CMB Probe Mission Study

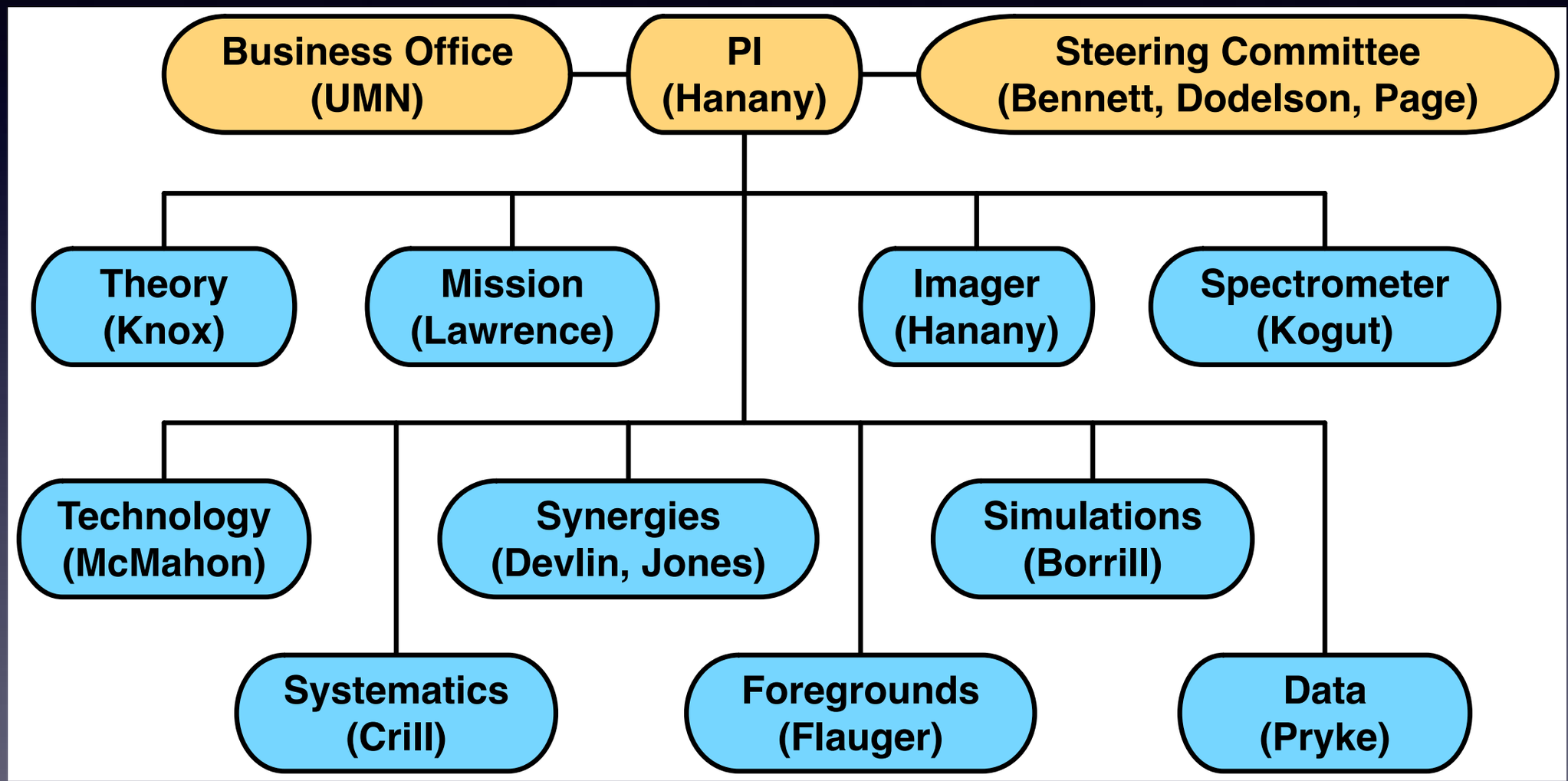
April 5, 2017

Why are we here?

- To study a Probe-Scale ($400M - $1000M) CMB space mission.
  - One of 8(+2) selections / 27 submissions
- Deliverable: a report to NASA in the fall of 2018.
  - Format: TBD
  - Report will be submitted to the 2020 decadal panel

Who are we?

US CMB Community as represented by



85 collaborators at proposal submission, including internationals. Study is open.

Management + Resources

- Interface with NASA HQ (POC): Keith Warfield (JPL)
- Mission Study Support: TeamX (JPL)
- Study Manager: Amy Transgrud

- TeamX is funded directly by NASA
  - Nominally two weeks; details to be negotiated with the team
- Additional JPL discretionary funds (~1 FTE)
- UMN $150k (workshop, travel to JPL, some summer salary)

Report + Mission Costing Process

- TeamX will produce a cost estimate for the mission
- The cost estimate is part of our report
- NASA will solicit an independent cost assessment (ICA)
  - Science Office of Mission Assessment (Langley, https://soma.larc.nasa.gov/)
- The ICA will also be forwarded to the decadal panel

Last Decade

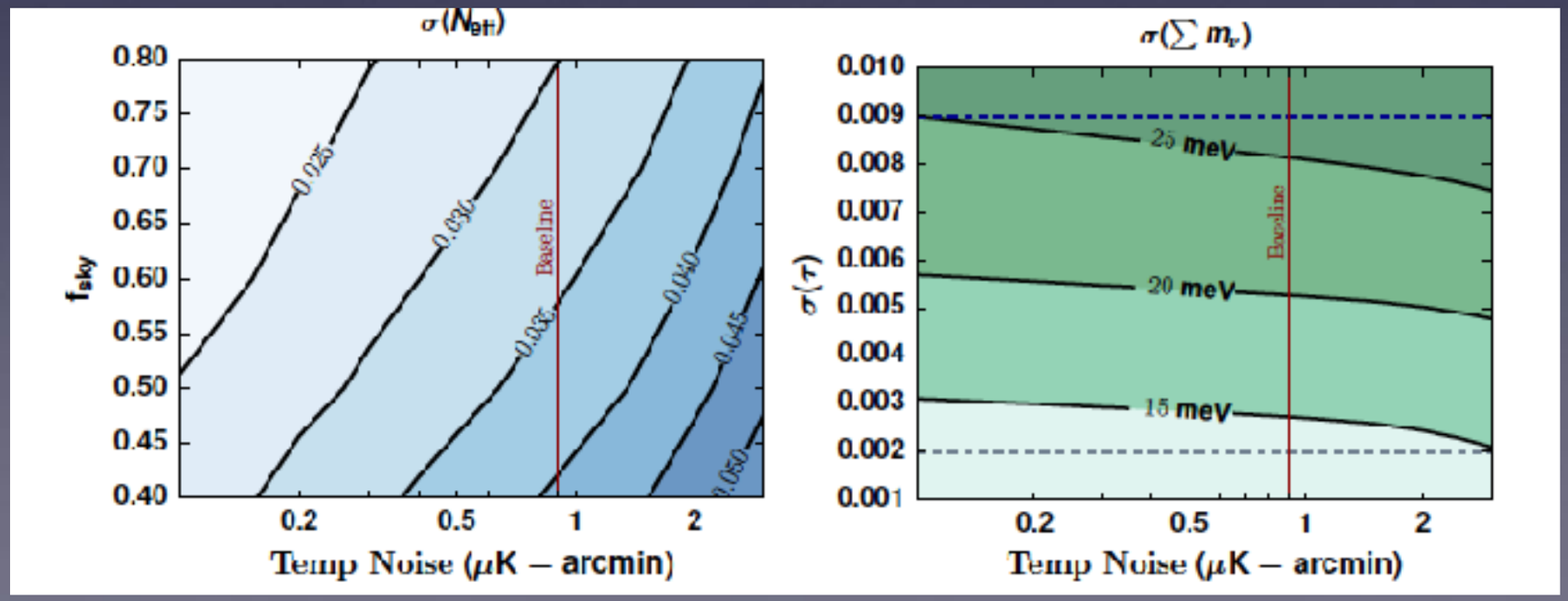
- NASA studies produced white papers that were submitted by the teams directly to the decadal panel
- One CMB ‘plan for the decade’ white paper (20 pages)
    - “A Program of Technology Development and of Sub-Orbital Observations of the Cosmic Microwave Background Polarization Leading to and Including a Satellite Mission”
- Several other theory + technology white papers
- 4 community workshops (theory, systematics, technology, experiments)

Lessons from Last Decade

- The decadal panel recommended most of what we suggested
    - Sustain funding, including NASA, which only funds activities that may lead to a space mission
    - Prioritize (although not as high as other projects)
    - Increase funding if a mission is forthcoming the following decade
    - Did not recommend a ‘mission project office’
- It is to our advantage to form a coherent story and recommend a clear, consistent program

Mission Consensus Statements (?)

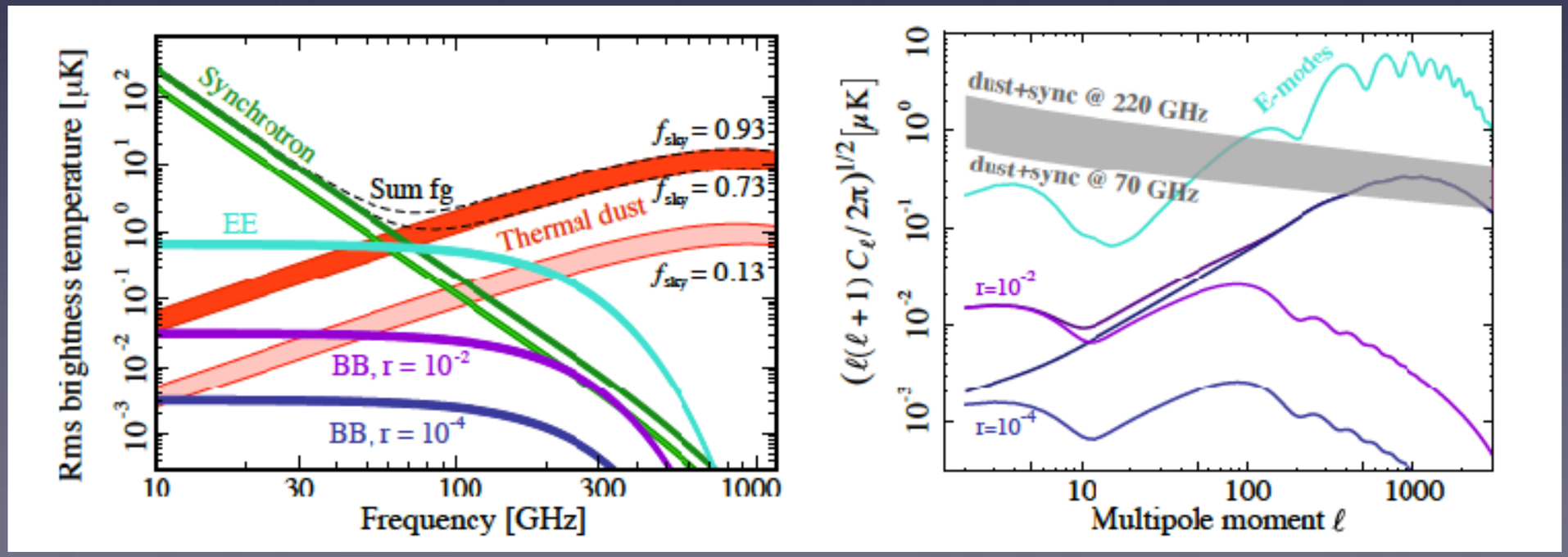
- A CMB space mission will survey the entire sky
  - r, tau, N_eff, (neutrino mass with tau and BAO)
  - Work: set science requirements, measurement requirements, instrument parameters



Probe Proposal

Mission Consensus Statements (?)

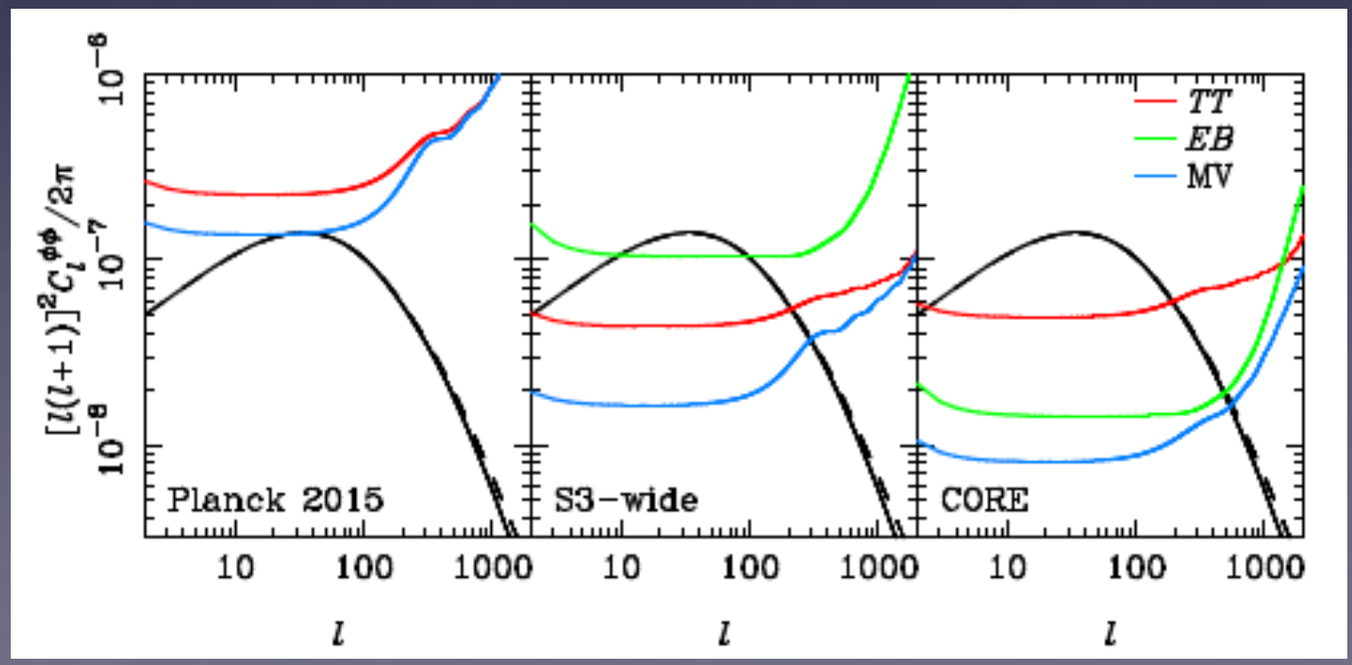
- A CMB space mission will implement a broad range of frequencies
- Work: decide on frequency bands and optimize band allocation



Probe Proposal

Mission: To Sort Out

- Imager: Resolution (EPIC-LC (30cm), LiteBIRD (50 cm) / EPIC-IM (140 cm))
    - CIB, Lensing, Galactic Magnetic field science
    - Complementarity with sub-orbital, S3/S4
    - Level of self-delensing
- Cost constraints

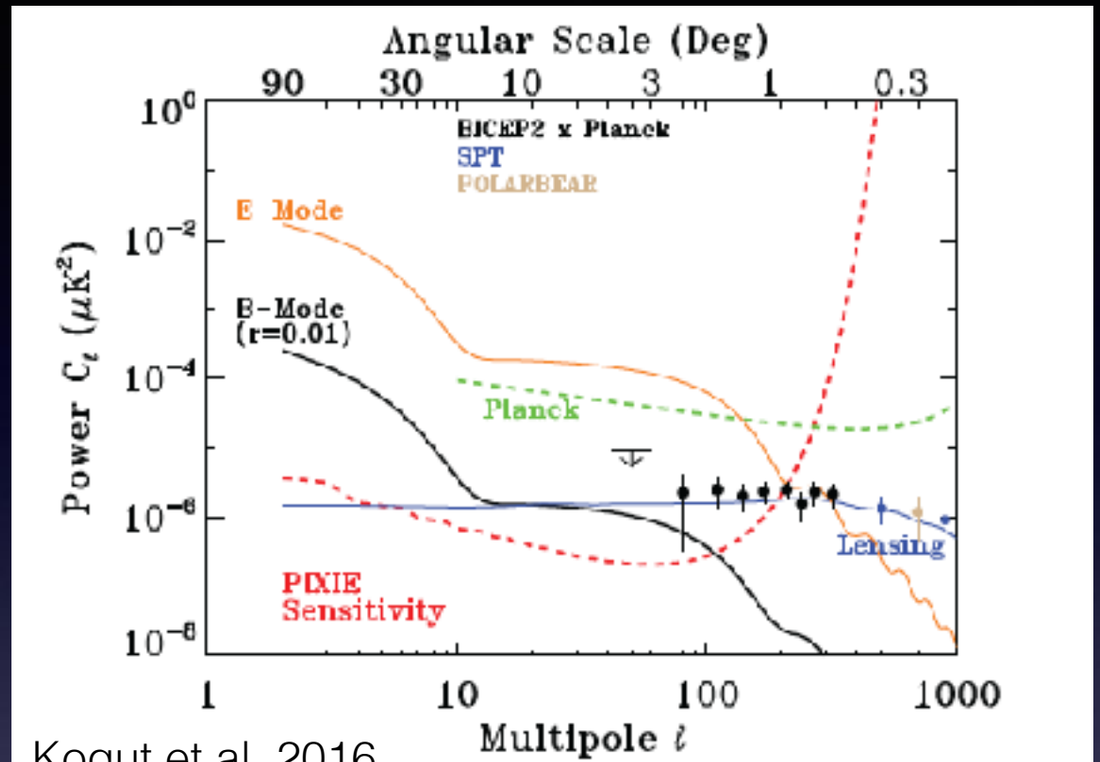


Reconstruction noise of lensing deflection power spectrum

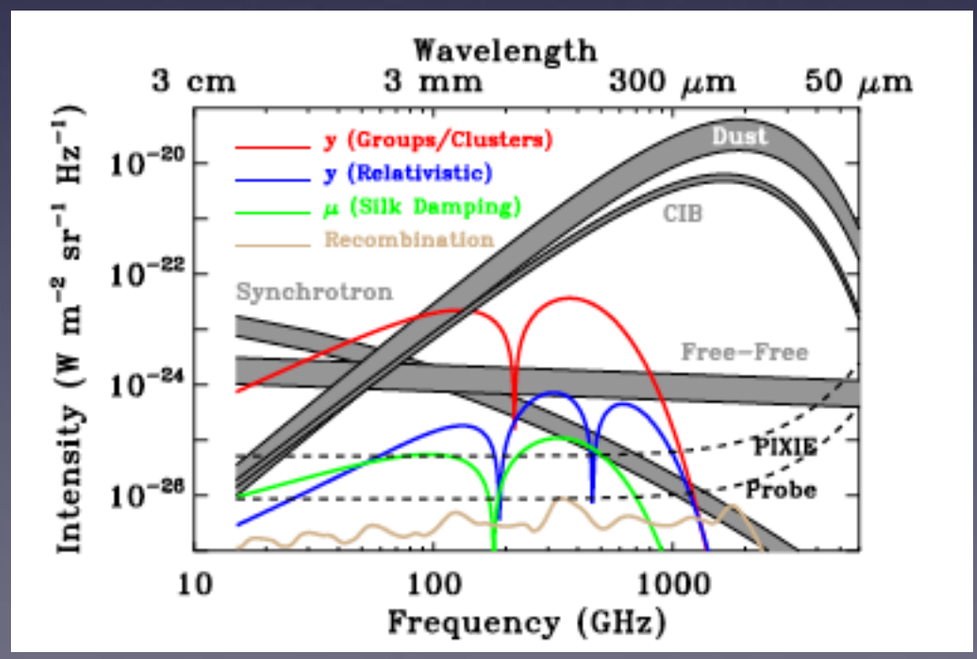
Core Proposal
Left: Planck
Middle: S3
Right: CORE
(2 uK*arcmin; 1.2 m)

Mission: To Sort Out

- Spectrometer (e.g. PIXIE) / Imager
  - Super Pixie alone?
    - What is the science gain relative to PIXIE250 (r<0.0004 2 sigma)
    - Complementarity with sub-orbital, S3/S4
    - Level of self-delensing
  - PIXIE+Imager
    - Cost vs. Science benefit



Kogut et al. 2016



Probe Proposal

Overall Plan: To Sort Out

- Do we push for a space mission, or wait for hints from sub-orbitals
- How important is it to continue the support for balloon measurements?
- What is NASA's role in technology development in the 2020s?
- Does it have any role in S4 if it is fully funded?

Other Topics

- ‘Complementarity’ workshop

- International contributions

- KISS Workshop

Additional Slides

Science Requirements

Space/Sub-Orbital Complementarity

Instrument Design