IPSAG Update – April 2013

Shaul Hanany

"All the News That's Fit to Print"

The New York Times

National Edition

Southern California: Sunny to partly cloudy. Locally breezy to windy. Snow showers in northeast Nevada. Highs in the 20s northeast, 80s south. Weather map, Page B10.

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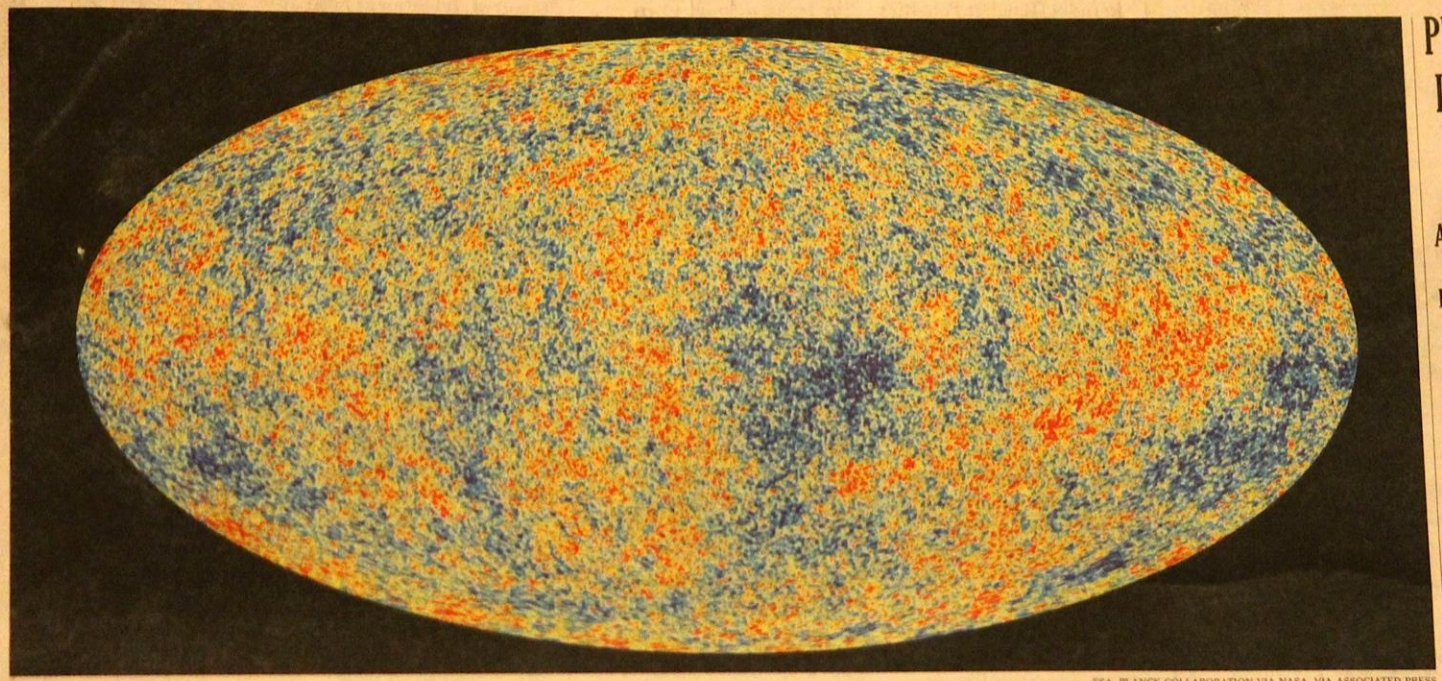


ESA, PLANCK COLLABORATION VIA NASA, VIA ASSOCIATED PRESS

The Cosmos, Back in the Day

An image from data recorded by a European Space Agency satellite shows a heat map of the universe as it appeared 370,000 years after the Big Bang. Page A10.

PRESIDENT URGES ISRAELIS TO PUSH EFFORT FOR PEACE

APPEAL AIMED AT YOUNG

In Jerusalem, He Eases Stance on Settlement Halt Before Talks

By MARK LANDLER

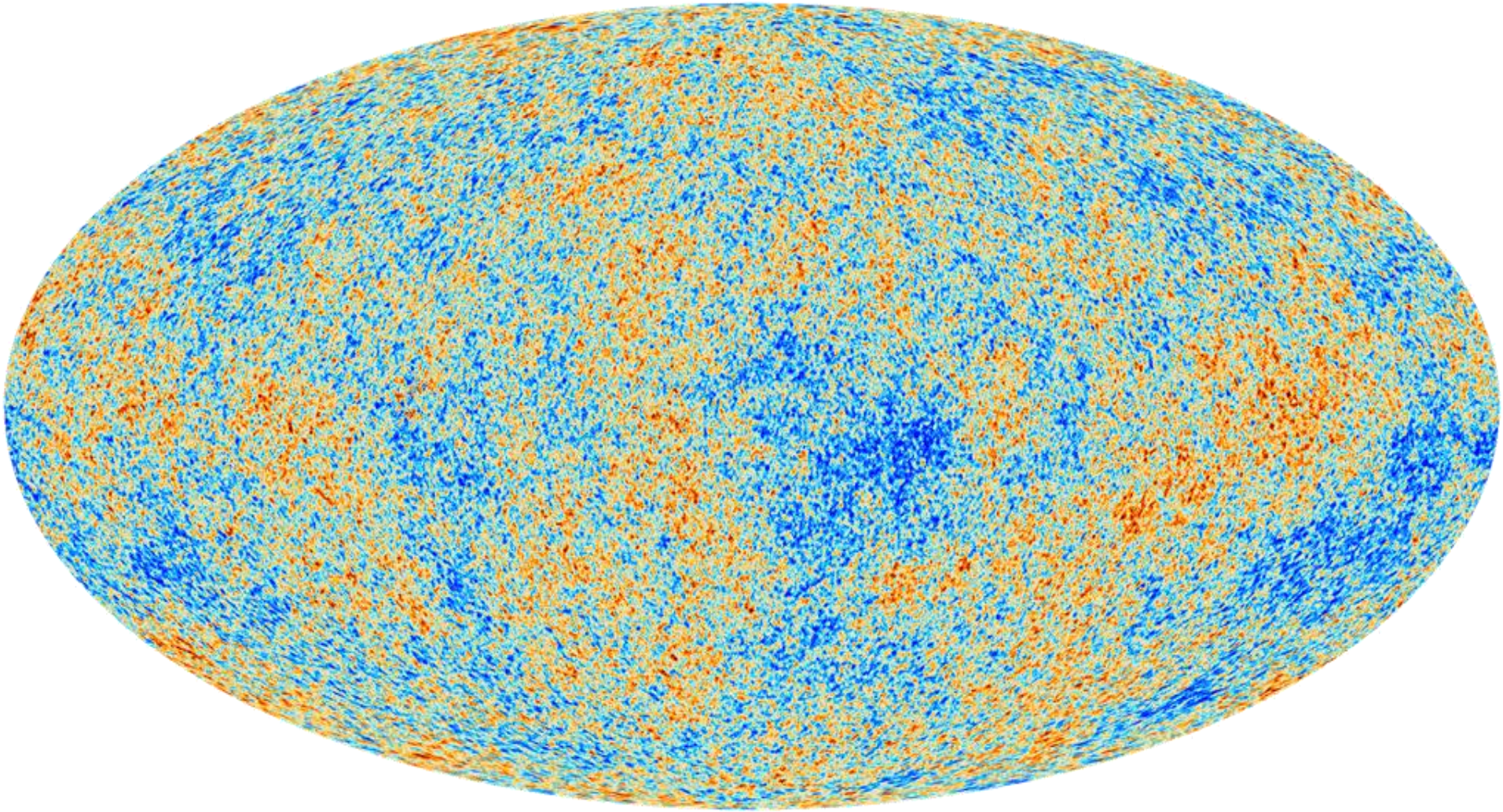
JERUSALEM — President Obama, appealing to very disparate audiences to solve one of the world's thorniest problems, moved closer on Thursday to the Israeli government's position on resuming long-stalled peace talks with the Palestinians, even as he passionately implored young Israelis to get ahead of their own leaders in the push for peace.

Addressing an enthusiastic crowd of more than 2,000, Mr. Obama offered a fervent, unsparing case for why a peace agreement was both morally just and in Israel's self-interest. Younger Israelis, Mr. Obama said, should empathize with their Palestinian neighbors living under occupation — or, as he put it, "look at the

As Pollution Worsens in China,

Once Few, Women Hold More Power in Senate

Exciting Planck Results Available
(Joint ESA/NASA mission)

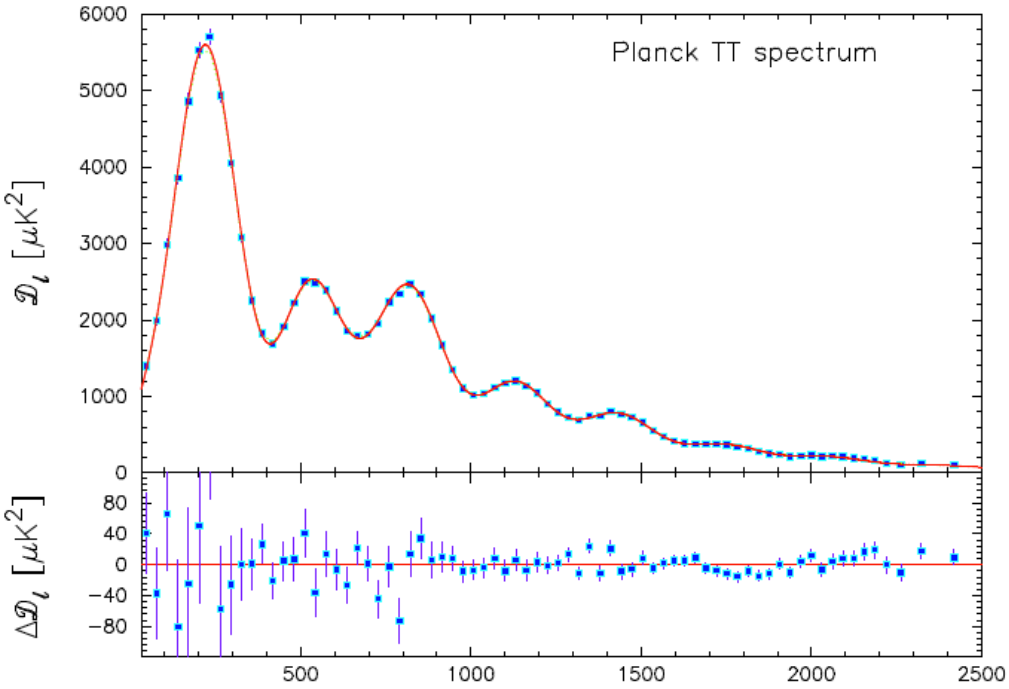


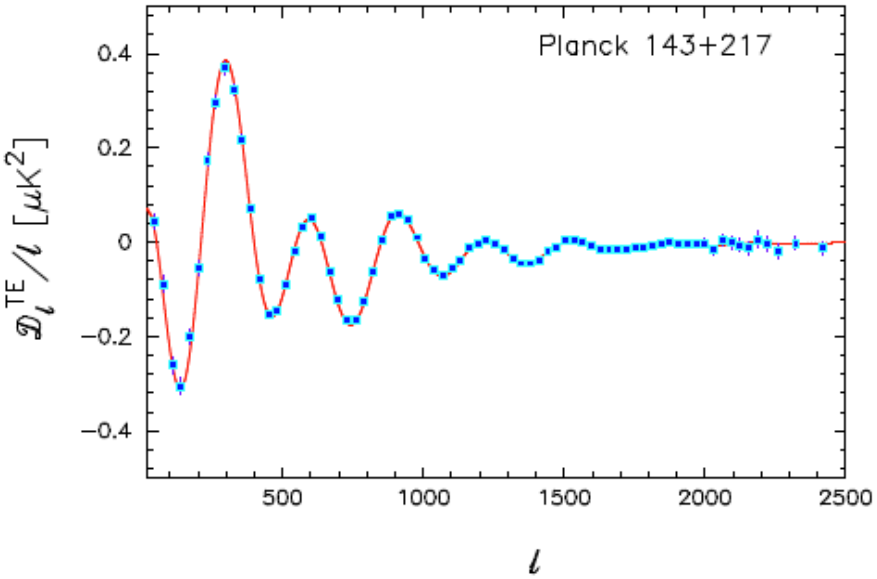
Polarization data release scheduled for 2014

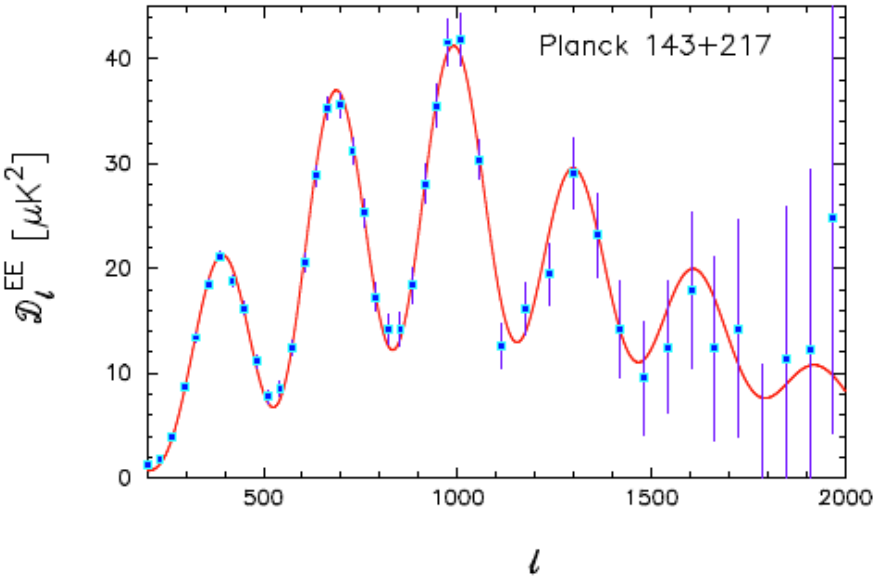
ΛCDM is Alive and Well

- Limits on inflationary potentials
- 3 neutrino families
- Fluctuations are *not* scale invariant
- Strong limits on non-Gaussianity

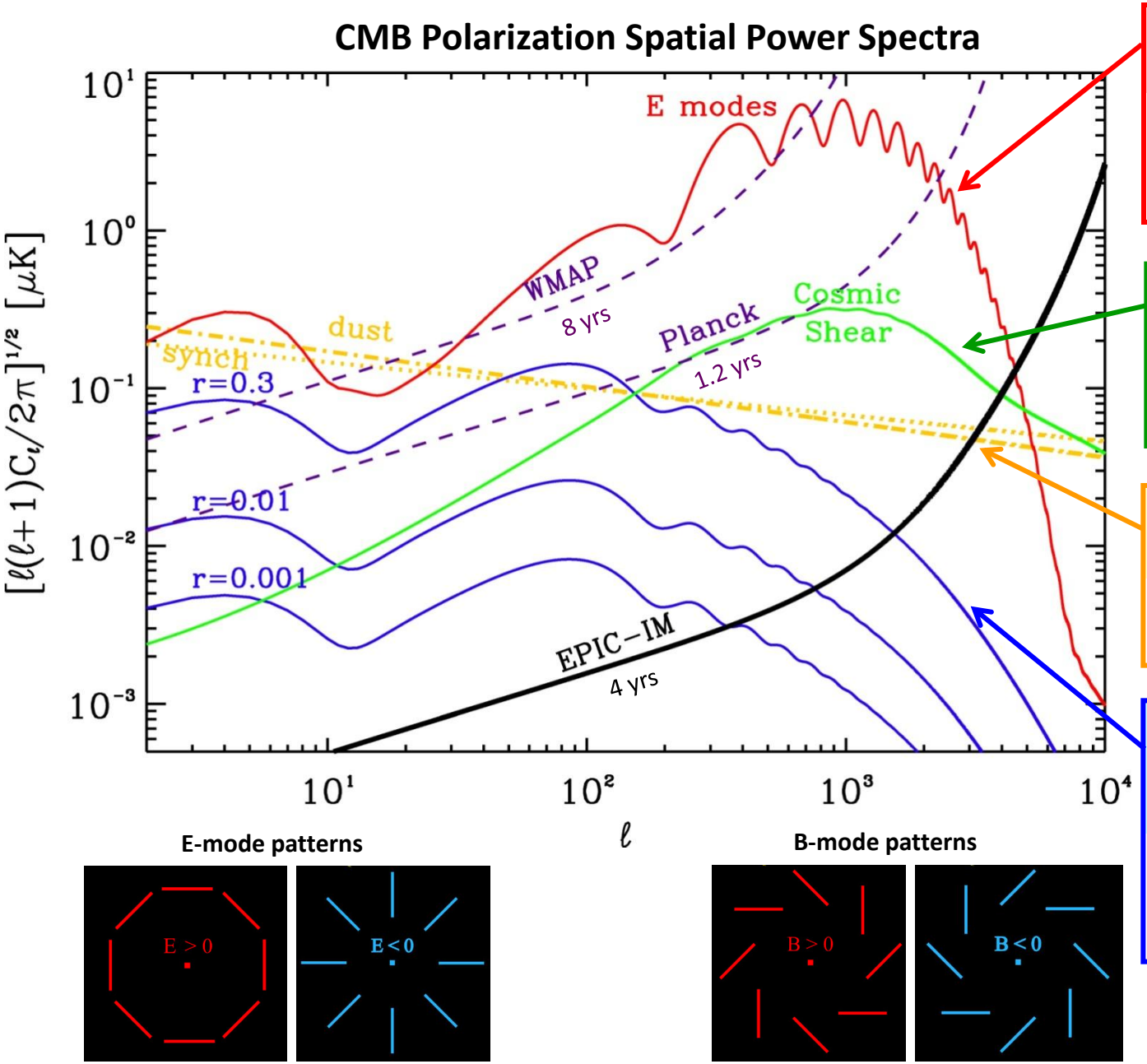
- ~1000 pages of papers covering
  - SZ clusters
  - CIB
  - Strings + other defects
  - Lensing
  - …..







Focus for Next Few Years: Polarization



Scalar Perturbations
E-modes

- Precision cosmology
- Departure from scale inv.
- Reionization history

Gravitational Lensing
B-Modes

- Neutrino mass hierarchy
- Dark energy at z > 2

Galactic Magnetic Fields
E & B-Modes

- Star formation
- Large-scale fields

Inflationary Gravitational Waves
B-modes

- GUT energy scale
- Large field inflation
- n_t / r consistency test

New Worlds, New Horizons

in Astronomy and Astrophysics

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

TABLE ES.4 Space: Recommended Activities—Medium-Scale (Priority Order)

Recommendation	Science	Appraisal of Costs[a]	Cross-Reference in Chapter 7
1. New Worlds Technology Development Program	Preparation for a planet-imaging mission beyond 2020, including precursor science activities	$100M to $200M	Page 215
2. Inflation Probe Technology Development Program	Cosmic microwave background (CMB)/ inflation technology development and preparation for a possible mission beyond 2020	$60M to $200M	Page 217

"A successful detection of B-modes from inflation could trigger a mid-decade shift in focus toward preparing to map them over the entire sky. In this case a notional decadal budget of $60 million is proposed. However, the level of late-decade investment required is uncertain, and the appropriate level should be studied by a decadal survey independent advice committee review. It could range between the notional budget used here up to a significant (perhaps on the order of $200 million) mission-specific technology program starting mid-decade."

Sub-Orbital and Ground-Based Experiments

	Experiment	Technology	Resolution (arcmin)	Frequency (GHz)	Detector Pairs	Modulator
US-led Balloon	COFE	HEMT/MMIC	83/55/42	10/15/20	3/6/10	wire grid
	EBEX	TES	8	150/250/410	398/199/141	HWP
	PIPER	TES	21/15/12/7	200/270/350/600	2560	VPM
	SPIDER	TES	60/40/30	90/150/280	288/512/512	HWP
US-led Ground	ABS	TES	30	150	200	HWP
	ACTpol	TES	2.2/1.4	90/145	1500	-
	BICEP2	TES	40	150	256	-
	BICEP3	TES	22	95	1280	-
	C-BASS	HEMT	44	5	1	ϕ-switch
	CLASS	TES	80/34/22	40/90/150	36/300/60	VPM
	Keck	TES	60/40/30	96/150/220	288/512/512	HWP
	POLARBEAR	TES	7/3.5/2.4	90/150/220	637	HWP
	QUIET	HEMT/MMIC	42/18	44/90	19/100	ϕ-switch
	SPTpol	TES	1.5/1.2	90/150	768	-
Int'l Ground	AMiBA	HEMT	2	94	20	Int.
	QUBIC	TES	60	90/150	256/512	Int.
	QUIJOTE	HEMT	54-24	10-30	38	-

- **Push to higher sensitivity than Planck: new detector array technologies**
- **Focused on B-mode science: target small, deep fields**
- **Explore the diversity of technology approaches**
- **Test new methodologies for systematic error control**
- **Rapid progress in sensitivity and systematic error control**

PhysPAG Meeting, August 2012

- Currently: four funded balloon-missions and a host of ground-based experiments.

- Results (B-modes, foregrounds, systematics) - within the next ~~few years.~~ 6-18 months

- Planck ~~will release~~ released temperature results in early 2013 and polarization results in early 2014

- *We advocate that a new IP mission concept study will begin in the 2014 time frame, sufficiently in advance to feed into the decision about the next mission*
  - *Revisit probe class design*
  - *Assess descopes to an explorer box*

PhysPAG Meeting, August 2012

- Currently: three funded balloon-missions and a host of ground-based experiments.

- Results (B-mod… …t few…

Progress is very quick
Motivation for a space probe can shift rapidly
Let's make sure we are ready

- Plan… …release temperature results in early 2013 and polarization results in early 2014

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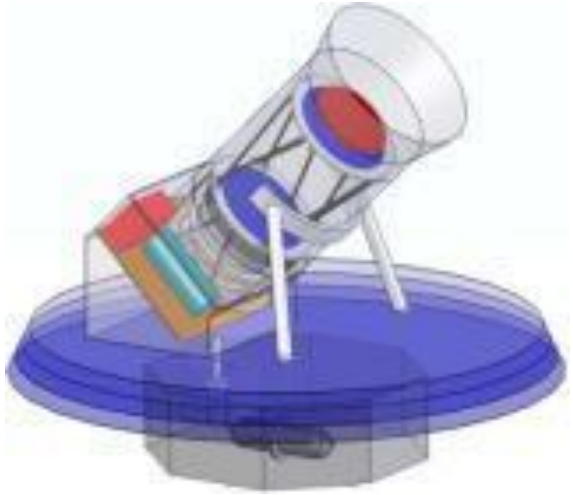
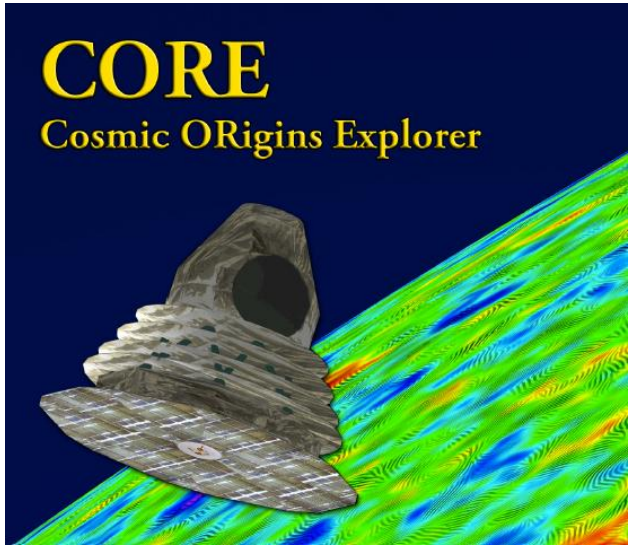
The International Scene

- LiteBIRD: a Japanese mission - preliminary design stage



- CORE: European mission submitted for M-class in 2011; planning to propose again in 2014.

- Interest in US participation expressed by both



NASA's Astrophysics Implementation Plan

- Mission study to begin 2015 – too late for mid-decade review
  - As a consequence – lower priority for technology development funding
- Not consistent with NWNH intentions
- Is there a drawback for being ready with a plan should the science landscape make a mission compelling?
- A study could also look at
  - Contributions to other international missions
  - Possible deliverables with descopes = cheaper mission

January 2012 AAS PhysPAG Meeting

- Discussion of PhysPAG statement to the APS
- A modified (shorter, simpler) statement:

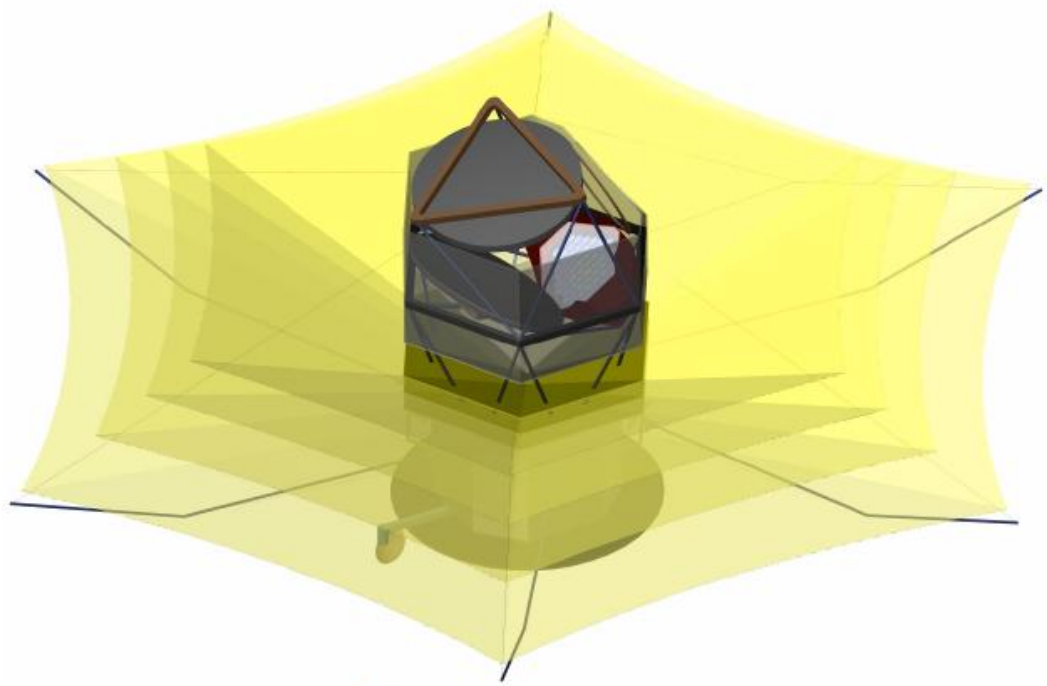
"Funding for the Inflation Probe has been given lower priority, but we encourage NASA to look for the most cost-effective ways to advance the project. Completing an Inflation Probe mission study in time for the mid-decade review, while continuing to support X-ray and GW studies, will inform NASA about options for probe-class and international implementations for a comparatively modest investment. "

Main Change: Dropped sentence about funding

"Mid-TRL technology funding is time-critical to assure scientific readiness of sub-orbital and ground-based CMB polarization measurements for the mid-decade assessment of the Inflation Probe program."

30-Year Roadmap Activity

The Inflation Probe should be an integral part of NASA's vision



Deployed Configuration

Launch Configuration
Atlas V 401

BackUp Slides

January 2012 AAS PhysPAG Meeting

- Discussion of PhysPAG statement to the APS

Funding for the Inflation Probe has been given lower priority, but we encourage NASA to look for the most cost-effective ways to advance the project. Mid-TRL technology funding is time-critical to assure scientific readiness of sub-orbital and ground-based CMB polarization measurements for the mid-decade assessment of the Inflation Probe program. Starting Inflation Probe mission study activities at the earliest opportunity, while continuing to support X-ray and GW studies, will inform NASA about options for probe-class and international implementations for a comparatively modest investment.

IP Community Plan for the Decade