



Hervé Dole – Université Paris-Saclay

Twitter: @herve_dole

Youtube: HerveDoleAstro

Contact radio en direct avec Thomas Pesquet dans l'ISS à l'Université Paris-Saclay – juin 2021
F5KEE, collège Albert Camus la Norville, AMSAT – 100k vues sur <https://www.youtube.com/live/rqrZ--LutTI>



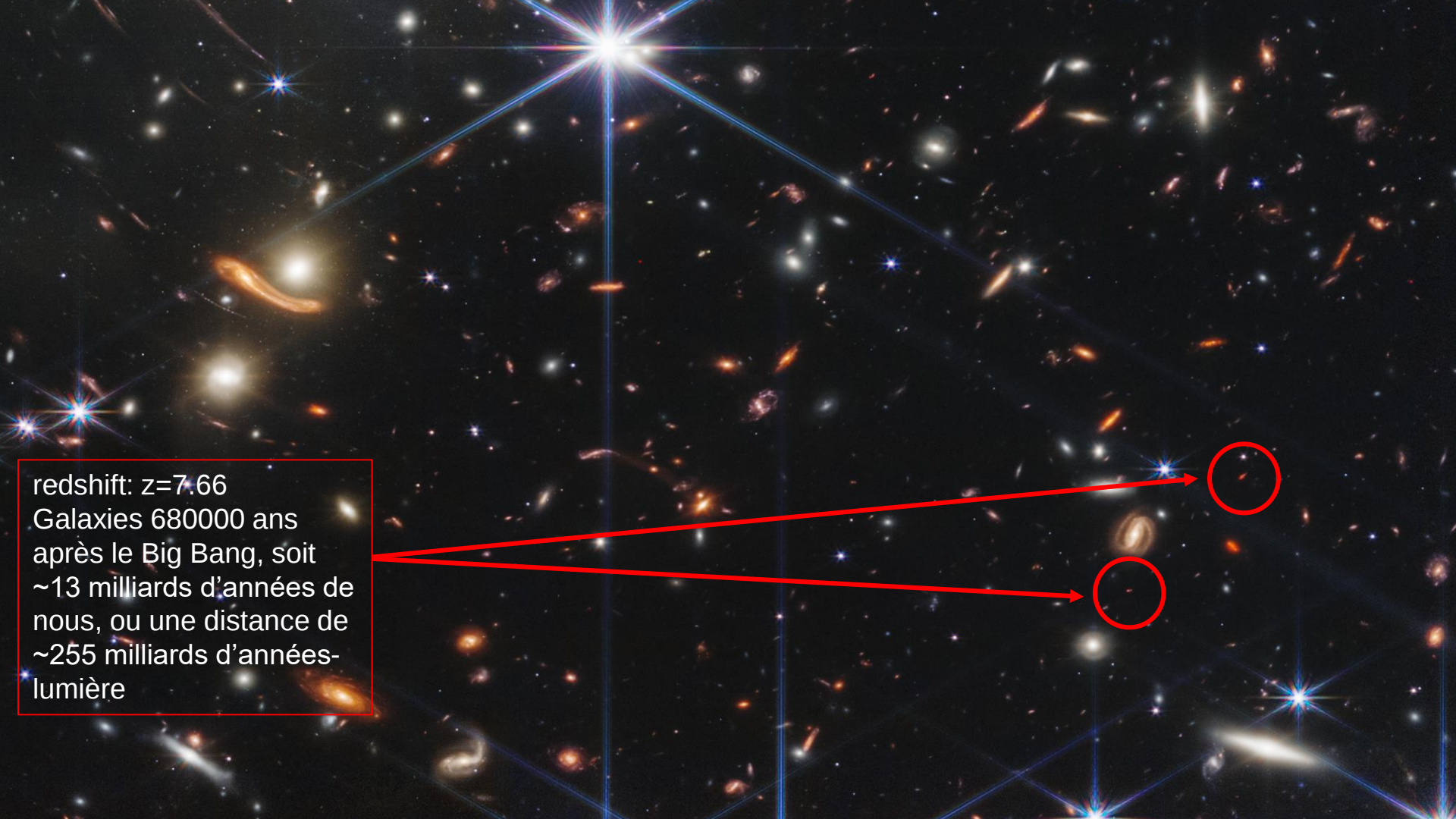
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A long time ago in a galaxy far,
far away....

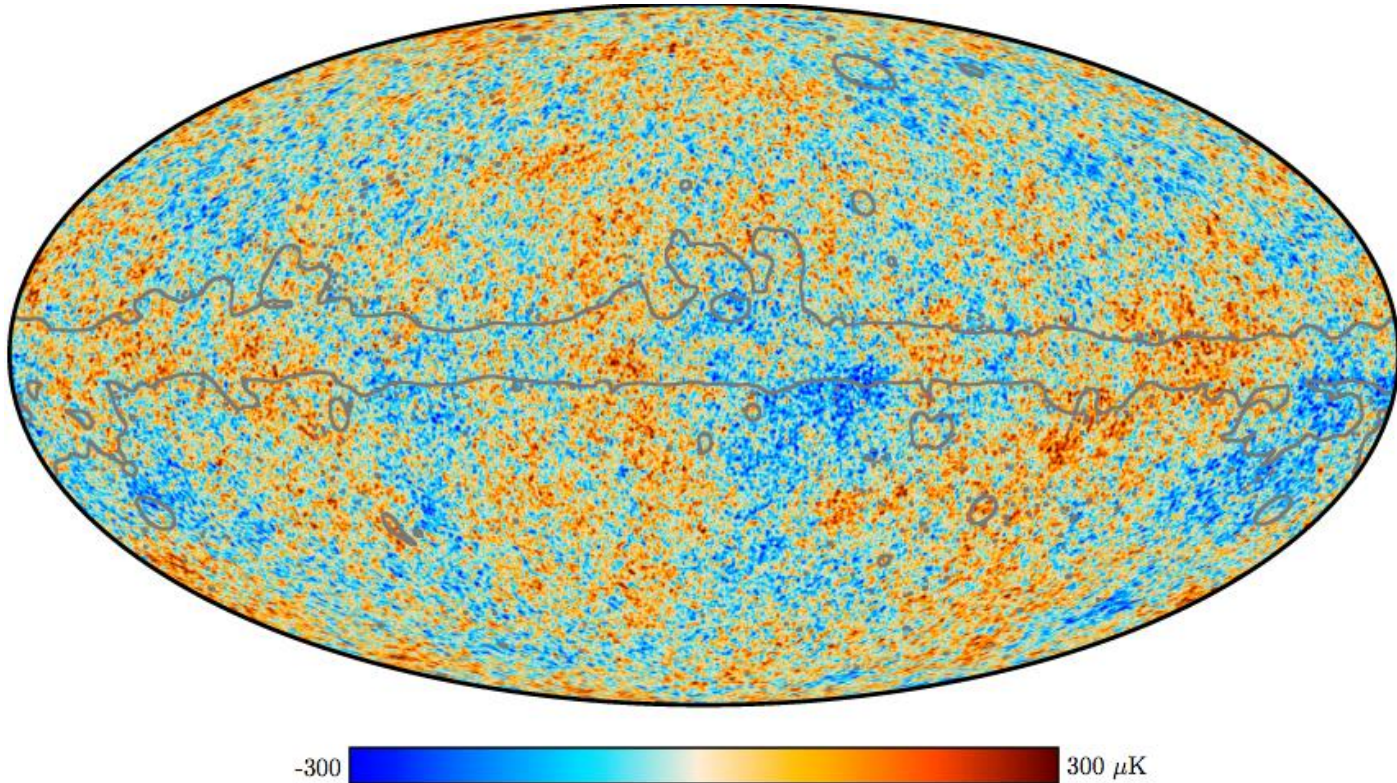


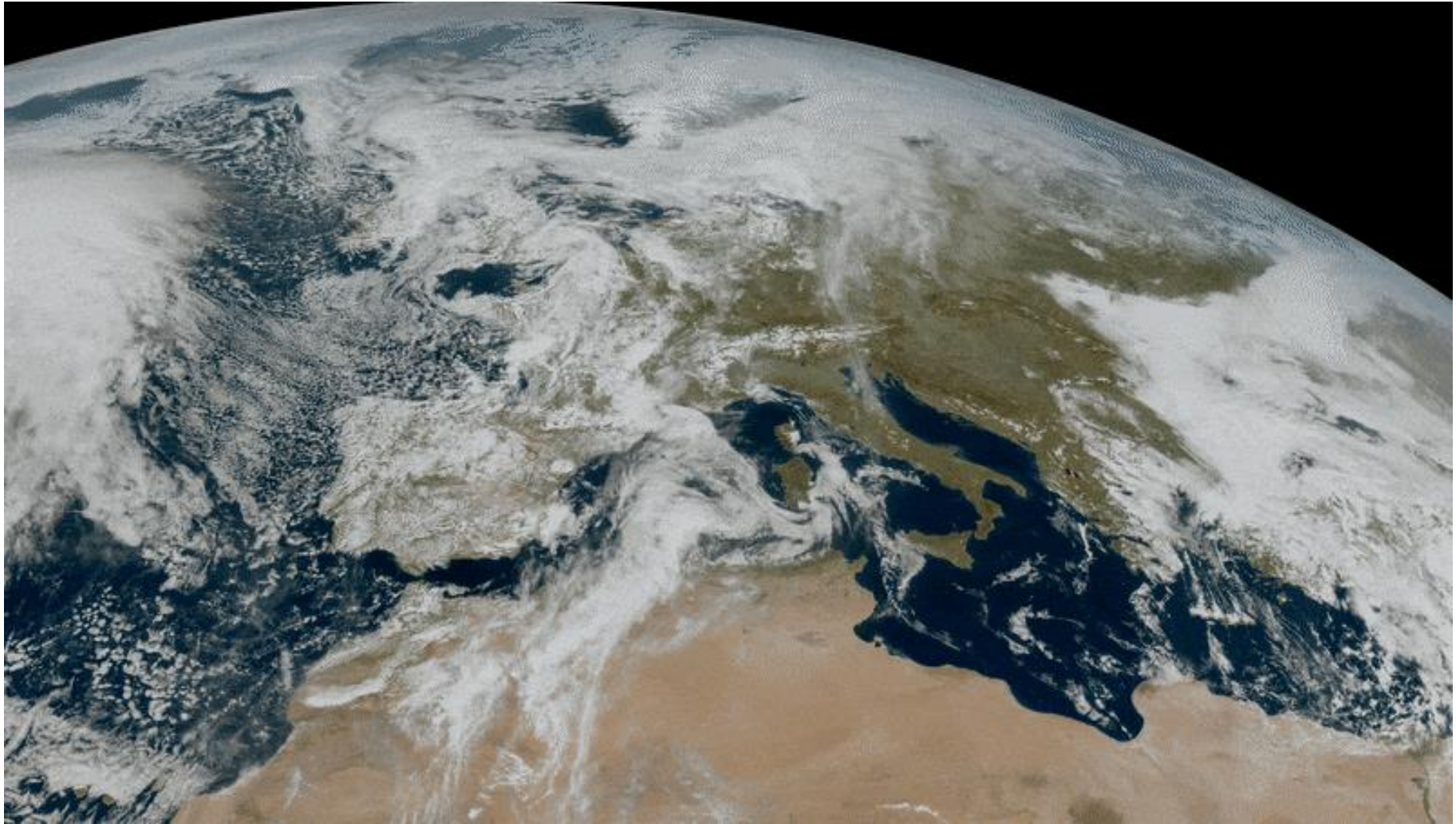


redshift: $z=7.66$
Galaxies 680000 ans
après le Big Bang, soit
~13 milliards d'années de
nous, ou une distance de
~255 milliards d'années-
lumière

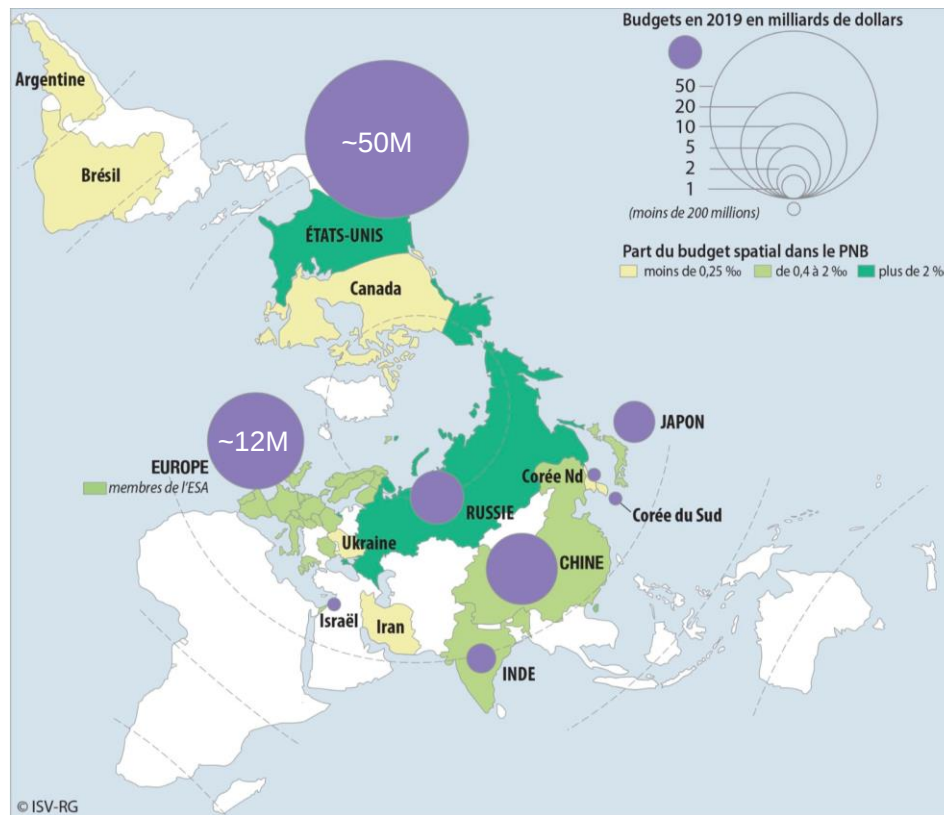
Première lumière de l'univers

Fond cosmologique: fluctuations de température du rayonnement





Accès à l'espace: investissements 2019

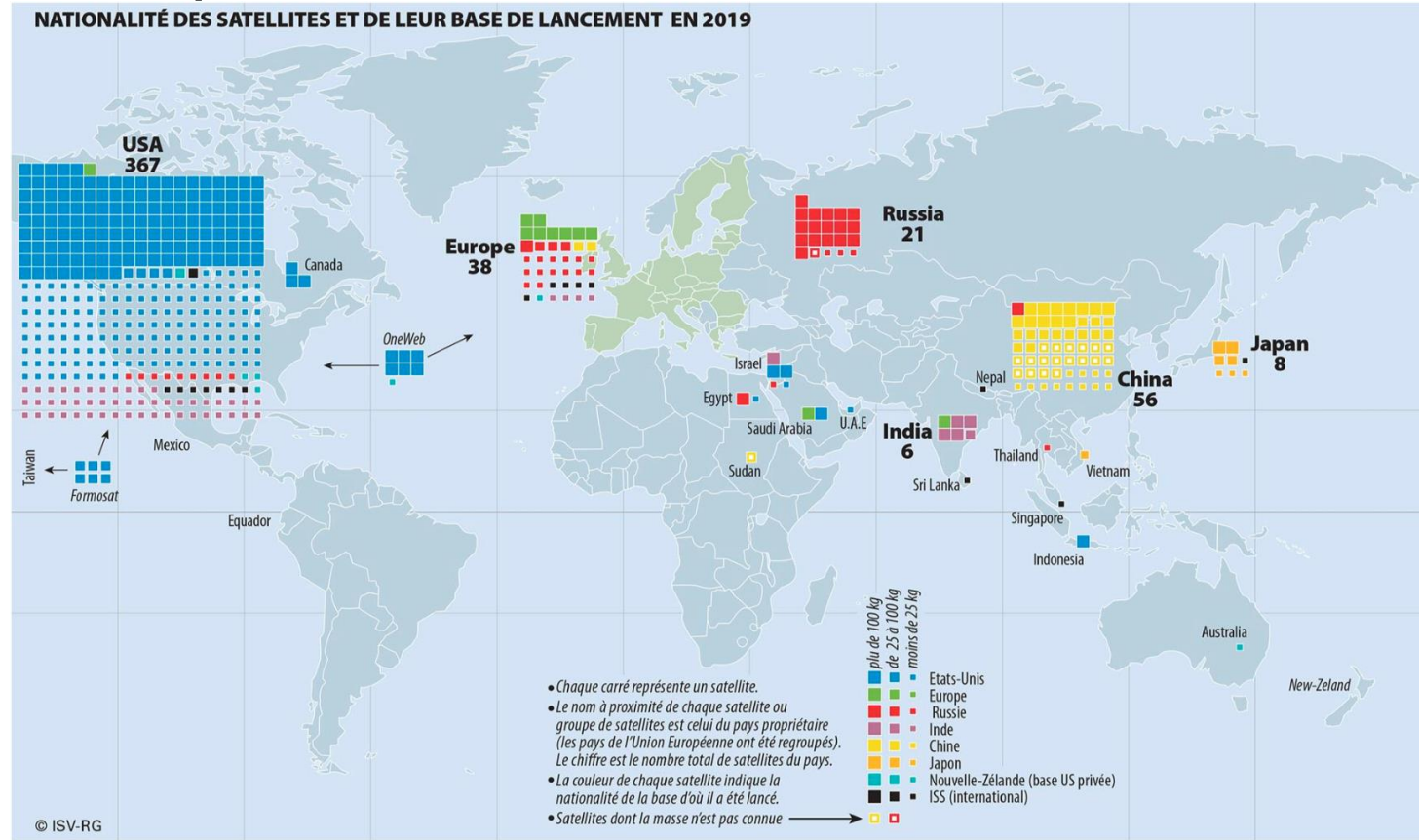


Isabelle Sourbès-Verger, 2021. Article original 2010:

<https://www.cairn.info/revue-l-information-geographique-2010-2-page-10.htm>

Sourbès-Verger, Isabelle. « Espace et géopolitique », L'Information géographique, vol. vol. 74, no. 2, 2010, pp. 10-35.

Accès à l'espace: combien de satellites en 2019 ?

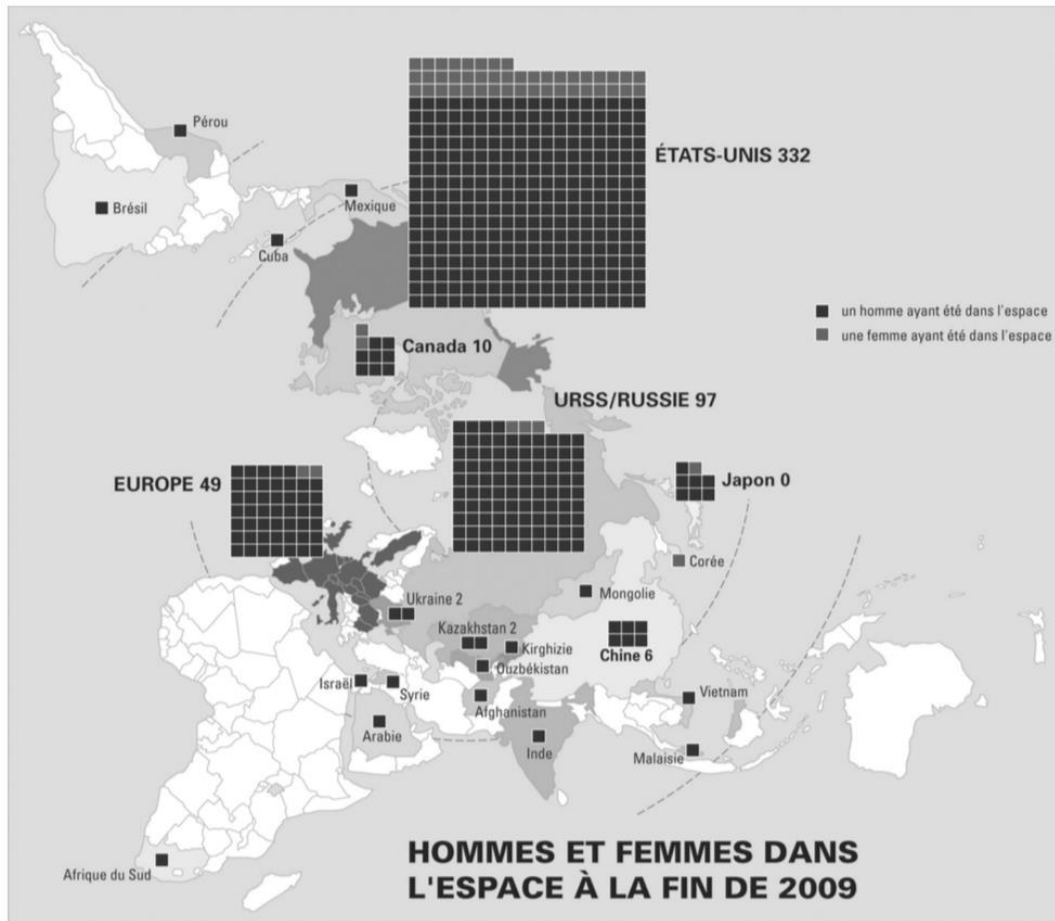


Isabelle Sourbès-Verger, 2021. Article original 2010:

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Sourbès-Verger, Isabelle. « Espace et géopolitique », L'Information géographique, vol. vol. 74, no. 2, 2010, pp. 10-35.

Fig. 3 : Nationalités des hommes et femmes dans l'espace en 2009



Accès à l'espace: combien d'humains ?

Isabelle Sourbès-Verger, 2021. Article original 2010:
<https://www.cairn.info/revue-l-information-geographique-2010-2-page-10.htm>

Sourbès-Verger, Isabelle. « Espace et géopolitique », L'Information géographique, vol. vol. 74, no. 2, 2010, pp. 10-35.

dans les galaxies: nébuleuses, étoiles, gaz



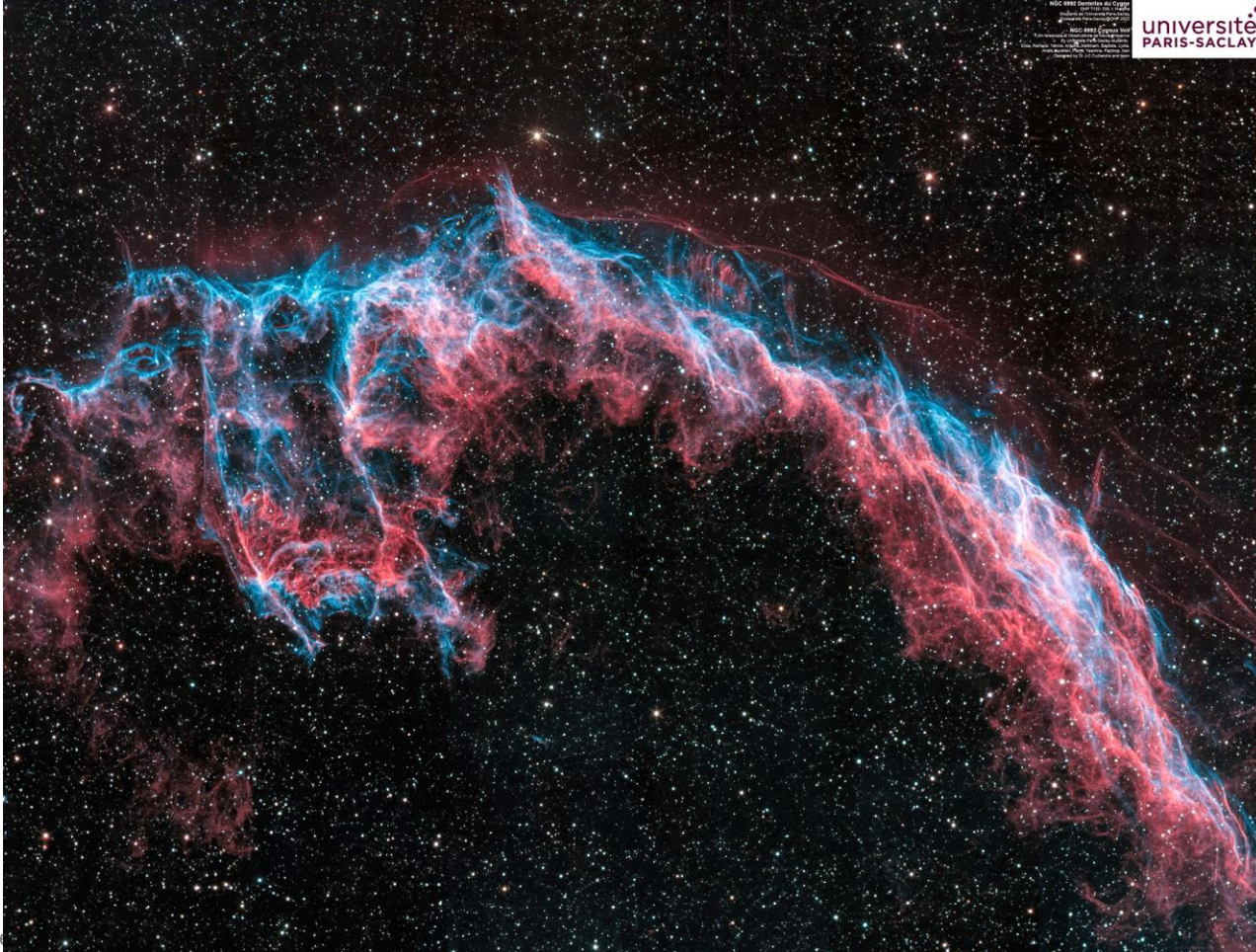
dans les galaxies: nébuleuses, étoiles, gaz

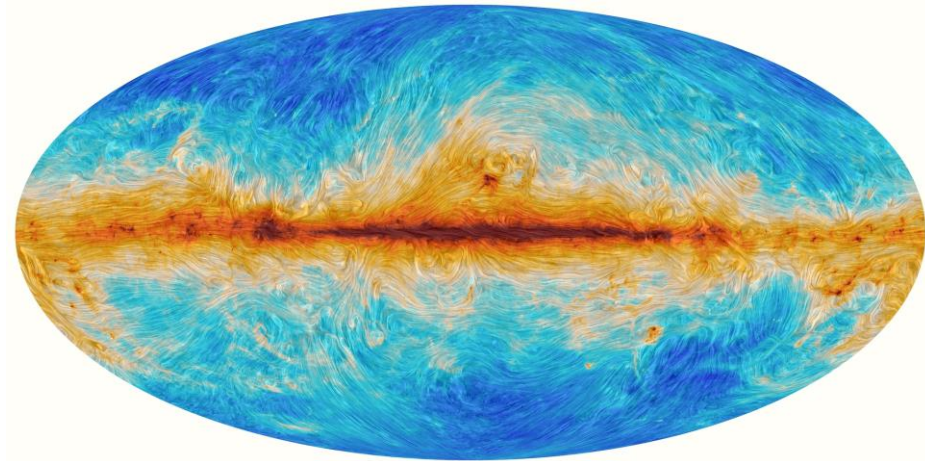
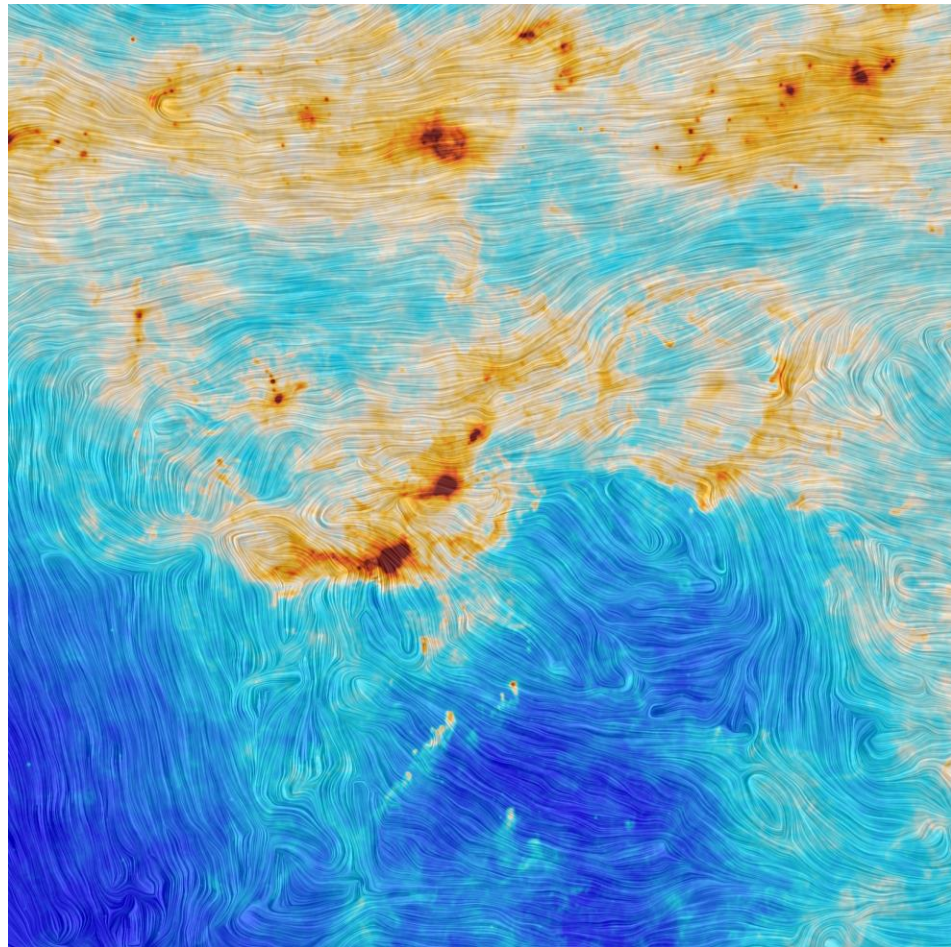


JWST

dans les galaxies: nébuleuses, étoiles, gaz

https://youtu.be/fvuv_WX77YE





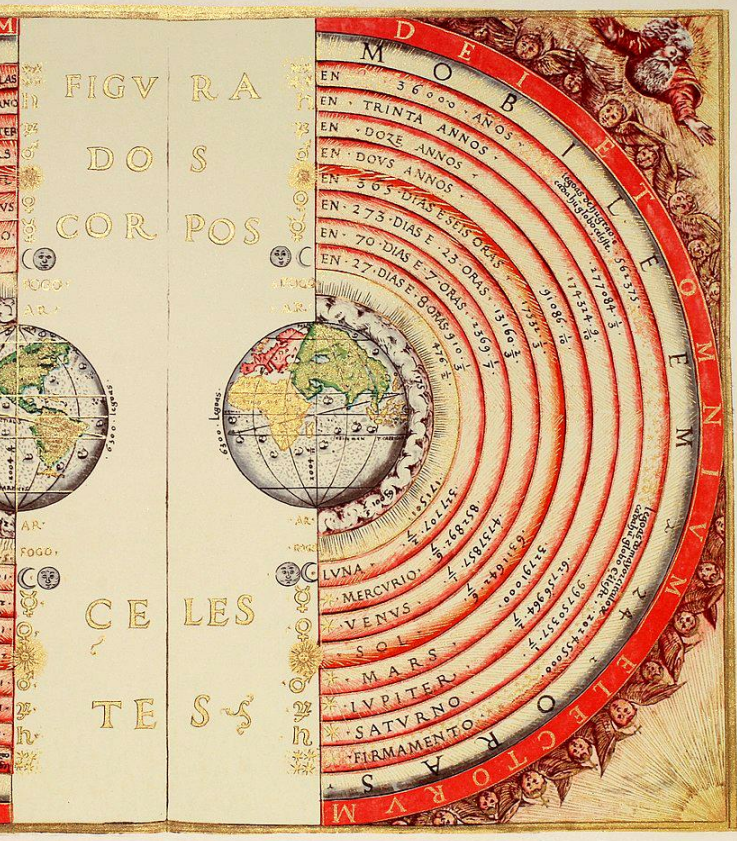
Planck / ESA



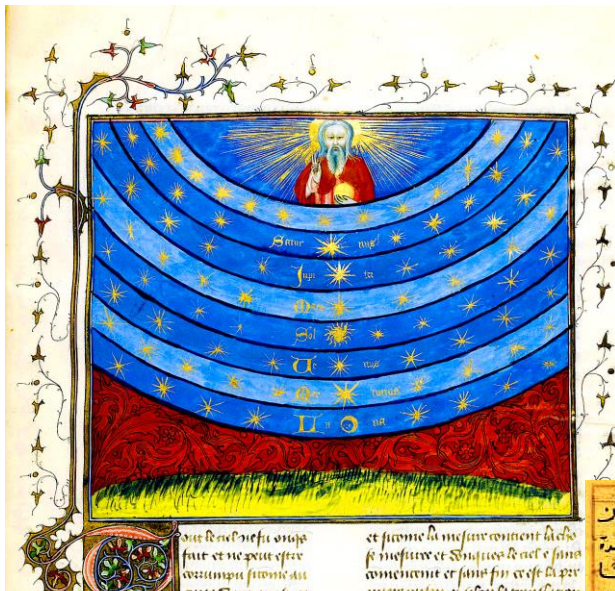
Nuit étoilée à Arles – Vincent Van Gogh 1888 – Wikipedia



Nuit étoilée – Jean-François Millet 1850 – Wikipedia



Bartolomeu Velho,
Cosmographia, 1568 pour
Charles IX (après Dom
Sebastião, roi du
Portugal)



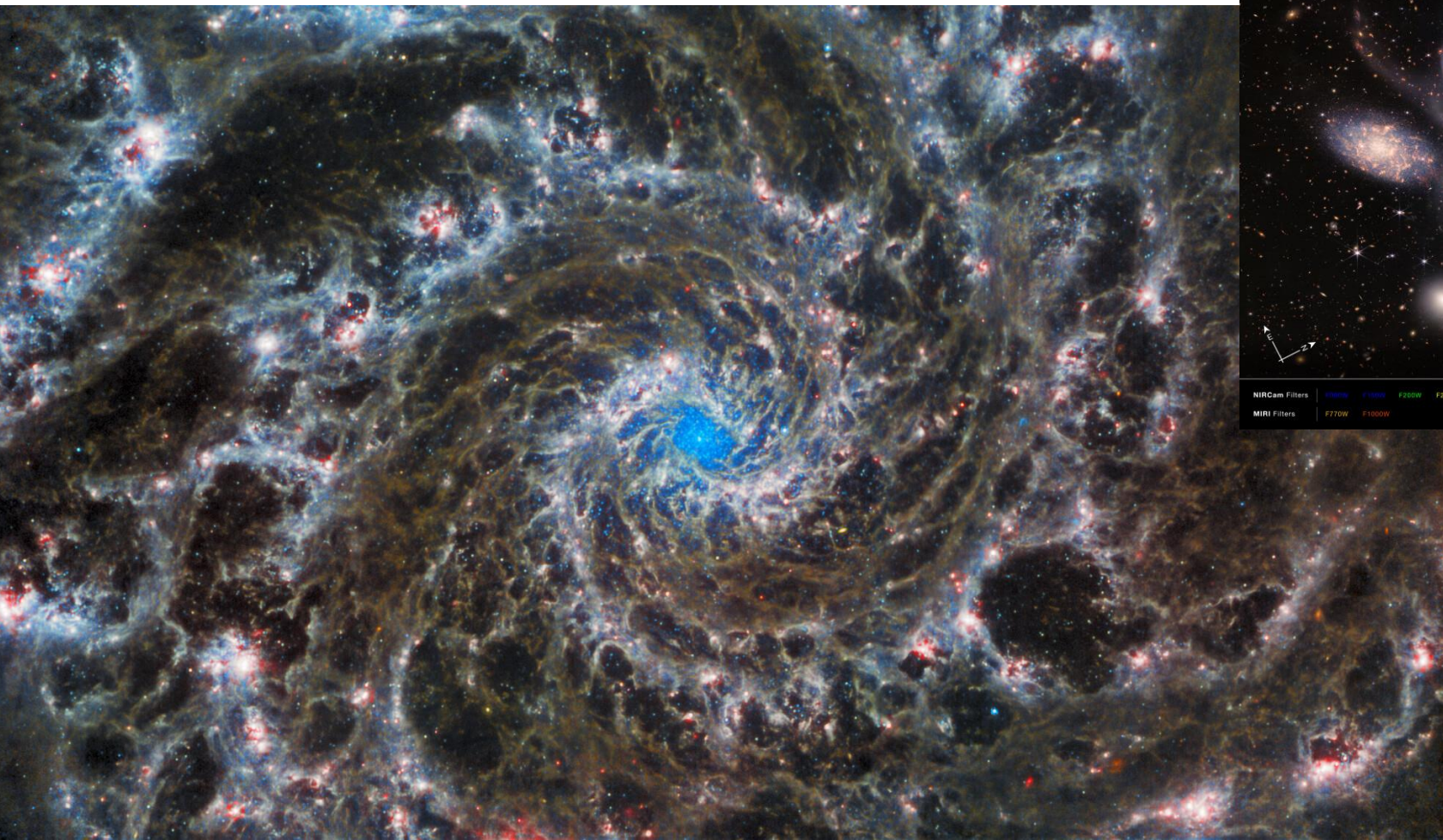
Liber Apollonii de principiabus rerum causis
Manuscrit du XII^e – 4 éléments



صورة الدارمين في الدار والتمركز	صورتهما بعدان قلت الصغرة	صورتهما بعدان قلت الصغرة	صورتهما بعدان قلت الصغرة
الصغيرة الى جهة الناظر والكبرة الى جهة يماوه	نصفها والكبرة ربعا	دورة والكبرة نصفها	دورة ونصف والكبرة لمدار ربع دورة
			

Al Tusi,
Mémoire sur
l'astronomie,
1389

galaxies proches et lointaines



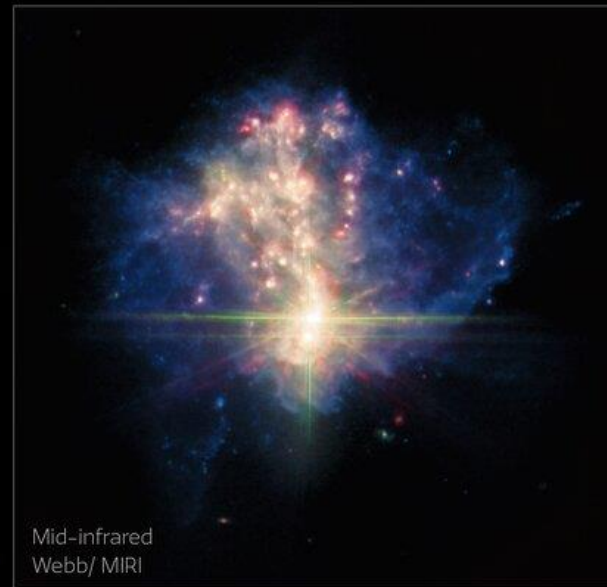
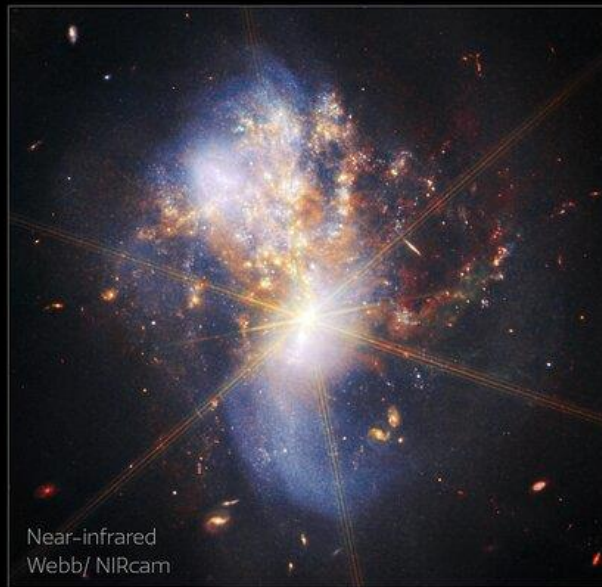
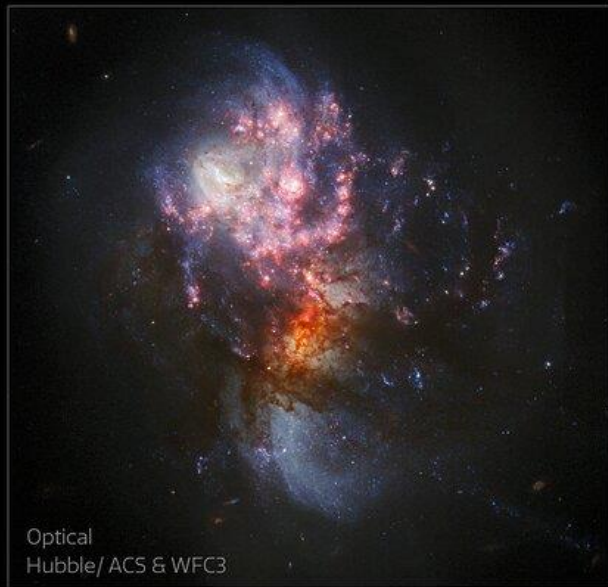
Images; JWST dans l'infrarouge

galaxies proches

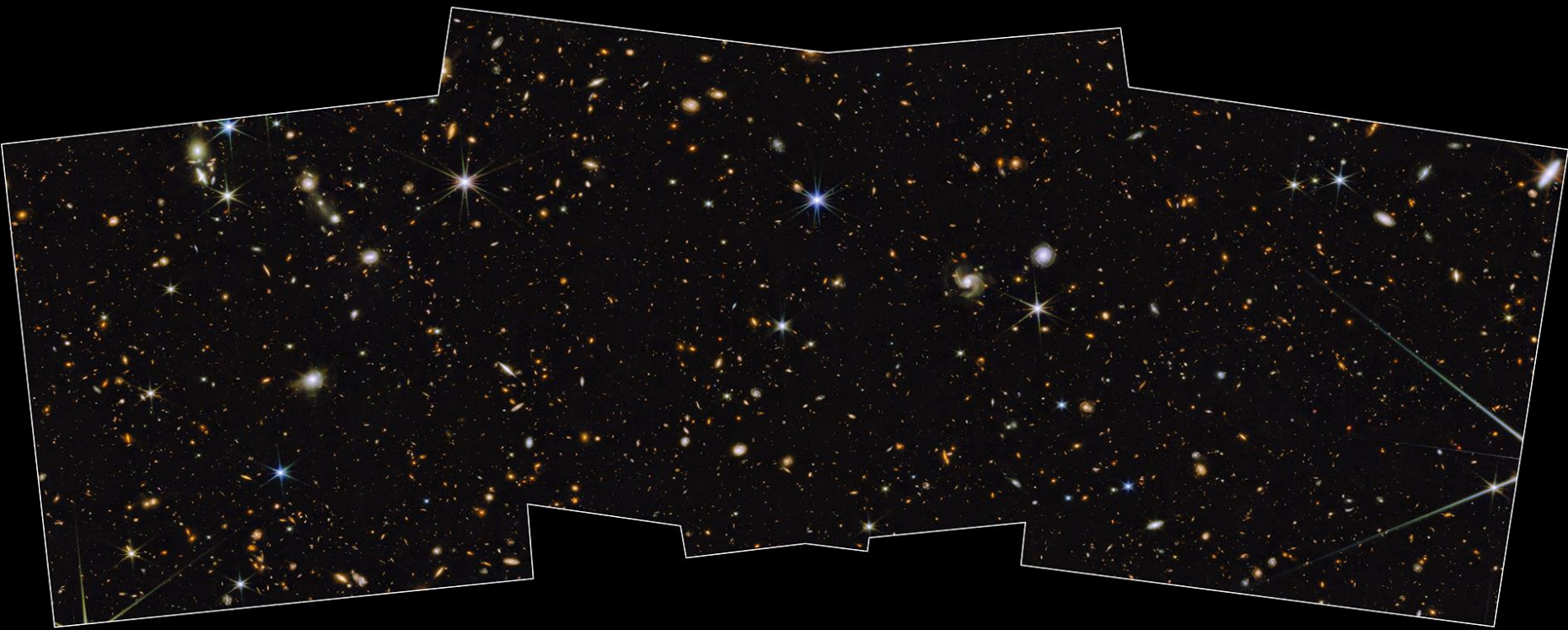


Images; JWST dans l'infrarouge

galaxies proches et lointaines



Images; JWST dans l'immense

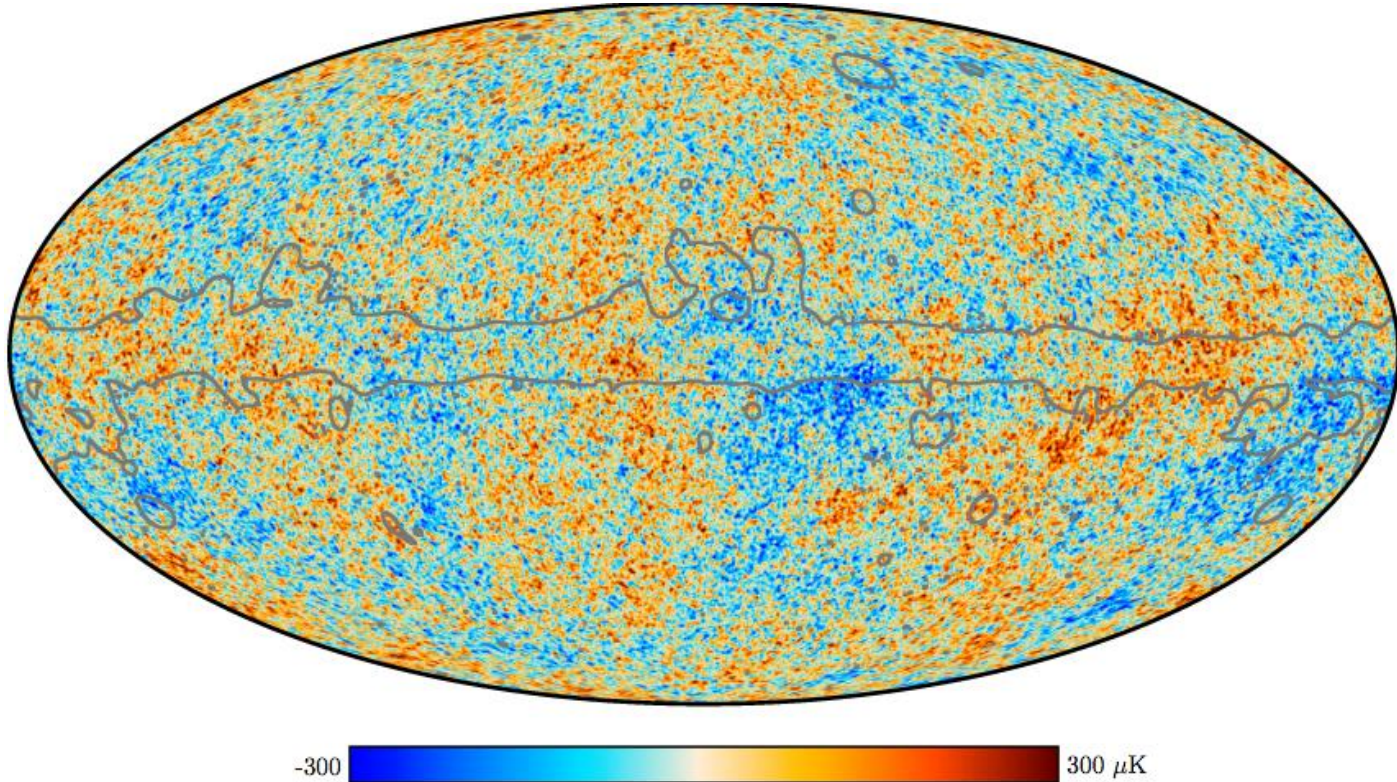


JWST PEARLS

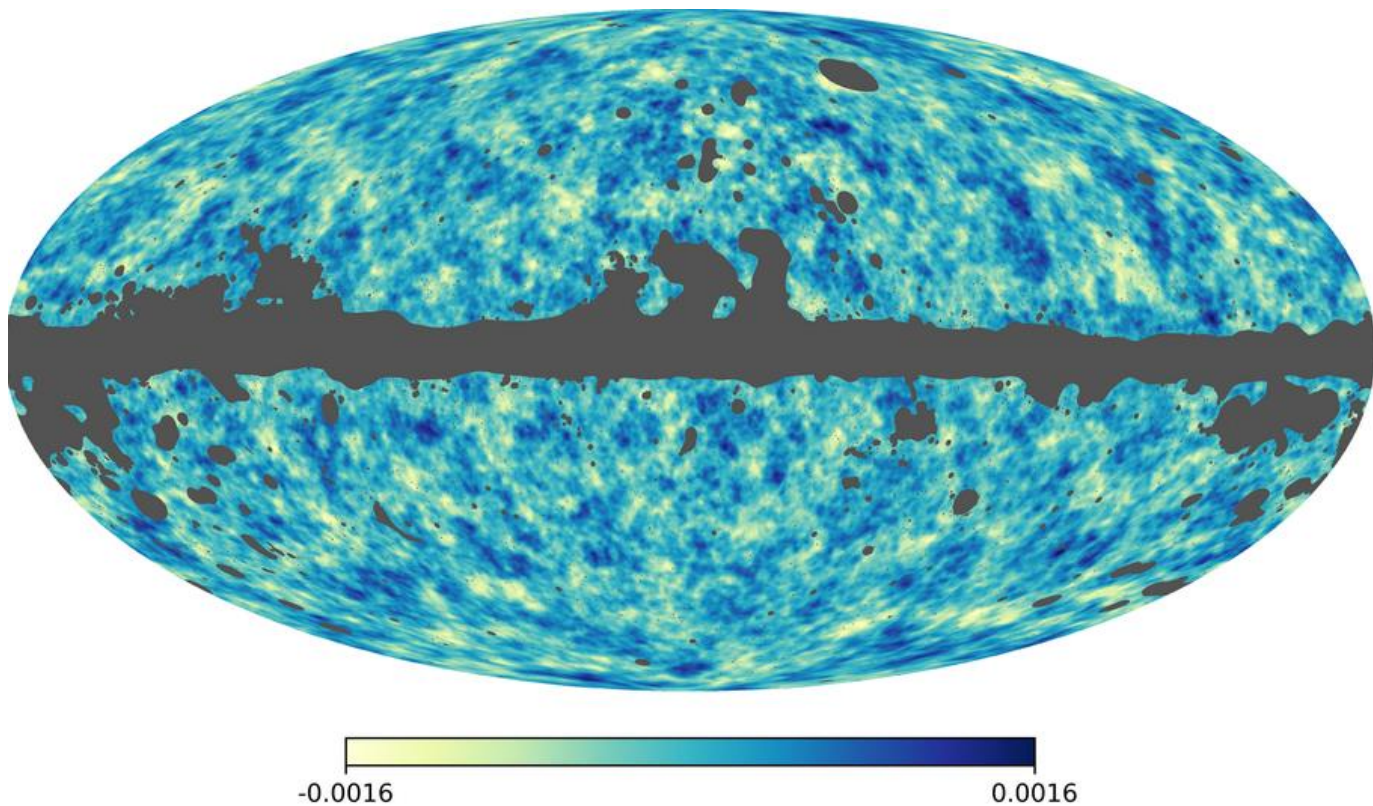


Première lumière de l'univers

Fond cosmologique: fluctuations de température du rayonnement



Répartition de la matière noire



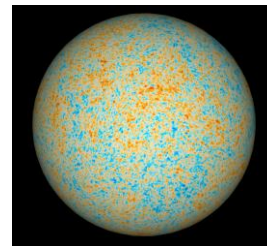
Densité d'énergie – en fonction de l'échelle spatiale



Système Solaire

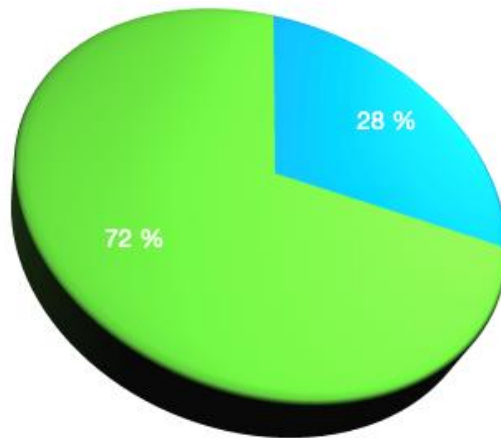
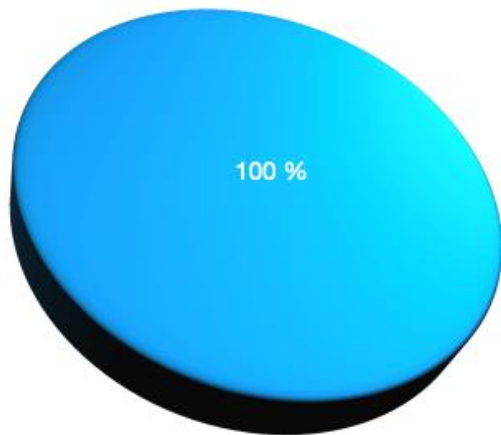


Voie Lactée, $R < 20$ kpc

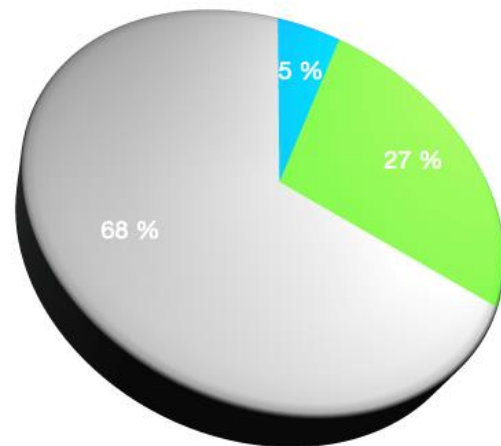


Univers / CMB

● Atomes ● Matière noire ● Energie sombre



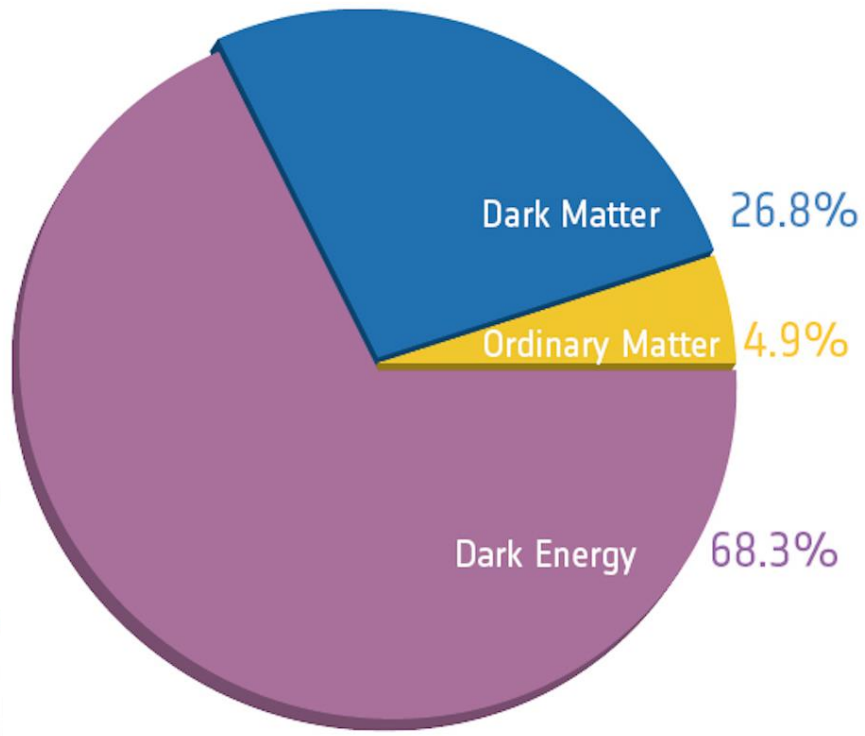
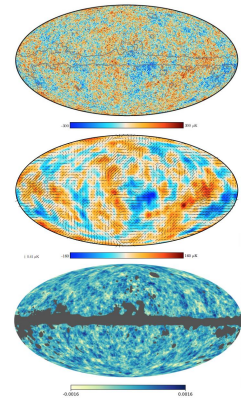
Posti & Helmi, 2019, A&A



Planck Collab., 2018

the dark universe

l'univers obscur



Parameter	Planck alone	Planck + BAO
$\Omega_b h^2$	0.02237 ± 0.00015	0.02242 ± 0.00014
$\Omega_c h^2$	0.1200 ± 0.0012	0.11933 ± 0.00091
$100\theta_{MC}$	1.04092 ± 0.00031	1.04101 ± 0.00029
τ	0.0544 ± 0.0073	0.0561 ± 0.0071
$\ln(10^{10} A_s)$	3.044 ± 0.014	3.047 ± 0.014
n_s	0.9649 ± 0.0042	0.9665 ± 0.0038
H_0	67.36 ± 0.54	67.66 ± 0.42
Ω_Λ	0.6847 ± 0.0073	0.6889 ± 0.0056
Ω_m	0.3153 ± 0.0073	0.3111 ± 0.0056
$\Omega_m h^2$	0.1430 ± 0.0011	0.14240 ± 0.00087
$\Omega_m h^3$	0.09633 ± 0.00030	0.09635 ± 0.00030
σ_8	0.8111 ± 0.0060	0.8102 ± 0.0060
$\sigma_8(\Omega_m/0.3)^{0.5}$	0.832 ± 0.013	0.825 ± 0.011
τ	0.0767 ± 0.0073	0.0782 ± 0.0071
Age[Gyr]	13.797 ± 0.023	13.787 ± 0.020
r_s [Mpc]	144.43 ± 0.26	144.57 ± 0.22
$100\theta_s$	1.04110 ± 0.00031	1.04119 ± 0.00029
r_{drag} [Mpc]	147.09 ± 0.26	147.57 ± 0.22
z_{eq}	3402 ± 26	3387 ± 21
$k_{eq}[\text{Mpc}^{-1}]$	0.010384 ± 0.000081	0.010339 ± 0.000063
Ω_K	-0.0096 ± 0.0061	0.0007 ± 0.0019
Σm_ν [eV]	< 0.241	< 0.120
N_{eff}	$2.89^{+0.36}_{-0.38}$	$2.99^{+0.34}_{-0.33}$
$r_{0.002}$	< 0.101	< 0.106

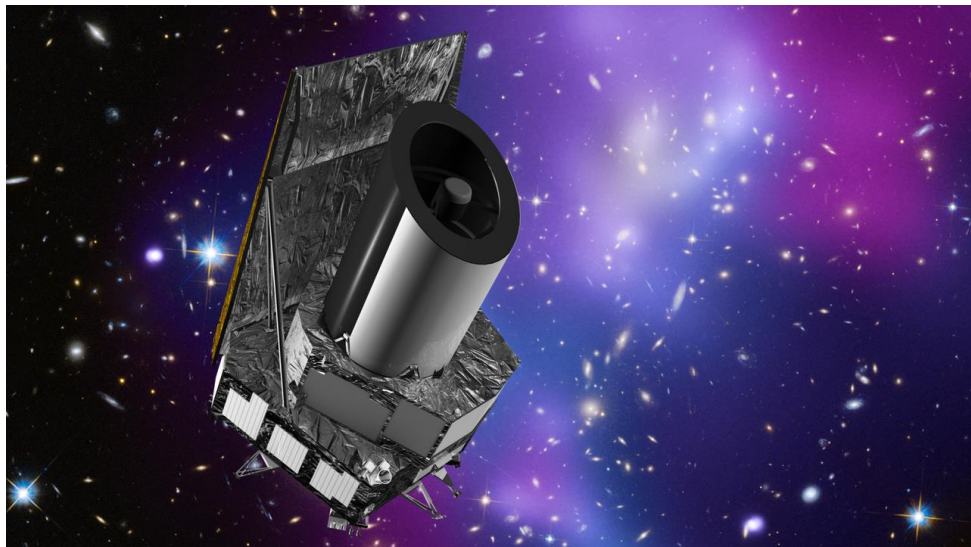
Episode IV

A NEW HOPE

*It is a period of civil war.
Rebel spaceships, striking
from a hidden base, have won
their first victory against
the evil Galactic Empire.*

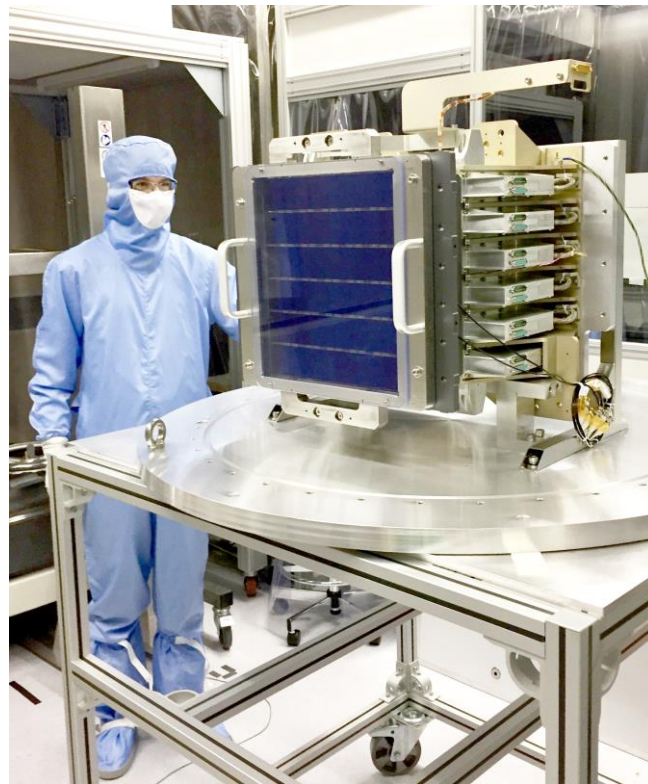
Bientôt : Euclid (ESA)

Mission européenne Euclid: lancement début juillet 2023



Matière noire
Énergie sombre

Et aussi : Vera Rubin (au sol) et Nancy Roman (espace)



Bientôt : Euclid (ESA)

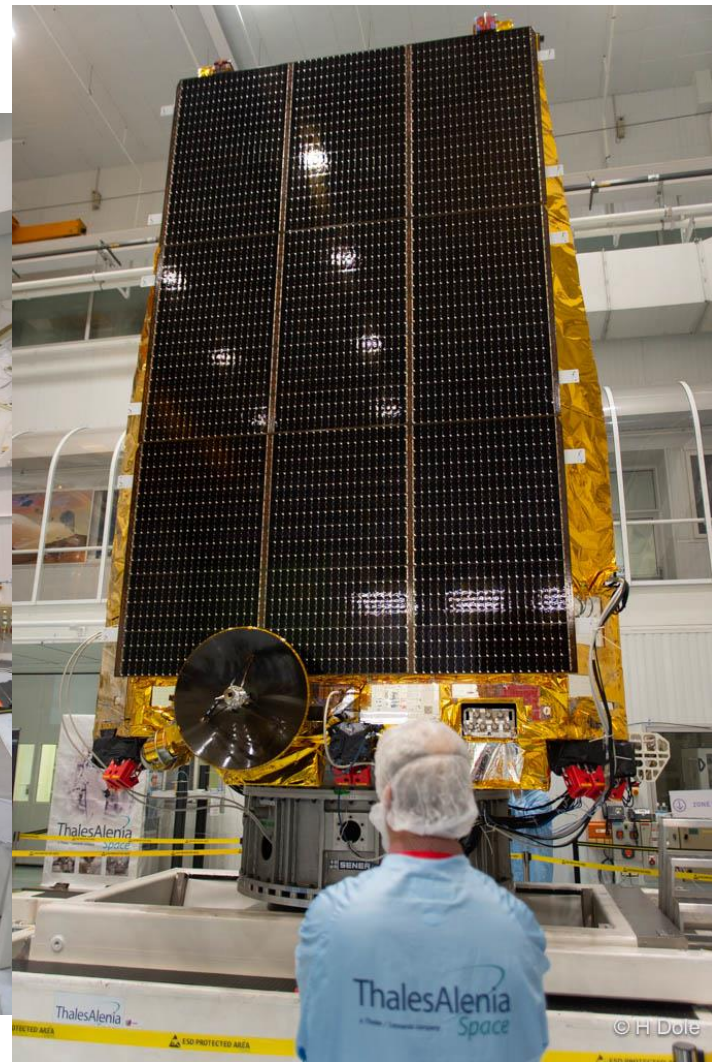


Thalès Alenia Space

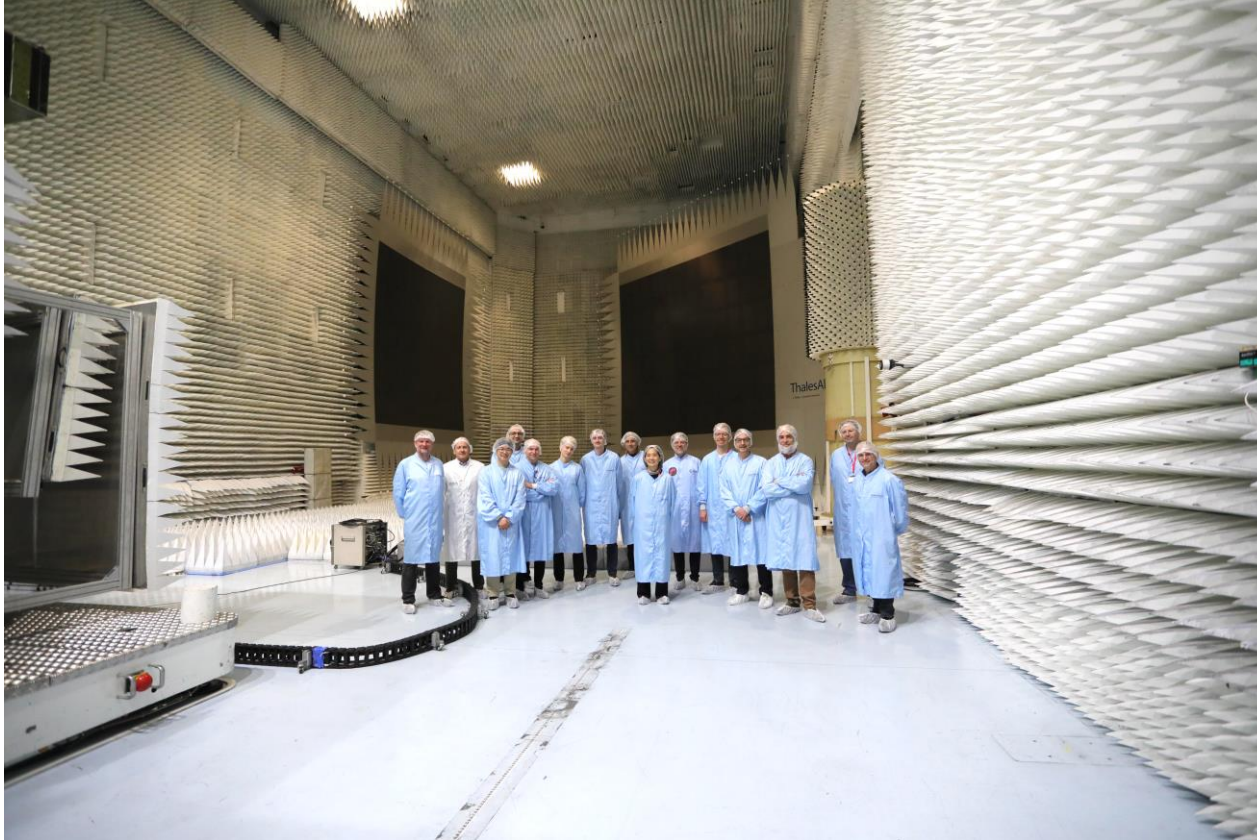
Bientôt : Euclid (ESA)



Bientôt : Euclid (ESA)

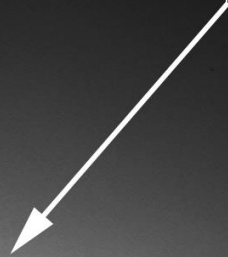


Bientôt : Euclid (ESA)



remarques finales

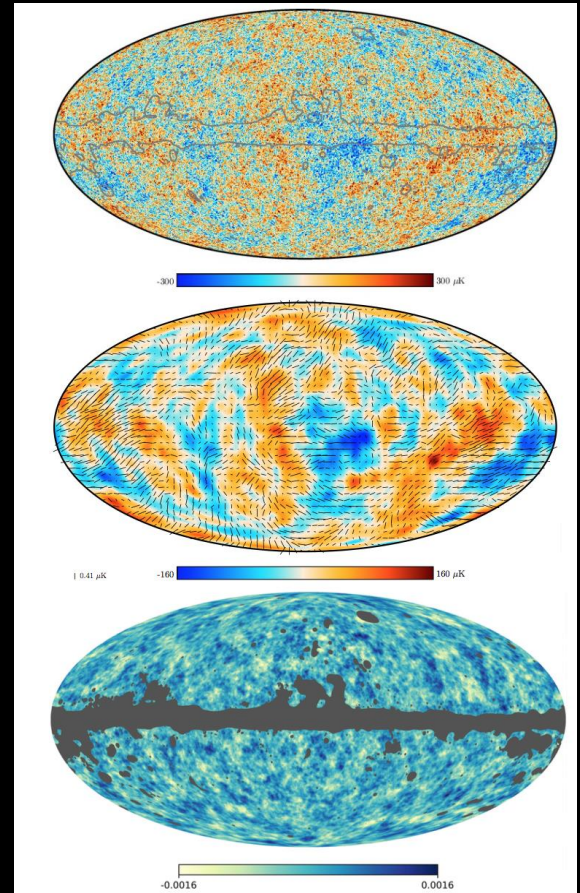
You are here



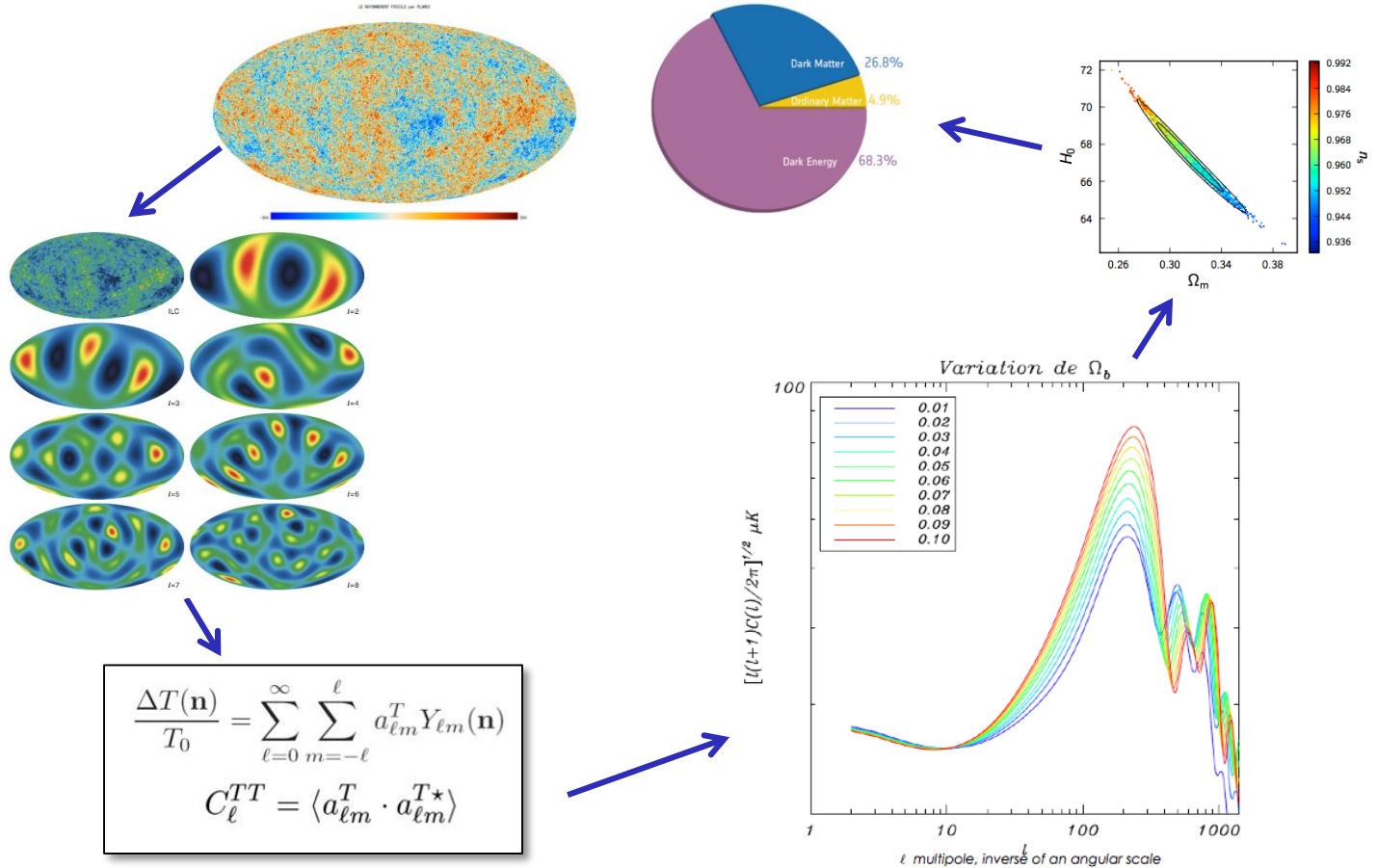


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3e. des images aux paramètres cosmologiques



theory confronts data

