Signal extraction for sky-averaged 21-cm experiments

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Collaborators: Jack Burns, Jonathan Pritchard, Judd Bowman and the DARE instrument verification team.

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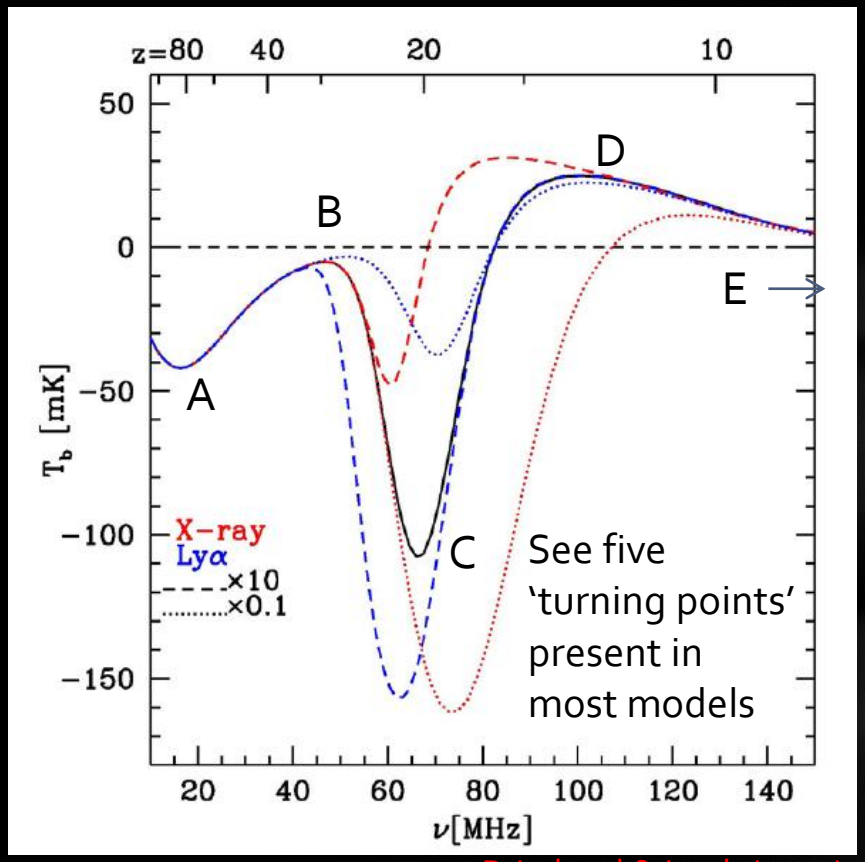
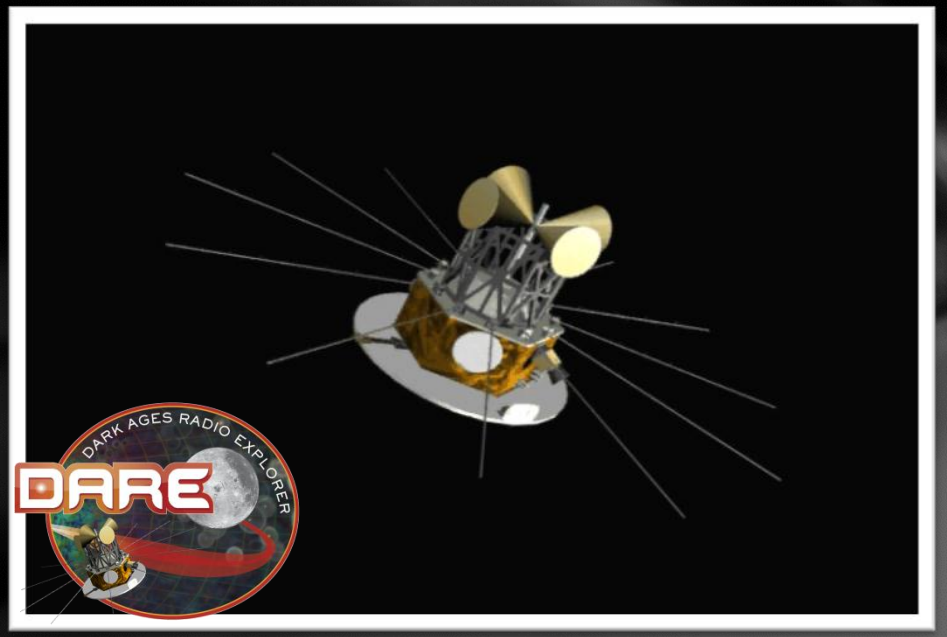
The global 21-cm signal and the Dark Ages Radio Explorer



See five 'turning points' present in most models

Pritchard & Loeb (2010)



- Proposed to NASA's Explorer program.
- Would detect the sky-averaged 21-cm signal from lunar orbit.
- For more details see Jack Burns' talk this afternoon in Session 328 (Instrumentation: Space Missions).
- Method presented here applicable to ground-based experiments too.

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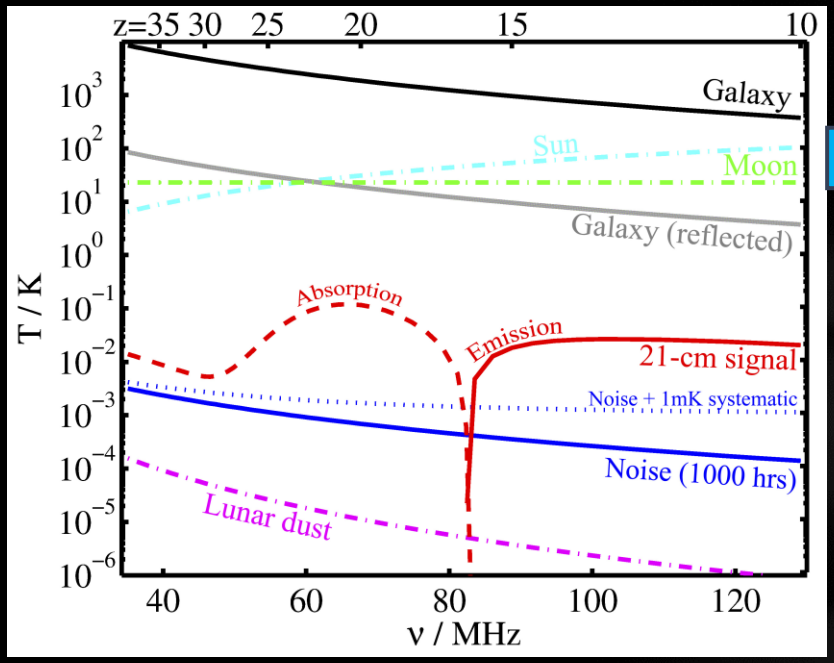
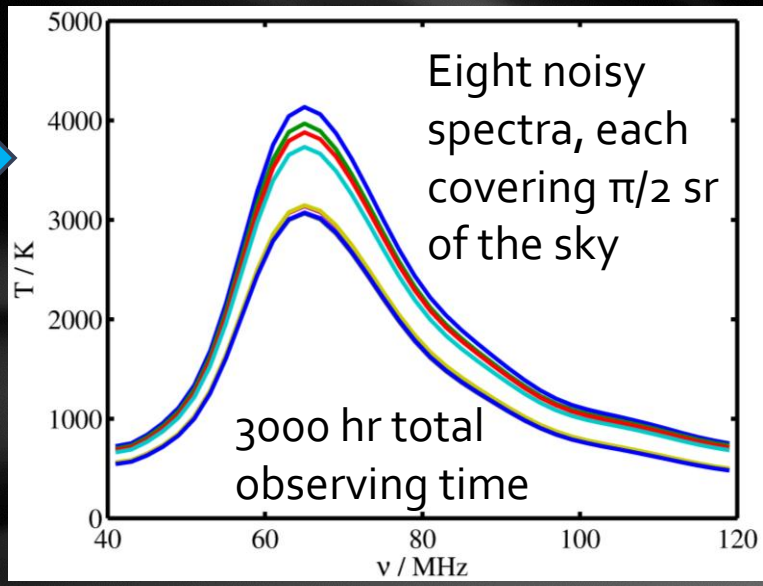
Foregrounds for 21-cm observations



Combine and include instrument response



General approach:

- Develop parametrized models of the signal, instrument, and the foregrounds in 8 sky areas.
- Produce simulated DARE data based on these models
- Find a way to infer parameters (+ errors) from the data

Parameter group	No. of parameters
21-cm signal	3x2 = 6
Diffuse foregrounds	4x8 = 32
Sun	8 + 3 = 11
Moon	2
Instrument	22
Total	**73**

Must explore high-dimensional parameter space!

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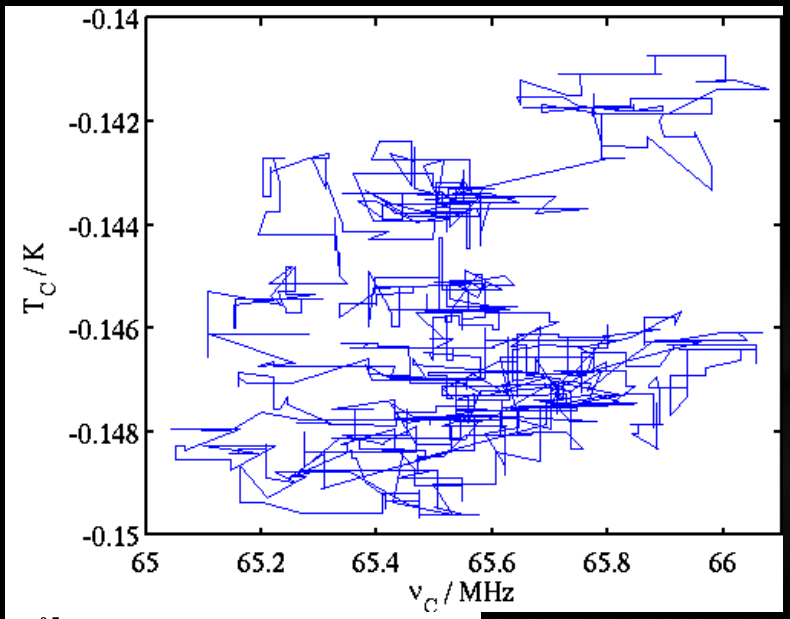
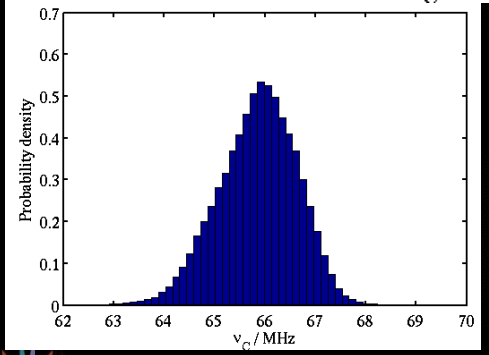
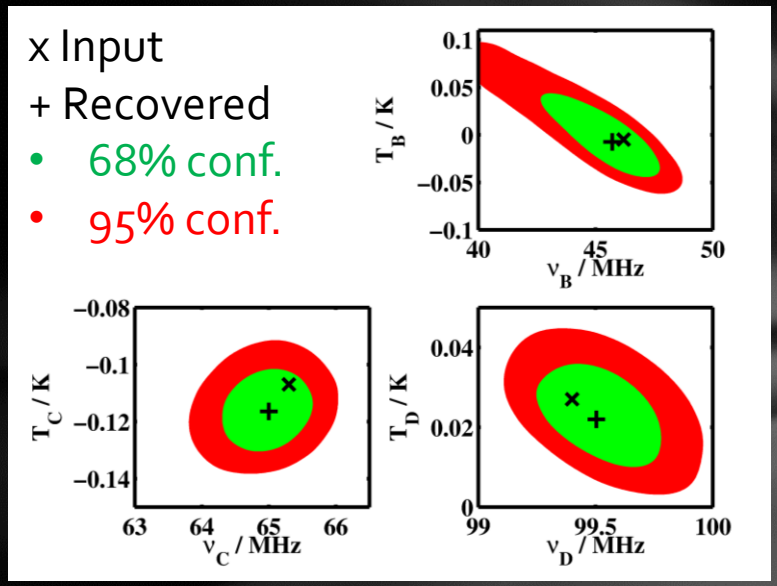
MCMC technique and results

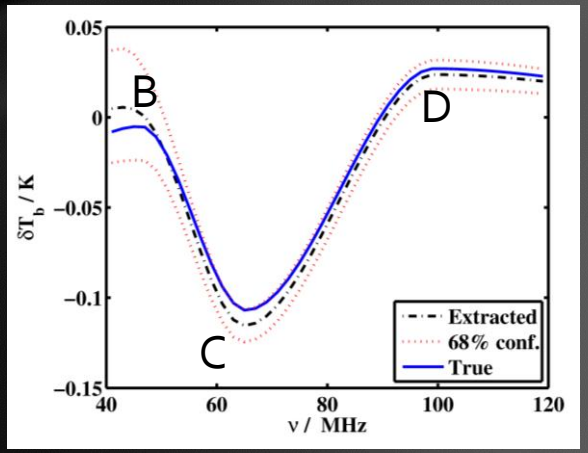




Random walk through parameter space
→ unbiased, random samples of the posterior probability distribution



Positions of turning points B, C and D



Shape of 21-cm signal

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For details see Harker et al. (2012), MNRAS, 419, 1070