Outline: Detector and Readout

Specifications

Timeline for developing technology options

Cost

Downselects

For polarimeters, cryogenic mux, and readout electronics

- Homogenous downselect?
- Different choices by frequency?
- Different by site?
- Different by aperture?

Detector technology options

- Beam forming
- On-chip signal processing (filters, polarization, etc.)
- Multichroic filters
- Sensors: TES, MKID, (HEMT?)
- Readout. Mature: TDM, FDM. High MUX factor: microwave SQUID, MKID
- How important is integration of mux elements on the chip?
- Room-temperature electronics

Specifications

What are the detector specifications required for CMB-S4?

Answers will be driven by science, foregrounds, observing strategies and telescope design – beyond scope of this session.

Address a few broad questions:

- How much do detector specs differ for different telescope platforms (aperture, optical configuration)?
- Are small apertures well matched to mono-chromatic pixel architectures and all reflective optics well matched to wider bandwidth pixel architectures?
- Is there a compelling science case for pixels with more than 2 frequencies?
- What do we need to specify bandwidth, beam symmetry, etc.?

Timeline

CMB-S4 timeline is subject to evolution

Kathy Turner has announced a “small funding wedge” in 2018. The DOE is engaging.

It seems likely that significant funding won’t happen before 2020 from the DOE.

It makes sense to develop technology options *at least* until major project funds turn on

- Reduces overall CMB-S4 cost
- Reduces CMB-S4 complexity
- Increases capabilities

What is the appropriate timescale for the development of technology options?

Cost

For detectors, cryogenic multiplexers, readout electronics, cost is a driver for CMB-S4. What are our cost targets for *production* of detector parts?

- O($100 / pixel) is too much
- O($10 / pixel) is good
- O($1 / pixel) is way past the point of diminishing returns to CMB-S4

Mass testing/characterization of detectors is also a critical cost driver.

What is the appropriate balance of investment early on to reduce production costs, system complexity, and test/characterization cost?

Downselects

For both detectors and MUX:

Does CMB-S4 use the same sensors, band-definition filters, beam-forming elements, cryogenic multiplexers, and readout electronics on all arrays?

- Political driver from DOE culture: downselect to one technology option.
- Political driver from an energetic and diverse community: use many technology options.
- Can we find the right balance of
  1. Science
  2. Risk
  3. Cost
  4. Politics

Different choices by frequency?

Different by site?

Different by aperture?