SPT-Pol

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Photo credit: J. Hrubes

SPT-Pol Collaboration

KICP
Kavli Institute
for Cosmological Physics
AT THE UNIVERSITY OF CHICAGO

Berkeley
University of California

Case
CASE WESTERN
RESERVE UNIVERSITY

THE UNIVERSITY OF
CHICAGO

McGill

Colorado
University of Colorado at Boulder

M
UNIVERSITY OF MICHIGAN

Argonne
NATIONAL LABORATORY

NIST
National Institute of
Standards and Technology
U.S. Department of Commerce

CARDIFF
UNIVERSITY
PRIFYSGOL
CAERDYDD

CMB Polarization

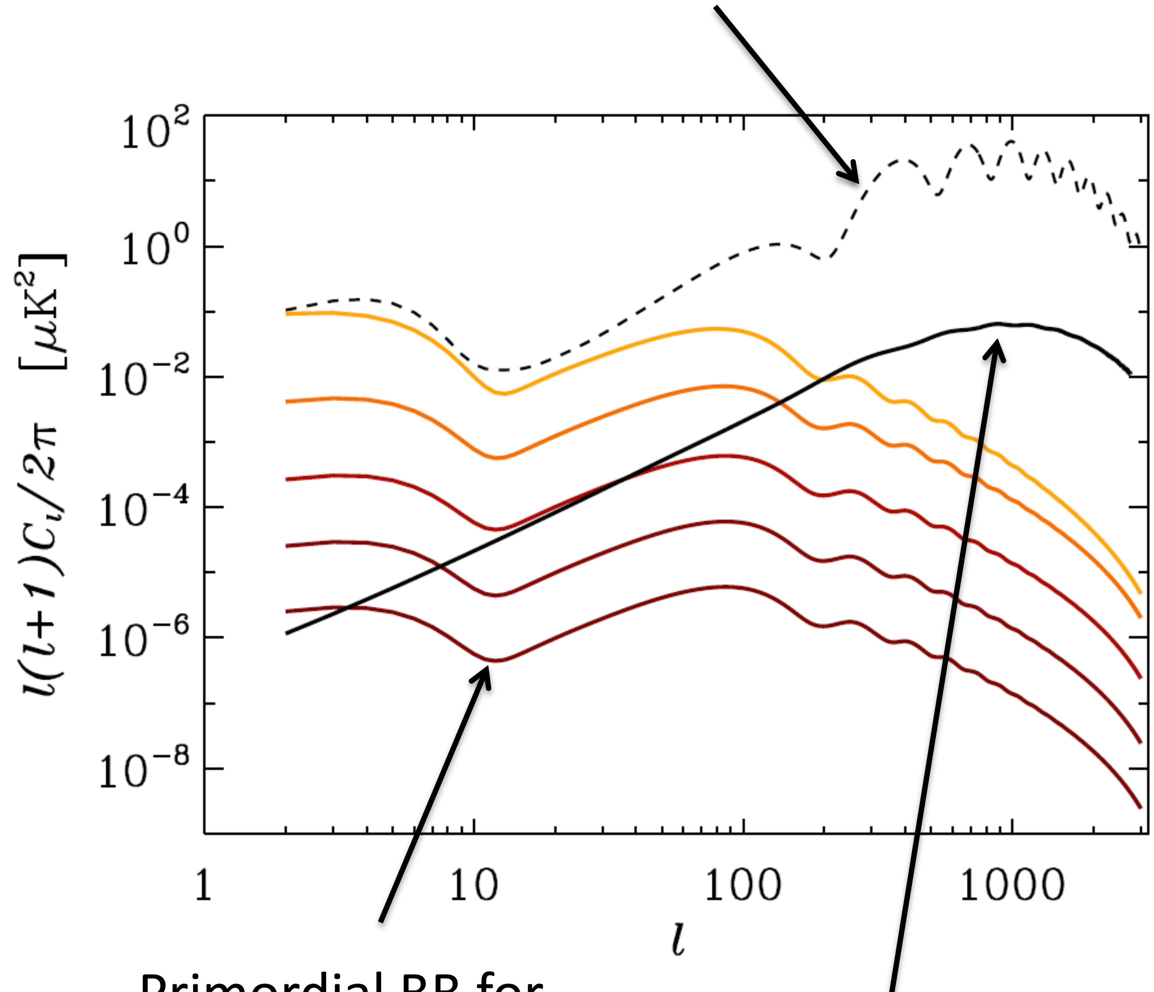
- Decompose polarization field into even and odd parity scalar fields termed "E" and "B"

- Density perturbations and acoustic oscillations produce E- modes only

- B-modes produced by inflationary gravitational waves and lensing

- Massive Neutrinos produce a measurable effect on the lensed B-mode signal

EE predicted by acoustic oscillations



Primordial BB for .001 < r < .43

Lensing BB

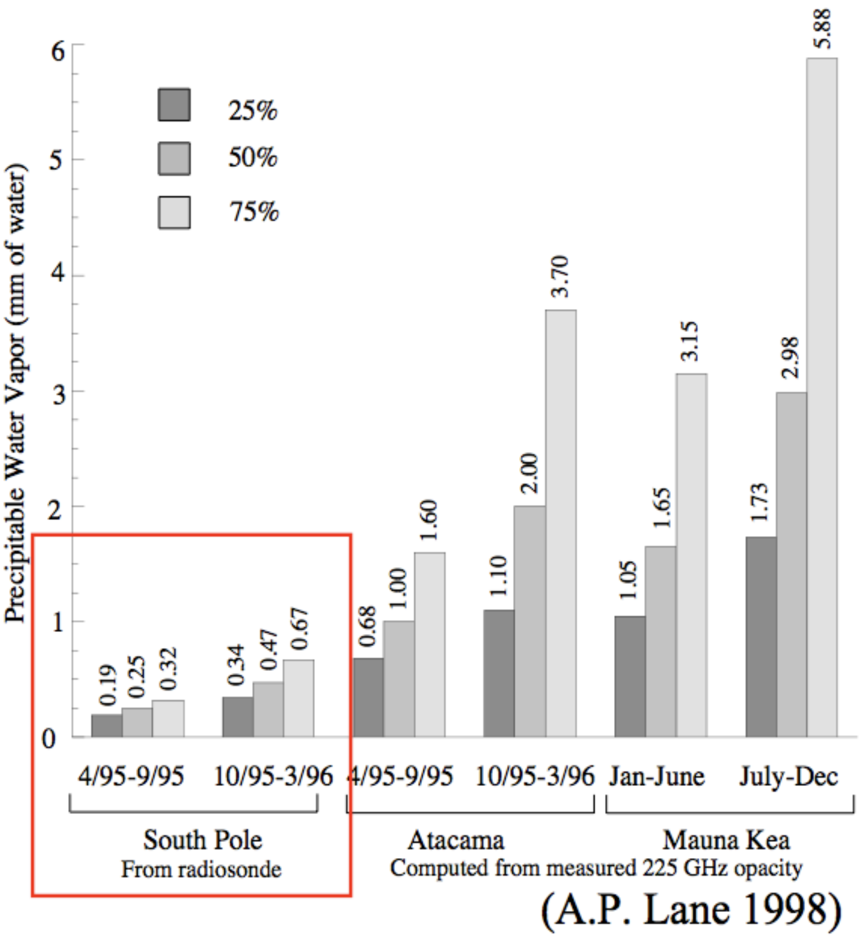
Figure: Smith arXiv:0811.3916

Advantages of SPT-Pol

- Premier site
- Simple, low scattering optics
- High sensitivity and low noise detectors

The site

- It is very dry
- The atmosphere and temperature are very stable



Predicted foreground polarization at 150GHz

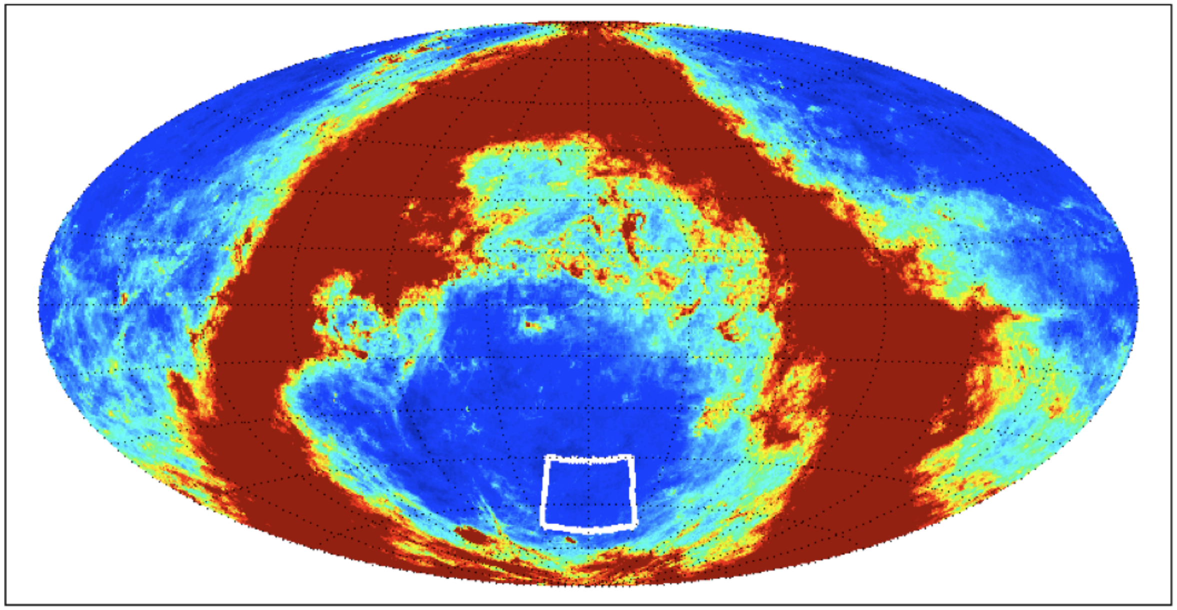
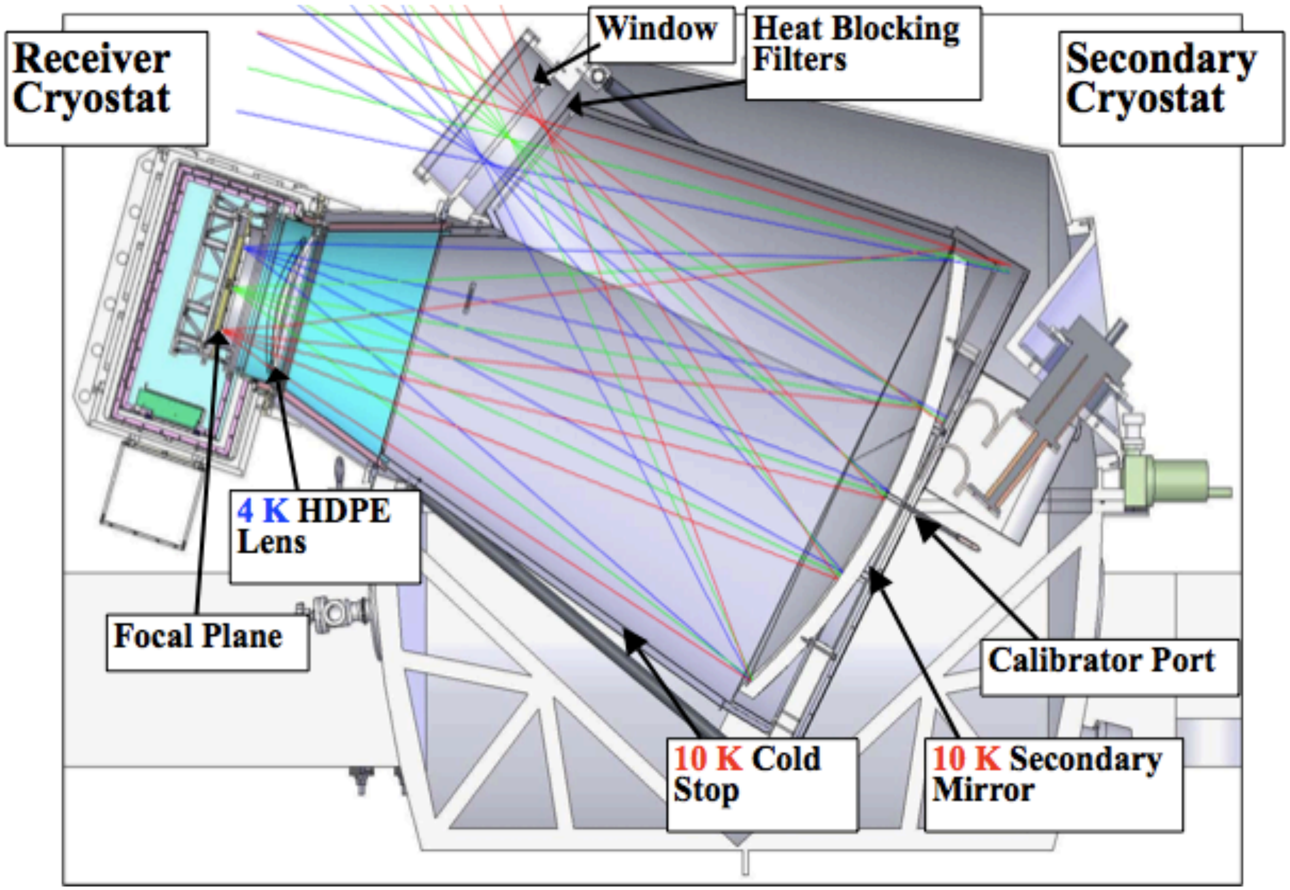


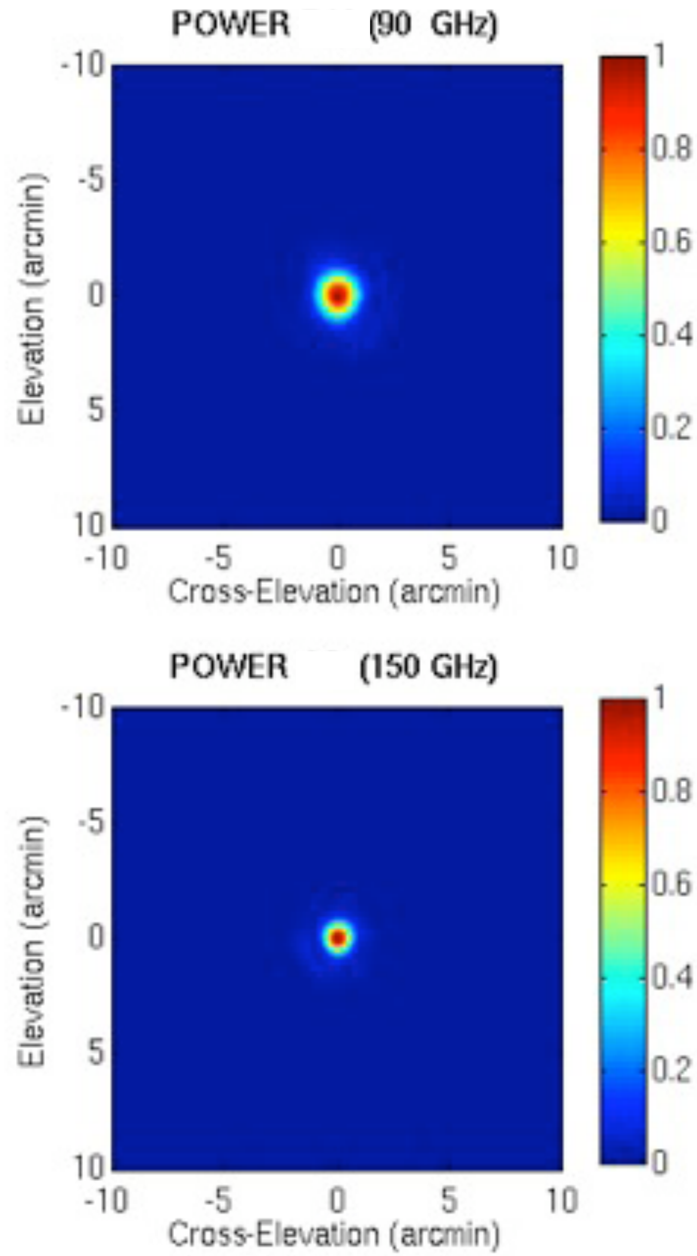
Figure: C. Pryke, J. Kovac

Color range 0 to 4μK

- Lowest foreground field
- Observable at same elevation 24 hrs/ day 365 days/year

The optics





- High-throughput low scattering design
- Cold aperture stop at secondary, under illuminated primary, and comoving ground shield.
- ~1 arcmin beam size

The detectors

150 GHz

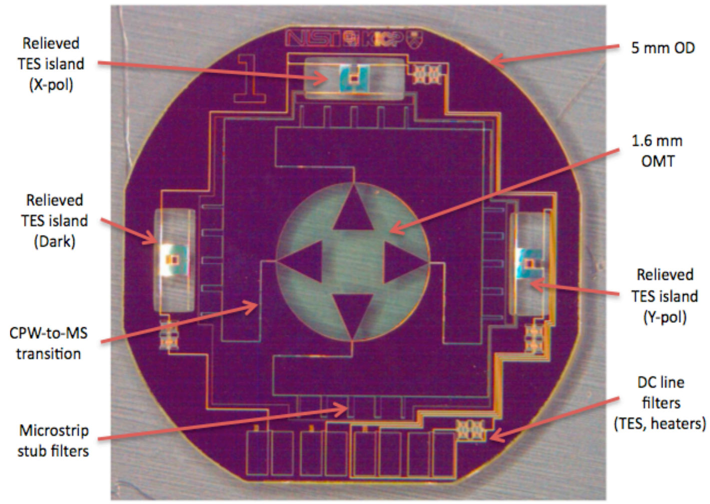
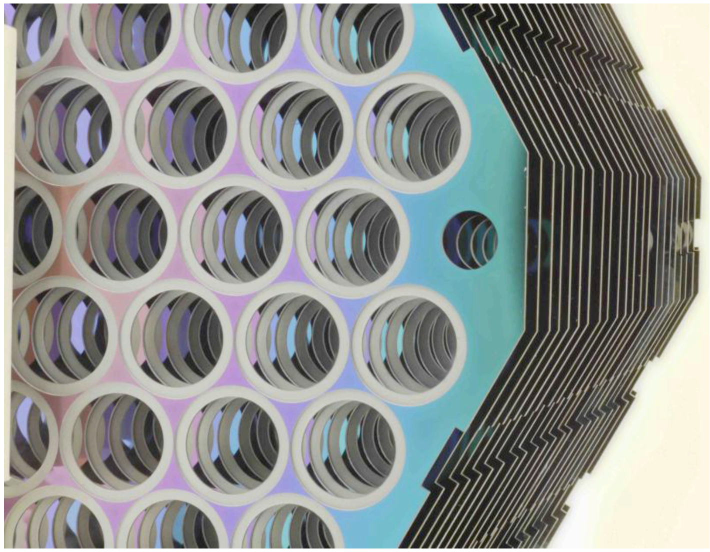
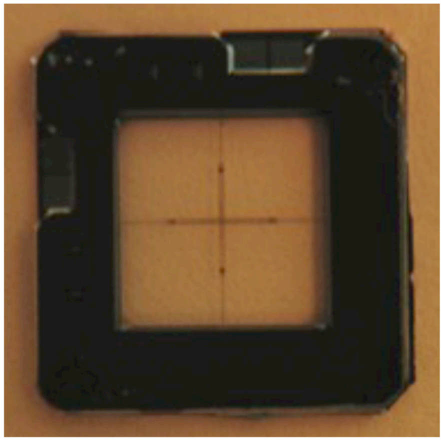
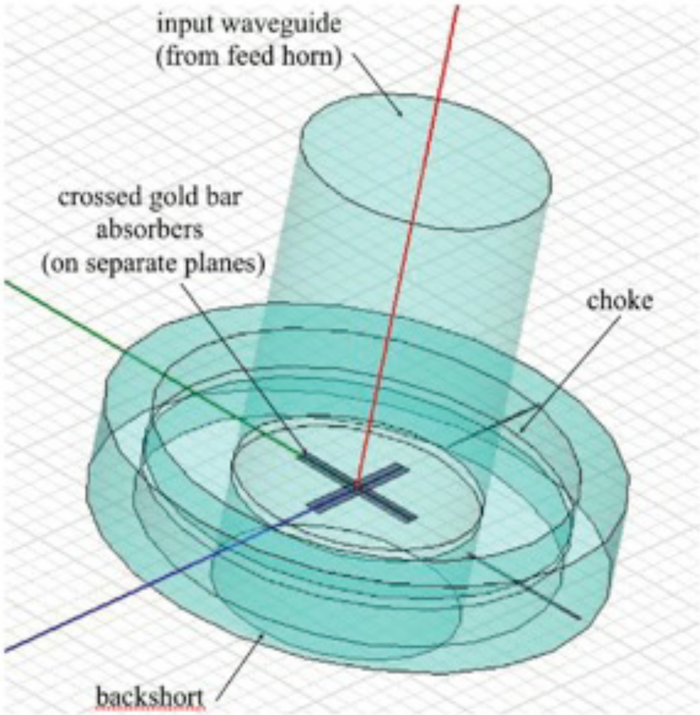


FIGURE 1. Prototype 145 GHz Polarimeter.



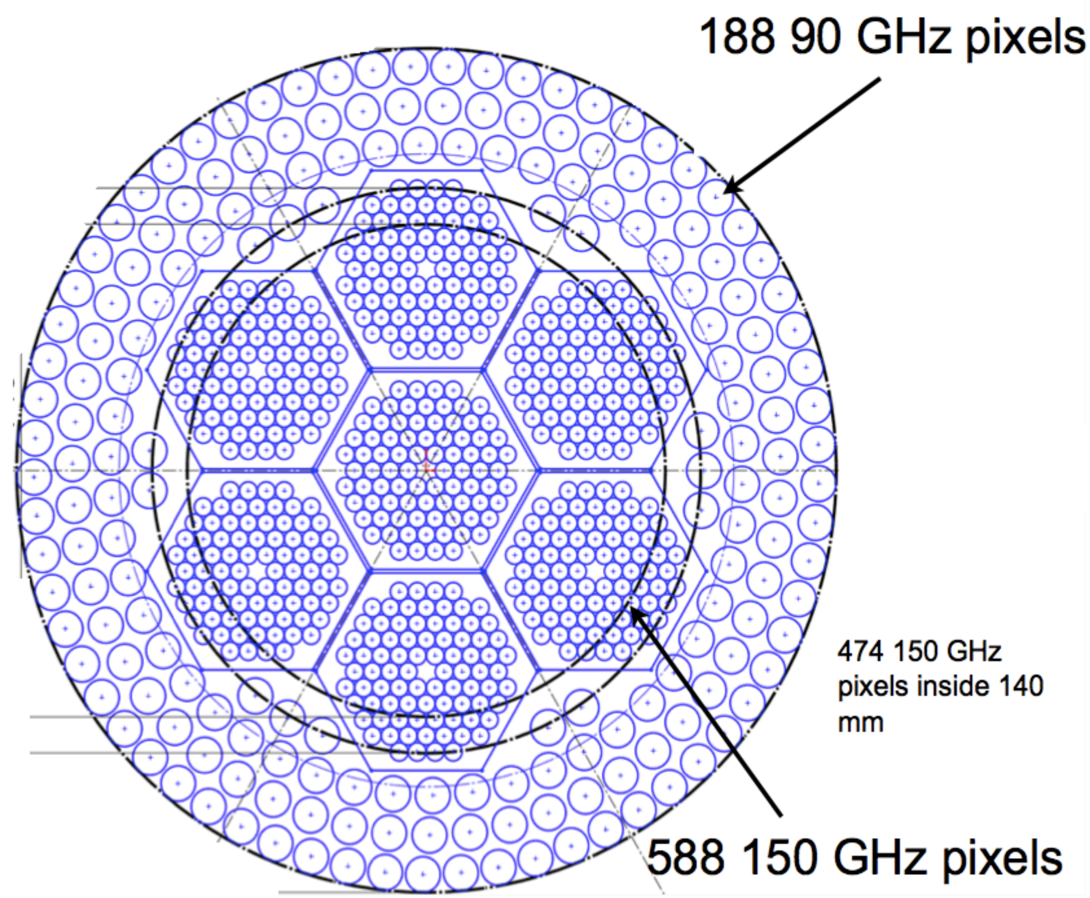
90 GHz



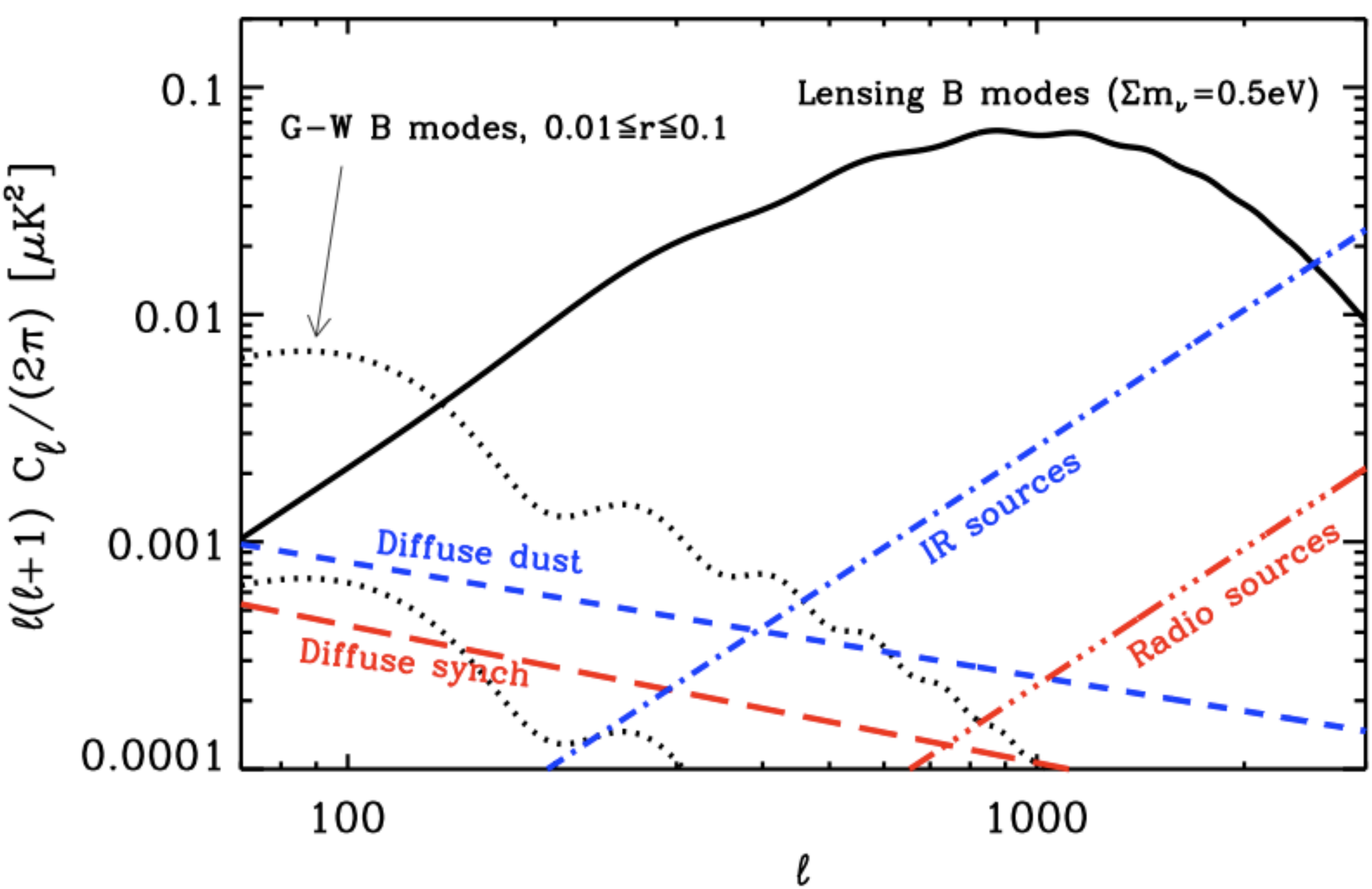


The focal plane

- 1552 TES bolometers (2 polarizations/pixel) at 270 mK
- Read out with digital frequency domain multiplexing, 12 bolometers per SQUID.
- 450/400 μK $_{CMB}s^{1/2}$ NET (90/150 GHz)
- 1.6/1 arcmin beams (90/150 GHz)
- 3 years of observation on ~625 square degrees
- 60% observing duty cycle



Projections



r =.03 (95% CL)

$\sigma(\sum(m_v))$ = .17eV

Current status

- Developing detector technology
  - Production of first complete 150 GHz array early 2011
  - Final design 90 GHz pixels in late 2010

- Receiver cryostats assembled, cryogenically sound, currently being outfitted with readout

First light early 2012

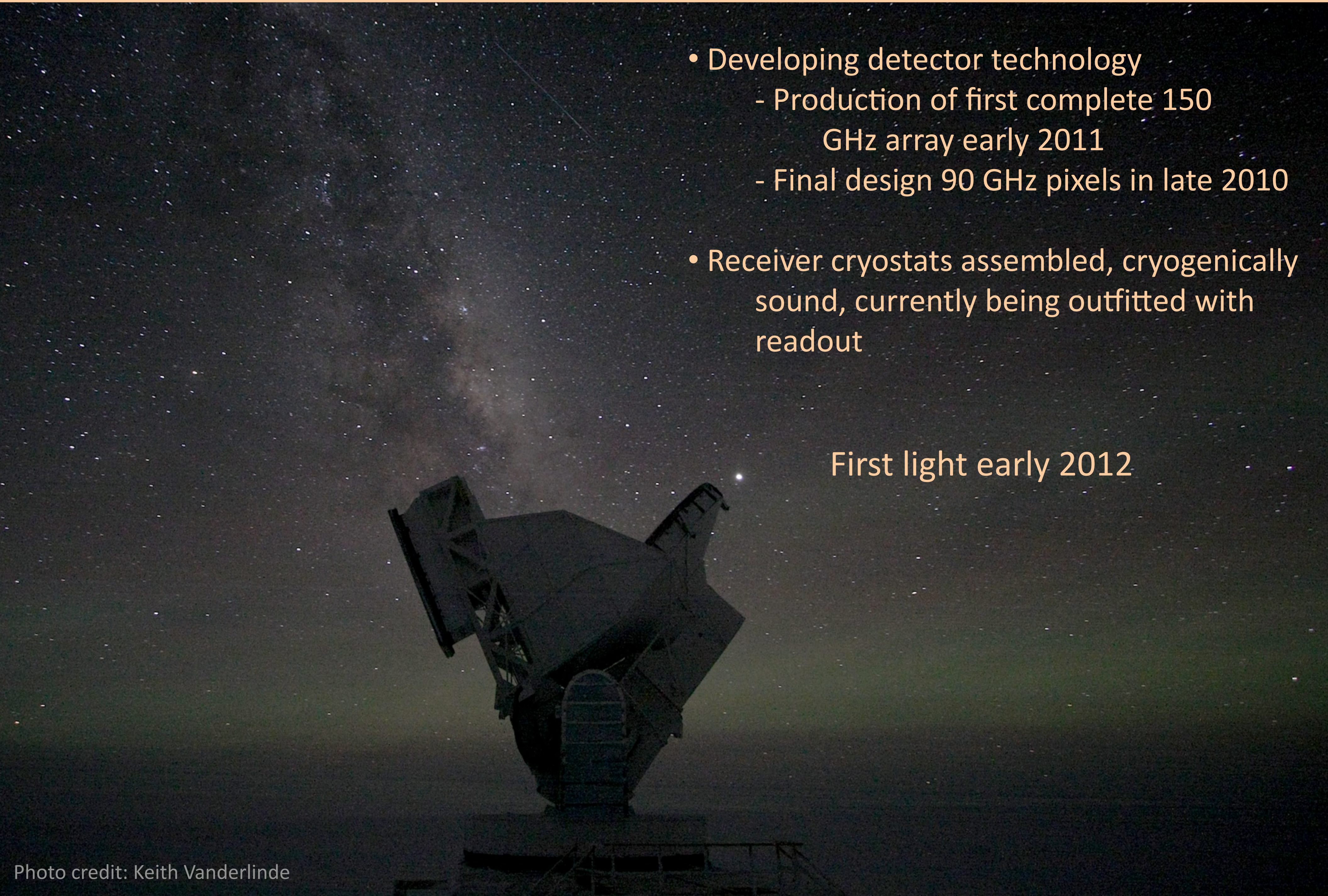
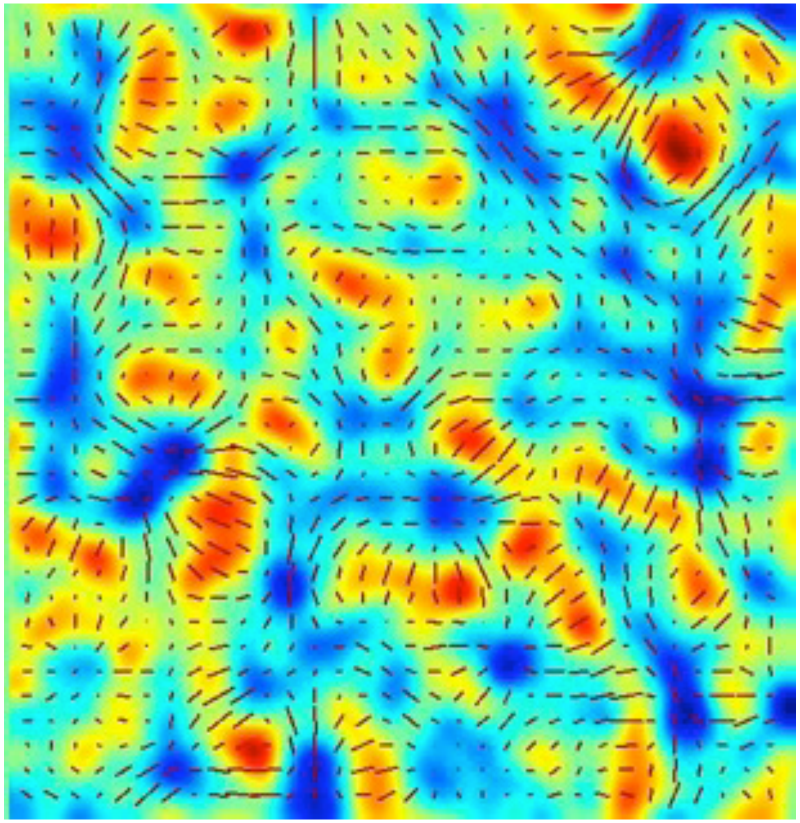
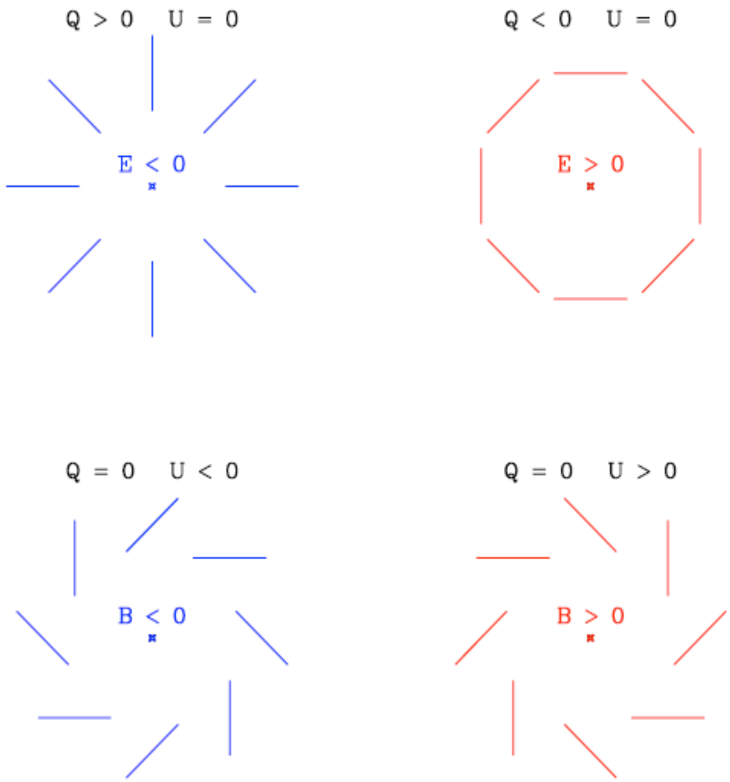


Photo credit: Keith Vanderlinde

Extra Material

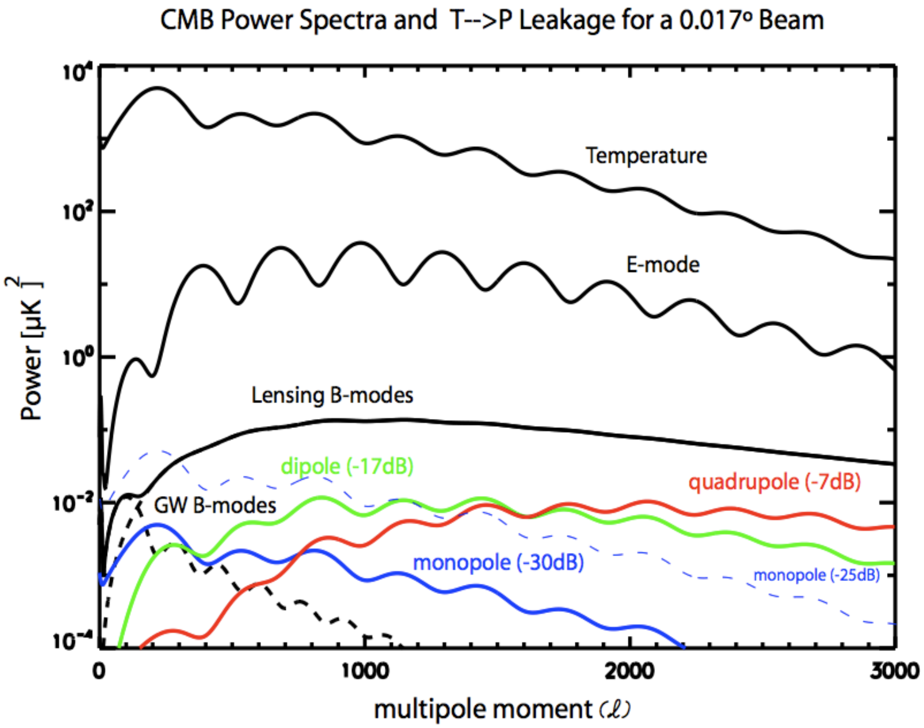
CMB Polarization

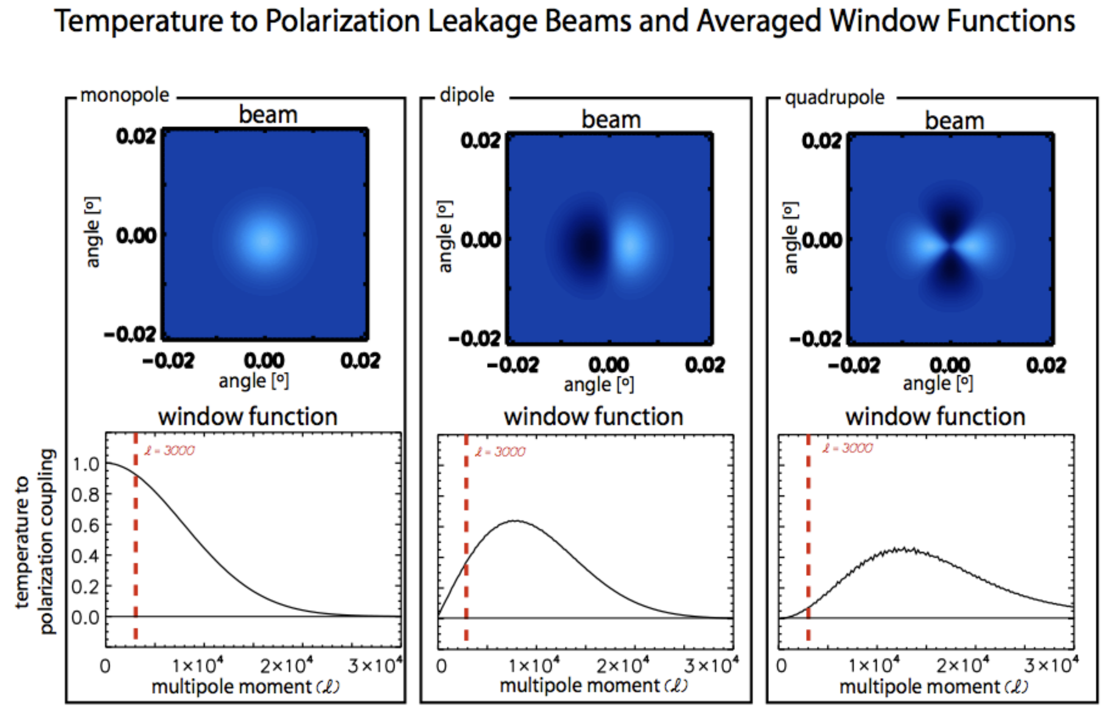




- Polarization described as a headless vector field
- Decompose into “curl-free” (E) and “divergence-free” (B) scalar fields
- Density perturbations and acoustic oscillations produce E-modes only

Polarization systematics





- Cross polarization systematics appear as undesired beam patterns on the sky
- Large primary places these effects are sub-arcmin scale (low CMB power)