The star-formation history of the Universe with the SKA

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• Measuring SFRs is the most fundamental observation for galaxy evolution
• Radio continuum is the best tracer of SFR
Seymour et al. (2008)
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(i) SF/AGN separation
(ii) $L_{1.4\,\text{GHz}} \rightarrow \text{SFR}$
(iii) redshift
Star-formation rate from radio continuum

Yun, Reddy & Condon 2001
The new radio continuum surveys & the evolution of activity

SFR – radio correlation from H-ATLAS (Jarvis et al. in prep.)
The new radio continuum surveys & the evolution of activity

SED fits using the energy-balance models of da Cunha et al. 2008

SFR – radio correlation from H-ATLAS (Jarvis et al. in prep.)
The new radio continuum surveys & the evolution of activity

SFR – radio correlation from H-ATLAS (MJJ et al. in prep.)

SFR $\propto L^{0.75-0.8}$

SFR-Radio Luminosity relation shallower that previous determinations.
Up to an order of magnitude difference at high-SFRs
Radio continuum

Log (Radio Flux Density) vs Log (Frequency)
There’s nothing as useless as a radio source

Log(Radio Flux Density)

Log (Frequency)

No redshift information!
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No redshift information!
But HI surveys at low-z!!
No flux error and no photometric redshift error

\[ \phi / \text{Mpc}^{-3} \log_{10}(L_{1400})^{-1} \]

- \[ S_{1400\text{MHz}} > 5 \text{uJy} \]
- \[ 0.17 < z < 0.23 \]

- 1000 sq.deg
- 100 sq.deg
- 10 sq.deg

\( \text{SFR} / M_\odot\text{yr}^{-1} \)
With flux error and photometric redshift error
Lower frequency ALWAYS better for extragalactic work if resolution retained

\[
\phi / \text{Mpc}^{-3} \log_{10}(L_{700})^{-1}
\]

- SFR / $M_\odot$ yr$^{-1}$
- 1000 sq.deg
- 100 sq.deg
- 10 sq.deg

$S_{700, \nu > 5\, \text{uJy}} > 0.17 < z < 0.23$
$S_{700\text{GHz}} > 5\text{.uJy}$

$1.14 < z < 1.25$
SFR / $M_\odot yr^{-1}$

$\phi / Mpc^{-3} \log_{10}(L_{700})^{-1}$

$S_{700,MHz} > 5.0uJy$
$3.87 < z < 4.12$
$S_{700,\text{MHz}} > 1.\text{uJy}$
$3.87 < z < 4.12$
Not possible $2000\text{hr} \ 1\text{deg}^2 = 50\text{nJy/beam rms}$
Sample variance for various surveys

M=10^10

M=10^11
The VIDEO Survey

- Depth and breadth enables Halo Occupation Distribution modelling at $0.5 < z < 4$
  - The link to the dark matter distribution
  - The timescale of activity

Tracing the environmental effects...

Matsuoko et al. 2011
How do radio sources trace the DM haloes?

- Depth and breadth enables Halo Occupation Distribution modelling at $0.5 < z < 4$
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Matsuoko et al. 2011
Summary

• We will have a superb understanding of where, when and how stars formed from the SKA
• SDSS + nearIR + JVLA is a great training camp for LSST + Euclid/WFIRST + SKA