Who am I?

A simple answer to a difficult question

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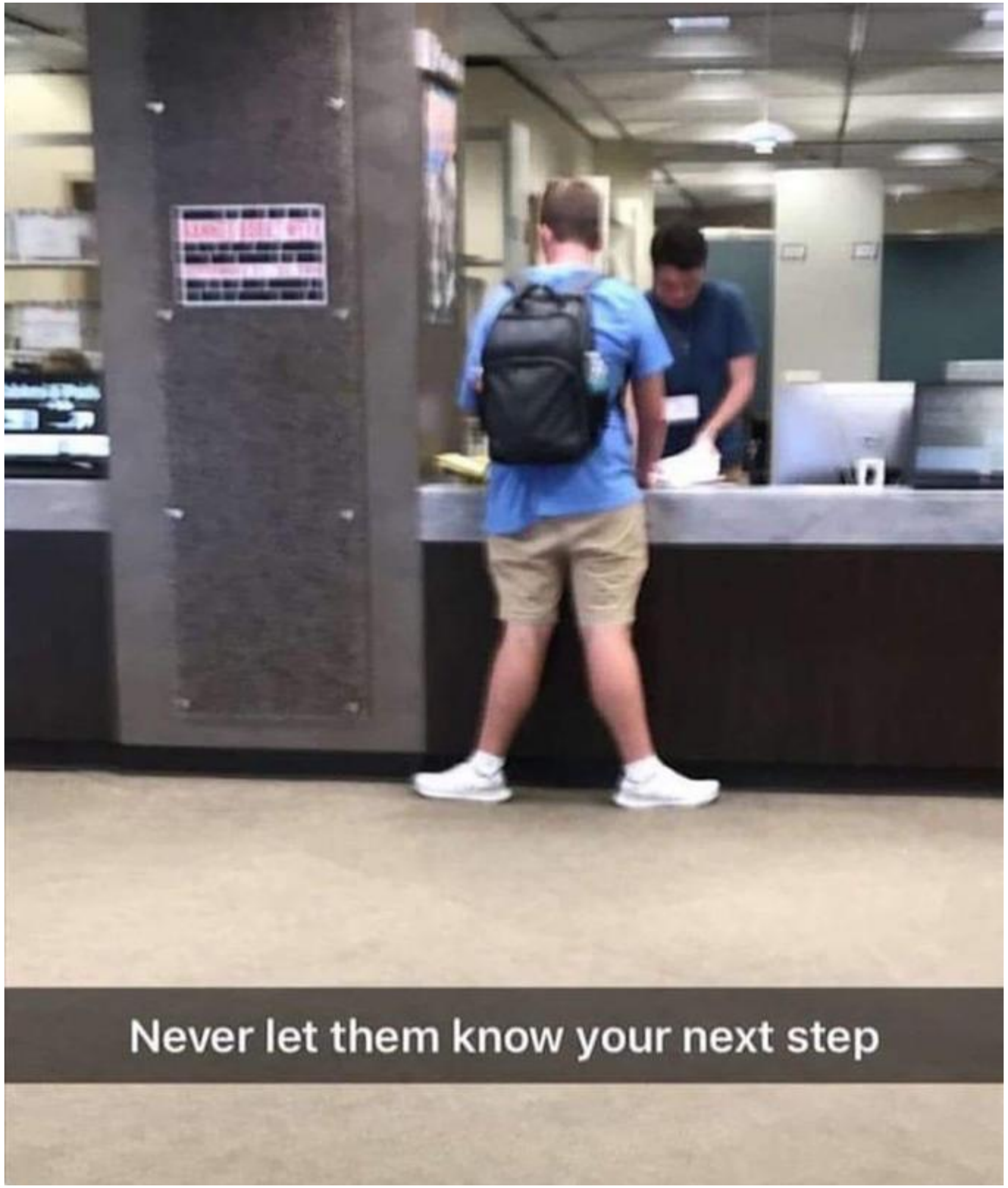
Past Projects

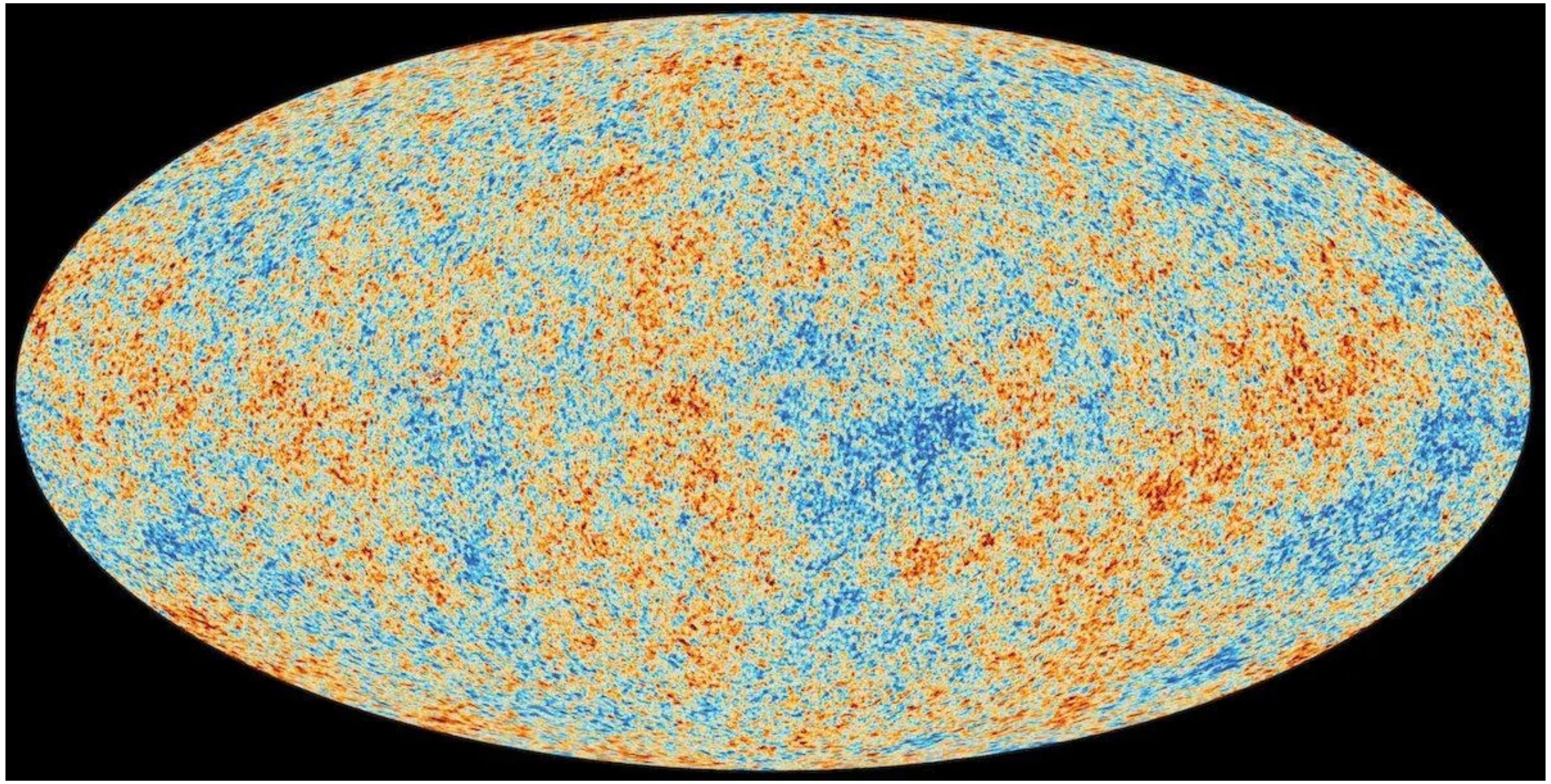
- Bachelor's thesis on Artificial Intelligence and quantum phase transitions
- Internship on quantum optics and quantum communication
- Master's thesis on twist-2 operators in N=4 Super Yang-Mills theory
- And now…

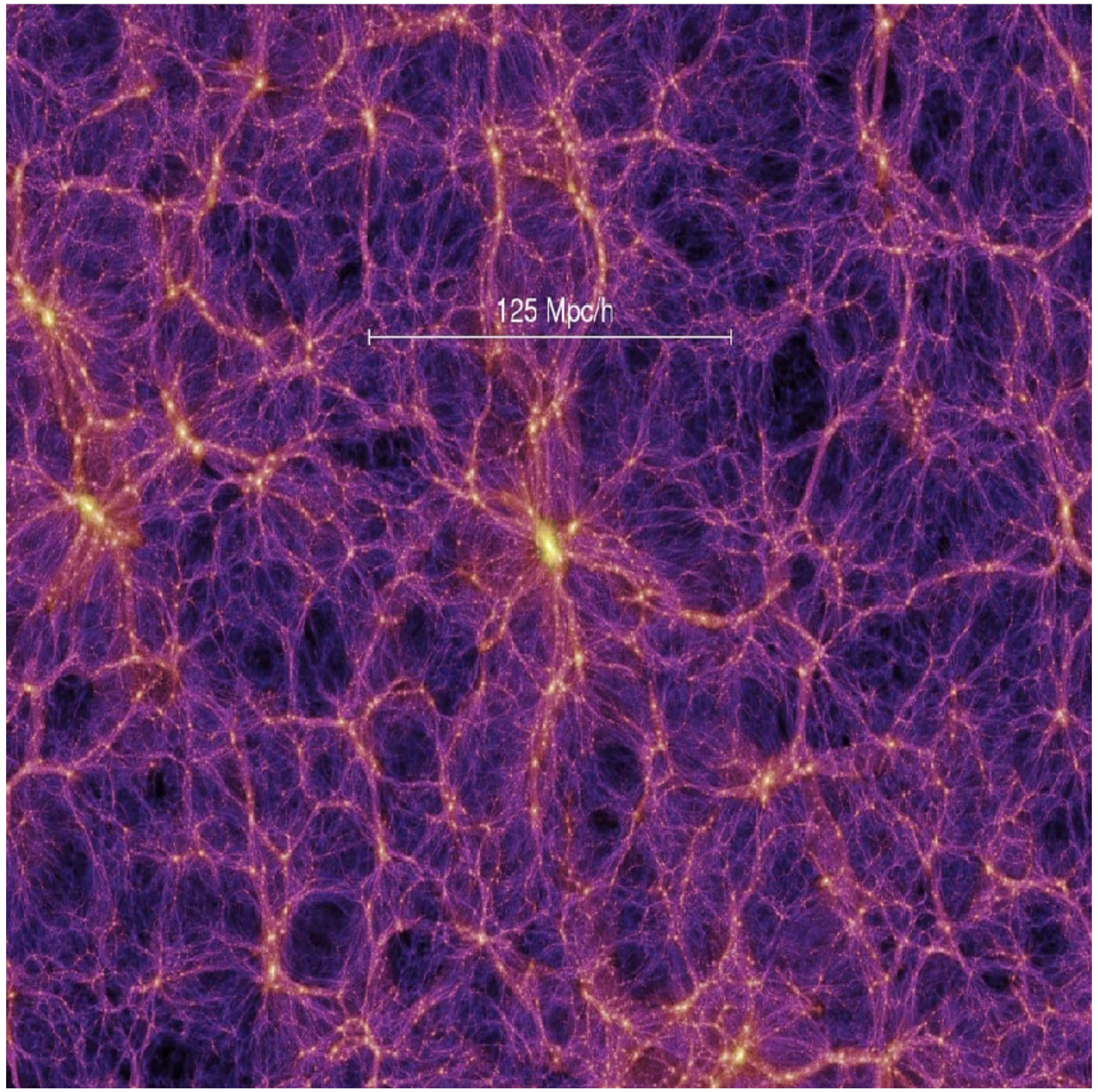


My PhD's project

Between IJCLab and APC

- Inflationary non-Gaussianities in the CMB and large-scale structure





CMB

Inflation = exponential expansion of space in the early universe
$10^{-36}s \rightarrow 10^{-33}s$

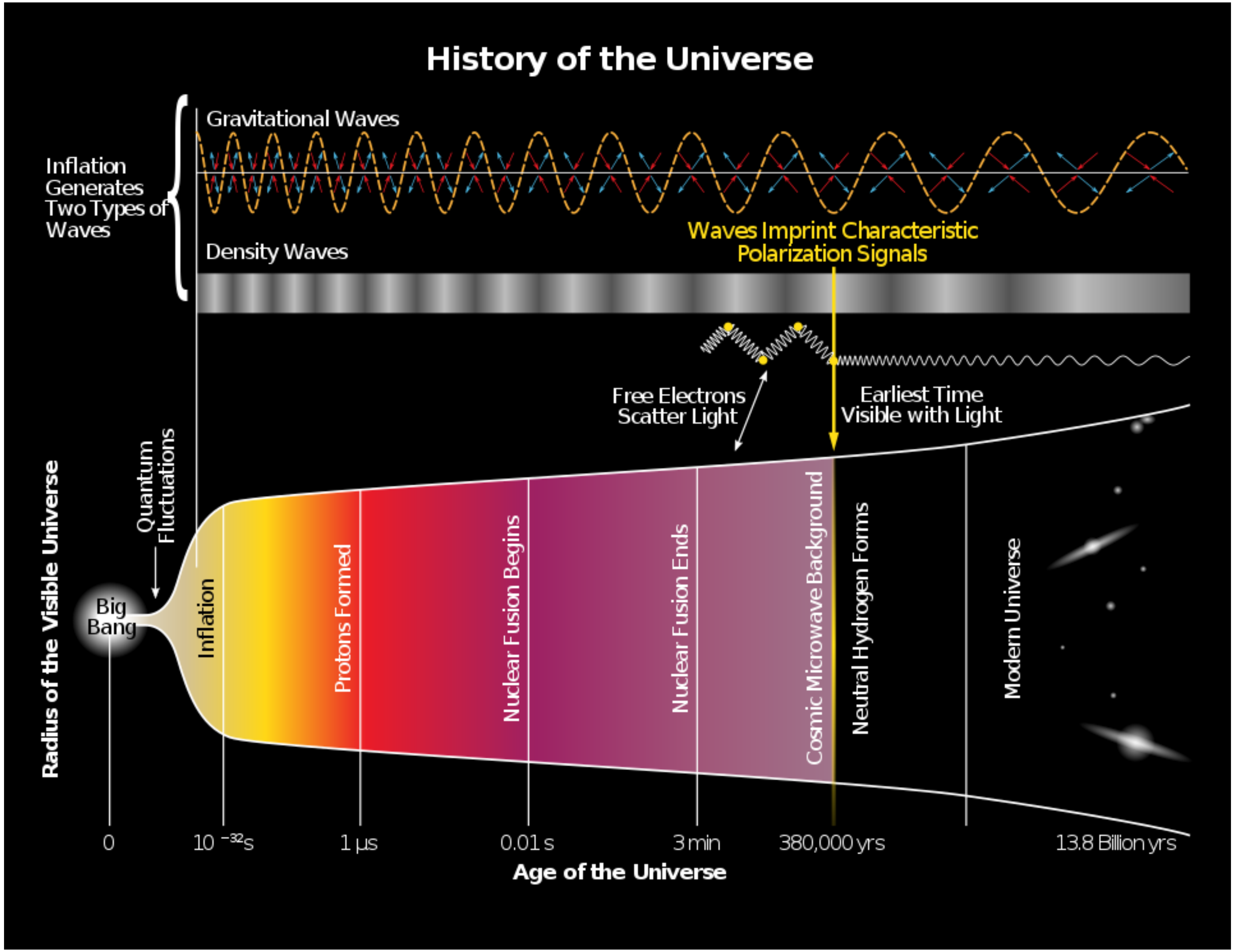
Explained by one (or more) scalar field (Inflaton) with an almost flat potential (“slow roll”)

Continued to expand and to cool down until 3000K after 380.000y

->Hydrogen forms

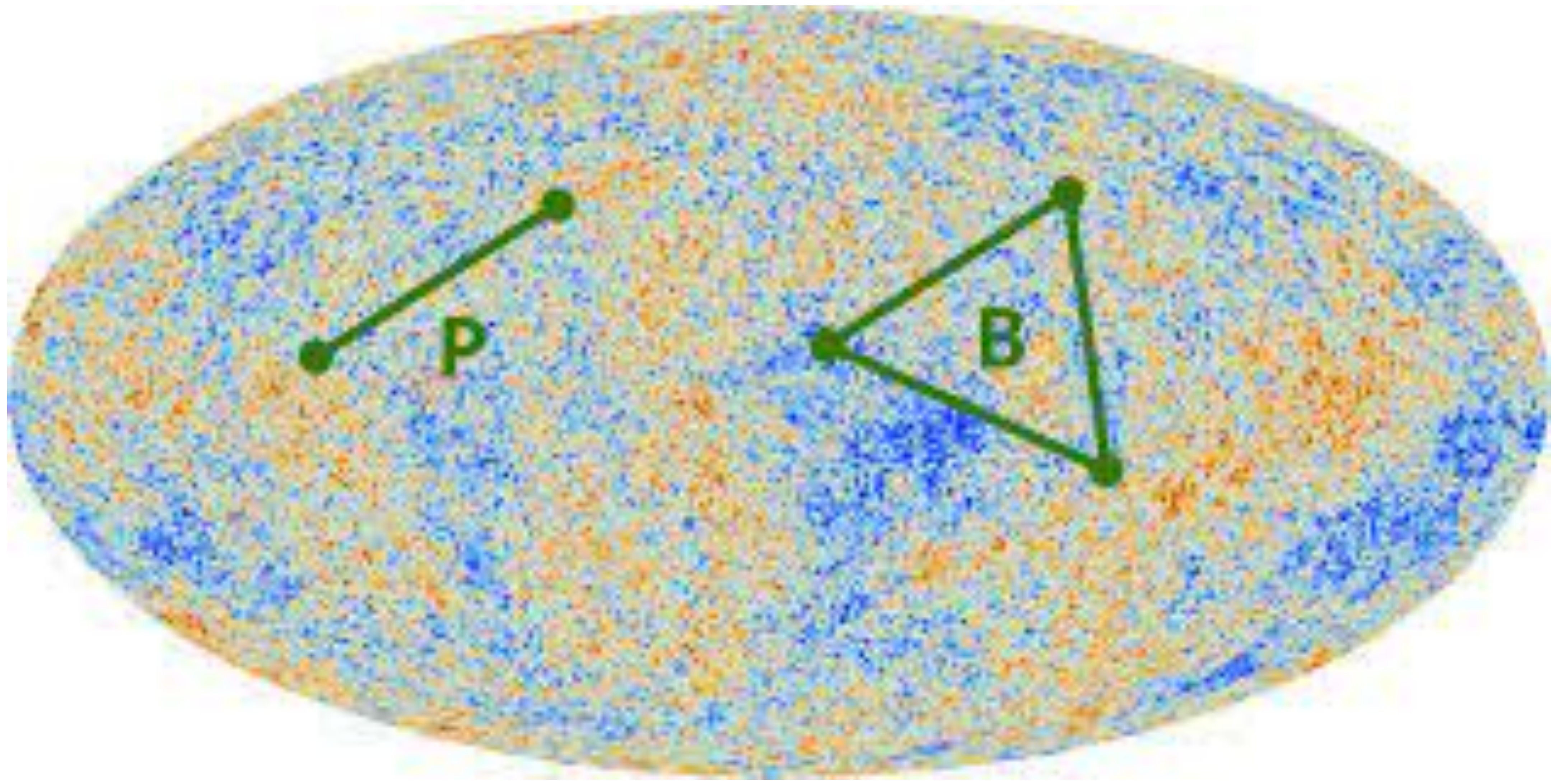
->The radiation travels freely: CMB (now black body at 2.725 K)

->Anisotropies (multipoles the level of 10^-5K)



CMB anisotropies: bispectrum

My research focuses on the 3-point correlator (bispectrum) of this distribution:



Non-Gaussianity manifests itself in odd n-point correlation functions or in the connected even n-point correlation functions, from which the trivial part expressible as combinations of two-point correlation functions (powerspectrum) has been subtracted away.

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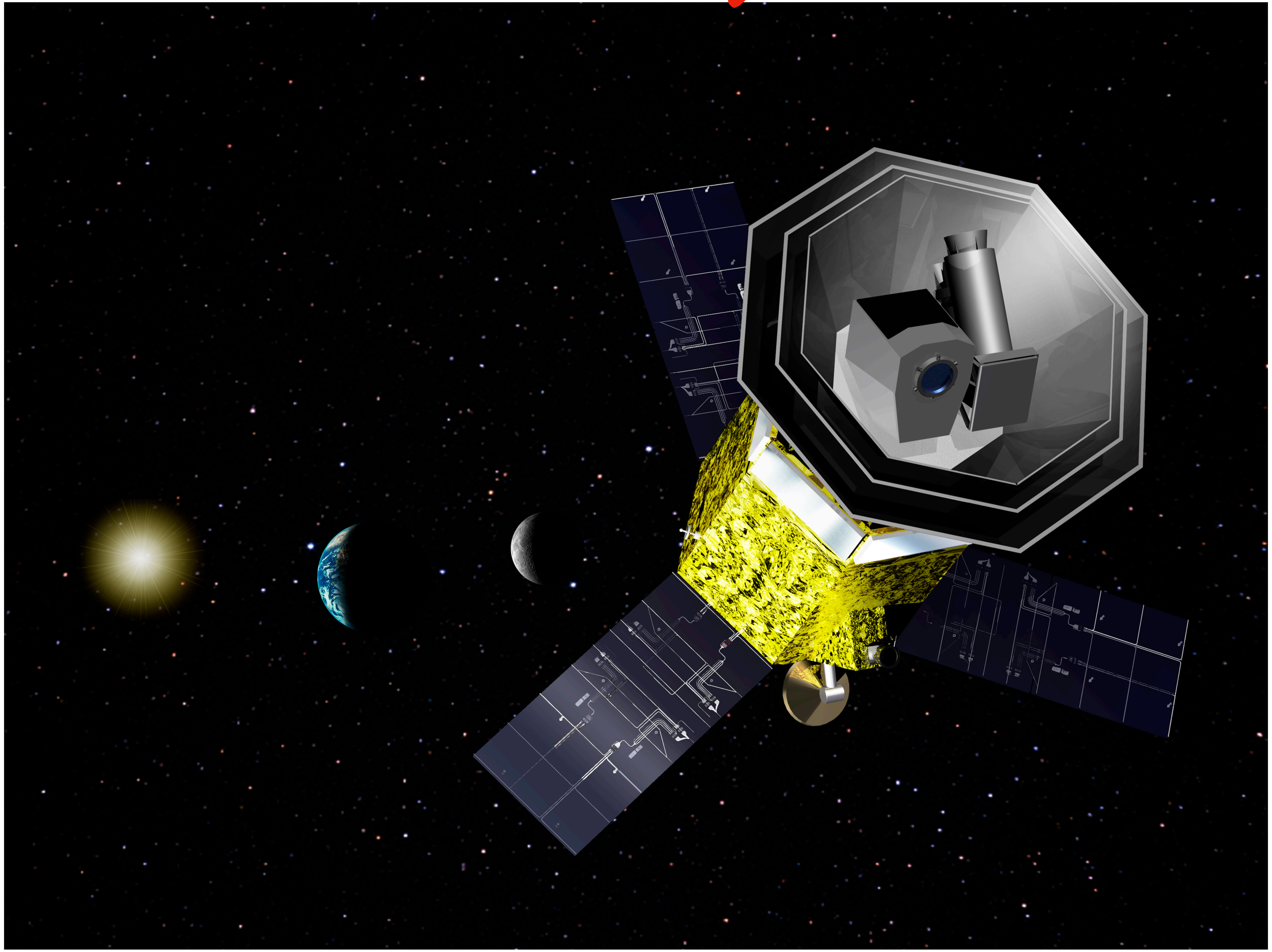
CMB: LiteBIRD collaboration (202~~9~~)

My current topic

- We have extended the existing binned bispectrum code to include B-mode polarization and we are using it for the Fisher forecasts for LiteBIRD



CMB: Component Separation

SMICA - blind method

We see all the radiation between the surface of last scattering and the detector: our goal is to distinguish the CMB from other signals.

Can non-Gaussianity be a discerning factor?

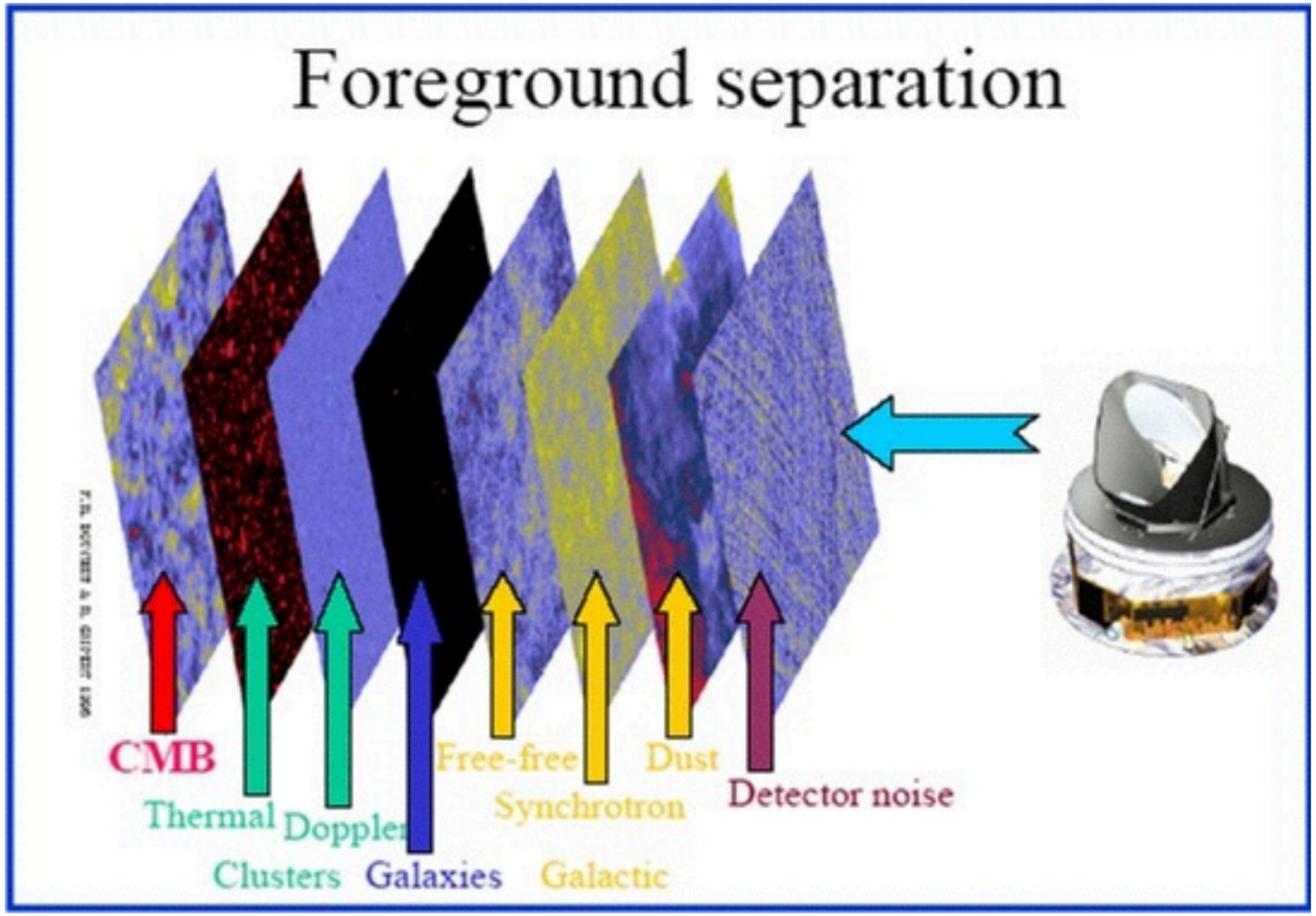
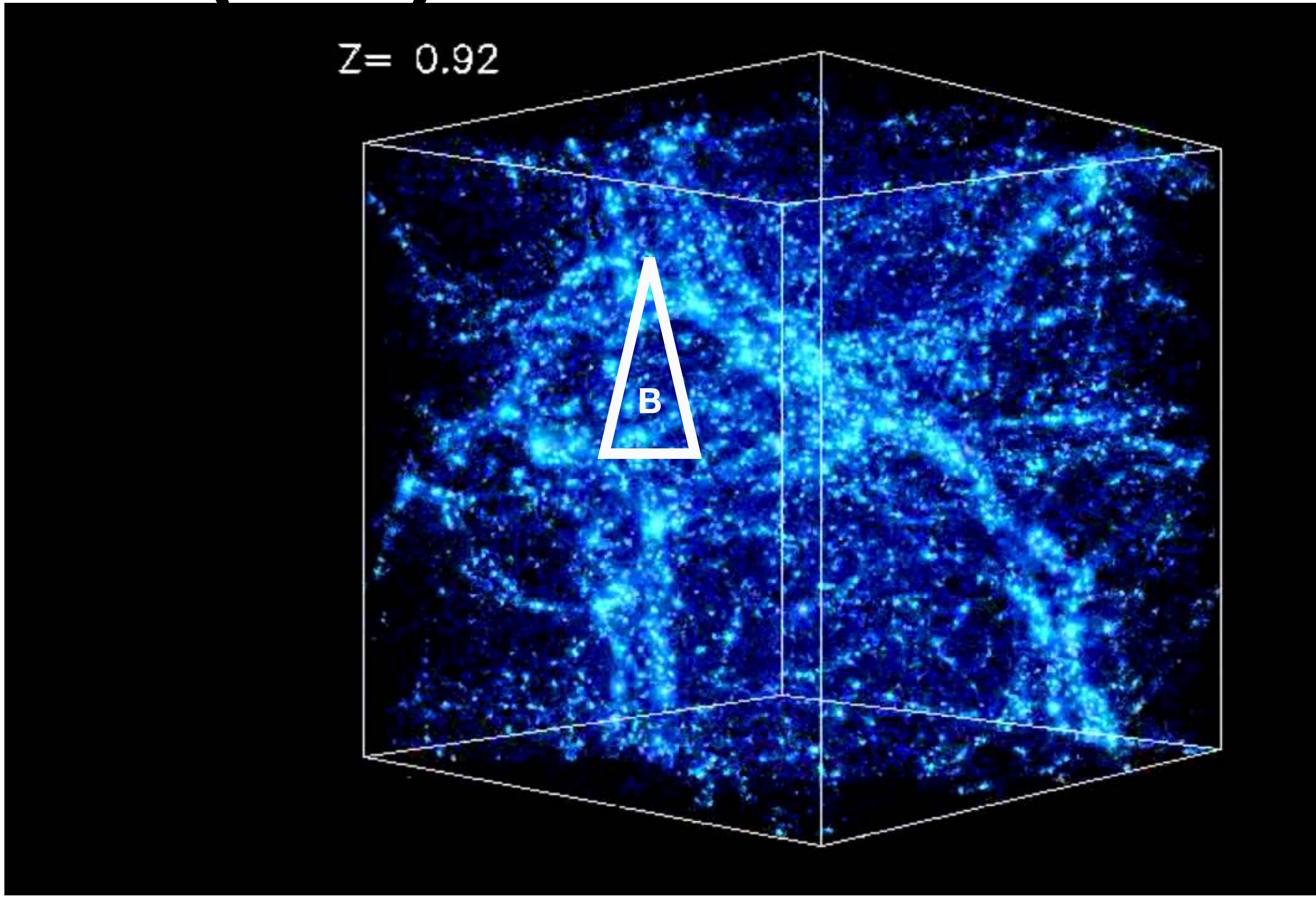


Image courtesy of F. Bouchet

Large Scale Structure (LSS)

The large scale structure of the universe also depends on the distribution of the Inflaton field

->One of the PhD's goals: probing 3D volume of data



More about me…

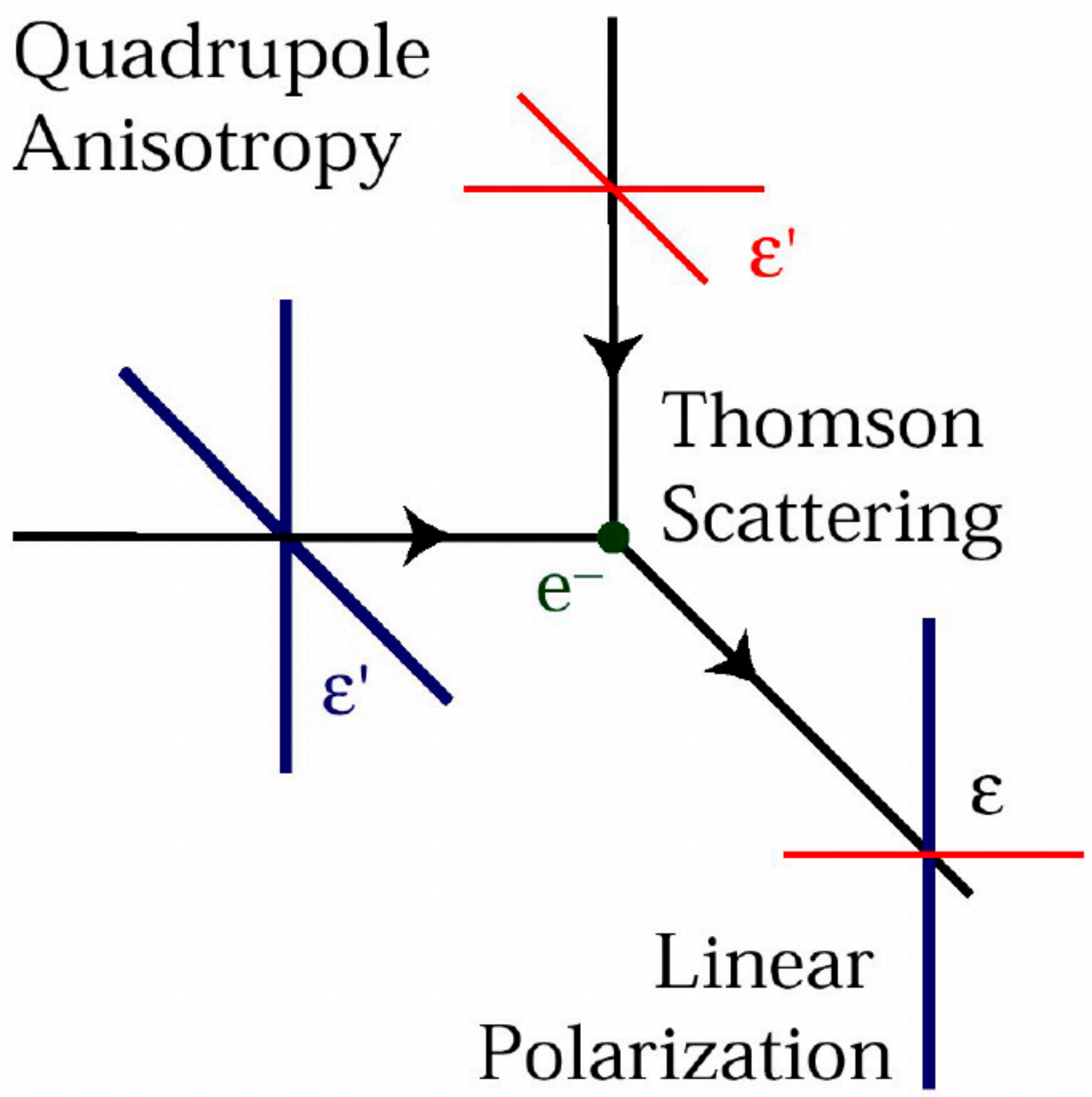
Gymnastics

Stand-up comedy

Volunteering


Okay, thanks. Bye.

BACK-UP SLIDES



N.B.

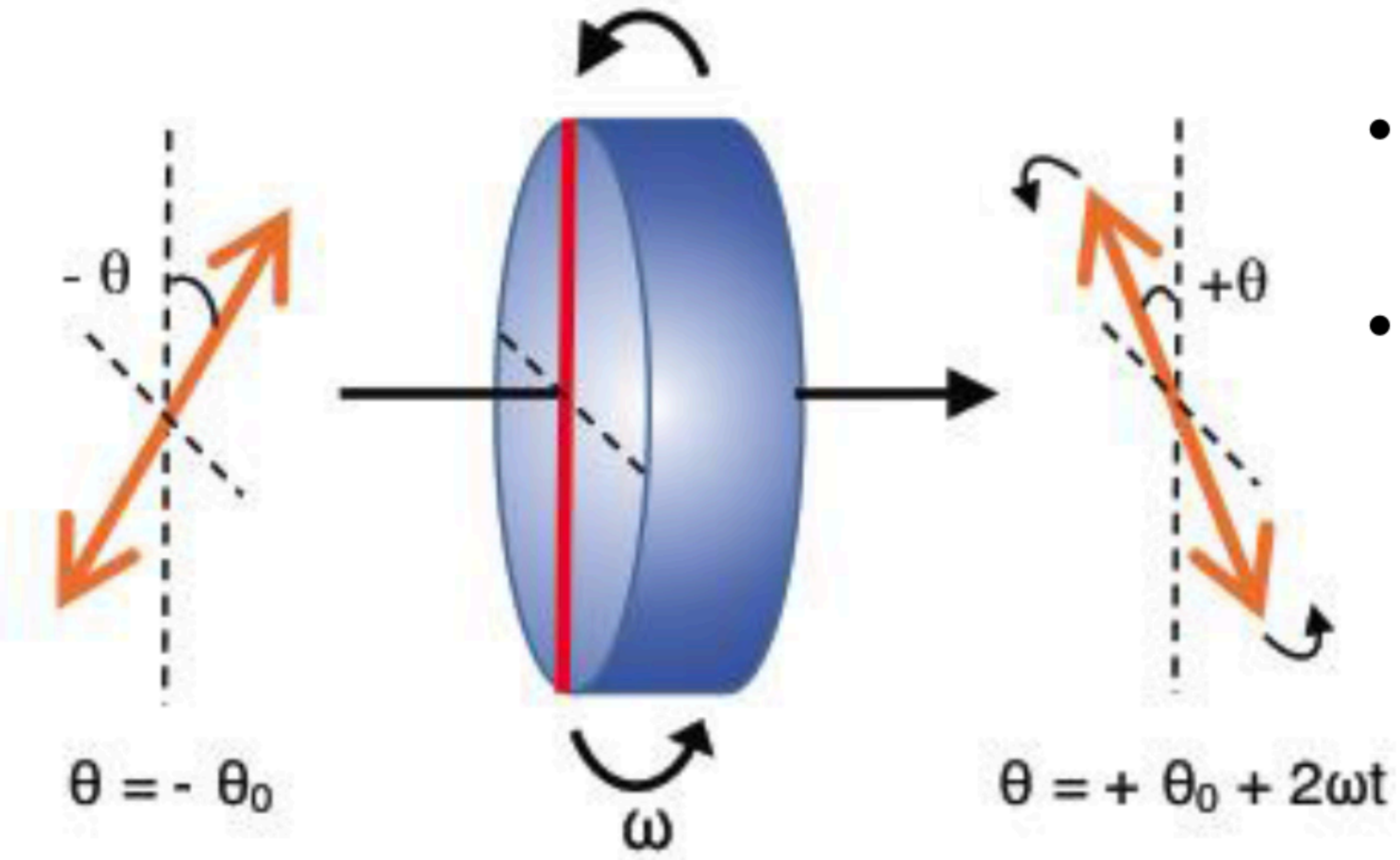
1) Temperature anisotropies at the last scattering surface lead to linear polarization of the CMB

2) Scalar perturbations can only create E-polarization, not B. Hence the primordial B-polarization signal will be a clear probe of the inflationary tensor perturbations.

$$\frac{Q(\theta,\varphi) \pm iU(\theta,\varphi)}{T_0} = -\sum_{\ell,m} (a^E_{\ell m} \pm i a^B_{\ell m})\, {}_{\pm 2}Y_{\ell m}(\theta,\varphi) \qquad \frac{E(\theta,\varphi)}{T_0} = \sum_{\ell,m} a^E_{\ell m} Y_{\ell m}(\theta,\varphi)$$

3) Q,U Stokes parameters. Instead of using Q and U to describe the CMB's polarization, CMB physicists often prefer using E and B

HWP



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JPS_Sep2016_23aSR-9, Sakurai et al.

CMB foregrounds

Everything between us and last scattering surface at z=1090

- **Diffuse Galactic radiation**
  - **Synchrotron**
  - **Free-free**
  - **Thermal (vibrational) dust**
  - **Spinning dust**
  - **Magnetic dust**
- **Extragalactic radio sources**
  - **Radio galaxies (radio)**
  - **Star-forming galaxies (sub-mm)**
  - **Cosmic Infrared Background (CIB)**
- **Line emission - CO….**

CMB Non-Gaussianity

1) However, it is also important to study the non-Gaussianity that was subsequently imprinted at late times through known processes, in particular the nonlinear dynamics of gravitational clustering, in order to `decontaminate' the primordial non-Gaussianity.

2) inflation does not predict exact Gaussianity no matter what model of inflation is assumed.

3)Cosmic variance = 1 sky only

4) $M^p(\Omega) = \sum_{\ell,m} a^p_{\ell m} Y_{\ell m}(\Omega).$ $M_\ell(\Omega) = \sum_{m=-\ell}^{+\ell} a_{\ell m} Y_{\ell m}(\Omega).$ $B_{\ell_1\ell_2\ell_3} = \int d\Omega \; M_{\ell_1}(\Omega) \; M_{\ell_2}(\Omega) \; M_{\ell_3}(\Omega),$

$$\mathrm{Covar}(B^{p_1p_2p_3}_{\ell_1\ell_2\ell_3}, B^{p_4p_5p_6}_{\ell_1\ell_2\ell_3}) = g_{\ell_1\ell_2\ell_3} h^2_{\ell_1\ell_2\ell_3} (\tilde{C}_{\ell_1})^{p_1p_4} (\tilde{C}_{\ell_2})^{p_2p_5} (\tilde{C}_{\ell_3})^{p_3p_6} \equiv V^{p_1p_2p_3p_4p_5p_6}_{\ell_1\ell_2\ell_3},$$

$$\langle B^A, B^B \rangle^{\text{no binning}} = \sum_{\ell_1 \le \ell_2 \le \ell_3} \frac{B^A_{\ell_1\ell_2\ell_3} B^B_{\ell_1\ell_2\ell_3}}{V_{\ell_1\ell_2\ell_3}}.$$

$\longrightarrow$

$$\hat{f}_{\mathrm{NL}} = \frac{\langle B^{\mathrm{th,exp}}, B^{\mathrm{obs}} \rangle}{\langle B^{\mathrm{th,exp}}, B^{\mathrm{th,exp}} \rangle}$$