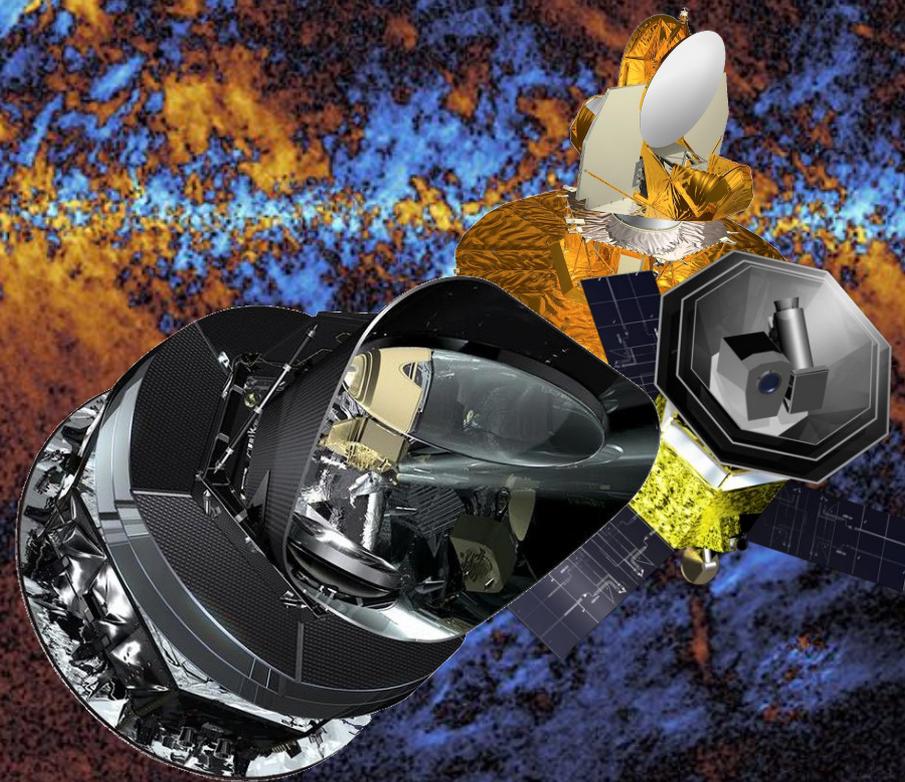


# Summary and Reflections

*Bruce Partridge*



***BeyondPlanck online release conference, November 18-20, 2020***

## Reflections

Charles Lawrence reviewed second half of CMB history, 1992 to now; let me look at pre-history (pre-*Planck* history) of anisotropies

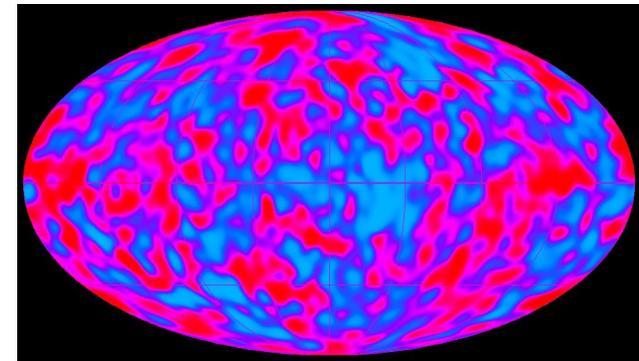
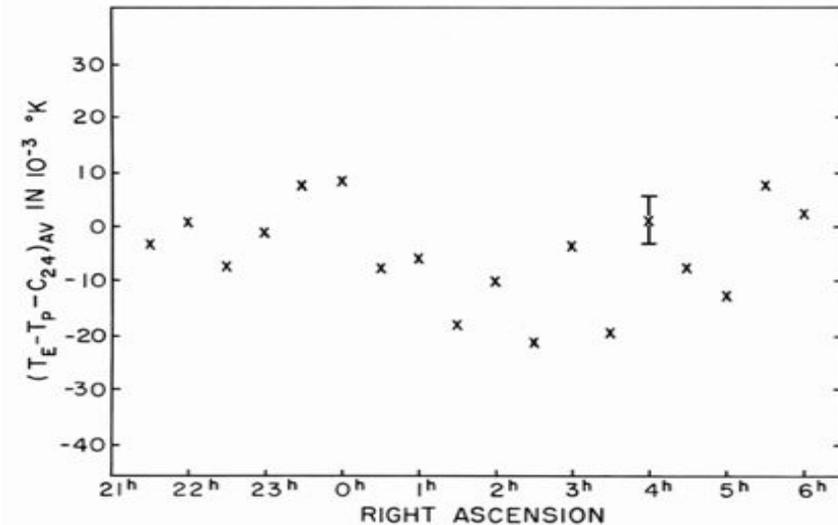
1965 -- 1985

- upper limits only (and 1D); few mK
- a test of the cosmic origin of the CMB
- finding the **dipole**

1990 COBE

- “wrong” angular scale
- but **primordial anisotropy detected**;  $\sim 0.1$  mK
- crucial guidance from theory enters

On to WMAP and *Planck*





And now in 2020...

There is life beyond *Planck*

- reanalysis of *Planck* (and WMAP?) data
- extracting new physics from current data products
- future experiments

An inescapable feature of all present and future CMB experiments:

- intertwined systematics and foreground signals



## Challenges

10-100 nanoK CMB science requires:

- $10^4$  to  $10^5$  detectors for sensitivity
  - implying large data volumes
- intertwined systematics and foreground signals
  - requiring careful design to minimize systematics, better (preflight) characterization of the instrument, tests for remaining systematics and better foreground (and noise) models
- better foreground measurements (multi-frequency)
  - again, large data volumes
- faithful and complete accounting of errors
  
- better understanding of foregrounds especially at low frequencies (synchrotron, free-free and AME all interact)



## Challenges

BeyondPlanck designed to help with many of these:

10-100 nanoK CMB science requires:

- $10^4$  to  $10^5$  detectors for sensitivity
  - implying **large data volumes**
- **intertwined systematics and foreground signals**
  - requiring careful design to minimize systematics, better (preflight) characterization of the instrument, **tests for remaining systematics** and better foreground (and noise) models
- multi-frequency foreground measurements
- **faithful and complete accounting of errors**

## What is next for BeyondPlanck?

Cosmoglobe -- but also

- urgent need for “Friends of BeyondPlanck” to streamline, improve and augment BeyondPlanck pipeline
- and extend to ground-based experiments
- and improve and augment sky models
- what can the BeyondPlanck Team do to attract this help?
- recruit a BeyondPlanck member to your team

BeyondPlanck (and NPIPE) show what a dedicated cadre of young scientists can do in a short time

- in BeyondPlanck and other CMB projects, young colleagues play a central role (including extracting new physics)
- future employers, take note!



# The BeyondPlanck collaboration

## EU-funded institutions



Kristian Joten Andersen  
 Ragnhild Aurlien  
 Ranajoy Banerji  
 Maksym Brilenkov  
 Hans Kristian Eriksen  
 Johannes Røsok Eskilt  
 Marie Kristine Foss  
 Unni Fuskeland  
 Eirik Gjerløw  
 Mathew Galloway  
 Daniel Herman  
 Ata Karakci  
 Håvard Tveit Ihle  
 Metin San  
 Trygve Leithe Svalheim  
 Harald Thommesen  
 Duncan Watts  
 Ingunn Kathrine Wehus



Sara Bertocco  
 Samuele Galeotta  
 Gianmarco Maggio  
 Michele Maris  
 Daniele Tavagnacco  
 Andrea Zacchei



HELSINGIN YLIOPISTO  
 HELSINGFORS UNIVERSITET  
 UNIVERSITY OF HELSINKI

Elina Keihänen  
 Anna-Stiina Suur-Uski



Stelios Bollanos  
 Stratos Gerakakis  
 Maria Ieronymaki  
 Ilias Ioannou



Marco Bersanelli  
 Loris Colombo  
 Cristian Franceschet  
 Davide Maino  
 Aniello Mennella  
 Simone Paradiso

## External collaborators



Brandon Hensley



Jeff Jewell



Reijo Keskitalo



Bruce Partridge



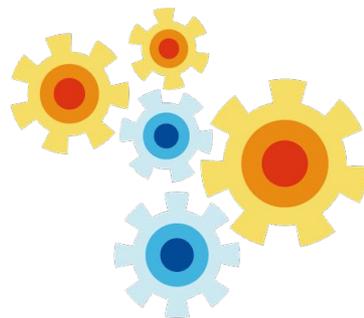
Martin Reinecke



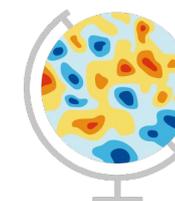
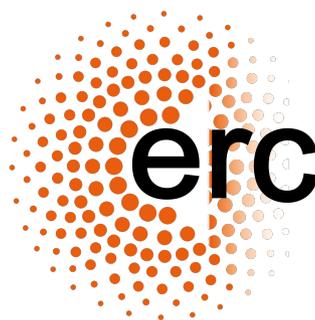
# Questions for Any Speaker?



# Beyond PLANCK



Commander



Cosmoglobe

