BPol — The Need for Space

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Outline

1. The Need for Space
   - Sky Coverage
   - Frequency Coverage and Foreground control
   - Systematics
2. Realism
   - $f_{\rm sky} = 1$ from the ground?
   - Arguments against space

Sky coverage

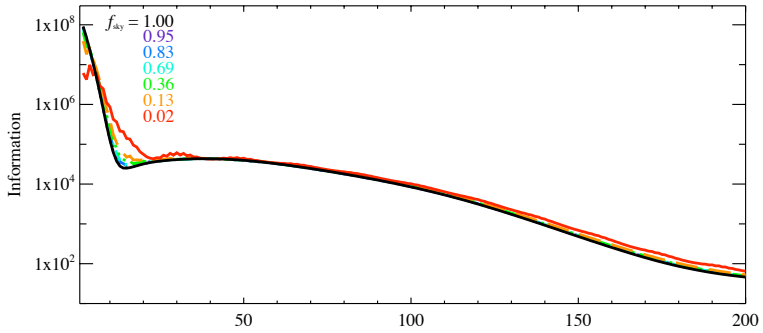
Need full sky for optimal tensor sensitivity.

- BPol needs to approach the cosmic variance limit at low ℓ.
- Naively expect

$$\Delta C_\ell \propto \sqrt{\frac{1}{f_{\rm sky}}}\left(C_\ell + \frac{f_{\rm sky}}{\omega B_\ell^2}\right)$$

- Design: $N_\ell \sim C_\ell^{\rm lens} \lesssim C_\ell$ for $f_{\rm sky} \simeq 1$
- Access to reionization bump
- Flexible scan strategies (deep areas)

- If we had a pure *B*-mode sky, this would be true...
- In fact, $f_{\rm sky} < 1$ is **even worse**:
- Due to E/B mixing *(Amarie, Hirata & Seljak astro-ph/0508293)*



(Courtesy Challinor/O'Dea)

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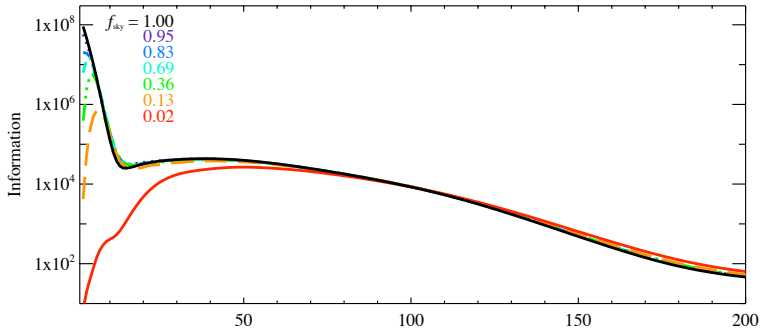
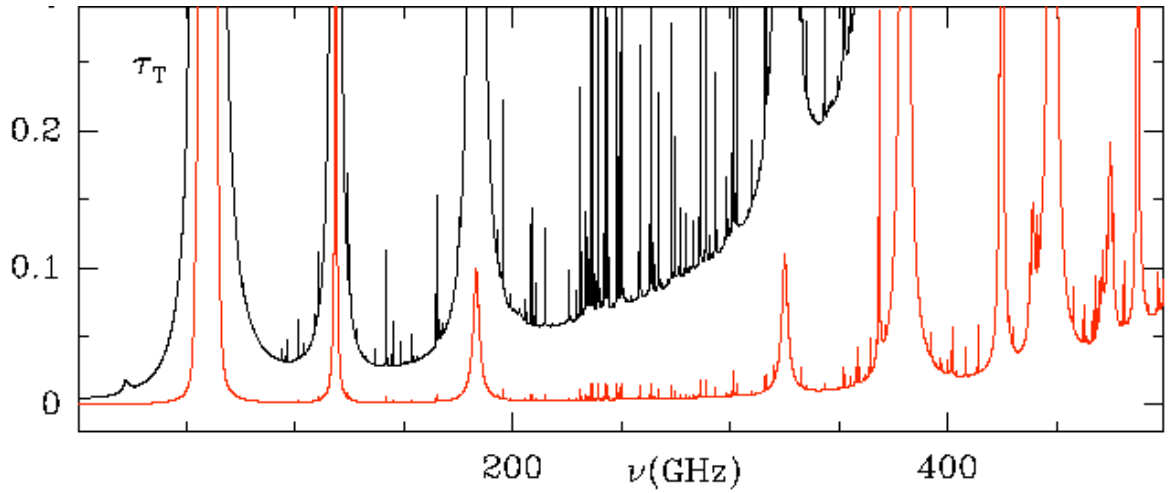


(Courtesy Challinor/O'Dea)

Frequency coverage and foreground control.

Eliminating atmospheric effects



Atmospheric Emission (black = $\times 20$)

- Minimize thermal loading of detectors.
- Couples dangerously to instrumental polarization.
- Still need T for foreground control.
  - Access to 50-70 GHz (?)

Systematics: Parasitic Signals.

L2 is a good place for a telescope:

- Thermal stability
- Eliminate/reduce sidelobe pickup.
- Spacecraft design: expect better straylight performance
- Planck SEWG and LFI studies?

$f_{\rm sky} = 1$ from the ground?

- Sidelobe minimization requires large zenith angle.
- Efficient scanning and cross-linking requires constant-elevation scans.
- $\therefore$ Can't see much from any single site.
- (Realistically, space forces greater systematics control than we usually achieve from the ground.)

Arguments against space.

- Can't fix it if it breaks
  - Need to use proven (i.e., old) technology
  - But we get 100% uptime (unless and until it breaks. . .)
- Atmosphere isn't polarized.
  - Actually it is (Zeeman)
  - And we need to track foregrounds with T
- Open question: How much sky will we really use? (I.E., what if foregrounds are **really** bad?)

Summary

- $f_{\rm sky} \simeq 1$ is crucial [if foregrounds allow it].
  - Maximizes signal power, minimizes E/B mixing issues.
- Not possible from the ground/balloons.
- Systematics only possible to control to ultimate level from space [L2]