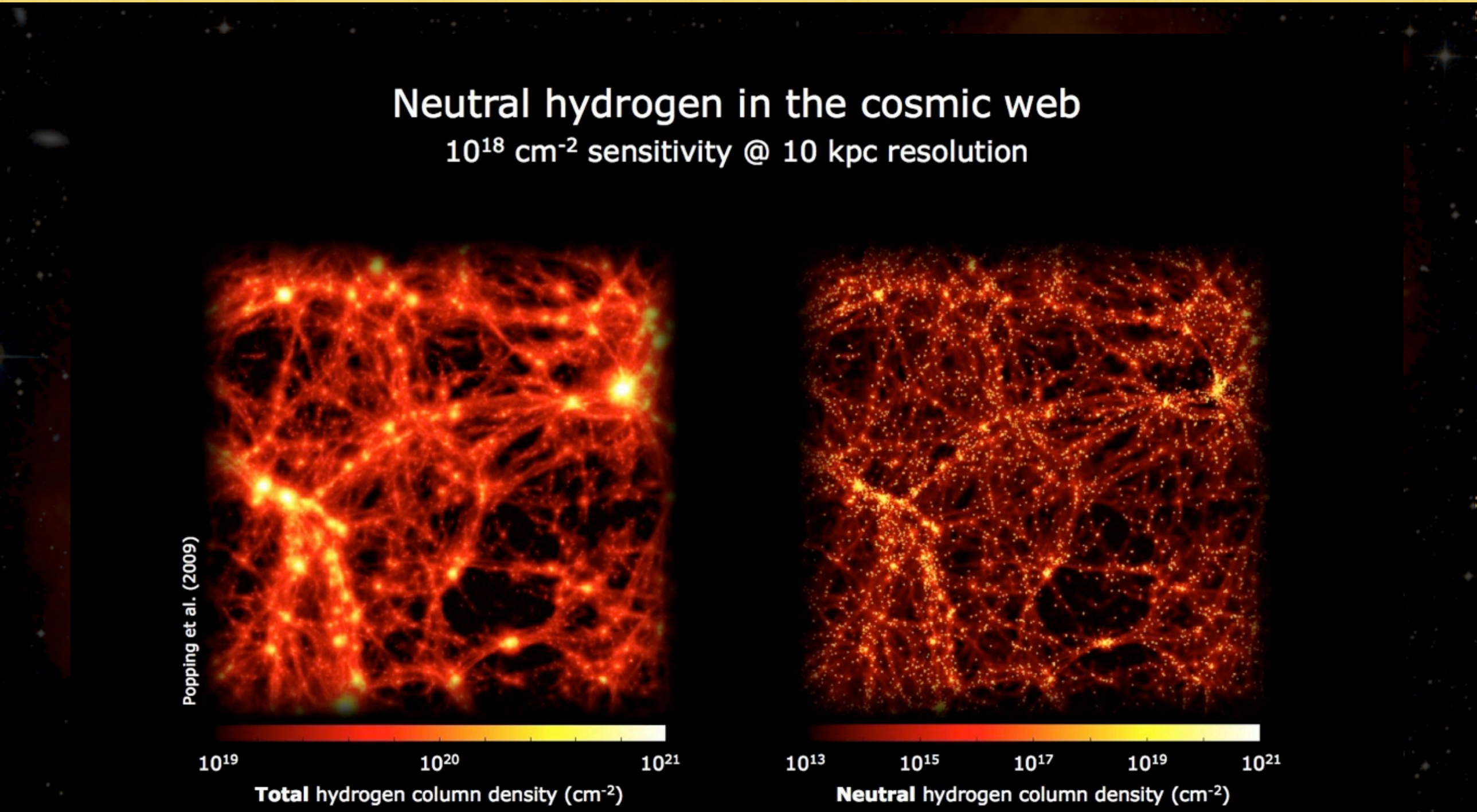
Scientific Goals



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Funding/Organizational

- Paolo Serra (PI) - Awarded ERC Grant
  - €1.5M over 5 years
  - Research Group at INAF, Cagliari
    - Entirely dedicated to the MeerKAT Fornax Survey!
    - 2×3yr PhD Positions
    - 3×3yr Postdocs
    - Research Focus
      - HI Morphology (gas stripping)
      - HI Mass Function
      - HI in the Cosmic Web
    - Includes funding to buy tapes for permanent storage of 5PB of visibility data.

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Draft Requirements/Support Documents

- In-group, currently being drafted
- Data Processing
- Data Volume and Storage
- Ancillary Data

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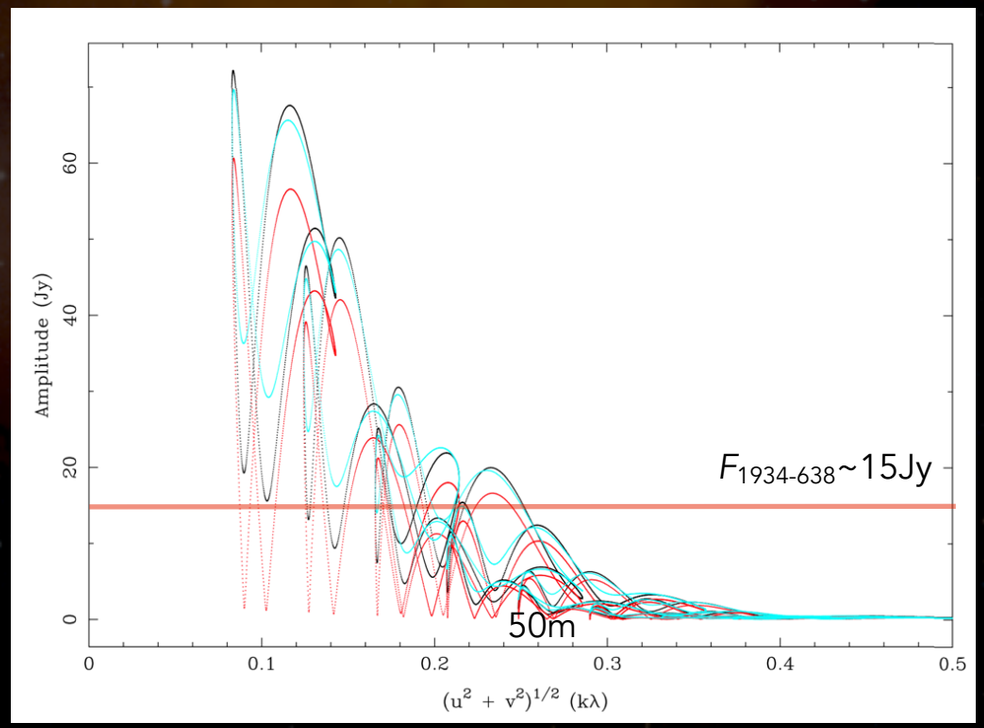
Data Processing

- Bandpass
  - $F_{\text{Fornax A}} >> F_{1934\text{-}638}$
  - For pointings close to Fornax A:
    - Difficult to calibrate short baselines
    - Smooth spectrum of calibrator (c.f., Oosterloo & Morganti 2005)
- Direction Dependent Gains
  - Have to deal with Fornax A rotating in the Primary Beam
  - Simulations with Sphe Makhathini, Oleg Smirnov and Ian Heywood
- Dynamic Range and Simulations
- Imaging/Deconvolution
  - Can we get away without joint-deconvolution
- Archiving
- Source Finding
  - Large involvement in SoFiA (Serra et al. 2015)
  - Busy week after PHISCC - see Tobias Westmeier's Talk.



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Data Volume & Storage

- MeerKAT Correlator Modes
  - Narrow-band fine: 5×4×1024 @ 3.3kHz/chan (we only need 2)
    - For 2/5 bands: 2.705PB
  - Wide-band fine: 1×32×1024 @ 23kHz/chan, total 750MHz
    - 10.821PB
- NF+WB ~ 13.5PB
  - Looking into time/frequency averaging for Long Term Storage
  - Averaging WB 5× in frequency ⇒ NF+WB′ = 5PB - this is what we have funding for.
  - Josh currently working on compression strategy.

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Ancillary Data 1/2

- Dust
  - Herschel Fornax Cluster Survey (HeFoCS, Davies et al. 2013), central 16deg-squared, in parallel with SPIRE (Griffin et al. 2010) and PACS (Poglitsch et al. 2010)
- Molecular Gas
  - CO - SEST 15m, Horellou, Casoli and Dupraz (1995)
  - Mopra CO (J=1-0), Follow up HeFoCS, 28 brightest sources, Smith et al. (in prep)
  - ALMA: NGC 1386, NGC 1365
  - ALMA Fornax Cluster Survey (PI Tim Davis; Serra and Smith co-I's)
    - 3'' ALMA imaging of ~30 galaxies with $M_* > 3\times10^8\ M_\odot$ (from Ferguson 1989)
- Optical Imaging
  - FOCUS (P.I. Peletier, Serra co-I), very deep survey with ESO/VST/OMEGACAM to cover 21 deg^2 in u/g/r/i
    - Equivalent to Next Generation Virgo Survey (CFHT/MegaCam, (Ferrarese et al.)
    - 50% Complete!
  - HST ACS, 43 ETGs (Jordan et al. 2007)

Ancillary Data 2/2

- Optical Spectroscopy
  - Drinkwater et al. (2001) Survey - does not cover full MFS area.
  - Considering new campaign with targets from FOCUS.
- UV Imaging
  - GALEX
- X-Ray Imaging
  - Scharf et al. (2005) with Chandra - covers Southwestern side of MFS.
- Simulations
  - Greg Bryan (Columbia) - hydrodynamical simulations tailored to Fornax (cluster mass, large scale environment...).

Conclusions

- Paolo's ERC Grant
  - Scientific and Technical Readiness
- Formal Technical Requirements being drafted
  - Allow us to re-evaluate survey goals in light of revised MeerKAT sensitivity
  - Preparation for MeerKAT PI Meeting in May
- Ample Multi-wavelength Ancillary Data
- Simulations for Calibration Strategy
- Going forward
  - Re-evaluate survey goals in light of revised MeerKAT sensitivity
  - Possibilities for early-science with MeerKAT sub-arrays
  - Simulations to understand calibration issues
  - Design of pipeline and choice of data reduction software.

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