Learning from the Current Generation:
Uncovering the Epoch of Reionisation
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The Epoch of Reionization
Detection
Foreground Mitigation
Difficulties
Image Credit: V. Jelic
Anything which releases ionizing radiation could contribute to reionization...

Population II and III stars

Miniquasars

Dark matter annihilation

Chandra X-Ray Image of Centaurus A
For redshift \( \sim 10 \), we would observe the radiation from hydrogen as having 2m wavelength.
Simulation taken from http://homepage.sns.it/mesinger/EOS.html
Simulated using 21cmFast.v2.
Mesinger, Greig and Sobacchi 2016
Backgrounds

We can model the foregrounds as a polynomial along the line of sight and simply subtract them off.

Foreground removal
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Foreground removal
Foreground avoidance only used the EoR window. Foreground suppression downweights scales according to a foreground model.

PAPER: Ali et al., AJ, 809 61, August 2015
But what if there are foregrounds we do not expect?

Or what if we don’t know our instrument as well as we think?

**Non-parametric Foreground removal**

LOFAR:
Harker et al. MNRAS 97 (2009) 1138-1152;
Ratio = \( \frac{cs}{fg_{\text{residuals}} + cs} \)

cs = cosmological signal

fg = foregrounds

i.e. red is GOOD

Chapman et al. 2016
Ratio = \frac{cs}{(fg_{\text{residuals}} + cs)}

cs = \text{cosmological signal}

fg = \text{foregrounds}

i.e. red is GOOD

1\% wiggle along the line of sight

Chapman et al. 2016
Foreground Mitigation Methods

What is the right direction to go?

- All of them!
- Methods are complimentary....
- ... But more importantly this signal is tiny and unknown ...

We need independent methods to produce a robust first detection
GMCA on LOFAR data

54hr data on NCP field

Excess noise in LOFAR data

Two main ways of determining instrumental noise:

- Taking the difference between maps very closely spaced in frequency
- Looking at the Stokes V (circularly polarized)

Ratio should be 1

Cable Reflections in MWA data

Beardsley
49 core members, aims to have membership reflective of SKA member countries.

8 active UK members:
Anna Bonaldi (SKA project scientist)
Emma Chapman
Ilian Iliev
Mike Jones
Suman Majumdar
Jonathan Pritchard (SKA EoR Working Group Management Team)
Kris Zarb-Adami

Associate members
Catherine Watkinson
Martin Sahlén
Koki Kakiichi

SKA EoR Working Group
Meets annually
Broken up into focus groups led by different core members
Aim to create end-to-end, consistent pipelines
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