Experience
SPT-3G

~16,000 detectors
(one of the largest mm-wave focal planes)
Preliminary Data...

SPT-3G

2018 Data
D. Dutcher et al., arXiv:2101.01684

[Images of data plots with labels and axes]
What are we doing now?

Next generation of microwave cosmology

1) Fabrication for CMB-S4
   - Joint DOE/NSF project involving majority of US CMB community
   - Two sites - Chile, SP
   - SATs + LATs
   - Total of 500k TES bolometers
     - ~ 400 wafers
     - more mm-wave detectors than have been fielded, ever

2) Next generation technology for future SPT receivers
Test Structures

Lots of them!

- Development of arrays for S4, building on foundation from 3G
- Require modifications to design and new processes
  - Increased process monitoring and QC
  - OMT antenna coupling (requires membrane release)
CMB-S4 pixel design
Path to prototype S4 wafers

- In collaboration with UChicago, working on new optimized S4 pixel designs

Improved OMT design (J. McMahon)

Standardized wafer layout

Double Tc TES
Process development
OMT-coupled bolometer arrays

- Demonstrated full fabrication process required for S4 design
- Ready to incorporate new designs and fabricate first round of prototype S4 wafers

Front side

Back side
SPT-4
Next generation SPT receiver

- Successor to SPT-3G, planned for deployment in 2024
- Take advantage of high-frequency (400GHz) capability of site and SPT
- Platform intended to serve as technology demonstration (e.g., spectroscopy)

**SPT4 focal plane**

7 tubes

- 350 GHz
- 270 GHz
- 220 GHz
- 350 GHz
- 350 GHz
- 270 GHz

These would require ~9-10" (23cm) silicon lenses (= totally doable)

~2 deg diameter FoV

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SPT Gregorian Focus
Stop
Focal Plane

Lens1
Lens2
Lens3
Vacuum Window

500 mm
SPT-4 leKID focal plane

The case for KID arrays

- Optimal pixel spacing for maximum approx. 1.3FL
- \( L = 0.85 \text{ mm} \rightarrow \sim 2.2 \text{ mm dia. pixel} \)

\sim 3500 \text{ pol. detectors/ 6” wafer}

- SPT-4 7 wafers \rightarrow 24.5k \text{ detectors}
  - TES readout currently limited to \(< \sim 2000 \text{ det/wafer (# bond pads)}\)

MKIDs offer an elegant solution to large-format arrays

Blast-TNG (NIST)

11 cm

250 \mu m Array
1836 Detectors

350 \mu m Array
938 Detectors

500 \mu m Array
544 Detectors
SPT-4 (imager)

First generation detector arrays

- SPT-4 3-colour imager (225/280/345 GHz)
- Science case - *stay for Adam’s talk!*
- First devices fabricated, now being testing
- Moving forward to wafer-scale arrays
SPT-4 (spectroscopy)
Second generation detector arrays

- Extension of on-chip filtering toward superconducting filter-bank circuits
- Each ‘pixel’ now becomes a medium resolution spectrometer
- Science case: *stay for Kirit’s talk!*

![Diagram](image_url)
SPT-SLIM
Pathfinder integral field spectrograph

- Science - line intensity mapping at mm-wavelengths
- SPT - Summer Line Intensity Mapper
- Pathfinder for future mm-wave LIM experiments
- Deployment set for next year
  - stay tuned!