# EBEX : the E and B EXperiment

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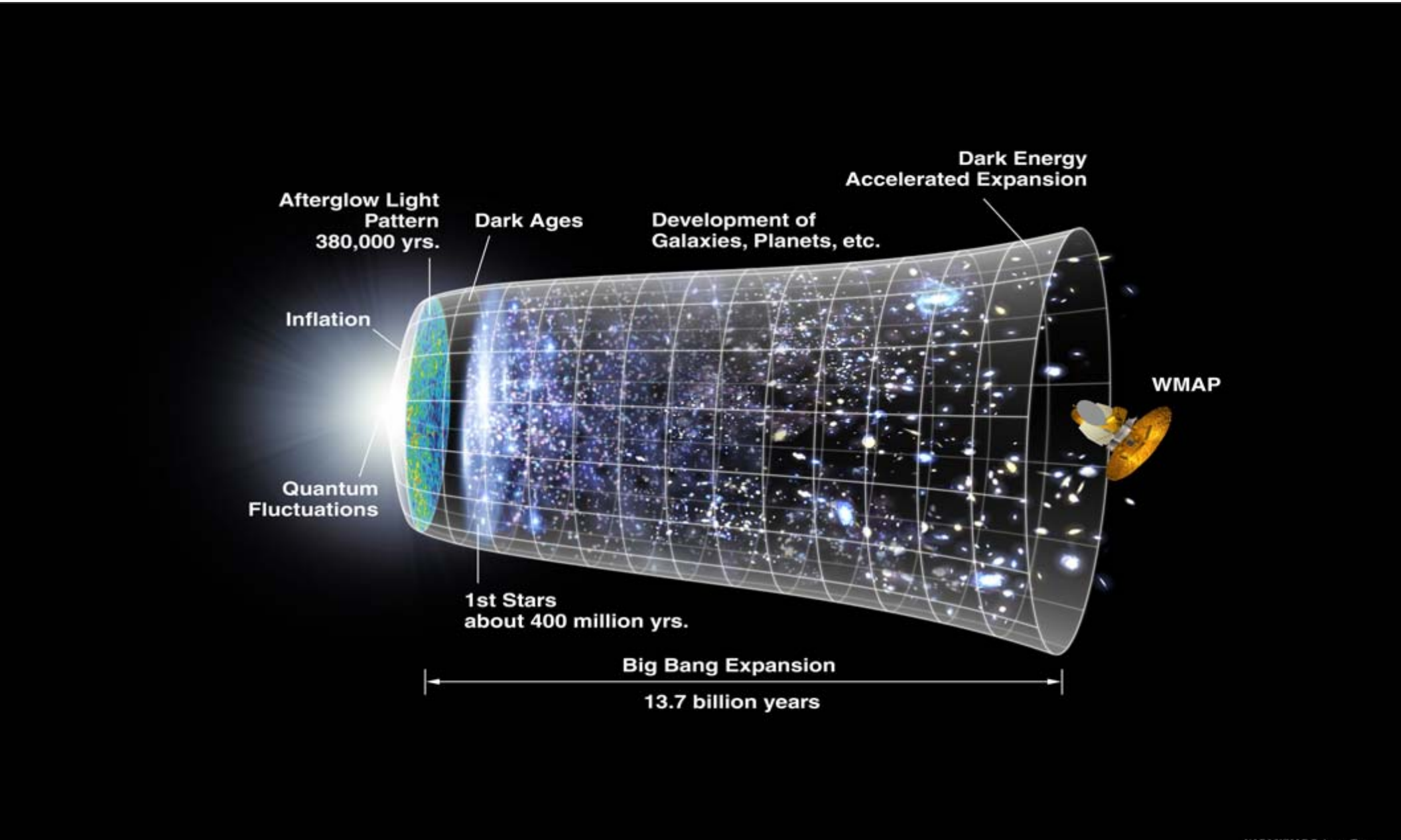
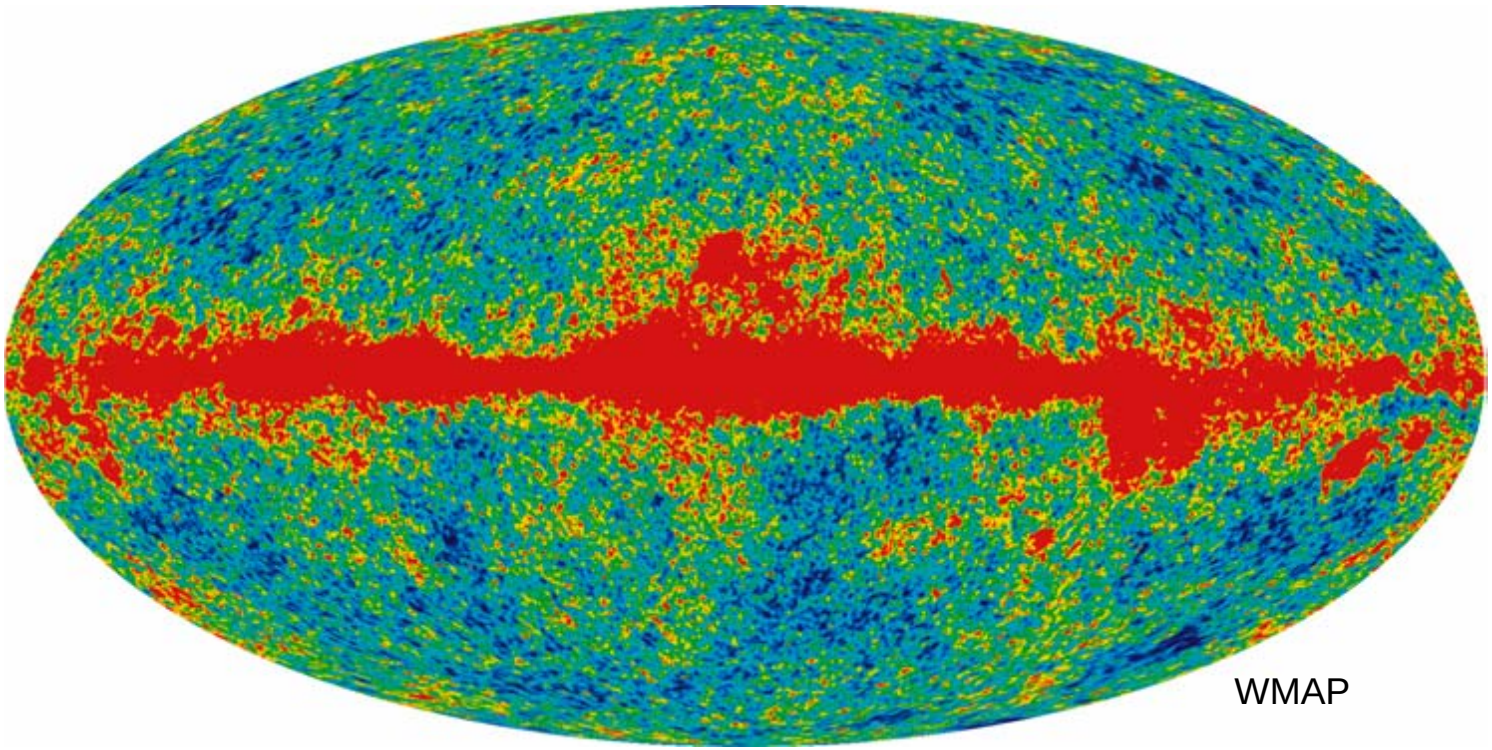
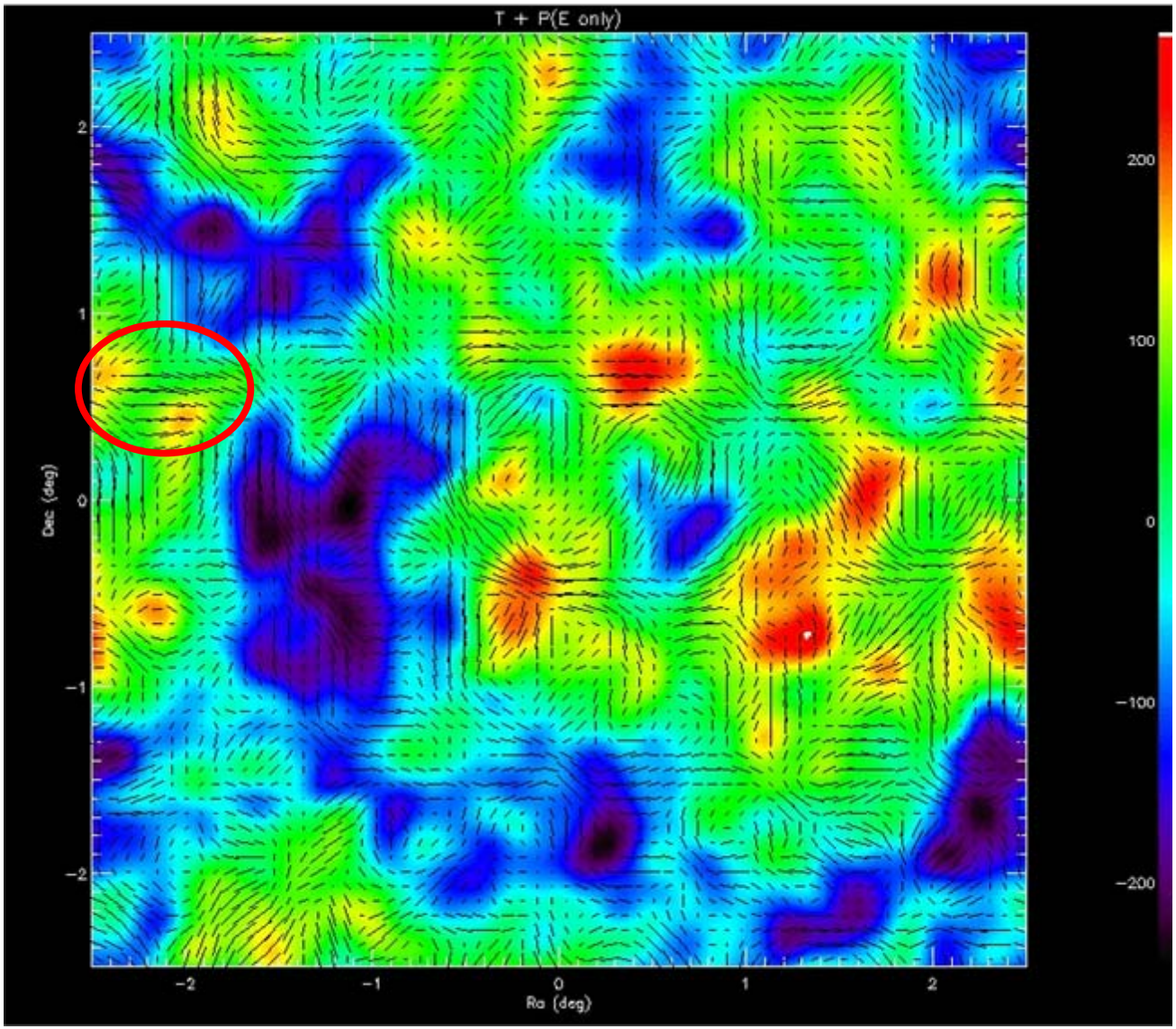
# Universe Timeline



# Cosmic Microwave Background Anisotropy



# Cosmic Microwave Background Polarization



# EBEX science goals

- Detect (or set upper limit) B-modes of Cosmic microwave background polarization caused by gravity waves.
  - Smoking gun of inflation.
- Detect B-modes generated by gravitational lensing.
- Determine the properties of polarized dust.

# Collaboration

- Canadian partners (Dobbs' group at McGill University) in EBEX funded by CSA.
- American partners in EBEX funded by NASA.
- NASA, by the intermediate of CSBF, is responsible for the EBEX launches.
- Each institution responsible for delivering subsystems.
  - McGill developed the digital frequency multiplexed detector readout system (DfMUX).

# Collaboration

*APC – Paris*
Radek Stompor

*Berkeley Lab*
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Christopher Cantalupo
Ted Kisner
Federico Stivoli

*Brown University*
Andrei Korotkov
Greg Tucker
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*CalTech*
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*Cardiff*
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Chaoyun Bao
Shaul Hanany
Hannes Hubmayr
Terry Jones
Jeff Klein
Michael Milligan
Dan Polsgrove
Ilan Sagiv
Kate Raach
Kyle Zilic

*Weizmann Institute of Science*
Lorne Levinson

# Student involvement

- Matt Dobbs group involved in EBEX :
  - François Aubin : Ph.D. student, full-time.
  - Kevin MacDermid : Ph.D. student, full-time.
  - Adam Gilbert : postdoc engineer, half-time.
  - Graeme Smecher : consultant M.Sc. Engineer, part-time.
  - Peter Dahlberg : physics undergrad, part-time.
  - Maxwell Schmitt : physics undergrad, part-time.
- Also, people that were trained and worked on EBEX :
  - Catherine Laflamme, physics undergrad.
  - Mohamed Najih, physics undergrad.
  - Rajat Mukherjee, physics undergrad.
  - Shahjahan Warraich, engineering undergrad.

# *EBEX*

- Long duration balloon borne

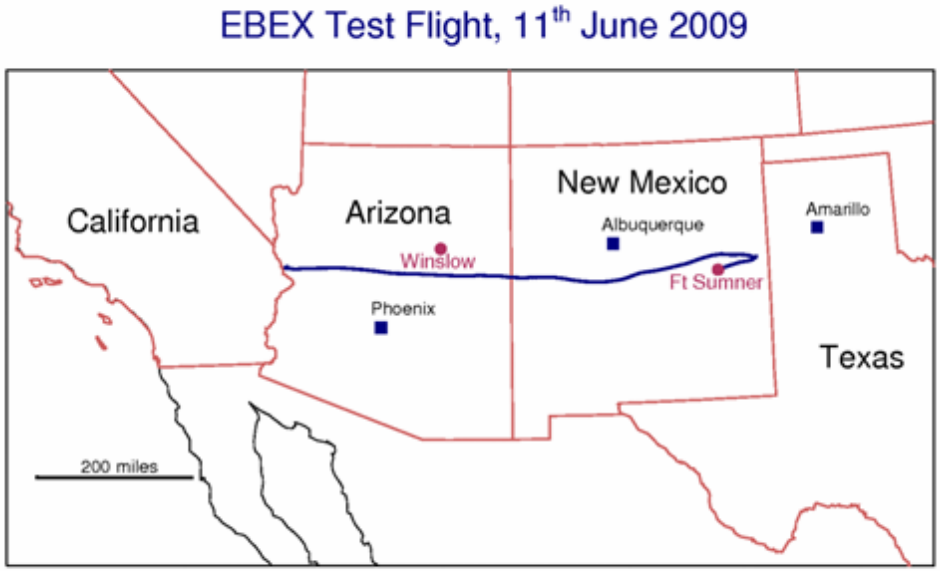
- Use 1476 bolometric TES (transition edge sensors)
  - photon absorber.
  - Superconducting device bias in its transition.
  - Read out with the DfMUX.

# Requirements

- EBEX payload weights 6000lbs.
- EBEX requires 14 days at float for LDB at an altitude of 35km
  - Antarctica is the ideal launch site.

# Schedule

- Engineering flight occurred in June 2009.
- Building missing hardware for long duration flight in 2010.
- Integration planned for first half of 2011.
- LDB planned for austral Summer of 2011-2012.



# Achievements

- McGill built the readout system for EBEX.
- Achieved the first successful operation of SQUIDs and TESs in a space-like environment.
- Improves readiness of technology (TES detectors and readout) for future satellite missions.


The End