European Commission
Beyond PLANCK
Next generation LFI processing with BeyondPlanck
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University of Oslo
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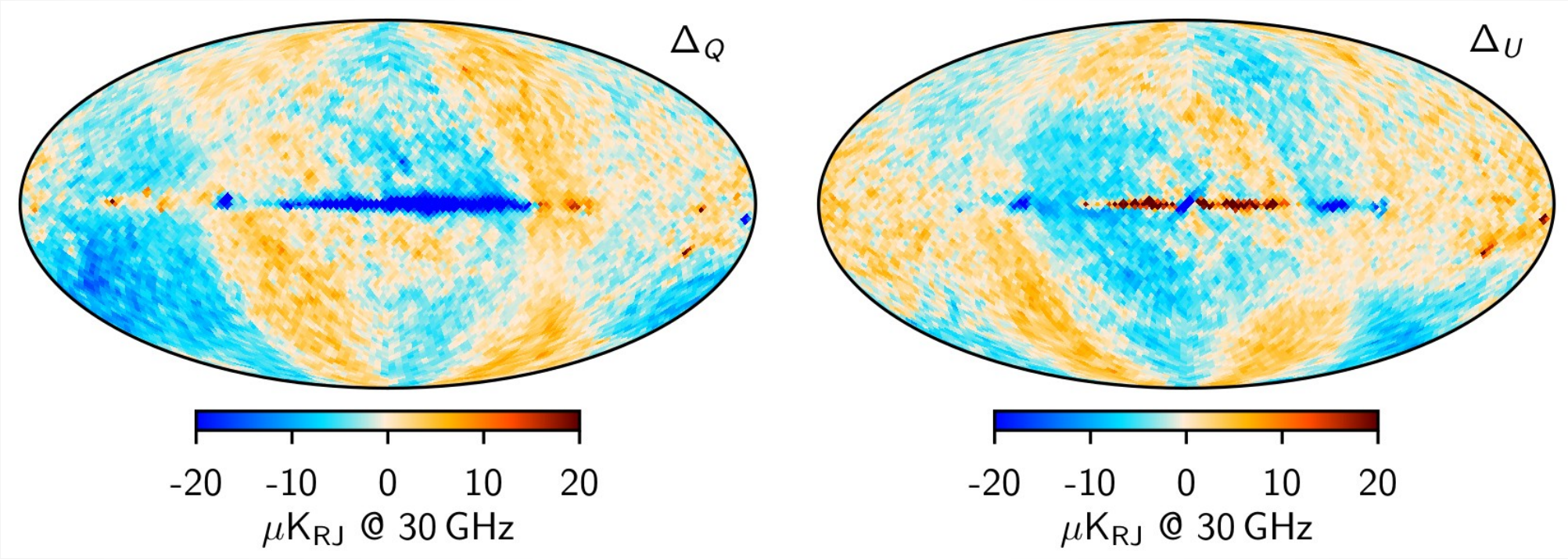
HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI
planetek hellas
Call: H2020-COMPET-2017
Topic: COMPET-4-2017
THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

Are we done yet?

Planck 2015 synchrotron – 0.39 WMAP K



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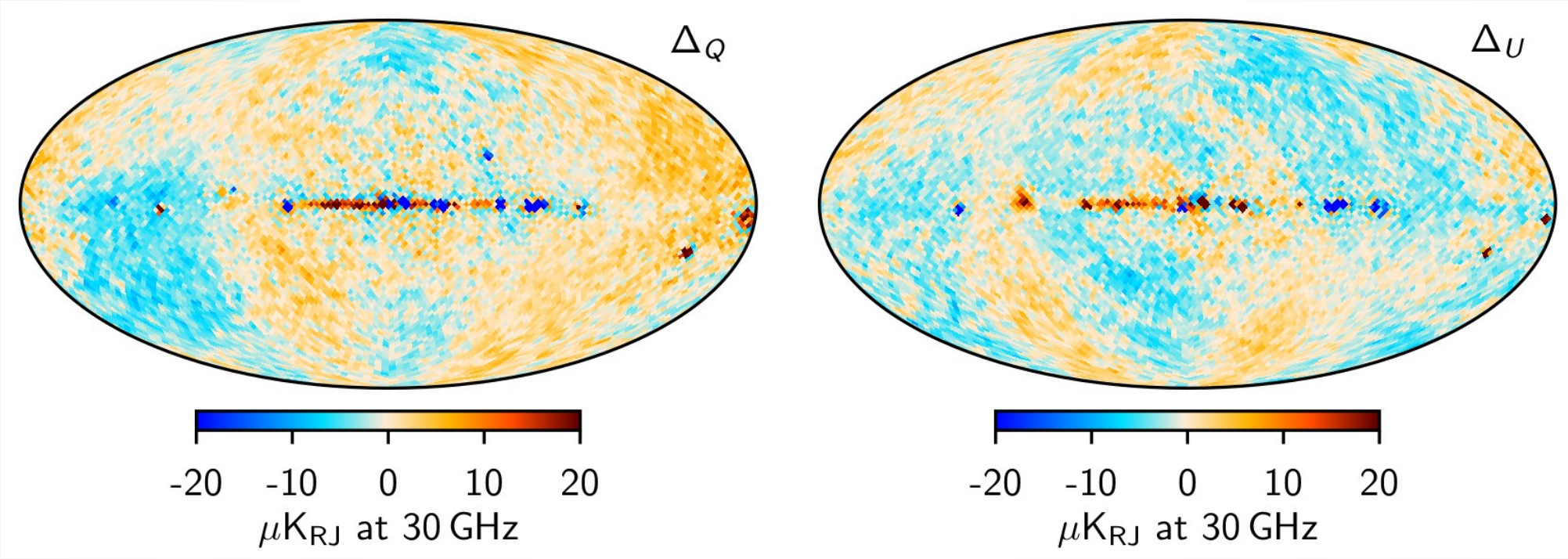
Planck 2018 synchrotron – 0.39 WMAP K



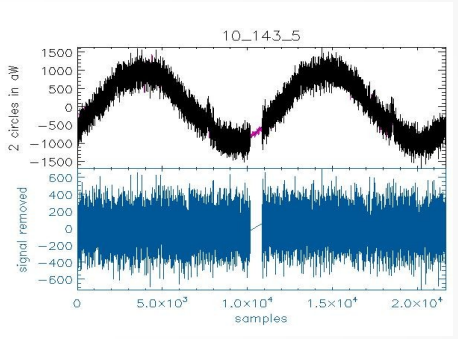
As a field, we are not really done until we understand the differences between Planck and WMAP

The BeyondPlanck project

- BeyondPlanck is an H2020 COMPET-4 project that funds two additional years of continued LFI processing, for a total budget of €1.5M
- Includes five institutions:
  - University of Oslo, Norway (coordinator)
  - INAF Trieste, Italy
  - Planetek, Greece
  - University of Helsinki, Finland
  - University of Milano, Italy
- A total of 21 people are fully or partially funded by the project, covering a total of 241 FTE months = 20 FTE years

Classic analysis pipeline

Observations



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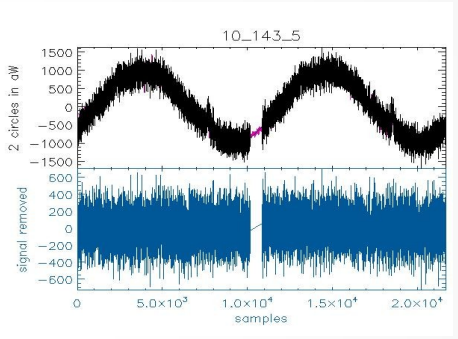

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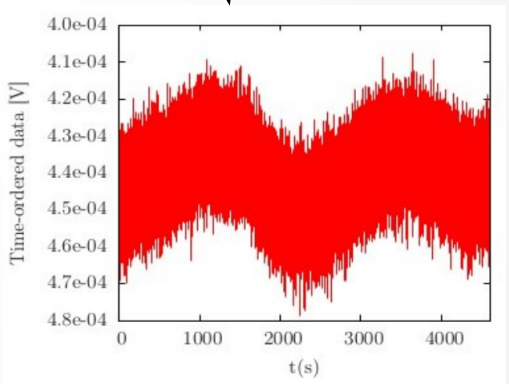

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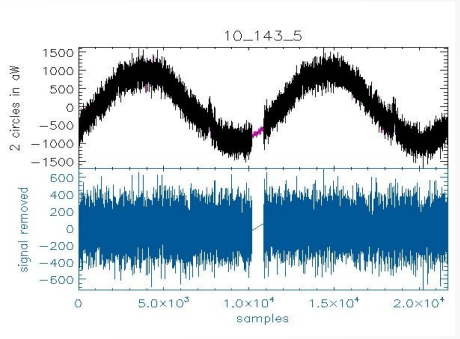

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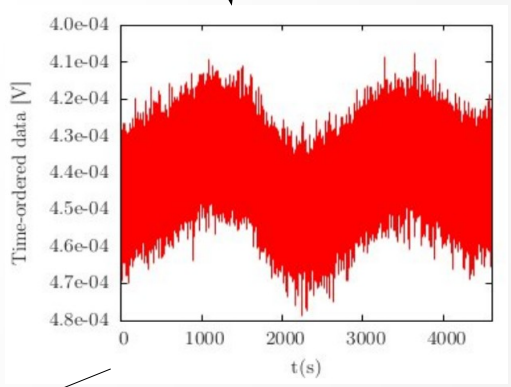
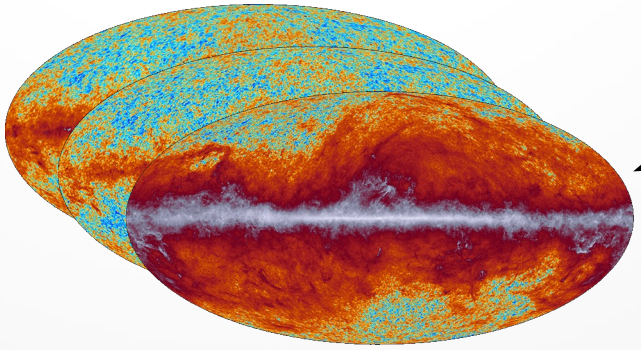


Map making



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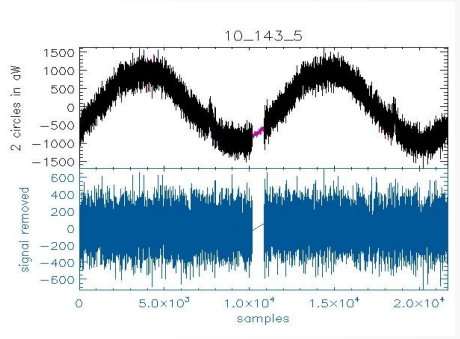

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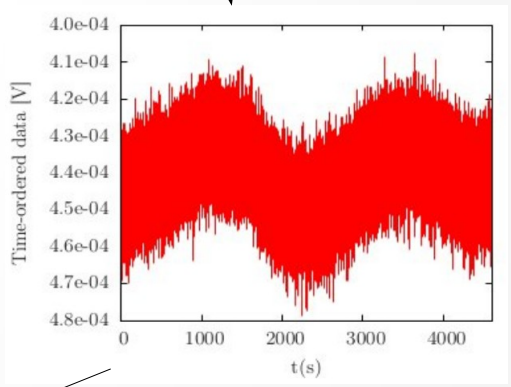

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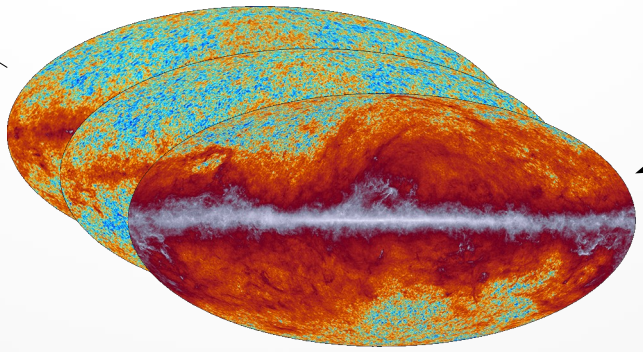
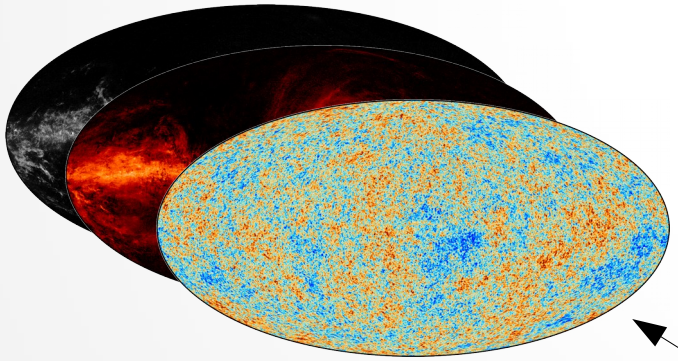


Component separation



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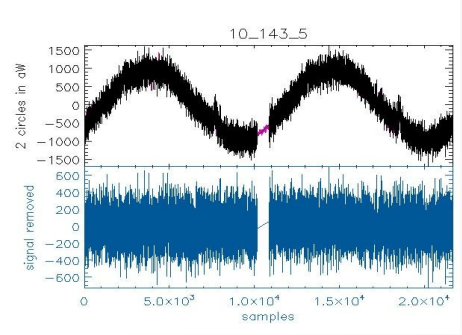

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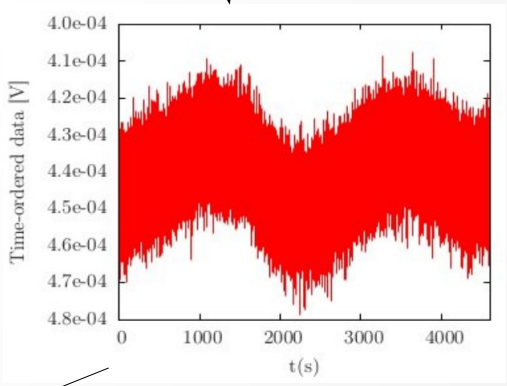

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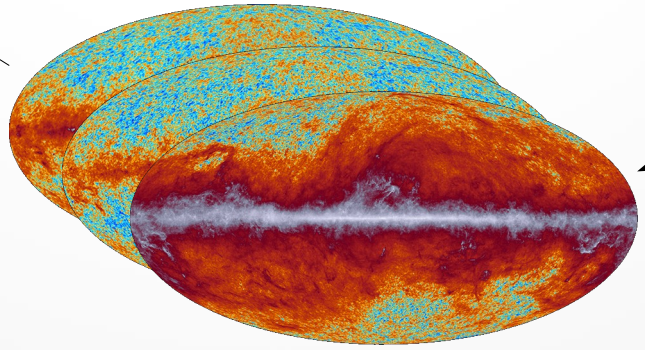

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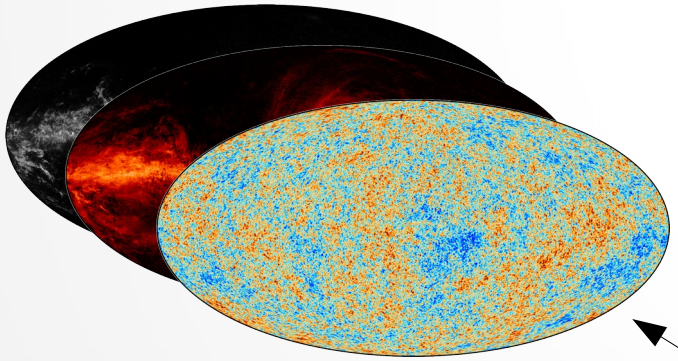
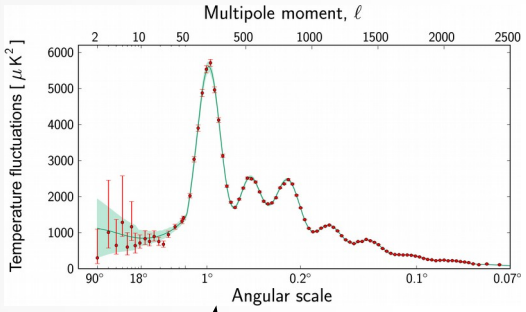


Power spectrum estimation



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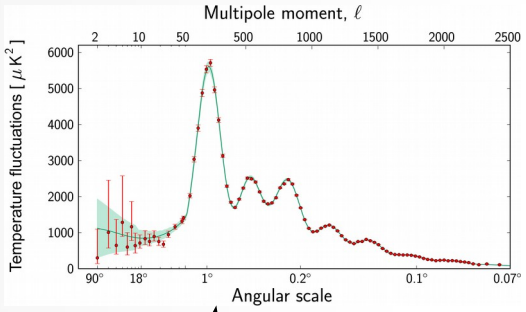

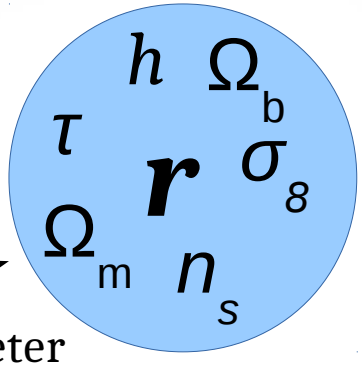

Parameter estimation

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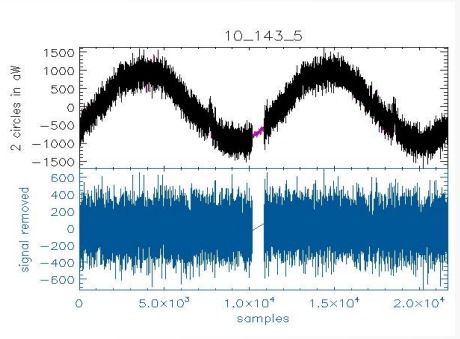

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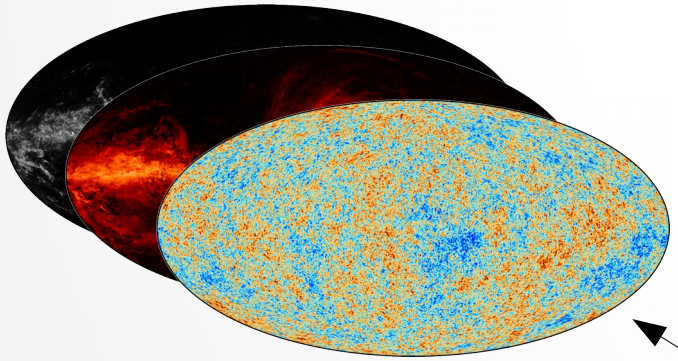

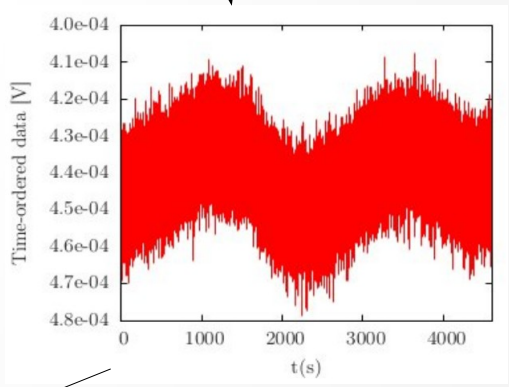

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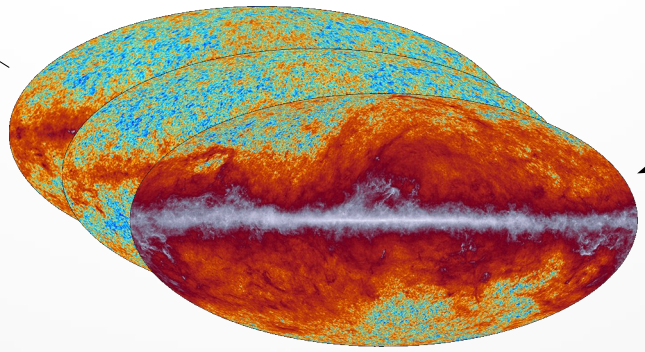

Map making

Beyond PLANCK

DX12: Closing the loop

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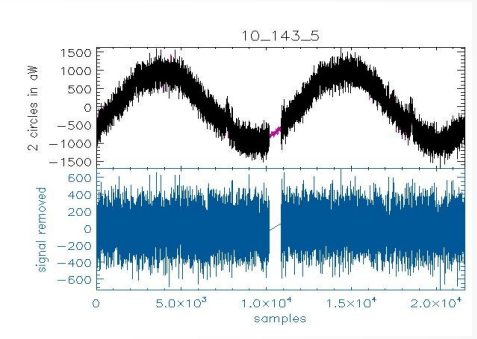

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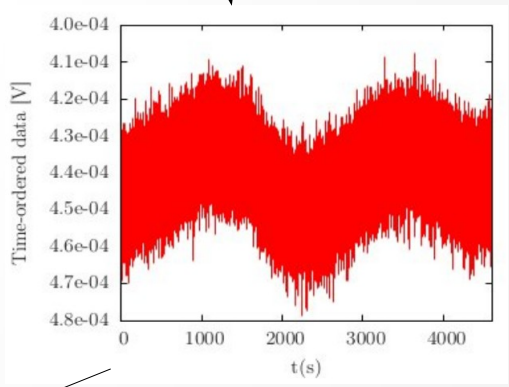

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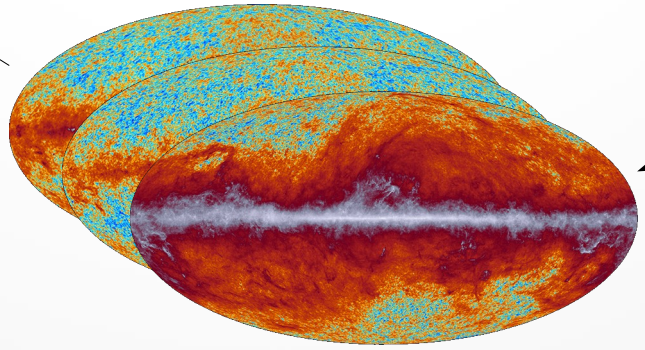

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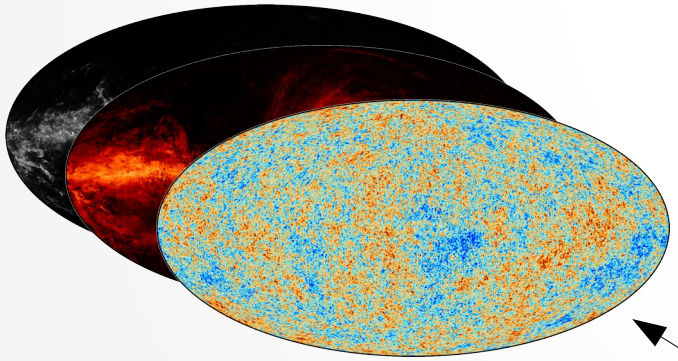

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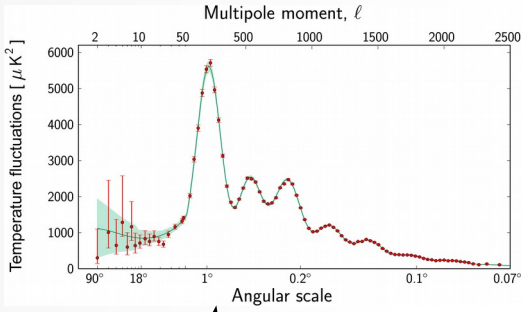

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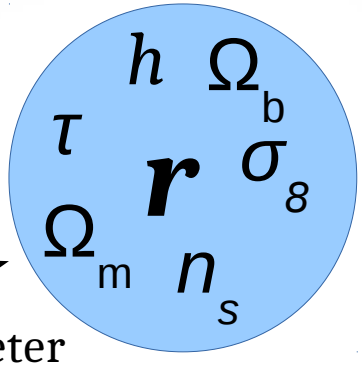

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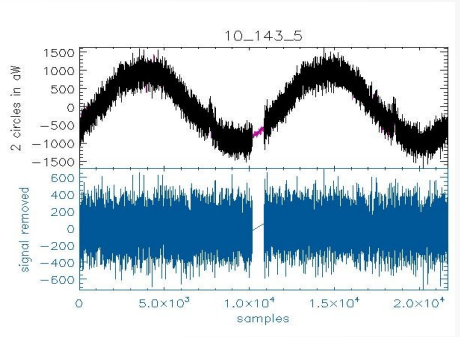

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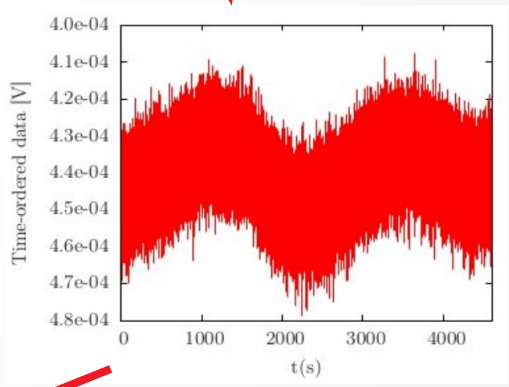

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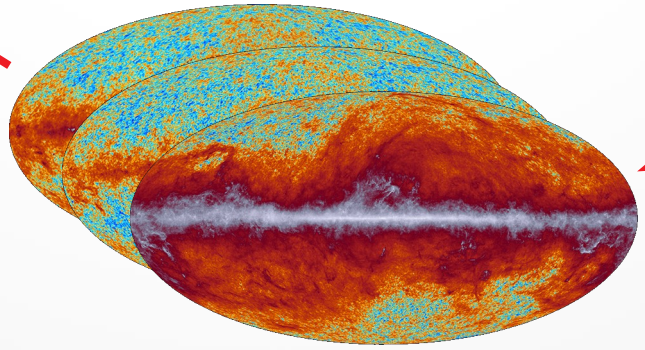

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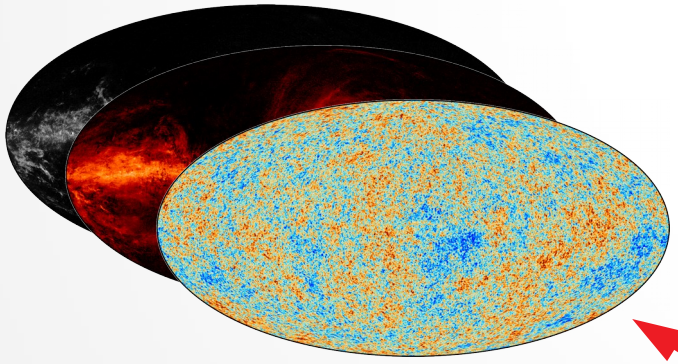

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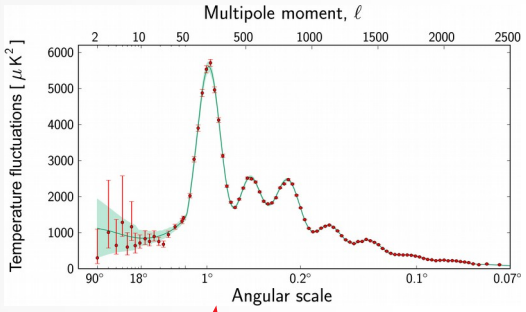

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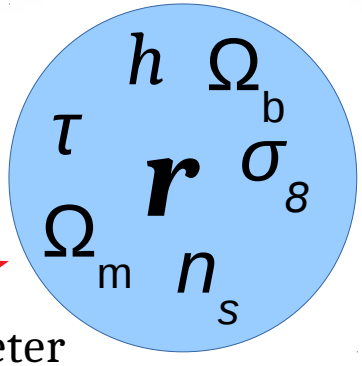
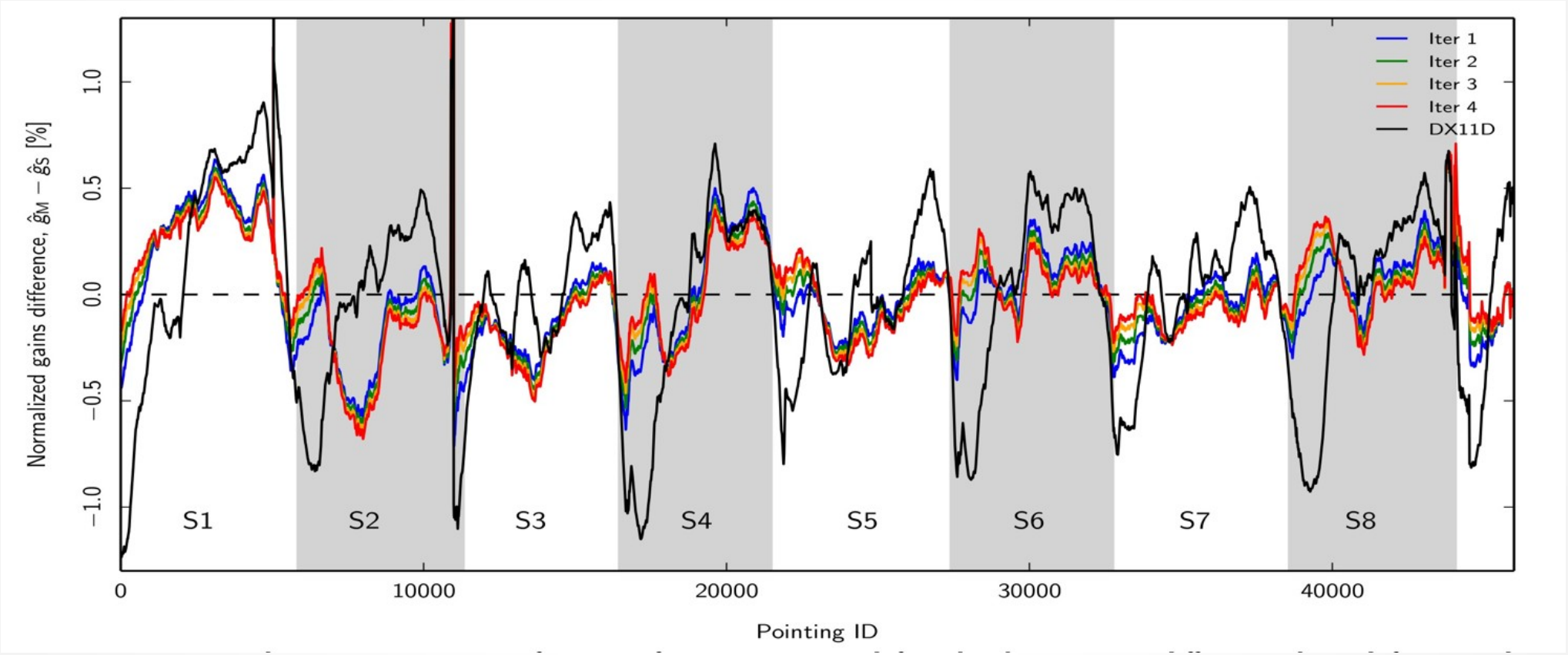


DX12 gain as a function of iteration



The LFI DX12 processing was stopped after four main iterations due to time constraints

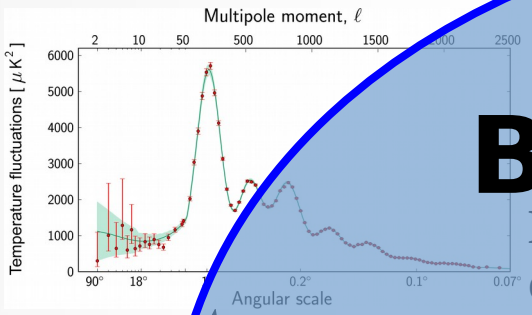
Each iteration was very slow (as in weeks), because it required manual processing and file transfer between Oslo and Trieste

Want to continue this process, and use what we've learned since 2016 to improve further

BeyondPlanck = Iterative global analysis

European Commission

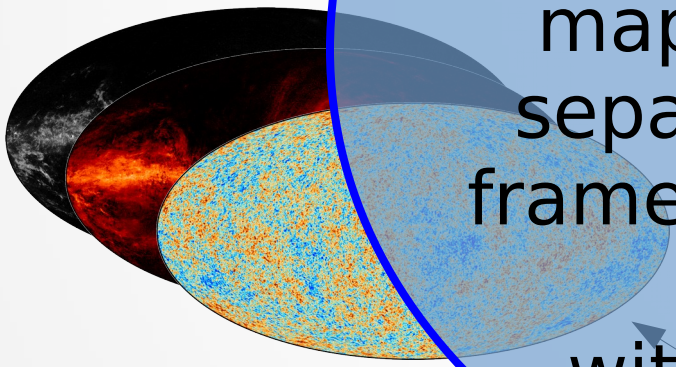
Observations

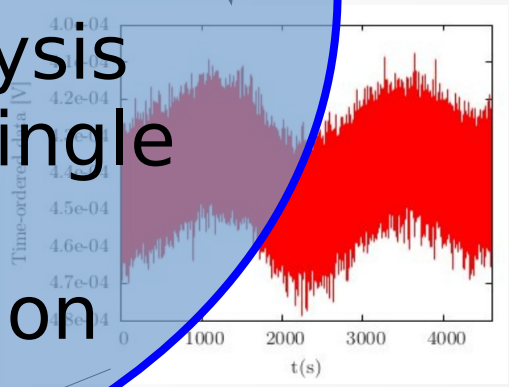


Parameter estimation

Power spectrum estimation

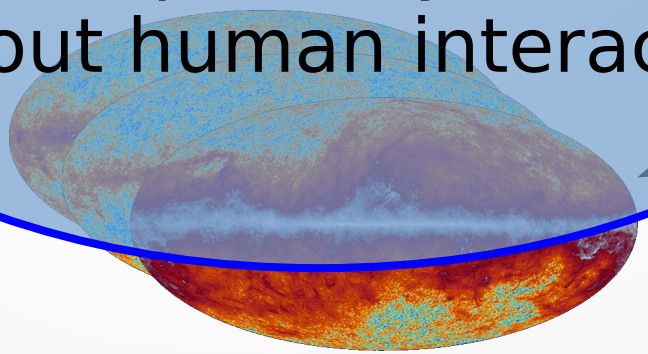
Data selection + calibration





Component separation

Map making



BeyondPlanck

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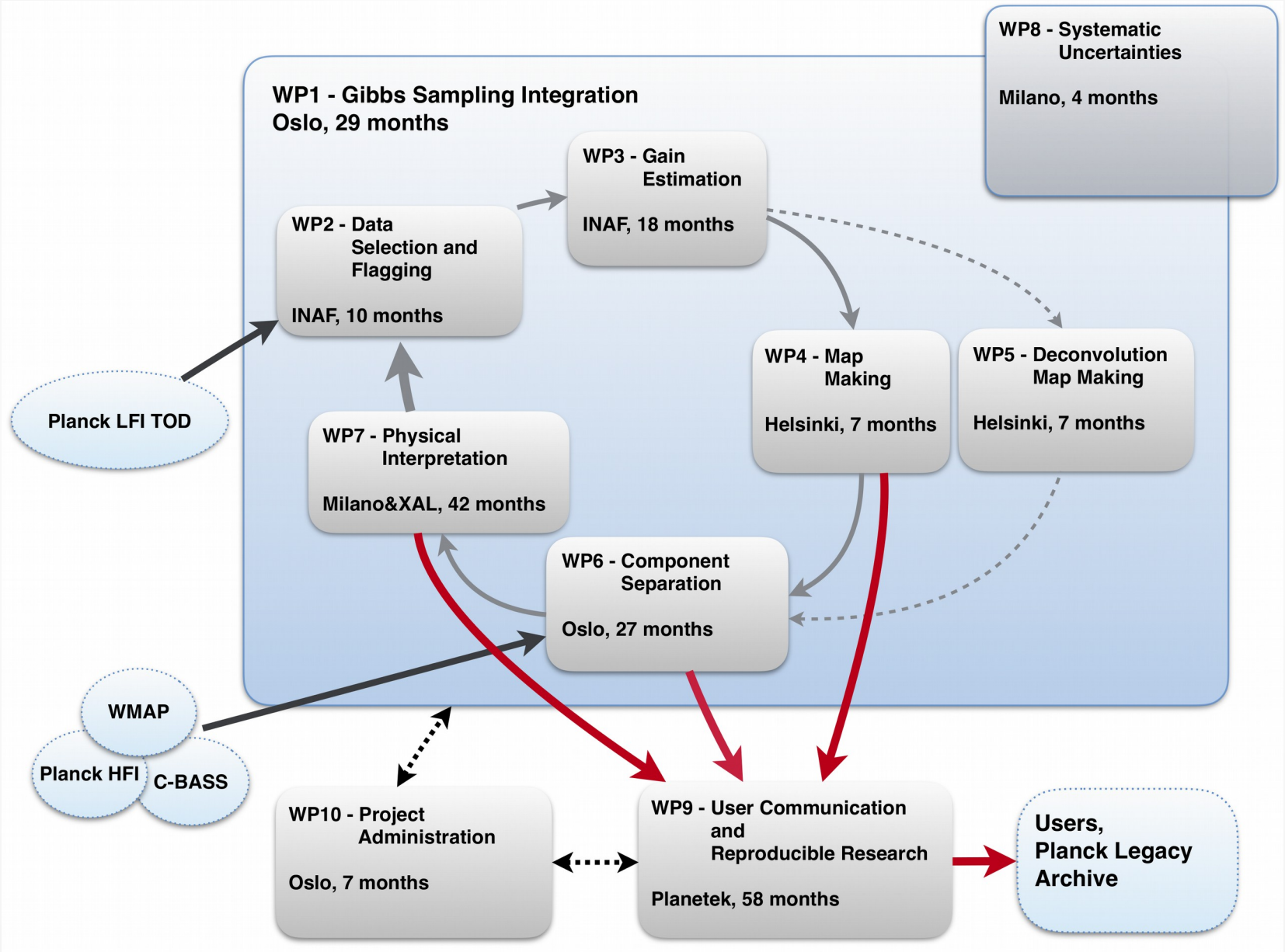
Integration of LFI calibration, mapmaking and component separation into ONE analysis framework, running on a single computer system without human interaction

Beyond PLANCK

Overview of work packages



Computer resources

- Pipeline will be run on the Owl CMB analysis cluster in Oslo
- This cluster currently consists of
  - 8 Xeon nodes, each with 24 Intel E5-2697 cores, 768 GB RAM
  - 4 Xeon nodes, each with 72 Intel E7-8870 cores, 1,5 TB RAM
  - 2 Xeon nodes, each with 64 Intel E7-4850 cores, 1,5 TB RAM
  - 5 AMD nodes, each with 64 EPYC 7551 cores, 256 GB RAM
- In total, 928 cores and 16 TB RAM
  - This is a significant upgrade from Ironthrone, which has 240 cores and a total of 1.4 TB RAM
  - Expanding by typically 2-6 new nodes per year
- Cluster is shared between the CMB/CO projects in Oslo (COMAP, LiteBIRD, PASIPHAE, SPIDER etc.), but available time is not a limitation

BeyondPlanck team

European Commission

- Kristian Joten Andersen (phd)
- Maksym Brilenkov (phd)
- Hans Kristian Eriksen
- Mathew Galloway (postdoc)
- Trygve Leithe Svalheim (phd)
- Ingunn Kathrine Wehus

- Samuele Galeotta
- Andrea Zacchei
- Gianmarco Maggio
- Michele Maris
- Daniele Tavagnacco

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HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

- Anna-Stiina Suur-Uski (postdoc)
- Elina Keihänen

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- Cristoforo Abbattista
- Stelios Bollanos
- Daniela Drimaco
- Stratos Gerakakis
- Maria Ieronymaki

NASA Jet Propulsion Laboratory
California Institute of Technology

- Jeff Jewell (external)

- Marco Bersanelli
- Loris Colombo
- Davide Maino
- Aniello Mennella
- Simone Paradiso (phd)
- Maurizio Tommasi

BERKELEY LAB
Lawrence Berkeley National Laboratory

- Reijo Keskitalo (external)

esa
European Space Agency

- Collaboration with ESA started with the scope to deliver BeyondPlanck products via the PLA

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PhD students and postdocs

Kristian Joten Andersen
PhD student, Oslo

Maksym Brilenkov
PhD student, Oslo

Mathew Galloway
Postdoc, Oslo
PhD from SPIDER, Toronto

Simone Paradiso
PhD student, Milano

Anna-Stiina Suur-Uski
Postdoc, Helsinki

Trygve Leithe Svalheim
PhD student, Oslo

Project status

- Hiring process have been completed, and all people are now available to work for the project
- All core codes (flagging, calibration, mapmaking, component separation) have been compiled and tested individually on the Oslo cluster
- An input sky model has been derived from NPIPE, and this will define the starting point of the BeyondPlanck analysis
  - See Ingunn and Reijo's talks tomorrow for details on NPIPE
- Full-scale work effort will commence after Christmas

Connection with bits2cosmology

- Bits2cosmology is a 5-year ERC Consolidator project led by HKE, running from 2018 to 2022
- Main goal is to develop a time-domain Gibbs sampler (“Commander3”), starting with raw TOD instead of maps for component separation, and apply this to LFI + WMAP + SPIDER
- Bits2cosmology is primarily algorithm-oriented, while BeyondPlanck is primarily LFI delivery oriented
  - Very strong scientific synergies
- We therefore have a basic LFI analysis effort funded for another 4-5 years from now, if necessary

Summary

- BeyondPlanck is a H2020 COMPET-4 project that funds two more years of LFI processing
  - Two-three additional years of funding are provided by bits2cosmology, an ERC CoG program in Oslo

- Main goal is to integrate the core LFI analysis pipeline into one framework, and make it run without intermediate human interaction, and in effect implement the first CMB time-domain Gibbs sampler

- This framework will allow us to finish the iterative process that was started with DX12, but never run until proper convergence