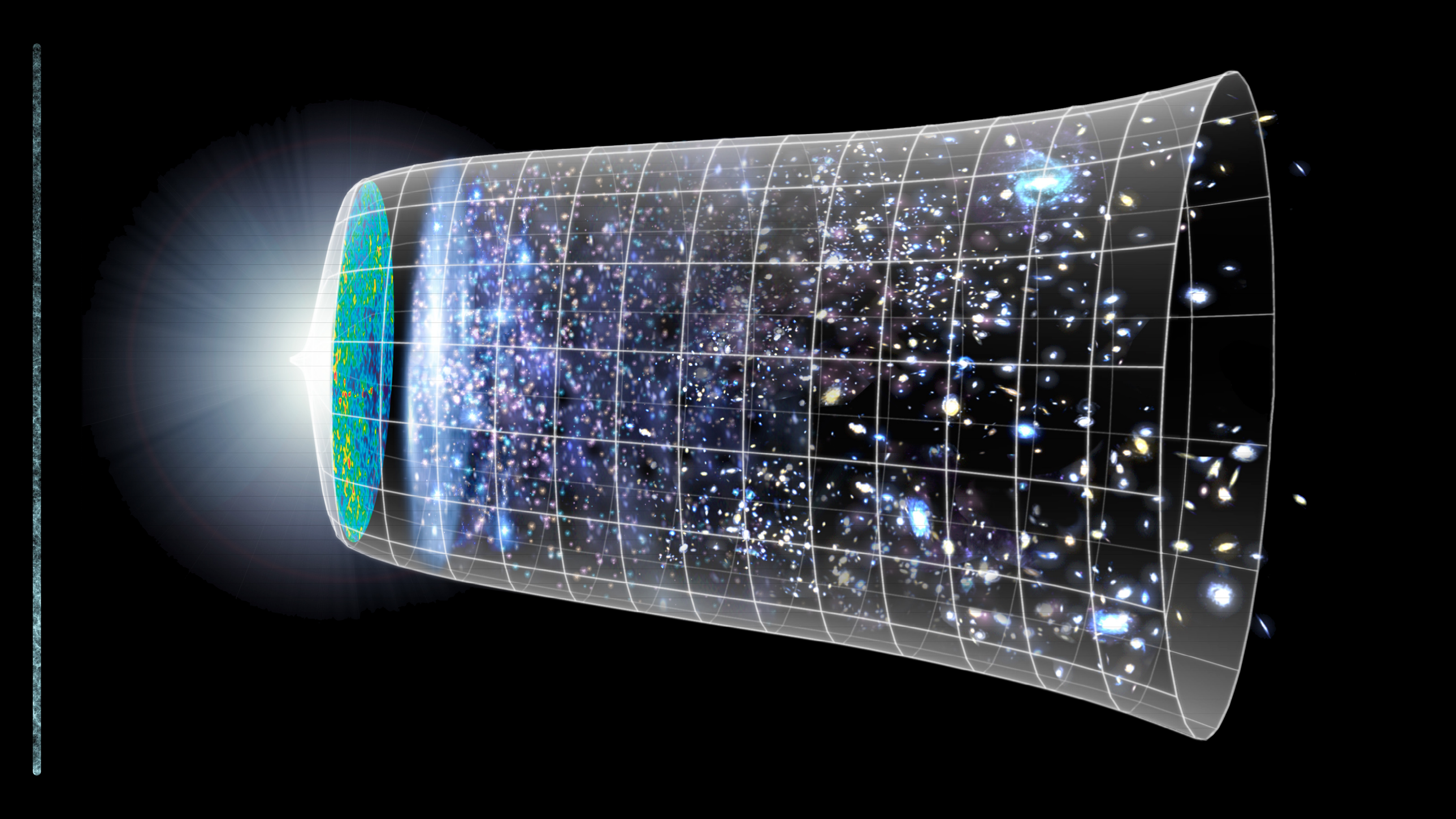
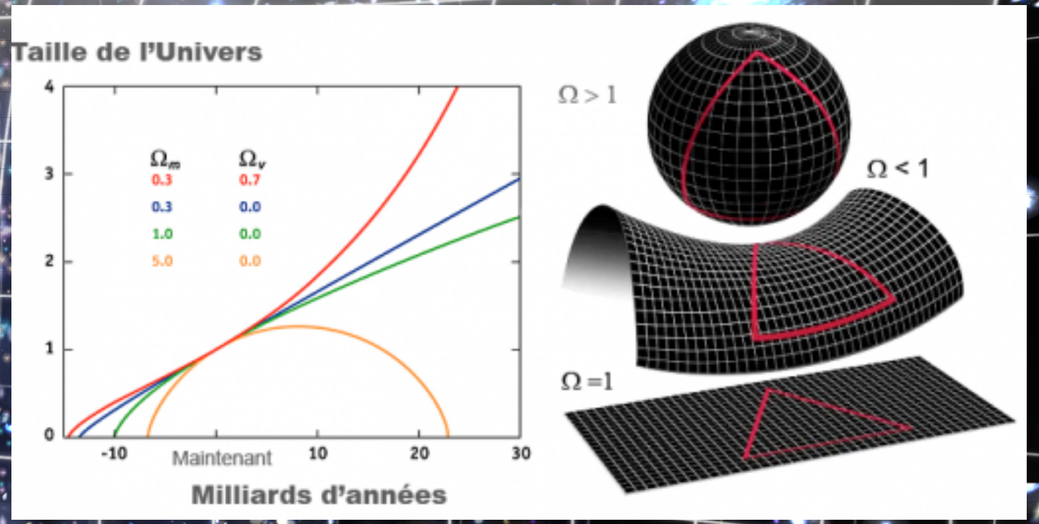
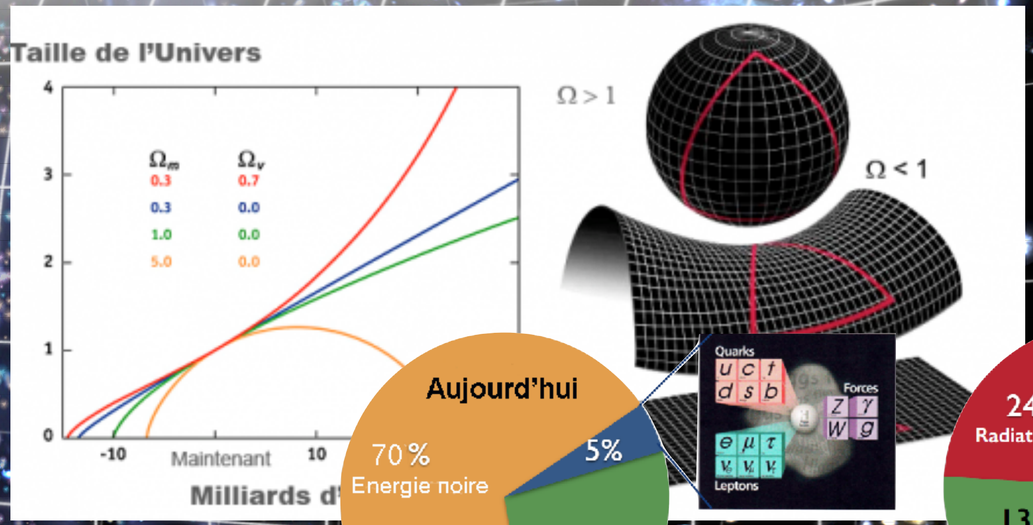
La cosmologie à Sorbonne Université

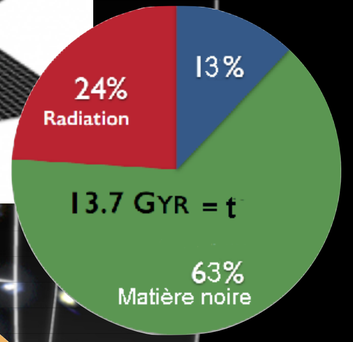




$$H^2(t) = \frac{8\pi G}{3c^2}\rho(t) - \frac{kc^2}{a^2(t)} + \frac{\Lambda c^2}{3}$$

$$\frac{\ddot{a}(t)}{a(t)} = -\frac{4\pi G}{3c^2}\left(\rho(t) + \frac{3p(t)}{c^2}\right) + \frac{\Lambda c^2}{3}$$





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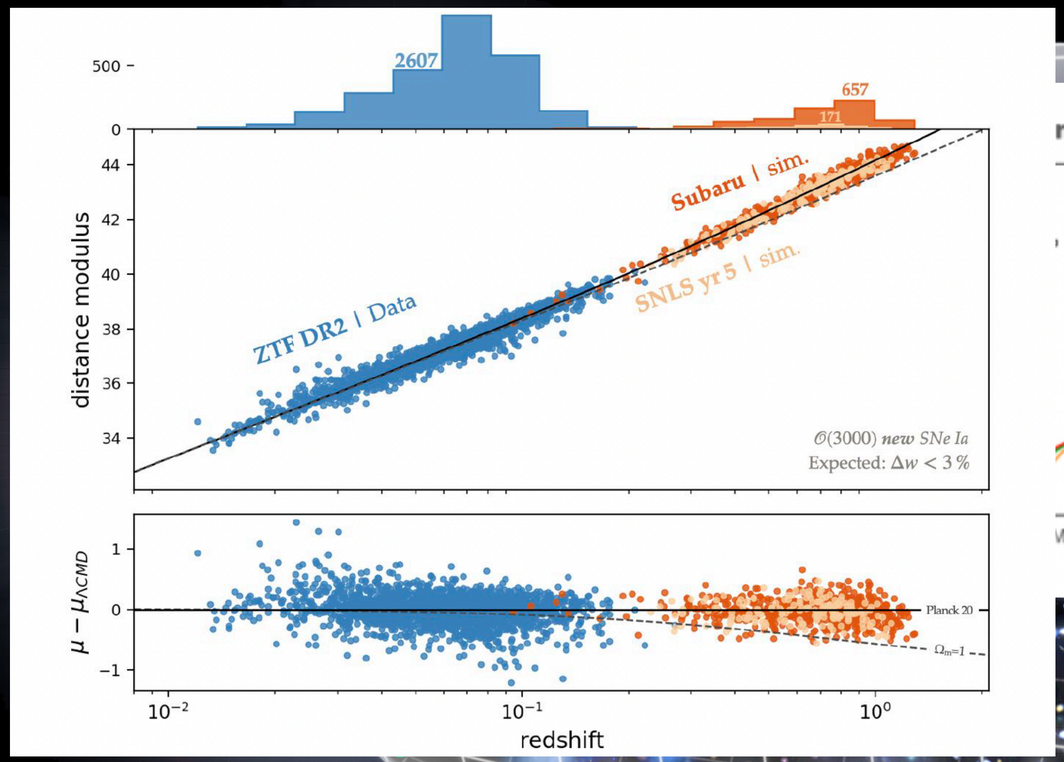

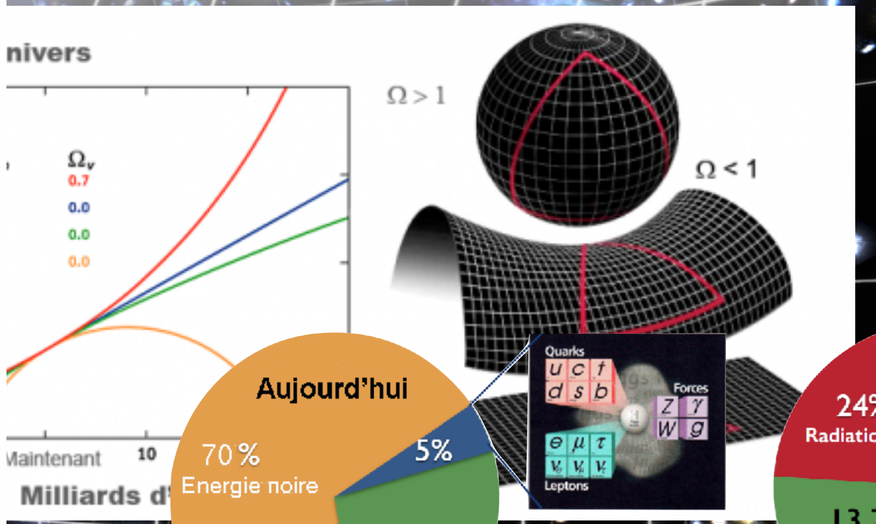

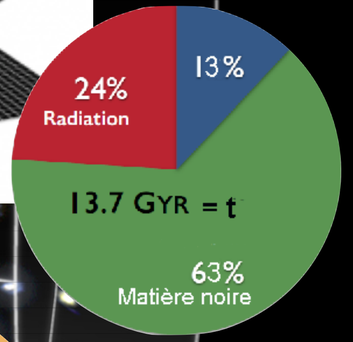

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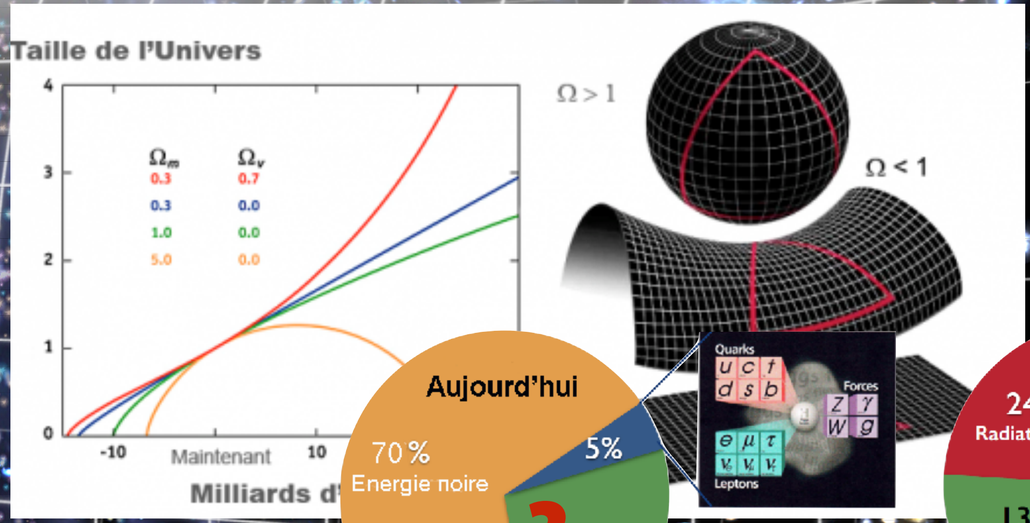

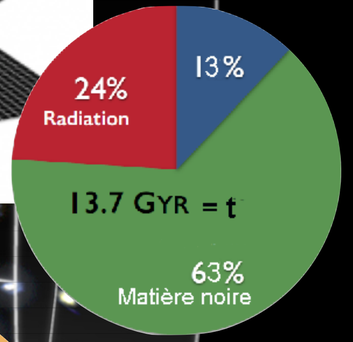

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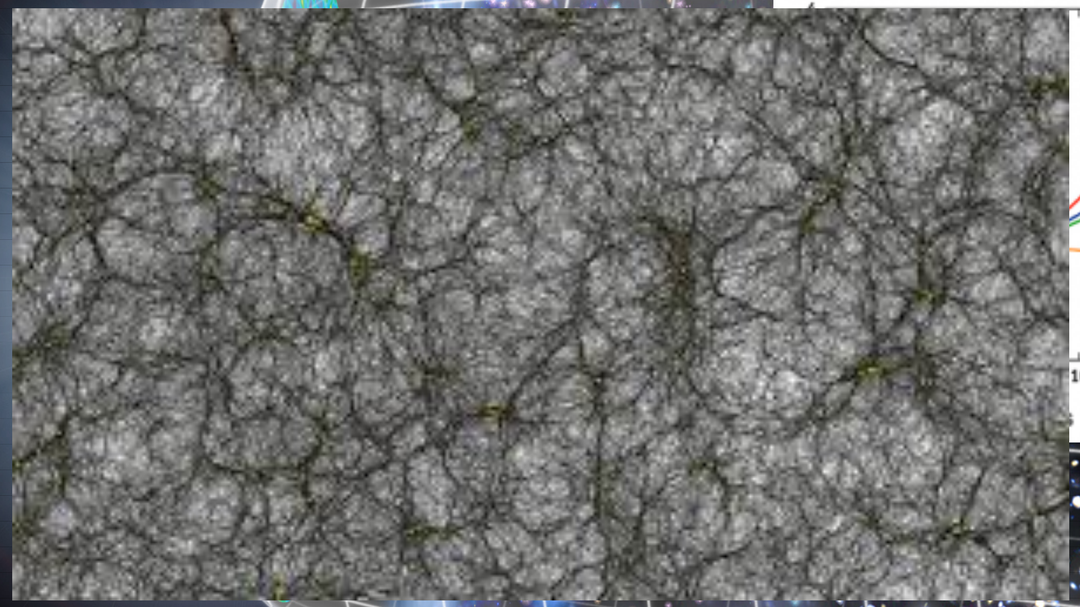

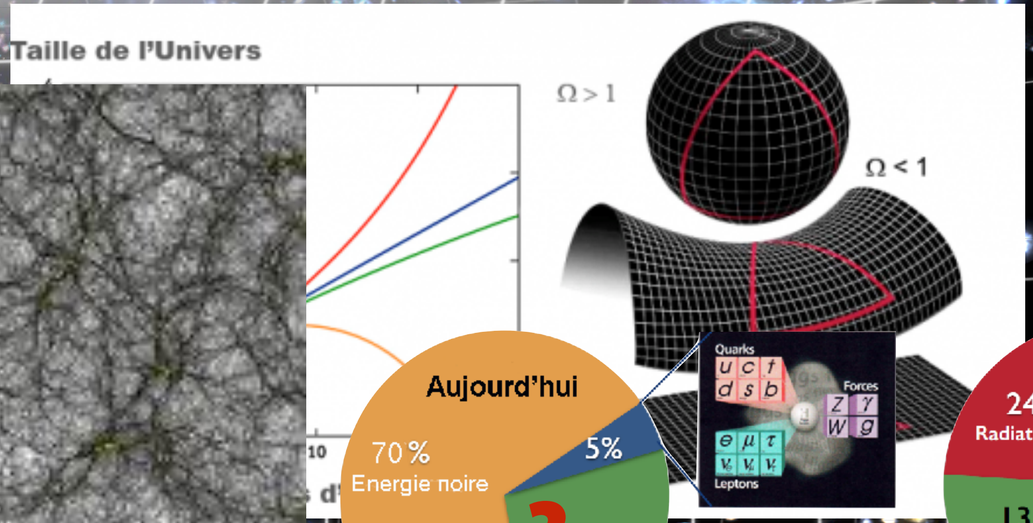

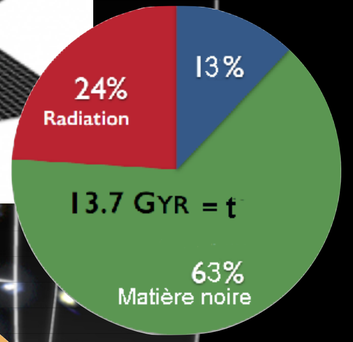

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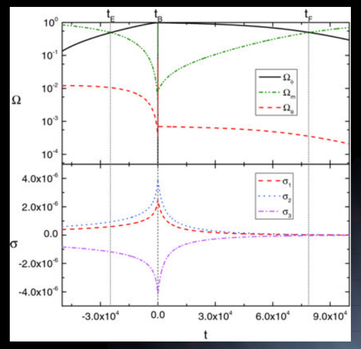
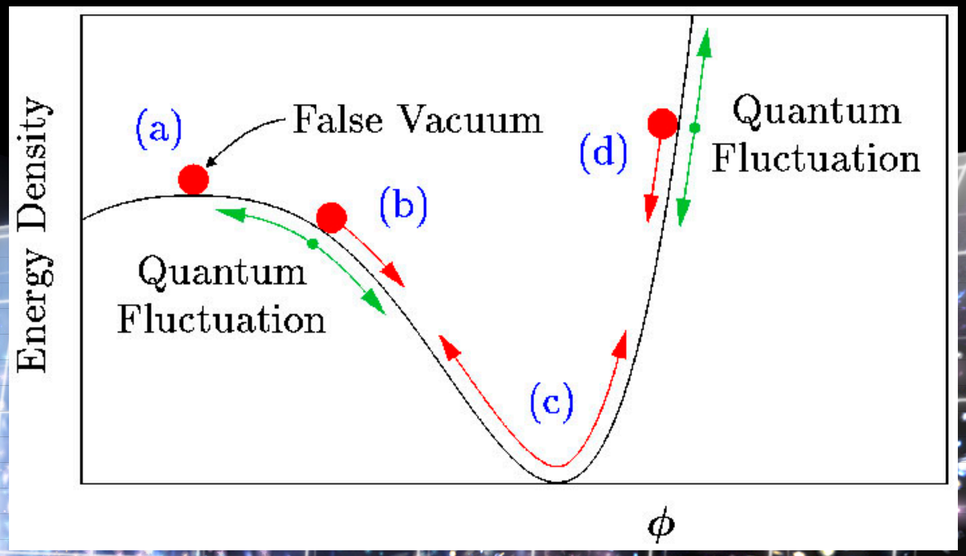
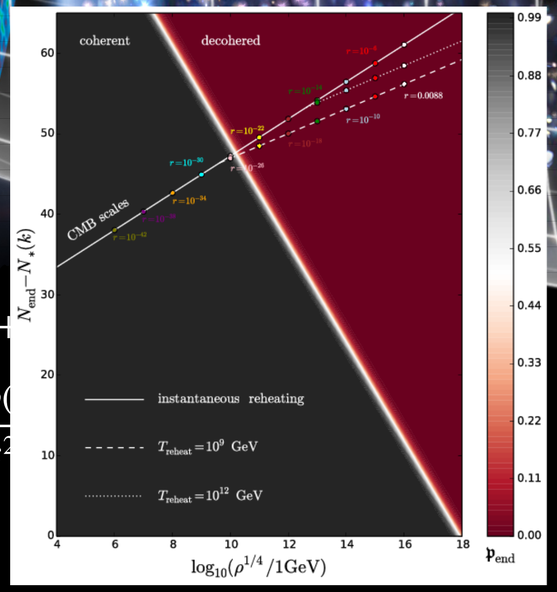


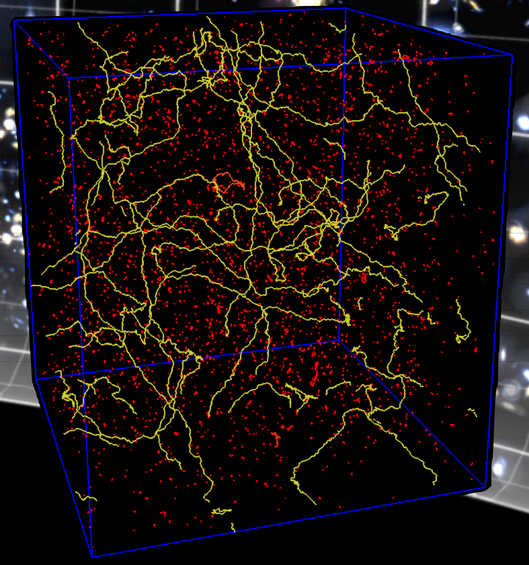


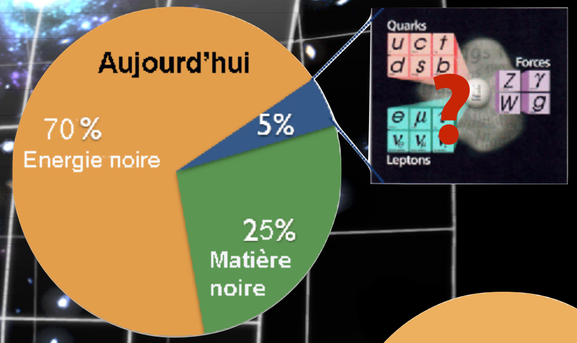
?

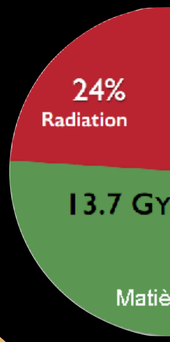
$$H^2(t) = \frac{8\pi G}{3c^2}\rho(t) - \frac{kc^2}{a^2(t)} +$$

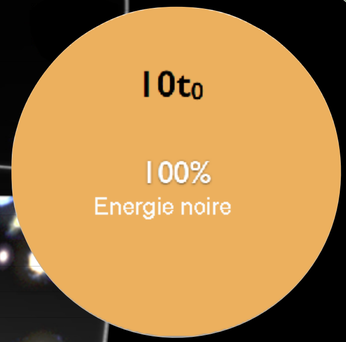
$$\frac{\ddot{a}(t)}{a(t)} = -\frac{4\pi G}{3c^2}\left(\rho(t) + \frac{3p(}{c^2}\right.$$

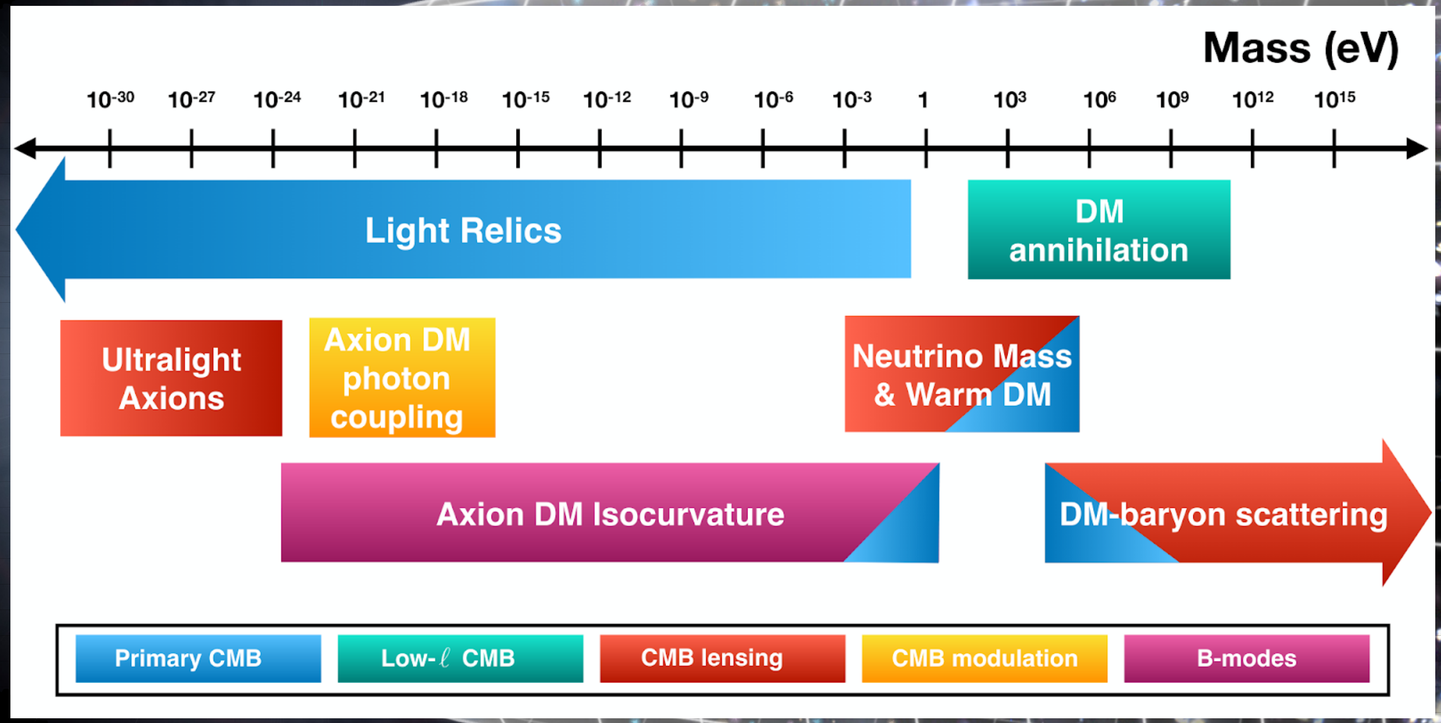


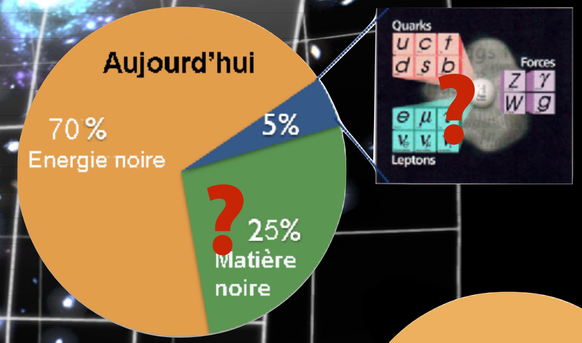


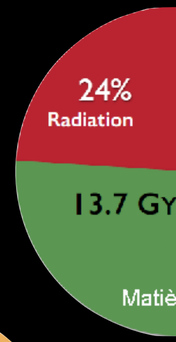


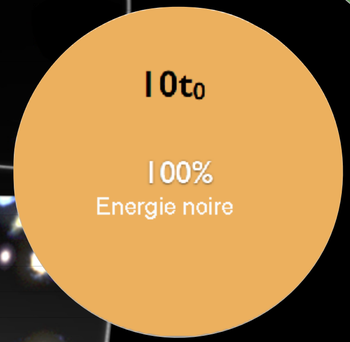












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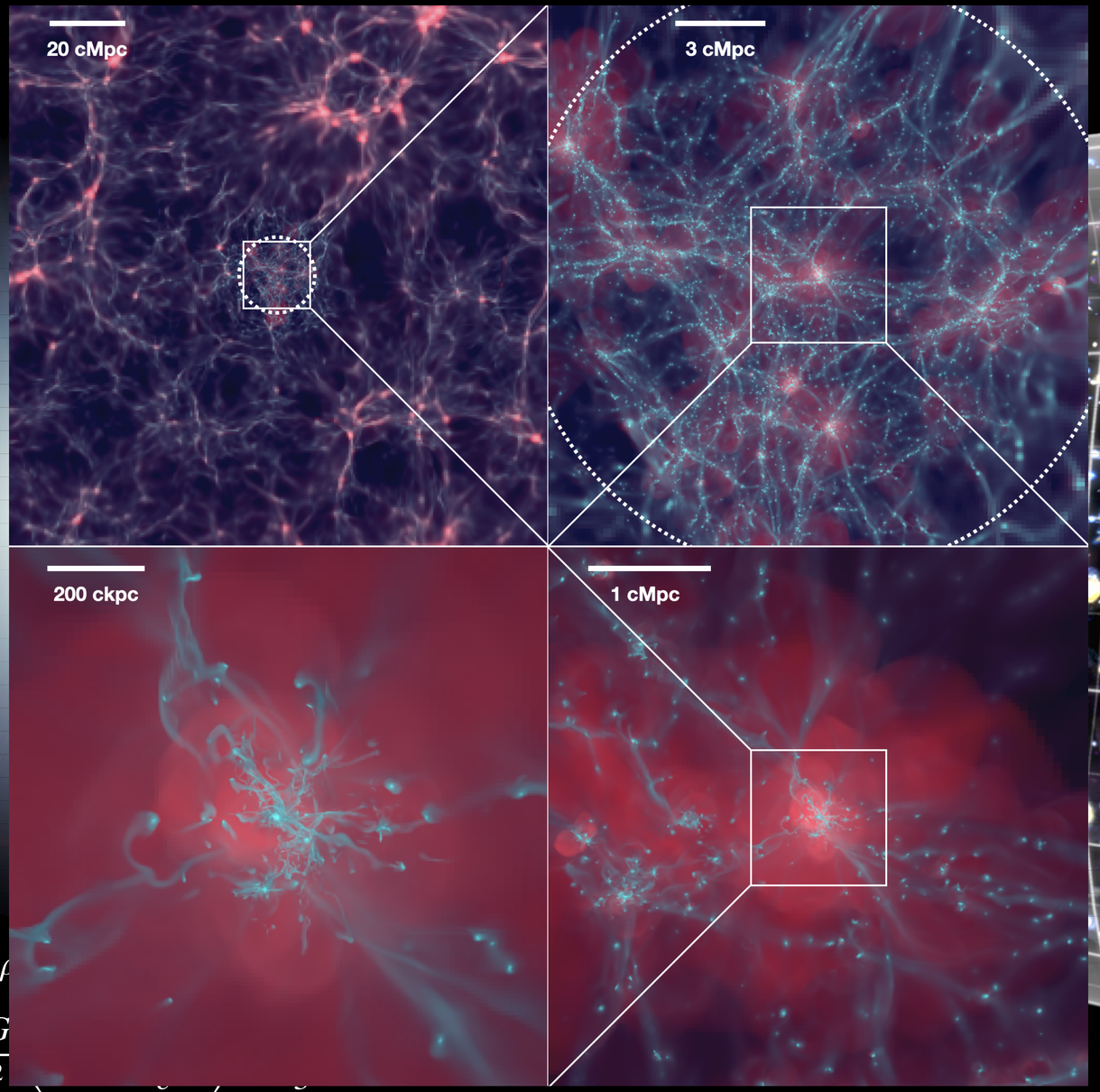

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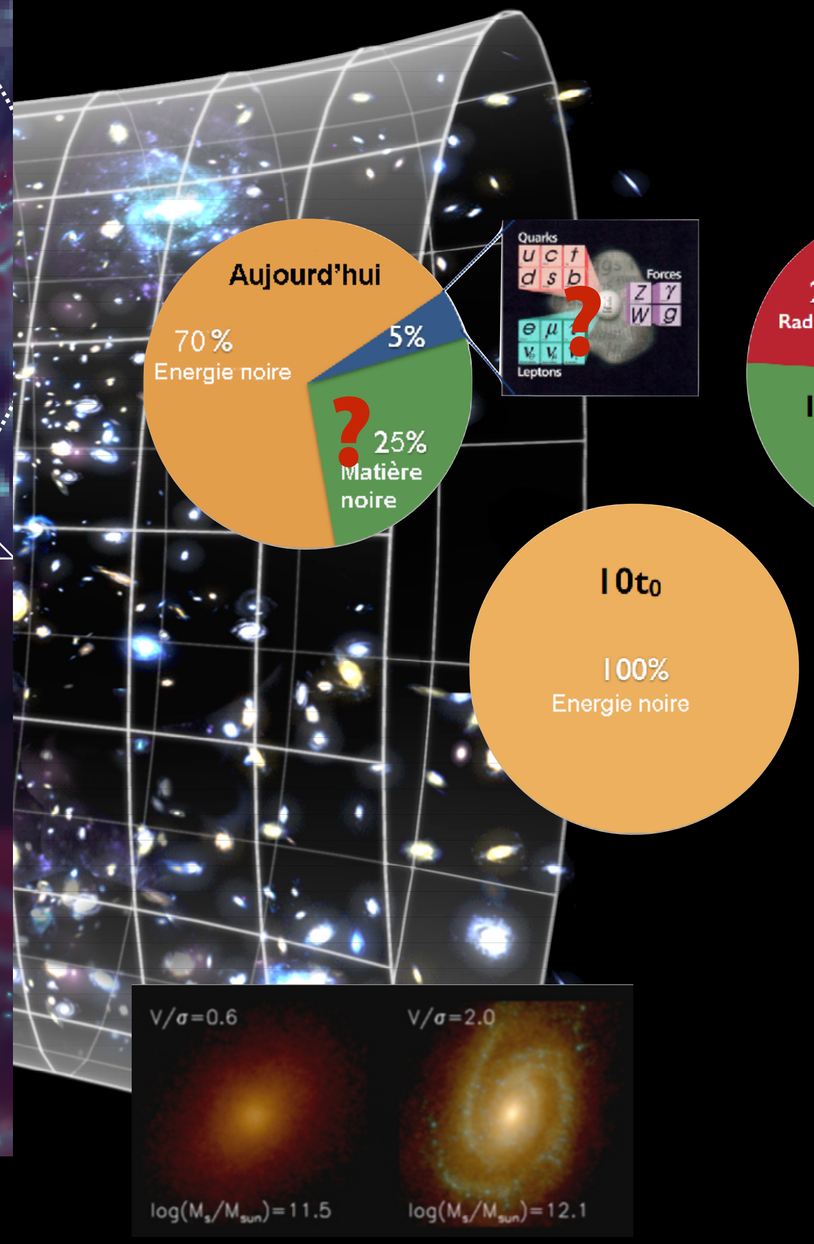
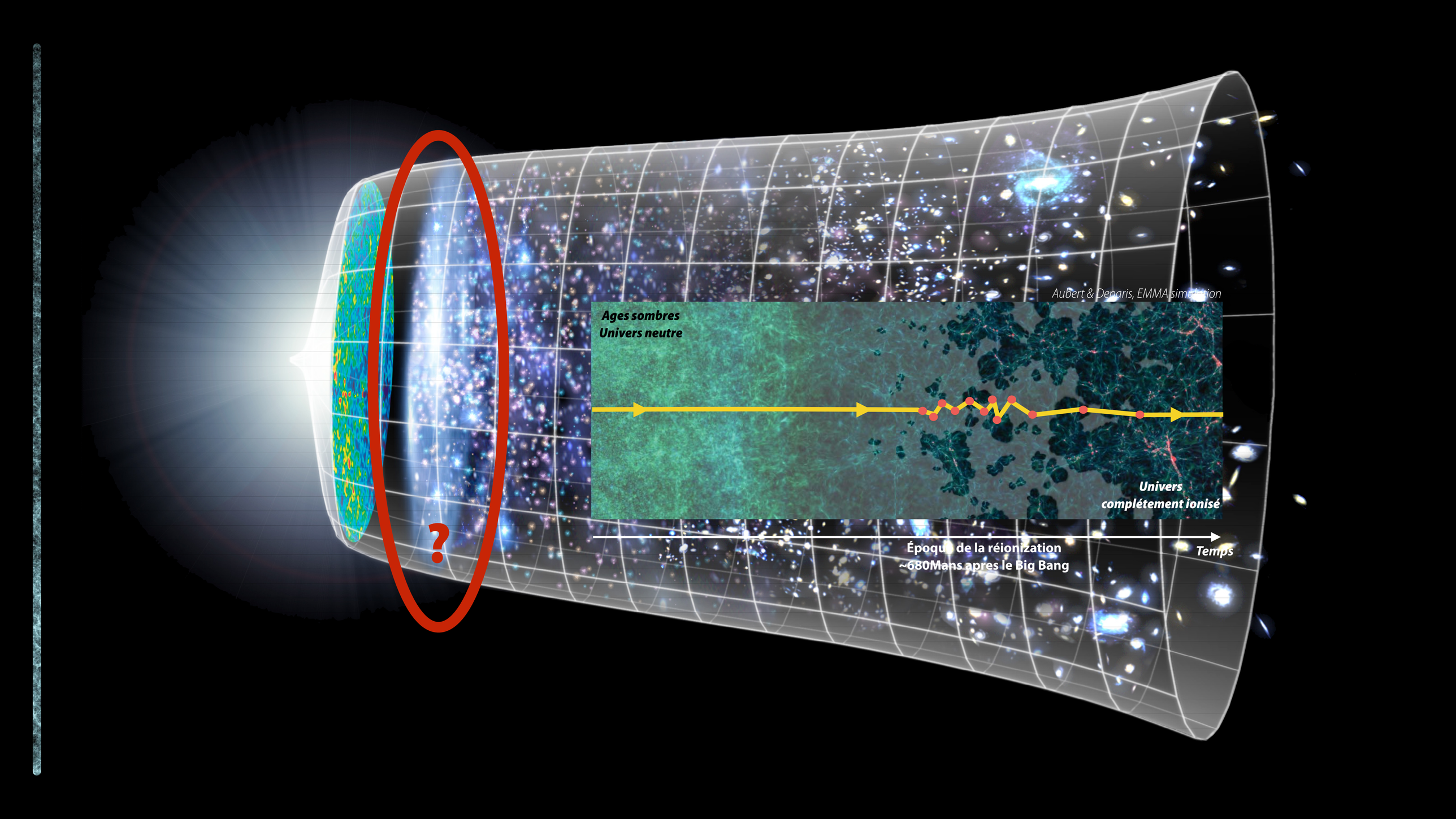
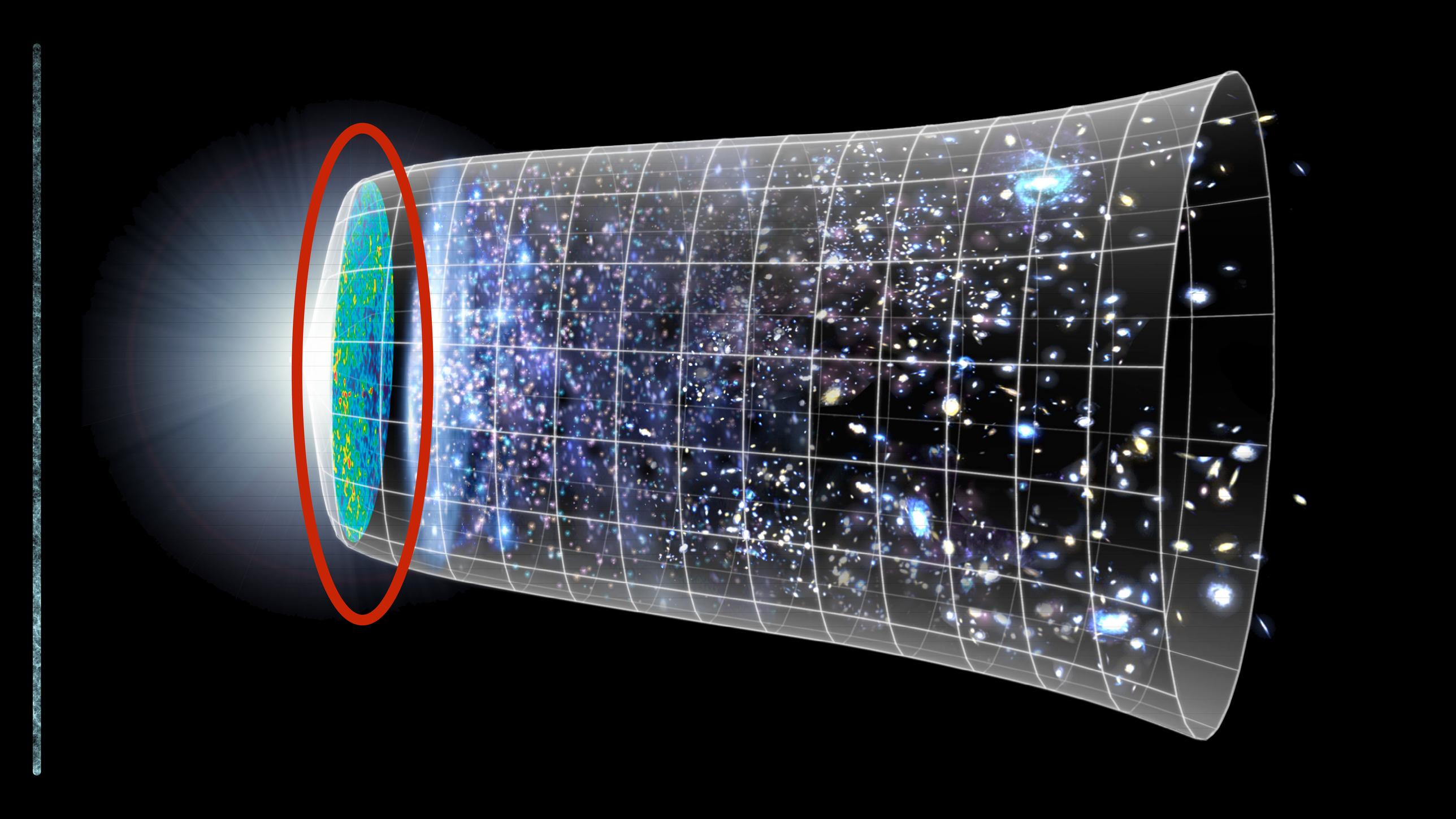
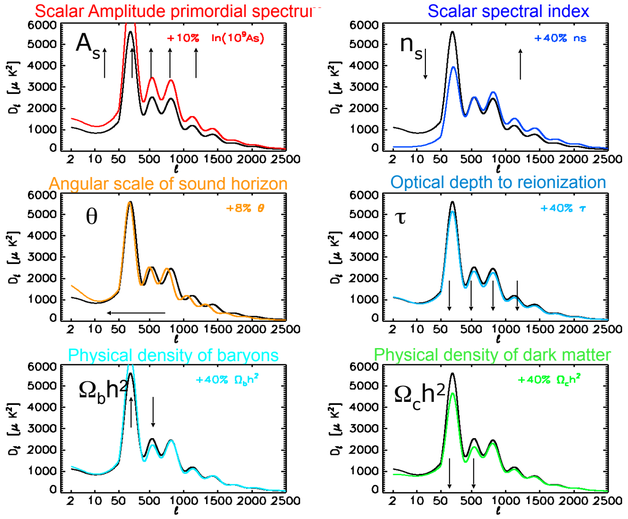
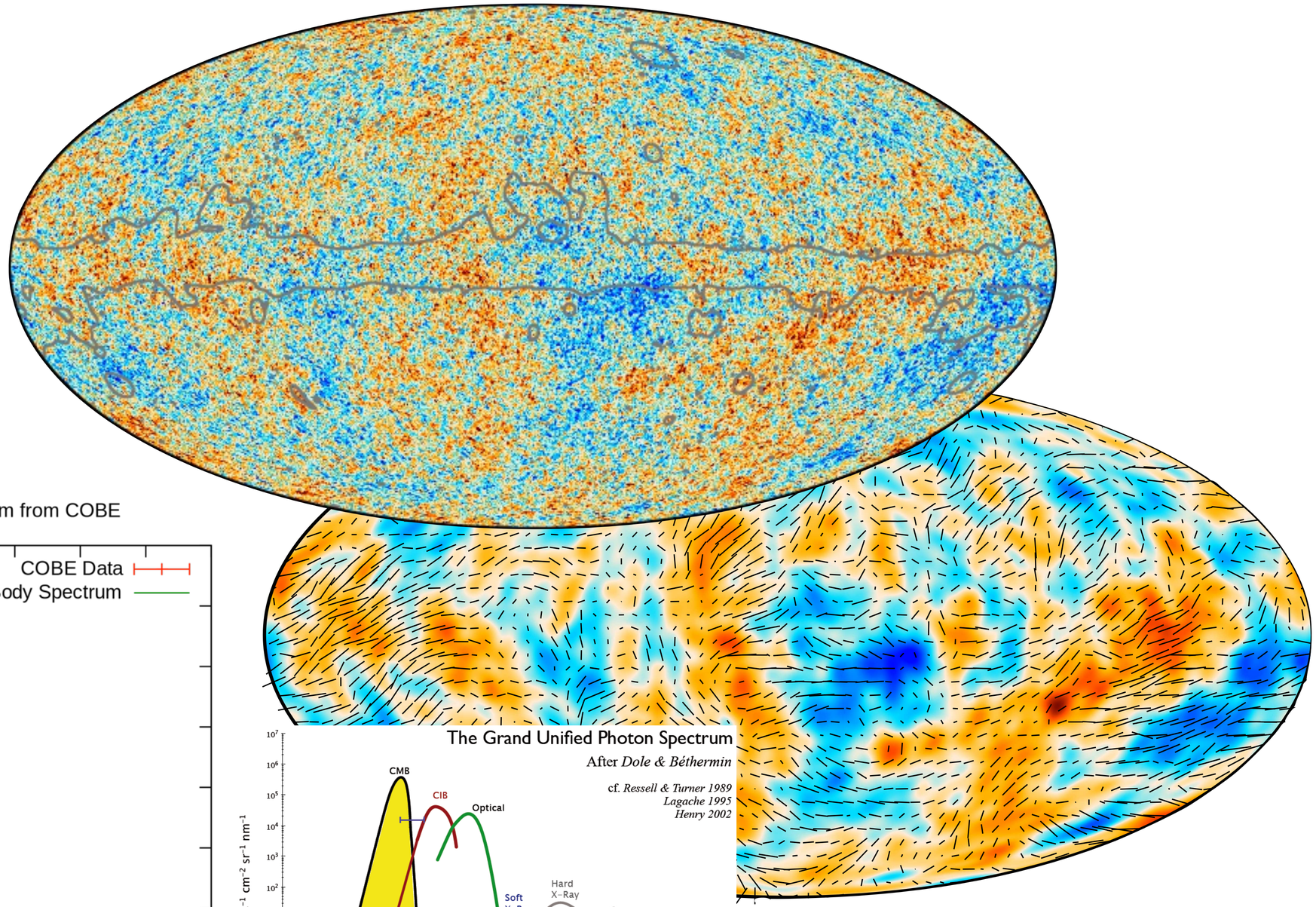
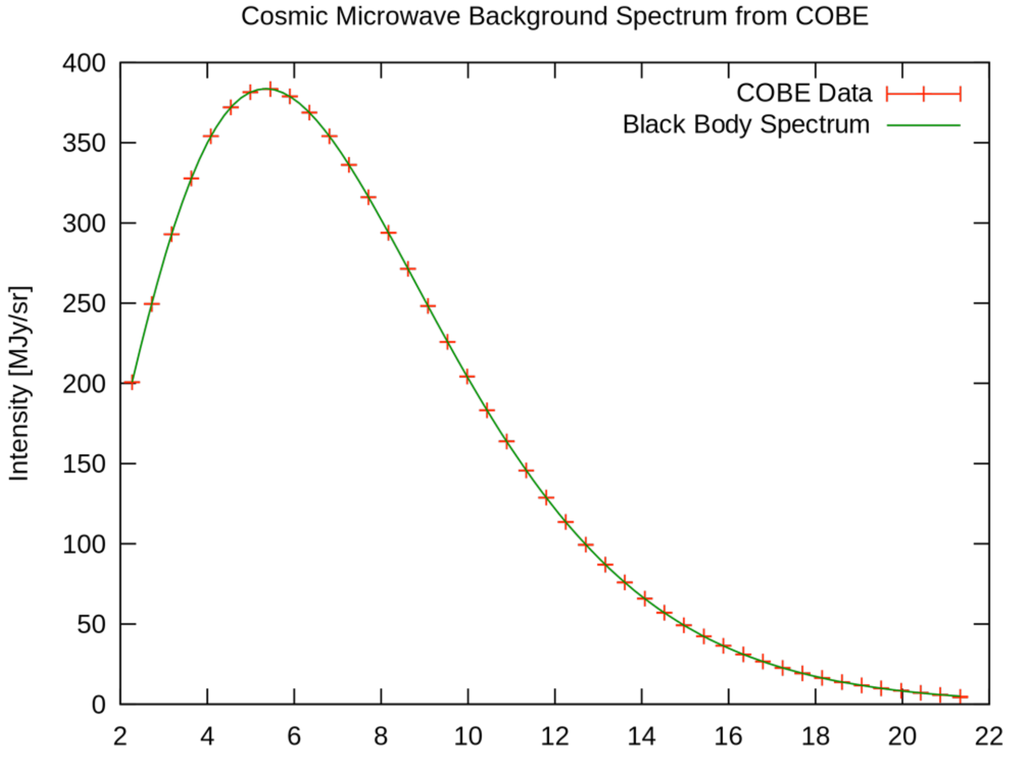



Aubert & Deparis, EMMA simulation
Ages sombres
Univers neutre
Univers
complétement ionisé
?
Époque de la réionization
~680Mans apres le Big Bang
Temps



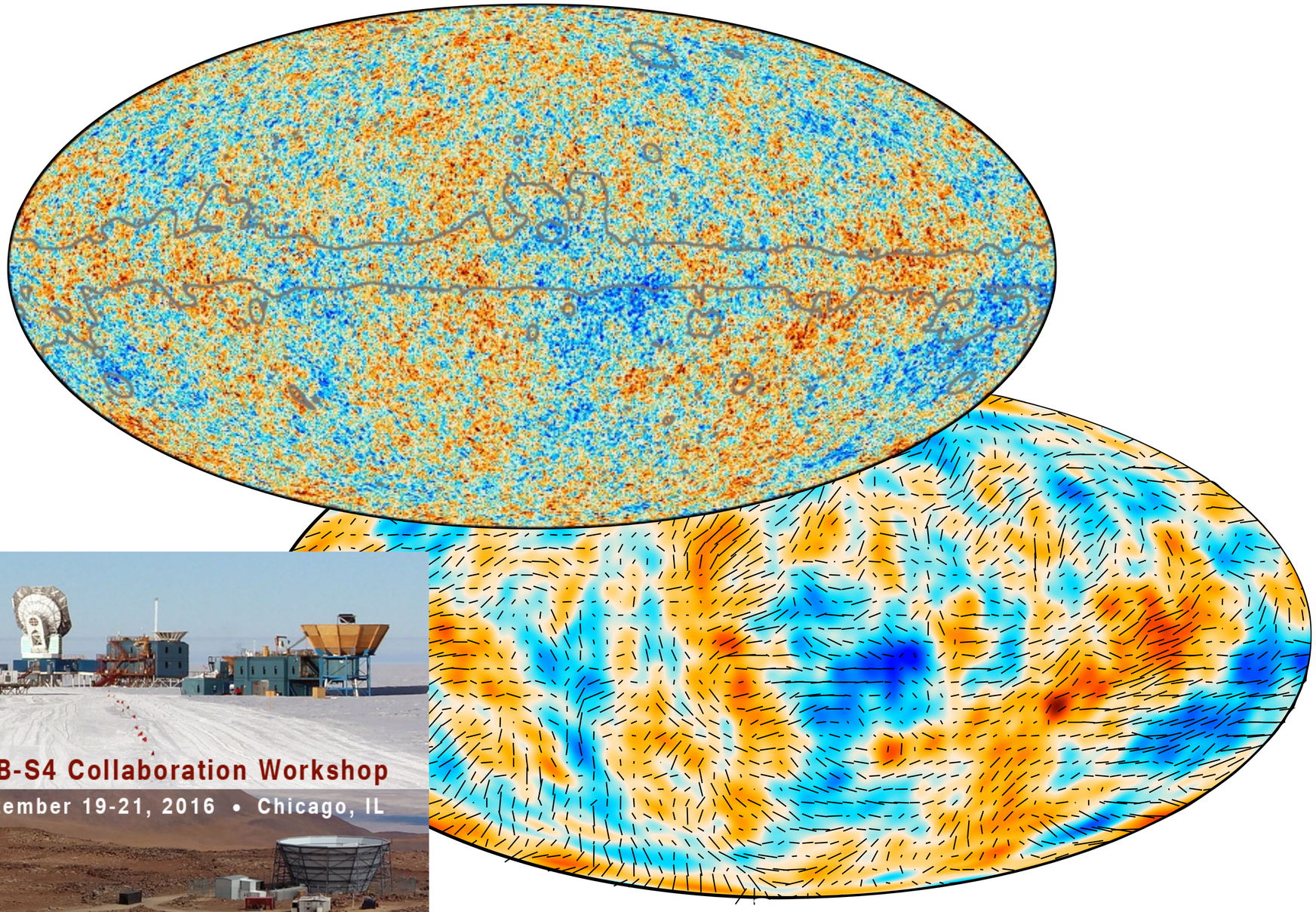




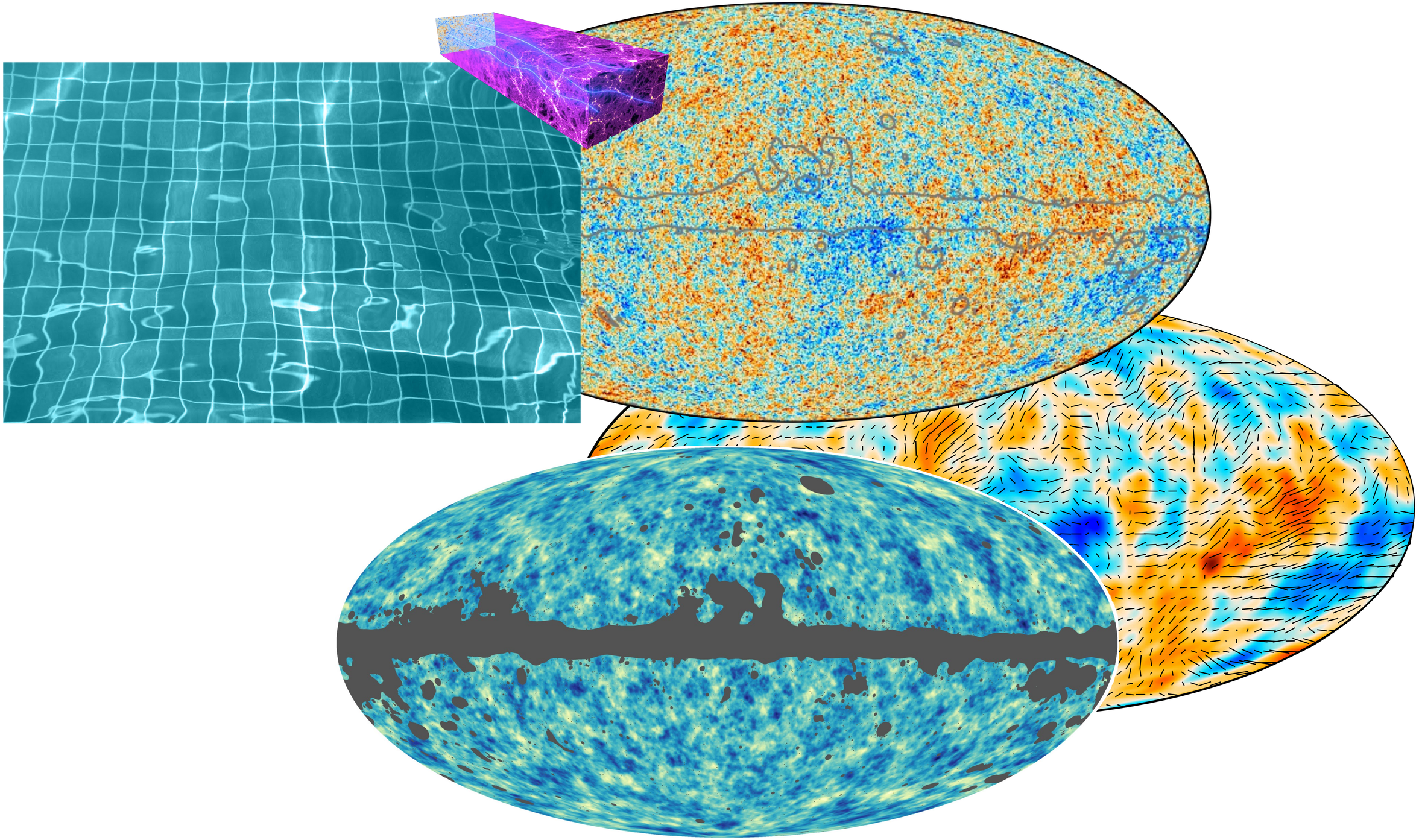


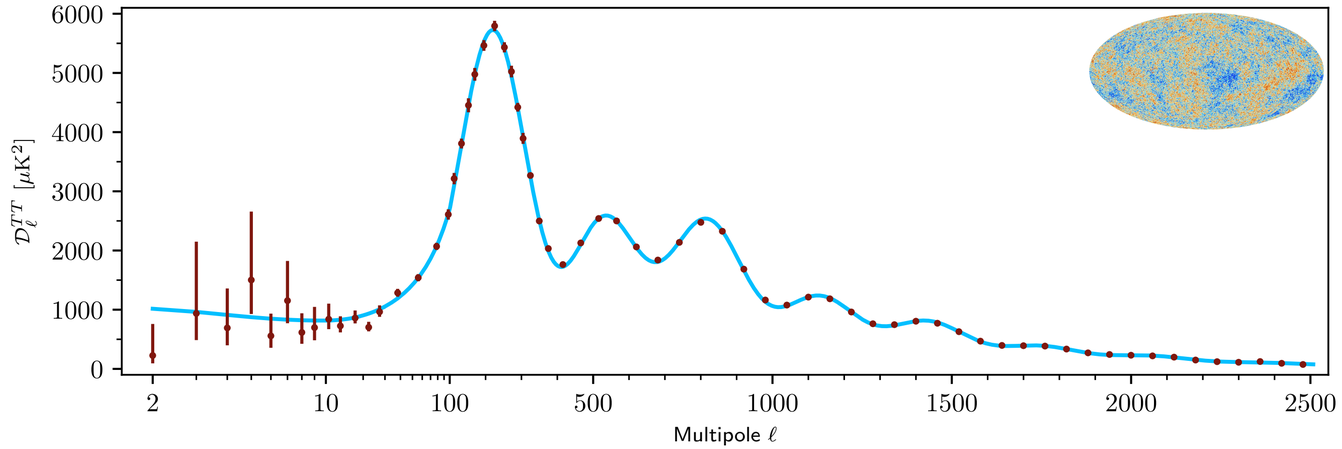
~10^{10} photons per baryon in the Universe
(most of them are the 2.73K CMB blackbody)

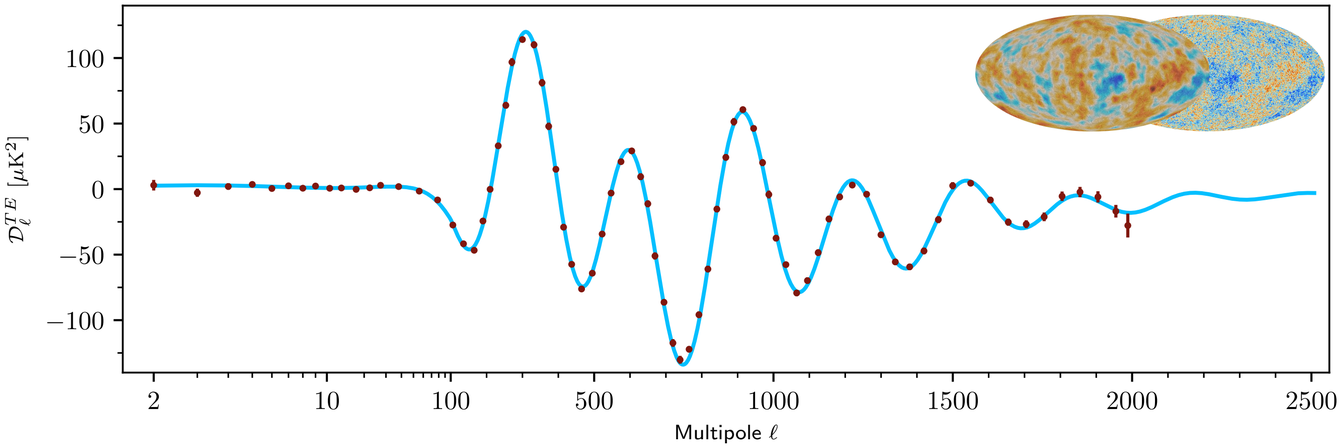

NORD

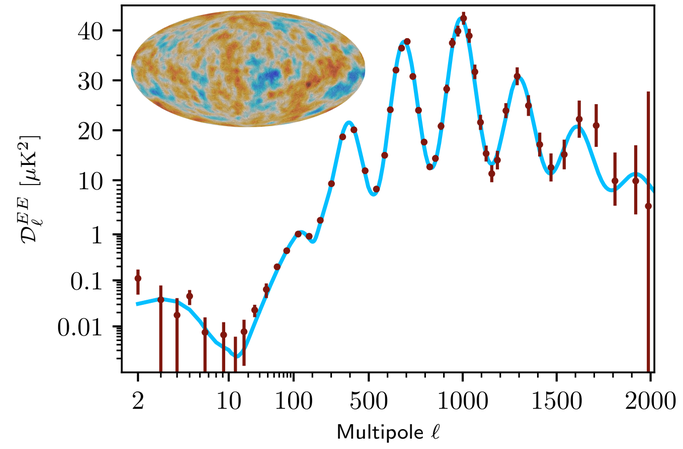


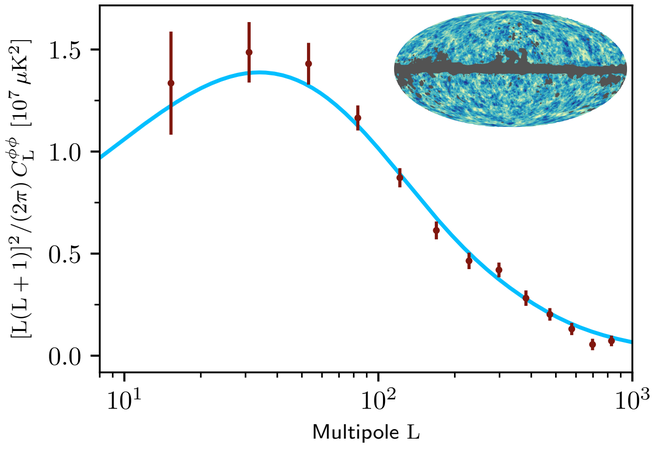

CMB-S4
Next Generation CMB Experiment
CMB-S4 Collaboration Workshop
September 19-21, 2016 • Chicago, IL

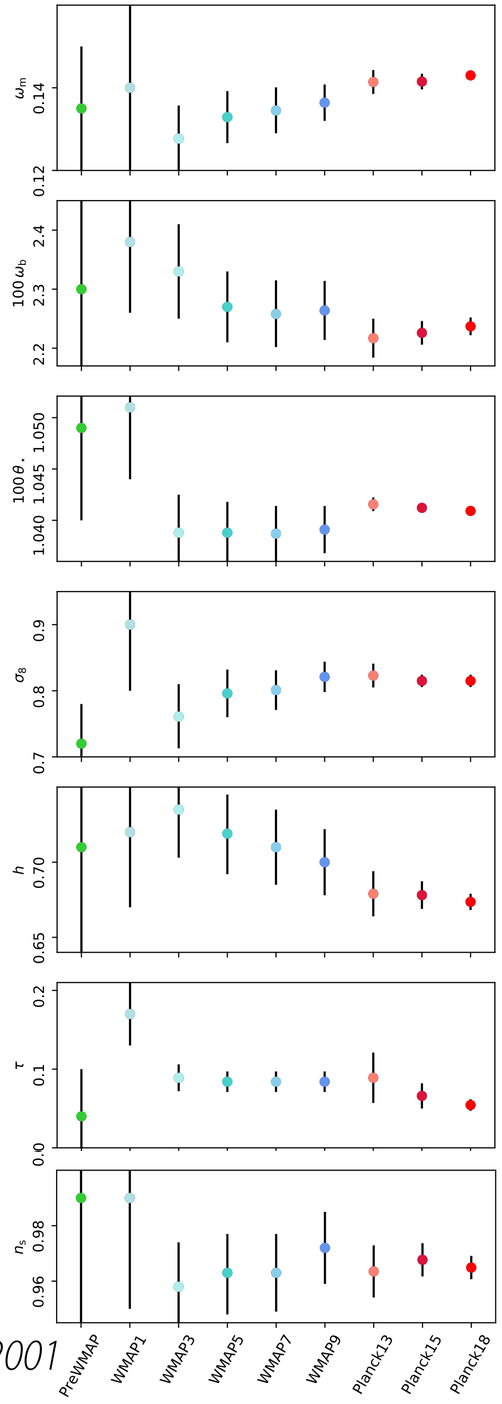


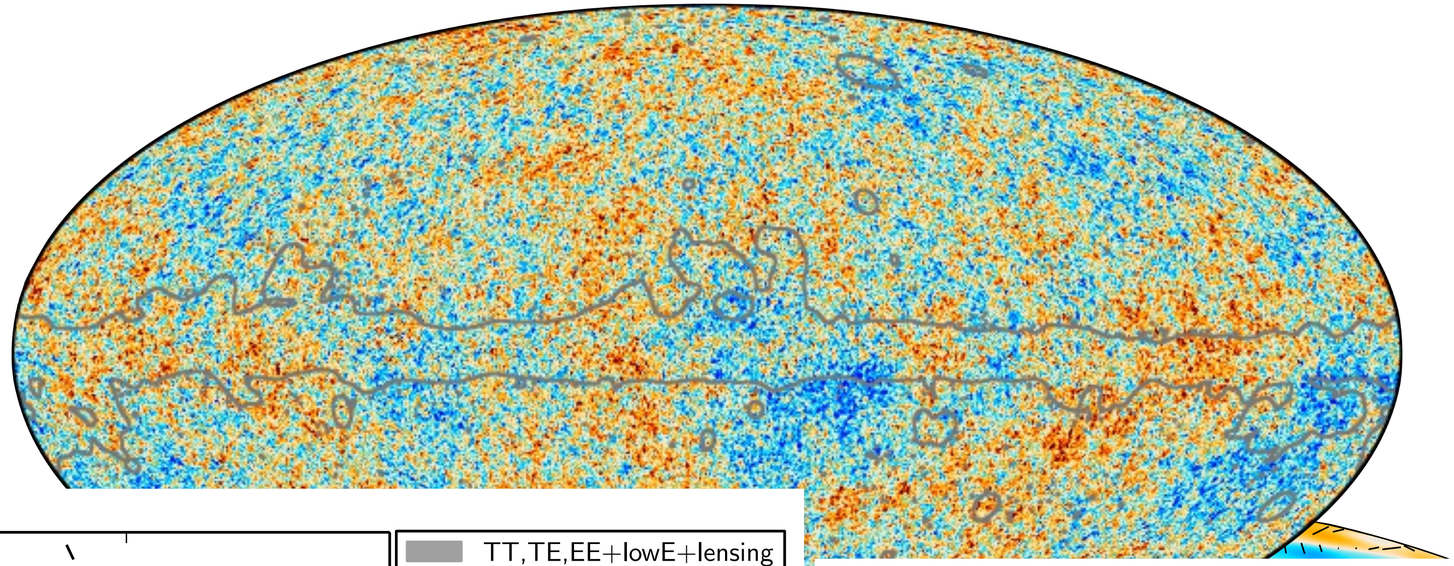

$\mathcal{D}_\ell^{TT}$ [μK^2]
Multipole ℓ

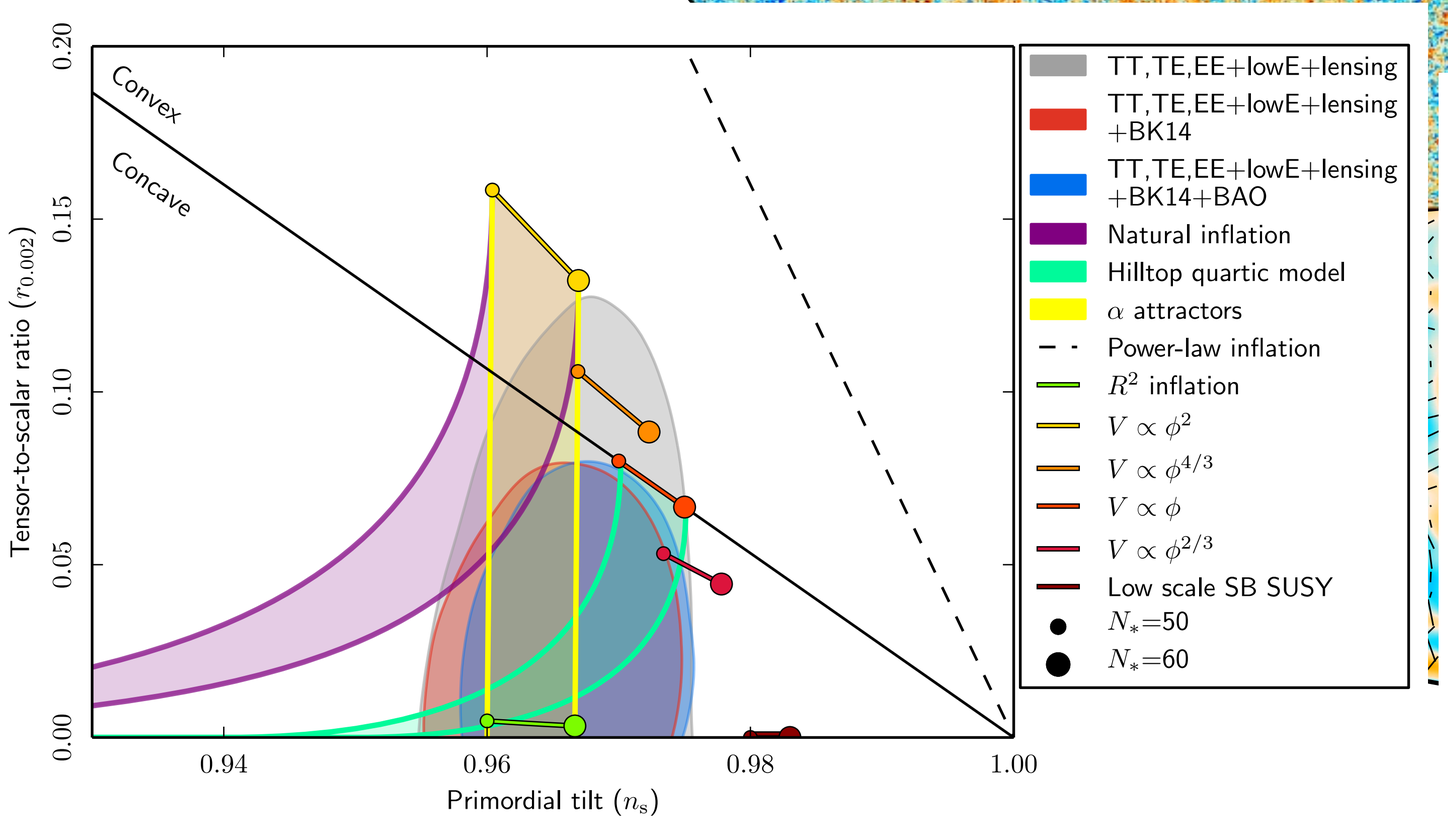

$\mathcal{D}_\ell^{TE}$ [μK^2]
Multipole ℓ

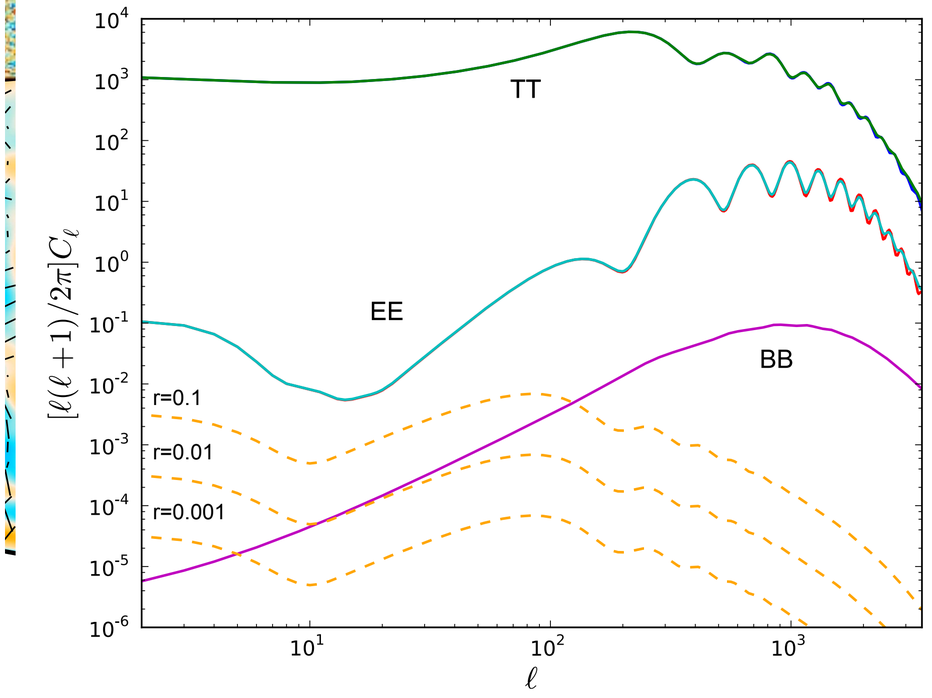

$\mathcal{D}_\ell^{EE}$ [μK^2]
Multipole ℓ

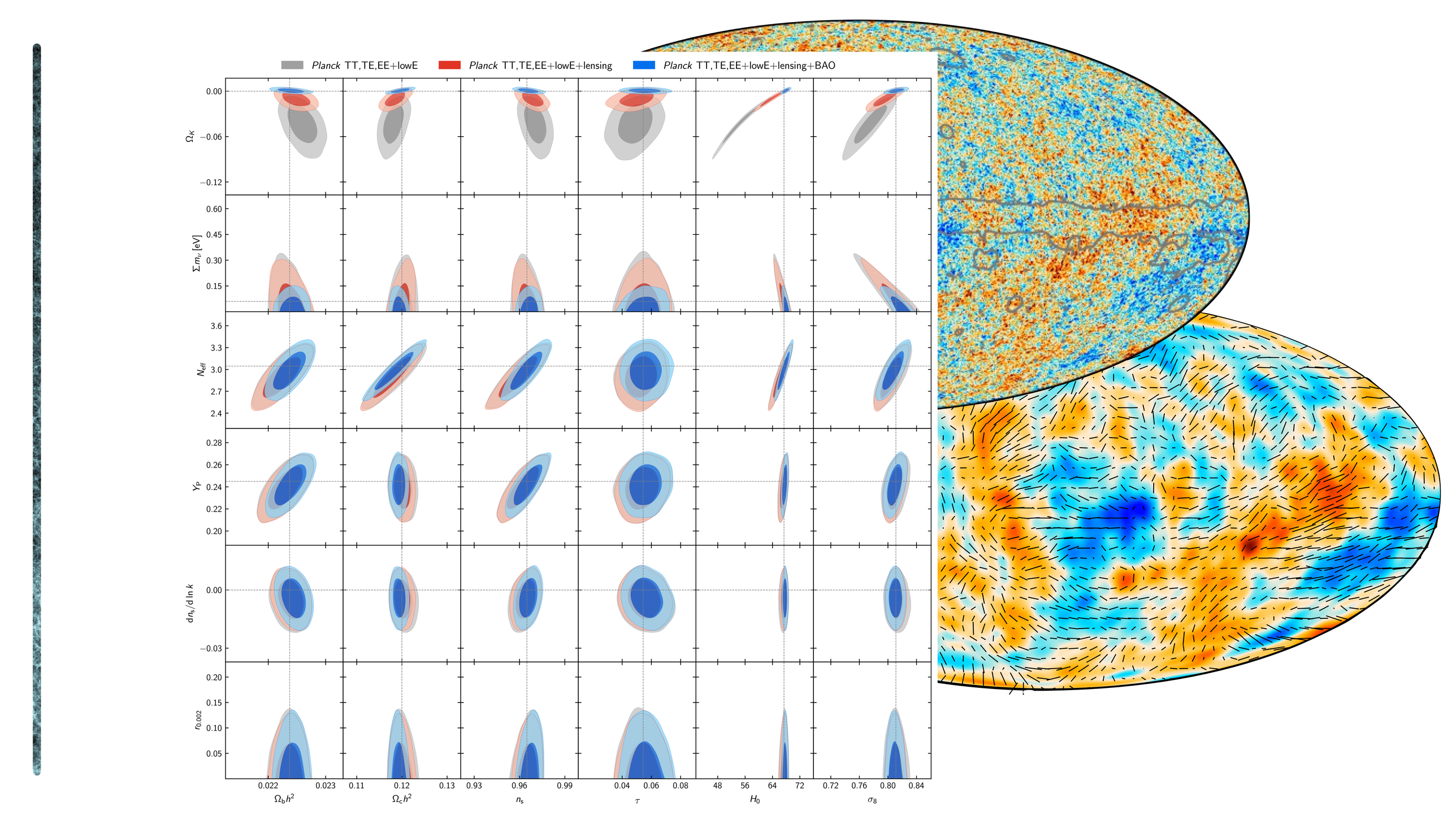

$[L(L+1)]^2/(2\pi)\,C_L^{\phi\phi}$ [10^7 μK^2]
Multipole L

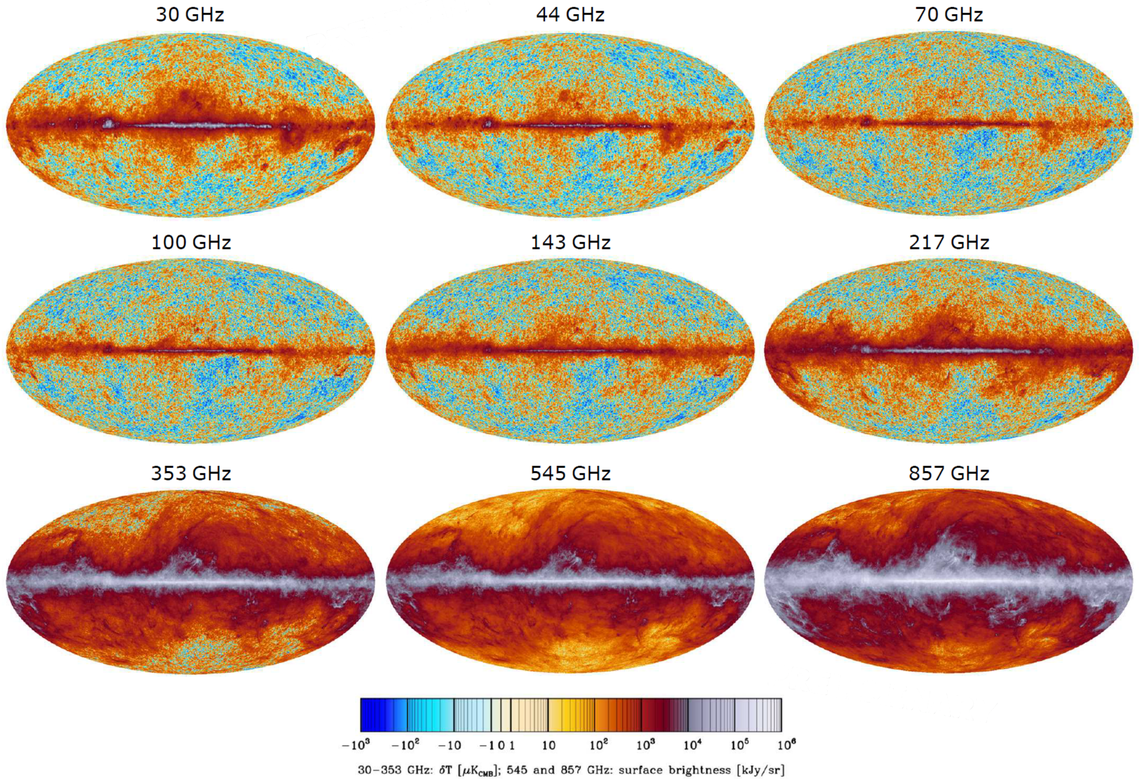

ω_m
$100\,\omega_b$
$100\,\theta_*$
σ_8
h
τ
n_s
2001
PreWMAP
WMAP1
WMAP3
WMAP5
WMAP7
WMAP9
Planck13
Planck15
Planck18
2019

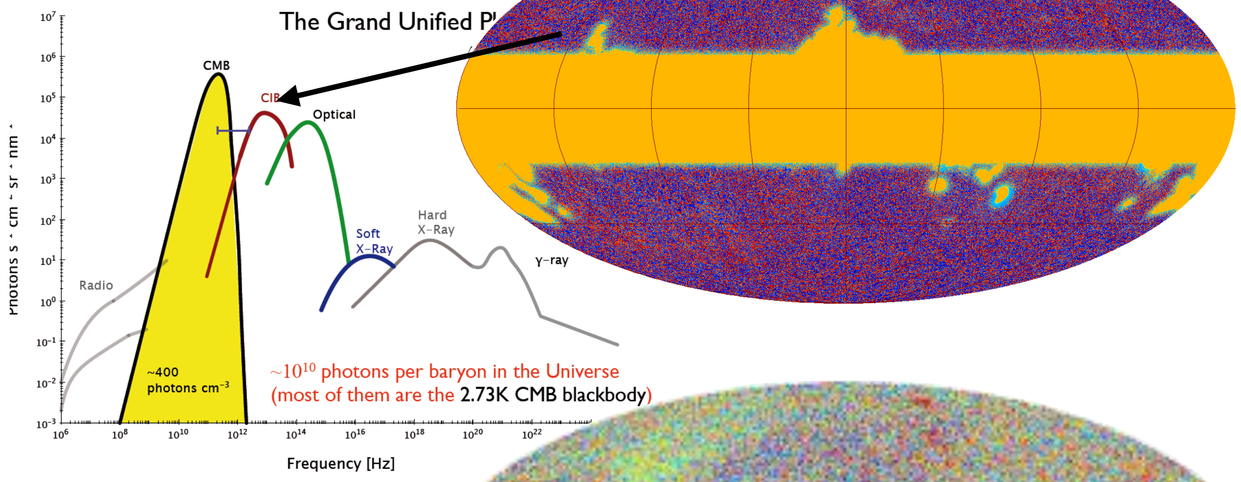



Convex
Concave
Tensor-to-scalar ratio ($r_{0.002}$)
Primordial tilt (n_s)
0.00
0.05
0.10
0.15
0.20
0.94
0.96
0.98
1.00
TT,TE,EE+lowE+lensing
TT,TE,EE+lowE+lensing +BK14
TT,TE,EE+lowE+lensing +BK14+BAO
Natural inflation
Hilltop quartic model
α attractors
Power-law inflation
R^2 inflation
$V \propto \phi^2$
$V \propto \phi^{4/3}$
$V \propto \phi$
$V \propto \phi^{2/3}$
Low scale SB SUSY
N_*=50
N_*=60


TT
EE
BB
r=0.1
r=0.01
r=0.001
$[\ell(\ell+1)/2\pi]C_\ell$
ℓ
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}
10^{1}
10^{2}
10^{3}


Planck TT,TE,EE+lowE
Planck TT,TE,EE+lowE+lensing
Planck TT,TE,EE+lowE+lensing+BAO
Ω_K
Σm_ν [eV]
$N_{\rm eff}$
$Y_{\rm P}$
$\mathrm{d}n_{\rm s}/\mathrm{d}\ln k$
$r_{0.002}$
$\Omega_{\rm b}h^2$
$\Omega_{\rm c}h^2$
$n_{\rm s}$
τ
H_0
σ_8





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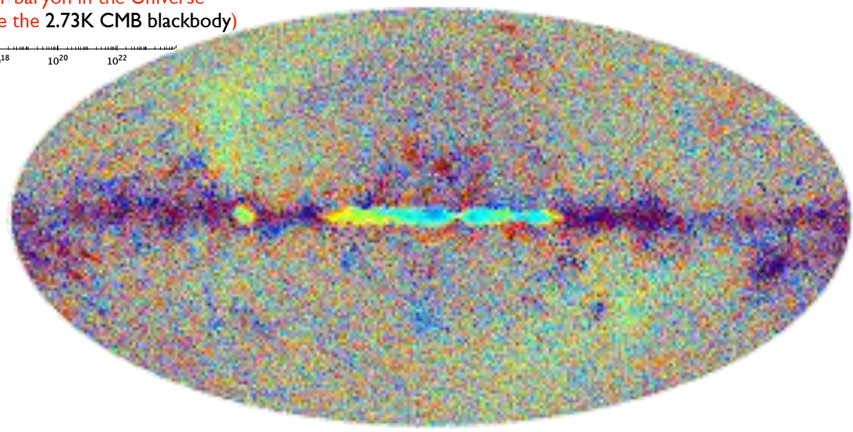
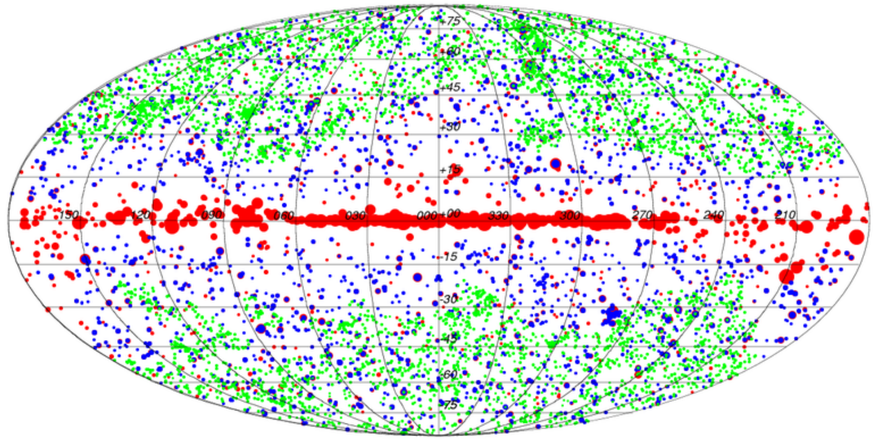
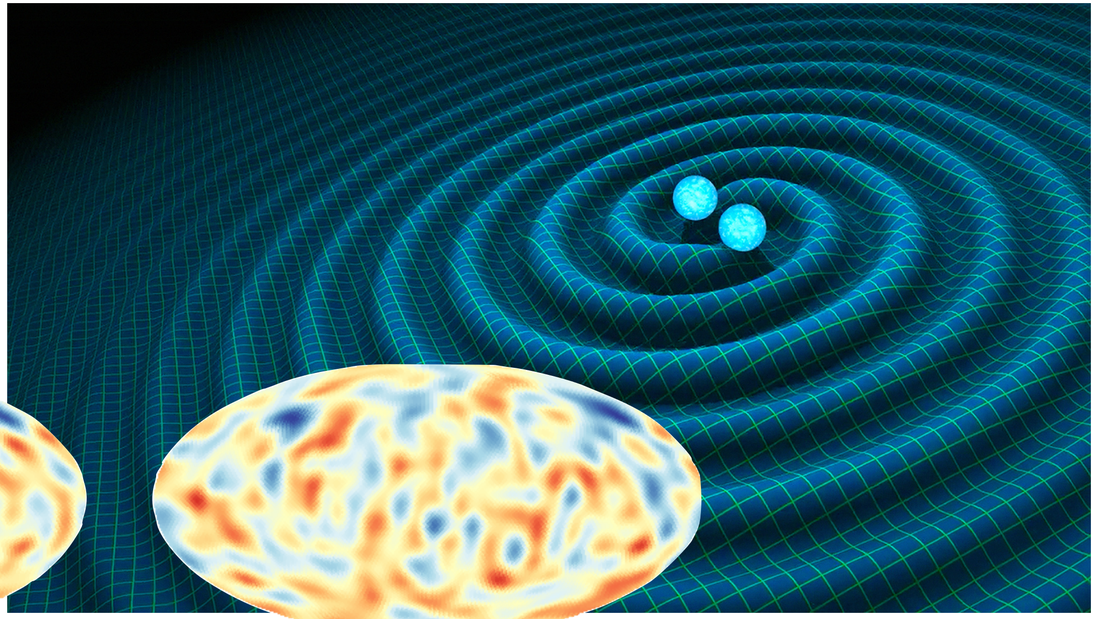
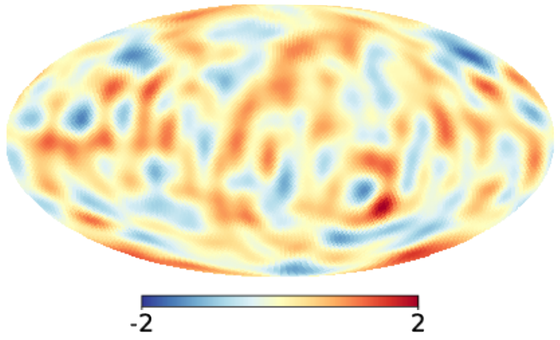
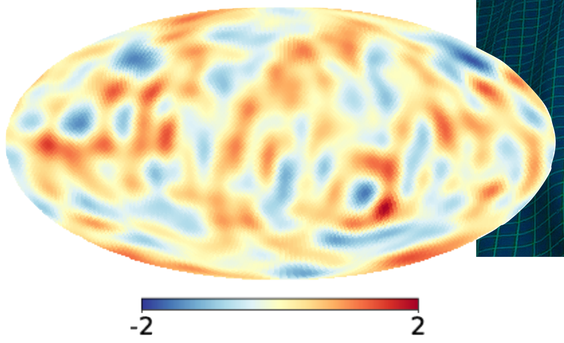




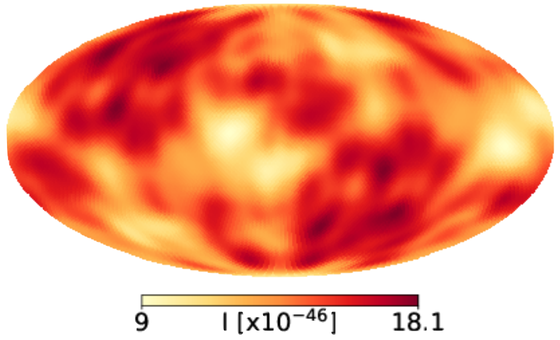


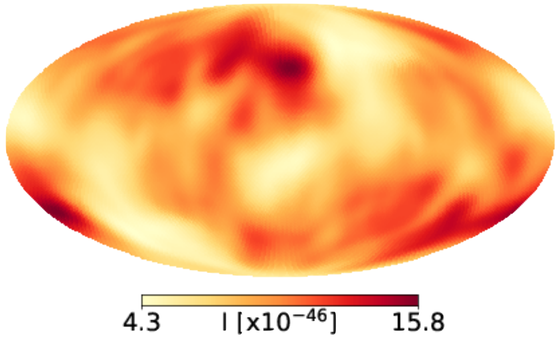
S/N

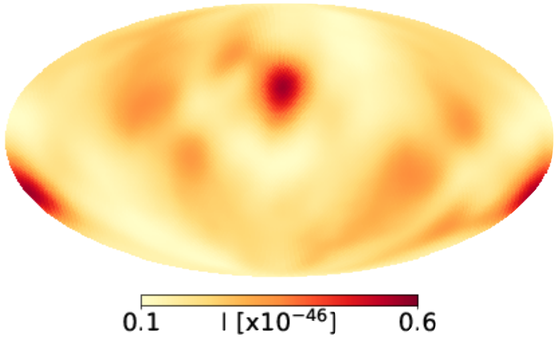




Noise



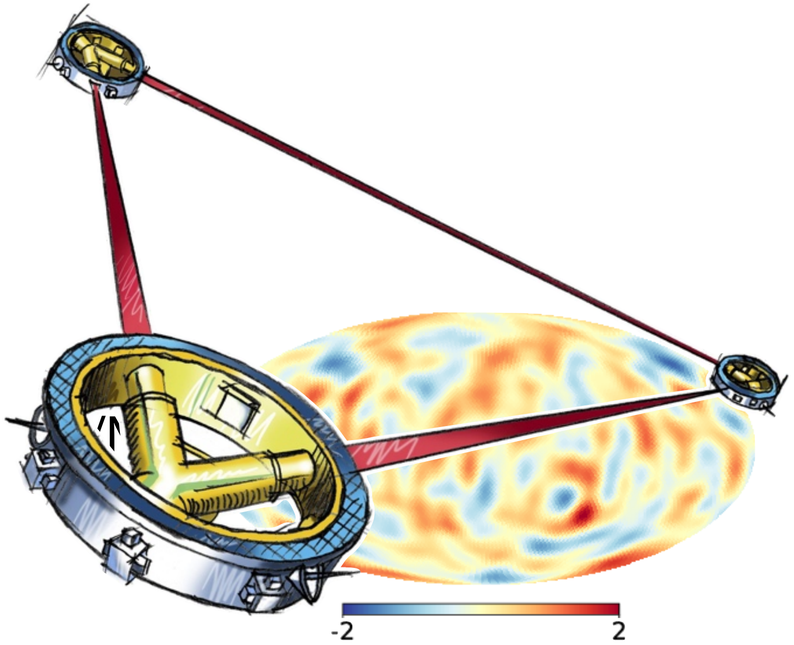


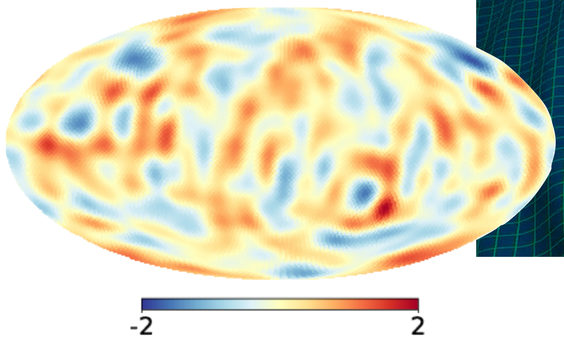


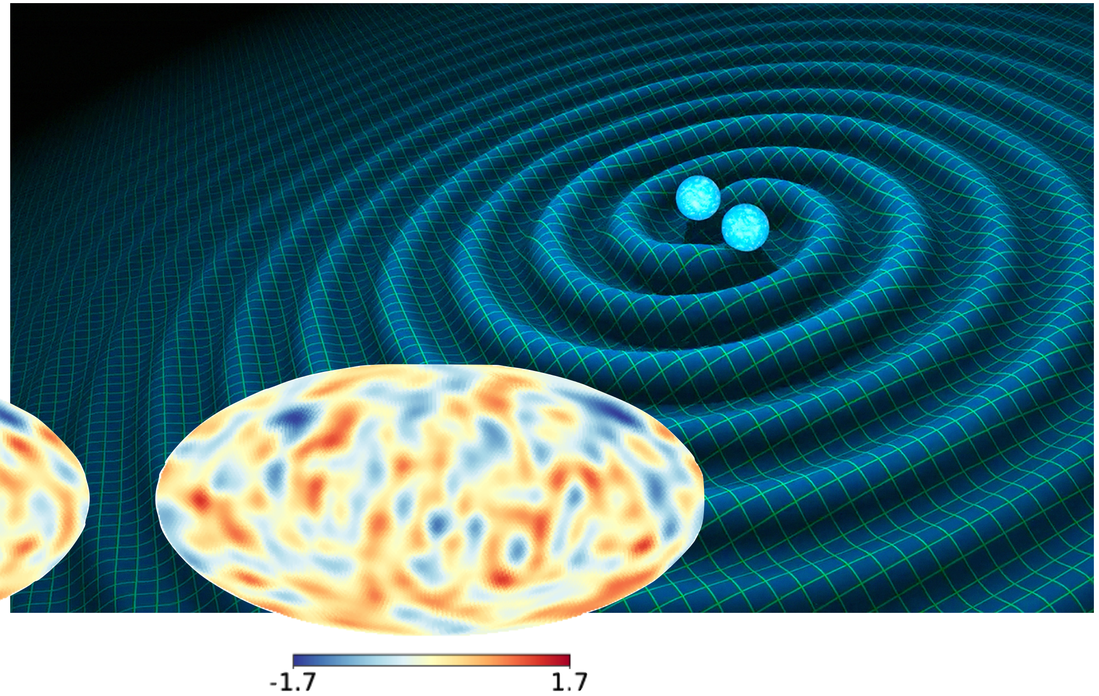
Primordial

object collapse $\alpha = 2/3$

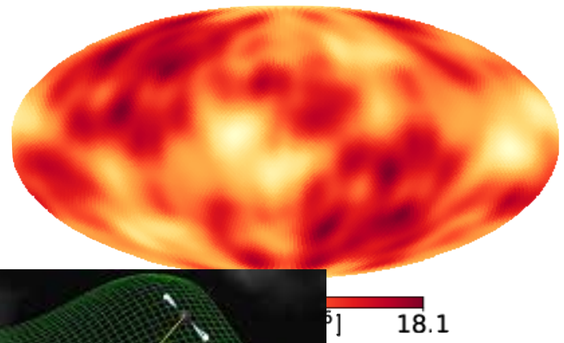
$\alpha = 3$

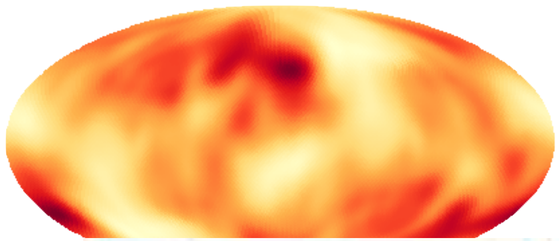


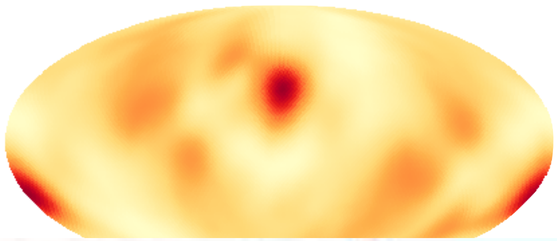


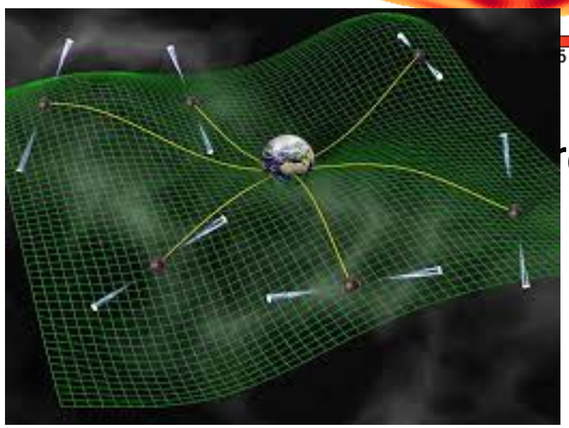


Noise



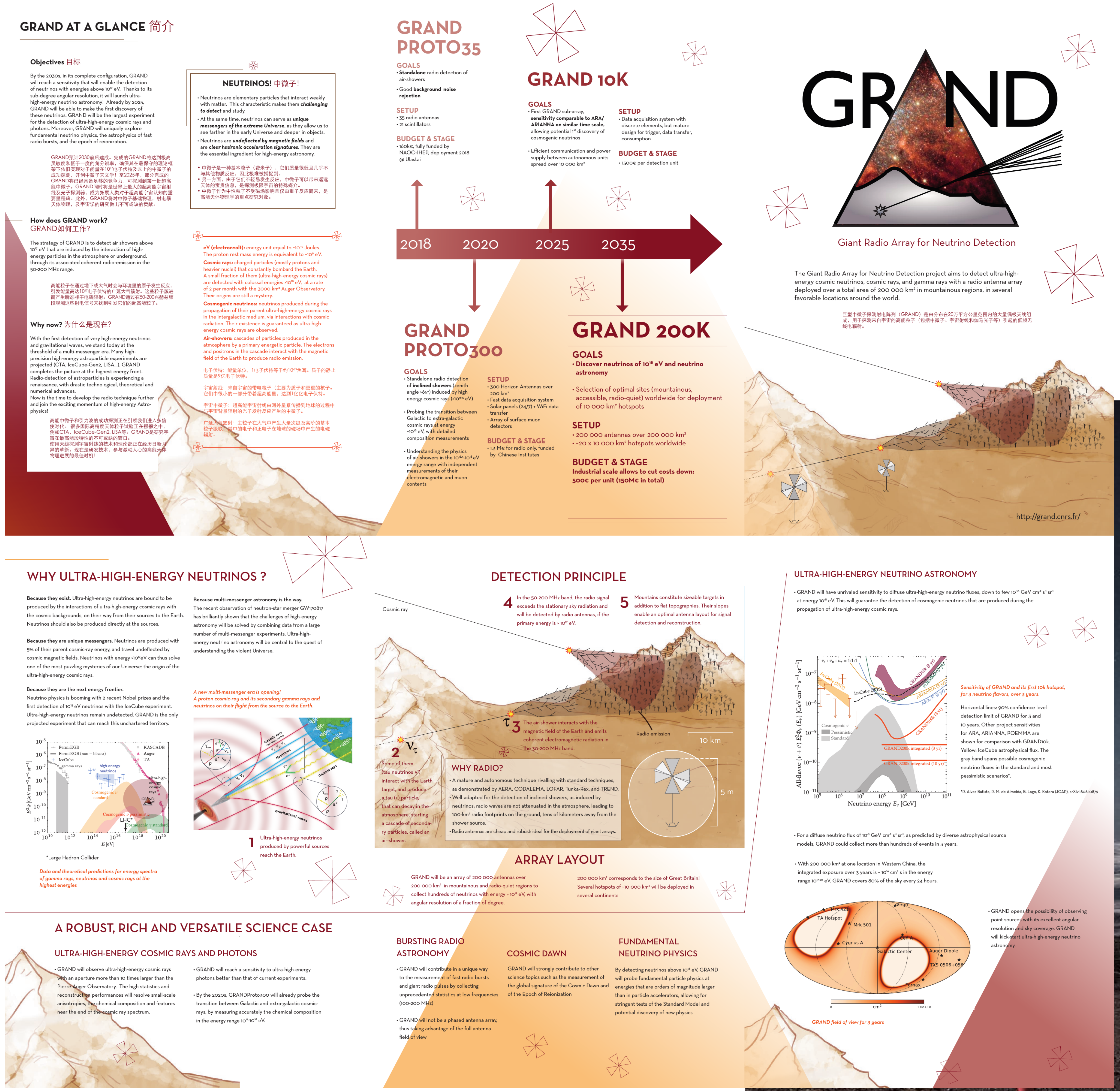


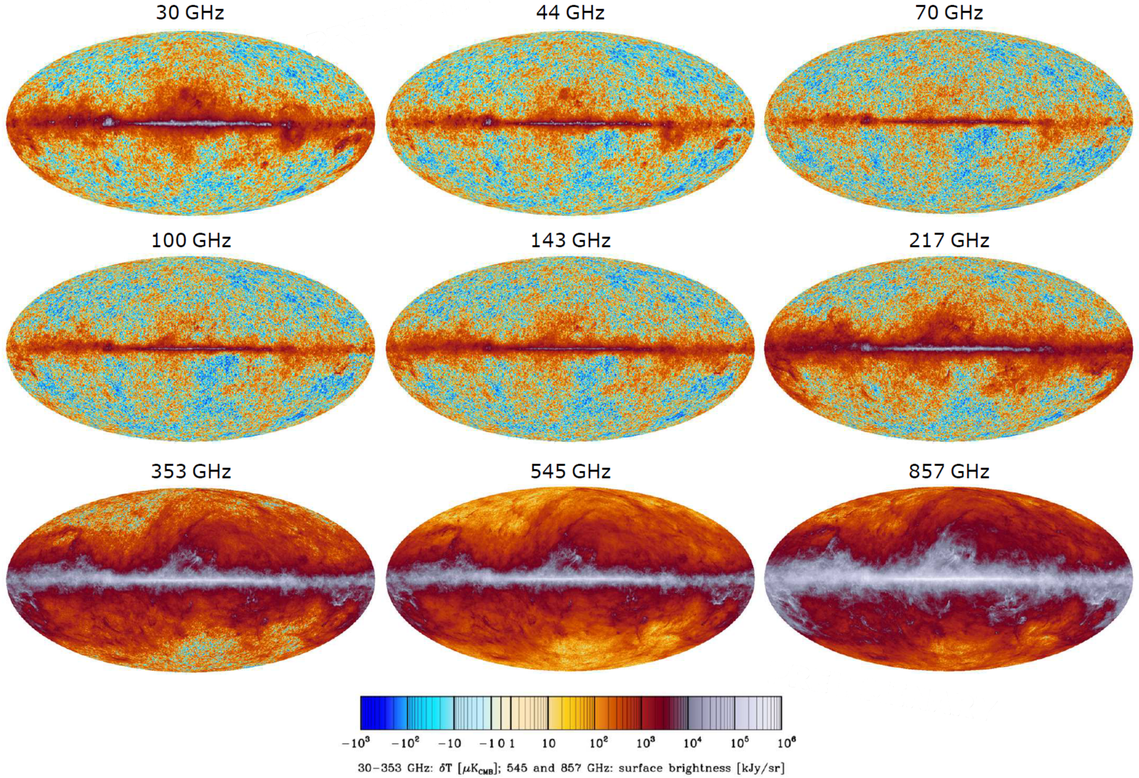


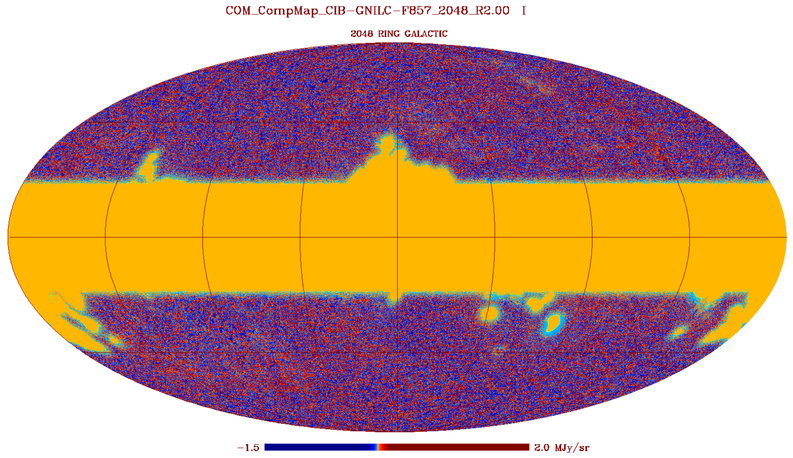


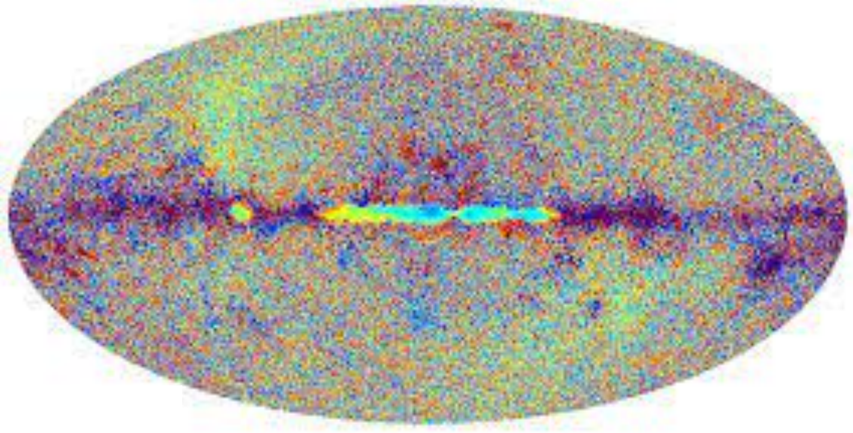
rdial

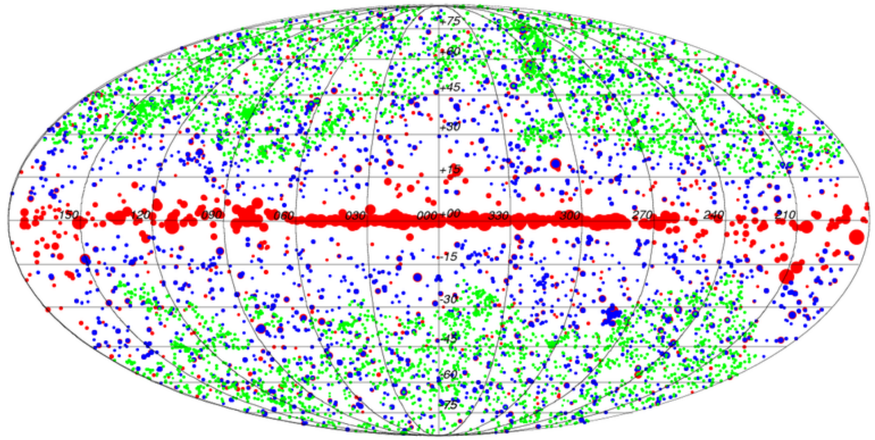
obj

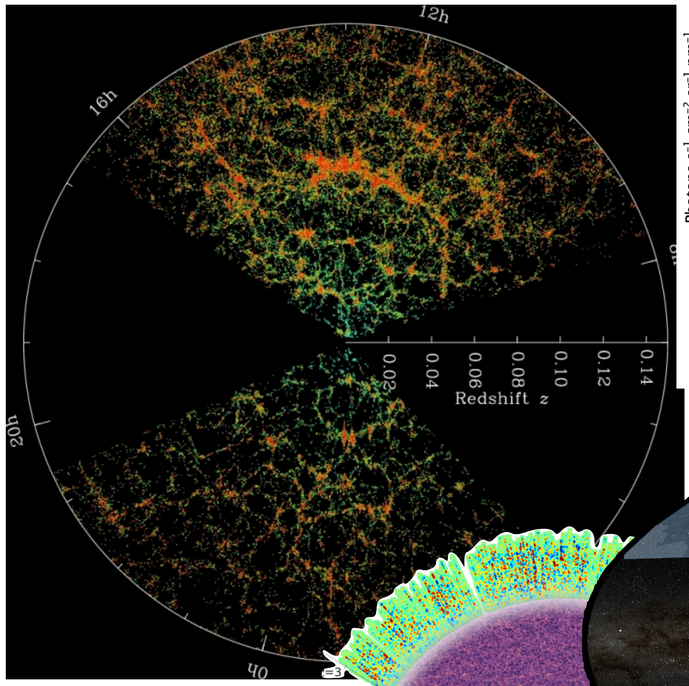

GRAND AT A GLANCE 简介
Objectives 目标
NEUTRINOS! 中微子!
How does GRAND work?
GRAND如何工作?
Why now? 为什么是现在?
GRAND PROTO35
GRAND 10K
GRAND
Giant Radio Array for Neutrino Detection
2018
2020
2025
2035
GRAND PROTO300
GRAND 200K
GOALS
SETUP
BUDGET & STAGE
http://grand.cnrs.fr/
WHY ULTRA-HIGH-ENERGY NEUTRINOS ?
DETECTION PRINCIPLE
WHY RADIO?
ARRAY LAYOUT
ULTRA-HIGH-ENERGY NEUTRINO ASTRONOMY
A ROBUST, RICH AND VERSATILE SCIENCE CASE
ULTRA-HIGH-ENERGY COSMIC RAYS AND PHOTONS
BURSTING RADIO ASTRONOMY
COSMIC DAWN
FUNDAMENTAL NEUTRINO PHYSICS

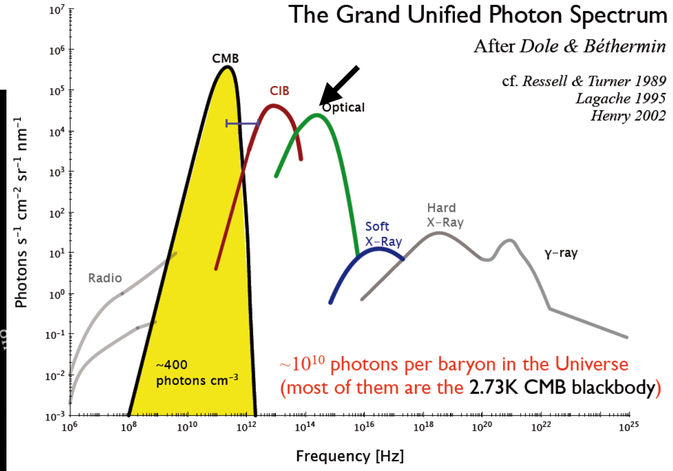

30 GHz
44 GHz
70 GHz
100 GHz
143 GHz
217 GHz
353 GHz
545 GHz
857 GHz
-10^3 -10^2 -10 -1 0 1 10 10^2 10^3 10^4 10^5 10^6
30–353 GHz: δT [μK_{CMB}]; 545 and 857 GHz: surface brightness [kJy/sr]

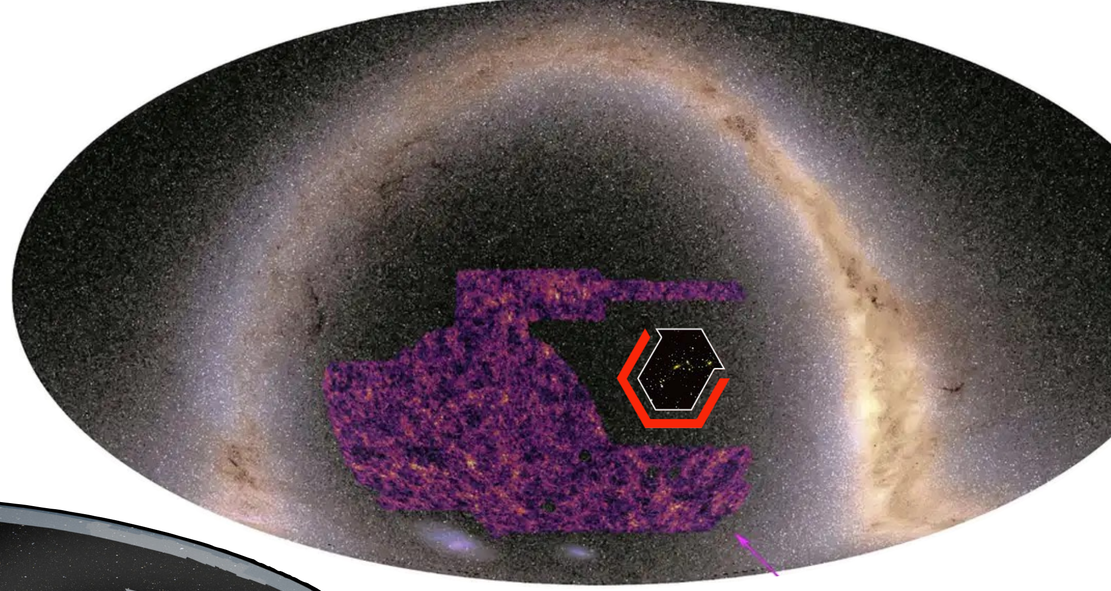

COM_CompMap_CIB-GNILC-F857_2048_R2.00 I
2048 RING GALACTIC
−1.5
2.0 MJy/sr

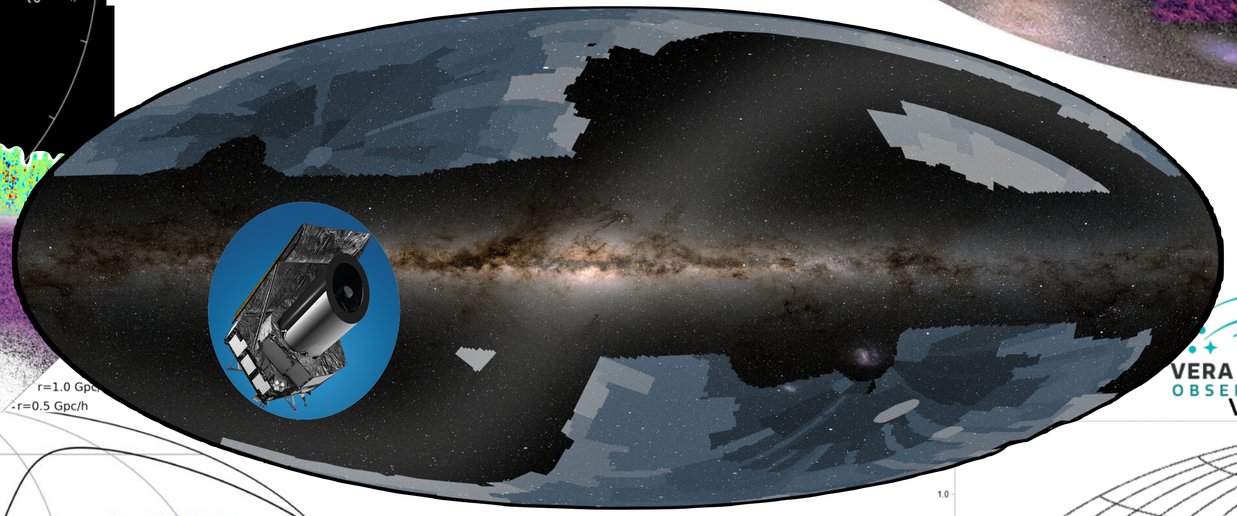


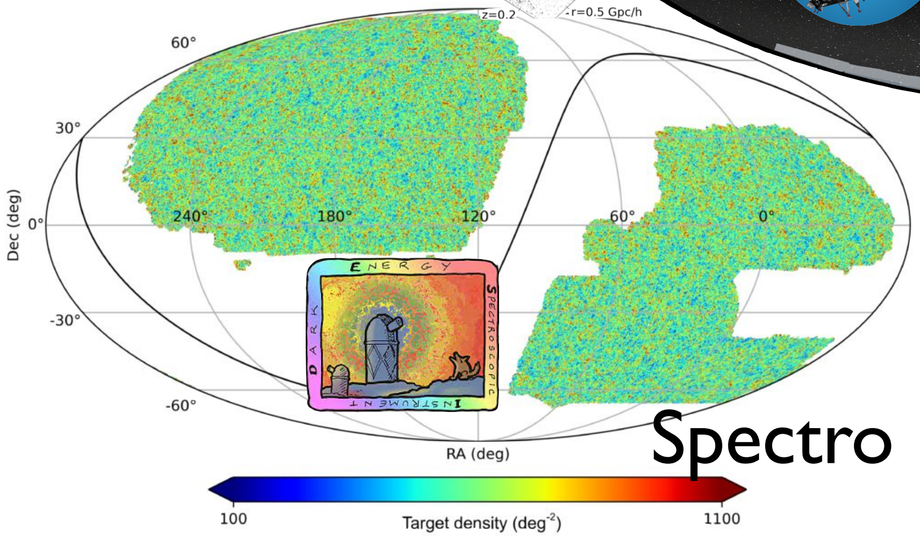








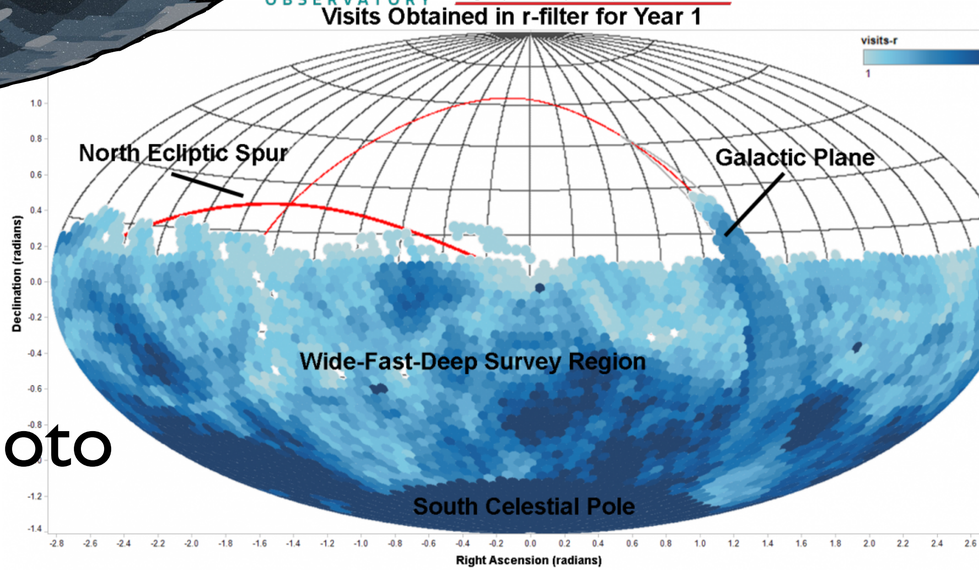




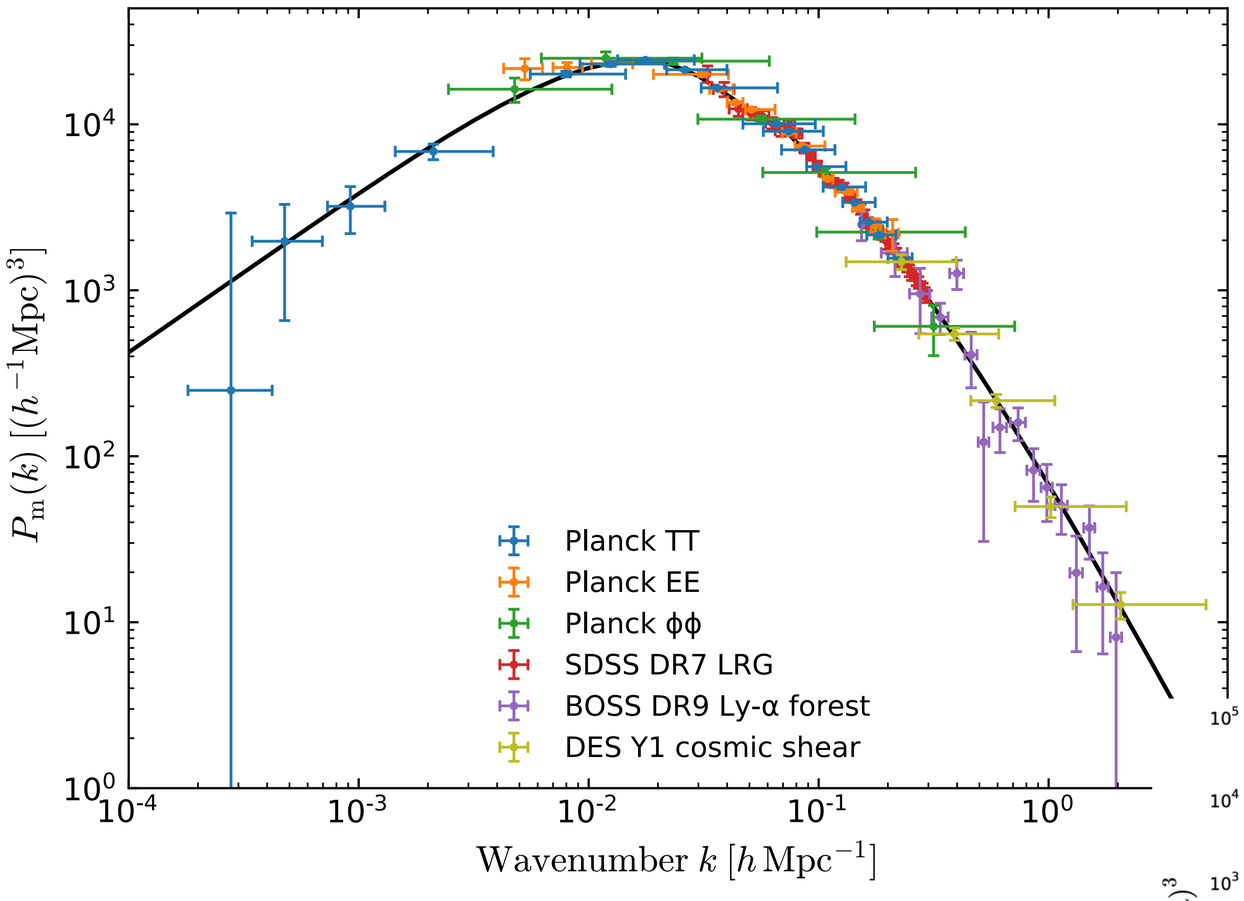
Spectro

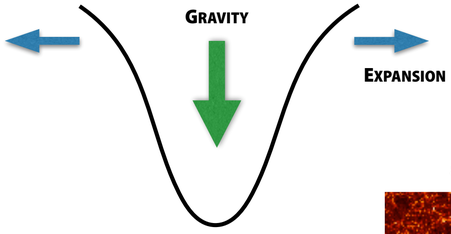
VERA C. RUBIN OBSERVATORY

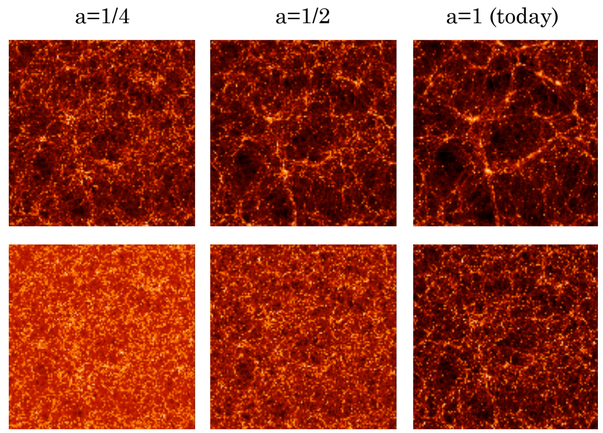
LSST Legacy Survey of Space and Time

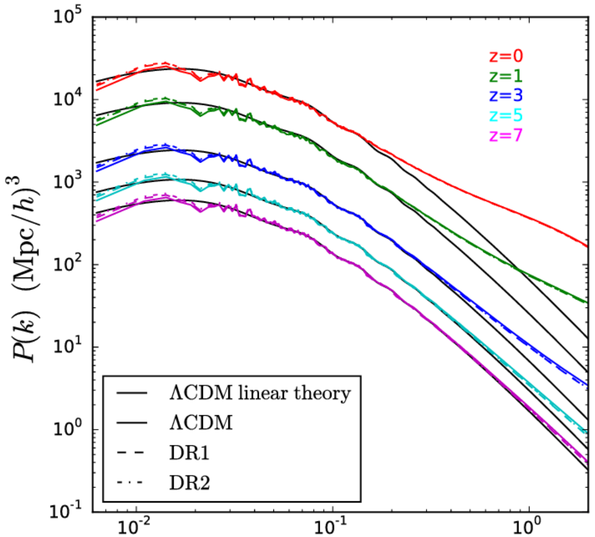


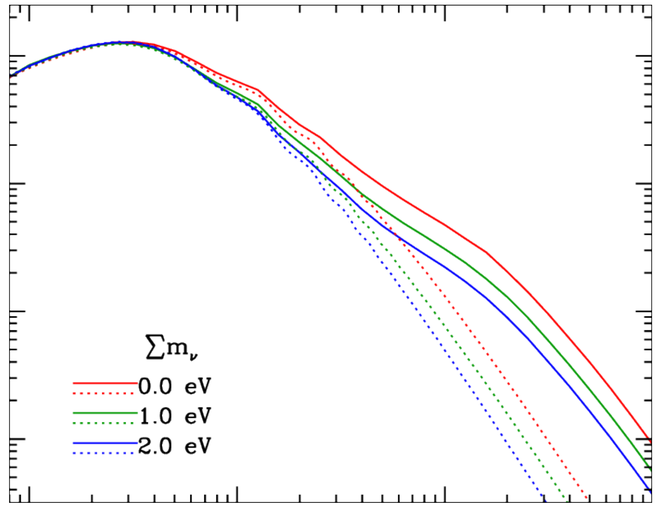
Photo

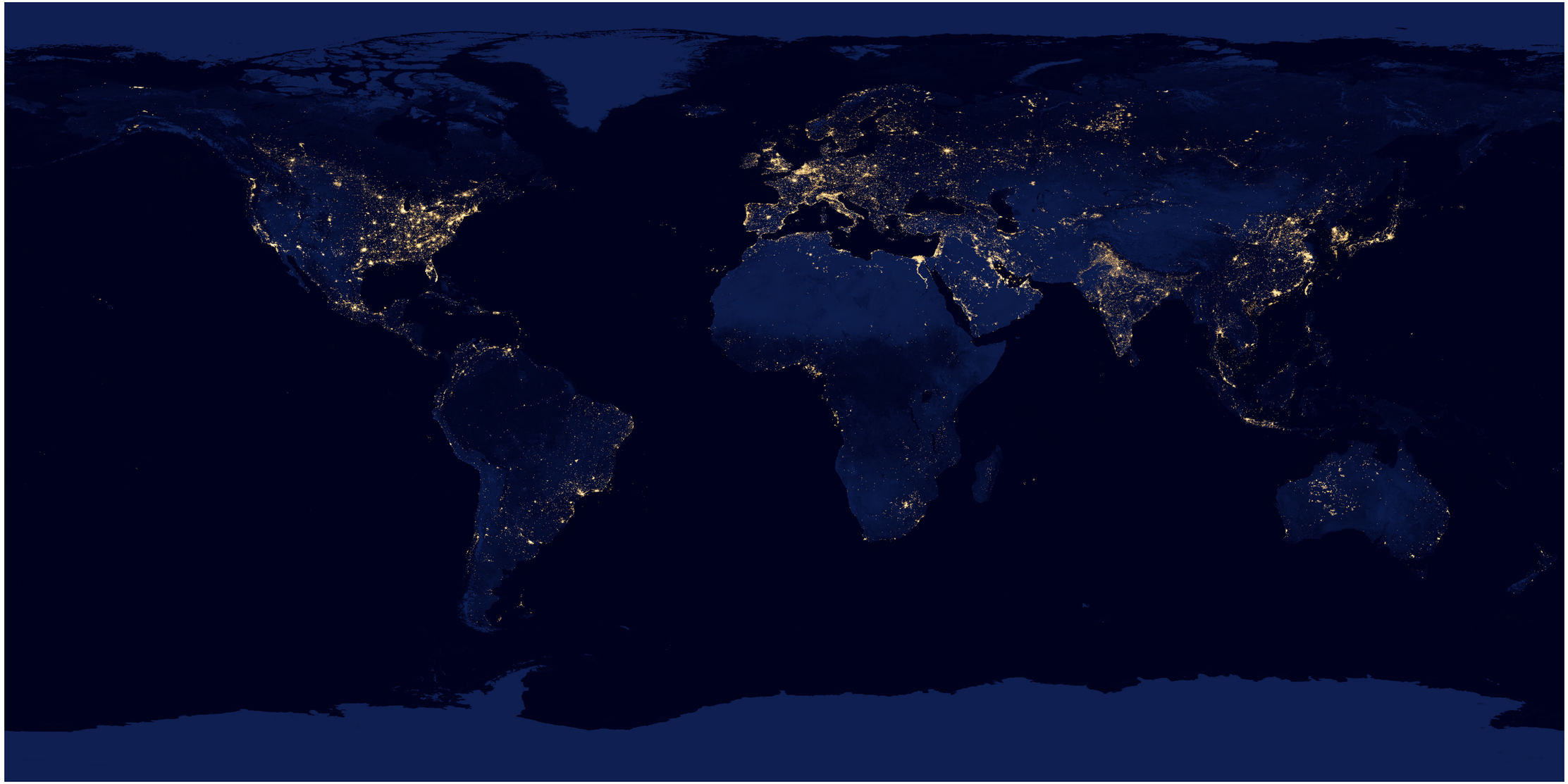

$P_{\rm m}(k)\ [(h^{-1}{\rm Mpc})^3]$
10^4
10^3
10^2
10^1
10^0
10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^0
Wavenumber $k\ [h\,{\rm Mpc}^{-1}]$
Planck TT
Planck EE
Planck ϕϕ
SDSS DR7 LRG
BOSS DR9 Ly-α forest
DES Y1 cosmic shear

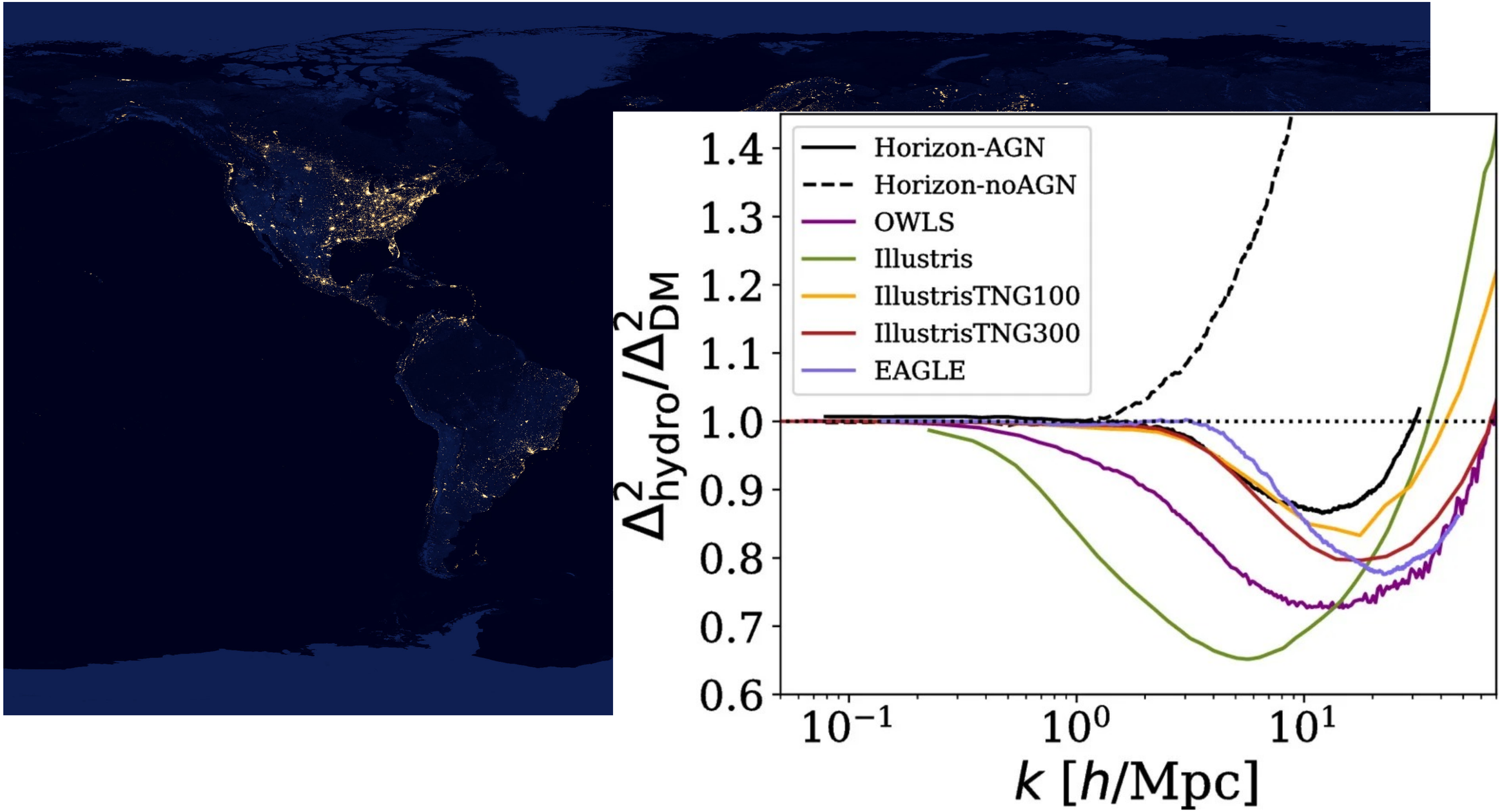

GRAVITY
EXPANSION

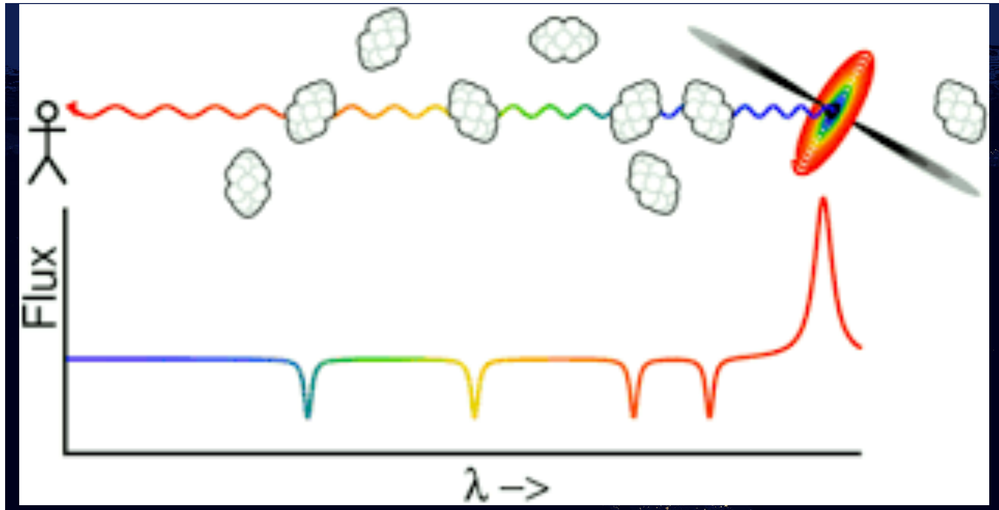

a=1/4
a=1/2
a=1 (today)
Dark Energy
Matter only

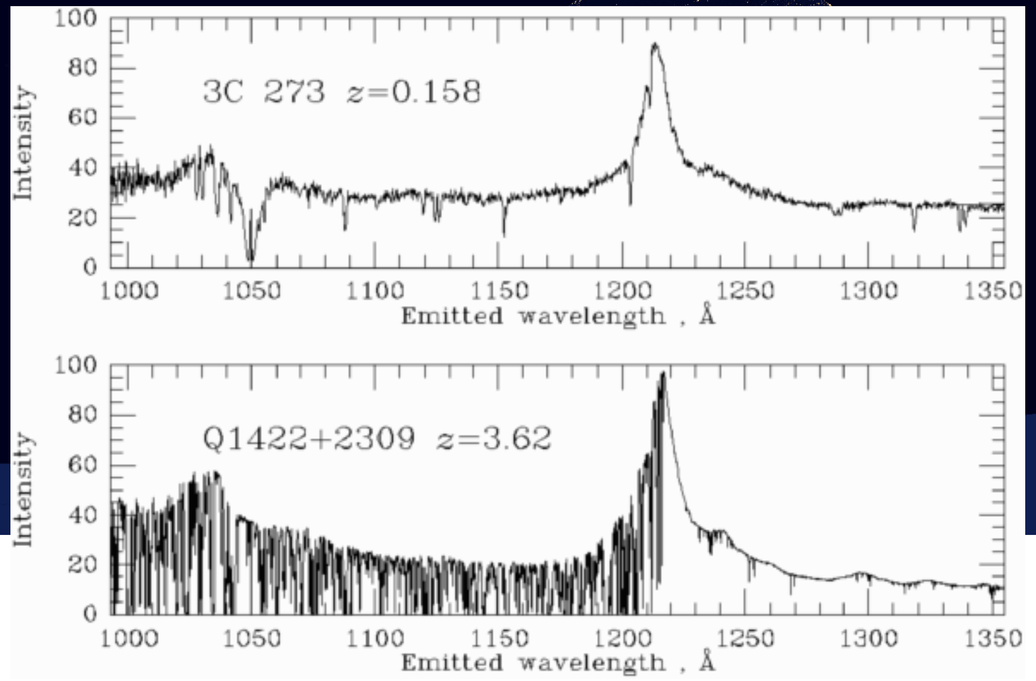

$P(k)\ ({\rm Mpc}/h)^3$
10^5
10^4
10^3
10^2
10^1
10^0
10^{-1}
10^{-2}
10^{-1}
10^0
z=0
z=1
z=3
z=5
z=7
ΛCDM linear theory
ΛCDM
DR1
DR2

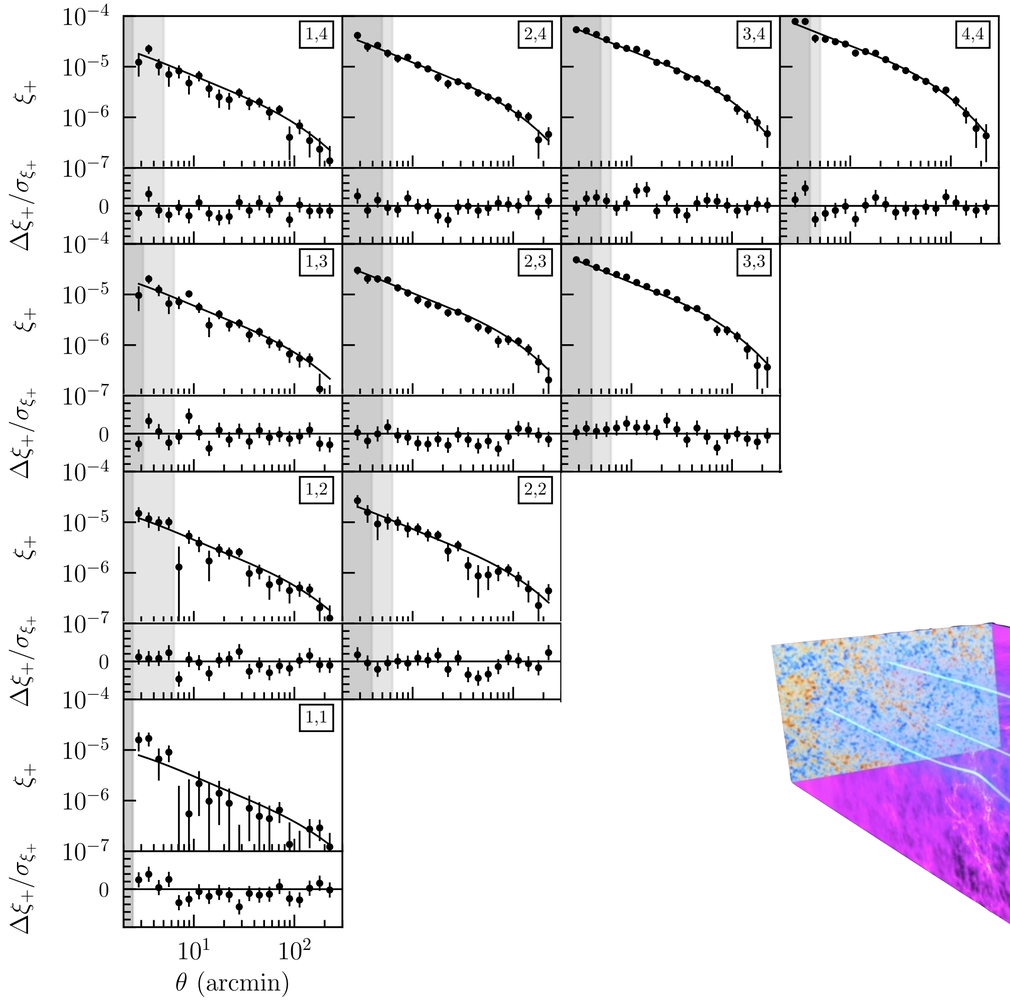

$\sum m_\nu$
0.0 eV
1.0 eV
2.0 eV

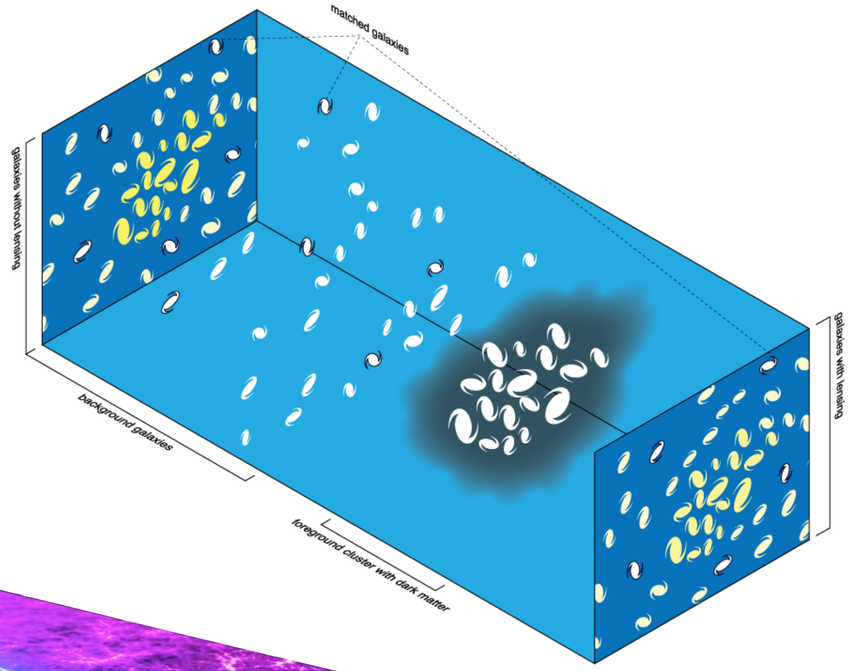


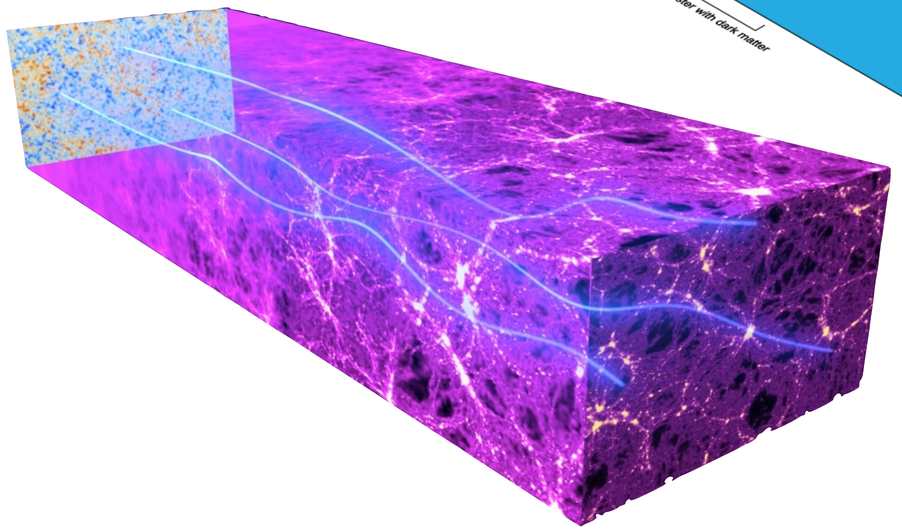

Horizon-AGN
Horizon-noAGN
OWLS
Illustris
IllustrisTNG100
IllustrisTNG300
EAGLE
$\Delta^2_{\rm hydro}/\Delta^2_{\rm DM}$
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
10^{-1}
10^{0}
10^{1}
k [h/Mpc]

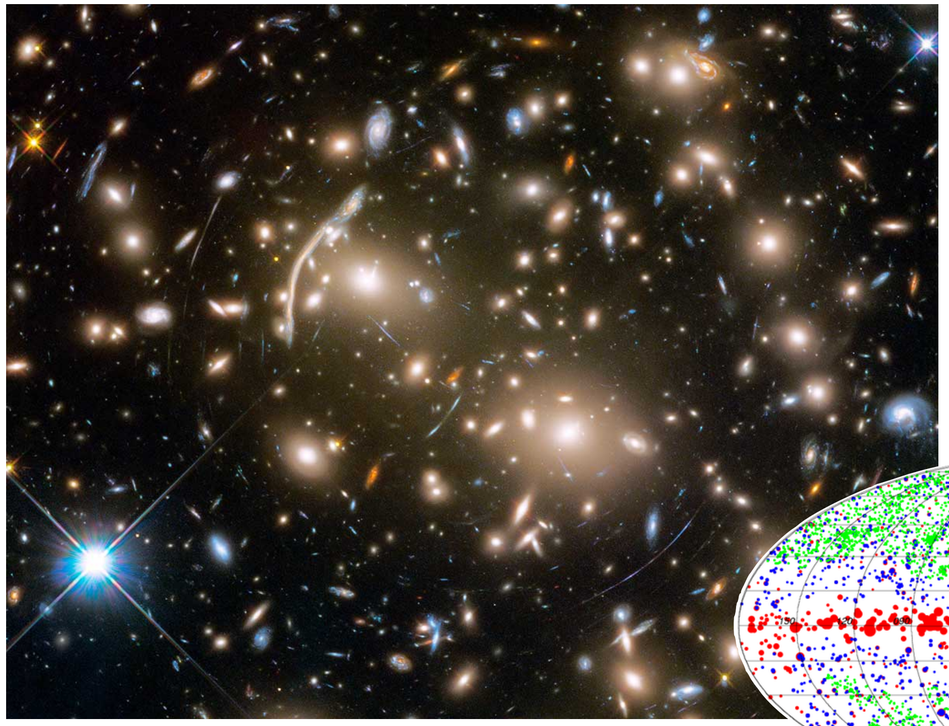

Flux
λ –>

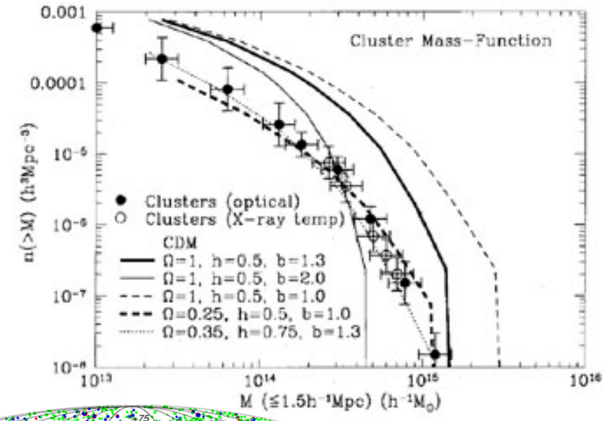

3C 273 z=0.158
Intensity
Emitted wavelength , Å
Q1422+2309 z=3.62
Intensity
Emitted wavelength , Å

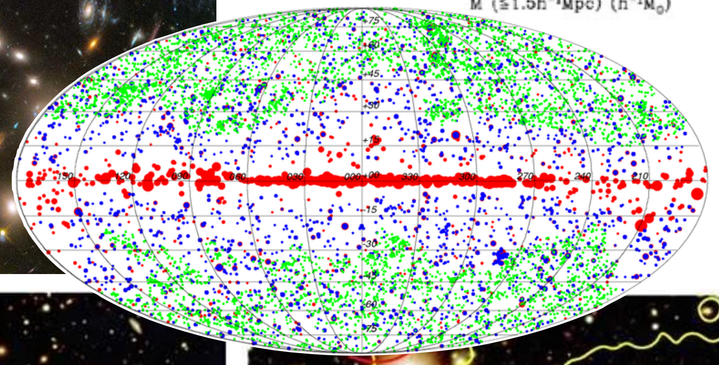

1,4
2,4
3,4
4,4
1,3
2,3
3,3
1,2
2,2
1,1
ξ_+
$\Delta\xi_+/\sigma_{\xi_+}$
10^{-4}
10^{-5}
10^{-6}
10^{-7}
0
10^1
10^2
θ (arcmin)

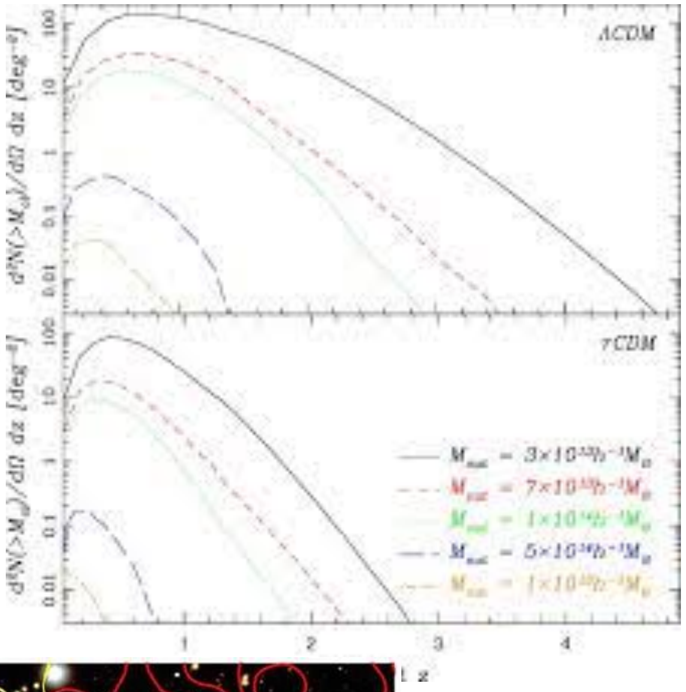

matched galaxies
galaxies without lensing
background galaxies
foreground cluster with dark matter
galaxies with lensing

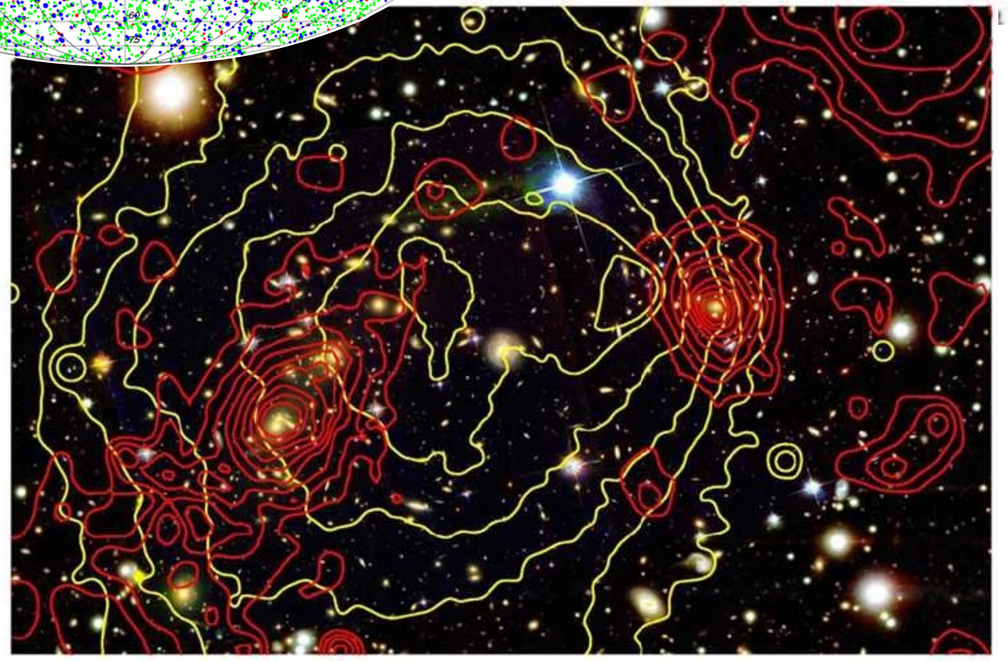




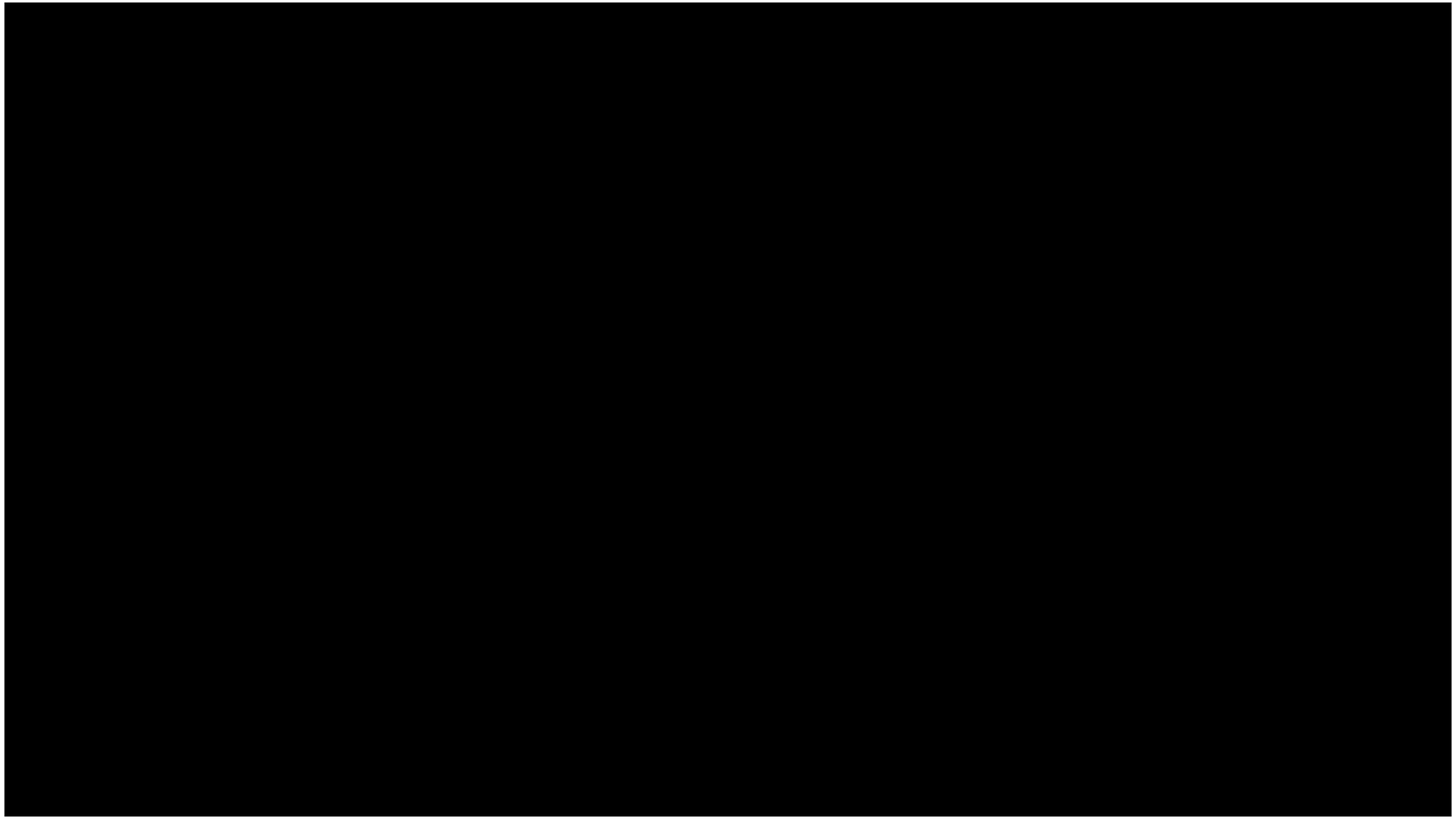

Cluster Mass-Function
0.001
0.0001
10^{-5}
10^{-6}
10^{-7}
10^{-8}
$n(>M)$ (h^3Mpc^{-3})
Clusters (optical)
Clusters (X-ray temp)
CDM
Ω=1, h=0.5, b=1.3
Ω=1, h=0.5, b=2.0
Ω=1, h=0.5, b=1.0
Ω=0.25, h=0.5, b=1.0
Ω=0.35, h=0.75, b=1.3
10^{13}
10^{14}
10^{15}
10^{16}
M (≦1.5h^{-1}Mpc) ($h^{-1}M_\odot$)

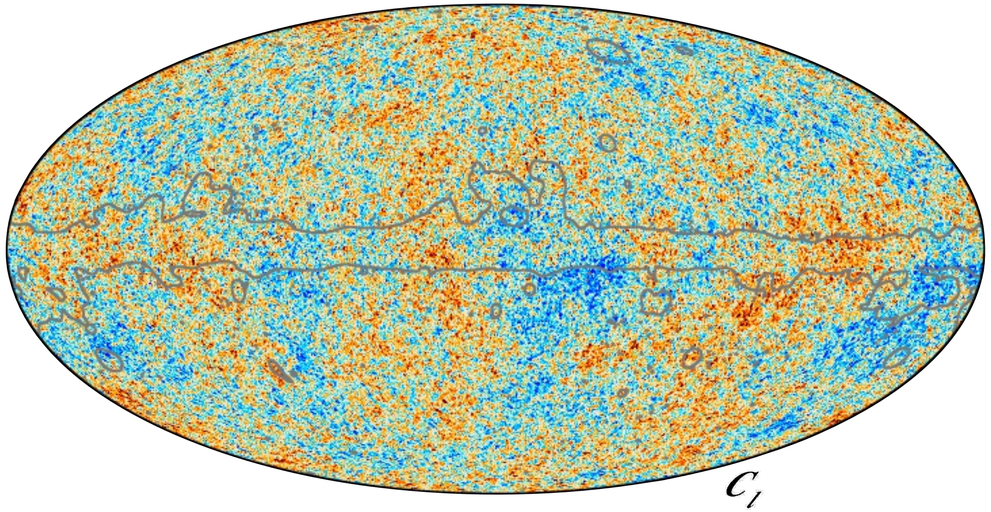


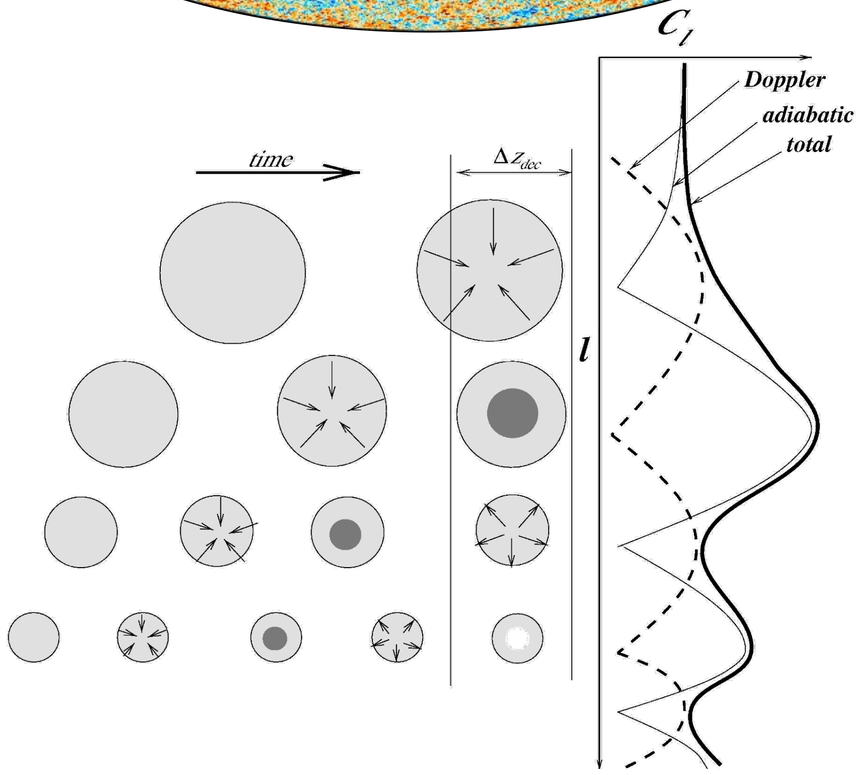

ΛCDM
τCDM
M_{min} = $3\times10^{13}h^{-1}M_\odot$
M_{min} = $7\times10^{13}h^{-1}M_\odot$
M_{min} = $1\times10^{14}h^{-1}M_\odot$
M_{min} = $5\times10^{14}h^{-1}M_\odot$
M_{min} = $1\times10^{15}h^{-1}M_\odot$
1
2
3
4
z

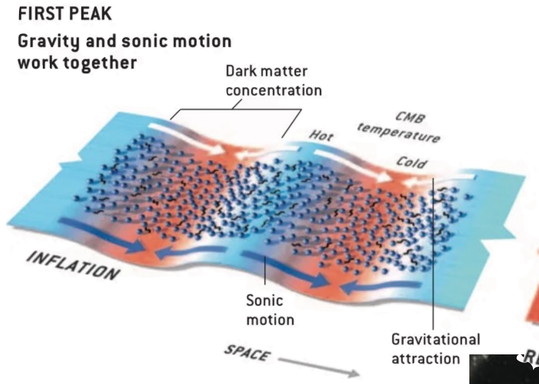


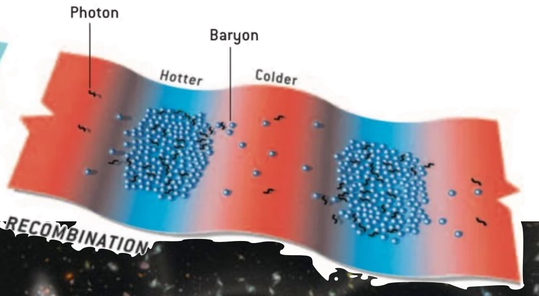
https://www.youtube.com/watch?v=N-lGQVpevAc

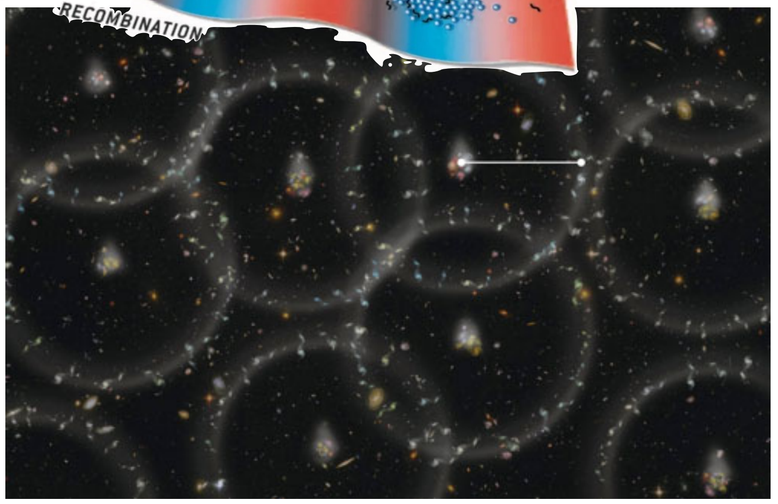


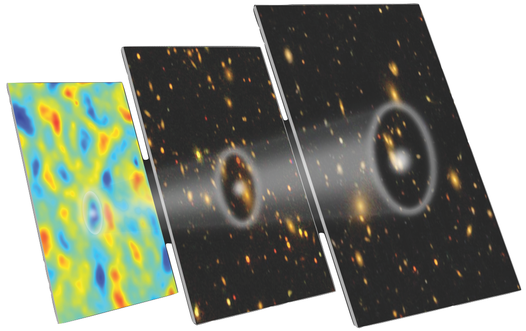


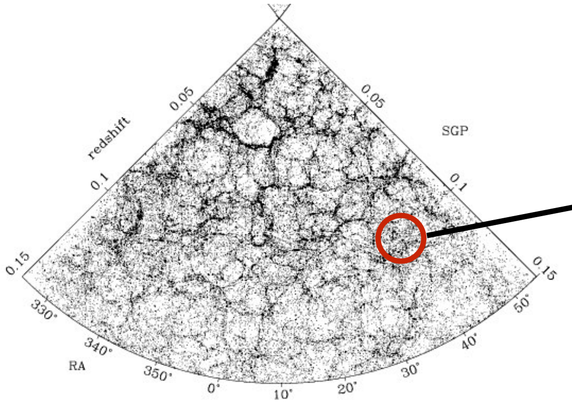

C_l
Doppler
adiabatic
total
time
Δz_{dec}
l

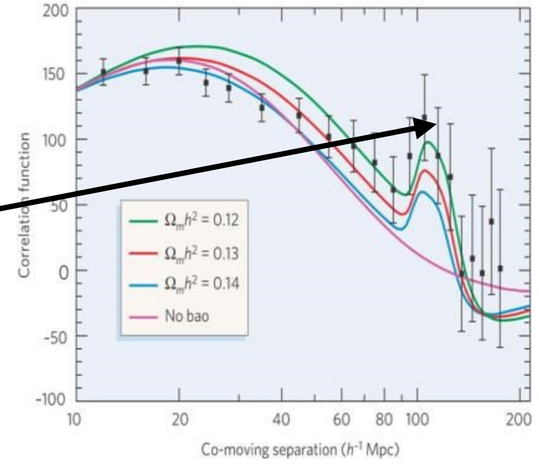

FIRST PEAK
Gravity and sonic motion work together
Dark matter concentration
Hot
CMB temperature
Cold
INFLATION
Sonic motion
Gravitational attraction
SPACE


Photon
Baryon
Hotter
Colder
RECOMBINATION

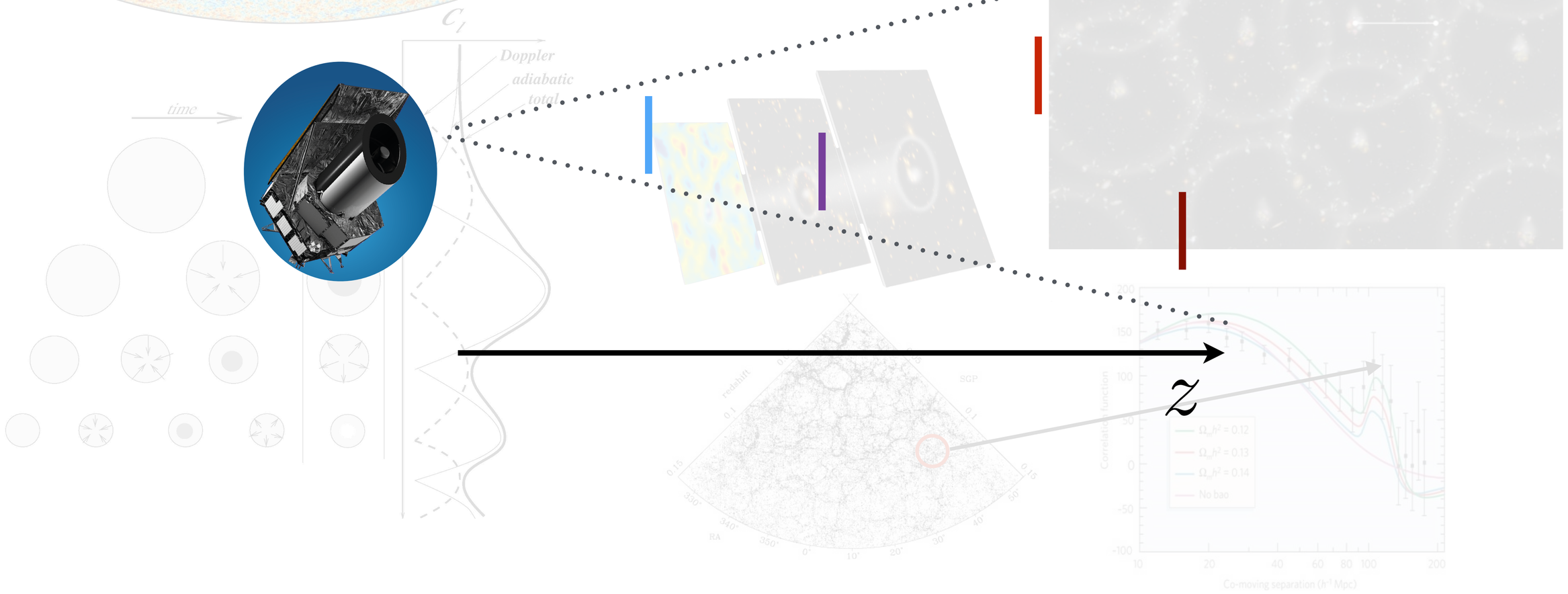


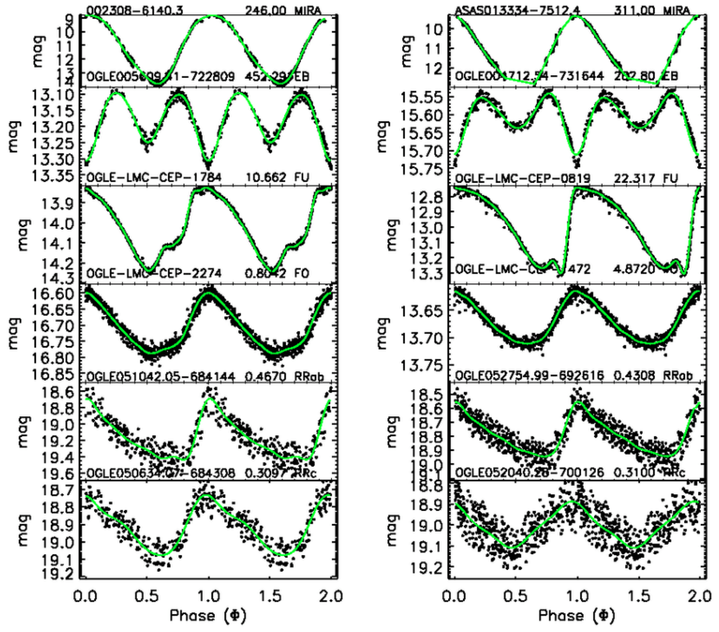


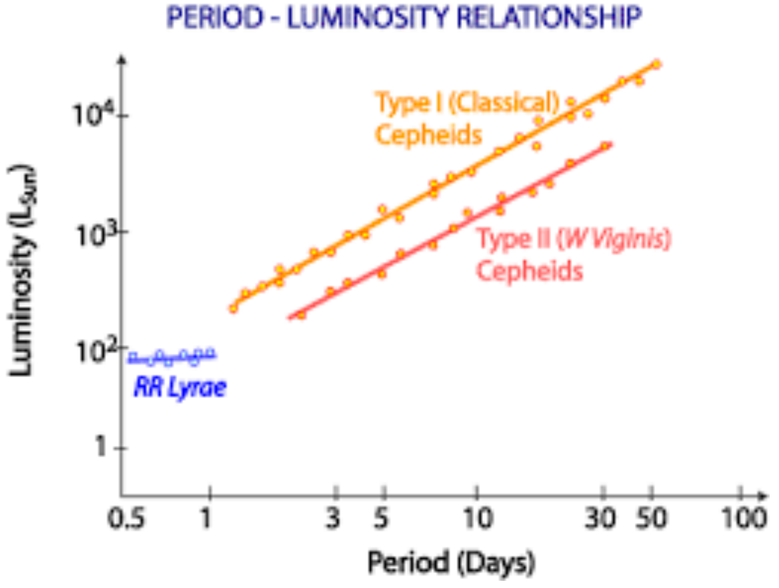

redshift
0.05
0.1
0.15
SGP
RA
330°
340°
350°
0°
10°
20°
30°
40°
50°

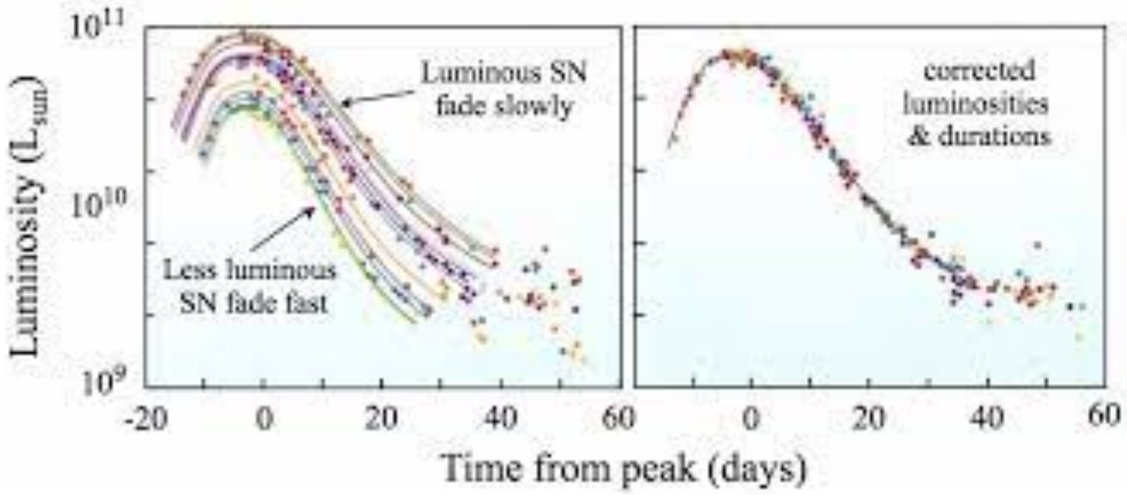

Correlation function
$\Omega_m h^2 = 0.12$
$\Omega_m h^2 = 0.13$
$\Omega_m h^2 = 0.14$
No bao
Co-moving separation (h^{-1} Mpc)

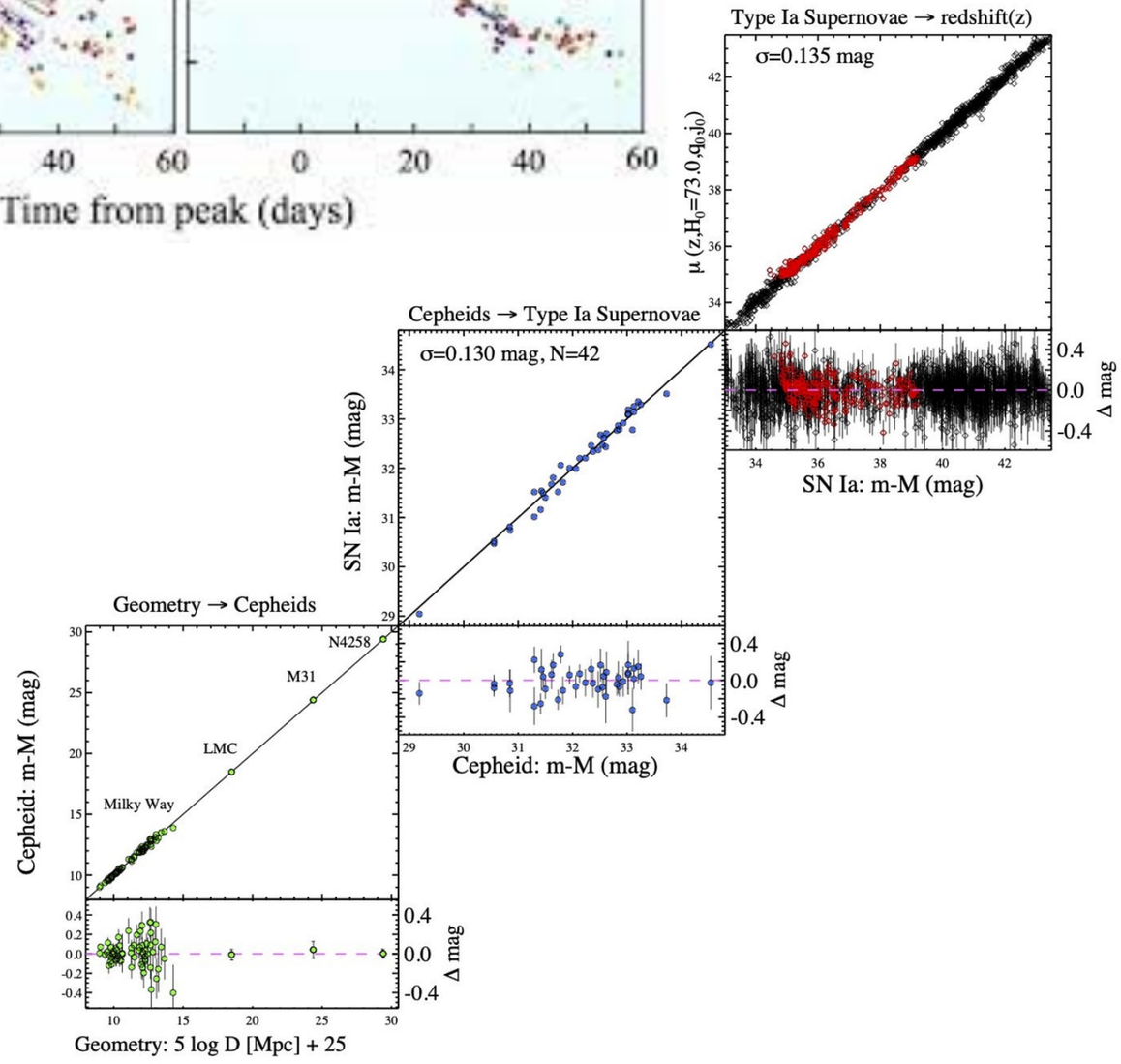
FIRST PEAK
Gravity and sonic motion work together
Dark matter concentration
CMB temperature
Hot
Cold
INFLATION
Sonic motion
Gravitational attraction
SPACE
Photon
Baryon
Hotter
Colder
RECOMBINATION

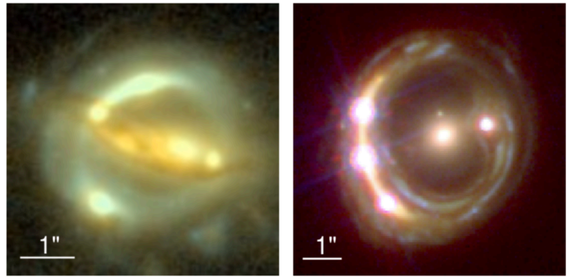

C_l
Doppler
adiabatic
total
time
z
redshift
SGP
RA
Correlation function
$\Omega_m h^2 = 0.12$
$\Omega_m h^2 = 0.13$
$\Omega_m h^2 = 0.14$
No bao
Co-moving separation (h^{-1} Mpc)


002308-6140.3 246.00 MIRA
ASAS013334-7512.4 311.00 MIRA
OGLE-LMC-CEP-1784 10.662 FU
OGLE-LMC-CEP-2274 0.8042 FO
OGLE051042.05-684144 0.4670 RRab
OGLE052754.99-692616 0.4308 RRab
OGLE052040.28-700126 0.3100 RRc
mag
Phase (Φ)


PERIOD - LUMINOSITY RELATIONSHIP
Type I (Classical) Cepheids
Type II (W Virginis) Cepheids
RR Lyrae
Luminosity (L_sun)
Period (Days)

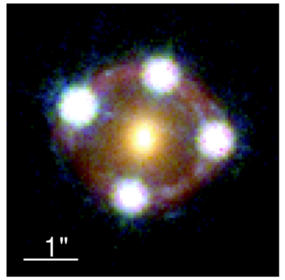

Luminous SN fade slowly
Less luminous SN fade fast
corrected luminosities & durations
Luminosity (L_sun)
Time from peak (days)


Type Ia Supernovae → redshift(z)
σ=0.135 mag
Cepheids → Type Ia Supernovae
σ=0.130 mag, N=42
SN Ia: m-M (mag)
Geometry → Cepheids
N4258
M31
LMC
Milky Way
Cepheid: m-M (mag)
Geometry: 5 log D [Mpc] + 25
Δ mag

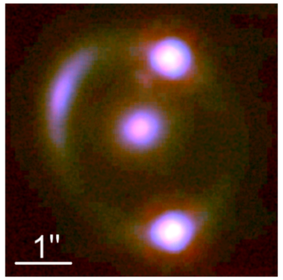


(a) B1608+656

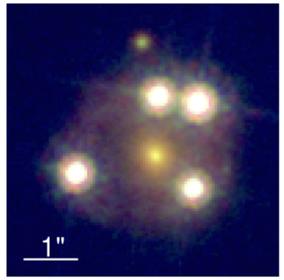
(b) RXJ1131−1231



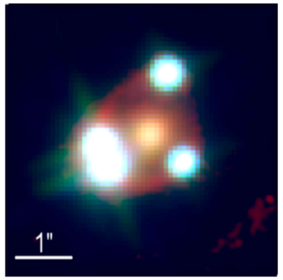
(c) HE 0435−1223



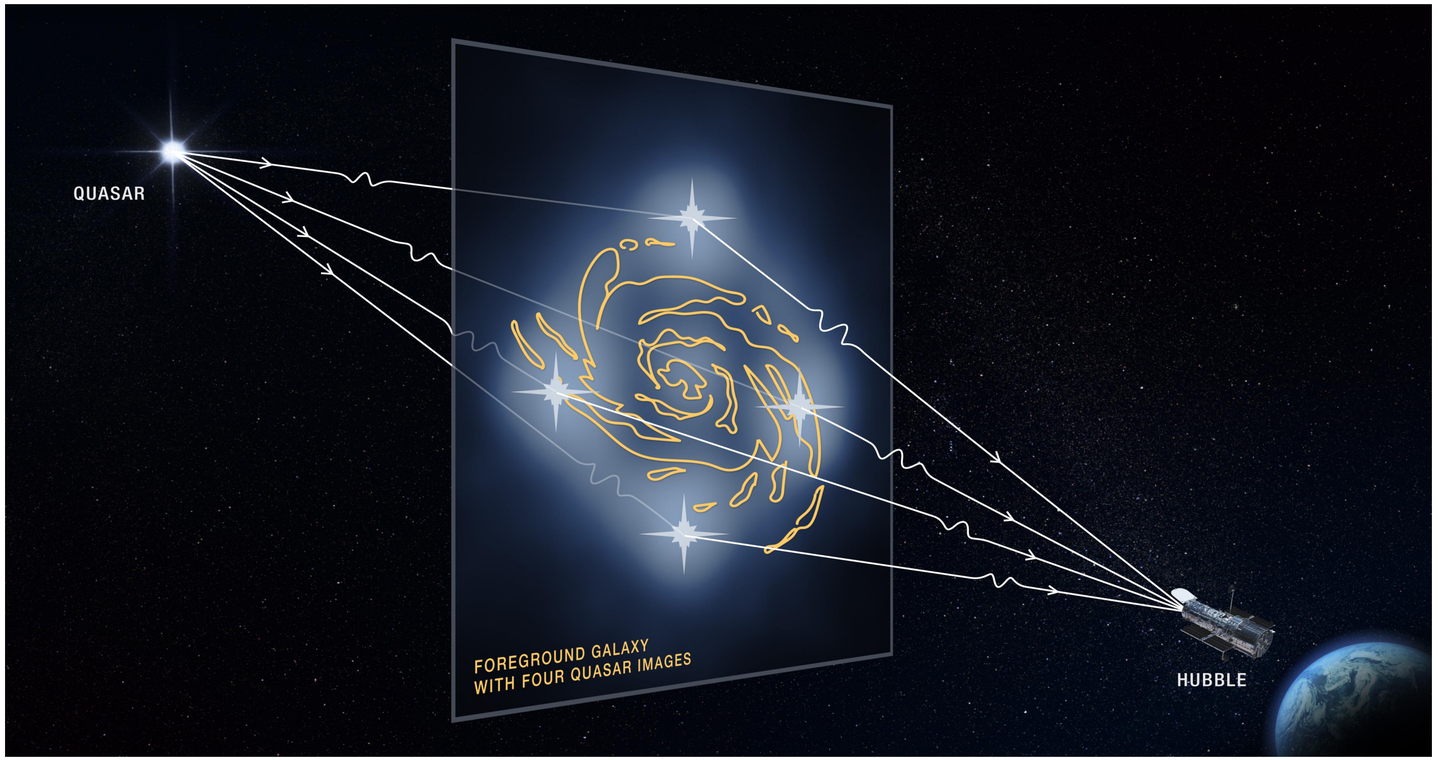
(d) SDSS 1206+4332

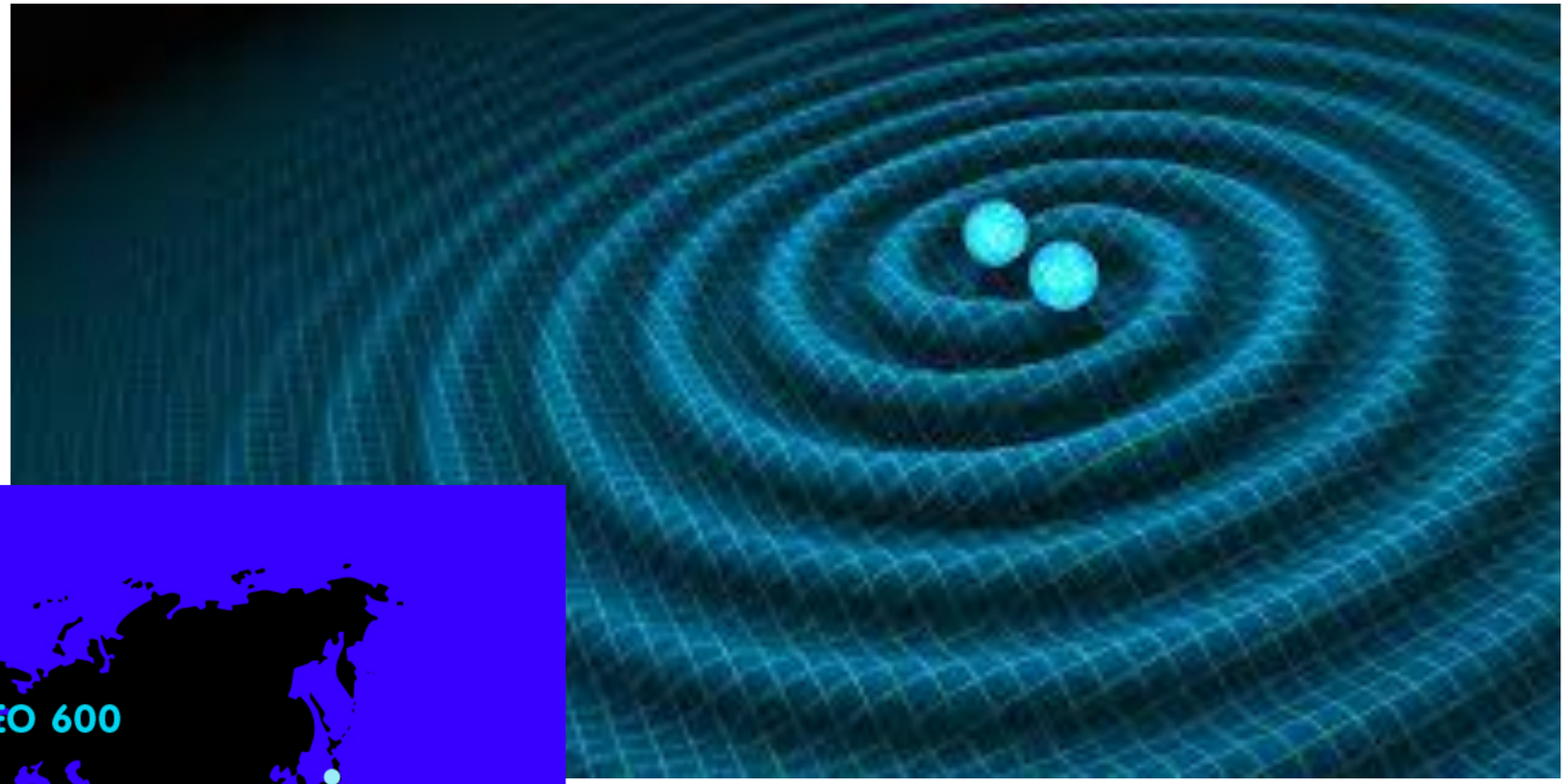


(e) WFI2033−4723



(f) PG 1115+080






LIGO
LIGO
GEO 600
VIRGO
LIGO INDIA
KAGRA

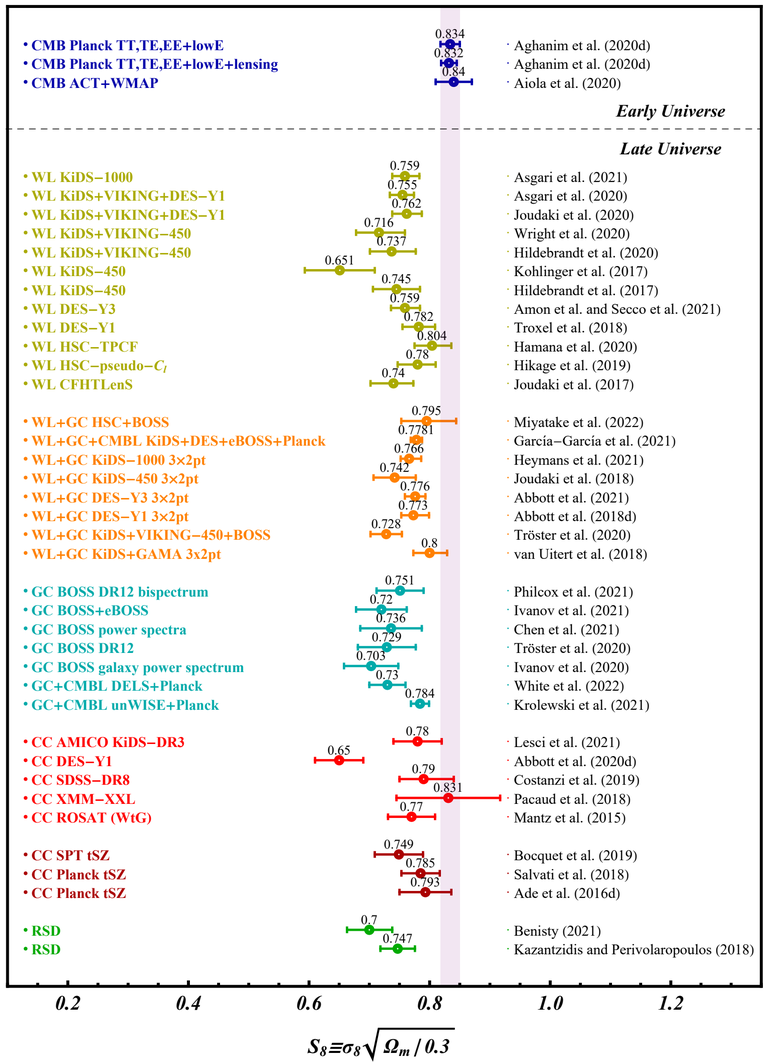
Cosmologie quelques grandes questions

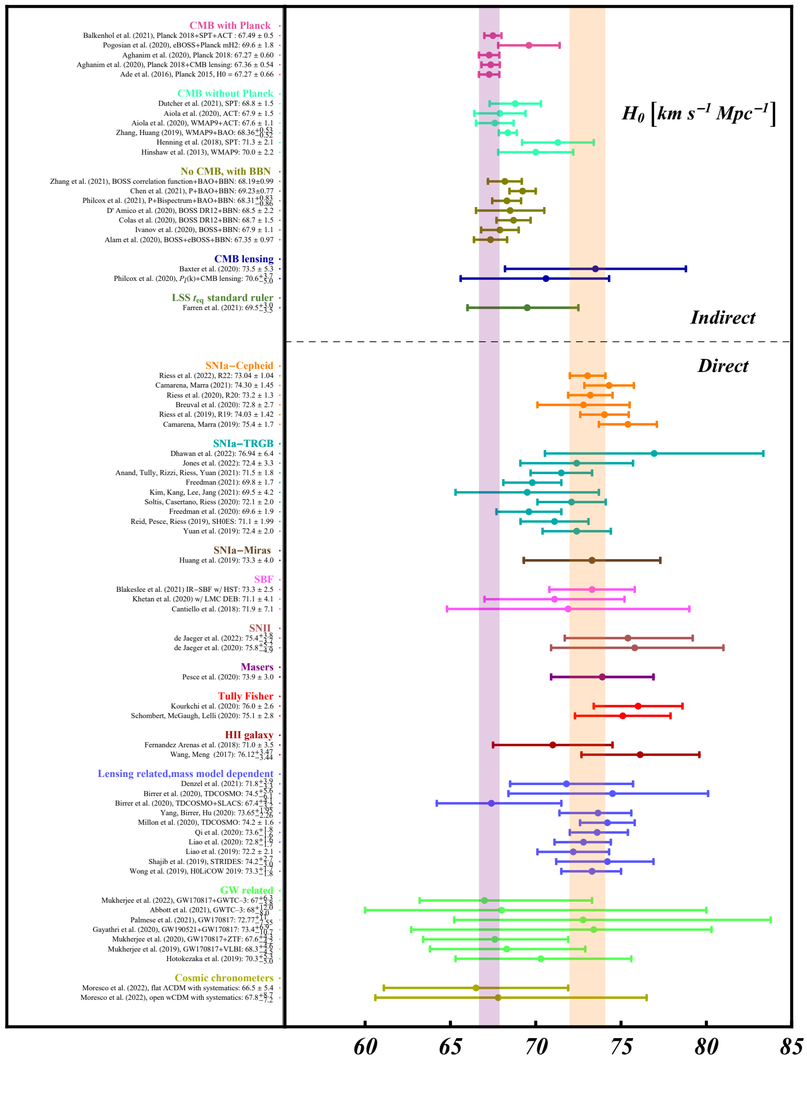
- **Quelle est l'histoire de formation et d'évolution de l'Univers ?**
  - Quelle est la nature de l'Inflation et est-ce le meilleur modèle pour expliquer les perturbations primordiales ?
  - Quelle est la nature de l'énergie noire et est-ce le meilleur modèle pour expliquer l'acceleration apparente tardive ?

- **Quel est son contenu ?**
  - Quelle est la nature de la matière noire ?
  - Combien y a t'il de familles de neutrinos, quelle sont leurs masses et leur propriétés, y a t'il d'autre reliques ?

- **Comment s'organise la matière dans l'Univers ?**
  - Quelle est l'influence des processus baryoniques sur la distribution de matière aux grandes échelles
  - Comment la matière se structure t'elle dans les objets, galaxies et amas et quelle est l'histoire de formation des galaxies ?

- **Notre modèle est-il complet ?**

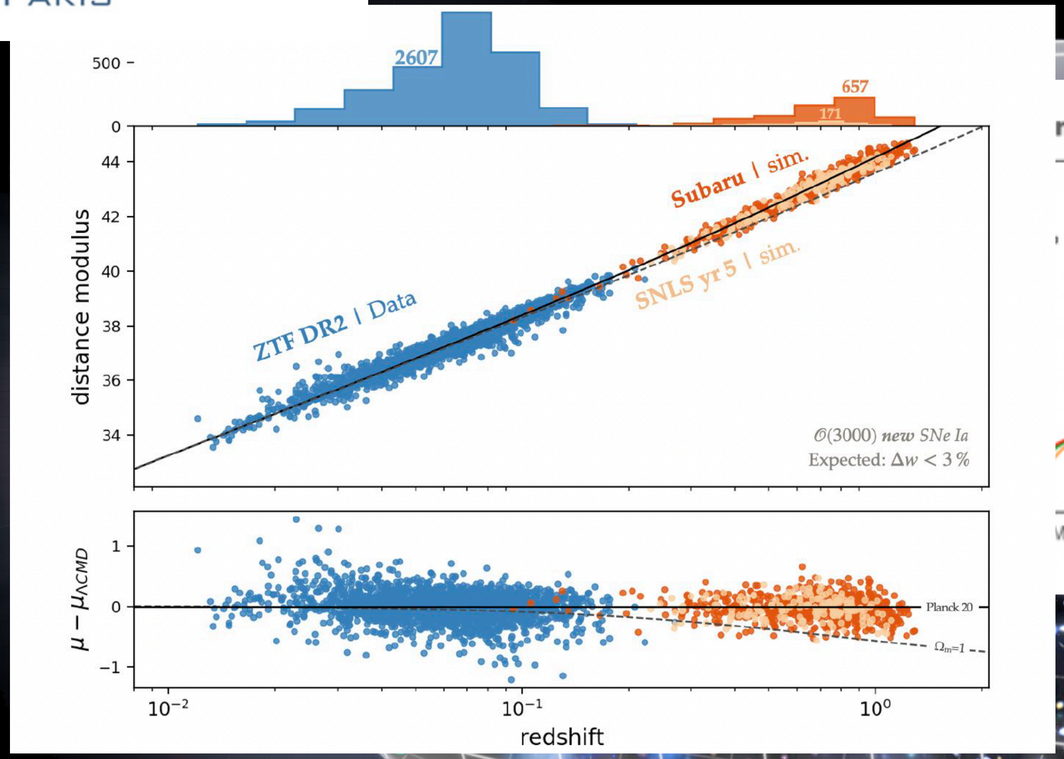


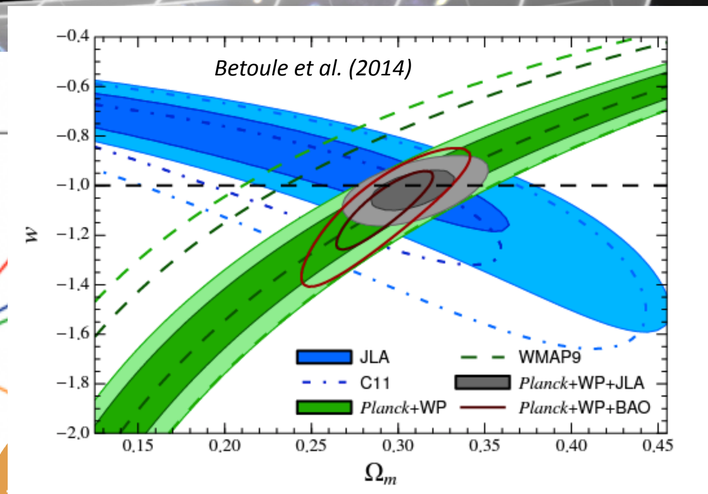


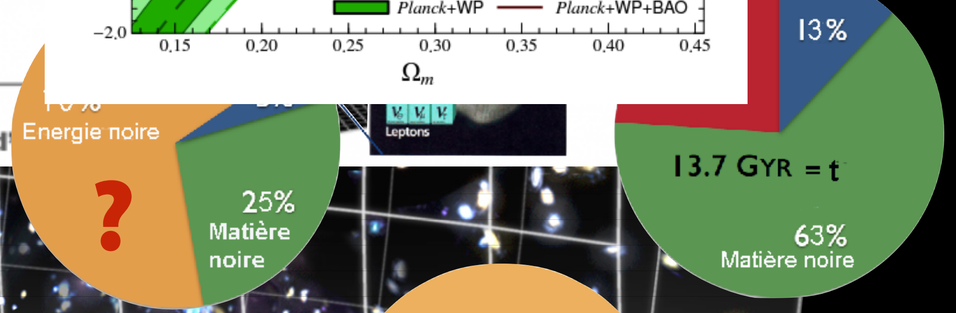
Structuration de la communauté

- **CNRS**
  - INSU
    - Programme Nationaux : PNCG, PNGRAM, PNHE
  - IN2P3
    - Astroparticule et cosmologie, ondes gravitationnelles, neutrinos
  - INP
  - *GDR CoPHY*
- **CNU 34 & 29**
- **à Sorbonne Université**
  - IAP, LPNHE, LPTHE, LERMA, LESIA, LPENS, SYRTE, LKB
    - *IAP, LPNHE, LPTHE, L3@Obs, L2@Obs, LPENS, L1@Obs, LKB*
  - Enseignement
    - 1 module L3 + 1PAD ~40 étudiants
    - 2 modules M1 (dont un anglais) + 1 PAD ~30 étudiants
    - M2 AAIS, M2 NPAC
    - ED A&A (1/3 soutenances cosmo, i.e. 3/an), ED PIF (+ ED Step'Up)
- **Ressources**
  - classiques : ERC, ANR, CNRS, PN…
  - CNES, pour les projets spatiaux
  - DIM-ACAV, DIM-Origines
  - ILP, IPI

LPNHE
PARIS



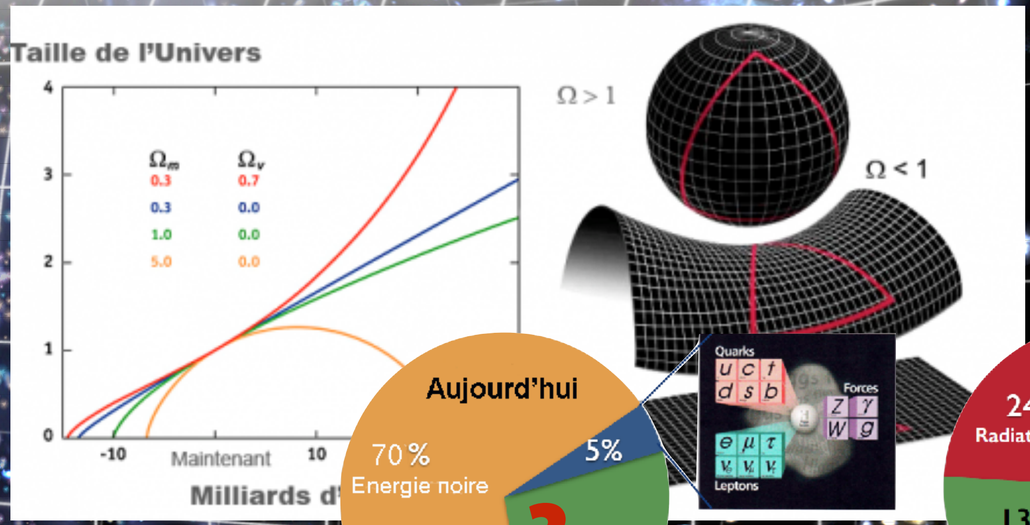


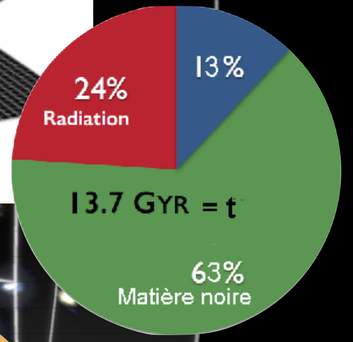


$$H^2(t) = \frac{8\pi G}{3c^2}\rho(t) - \frac{kc^2}{a^2(t)} + \frac{\Lambda c^2}{3}$$

$$\frac{\ddot{a}(t)}{a(t)} = -\frac{4\pi G}{3c^2}\left(\rho(t) + \frac{3p(t)}{c^2}\right) + \frac{\Lambda c^2}{3}$$

LPNHE
PARIS





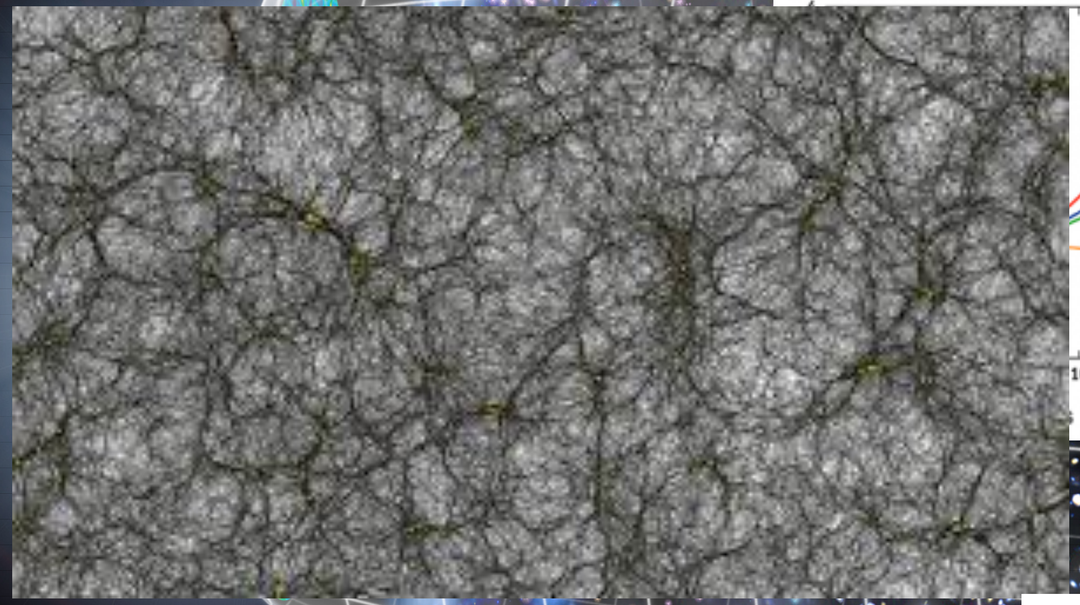
$$H^2(t) = \frac{8\pi G}{3c^2}\rho(t) - \frac{kc^2}{a^2(t)} + \frac{\Lambda c^2}{3}$$

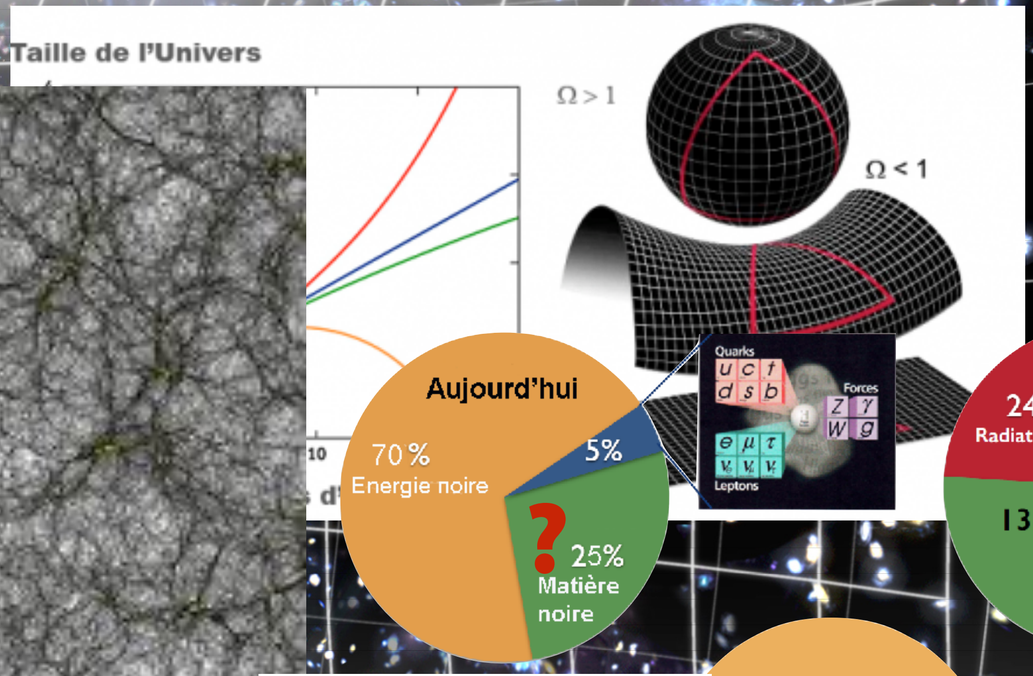
$$\frac{\ddot{a}(t)}{a(t)} = -\frac{4\pi G}{3c^2}\left(\rho(t) + \frac{3p(t)}{c^2}\right) + \frac{\Lambda c^2}{3}$$

LPTHE
LABORATOIRE DE PHYSIQUE
THEORIQUE ET HAUTES ENERGIES

LPNHE
PARIS

l'Observatoire de Paris





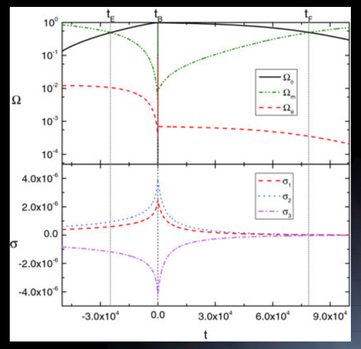
$$H^2(t) = \frac{8\pi G}{3c^2}\rho(t) - \frac{kc^2}{a^2(t)} + \frac{\Lambda c^2}{3}$$

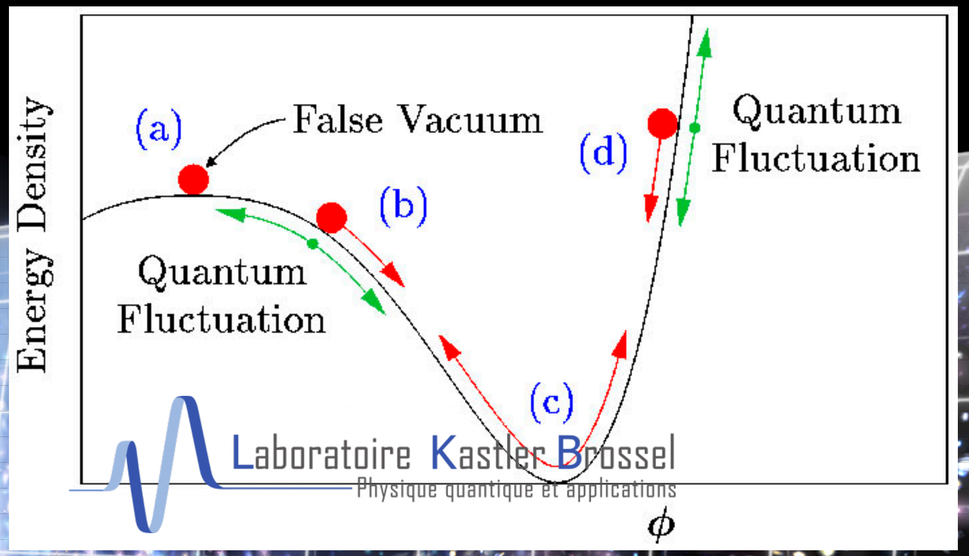
$$\frac{\ddot{a}(t)}{a(t)} = -\frac{4\pi G}{3c^2}\left(\rho(t) + \frac{3p(t)}{c^2}\right) + \frac{\Lambda c^2}{3}$$

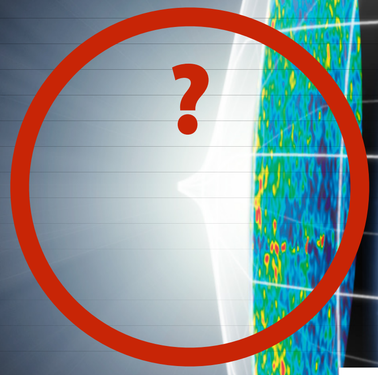
IAP

10t_0

100%
Energie noire



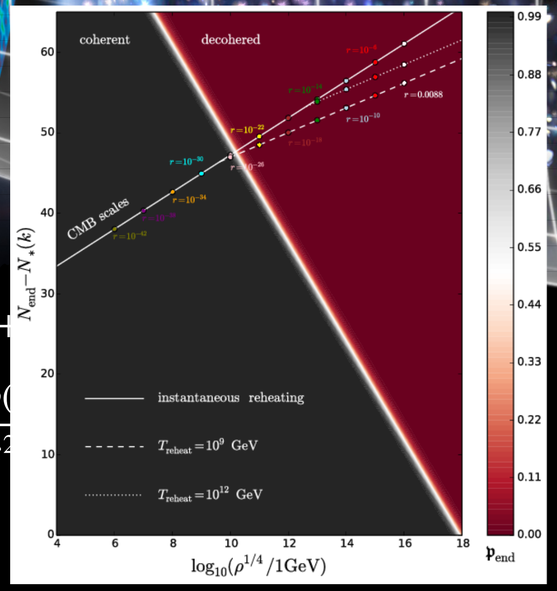


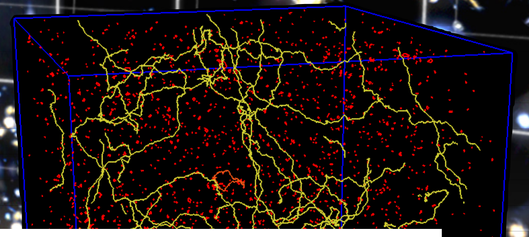


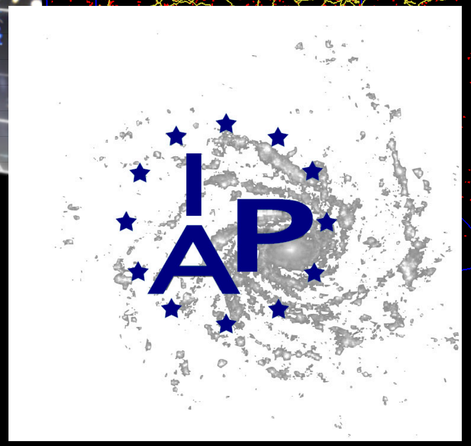
LPENS
LABORATOIRE DE PHYSIQUE
DE L'ÉCOLE NORMALE SUPÉRIEURE

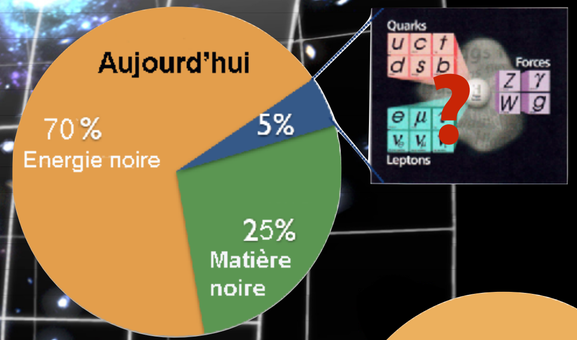
$$H^2(t) = \frac{8\pi G}{3c^2}\rho(t) - \frac{kc^2}{a^2(t)} +$$

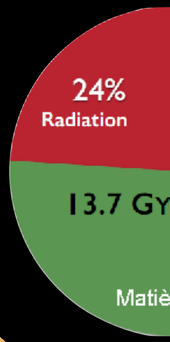
$$\frac{\ddot{a}(t)}{a(t)} = -\frac{4\pi G}{3c^2}\left(\rho(t) + \frac{3p(}{c^2}\right.$$

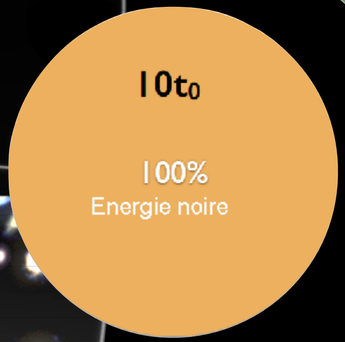












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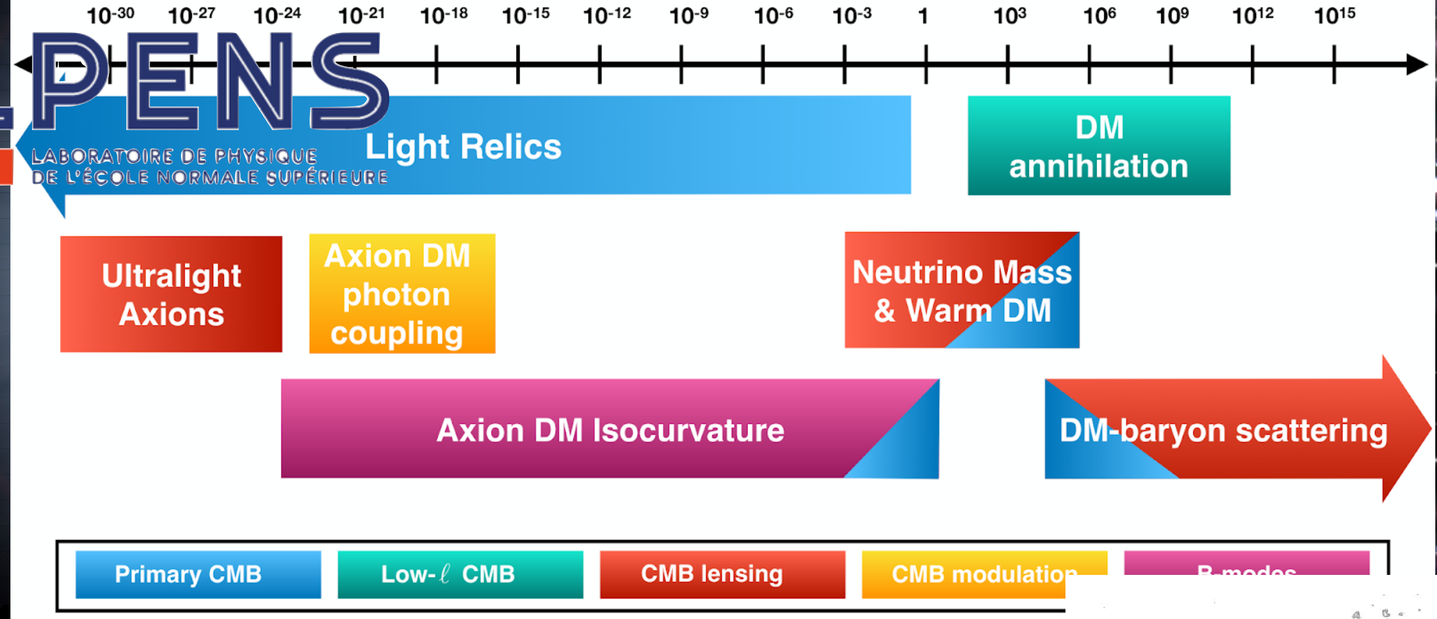
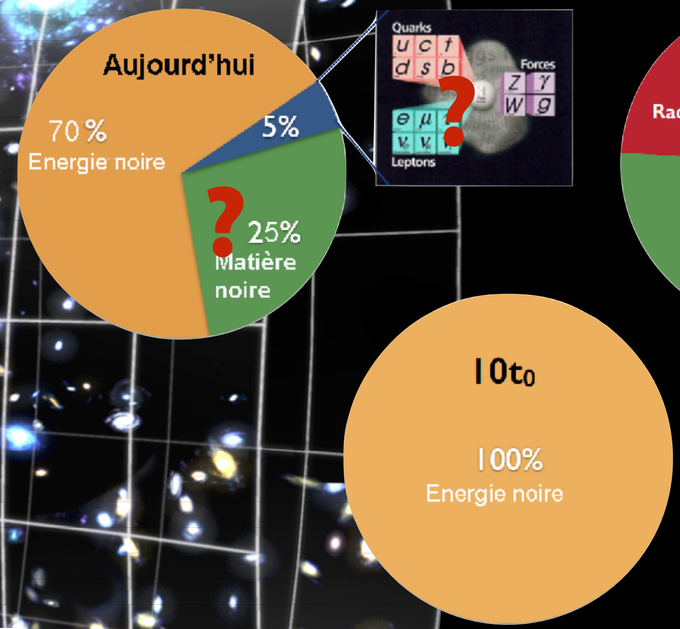
LPNHE
PARIS

LPENS
LABORATOIRE DE PHYSIQUE
DE L'ÉCOLE NORMALE SUPÉRIEURE





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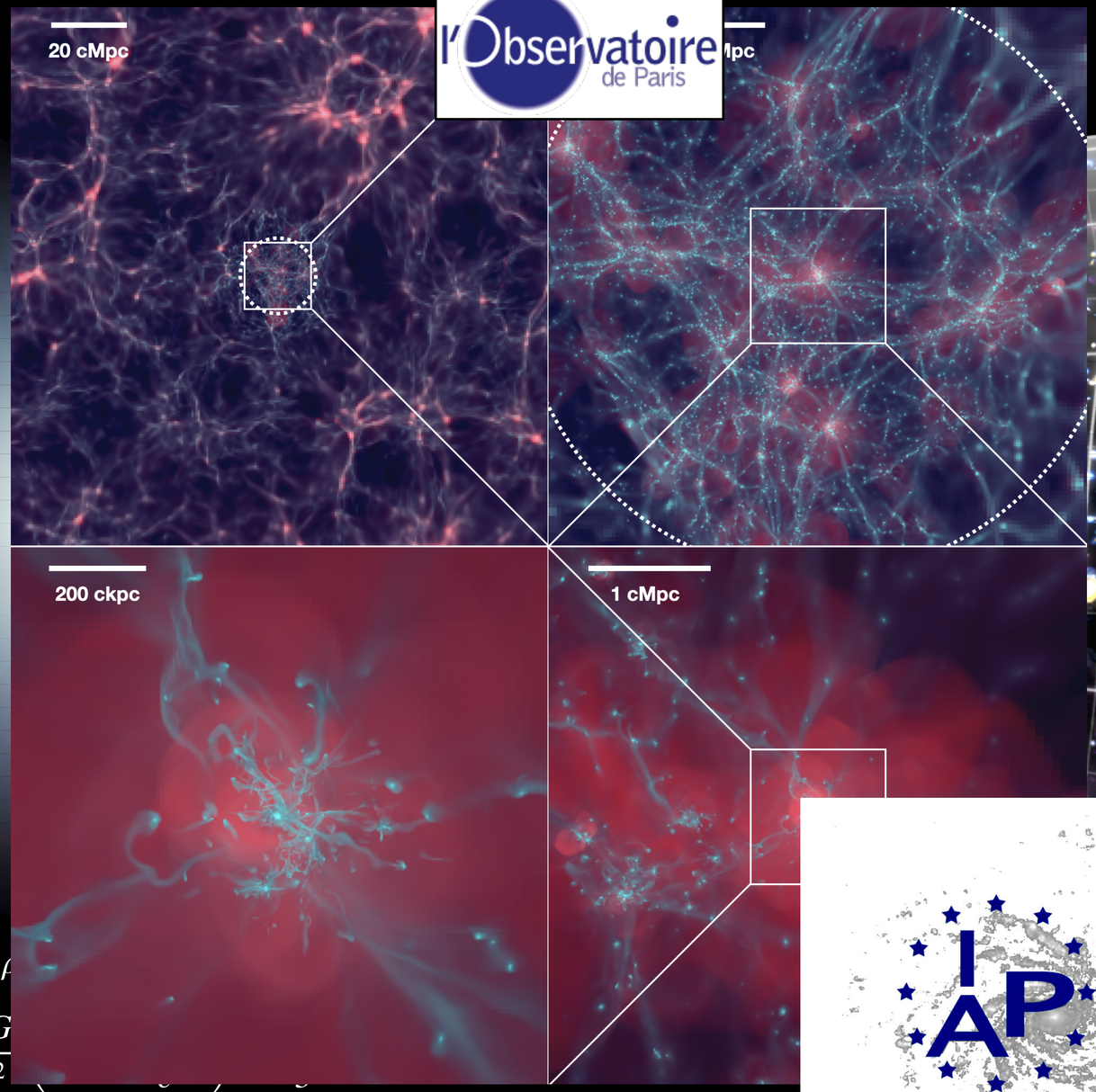
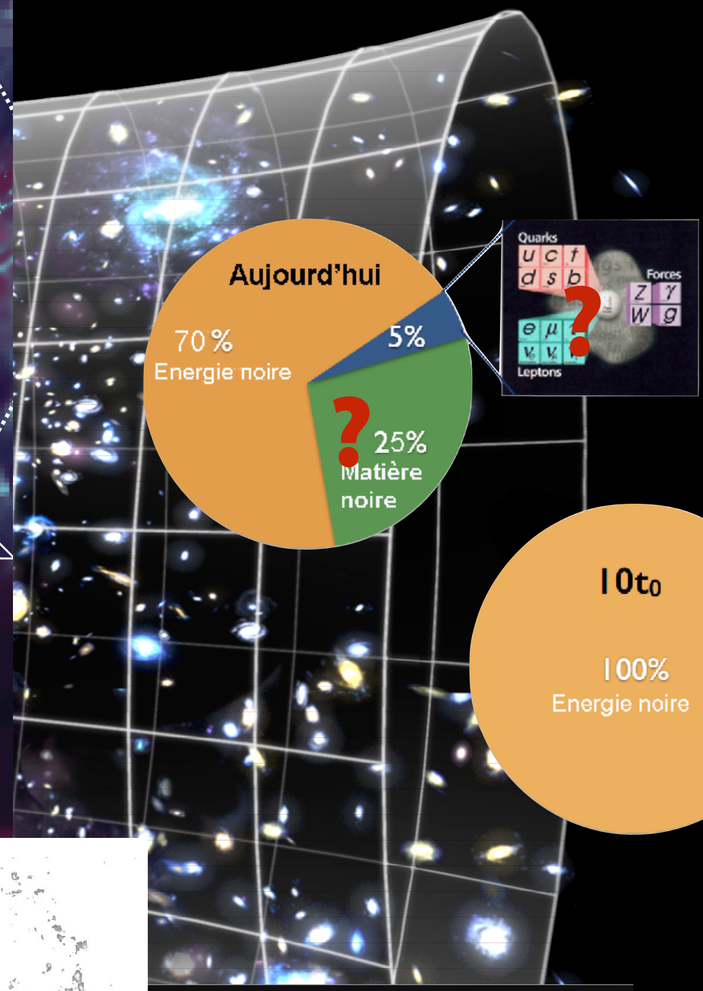
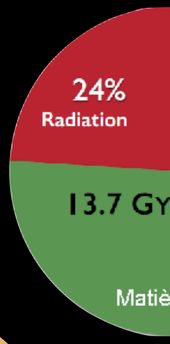
$$\frac{\ddot{a}(t)}{a(t)} = -\frac{4\pi G}{3c^2}\left(\rho(t) + \frac{3p(t)}{c^2}\right) + \frac{\Lambda c^2}{3}$$

IAP



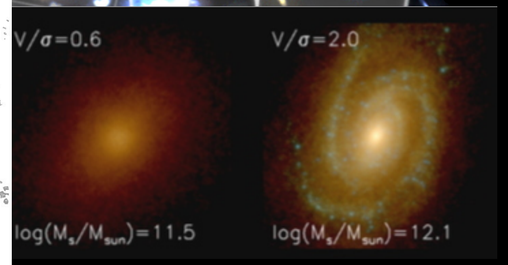
l'Observatoire de Paris





$$H^2(t) = \frac{8\pi G}{3c^2}\rho$$

$$\frac{\ddot{a}(t)}{a(t)} = -\frac{4\pi G}{3c^2}$$



REU23

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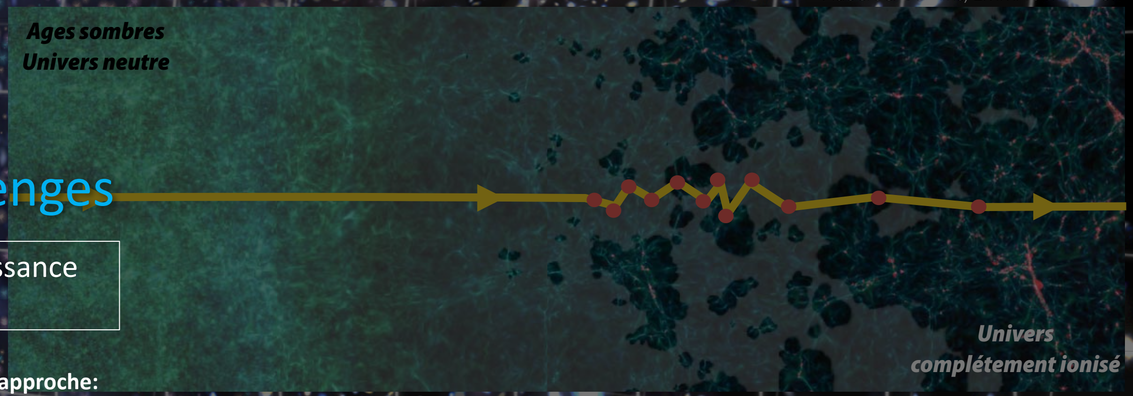
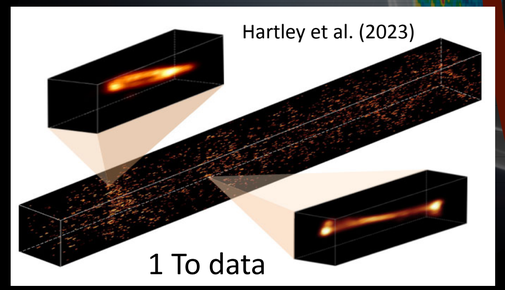
Implication dans les SKA data chalenges

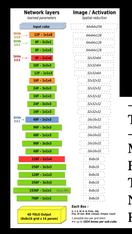
Aubert & Deparis, EMMA simulation



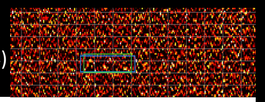
SDC 2: détecter/caractériser sources HI



Equipe MINERVA (PI D. Cornu) 1iere place



YOLO-CIANNA
(Cornu et al. 2024)



Team name	Score	N_d	N_m	R	C	A
MINERVA	23 254	32 652	30 841	0.945	0.132	0.81
FORSKA-Sweden	22 489	33 294	31 507	0.946	0.135	0.77
Team SOFIA	16 822	24 923	23 486	0.942	0.101	0.78
NAOC-Tianlai	14 416	29 151	26 020	0.893	0.112	0.67
HI-FRIENDS	13 903	21 903	20 828	0.951	0.089	0.72

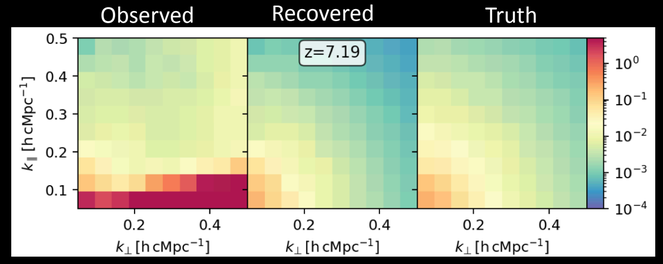
SDC 3: spectre de puissance du 21-cm EoR

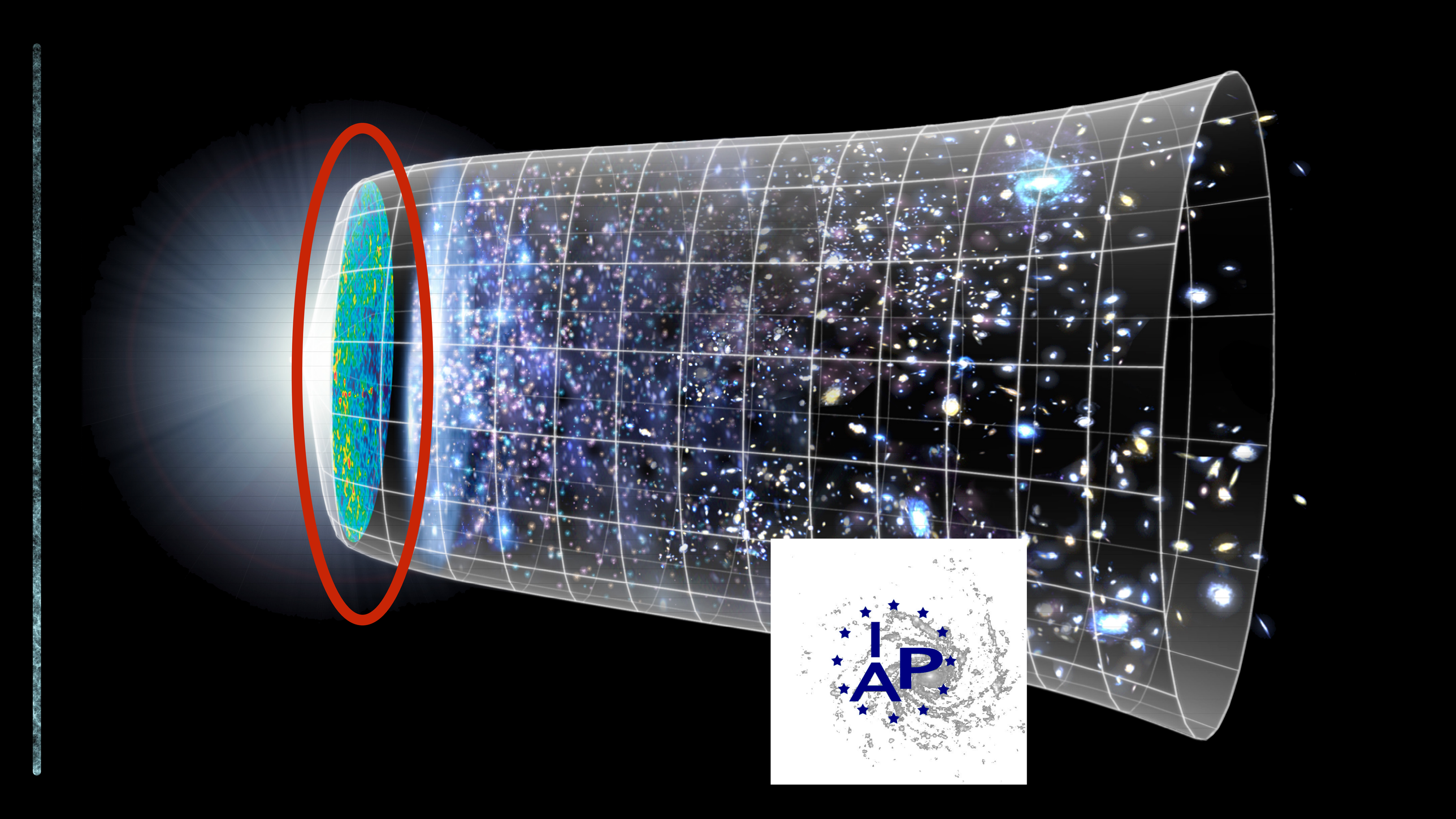
2ième place

DOTSS-21
Equipe Fr-NI
(PI F. Mertens)

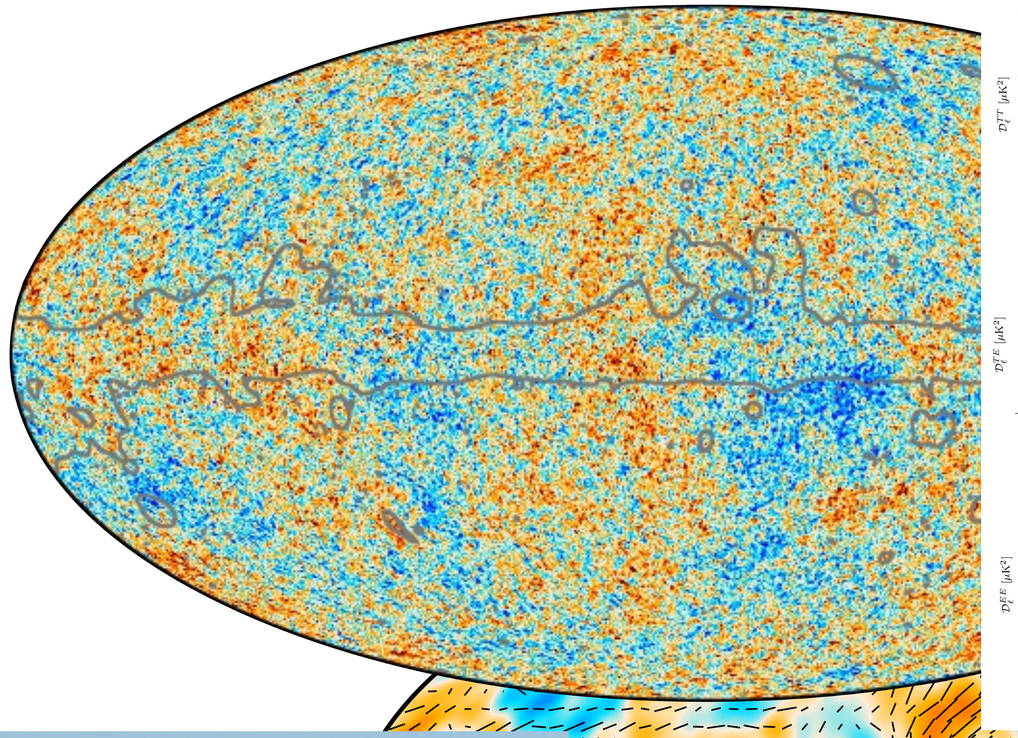
Notre approche:

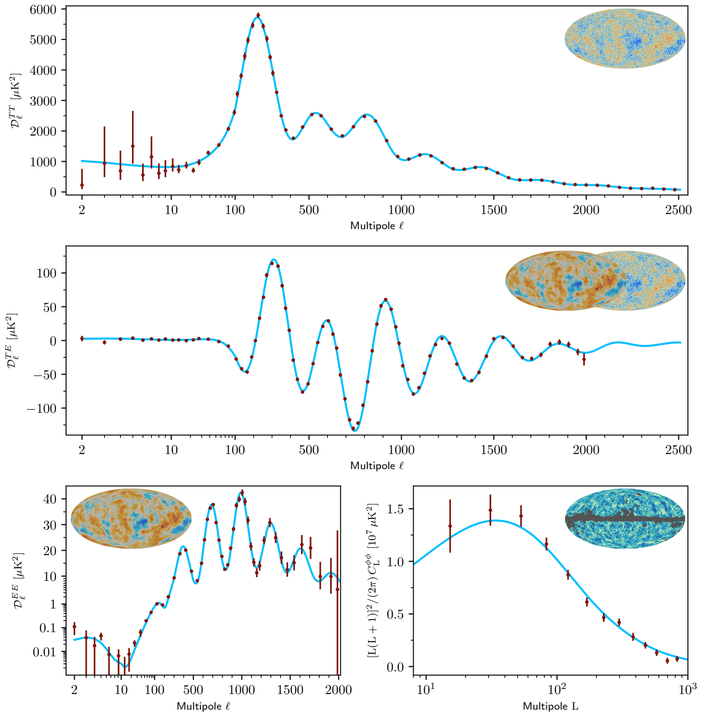
Soustraire sources compactes
Modéliser et soustraire fond diffus Galactique
Extraire le signal 21-cm avec ML-GPR
Produire le spectre de puissance



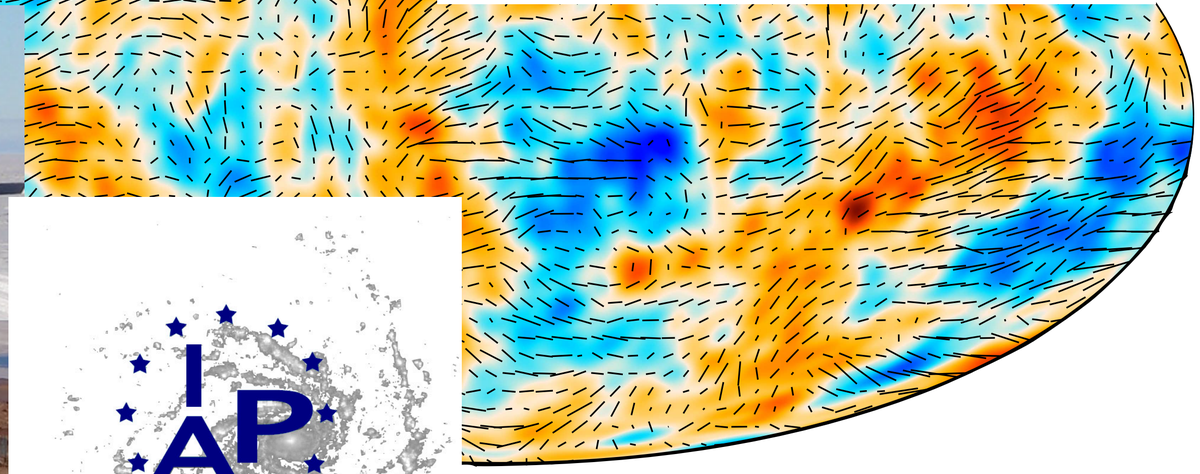

IAP


NORD

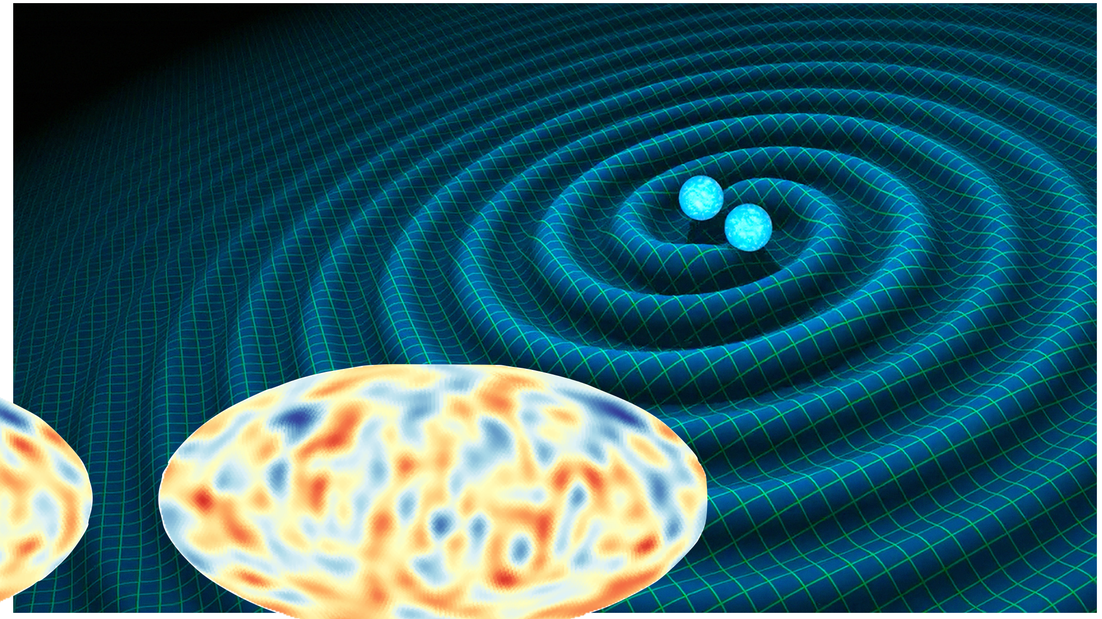



$\mathcal{D}_\ell^{TT}$ [μK^2]
Multipole ℓ
$\mathcal{D}_\ell^{TE}$ [μK^2]
Multipole ℓ
$\mathcal{D}_\ell^{EE}$ [μK^2]
Multipole ℓ
$[L(L+1)]^2/(2\pi)\,C_L^{\phi\phi}$ [10^7 μK^2]
Multipole L

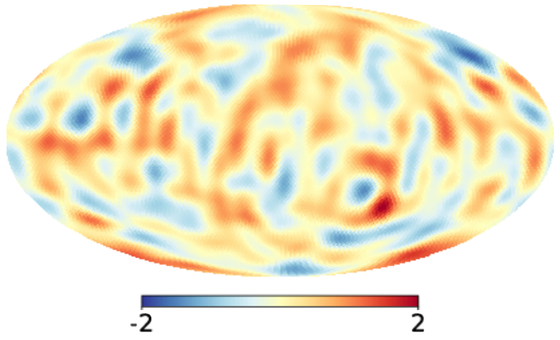

CMB-S4
Next Generation CMB Experiment
CMB-S4 Collaboration Workshop
September 19-21, 2016 • Chicago, IL

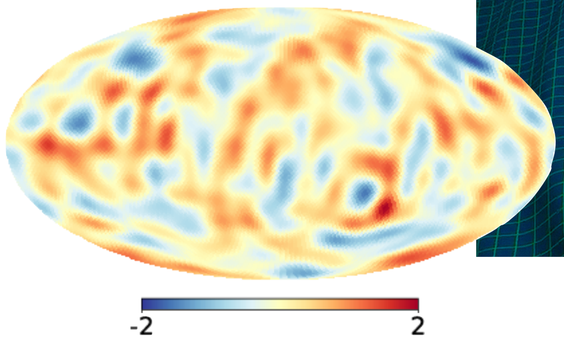


IAP

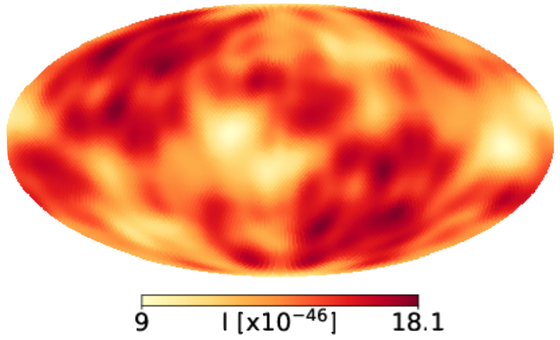


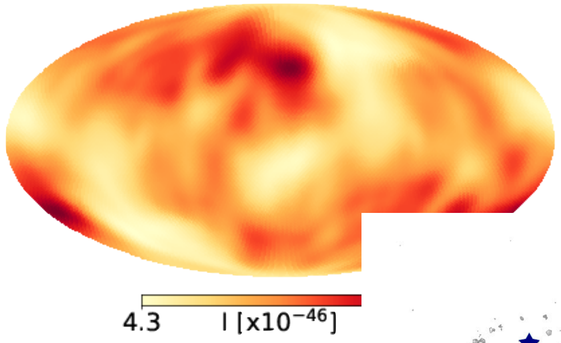
S/N

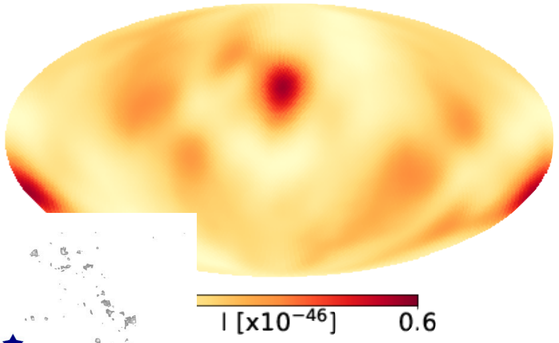




Noise



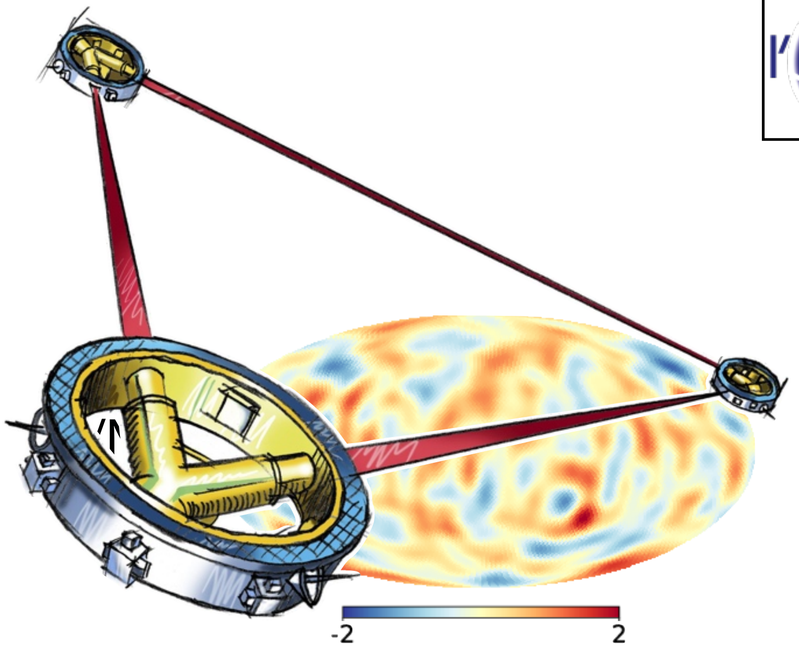


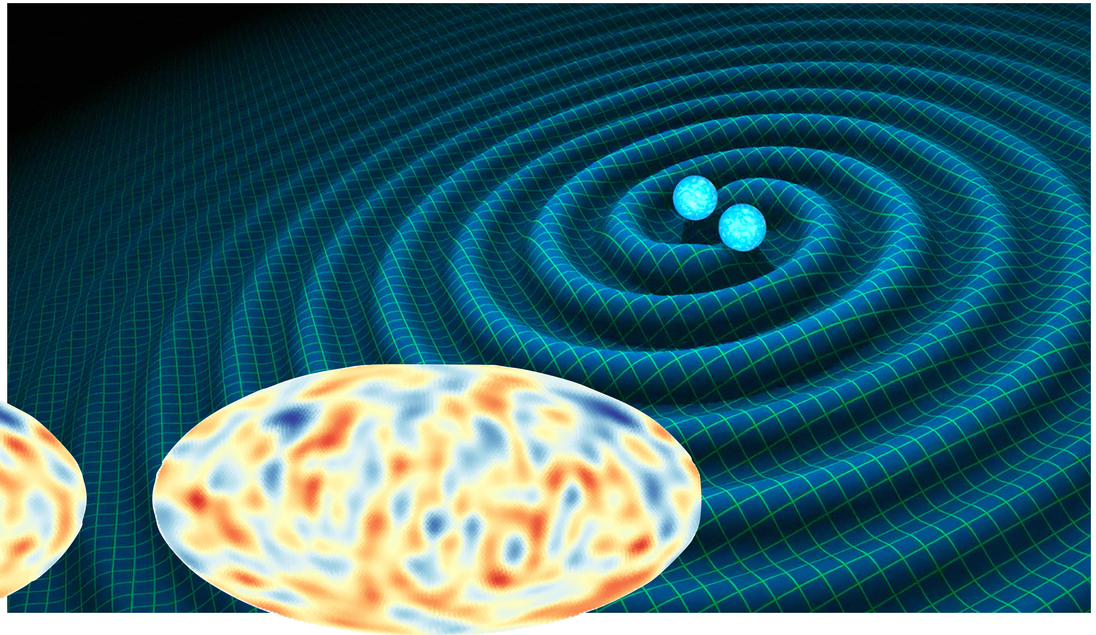


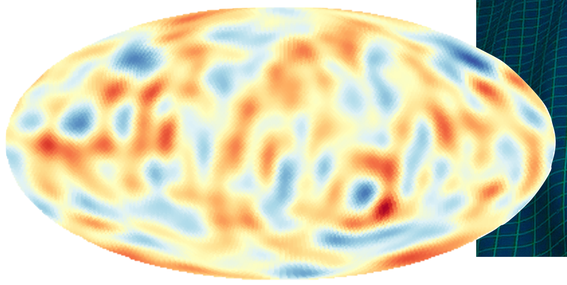
Primordial

object collapse ($\alpha = 3$

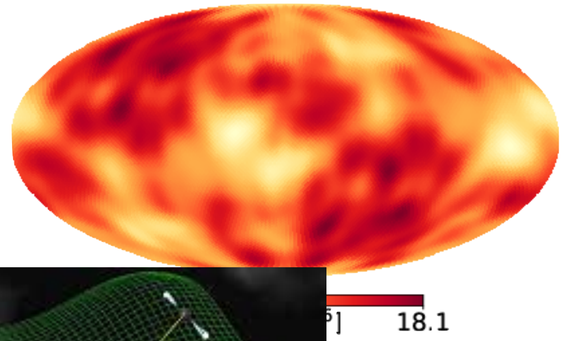
l'Observatoire de Paris

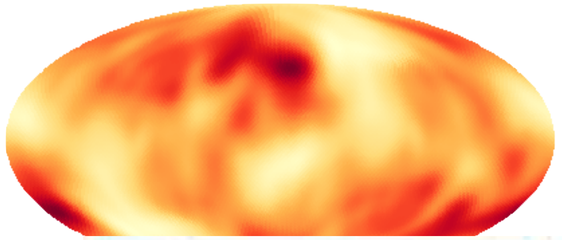


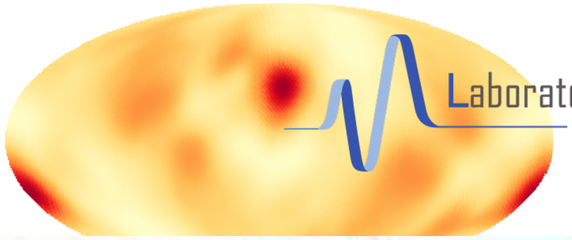




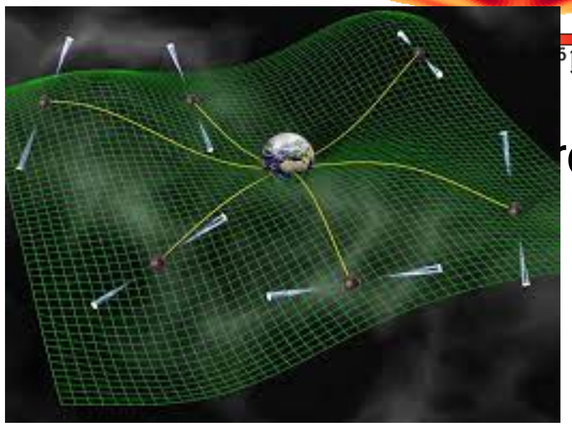
Noise





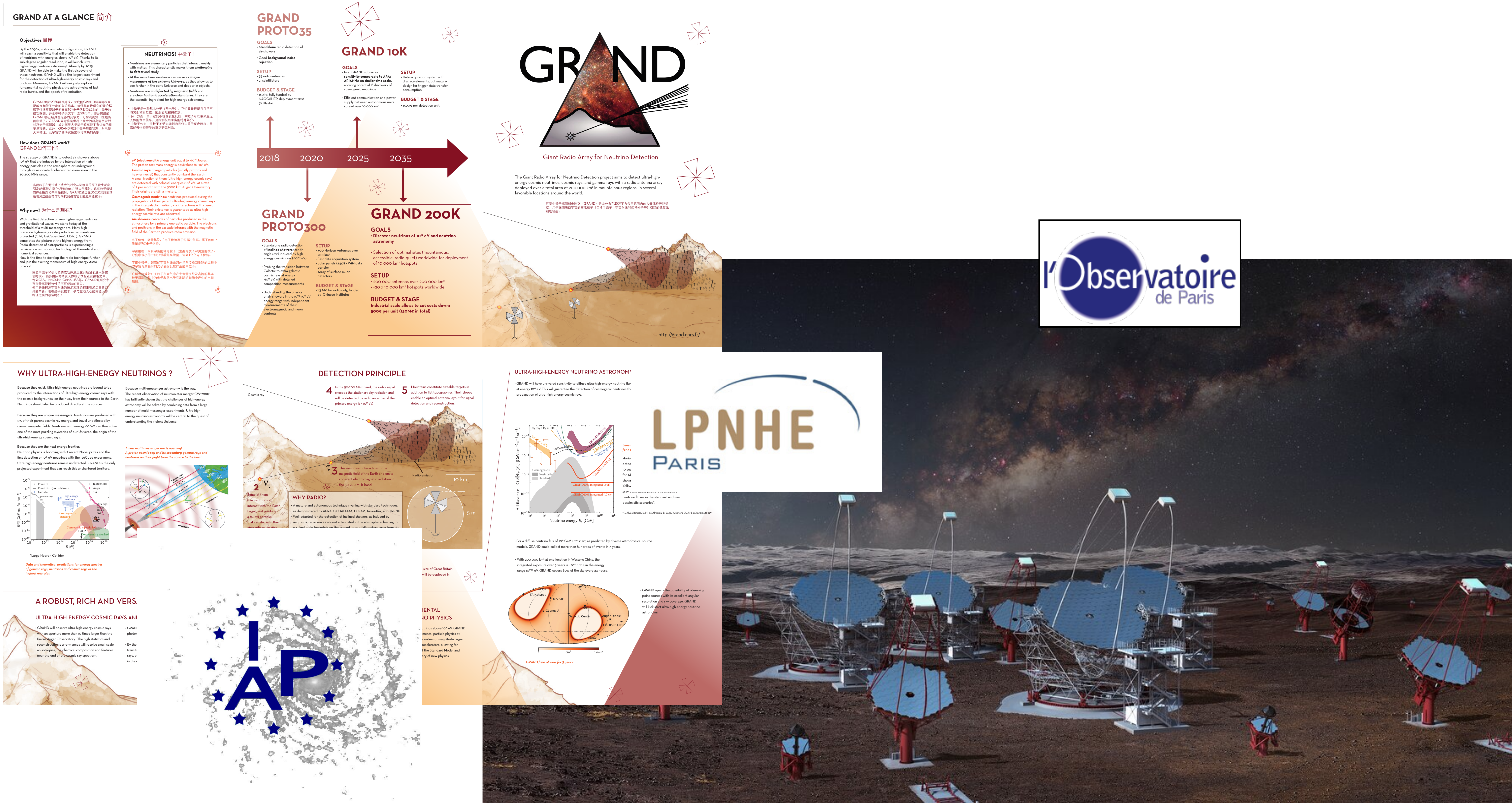


Laboratoire Kastler Brossel
Physique quantique et applications



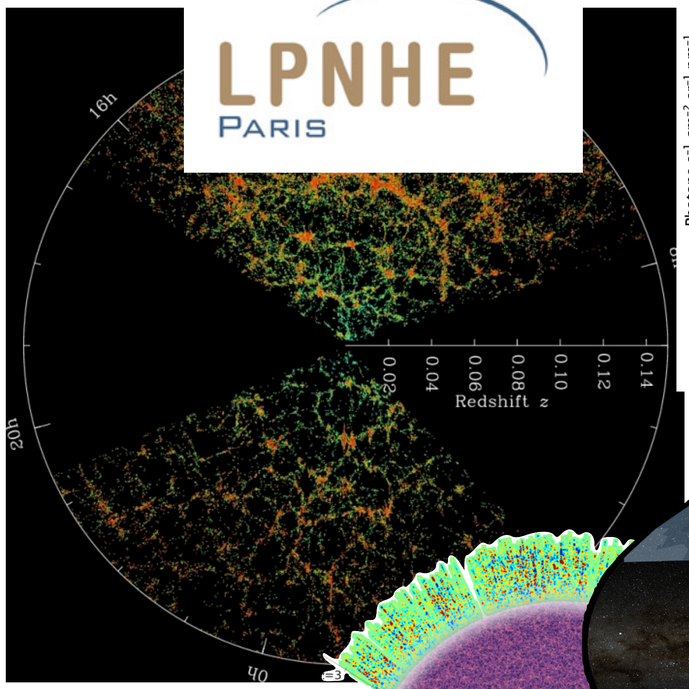
rdial

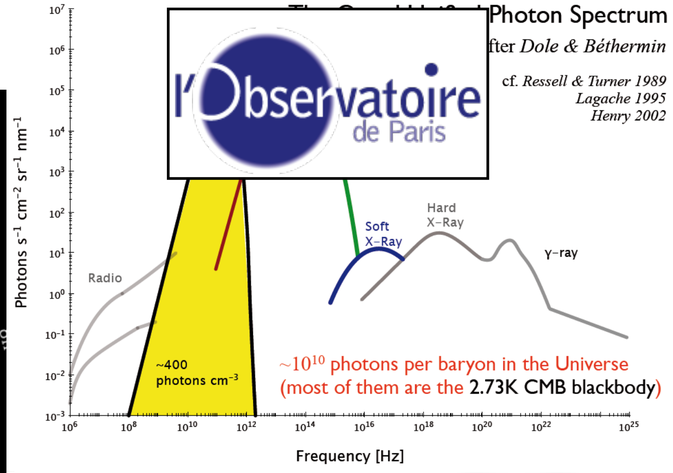
obj


GRAND AT A GLANCE 简介
Objectives 目标
NEUTRINOS! 中微子!
How does GRAND work?
GRAND如何工作?
Why now? 为什么是现在?
GRAND PROTO35
GRAND 10K
GRAND PROTO300
GRAND 200K
2018
2020
2025
2035
GRAND
Giant Radio Array for Neutrino Detection
http://grand.cnrs.fr/
WHY ULTRA-HIGH-ENERGY NEUTRINOS ?
DETECTION PRINCIPLE
WHY RADIO?
ULTRA-HIGH-ENERGY NEUTRINO ASTRONOMY
A ROBUST, RICH AND VERS
l'Observatoire de Paris
LPNHE PARIS
IAP

LPNHE
PARIS

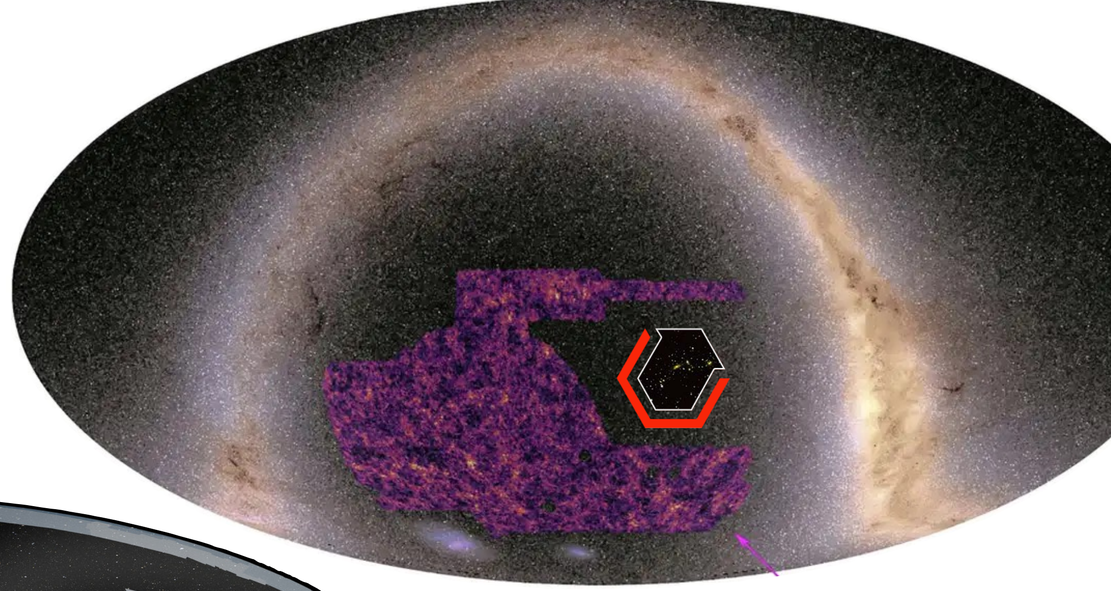
l'Observatoire de Paris

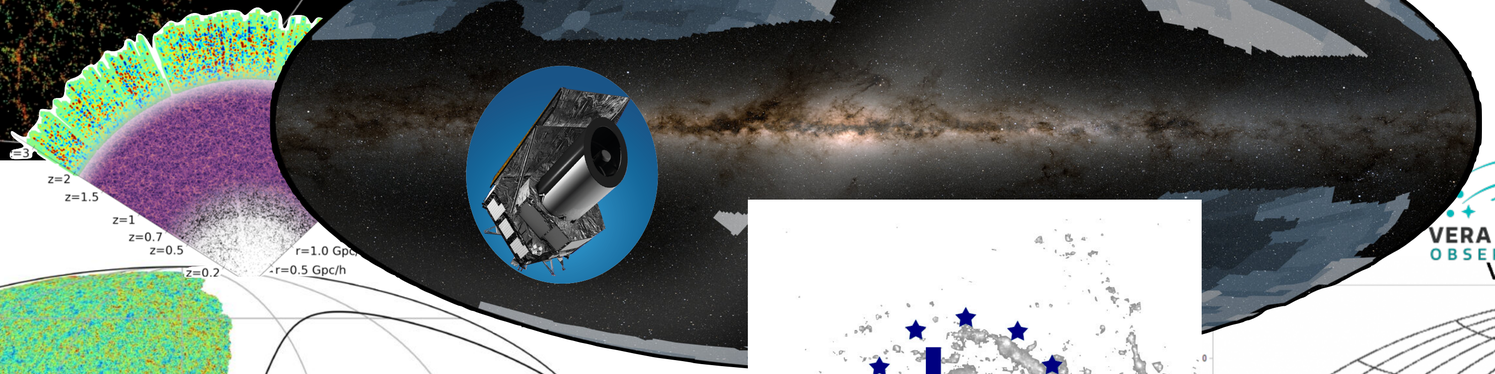


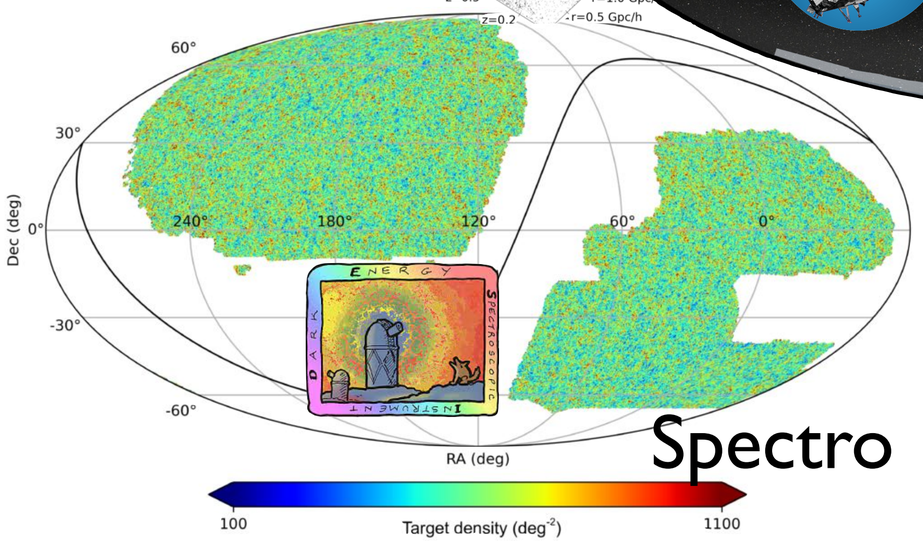


Photon Spectrum
after *Dole & Béthermin*
cf. *Ressell & Turner 1989*
Lagache 1995
Henry 2002

~10^{10} photons per baryon in the Universe
(most of them are the 2.73K CMB blackbody)







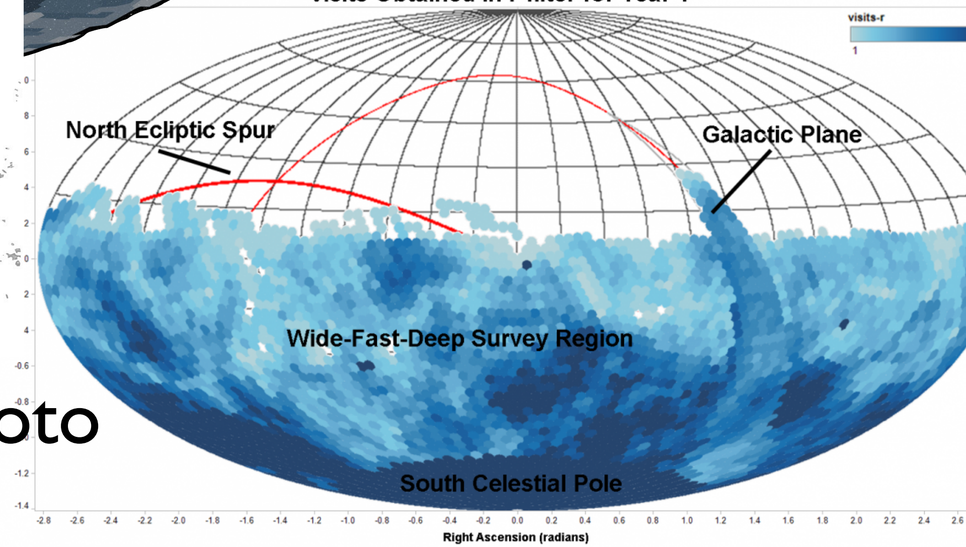
Spectro

IAP

VERA C. RUBIN OBSERVATORY

LSST
Legacy Survey of Space and Time

Visits Obtained in r-filter for Year 1



Photo

LPNHE
PARIS

l'Observatoire

Photon Spectrum
fter *Dole & Béthermin*
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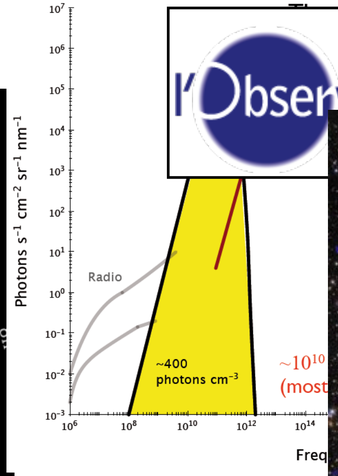
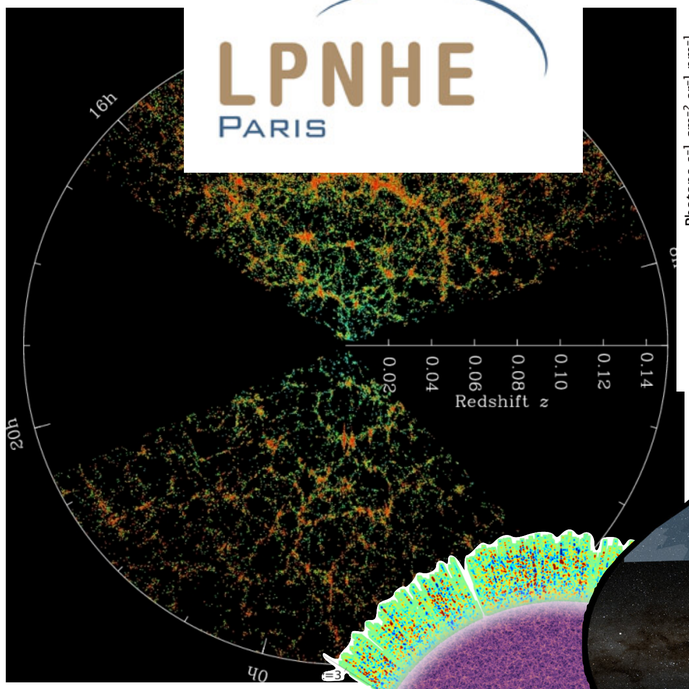
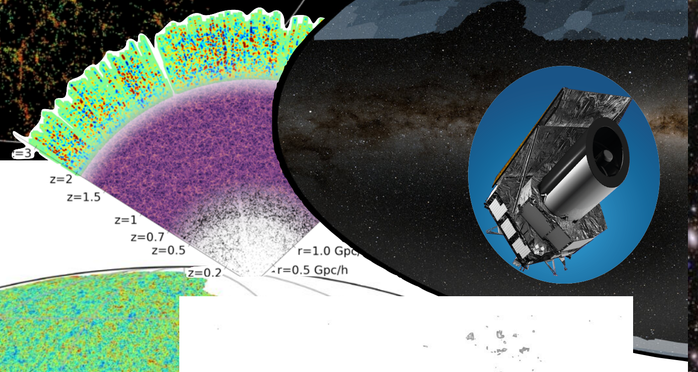
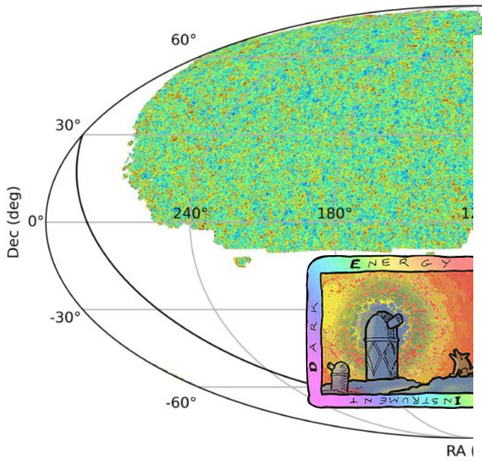
Lagache 1995

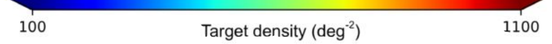








IAP



LPNHE
PARIS

l'Observatoire de Paris

Photon Spectrum
after *Dole & Béthermin*
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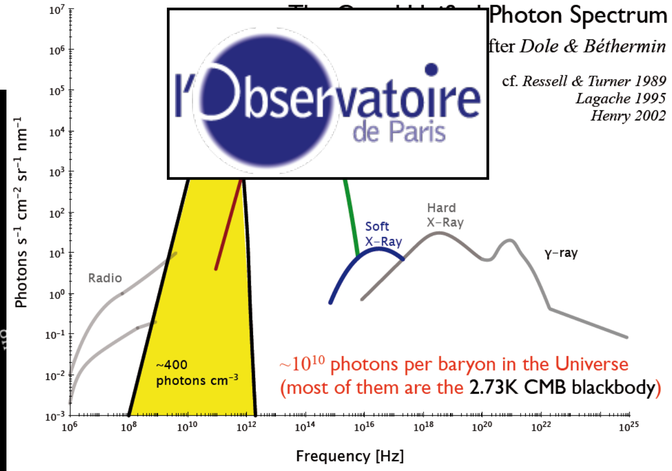

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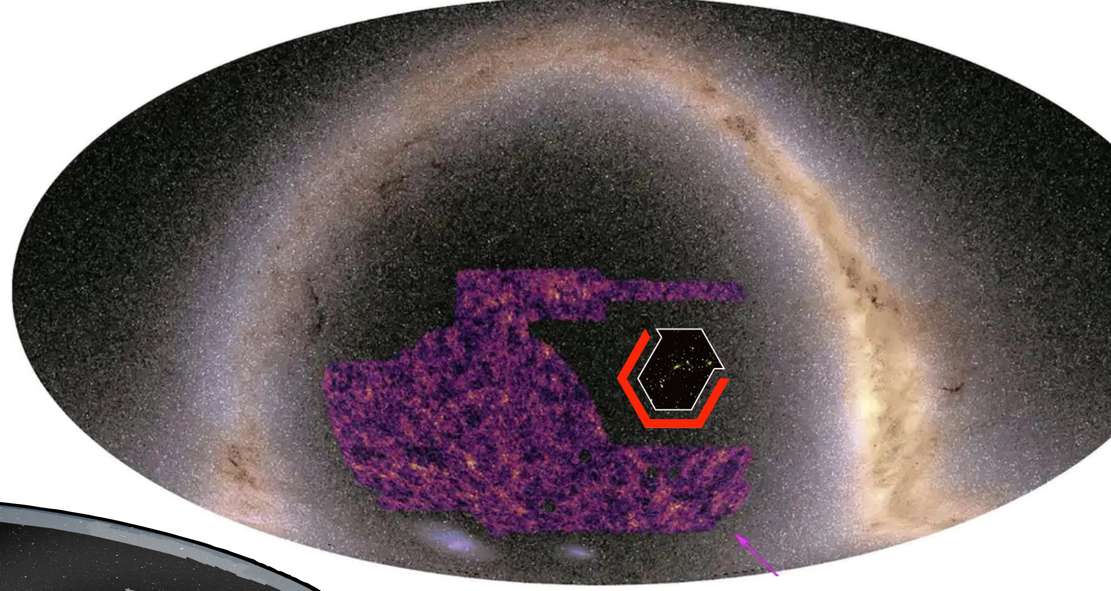
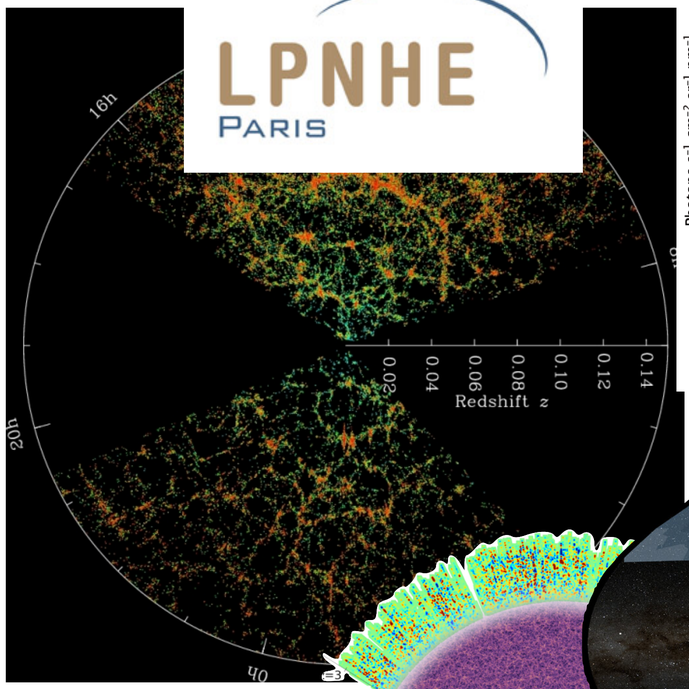
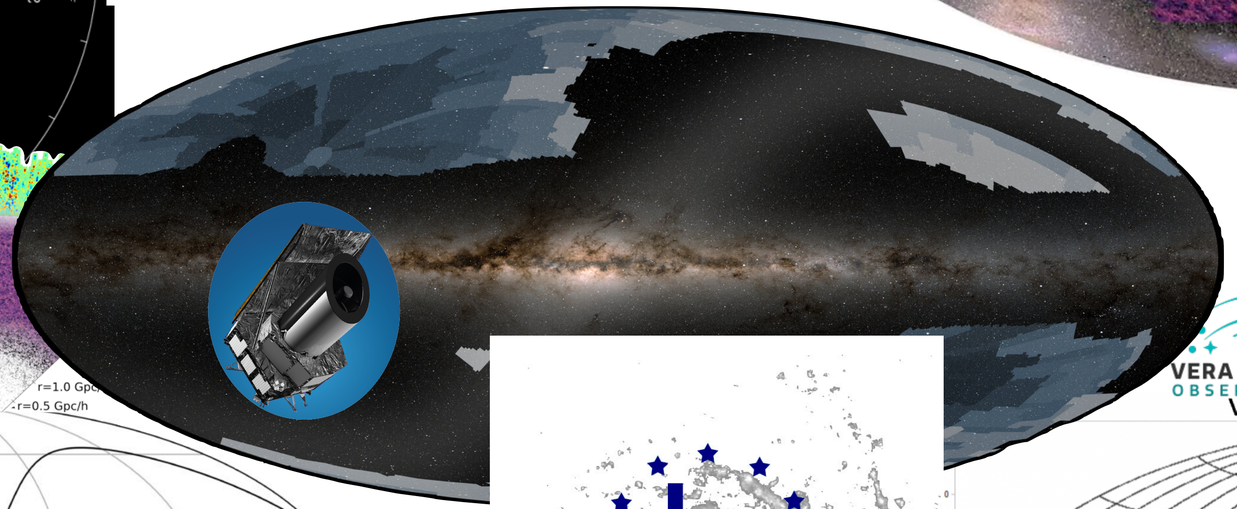
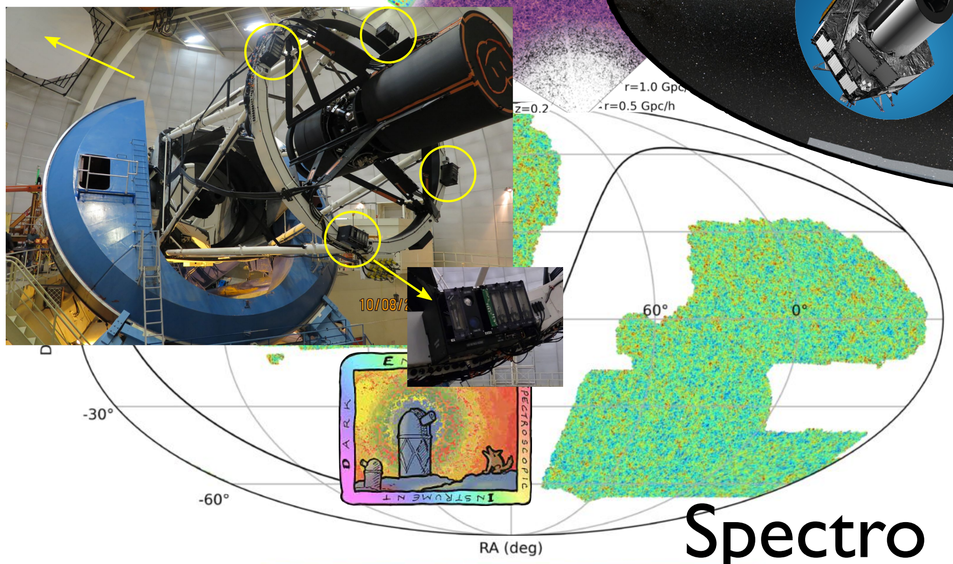






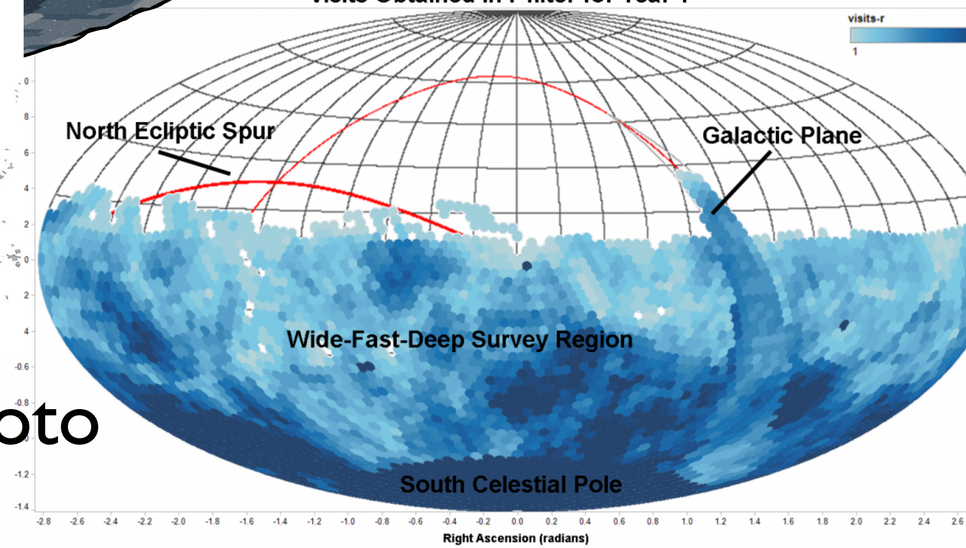


Spectro

IAP

VERA C. RUBIN OBSERVATORY

LSST
Legacy Survey of Space and Time



Photo

Contribution au Plan focal de LSST

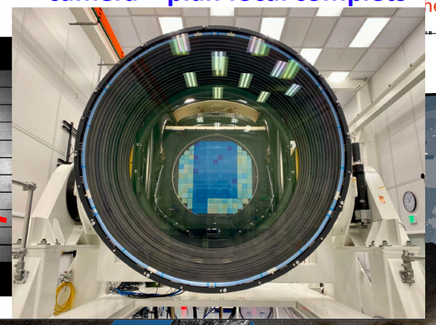
- **Début de l'implication dans les ASICs du plan focal : fev 2007**
- **2 labos (LPNHE , IJCLab) impliqués dans ces développements ASICS**
- **En plus au LPNHE : interaction CCD-vendeur , Optimisation lecture CCD & contrib. design readout , micro-code du plan focal**
- **Au LPNHE : un banc test CCD LSST dédié à l'optimisation de la lecture & études fines CCD**
- **Plan Focal** au LPNHE: 35 ETP ITA (0.2 ETP ITA en 2023) pour un total IN2P3 ~3 M€ > 50 ETP ITA
- **Participation au commissioning**

C.Juramy , Cristal 2020 pour son travail sur les CCD dans le cadre du Plan focal de LSST

Première image 18 août 2020

Sep 2022 :

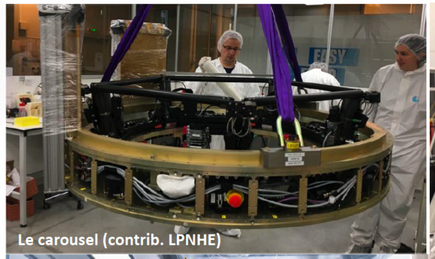
caméra + plan focal complets

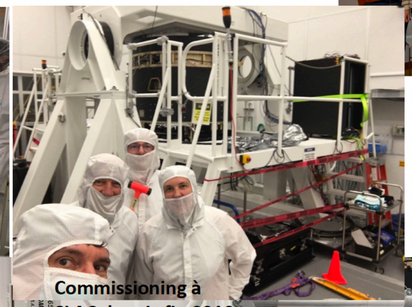


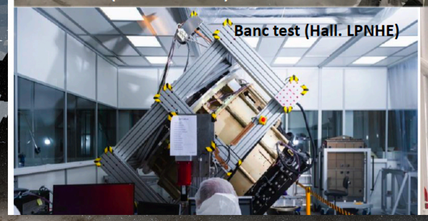
Le Changeur de Filtre de la caméra de LSST

- 1ère études fin 2006 (carousel au LPNHE)
- 5 labos de l'IN2P3 impliqués
- un cout total à l'IN2P3 de 2.3 M€ + > 100 FTE
- Au LPNHE: ~ 40 ETP ITA (dont ~0.7 ETP en 2023)

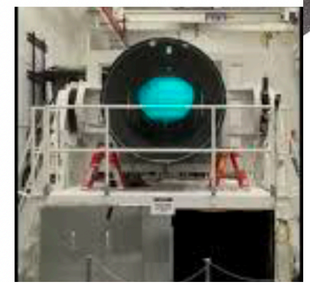
11 ITA des labos du changeur de filtre (APC,CCPM,LPC,LPNHE,LPSC) (dont 4 du LPNHE) ont reçu le Cristal Collectif 2021 !!!

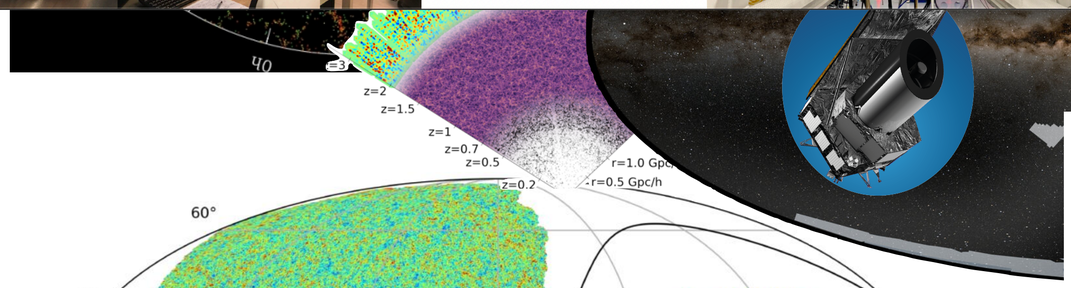


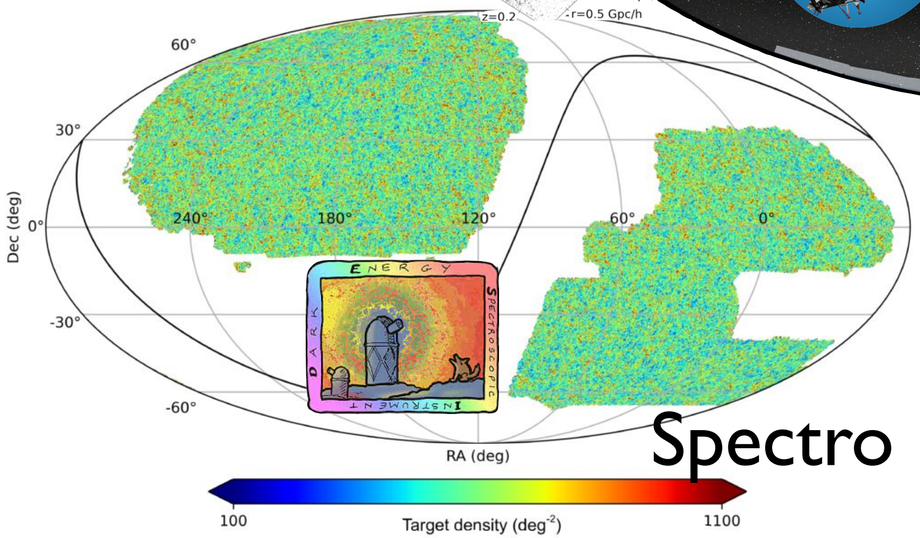




Changeur de filtre installé à SLAC depuis fin 2019 : 100% opérationnel aujourd'hui



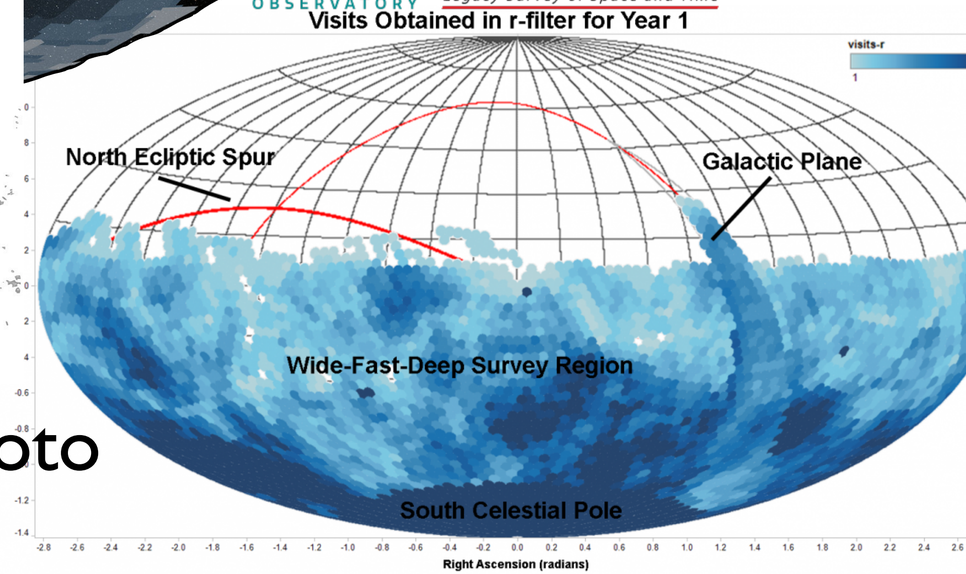




Spectro

VERA C. RUBIN OBSERVATORY

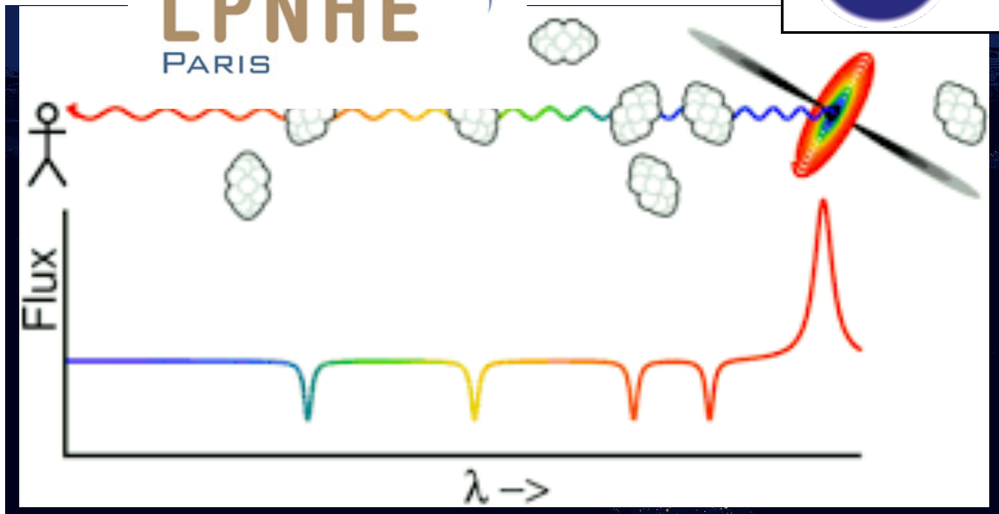
LSST Legacy Survey of Space and Time



Photo

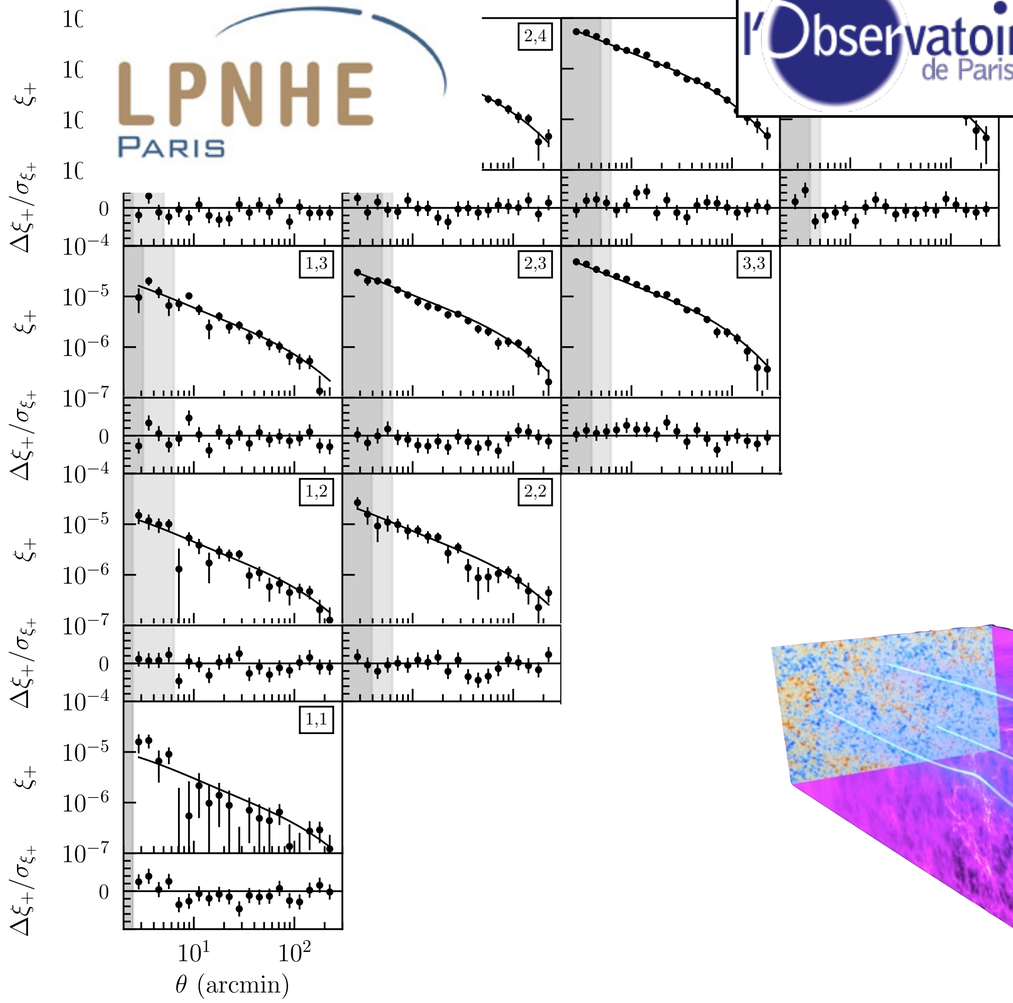
LPNHE
PARIS

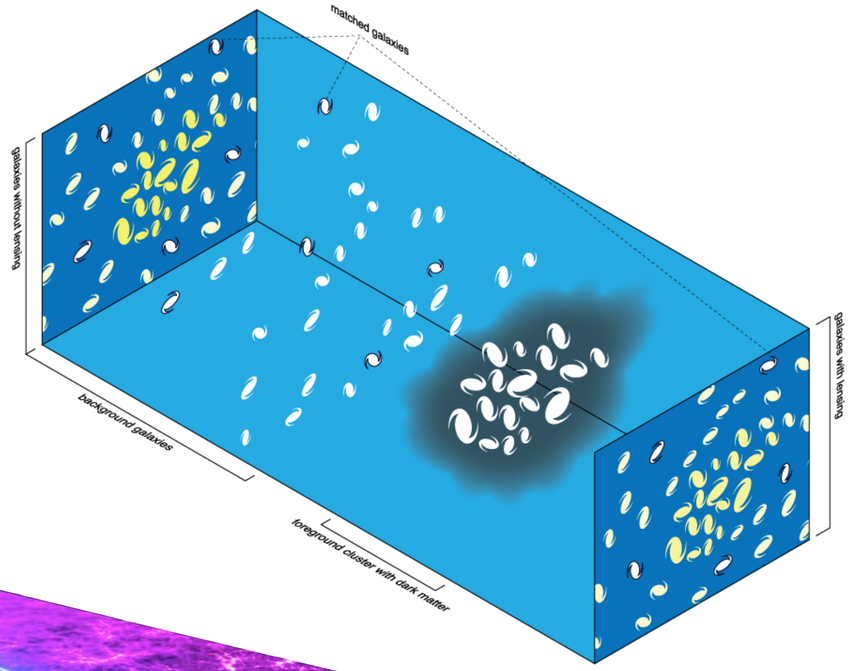
l'Observatoire de Paris

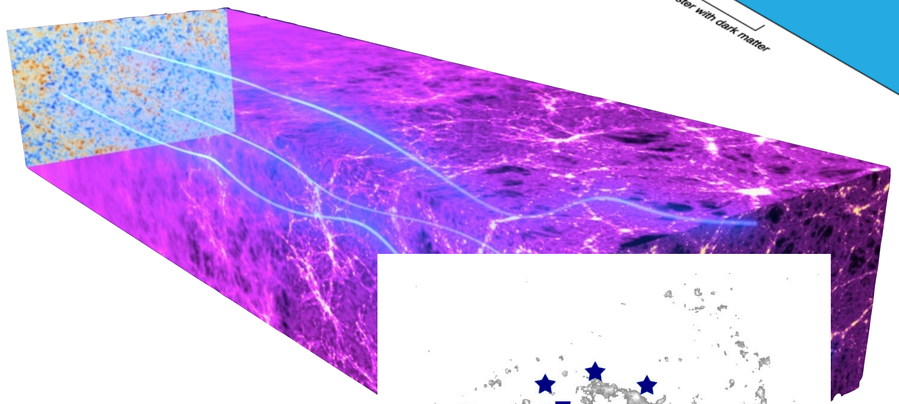


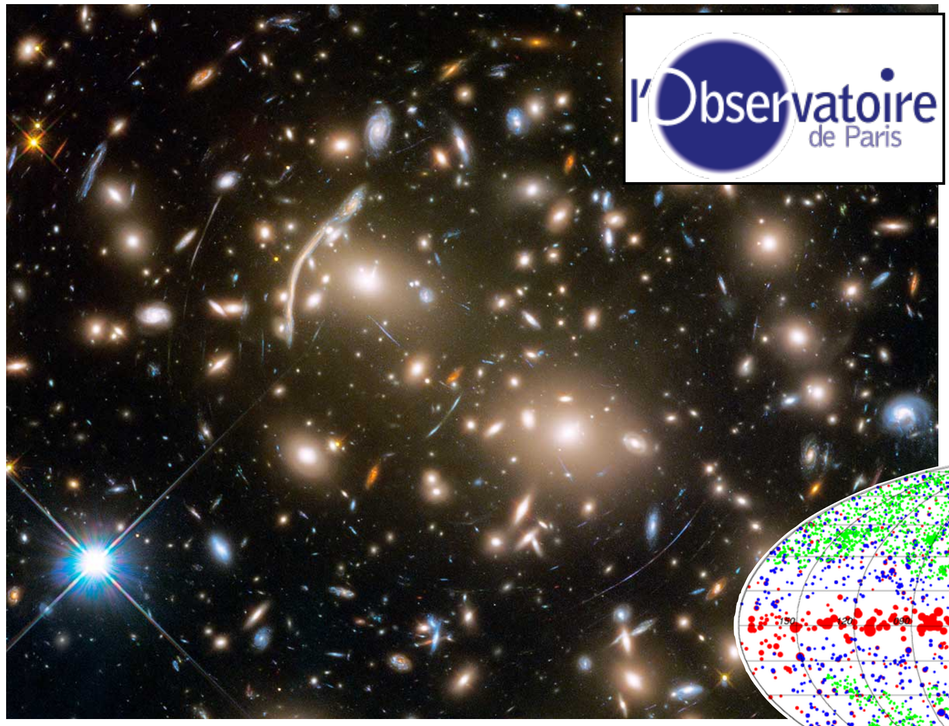
IAP

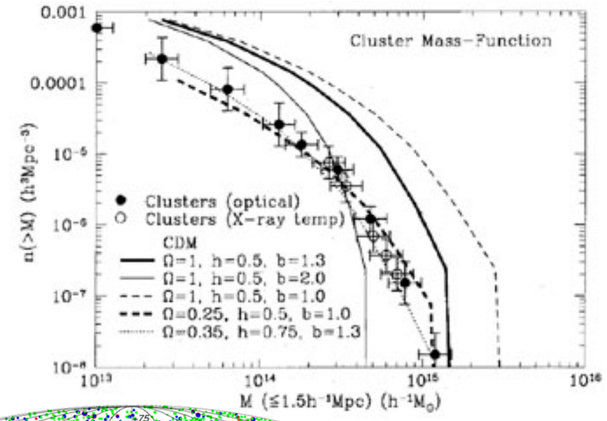
l'Observatoire de Paris

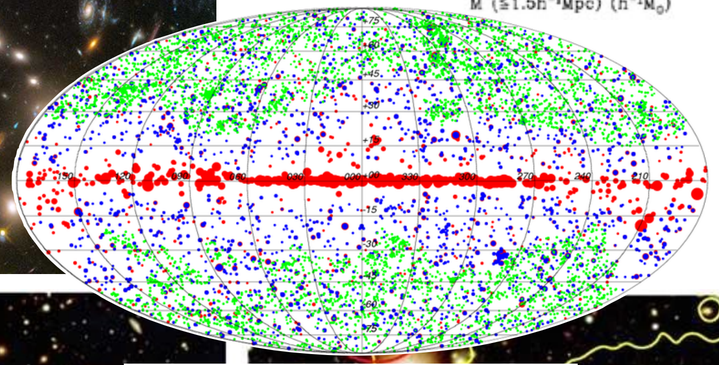

2,4
1,3
2,3
3,3
1,2
2,2
1,1
ξ_+
$\Delta\xi_+/\sigma_{\xi_+}$
10^{-4}
10^{-5}
10^{-6}
10^{-7}
0
10^1
10^2
θ (arcmin)

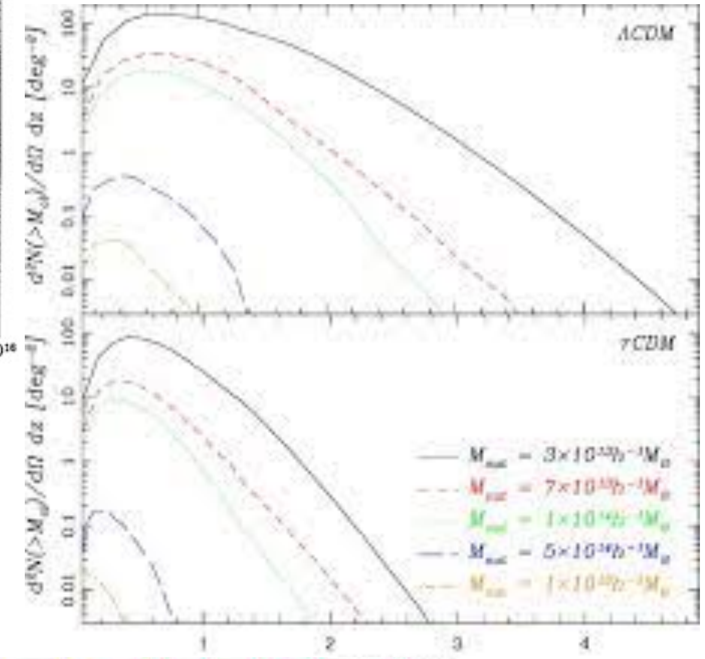

matched galaxies
galaxies without lensing
background galaxies
foreground cluster with dark matter
galaxies with lensing

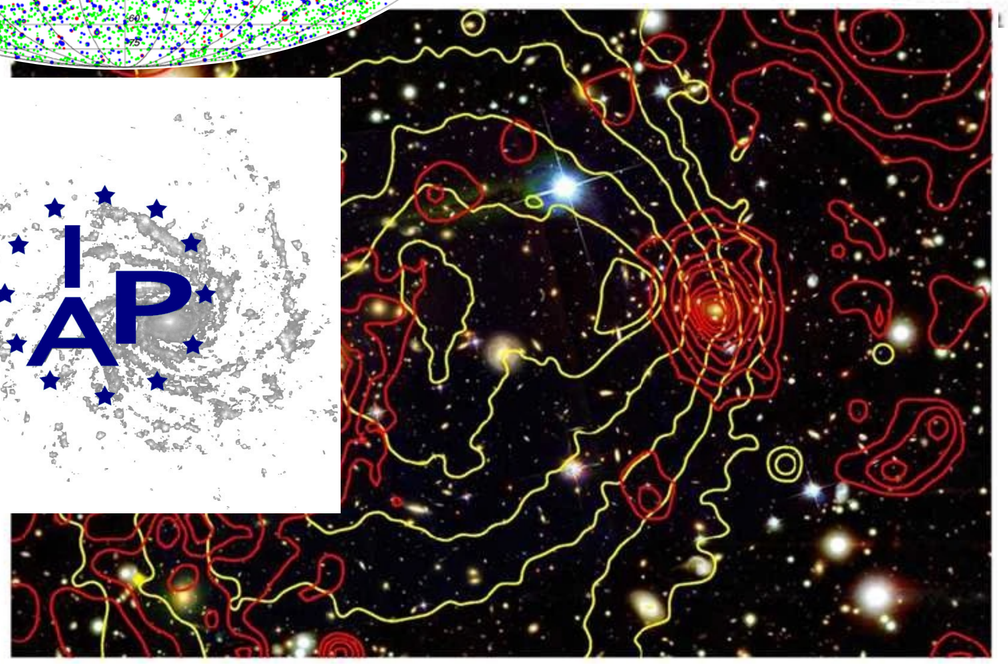




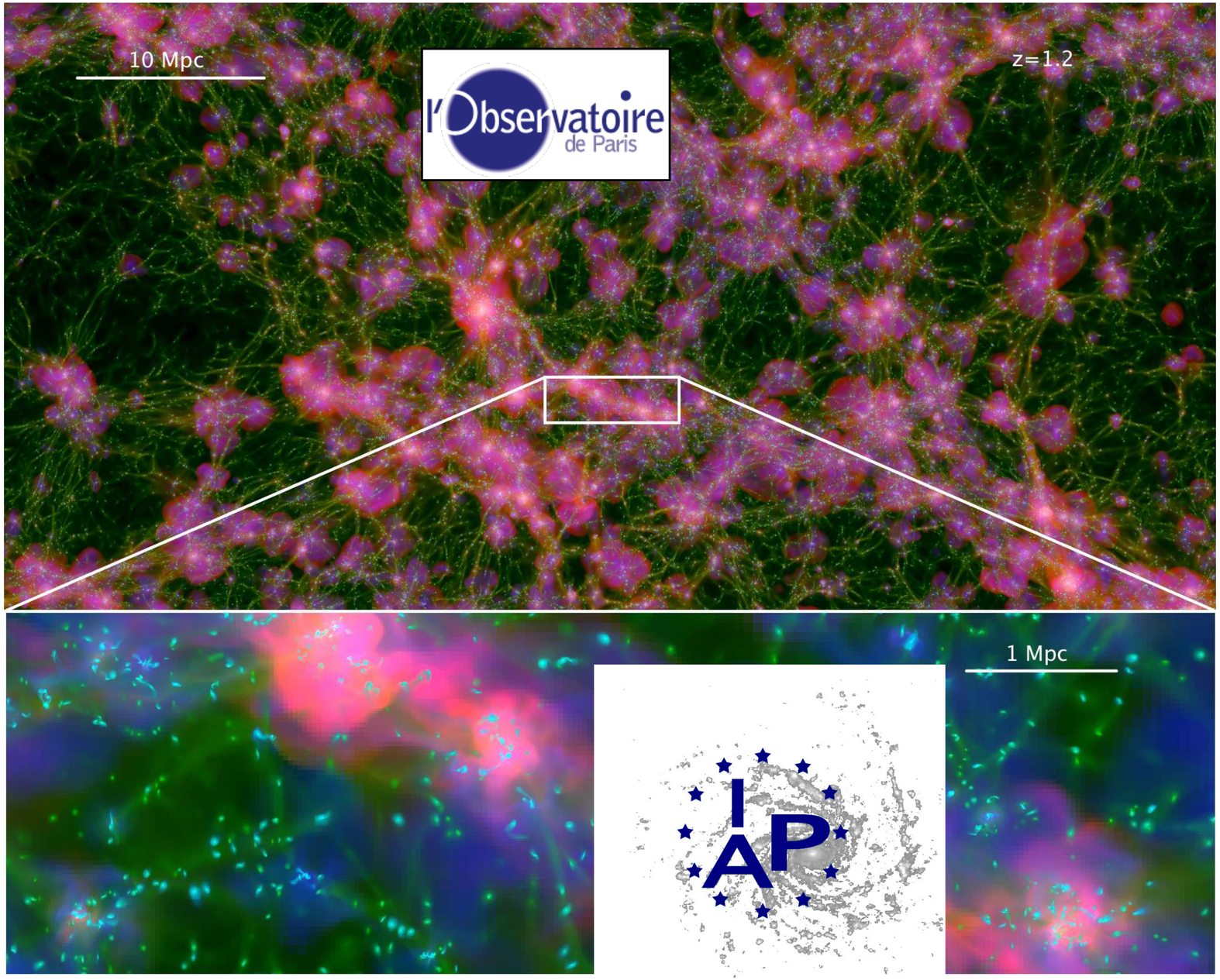

Cluster Mass-Function
Clusters (optical)
Clusters (X-ray temp)
CDM
Ω=1, h=0.5, b=1.3
Ω=1, h=0.5, b=2.0
Ω=1, h=0.5, b=1.0
Ω=0.25, h=0.5, b=1.0
Ω=0.35, h=0.75, b=1.3
n(>M) (h³Mpc⁻³)
M (≦1.5h⁻¹Mpc) (h⁻¹M⊙)



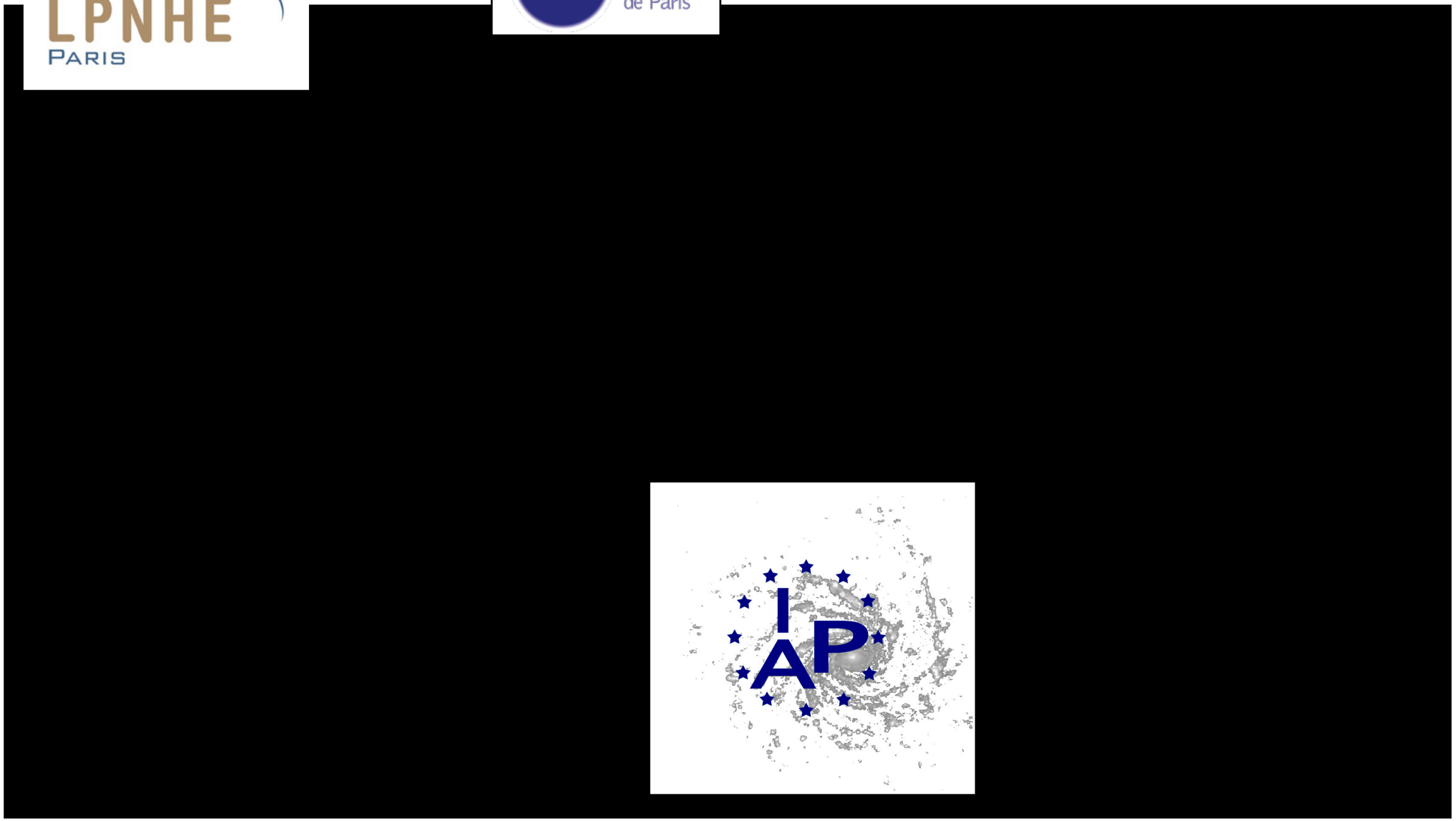

ΛCDM
τCDM
z

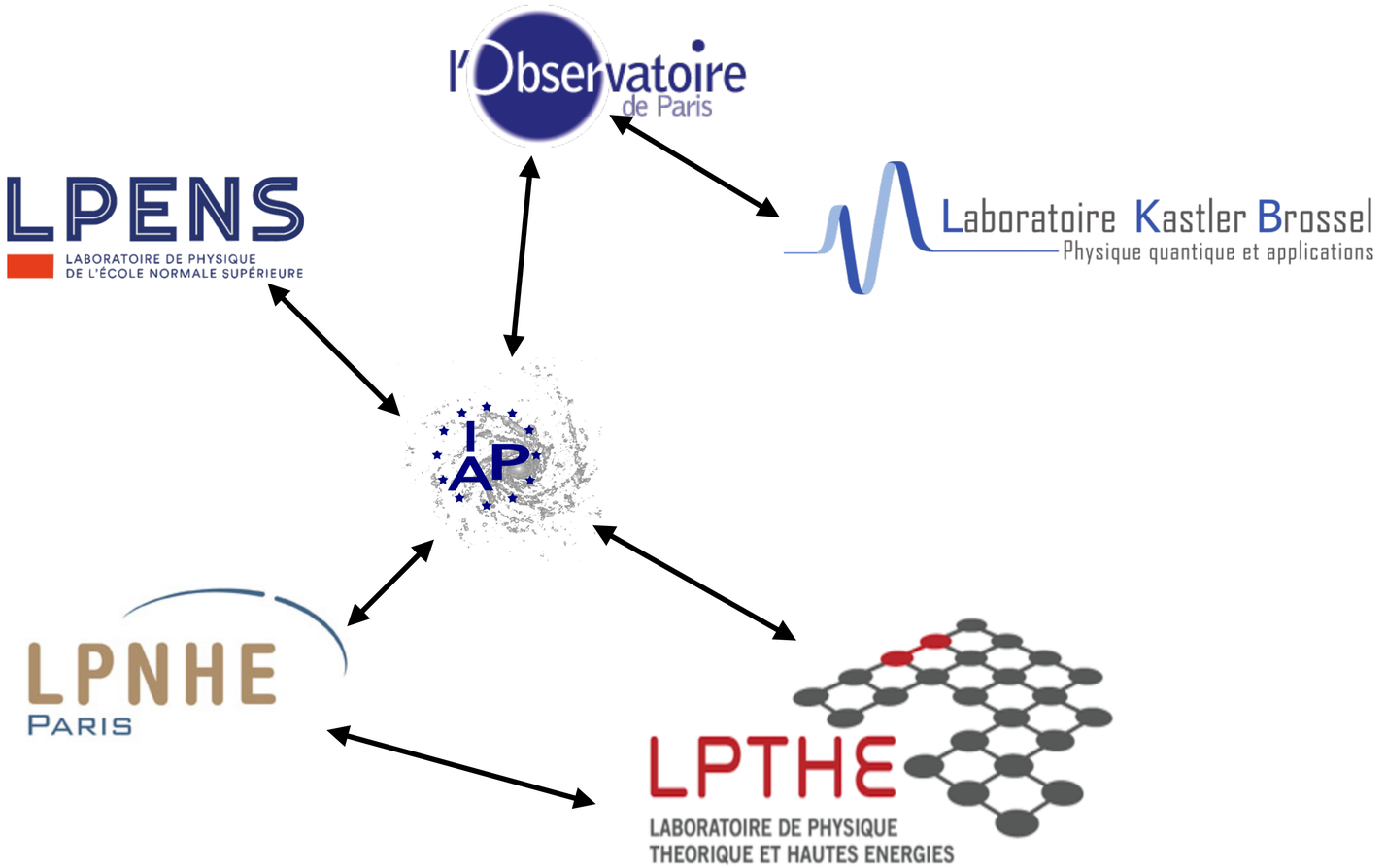


IAP


10 Mpc
z=1.2
l'Observatoire de Paris
1 Mpc
IAP

https://www.youtube.com/watch?v=N-lGQVpevAc




l'Observatoire
de Paris
LPENS
LABORATOIRE DE PHYSIQUE
DE L'ÉCOLE NORMALE SUPÉRIEURE
Laboratoire Kastler Brossel
Physique quantique et applications
IAP
LPNHE
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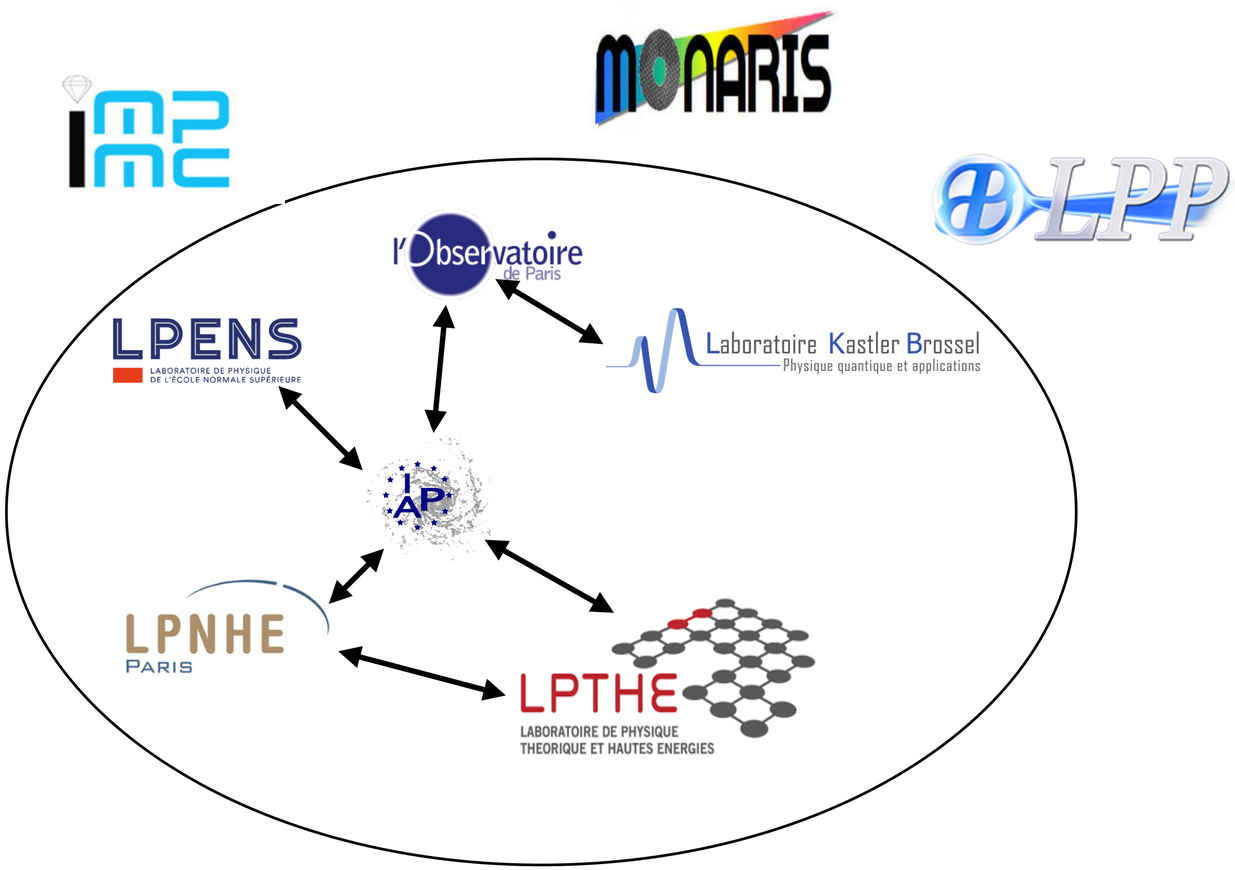
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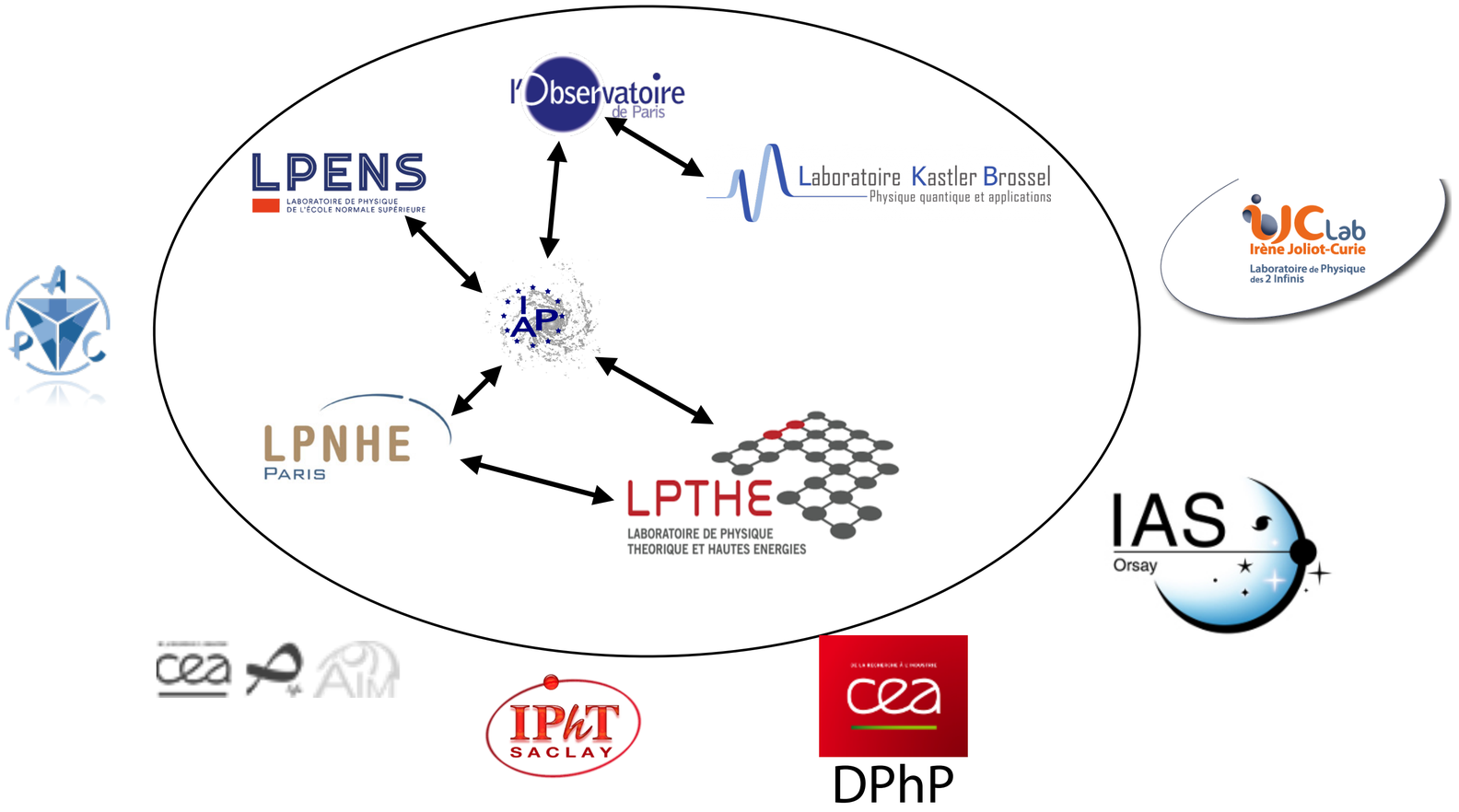
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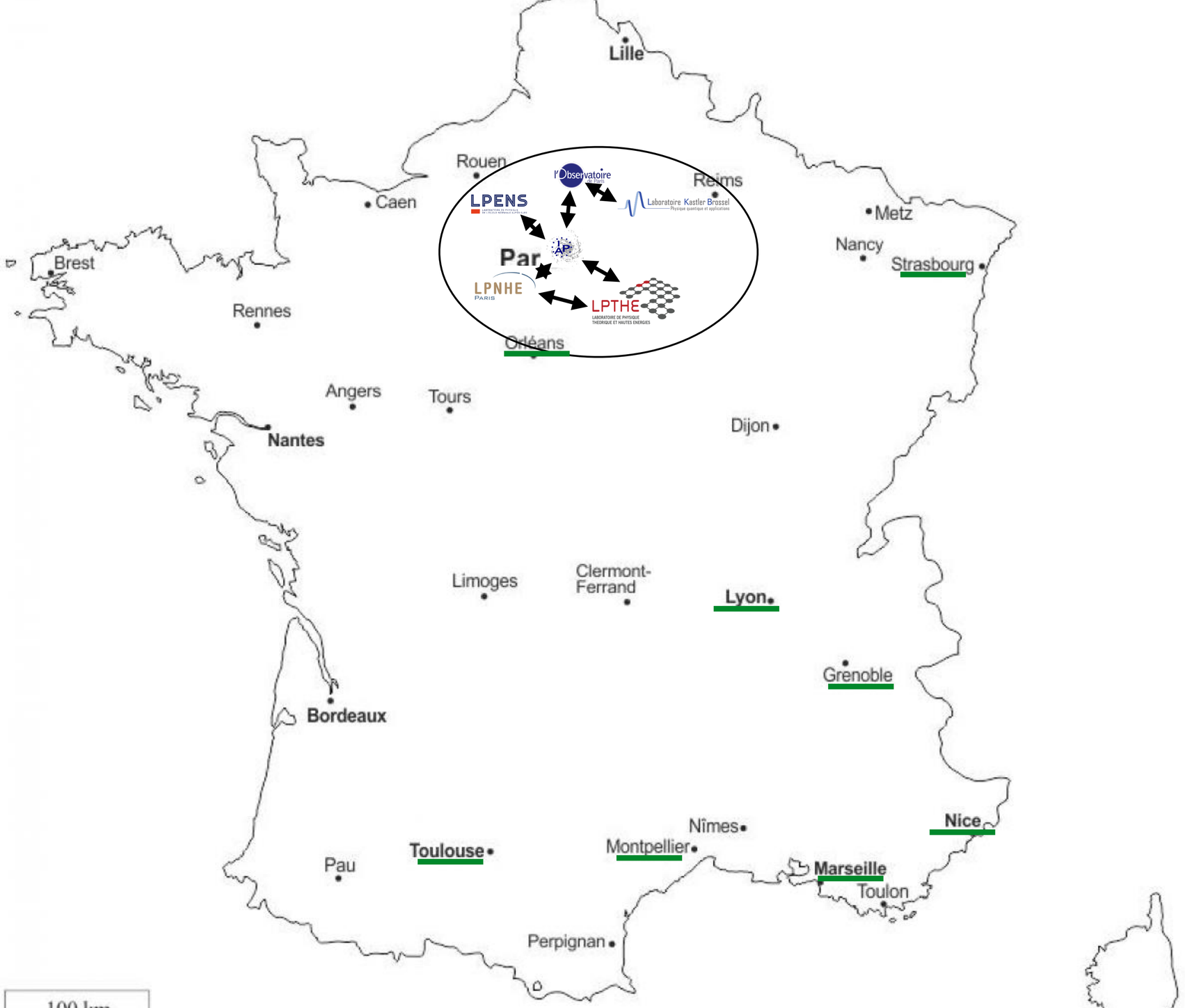
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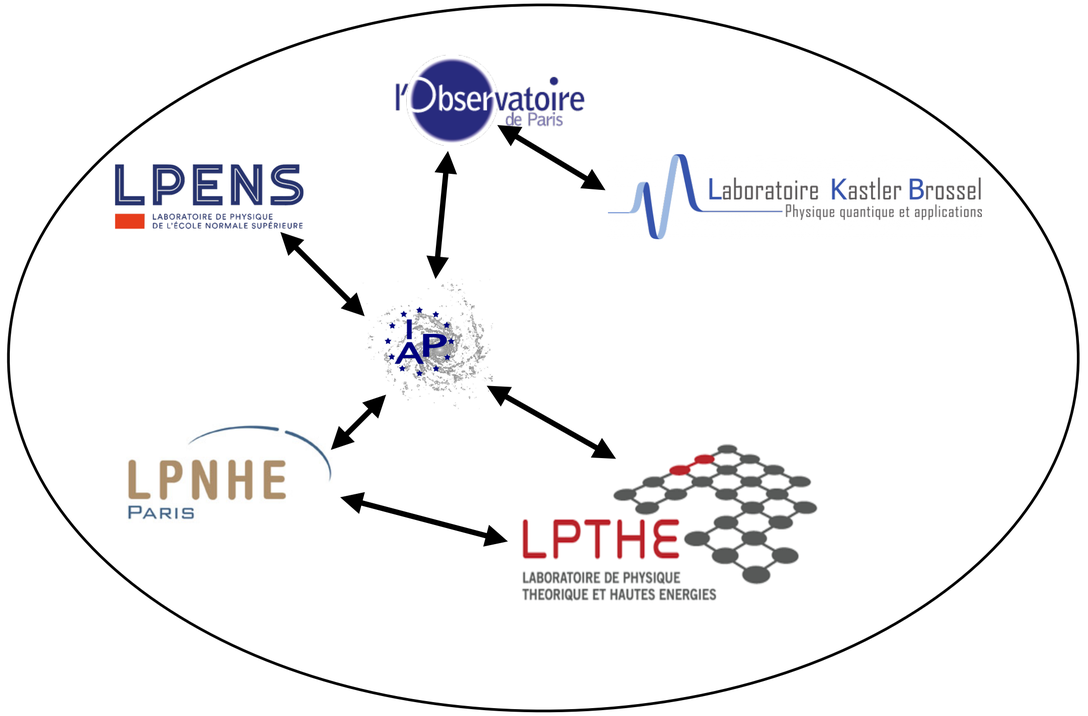
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Combien de divisions ?

- **Evaluation parcellaire…**
- **IAP : Theorie : CNRS 6/4, Cosmologie : CNRS 5/3, SU 1/0, CNAP 3/3, Hautes Energies & Galaxies : CNRS 4/2, SU 0/3, CNAP 1/2 -> 37**
- **LPNHE : CNRS 3/3, SU 3/3 -> 12**
- **LPTHE : CNRS 3 SU 1 -> 4**
- **LKB : 2**
- **LPENS : 2**
- **Observatoire : Univers 12, Grandes Structures 17, Galaxies formation/evolution 21, Galaxies structure interne 21 -> 50 (dont 25 nouveaux arrivants)+21**

Structuration interne et besoins

- Doctorants
  - Déjà très structurés avec les ED
  - mais : Bourses en particulier pour cotutelles entre labos SU
- Post Doc
  - Bourses !!!!!
- Soutien aux projets communs au sein de SU
  - *simplification admin… Problème des budgets CNRS/SU/autres…*
  - IPI était aussi une source de support important pour les conférences
- Séminaires communs
  - déjà très structuré et organisé (ICAP, journal club IAP videodiffusé, séminaire GRECO, etc…)

- **Domaine riche avec de VRAIS résultats (grml !)**
  - *Seule une fraction des observables « simples » (i.e. linéaires) est exploitée*
  - *De réels progrès sur les choses plus complexes*
  - *Encore de beaux mystères à éclaircir*
  - *Investissement observationnel important : de nombreux nouveaux résultats majeurs dans les 10 prochaines années*

- **Thème de recherche très visible à l'international et avec un grand interêt societal**

- l'Ile de France est un réel poids lourd dans la discipline, avec une densité de chercheurs importante (mais c'est sans doute vrai de la plupart des thématiques…)
  - *SU est collectivement l'acteur le plus important d'IdF et porte des thématiques fortes et très visibles*
  - *aussi un acteur majeur des projets observationnels majeurs des 10 prochaines années*

- Domaine très éclaté : 3 instituts, 2 CNU, multi labo…
  - *Outils de structuration critiques pour faire fructifier la position forte de SU*
  - *Intérêt pour SU à valoriser, à reconnaitre et à faire connaitre cette pépite !*
    - *au même titre que de nombreuses autres !*