EDGES:
(Experiment to Detect the Global EOR Signature)
Status Report

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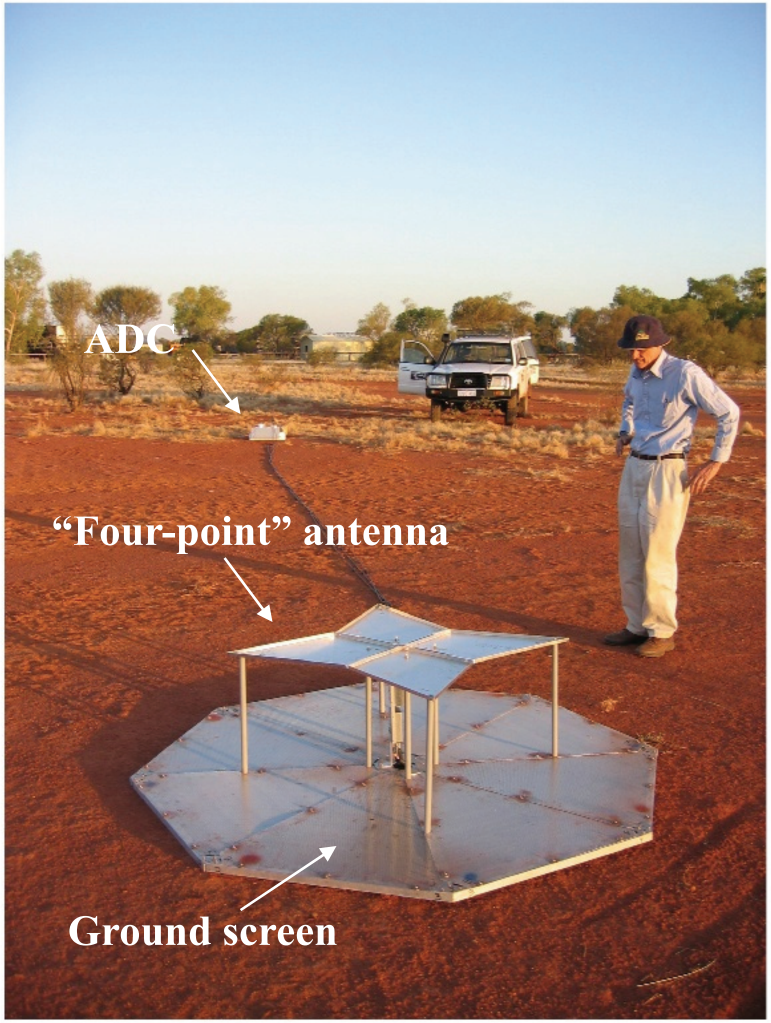
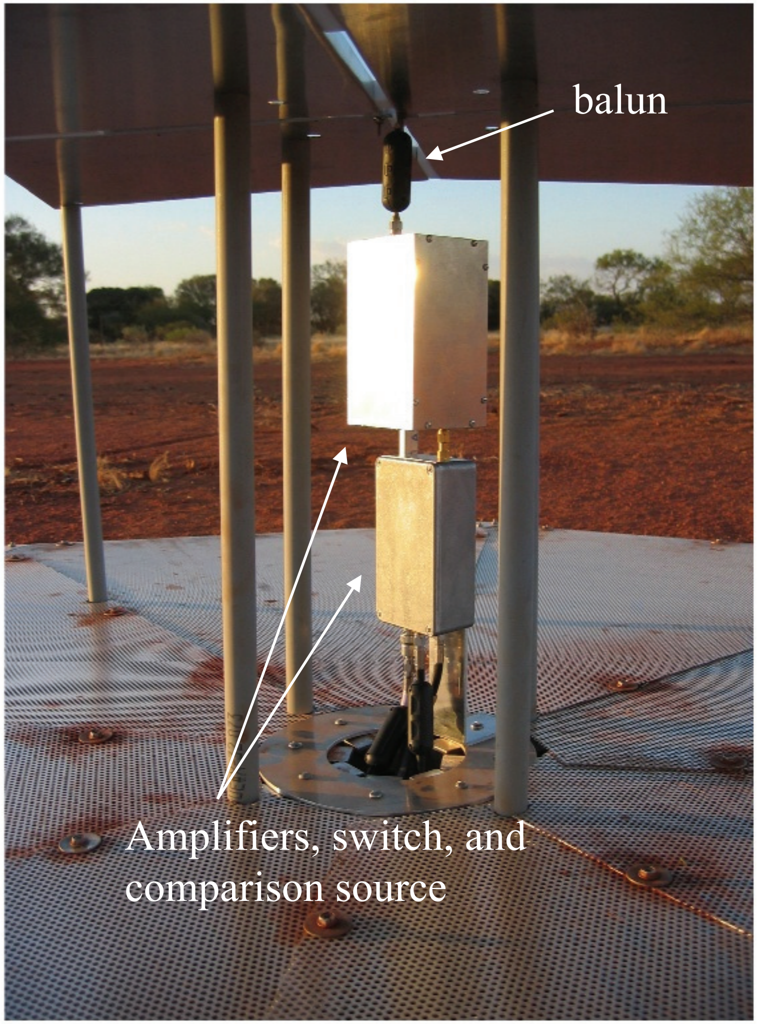
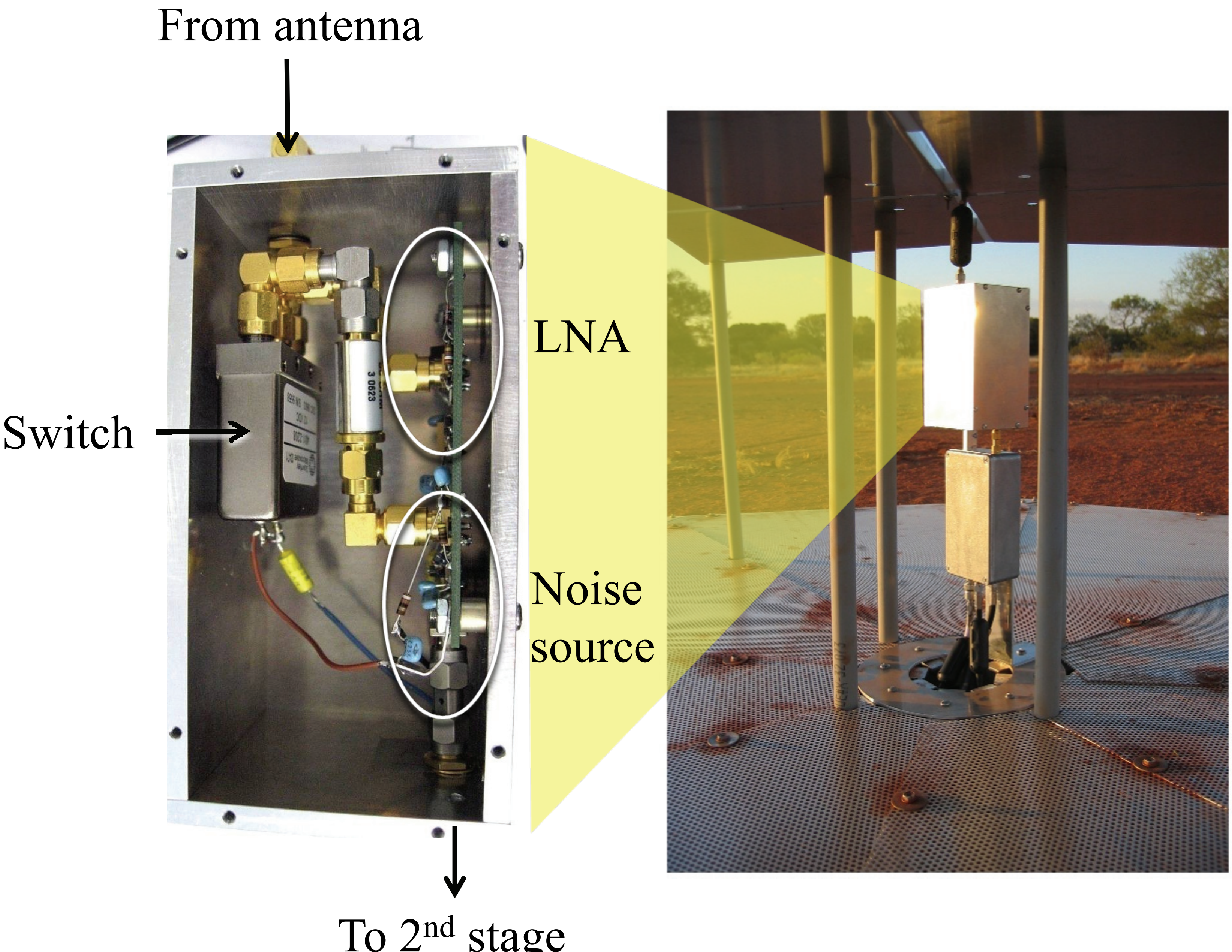
EDGES: System Overview

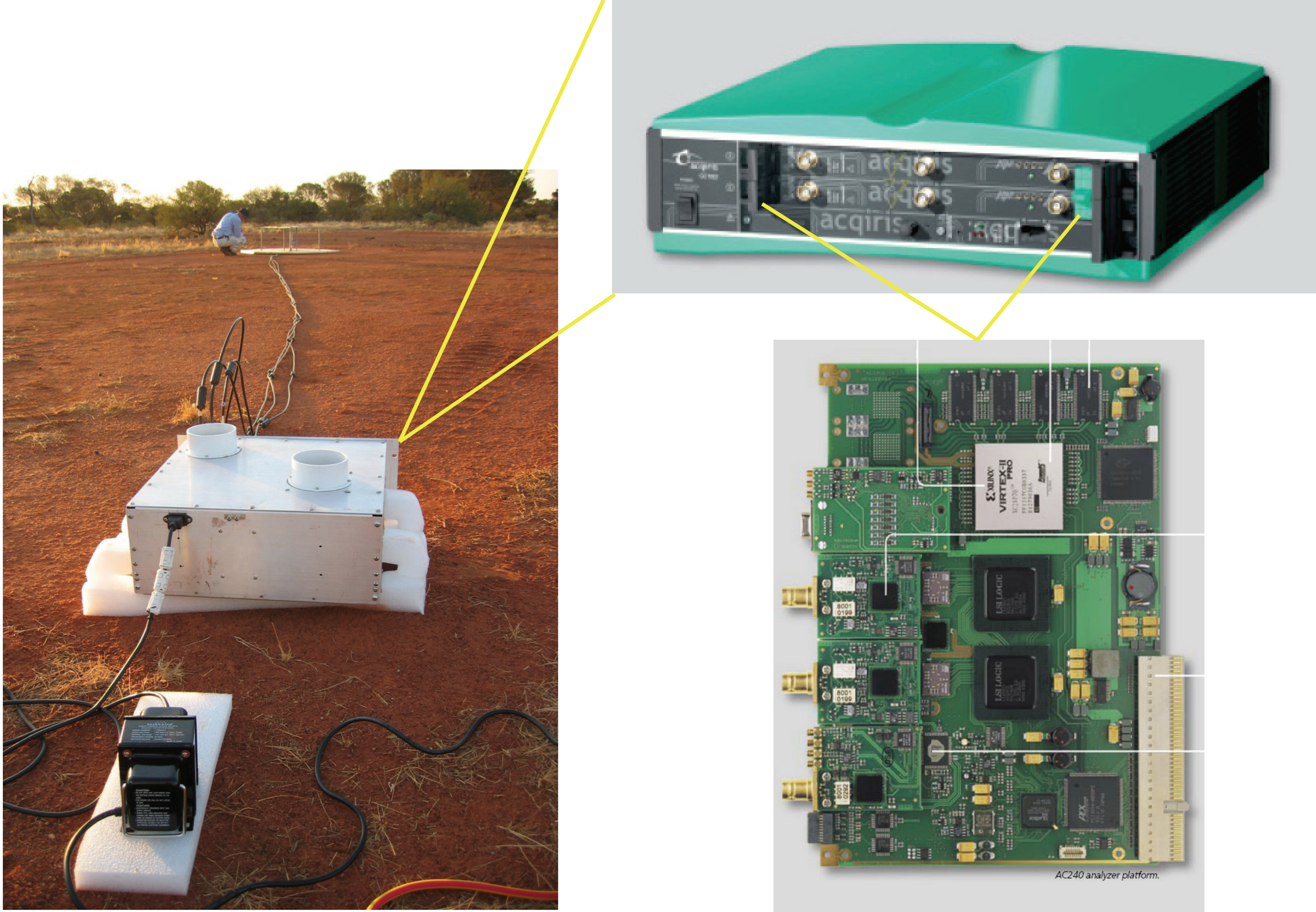
- Single dipole, FOV = 120 deg
- Instantaneous bandwidth = 50-250 MHz
- Spectral resolution = 32 kHz → 130 kHz
- Temporal resolution = 1 s
- Data volume = 50 MB/hour
- Data storage = USB flash drive
- Internal noise comparison switch
- No ionospheric calibration

EDGES: System Overview





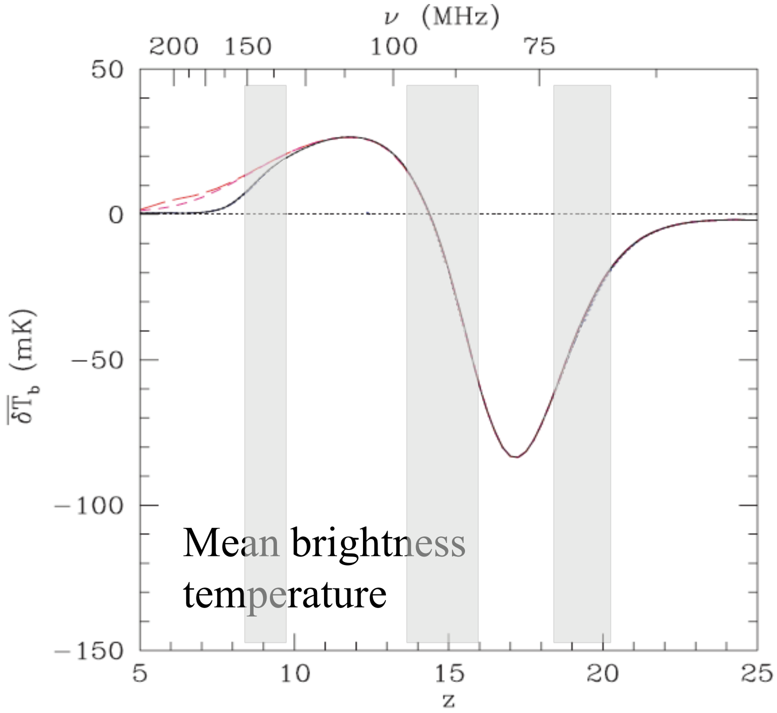

From antenna
Switch
LNA
Noise
source
To 2nd stage

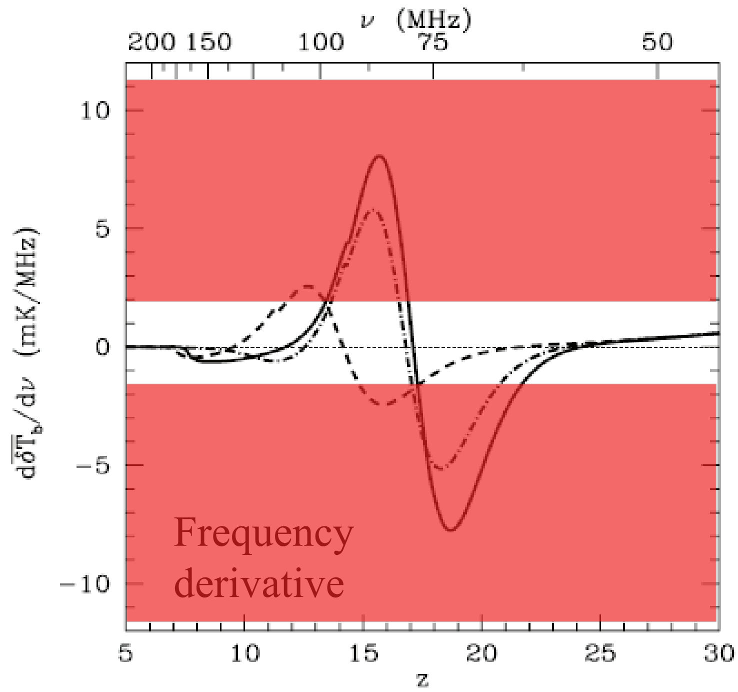


Acqiris AC240: 8-bit, 1 GS/s

EDGES: 21 cm Science

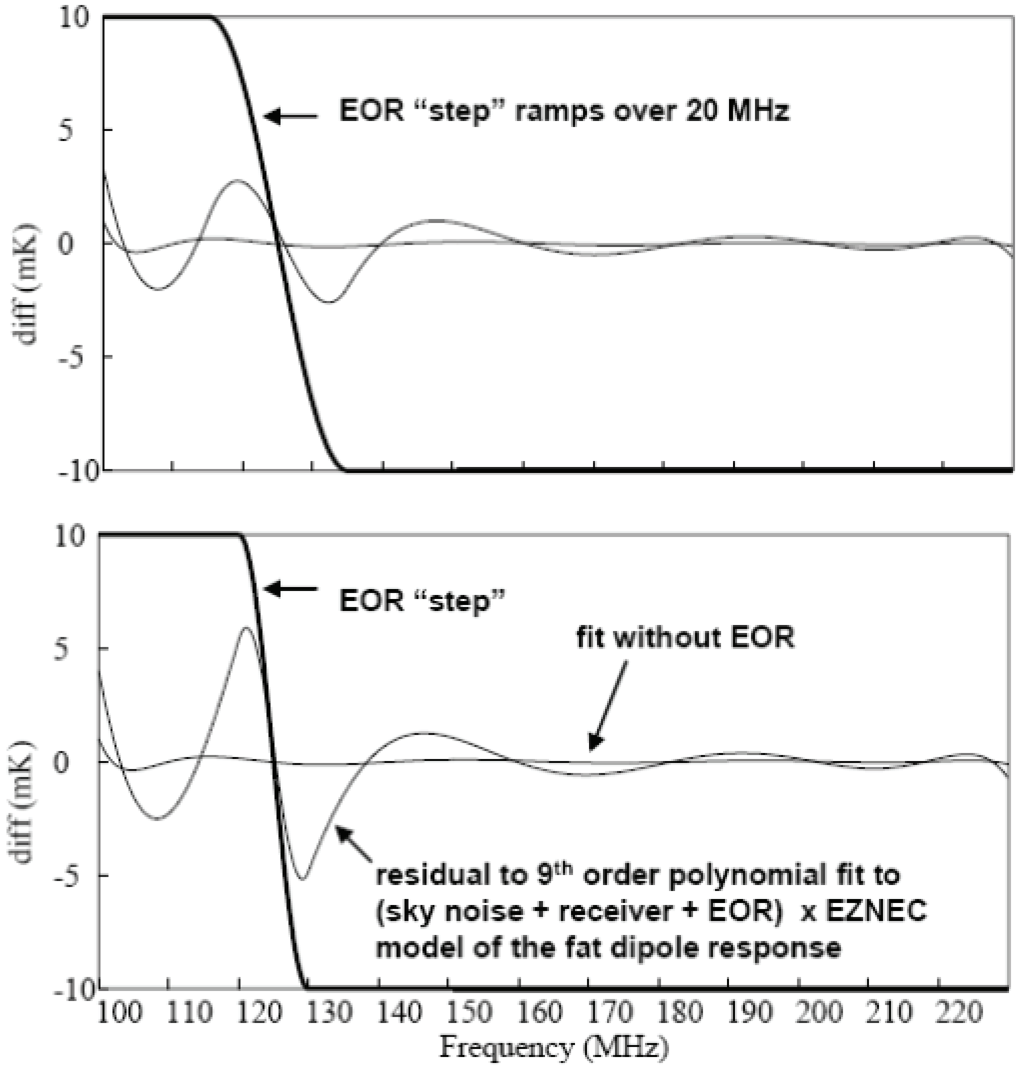
- Constrain $T_{21}(z)$
  - Test for fast reionization only ($\Delta z \leq 2$)
  - In effect, constrain *derivative* of $T_{21}(z)$ to <1 mK/MHz





Furlanetto 2006

EDGES: Technique



Why Global 21 cm?

- *(Basically)* same science as 1st generation arrays
  - Short term: $\sigma_{21}(z)$ vs. $\Delta T_{21}(z)$ → $x_{HI}(z)$
- "Simpler" than imaging/power spectrum
  - Average over large solid angle
  - Signal fills aperture of any antenna
  - Ignore ionospheric distortions
  - Polarized foregrounds reduced
  - Foregrounds easier to model (less precision required)
- Pathfinders for arrays
  - Inform decisions on frequencies to target to with arrays
- Long term: Reach high-z (>15) sooner

EDGES: Challenges

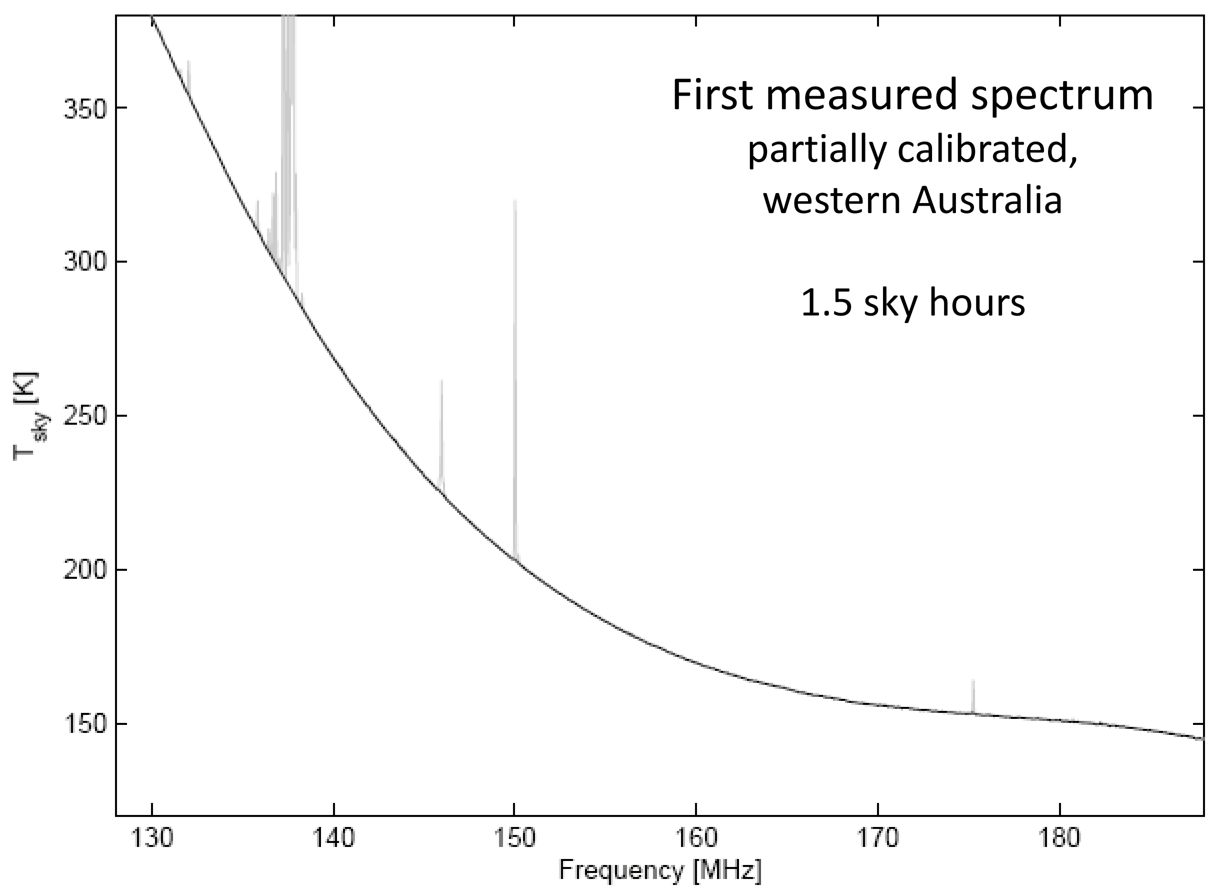
- Still need to separate signal from foregrounds with high DR
  - Differences in spectral structure less significant
  - Much less information available (need models)

- Difficult to calibrate absolute response of radiometer to better than 1%

- No empty fields for comparison (on/off target)

- Differential measurements are easier in *angle* than *frequency*
  - Instrument properties invariant to sky position, but not spectral translation: $G, B, T_{rcv} \rightarrow G(\upsilon), B(\upsilon), T_{rcv}(\upsilon)$
  - "mixes" sky and instrumental effects

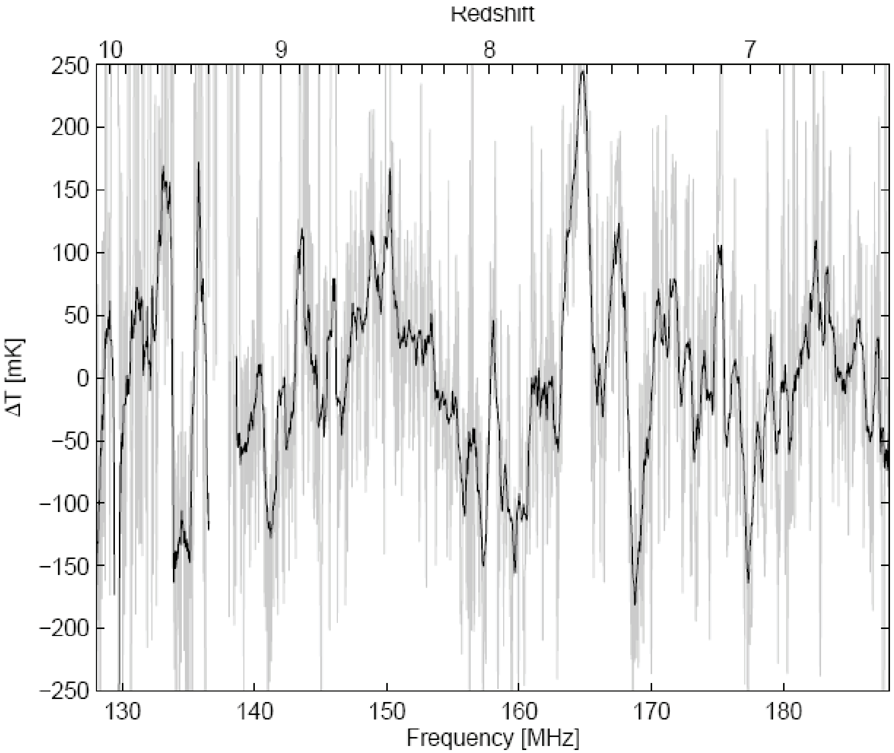
EDGES: Smoothness



Bowman, Rogers & Hewitt 2008

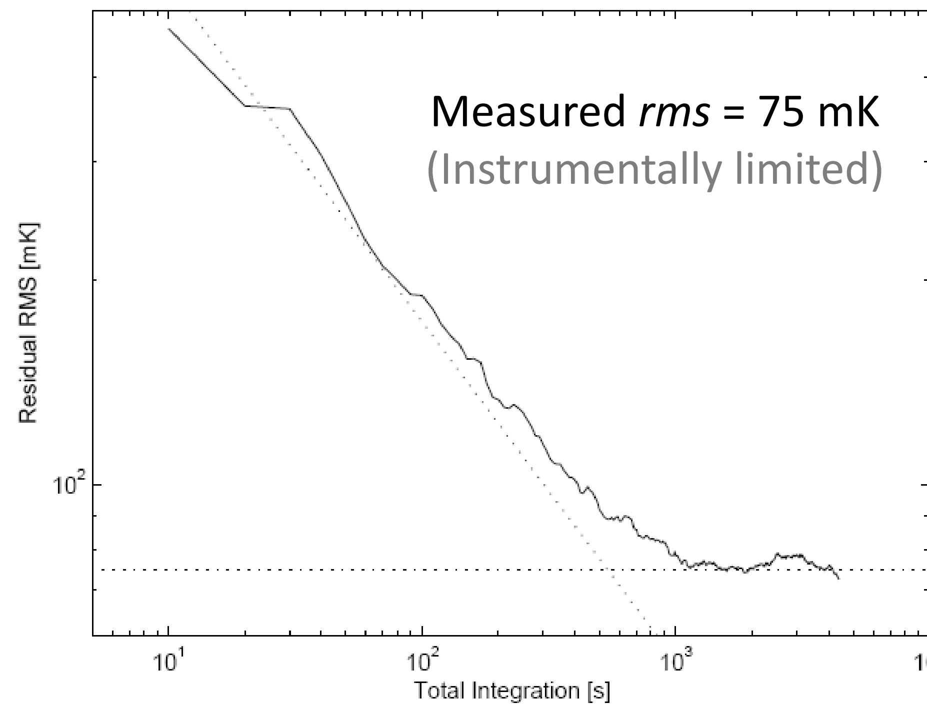
EDGES: Smoothness

Residuals after 7th order polynomial fit to spectrum



Black line: smoothed to 2.5 MHz

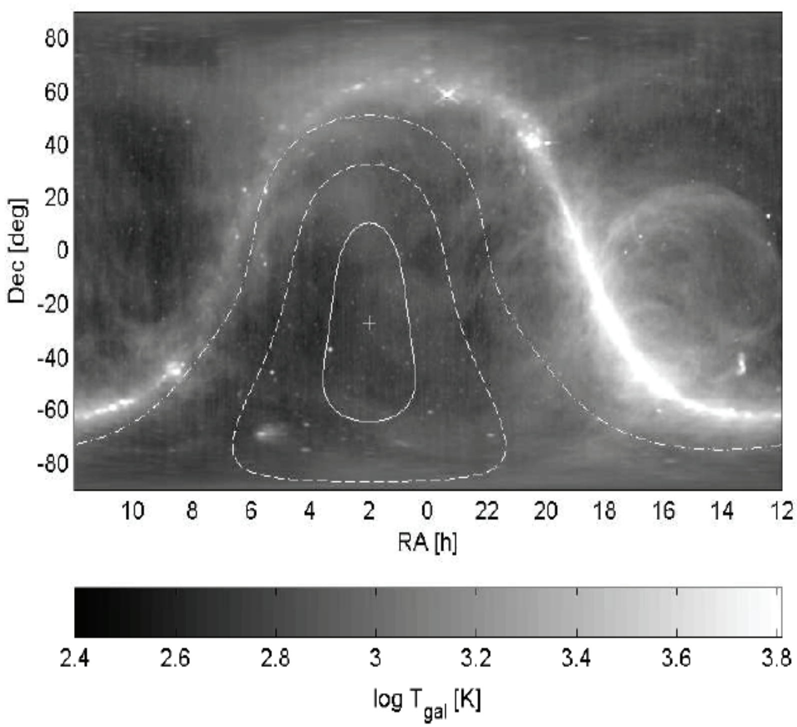
rms vs. integration time

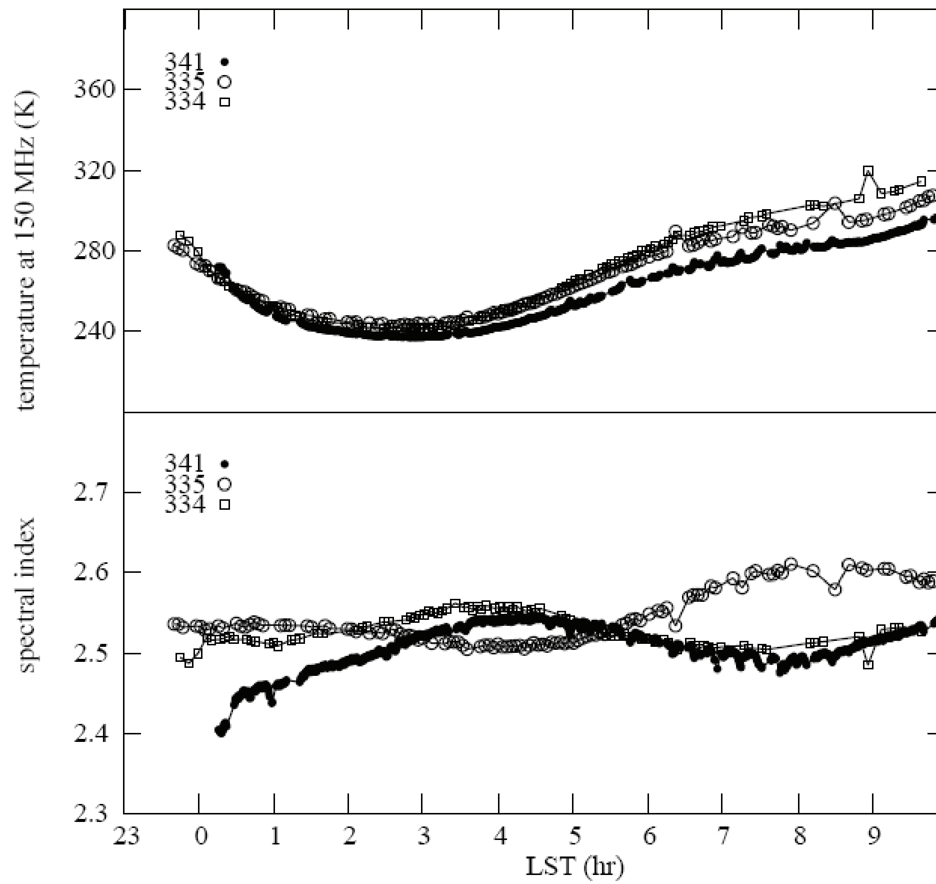


Preliminary Upper limit: $\Delta T_{21} < 450$ mK for rapid reionization at z = 8

Bowman, Rogers & Hewitt 2008

EDGES: Drift Scans





Rogers & Bowman 2008

EDGES: Status

• Jan 2006	Project start
• Dec 2006	“First light” in Western Australia
• Spring 2007	Preliminary analysis and characterization

Analog to digital converter limiting component:

Replace with UC Berkeley/CASPER iBob2-based system and/or scanning low-bandwidth up-down converting system

• Spring 2008	Implemented up-down receiver
• Summer 2008+	Improve signal extraction techniques (with R. Barkana et al.)
• Aug/Sep 2008	Interim deployment in California/Nevada
• 2009-2012	Seeking NSF ATI funding this November to integrate iBob2 and conduct series of observations and technology refinement

EDGES: Summary

- Preliminary constraint:
  ΔT_{21} < 450 mK (if reionization occurred abruptly at $z \approx 8$)
  Likely to improve in the next few weeks

- Demonstrated viable approach
  First run within order of magnitude (75 mK [rms] compared to $\leq$ 7.5 mK)

- Clear paths to improve performance
  - New receiver system
  - Increase bandwidth of antenna impedance match
  - Deploy to very remote sites
  - Improve constraint fitting techniques (matched filters, etc.)

- Should determine duration of reionization or constrain to:
  $\Delta z \geq 2$ or better