From few to kilo and more detectors - a DA perspective

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More detectors is generically good …

this is what drives the sensitivity of the current and future CMB experiments ....

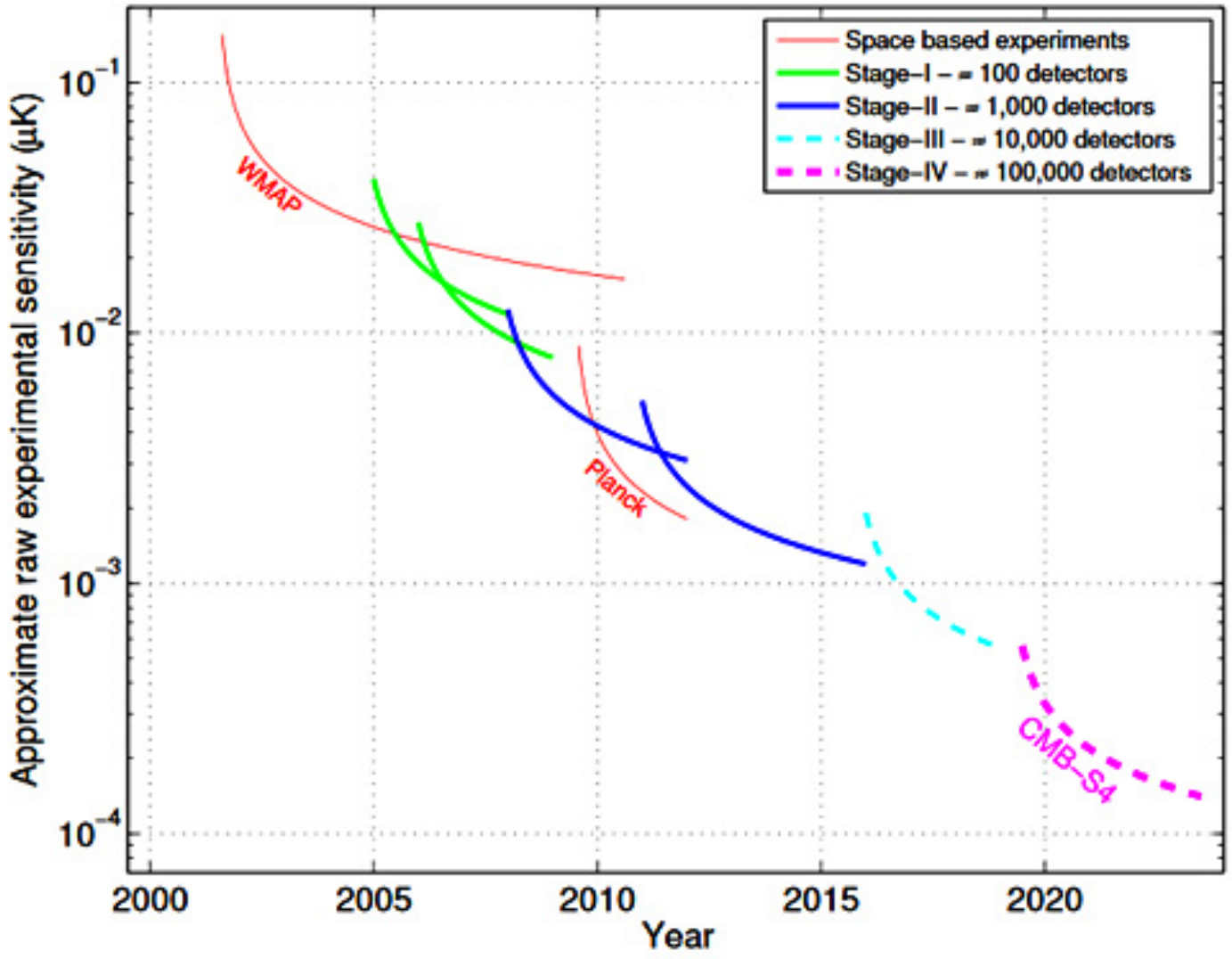
But it comes with some downsides ...

data volumes;

need for characterization of large number of detectors;

potential extra systematic effects: cross-talks, correlations, etc.

CMB from the ground



So far, so good … (1)

- Multiple demonstrations of successfully analyzed Stage-II data sets
  - featuring O(10^3) detectors and data volumes typically O(10) x Planck data set.

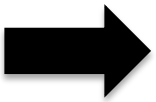
- But well this was ‘easy’ ....

So far, so good … (2)

- Some compromises have been typically made. Some necessary, some merely convenient ...

- E.g.,
  - simple filter-and-bin map-making;
  - simplified noise weights passed between stages of the pipeline, e.g., 'divide-and-conquer' map-making;
  - correction 'fudge factors' derived via MCs and applied on later stages;
  - use of cross- as opposed to auto-spectra;
  - simplified MCs, or semi-analytic arguments, to get the final uncertainty.

- More time-consuming techniques used more for cross-check than a production of actual results or applied to simplfied, e.g., underpixelized, data, only subset of null/consistency tests, etc ...



Number of the extra degrees of freedom by far dominates the number of the useful one.

So far, so good … (3)

Systematics effects safeguards/treatment:

- multi-criteria data selection in multiple domains;
- verified by null test suite plus high-level statistics;
- filtering and, occasionally, deprojection, templating…;
- use of Planck: templates, calibrators, etc
- new techniques for cross-talks, atmosphere correction, etc
- ab initio simulations of anticipated effects;
- use of composite and detector-specific characteristics;
- a global angle calibration derived/verified by EB = 0.

Stage-II DA upshot

Overall:

- Very pragmatic, but probably got most of the science out of the existing data sets.
- Hinged on assumptions.
- Relied on huge redundancy, quality of the instruments, sheer power of the data ?!
- Successful …

Beyond Stage-II (1)

- Can (should?!) the Stage-II DA experience be replicated ?
- Some but …
  1. Volume:
     - Stage-III data = O(10) x Stage II;
     - Stage-IV data = O(50) x Stage III;
  2. Complexity:
     - multi-frequency/foreground cleaning.
  3. Precision.

Beyond Stage-II (2)

- Efficient I/O layer:
  software: staging, caching, overlapping,
  hardware: non-volatile memories.
- New algorithms: from TOD up to maps.
  - Supercomputers … new programming models ...
- Advanced instrument/data models.
- Calibration strategies – in the lab and the field;
- Hardware solutions;
- Efficient, flexible, comprehensive simulations (“on-the-fly”) of statistical and systematic effects at the scale;
- Adaptable foregrounds simulations;

Instead of conclusions

- Data analysis as an open-ended process …
- Blindness ...
- Should be cautiously optimistic about the future … but more work is needed ....
  - And, yes, it is great to have Stage-III before Stage-IV !
- Simple, pragmatic approaches – a great starting point; second pass – certainly helpful and informative.