

Development of the low-frequency detectors for BICEP Array

Cheng ZHANG¹ and BICEP/Keck Collaboration ¹California Institute of Technology



- BICEP Array(BA) is the new generation of the BICEP/Keck(BK) B-mode searching CMB polarization experiment
- Up to 2017, BICEP/Keck(BK) sensitivity is limited by synchrotron foreground. The **BA 30/40 GHz** receiver will largely improve the constrain on synchrotron with 1 yr observation
- Detector design for 30/40 GHz is done and lab measurements have been performed for fabricated 40 GHz devices.

Antenna array and optical efficiency

- We are using 2 sets of orthogonal slot antenna
- Nominal 40 GHz FTS interferogram and resulting spectra are shown below.



Percentage band width about 27%

- Optical efficiency is measured to be **30-36%**
 - Lower loss of Nb microstrip line at lower frequency compensates the enlarging of the pixel size. Right plot shows the result of loss measurement. Total length of transmission line in 40 GHz is 1.8 cm





Bolometer design and noise performance

 $G_c < \frac{2h\nu Q + \frac{2Q^2}{\Delta\nu}}{2}$ Thermal conductivity has been controlled for achieving

photon noise dominated performance and avoiding saturation $G_c > \frac{(\beta + 1)2QT_c^{\beta}}{T_c^{\beta+1} - T_{bath}^{\beta+1}}$ Dark noise has been measured, see below. Individual device Dark noise has been measured, see below. Individual device is stable to very low frequency, and pair differenced gives state of art noise level Estimated NET for single bolometer is shown on right



 $4fk_BT_c^2$

6" tile uniformity We enlarged detector tile from 4" to 6" to increase fabrication through put and sensitivity area. Here we are showing the uniformity across 6" tile with several key detector parameters.



proposal sensitivity



BK14

BA 30/40

BK18 prediction (with B3)