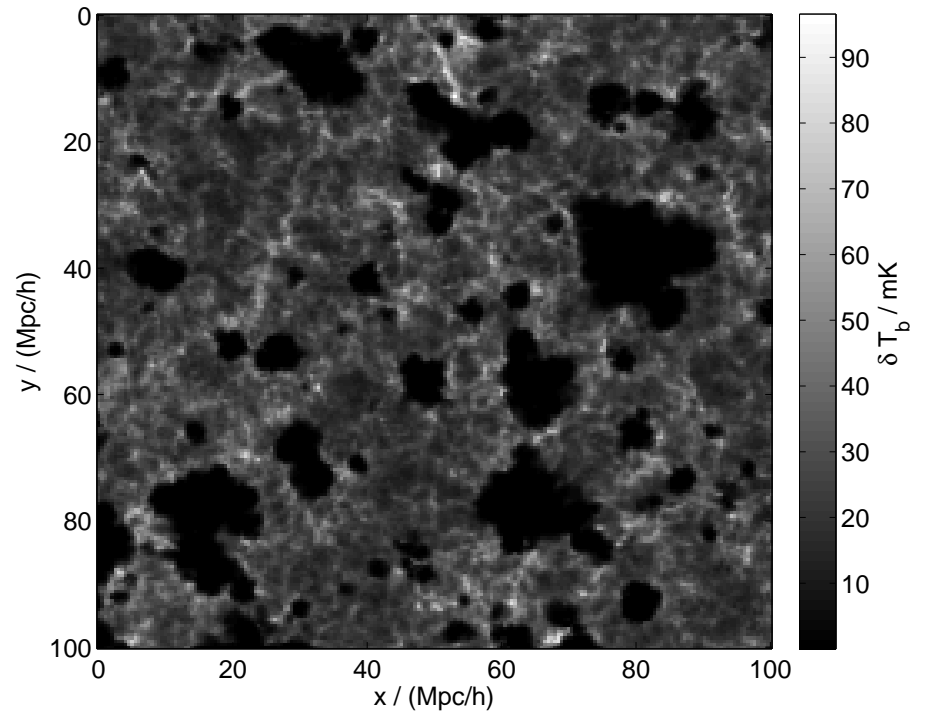
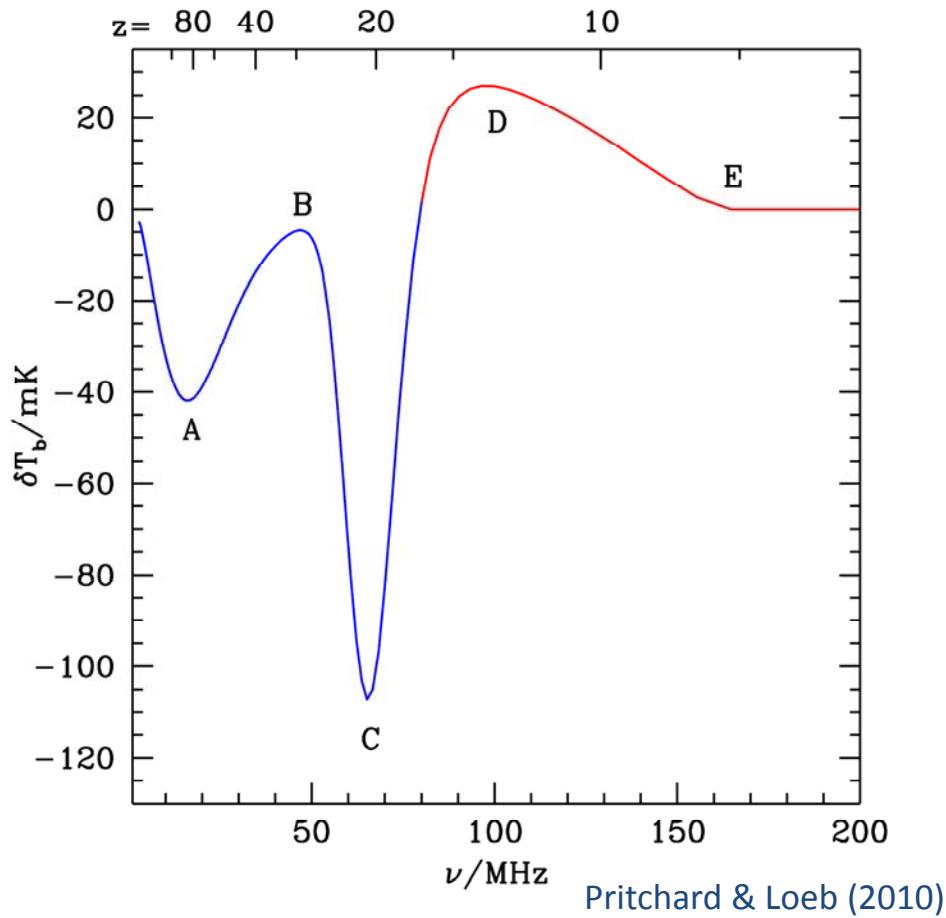


Foreground removal for 21-cm observations of the cosmic dawn

Geraint Harker

CASA/LUNAR

History and fluctuations of the high-redshift 21-cm brightness temperature

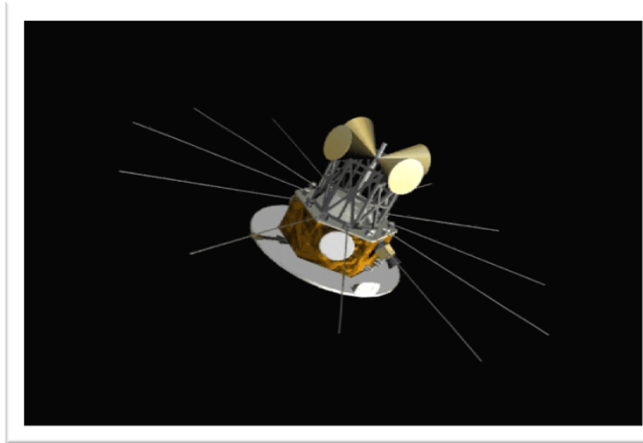


Mellema et al. (2006)

Highly redshifted 21-cm experiments and projects

Global signal

- DARE
- EDGES
- CoRE/CoRE2
- BIGHORNS
- LEDA (LWA)

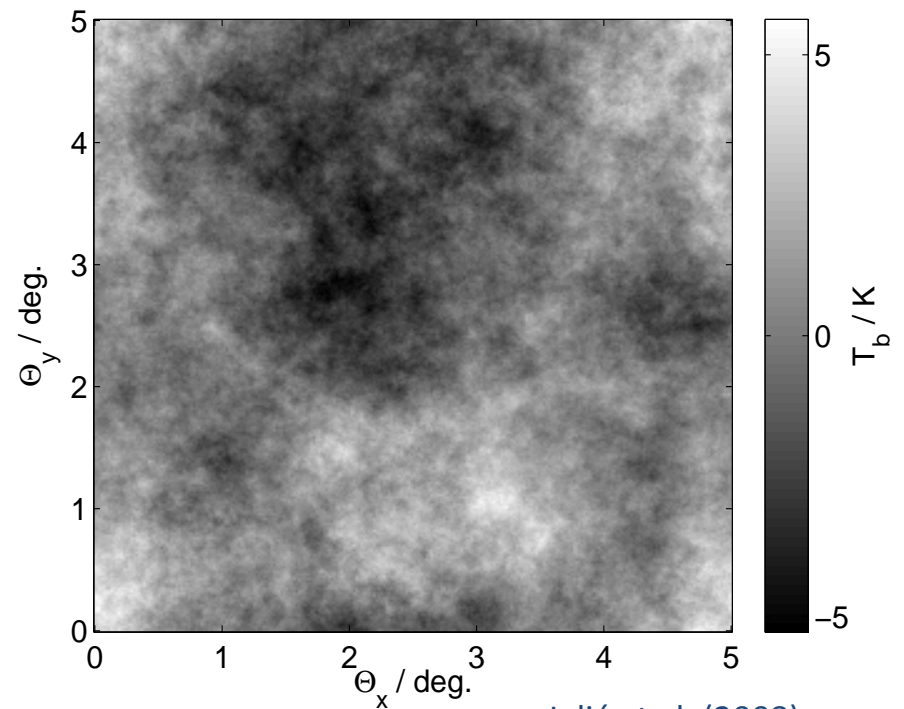
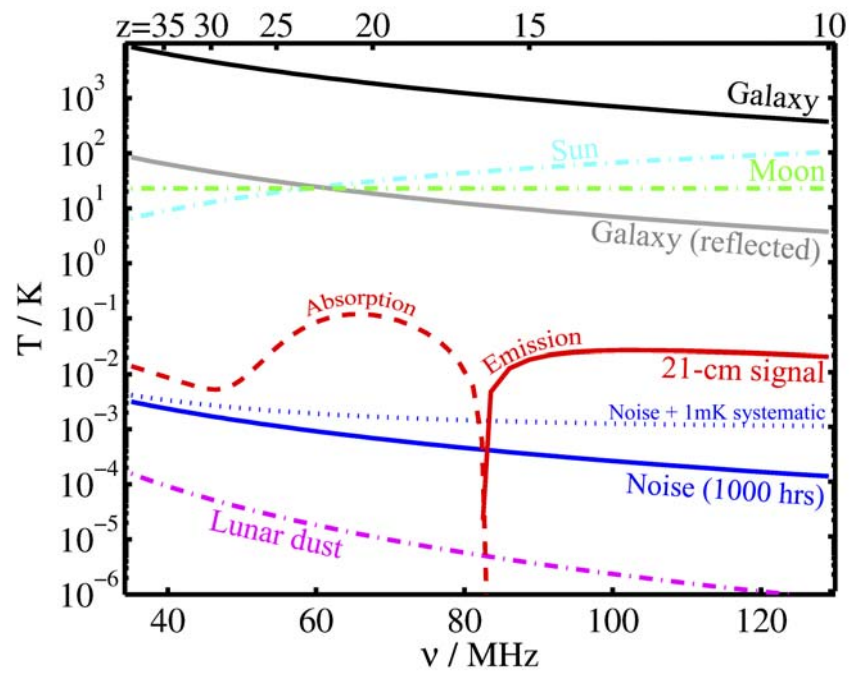


Fluctuations

- GMRT
- PAPER
- 21CMA
- MWA
- LOFAR



Foregrounds



Jelić et al. (2008)

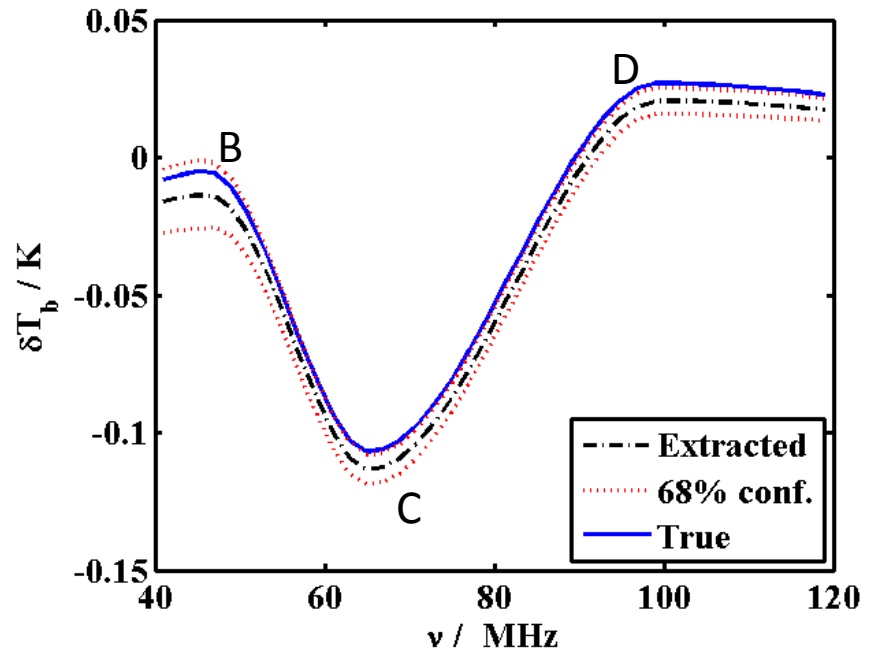
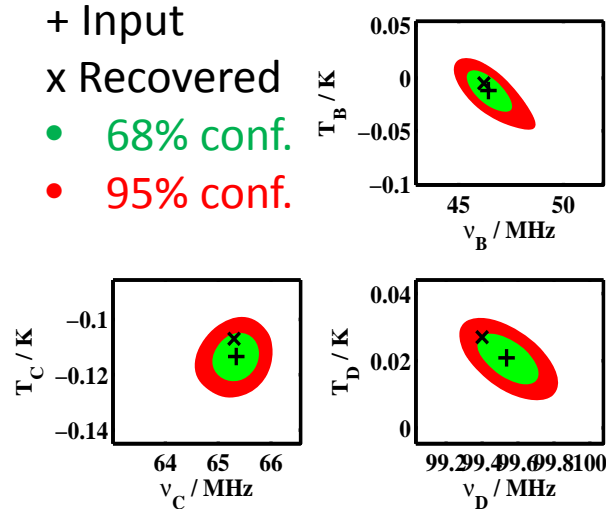
Recovering the shape of the global 21-cm signal from simulated DARE data

Developed parametrized models of the signal and foregrounds in eight directions:

- Galaxy and diffuse extragalactic sources
- Sun
- Moon (emission and reflections)
- Instrument

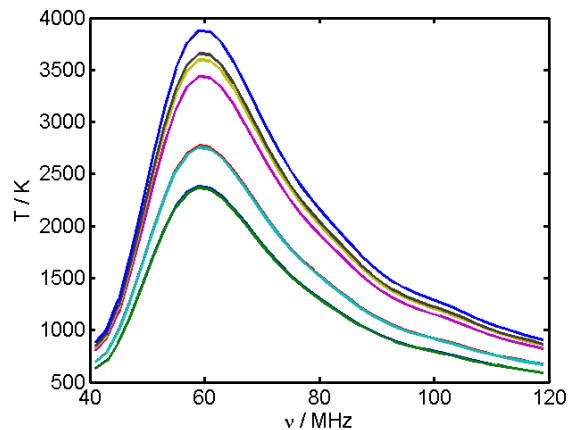


- Simulate data
- Fit the parameters and derive errors with a Markov Chain Monte Carlo code

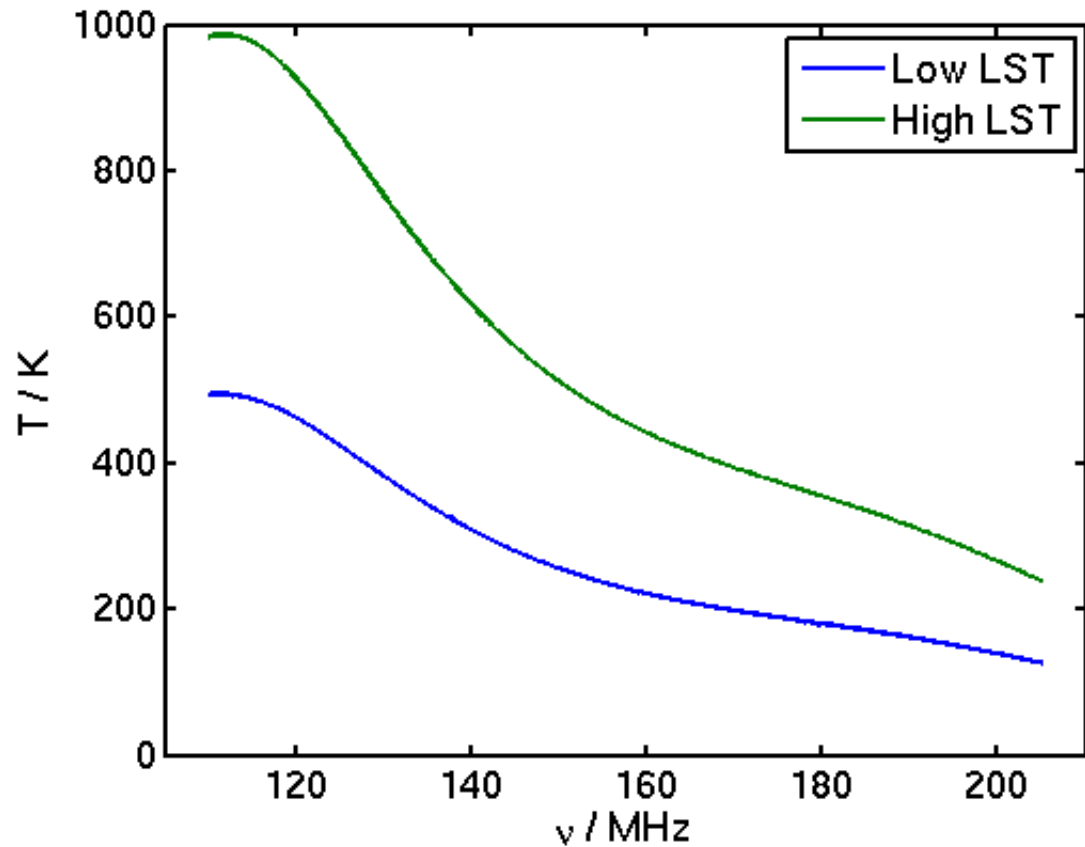


Applying MCMC to EDGES data

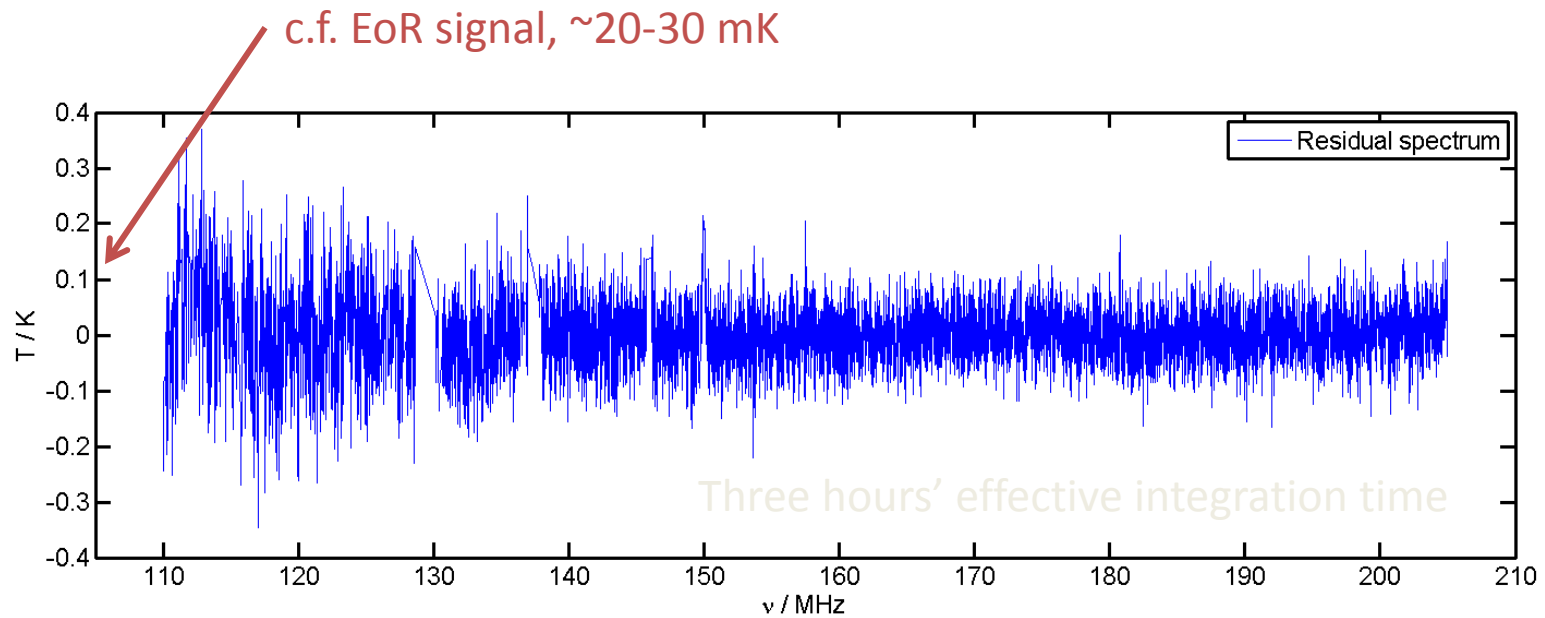
How does this analysis pipeline work with real data? Can we improve constraints on the epoch of reionization data?



c.f. simulated
DARE data

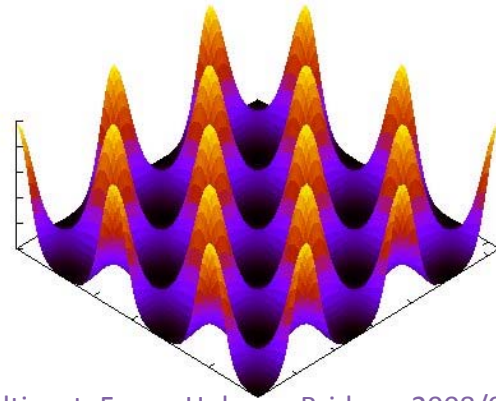


Applying MCMC to EDGES data



Coming up: code development and the DARE prototype system

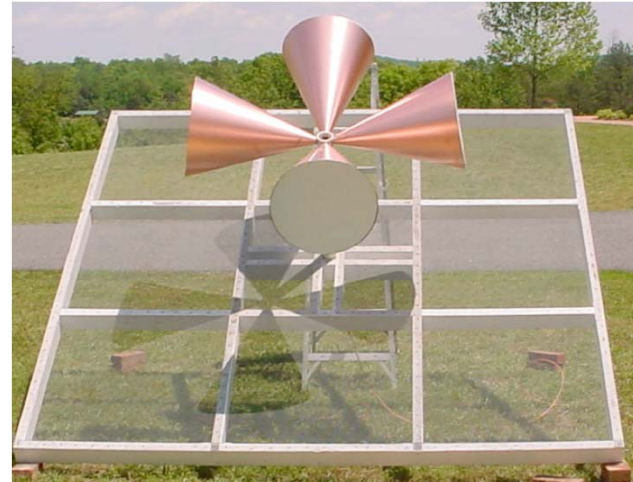
- Increase the power and flexibility of the MCMC code:
 - Incorporate existing code base developed by other groups.
 - Find a way to start from high-resolution, time-ordered satellite data rather than assuming we begin with preprocessed data.
 - Include a wider range of 21-cm models: do *model selection* rather than simply parameter estimation.



Multinest: Feroz, Hobson, Bridges, 2008/9

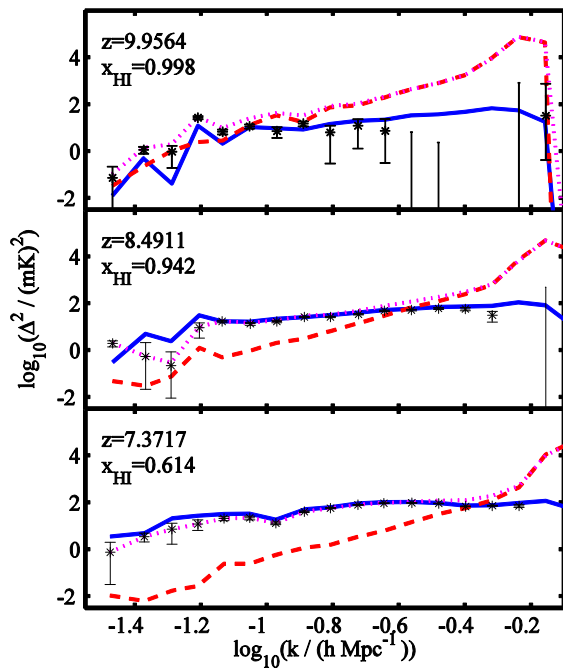
Coming up: code development and the DARE prototype system

- Applying the MCMC code to data from the DARE prototype system will be a good test of the code and will also require further development:
 - Incorporating the effects of environmental changes, solar bursts etc. will require the use of the time-ordered data
 - Can we also incorporate effects such as the ionosphere into the MCMC modelling?
 - Are any real constraints on the 21-cm signal possible from this or EDGES? Can we prove it?

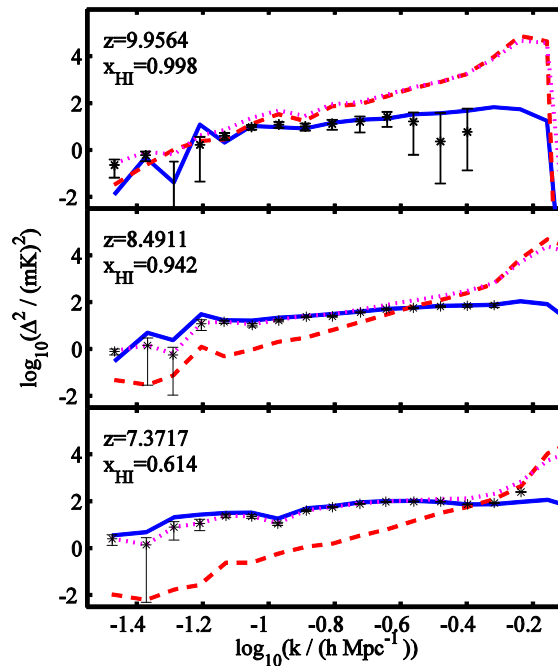


LOFAR extraction: power spectrum of fluctuations during reionization

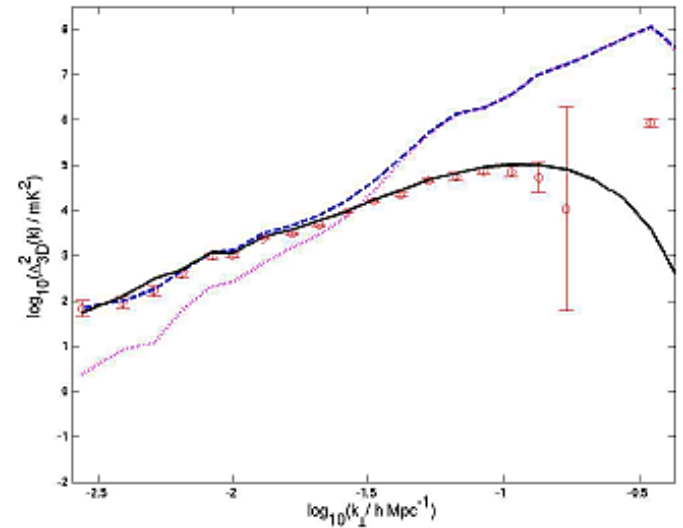
Polynomial fitting



Wp smoothing



Independent component analysis



Chapman et al. (in prep.)

Robust extraction of other quantities

What statistics other than power spectra can be applied usefully to foreground-subtracted data?

It's often been assumed that imaging will be impossible for first-generation experiments, but this may not be true on large scales.

