

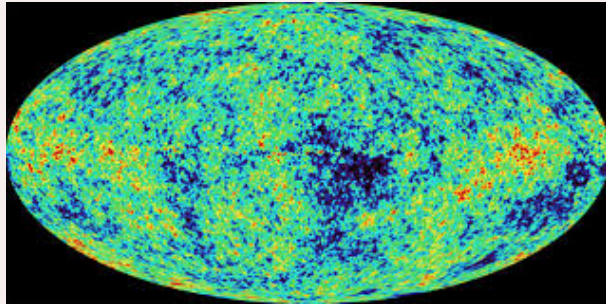
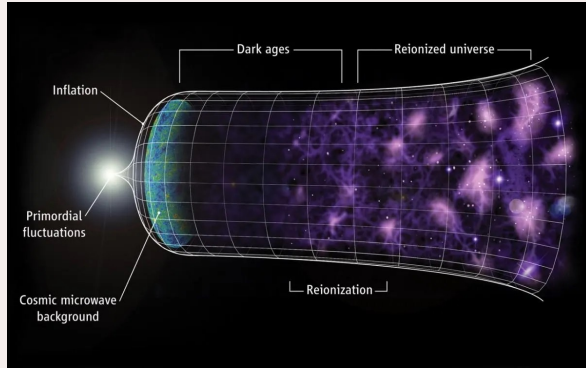
# Cosmic Birefringence

Josquin Errard, Radek Stompor

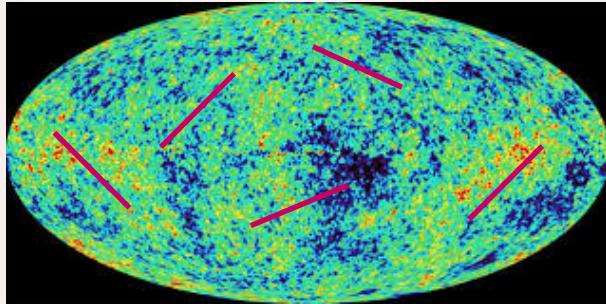
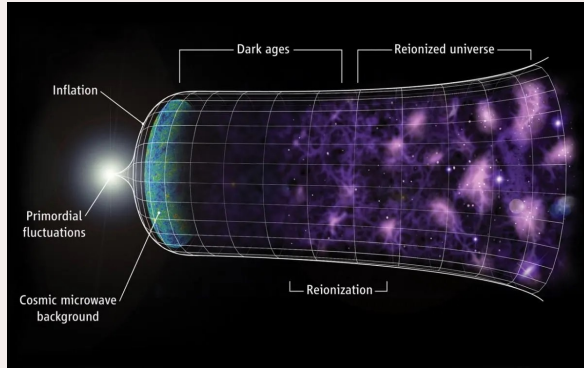
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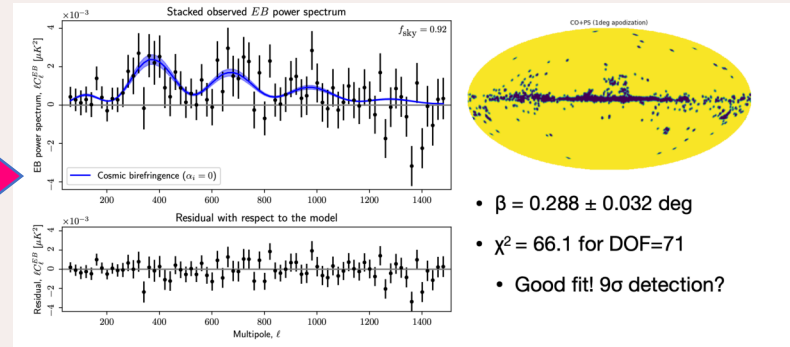
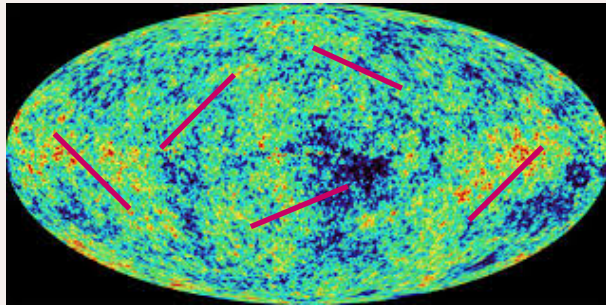
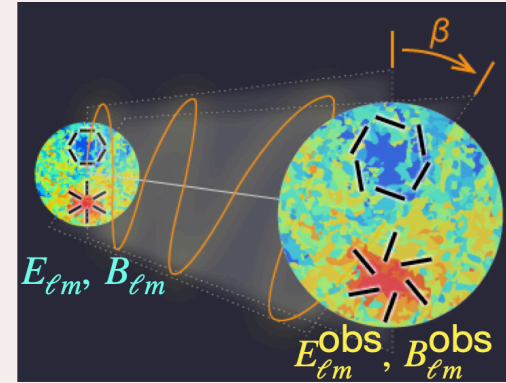
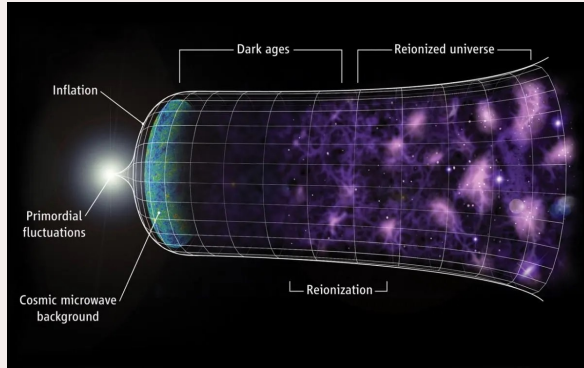
# Cosmic birefringence



# Cosmic birefringence



# Cosmic birefringence



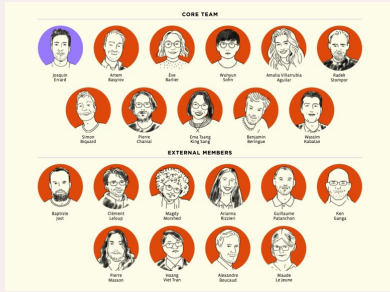
# Impact of miscalibration of polarization angles



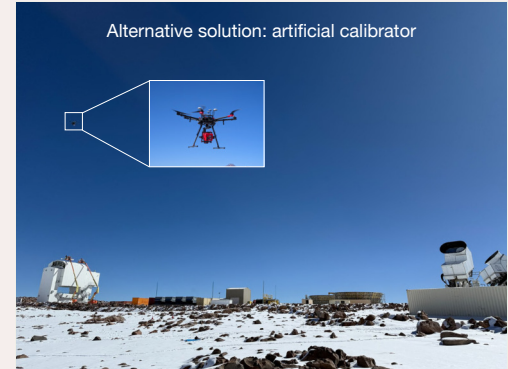
Cosmic or instrumental ?

# Impact of miscalibration of polarization angles

Credit : Eye Barrier



Cosmic or instrumental ?



## — The Simons Observatory: Observatory Site

- **CMB observatory** located in the **Atacama desert** (Chile);
- Site offers excellent conditions for CMB observations:
  - Altitude of **5200 m** → average PWV of 1.2 mm,
  - Latitude of **-23°** → possibility to observe up to 80% of the sky.

**LARGE APERTURE TELESCOPE (LAT)**

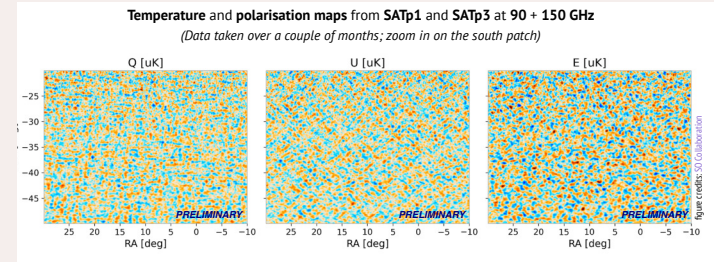
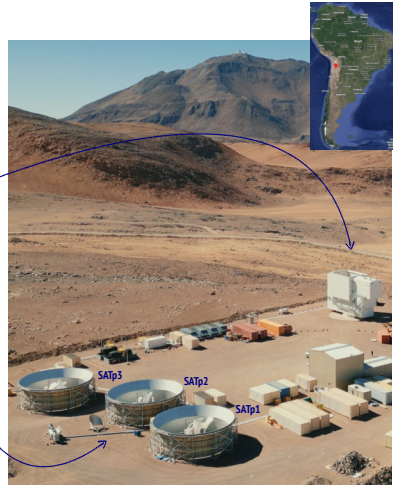
Making **wide maps** of the sky with a **high angular resolution**.

- **Cross-Dragone telescope** (6m mirror) with **30 000 TES detectors**;
- Observing in 6 frequency bands [27, 39, 93, 145, 225, 280] GHz.

**SMALL APERTURE TELESCOPES (SATs)**

Making **deep maps** of the sky with a **low angular resolution**.

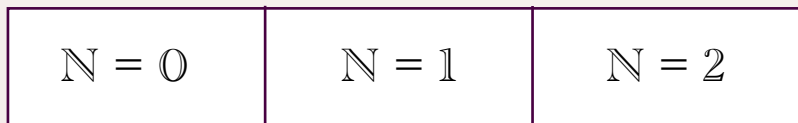
- **3 "nominal" SATs** + 3 more SATs (SOJUK & SOJIP) deployed in 2026/2027 (Advanced SO);
- Observing in 6 frequency bands [27, 39, 93, 145, 225, 280] GHz;
- **SATp1 & SATp3** observing at 90/150 GHz are taking **initial science data** since late 2024;
- **SATp2** observing at 220/280 GHz is being **commissioned**.



Credit : Amalia Villarrubia Aguilar

# Cosmic birefringence phenomenology :

Frequency dependency :  $B(\nu) = \nu^N$



Cherns-Simons

Quantum gravity

Cosmological magnetic fields

$$I_{CS} = -\frac{1}{4}\alpha \int d^4x \theta F \tilde{F}$$



Credit : Eiichiro Komatsu

## Axions-like particles : Distinction between DE and DM

How small is its mass? Example of  $V(\chi) = m^2\chi^2/2$

The useful criterion is the equation of state parameter,  $w$ .

$$w = \frac{P}{\rho} = \frac{\langle \dot{\chi}^2 \rangle - m^2 \langle \chi^2 \rangle}{\langle \dot{\chi}^2 \rangle + m^2 \langle \chi^2 \rangle}$$

- $w \simeq -1$ : Dark Energy (DE)
  - $m \lesssim H_0 \simeq 10^{-33}$  eV
- $w \simeq 0$ : Dark Matter (DM)
  - $m \gtrsim H_0$

