

IL SUONO DELL'UNIVERSO

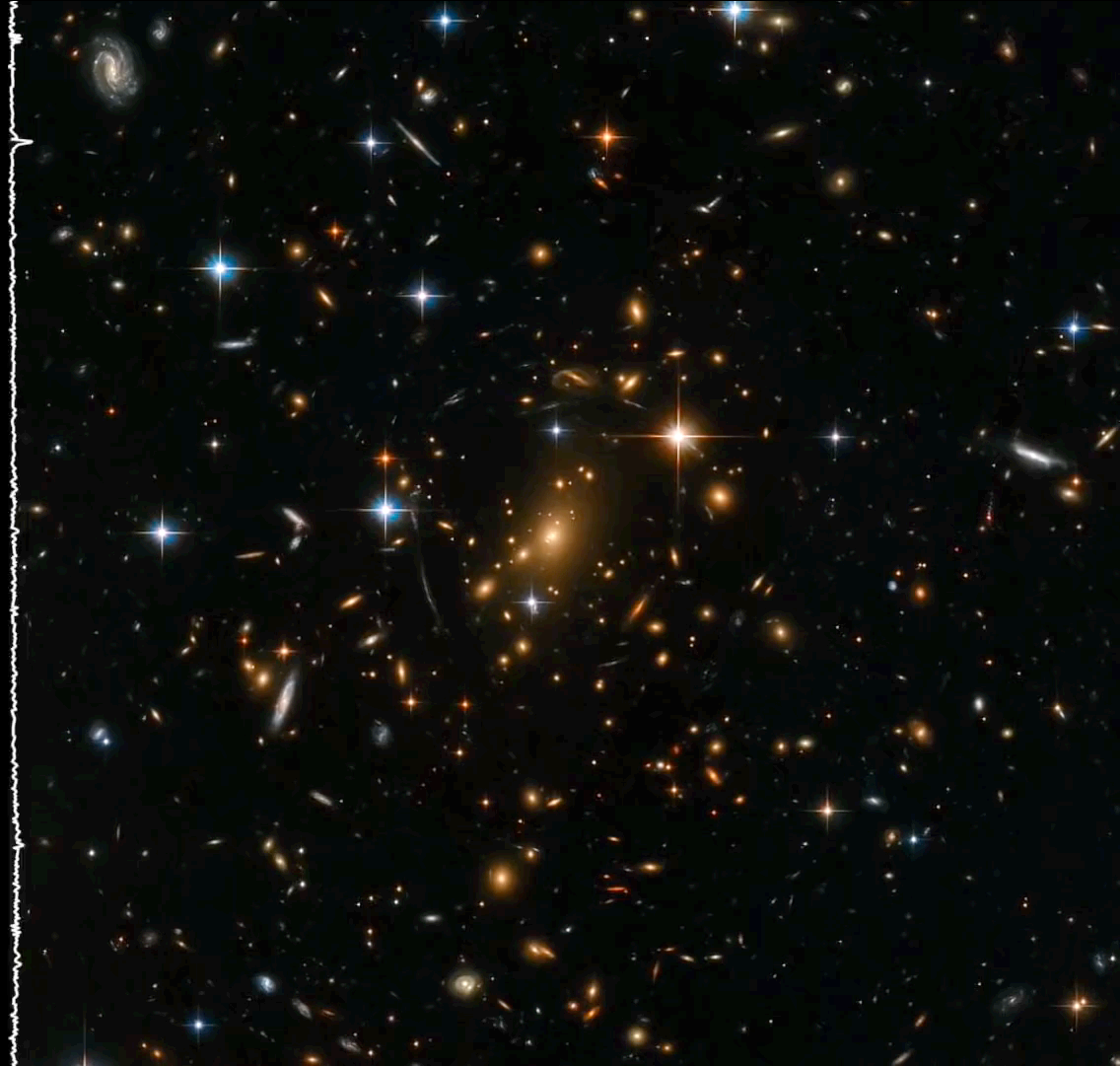


Fabio Peri

CIVICO PLANETARIO "ULRICO HOEPLI"



SUONI DALL'UNIVERSO...



Fonte: **NASA**



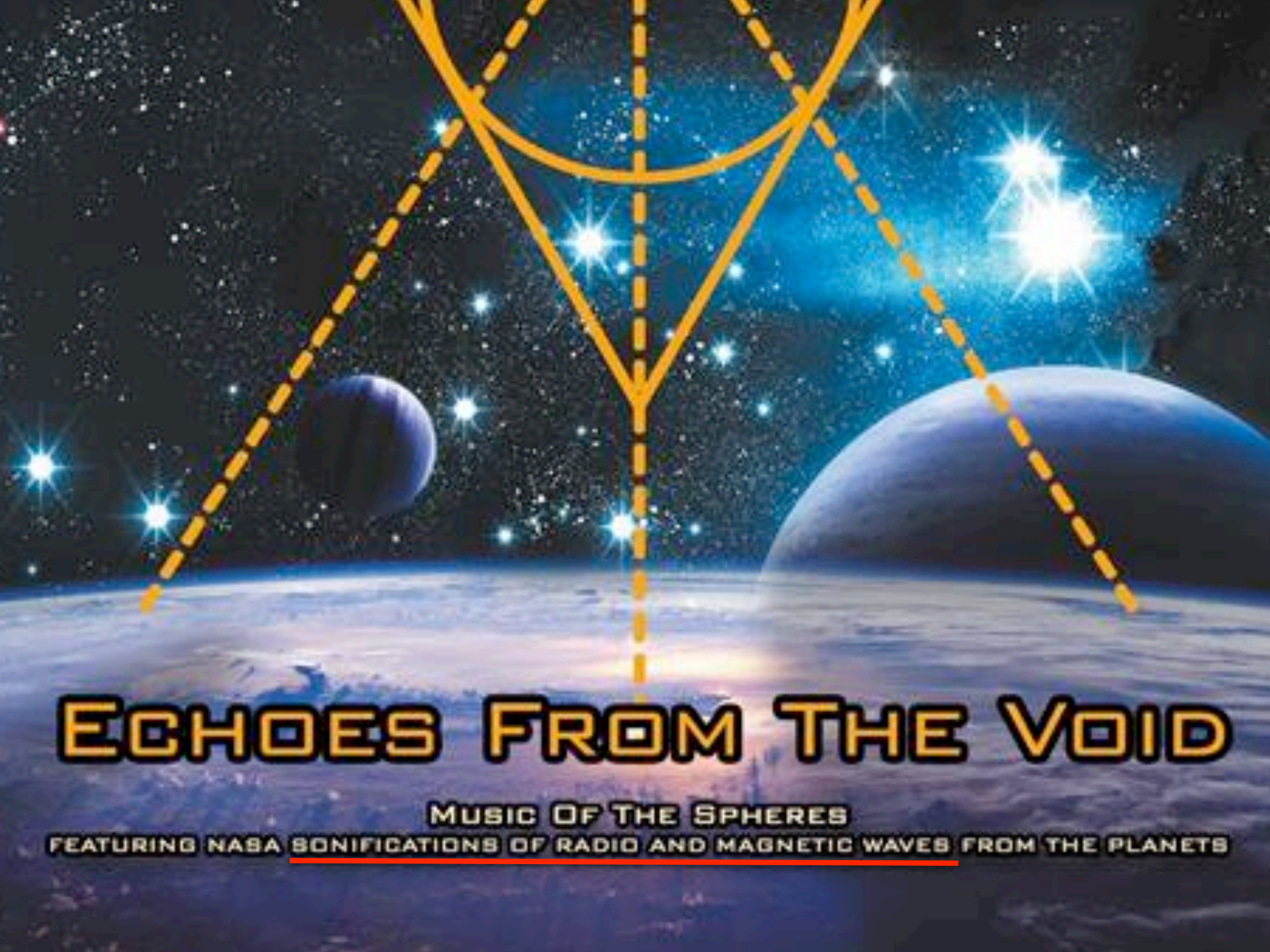


SONIFICATION

ECHOES FROM THE VOID

MUSIC OF THE SPHERES

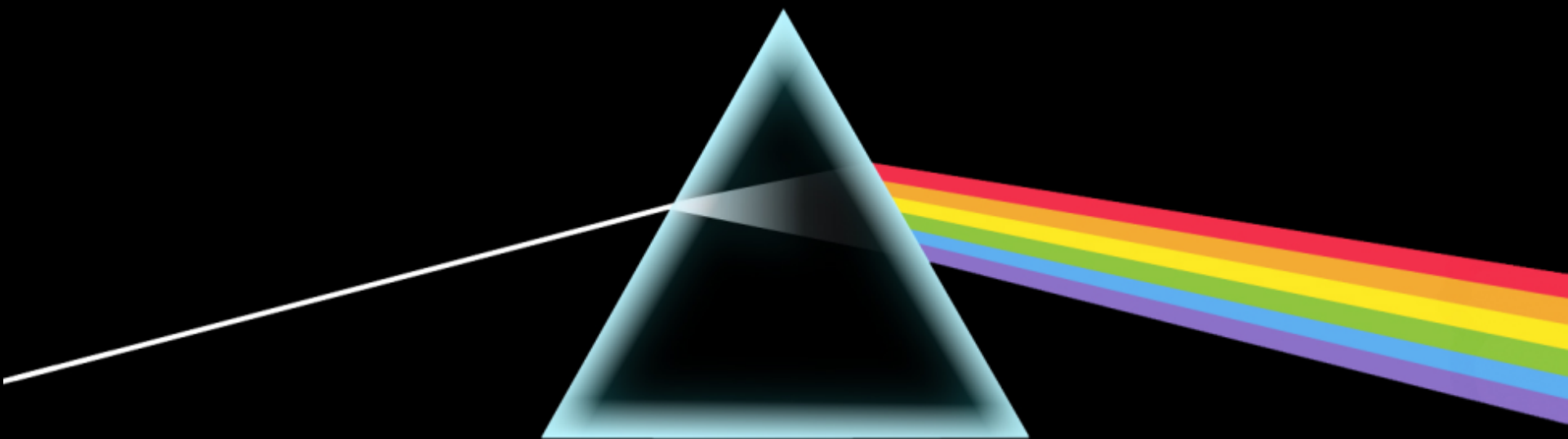
FEATURING NASA SONIFICATIONS OF RADIO AND MAGNETIC WAVES FROM THE PLANETS

A cosmic-themed background featuring a dark space filled with stars and nebulae. In the foreground, the curved horizon of a planet is visible. Two other celestial bodies, one smaller and one larger, are positioned on either side of the center. Overlaid on the scene are several bright orange geometric lines: a central vertical dashed line, two diagonal dashed lines forming a wide 'V' shape, and a solid orange arc at the top connecting the ends of the dashed lines.

ECHOES FROM THE VOID

MUSIC OF THE SPHERES

FEATURING NASA SONIFICATIONS OF RADIO AND MAGNETIC WAVES FROM THE PLANETS

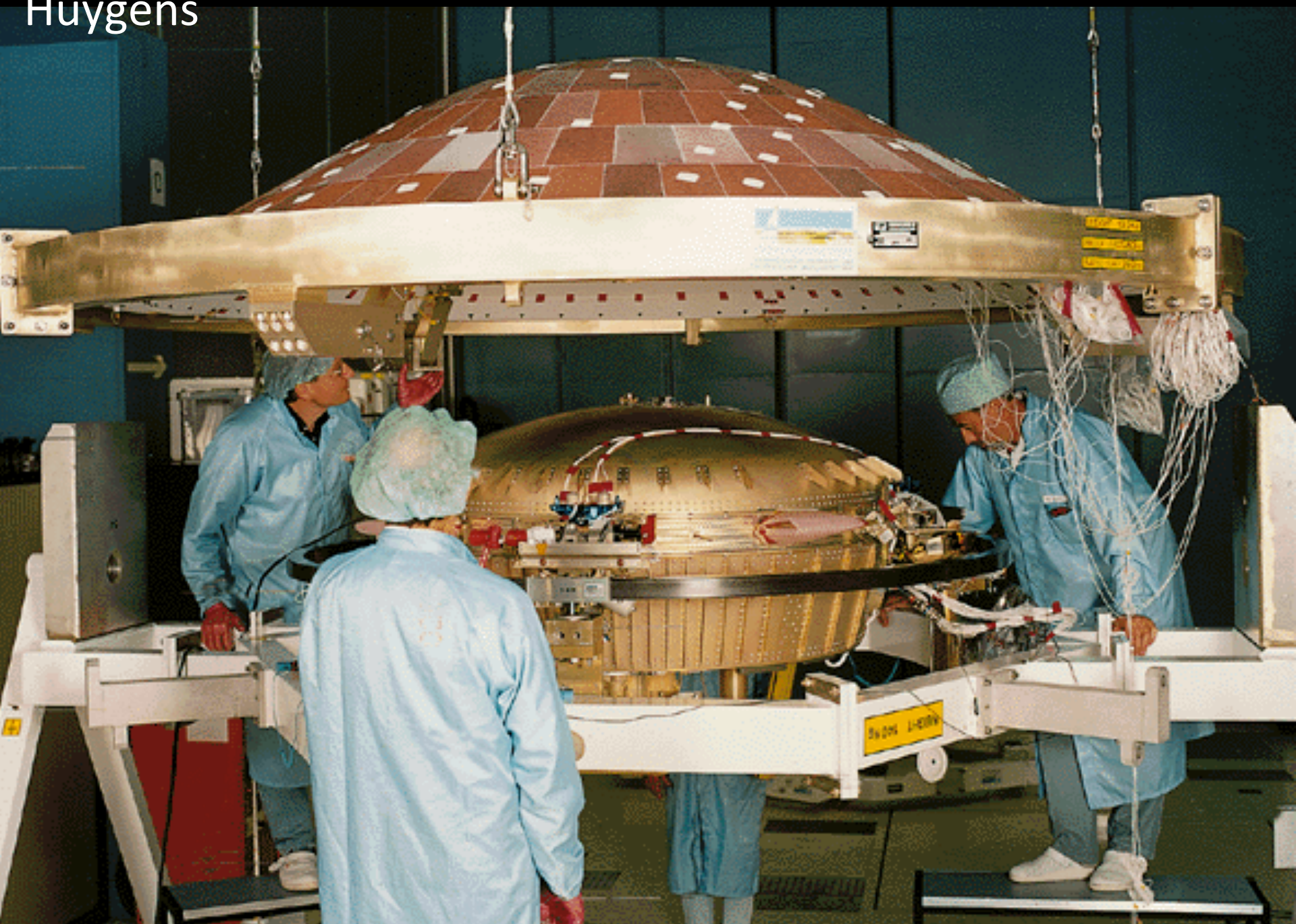


SUONI DAI PIANETI...

Mars Polar Lander (1998)



Huygens



14 Gennaio 2005

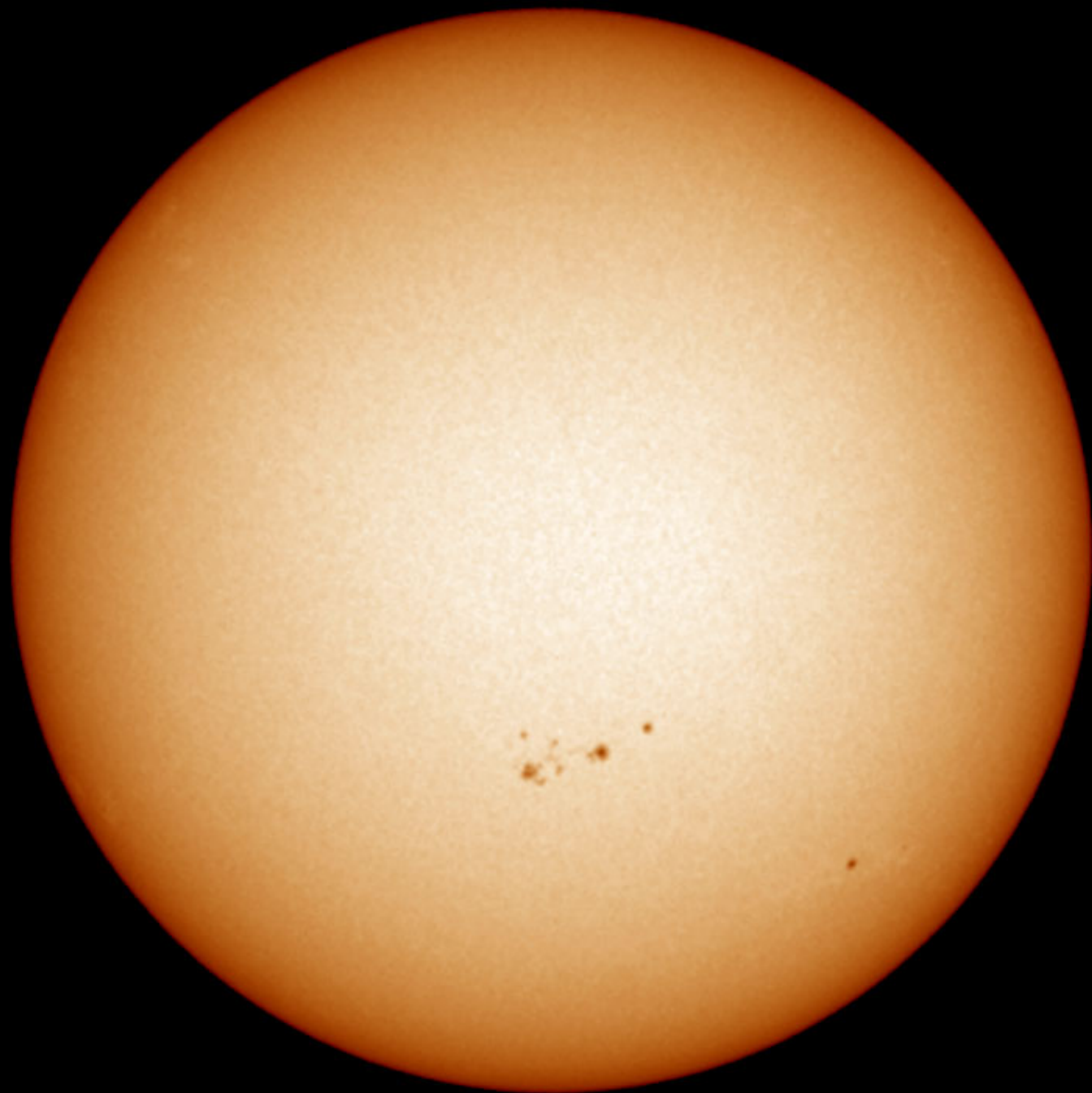


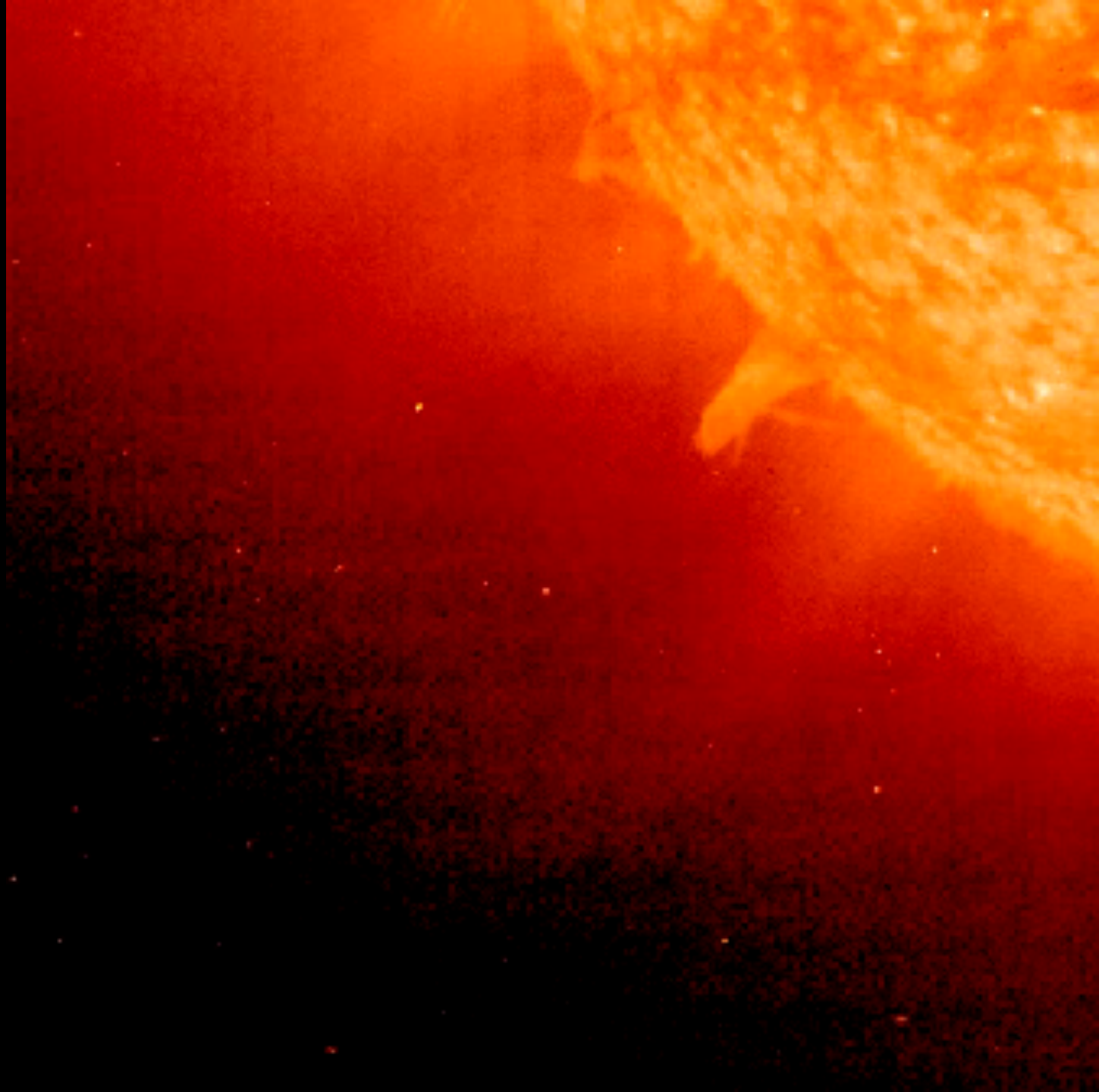
152.4 km

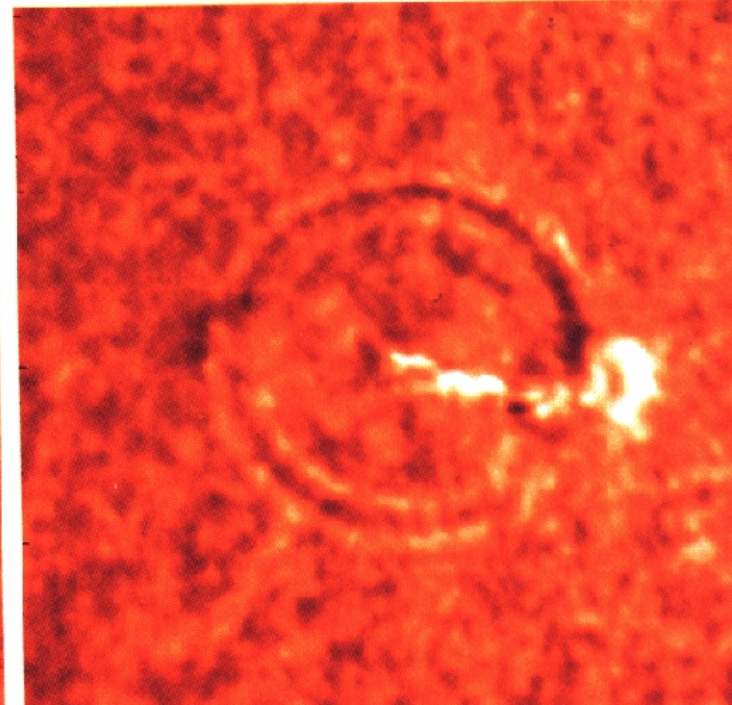
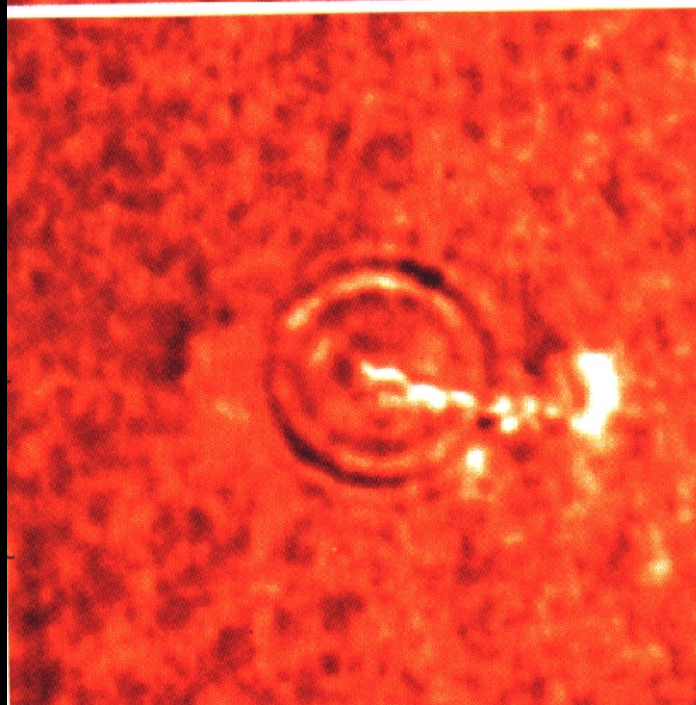
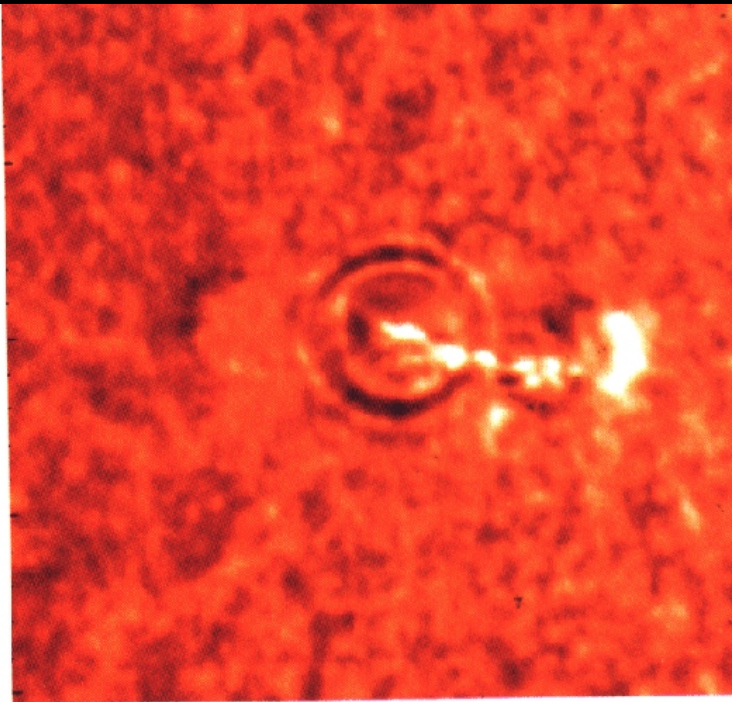
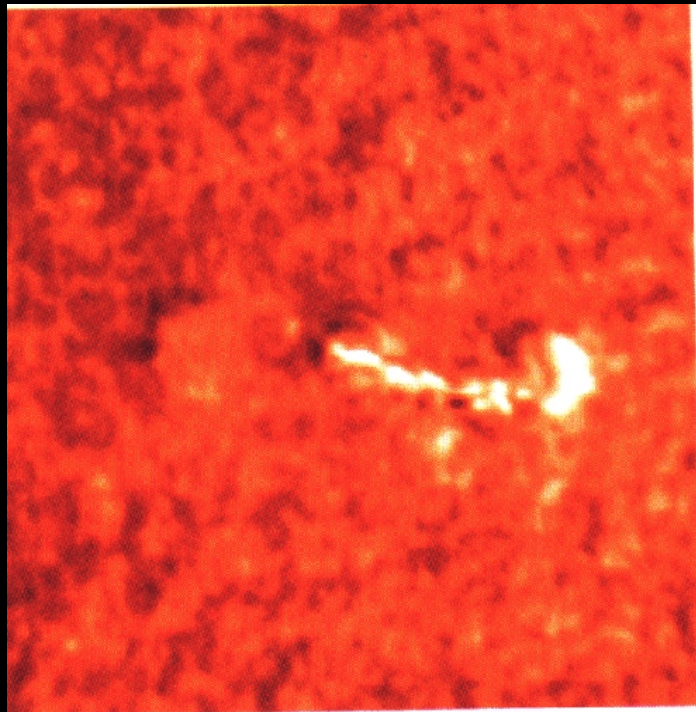
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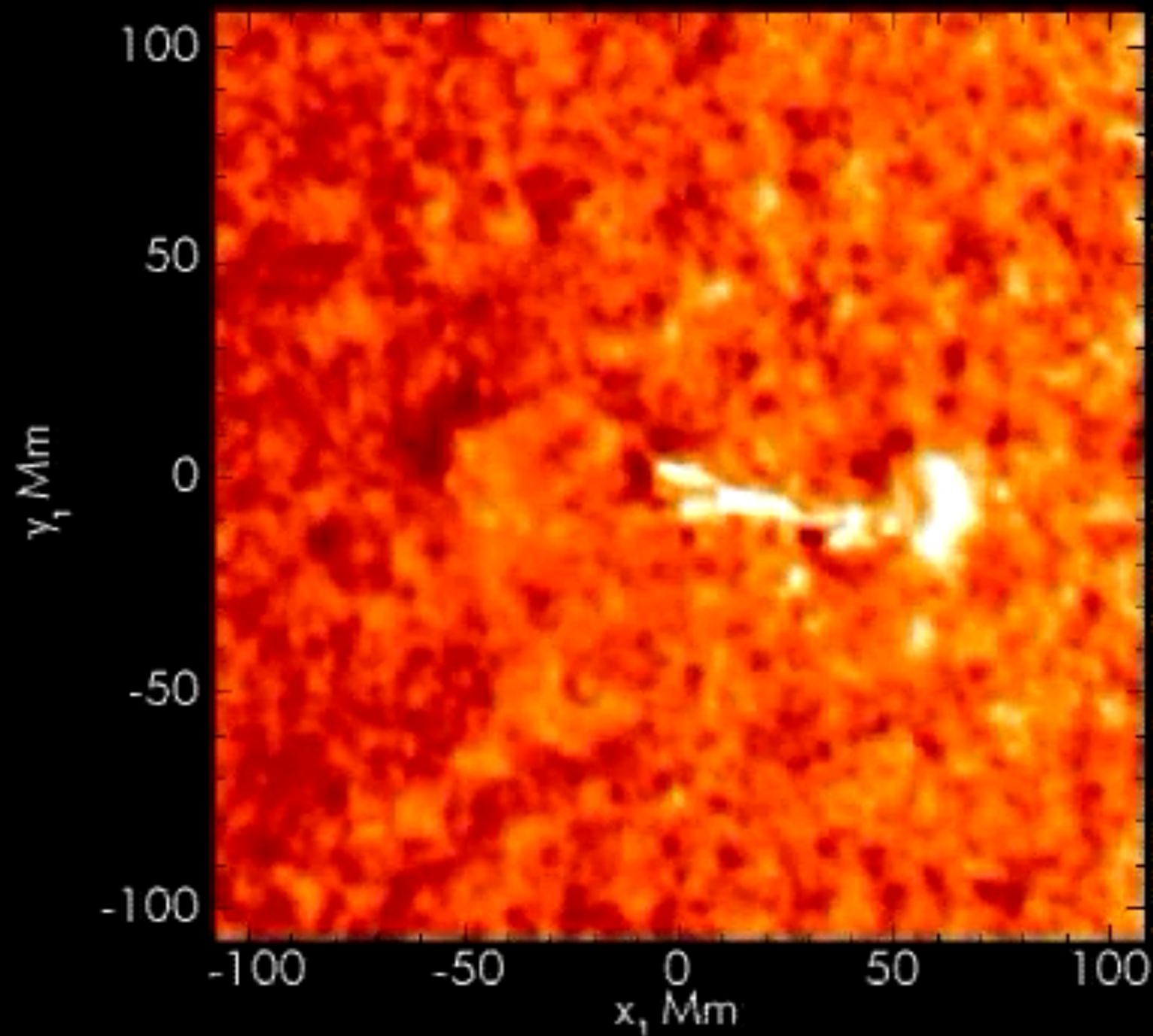


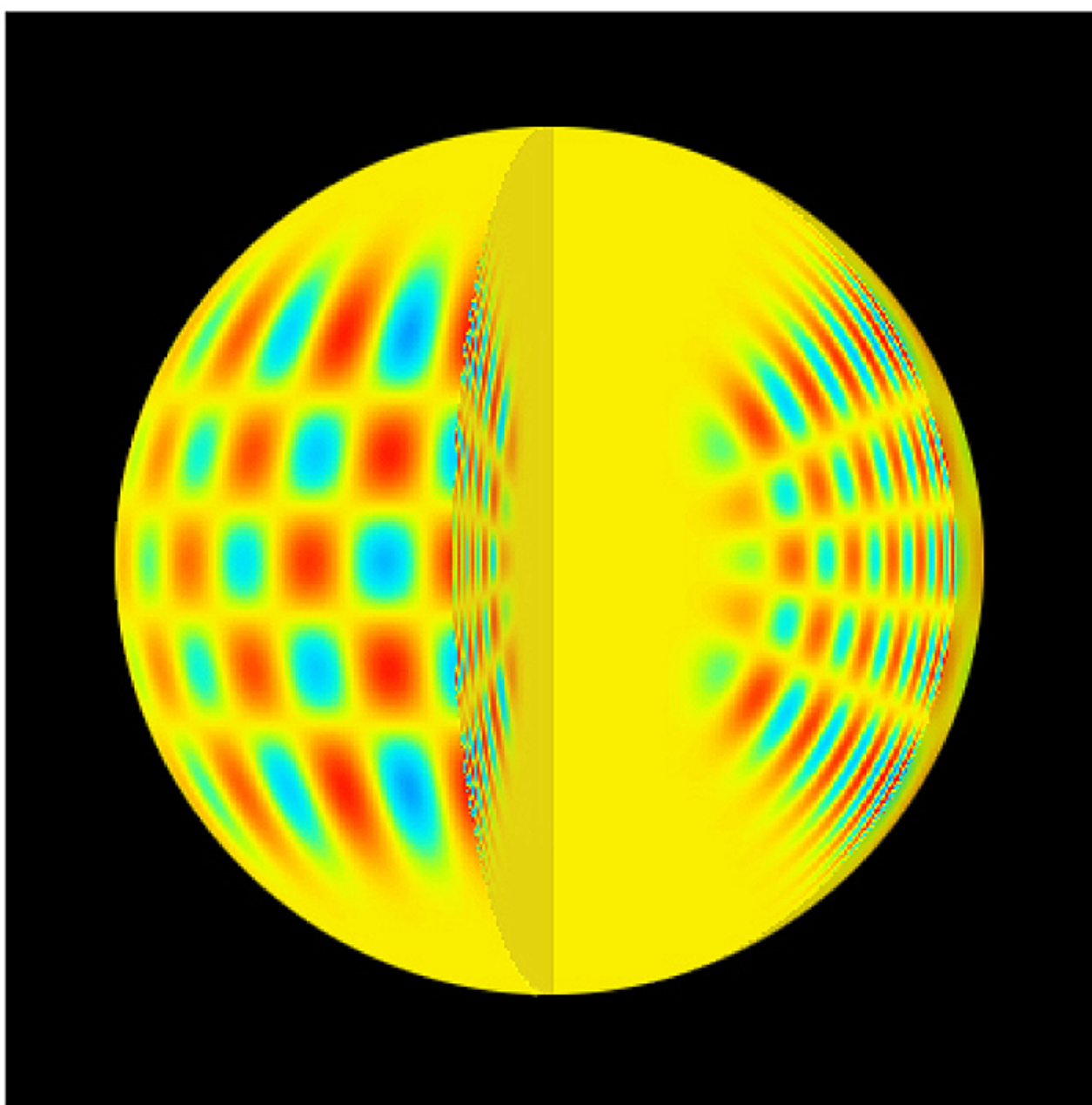
IL TAMBURO SOLARE...



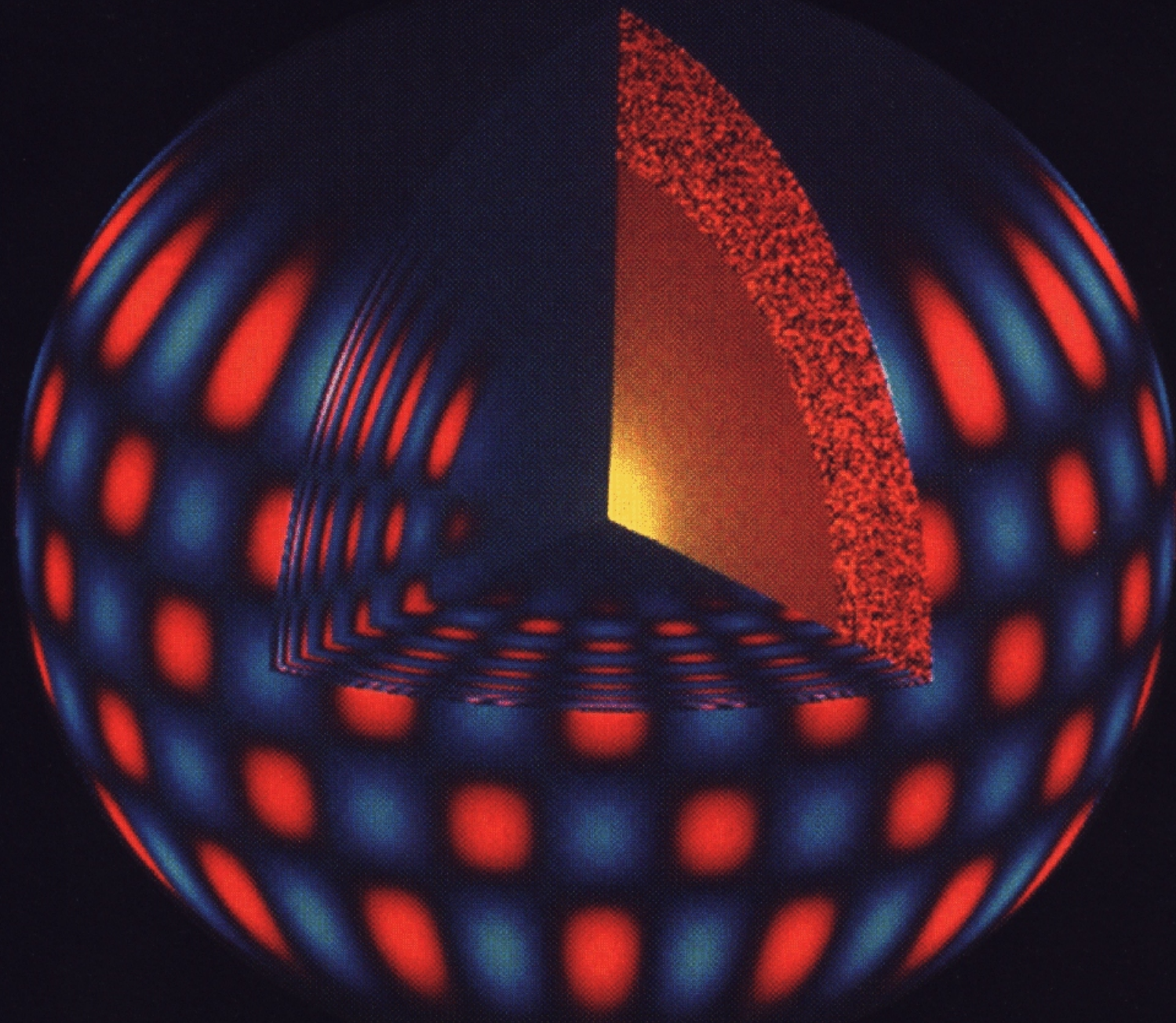




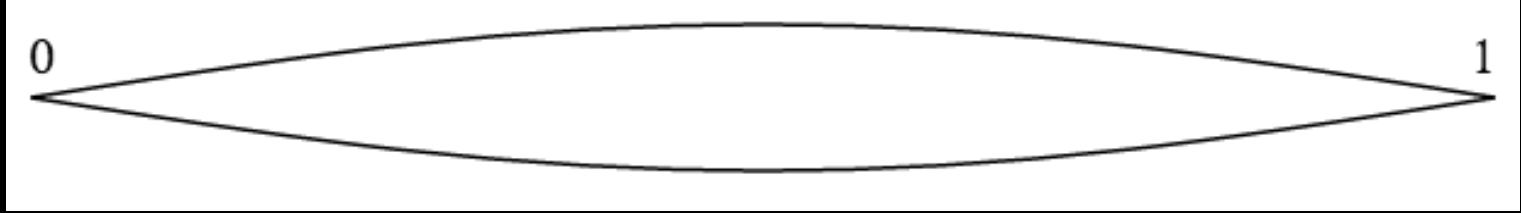




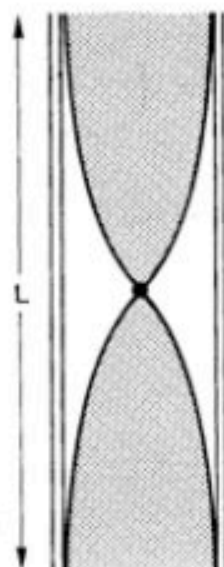
Acoustic Waves in a Solar-like Star



I SEGRETI DEL SUONO

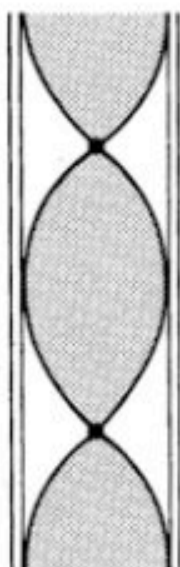






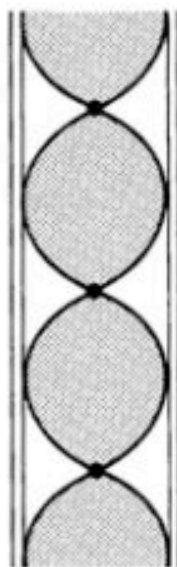
$$\lambda_1 = 2L$$

$$f_1 = \frac{v}{2L}$$



$$\lambda_2 = L$$

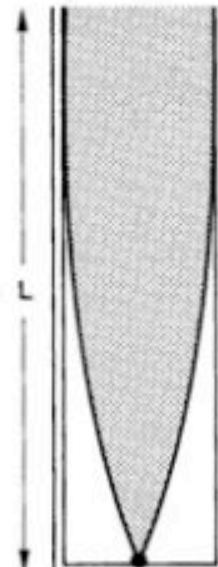
$$f_2 = 2 \frac{v}{2L}$$



$$\lambda_3 = \frac{2}{3} L$$

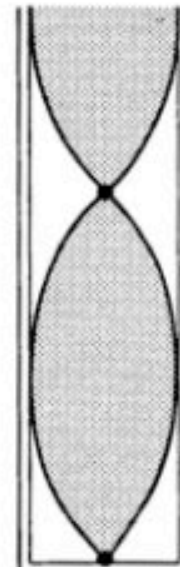
$$f_3 = 3 \frac{v}{2L}$$

Modi di vibrare dell'aria in un tubo aperto alle due estremità.
Tutte le armoniche sono presenti.



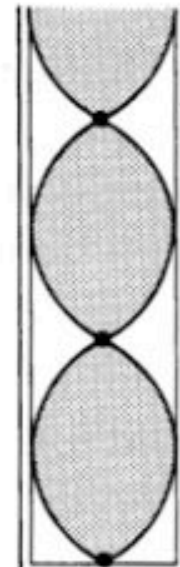
$$\lambda_1 = 4L$$

$$f_1 = \frac{v}{4L}$$



$$\lambda_3 = \frac{4}{3} L$$

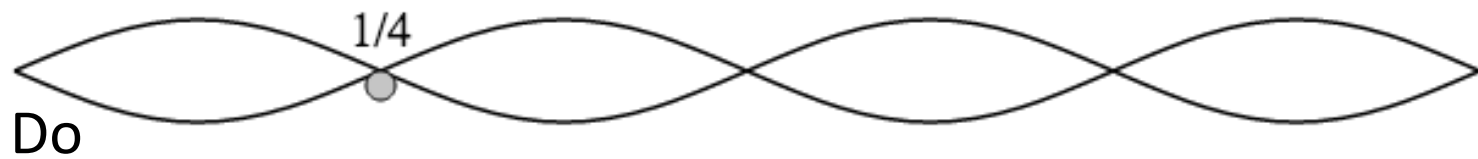
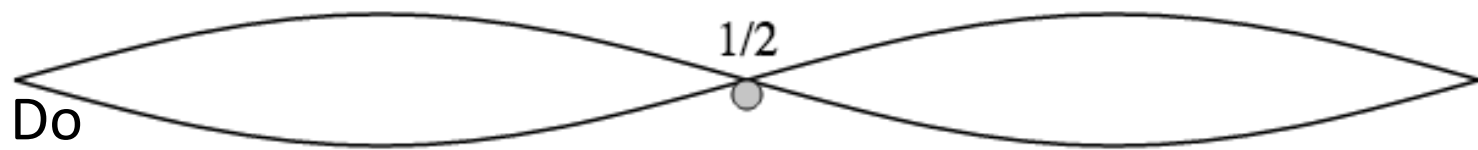
$$f_3 = 3 \frac{v}{4L}$$



$$\lambda_5 = \frac{4}{5} L$$

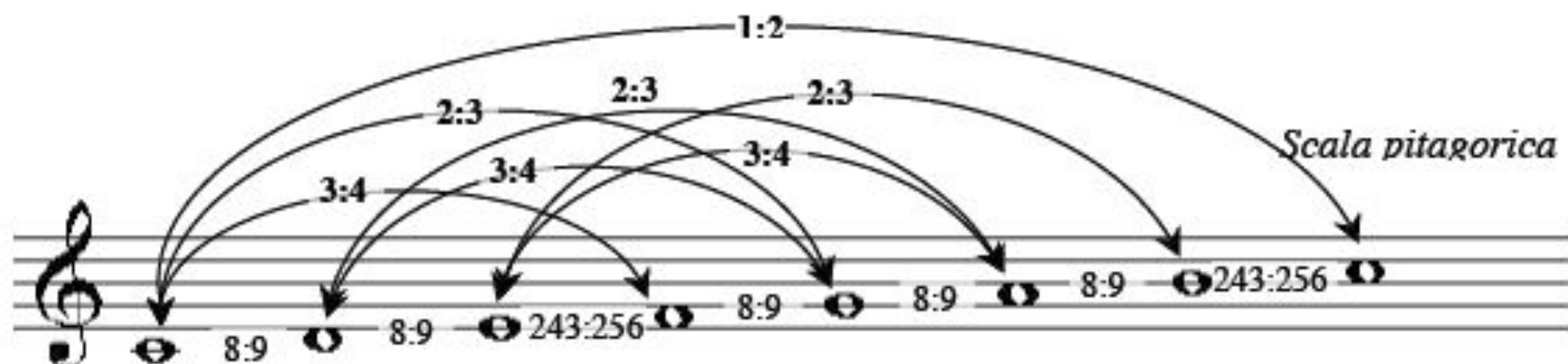
$$f_5 = 5 \frac{v}{4L}$$

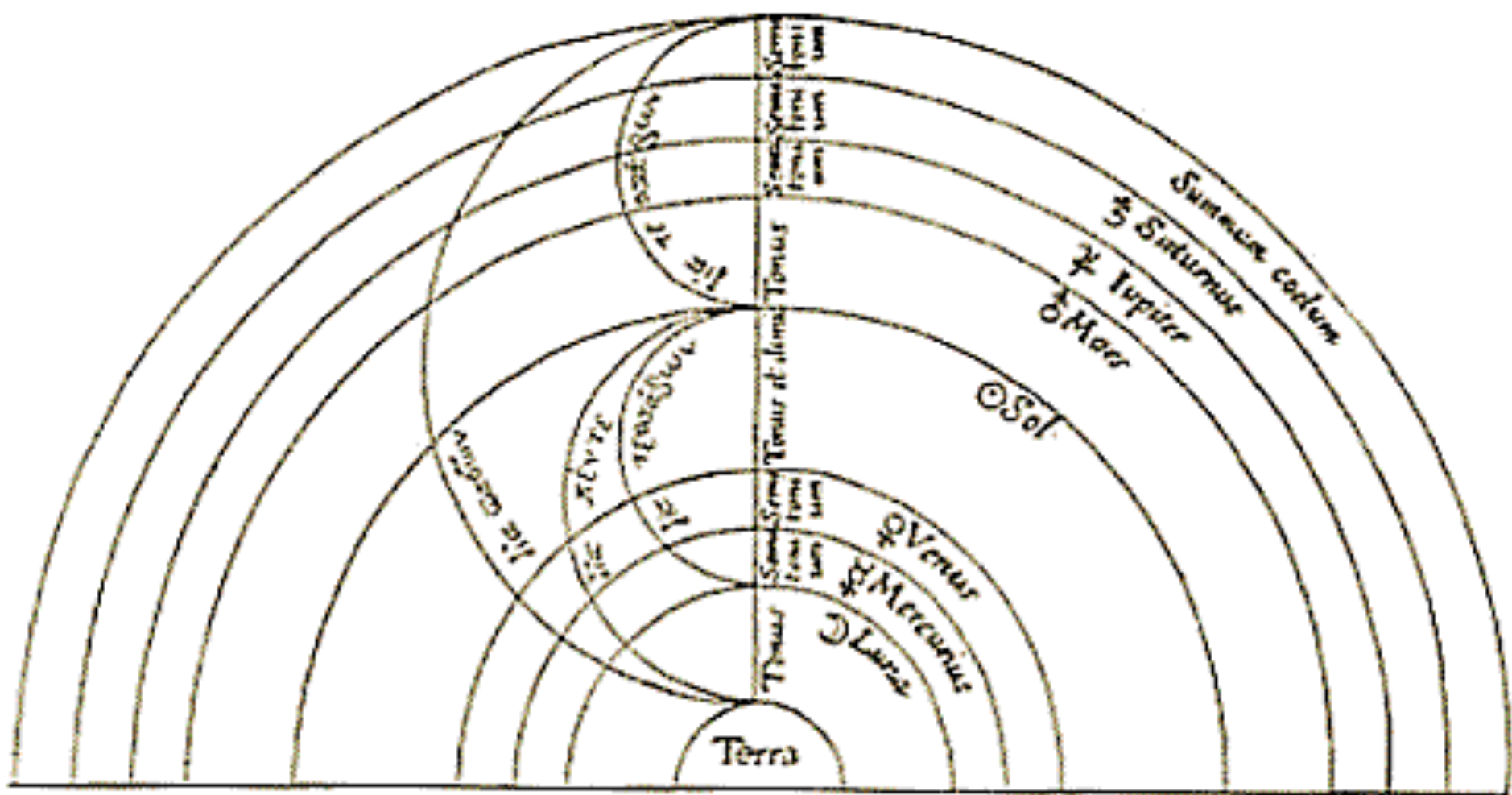
Modi di vibrare dell'aria in un tubo aperto ad una sola estremità.
Sono presenti solo le armoniche dispari.

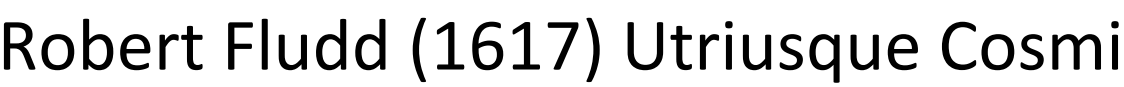


Come suonano **insieme**?

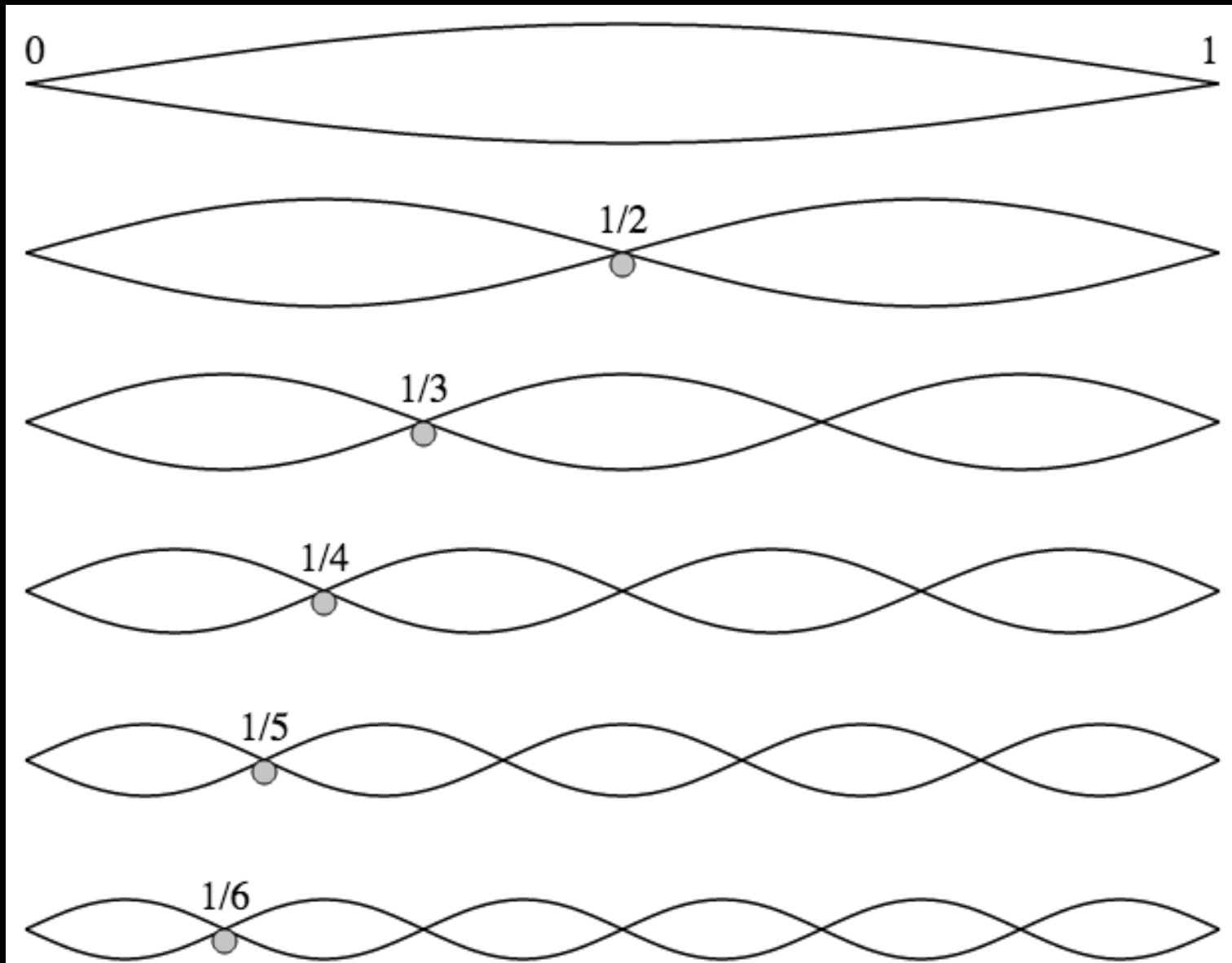


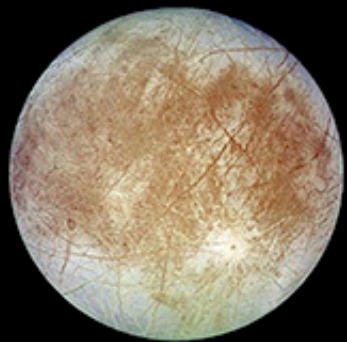
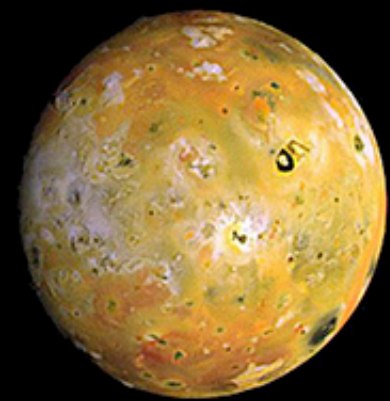




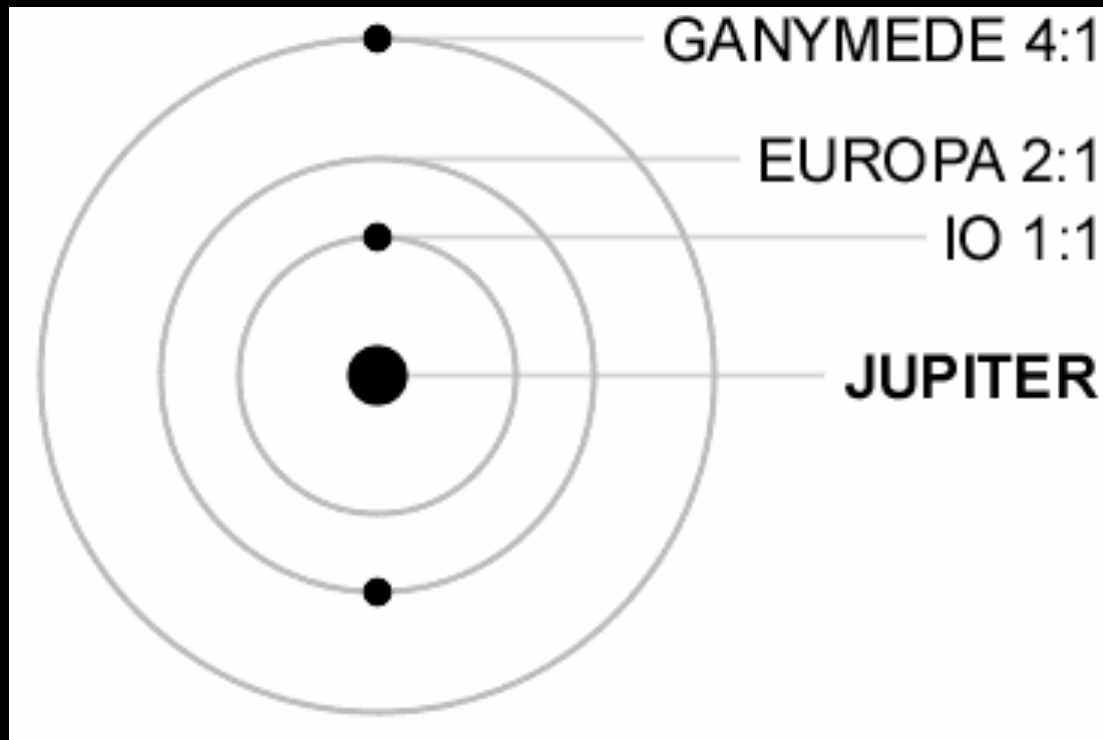


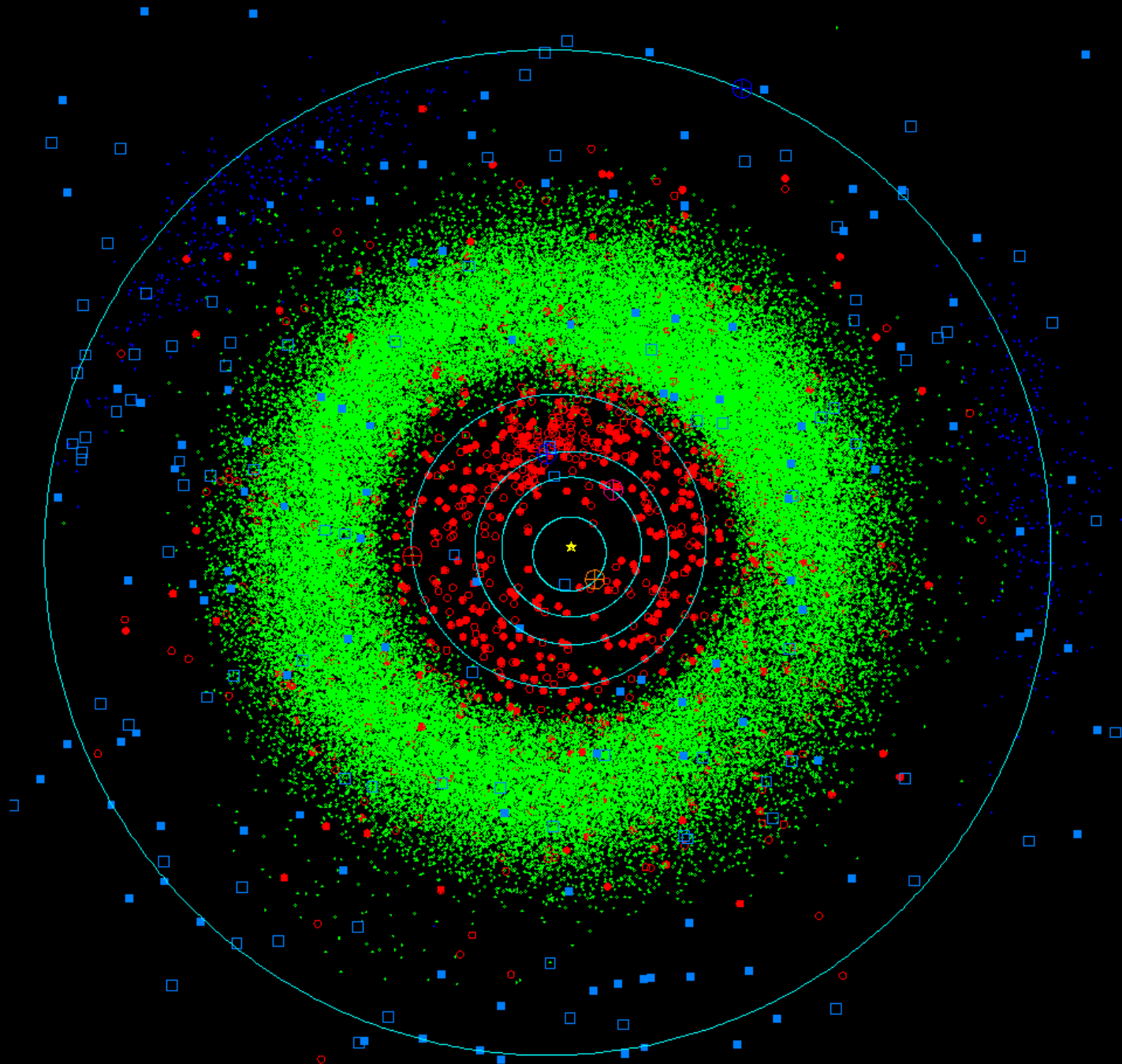
RISONANZE...





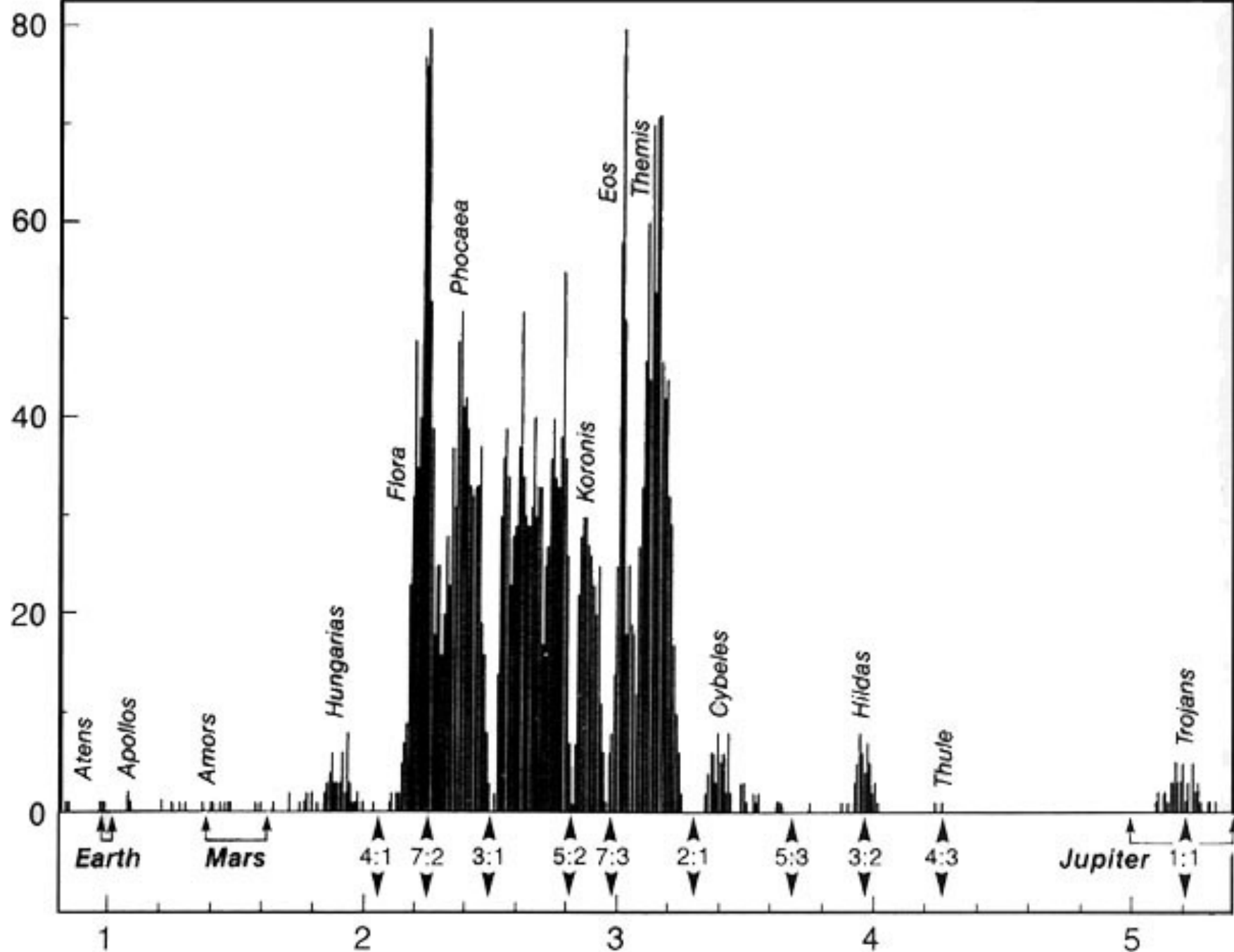
Nome	Periodo
Io	1.77 giorni
Europa	3.55 giorni
Ganimede	7,16 giorni
Callisto	16,69 giorni





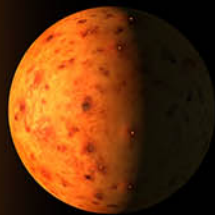
■ Plot prepared by the Minor Planet Center (2001 Jan 4). Unauthorized reproduction prohibited.

NUMBER OF CATALOGUED ASTEROIDS

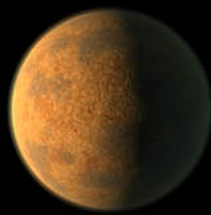


MEAN DISTANCE FROM SUN (astronomical units)

TRAPPIST-1 System



b



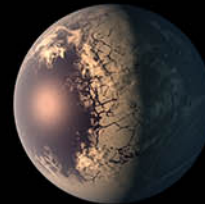
c



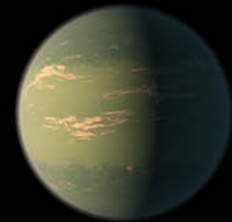
d



e



f



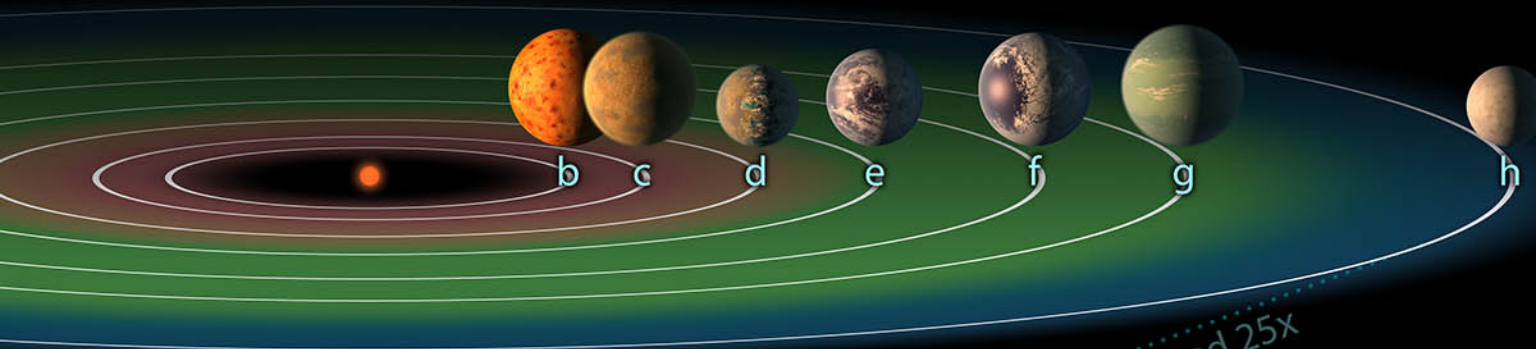
g



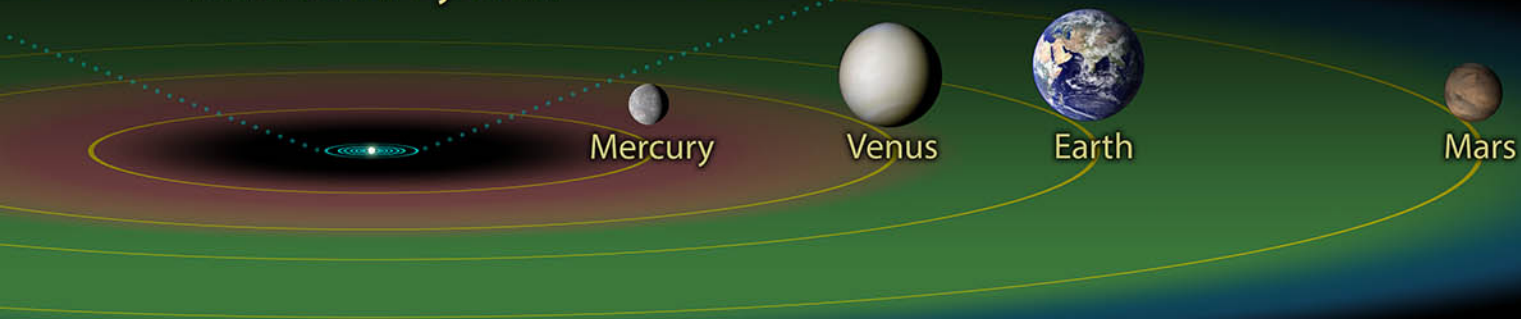
h

Illustration

TRAPPIST-1 System

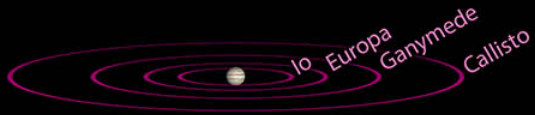


Inner Solar System

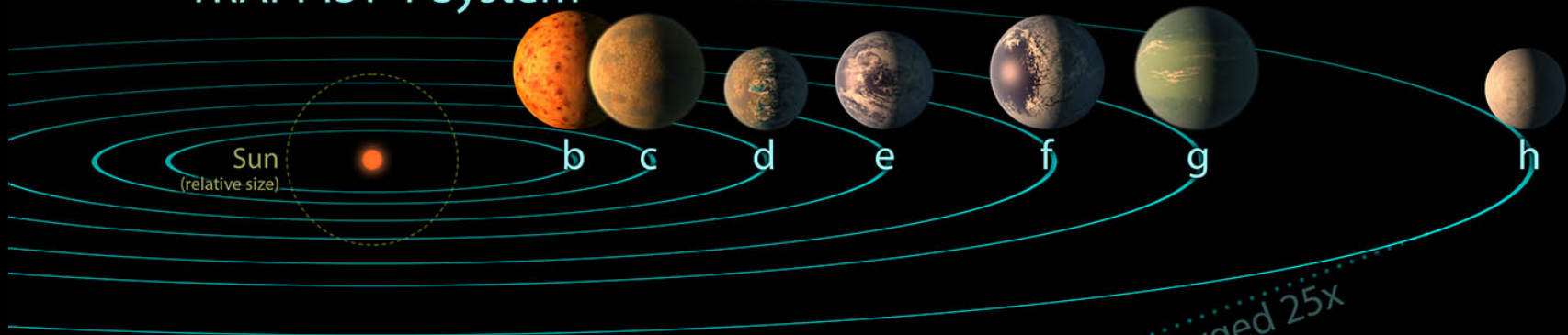


Illustration

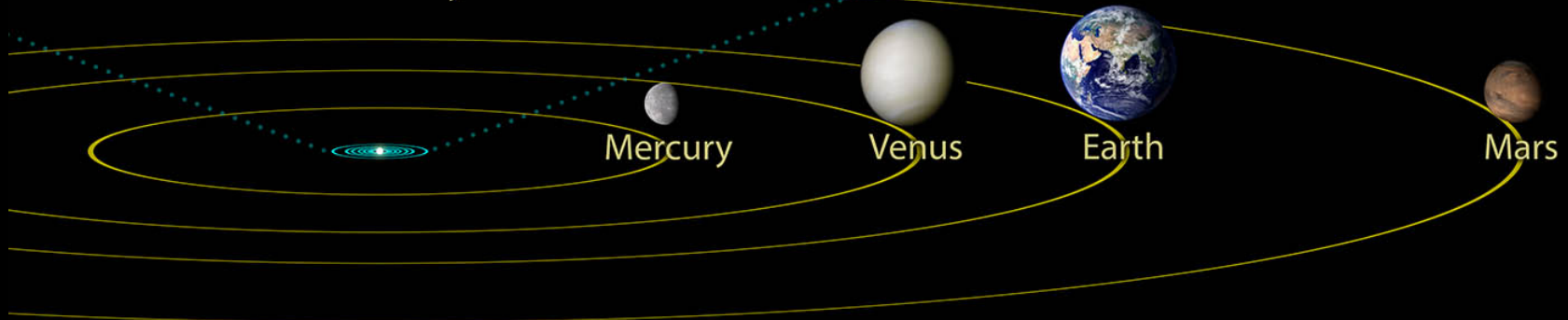
Jupiter & Major Moons



TRAPPIST-1 System



Inner Solar System

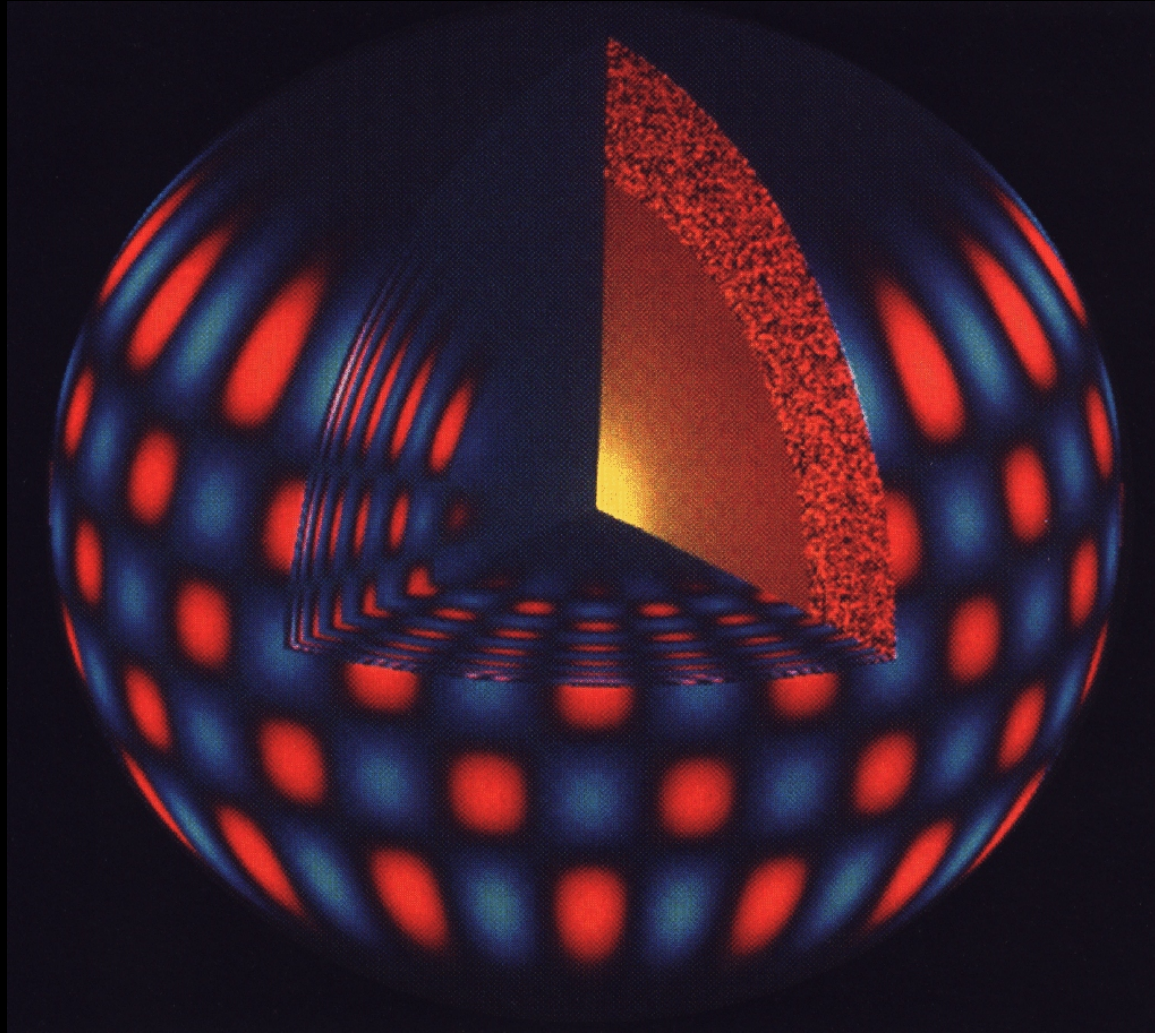


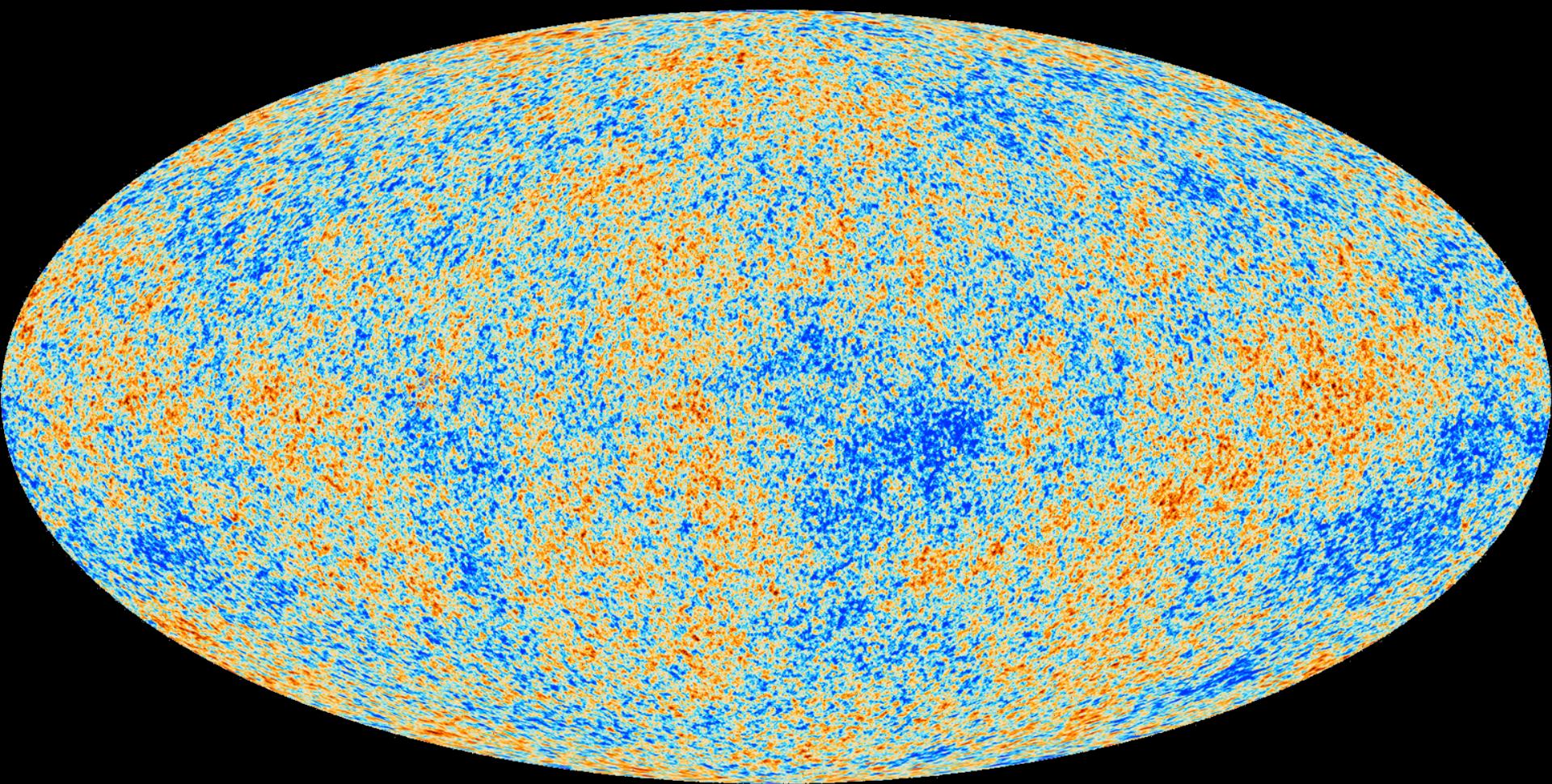
Musica Trap

Periodi: 2, 3, 4, 6, 9, 15, 24

SUONI ANTICHI...

Quando l'universo era un Sole...





The first sound waves

a) gas falls into valleys, gets compressed, & glows brighter

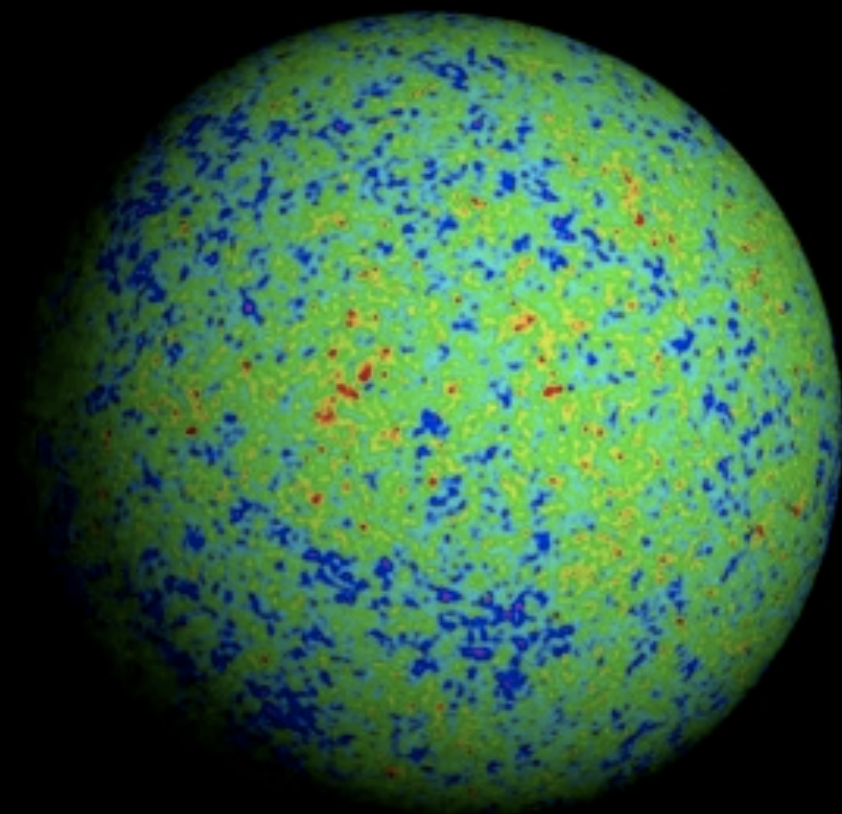
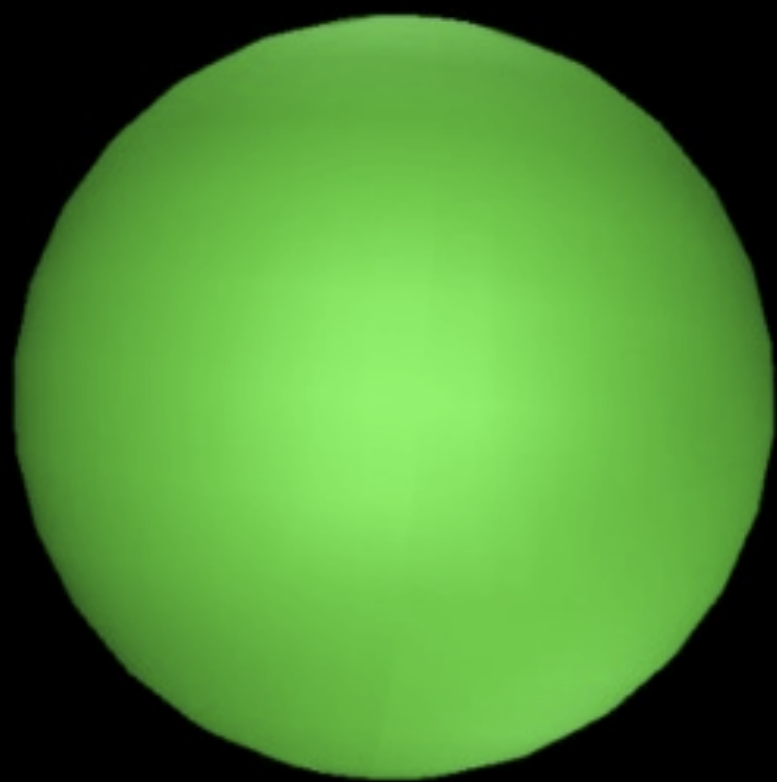


b) it overshoots, then rebounds out, is rarefied, & gets dimmer

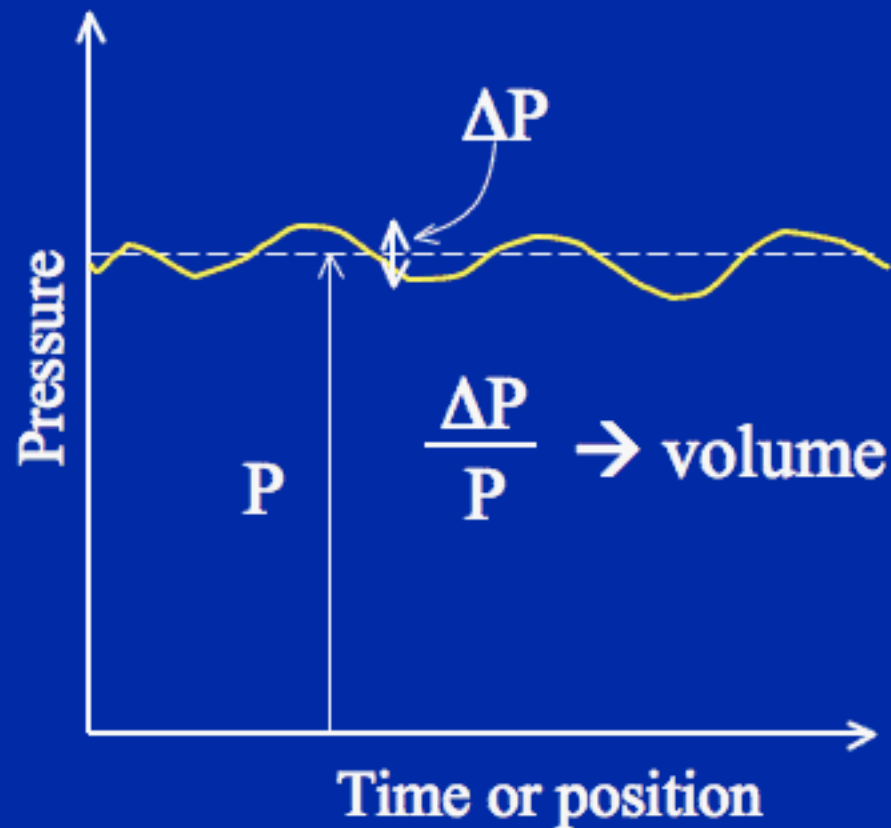


c) it then falls back in again to make a second compression

→ the oscillation continues → sound waves are created



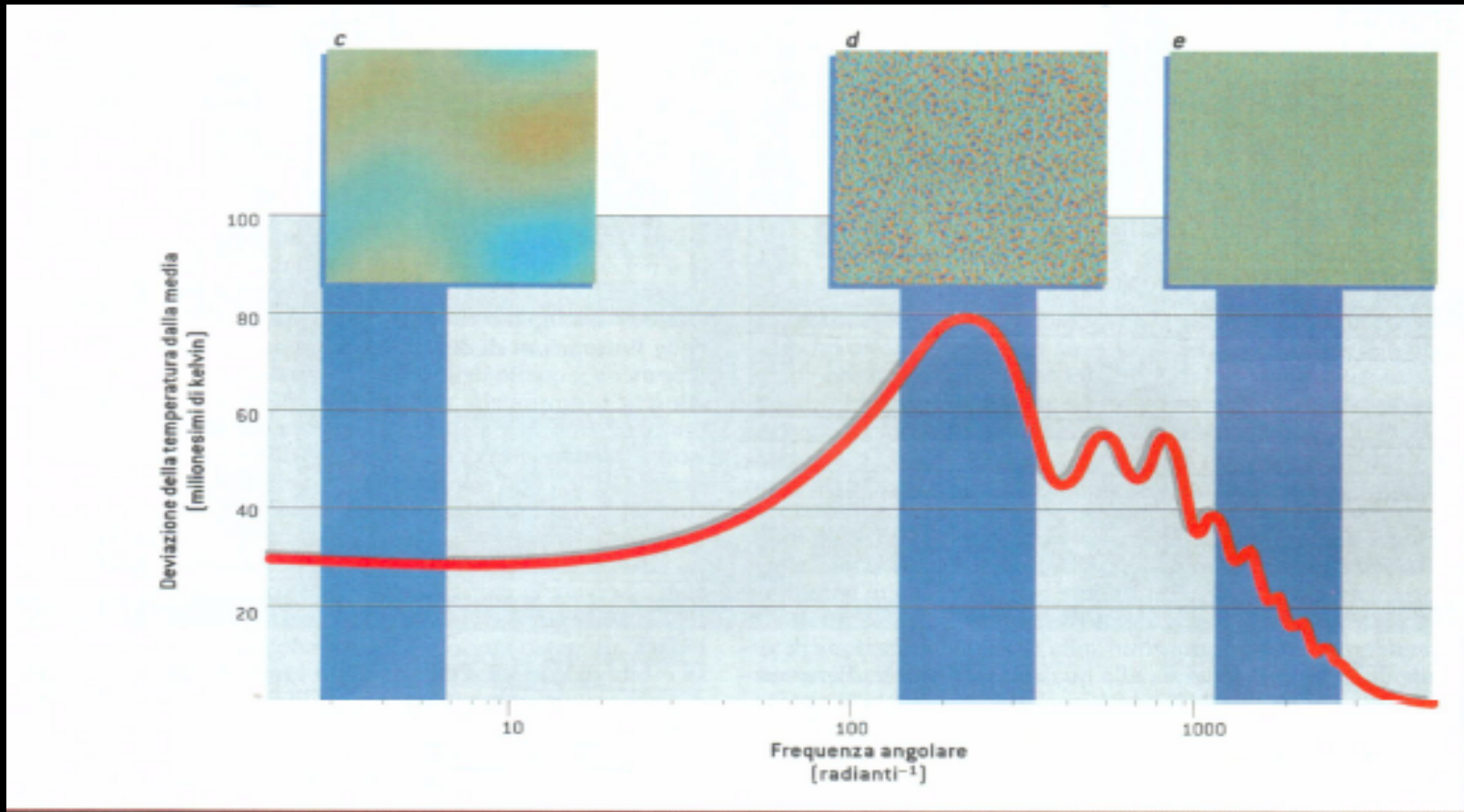
Pressure variations define loudness



$\Delta P/P$	<u>decibels</u>	<u>volume</u>
10^{-9} billionth	15	v. quiet
10^{-6} millionth	75	noisy
10^{-3} thousandth	135	deafening

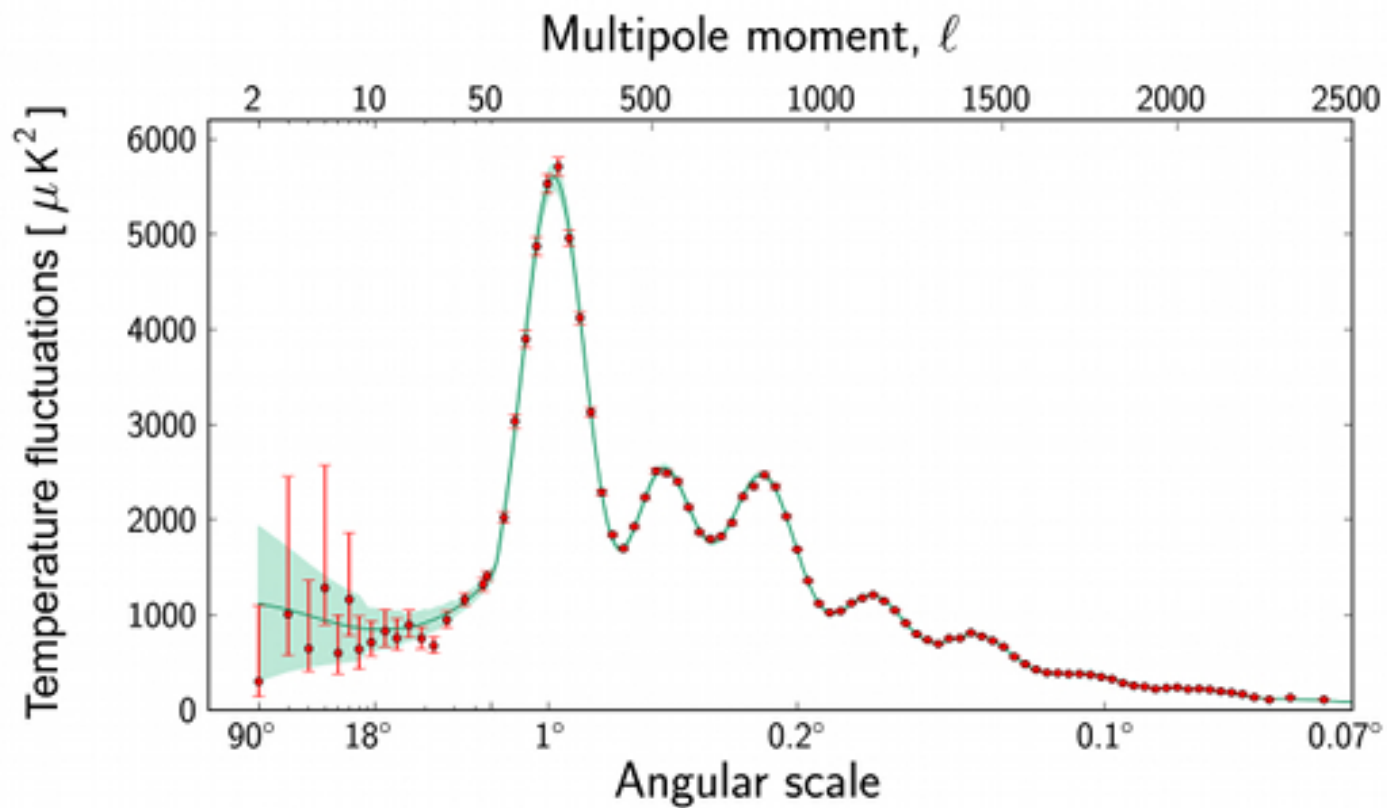
Cosmic sound : $\Delta P/P = 10^{-4} \rightarrow 110$ decibels !

Tutte le macchie di una certa dimensione
saranno causate da perturbazioni della stessa estensione
che quindi avranno la stessa frequenza

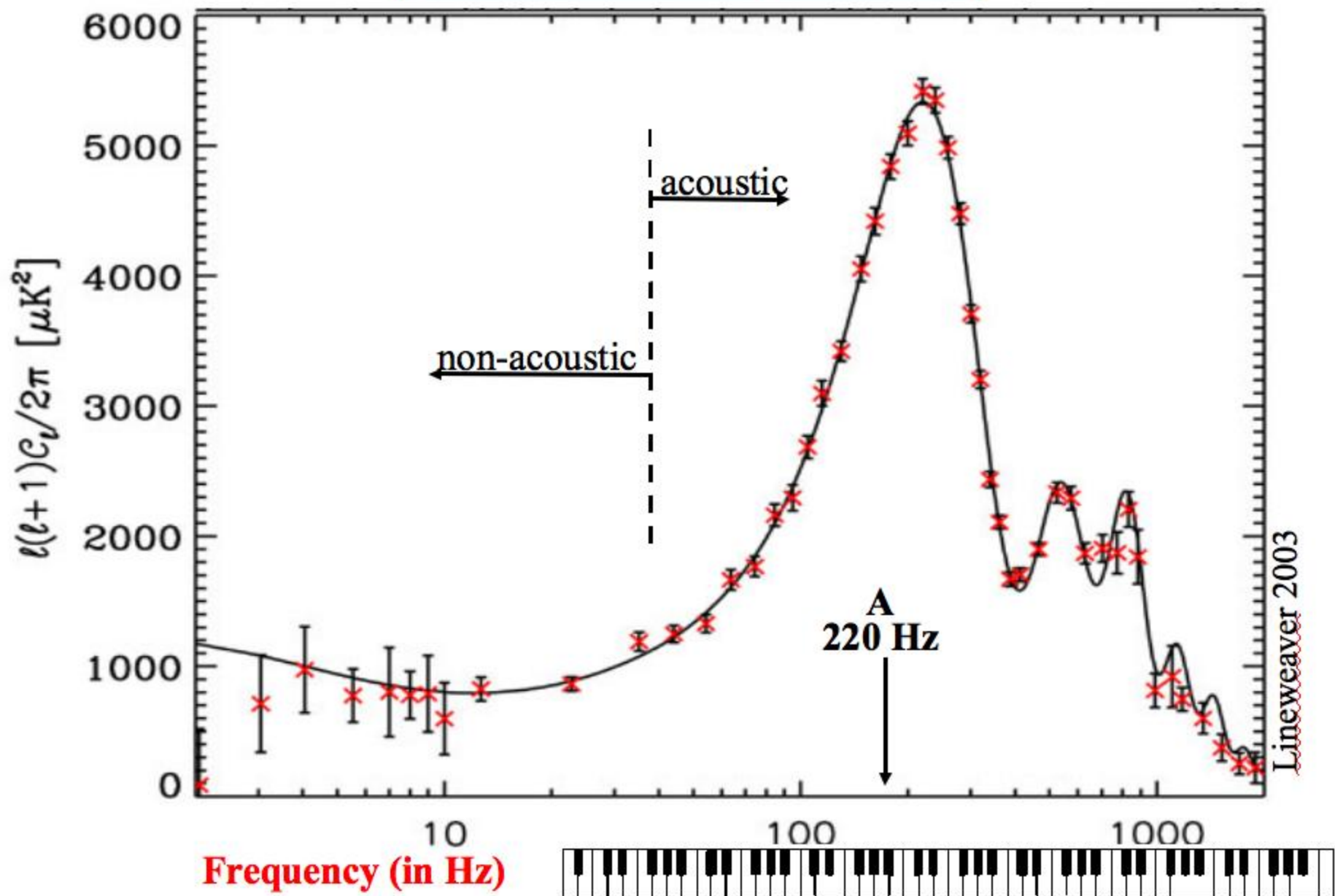


Variazioni di temperatura → spettro in frequenze!

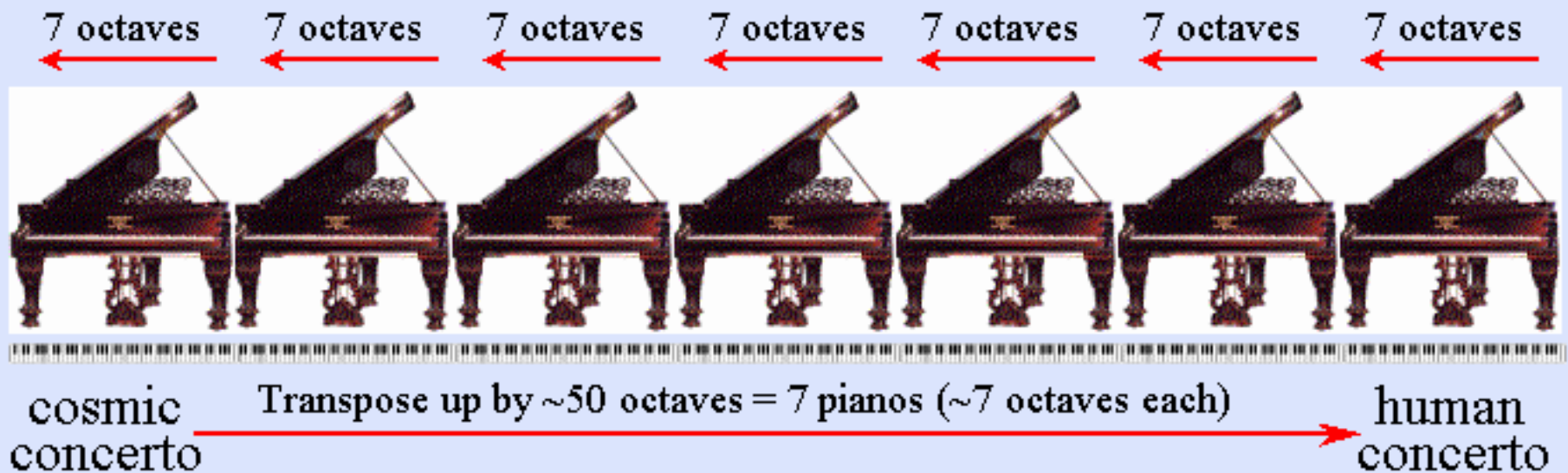
Planck



CMB Sound Spectrum

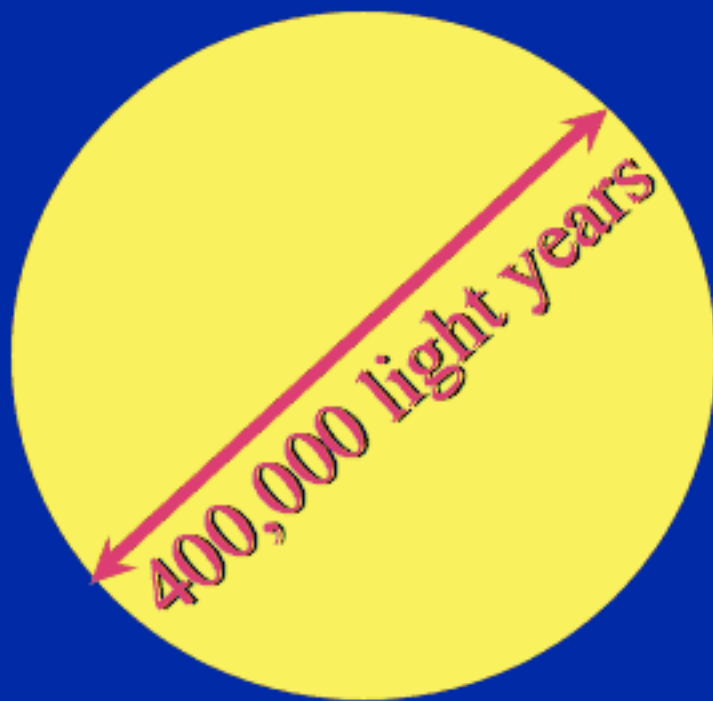


È un suono un po' basso...



Primordial sound is so DEEP because the Universe is so BIG

Universe

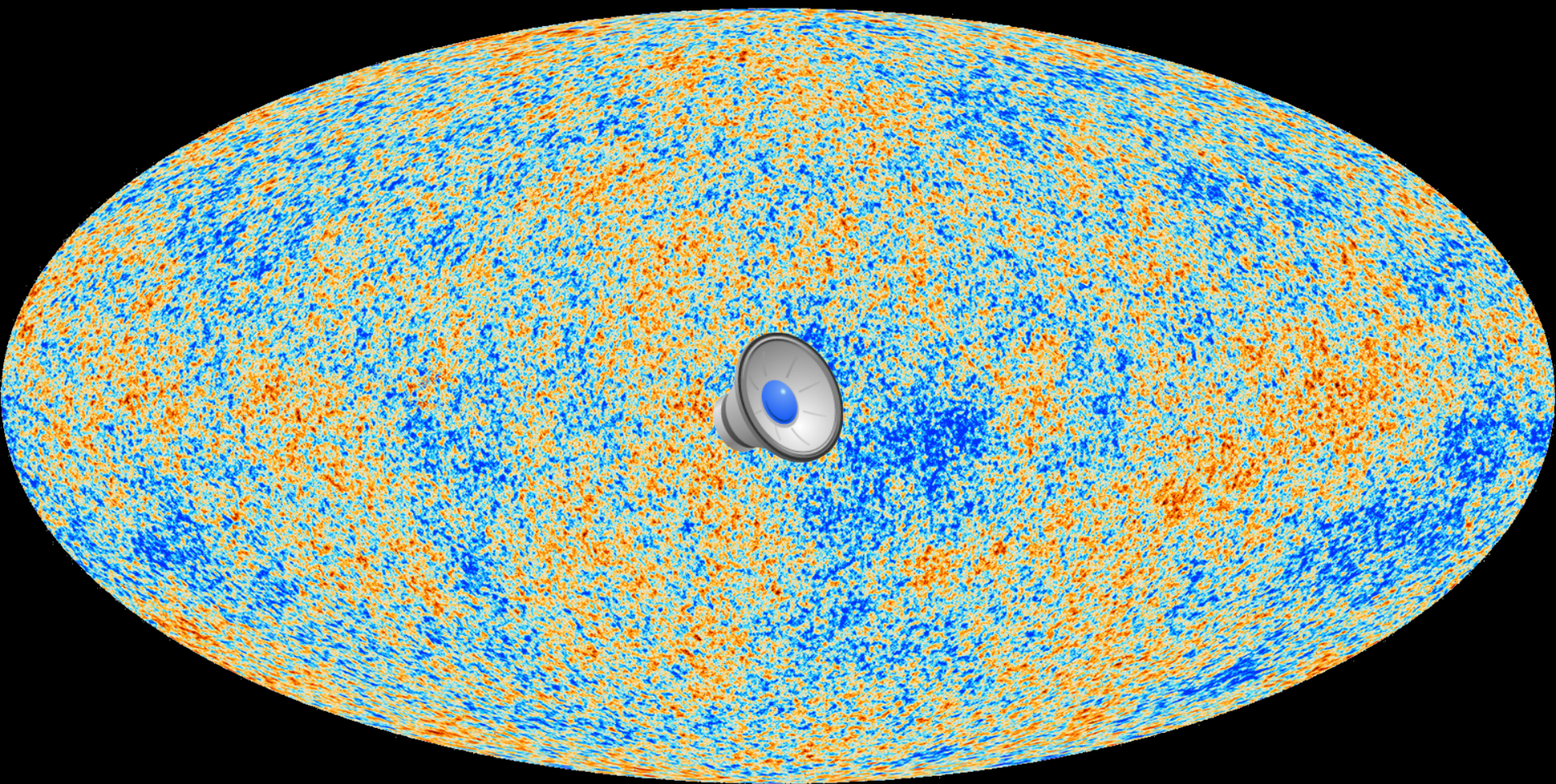


Cathedral Organ

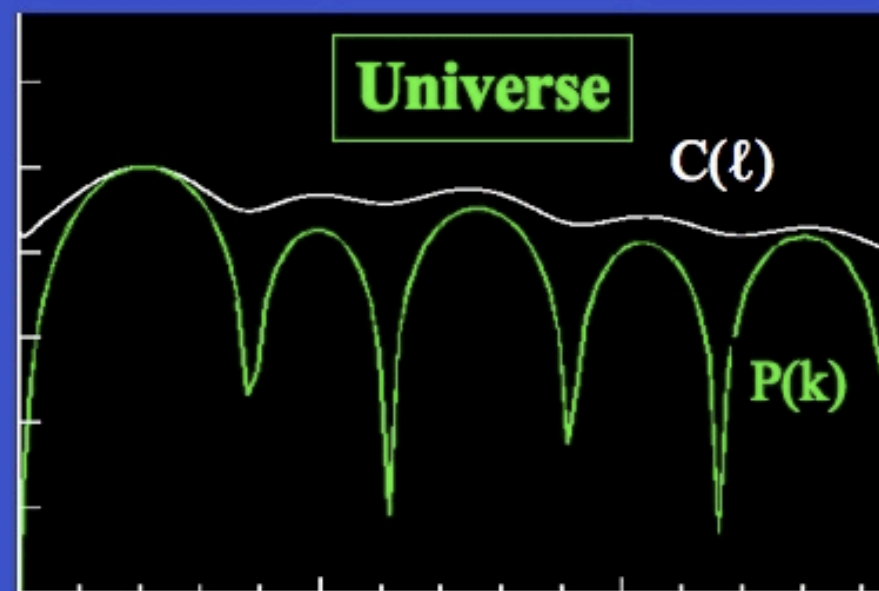
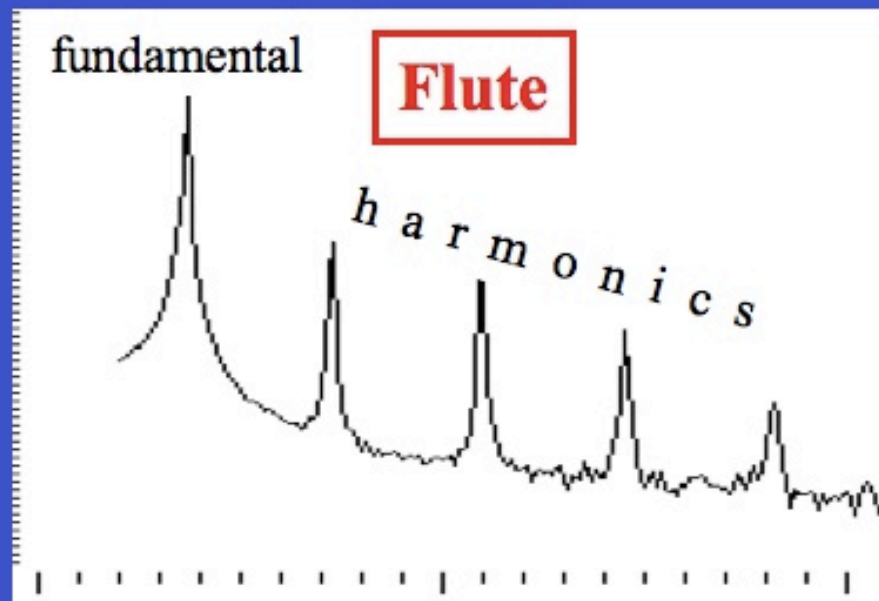


Pan Pipes

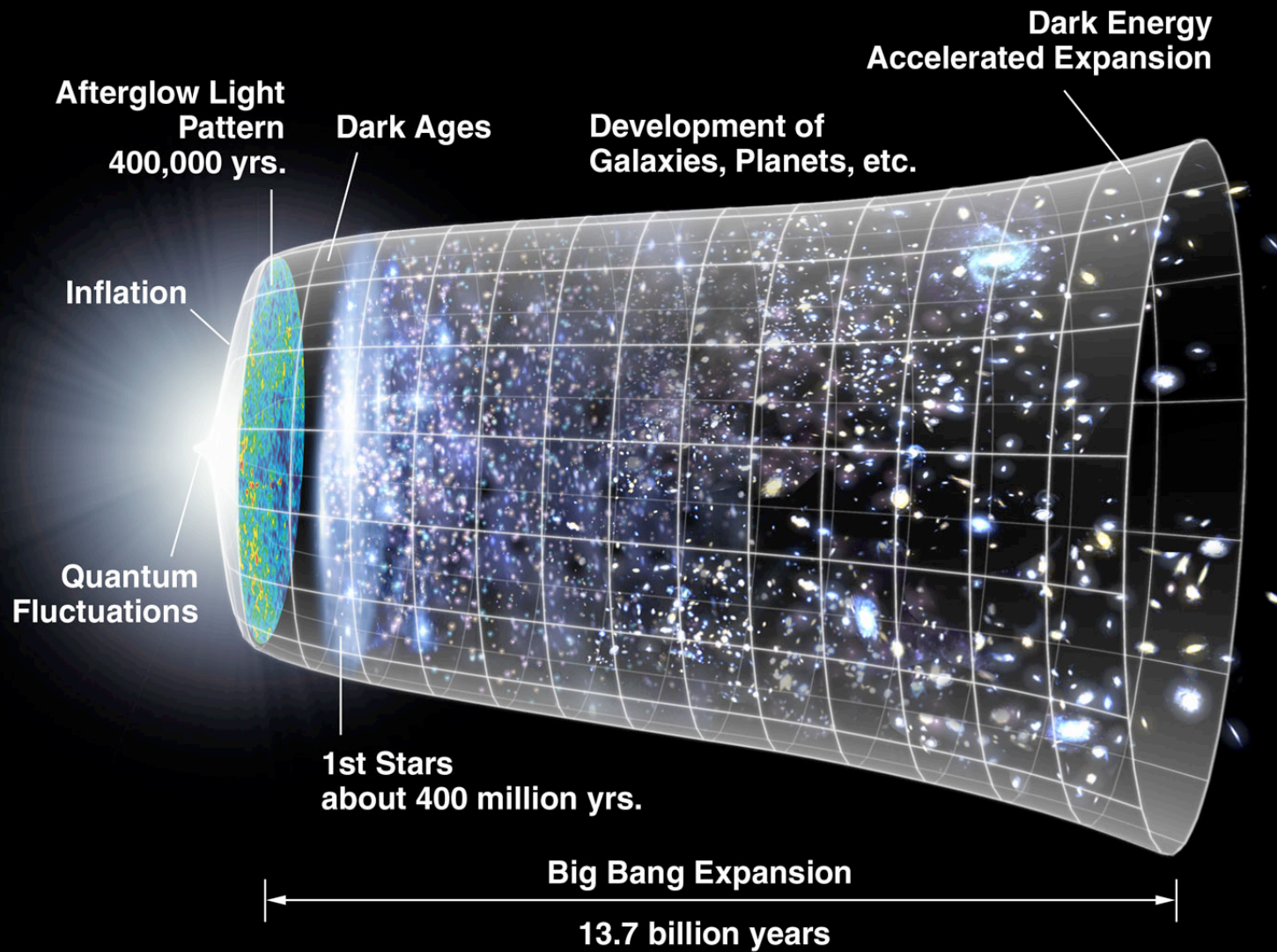




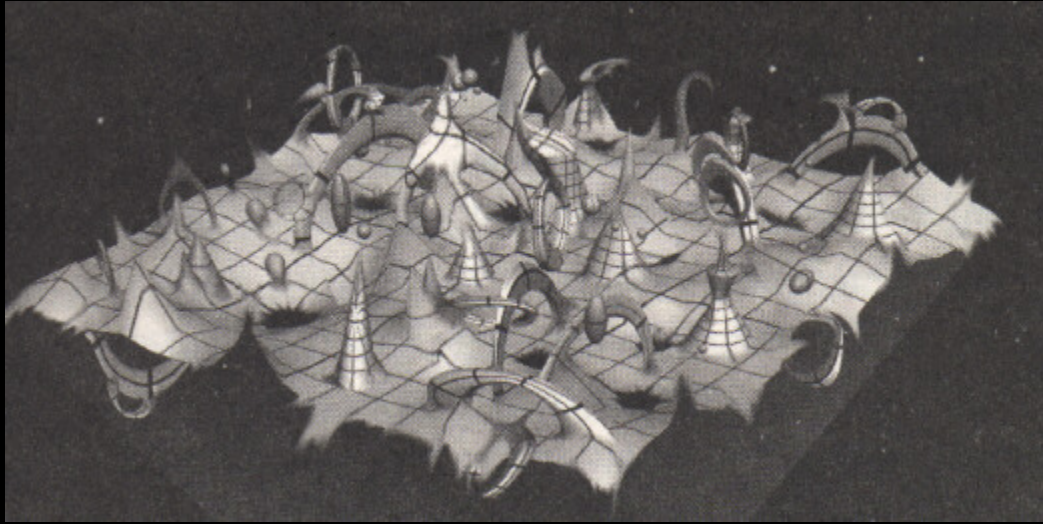
decibel scales

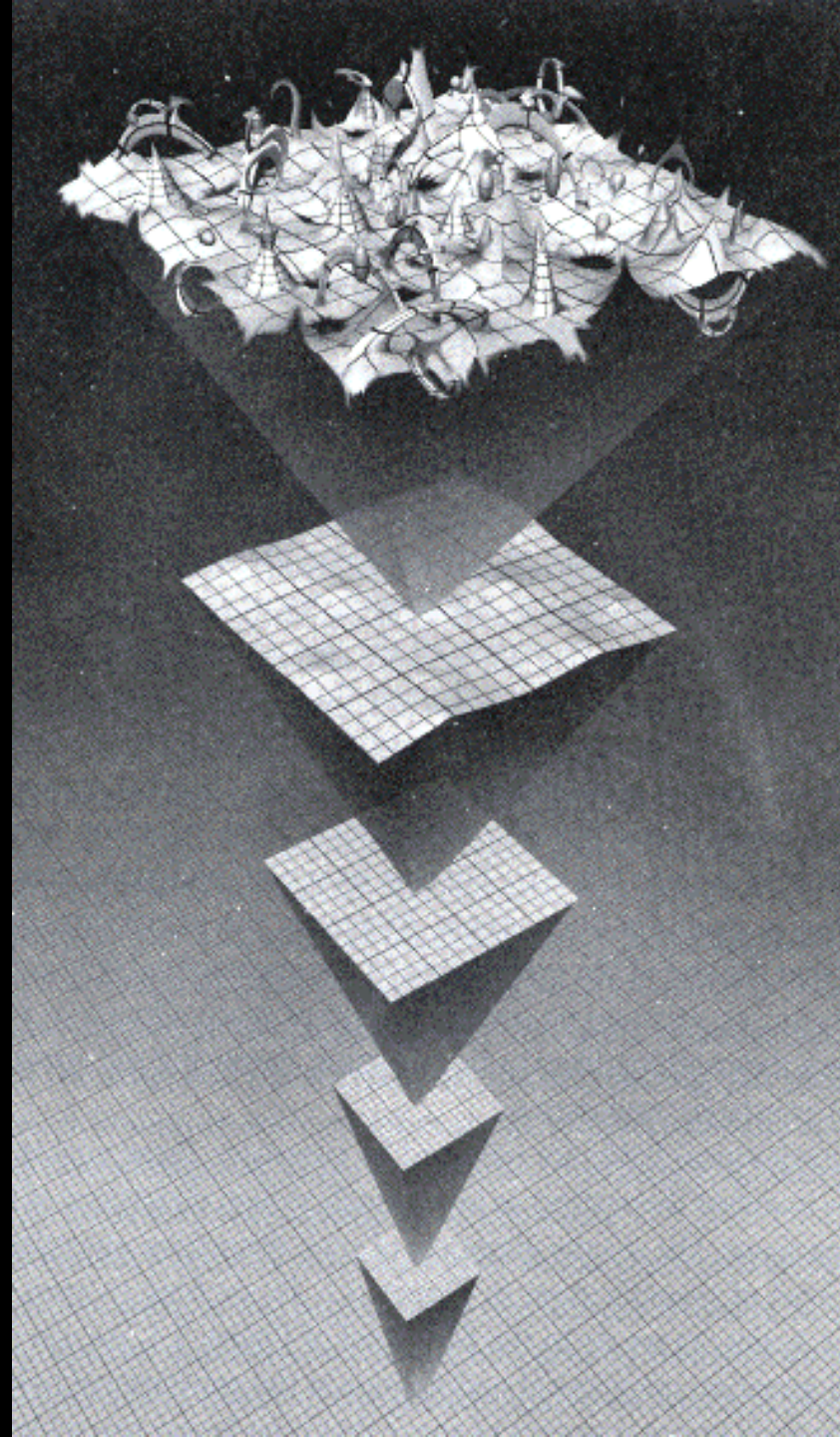


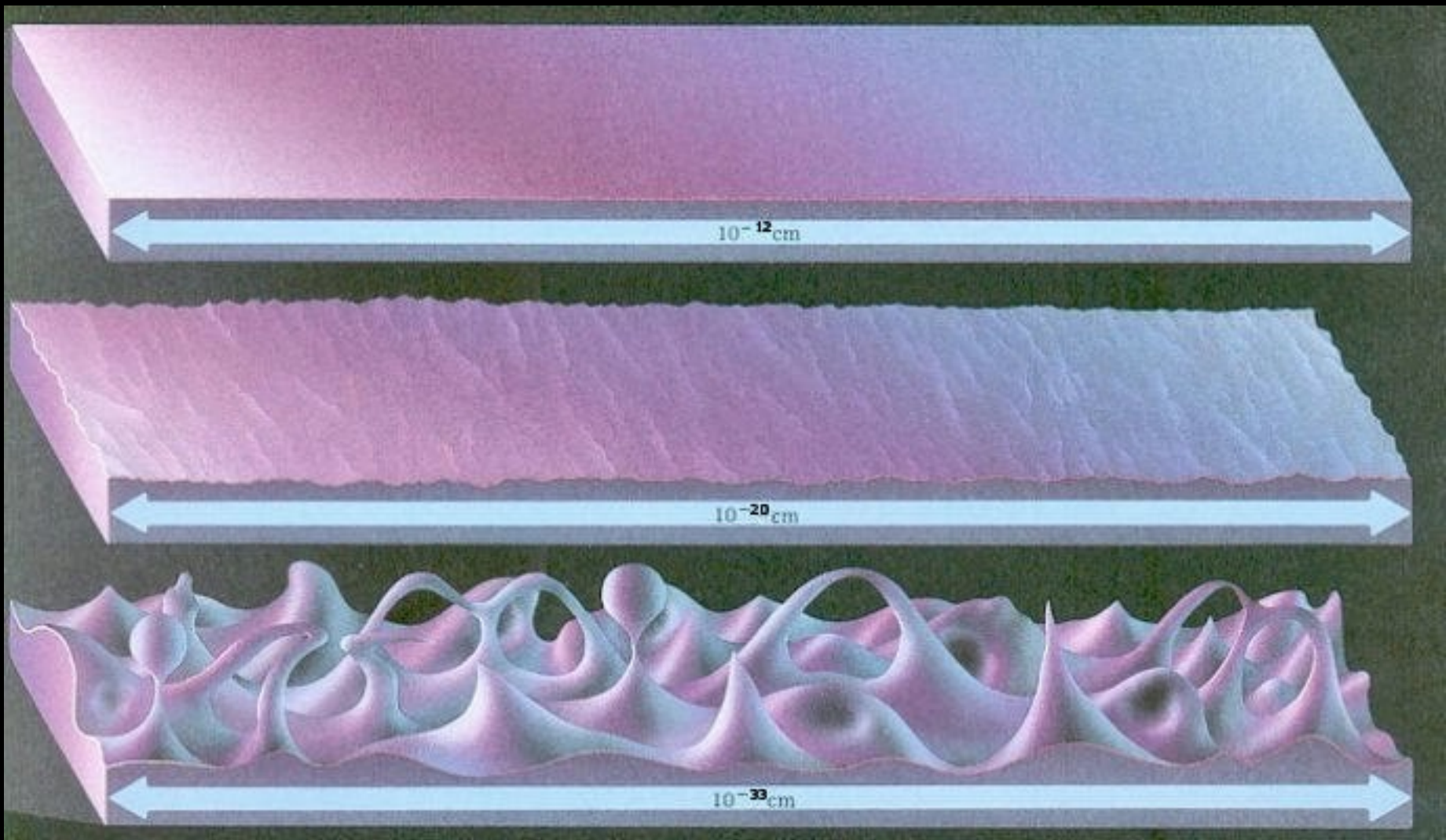
Frequency

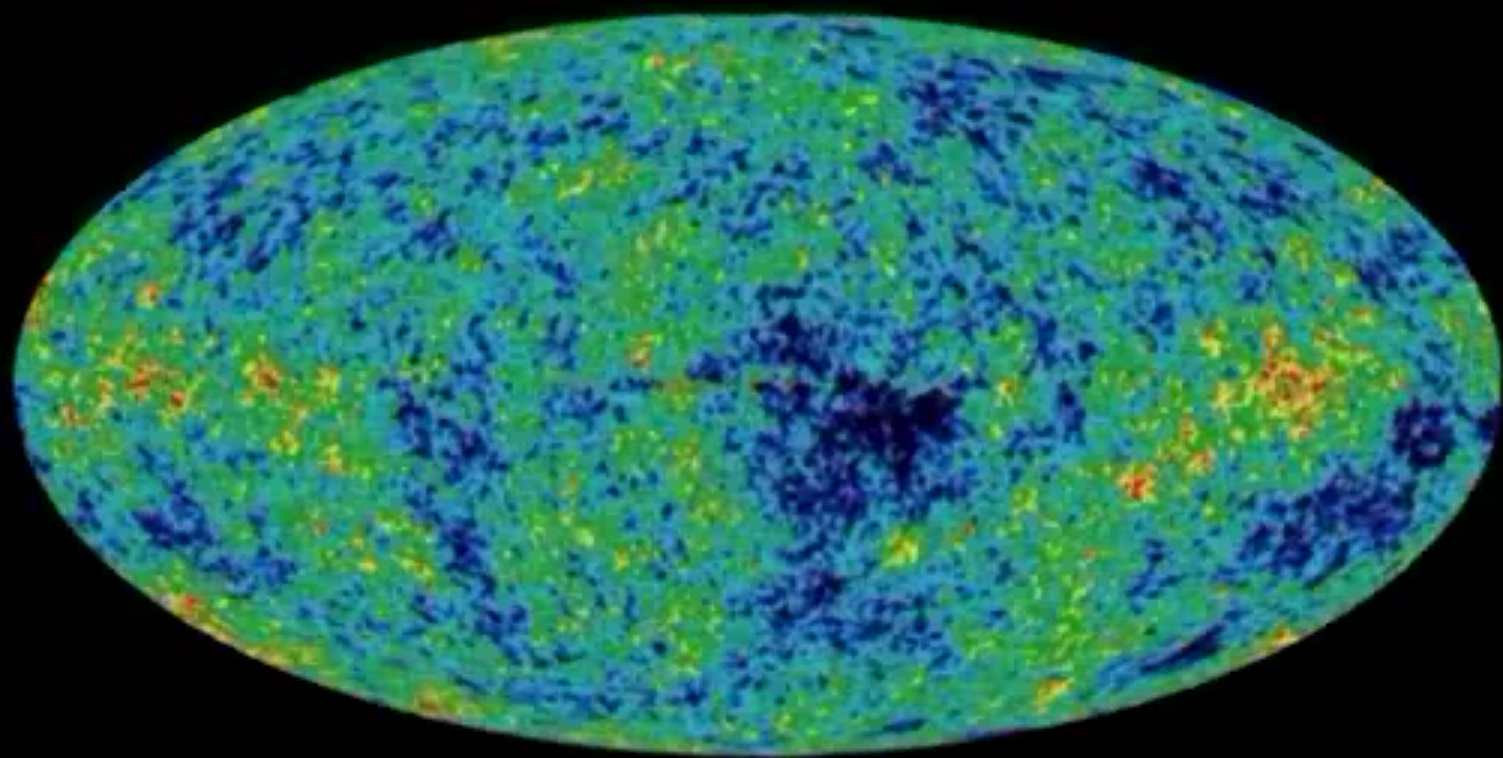


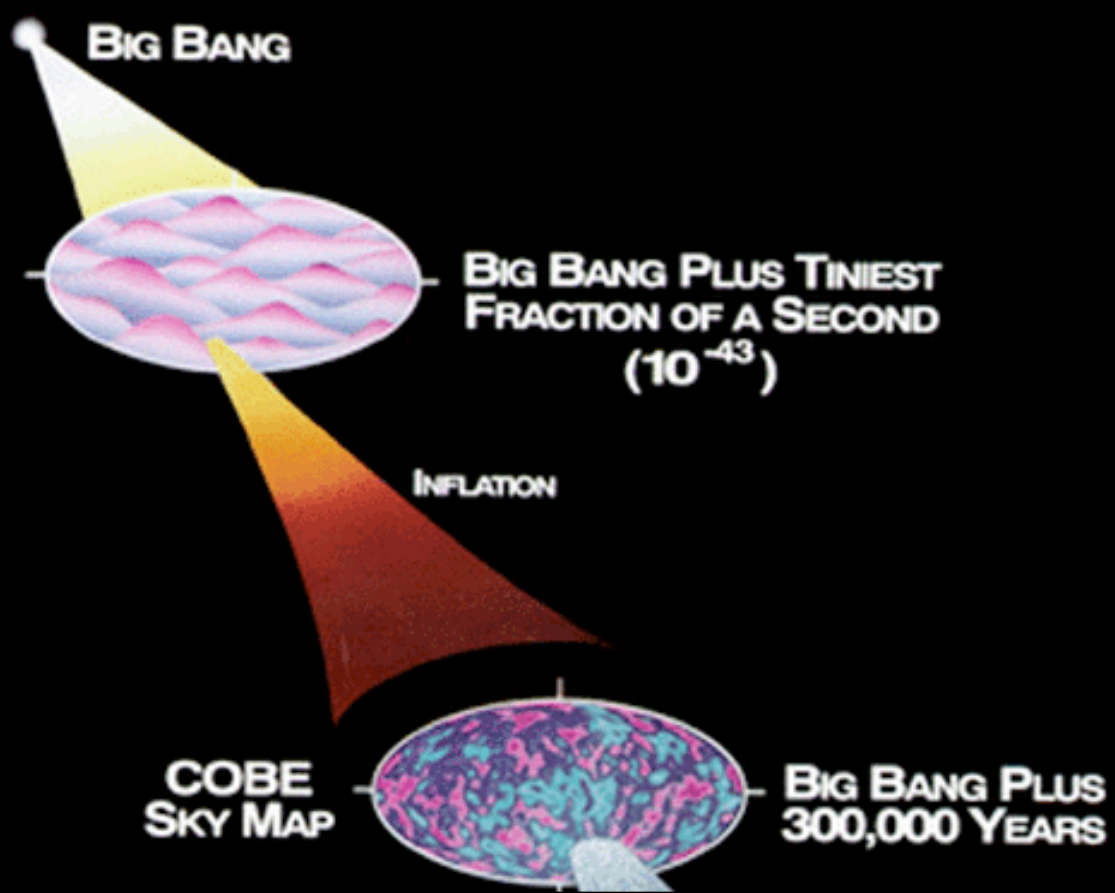


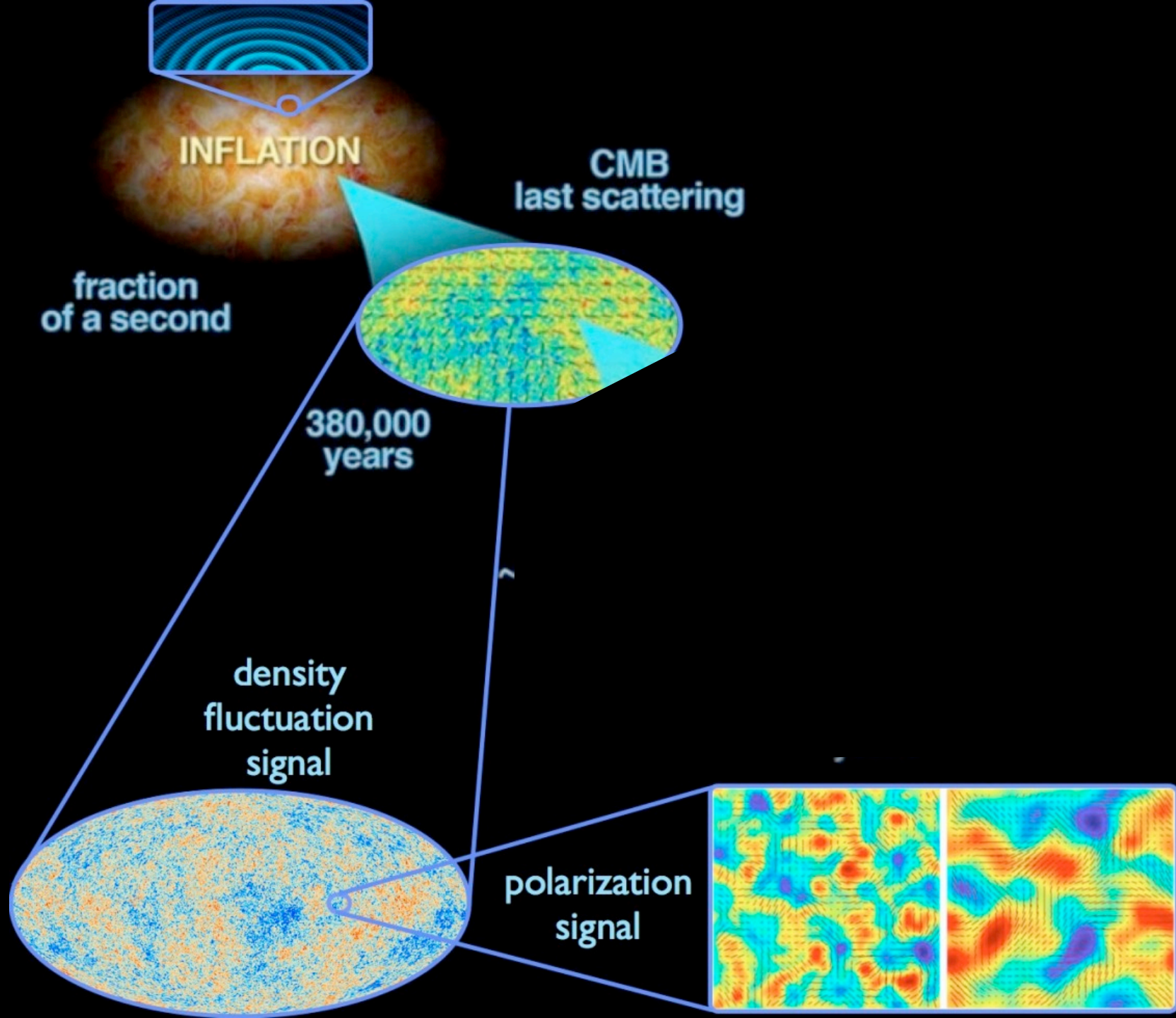


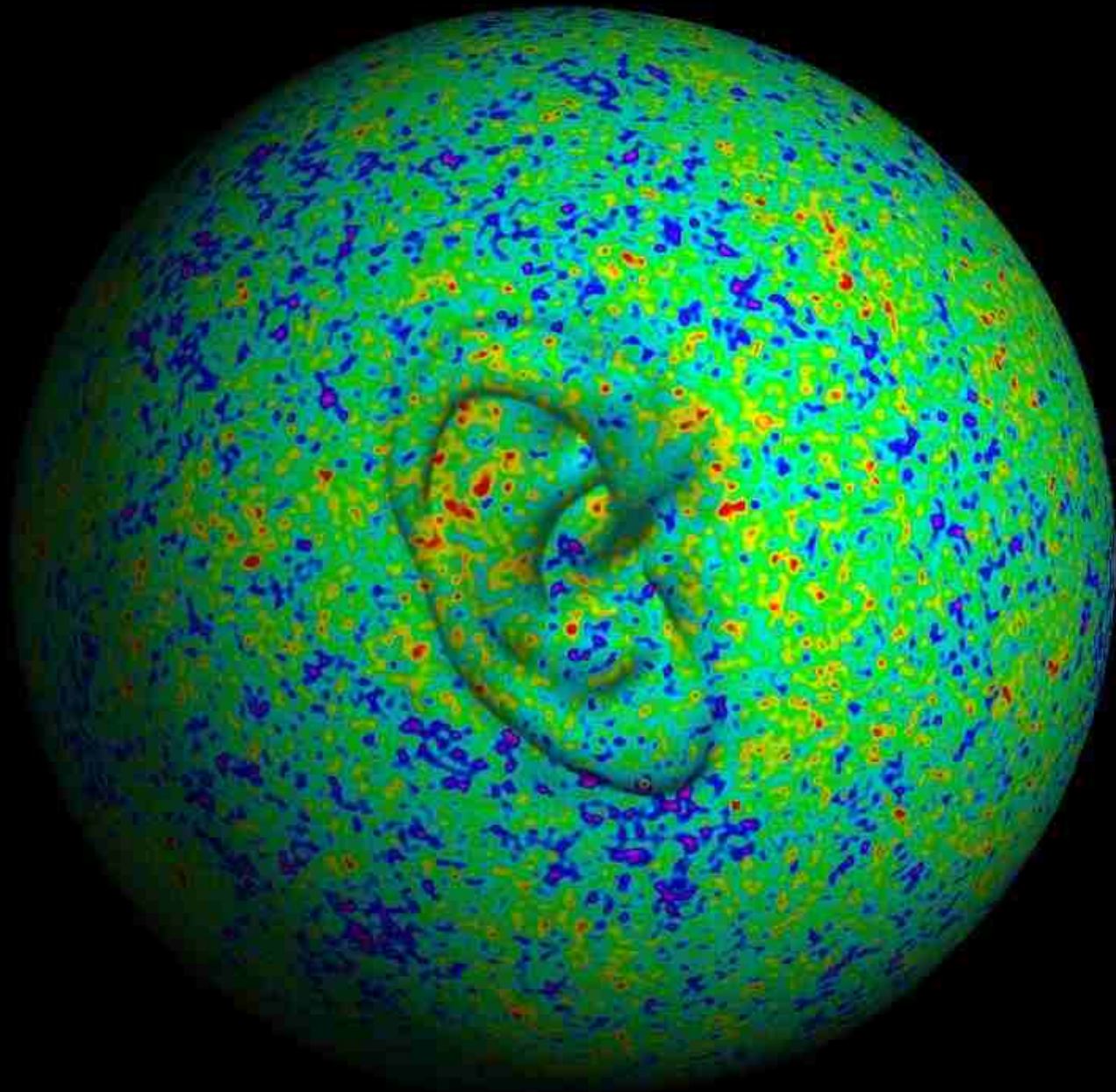






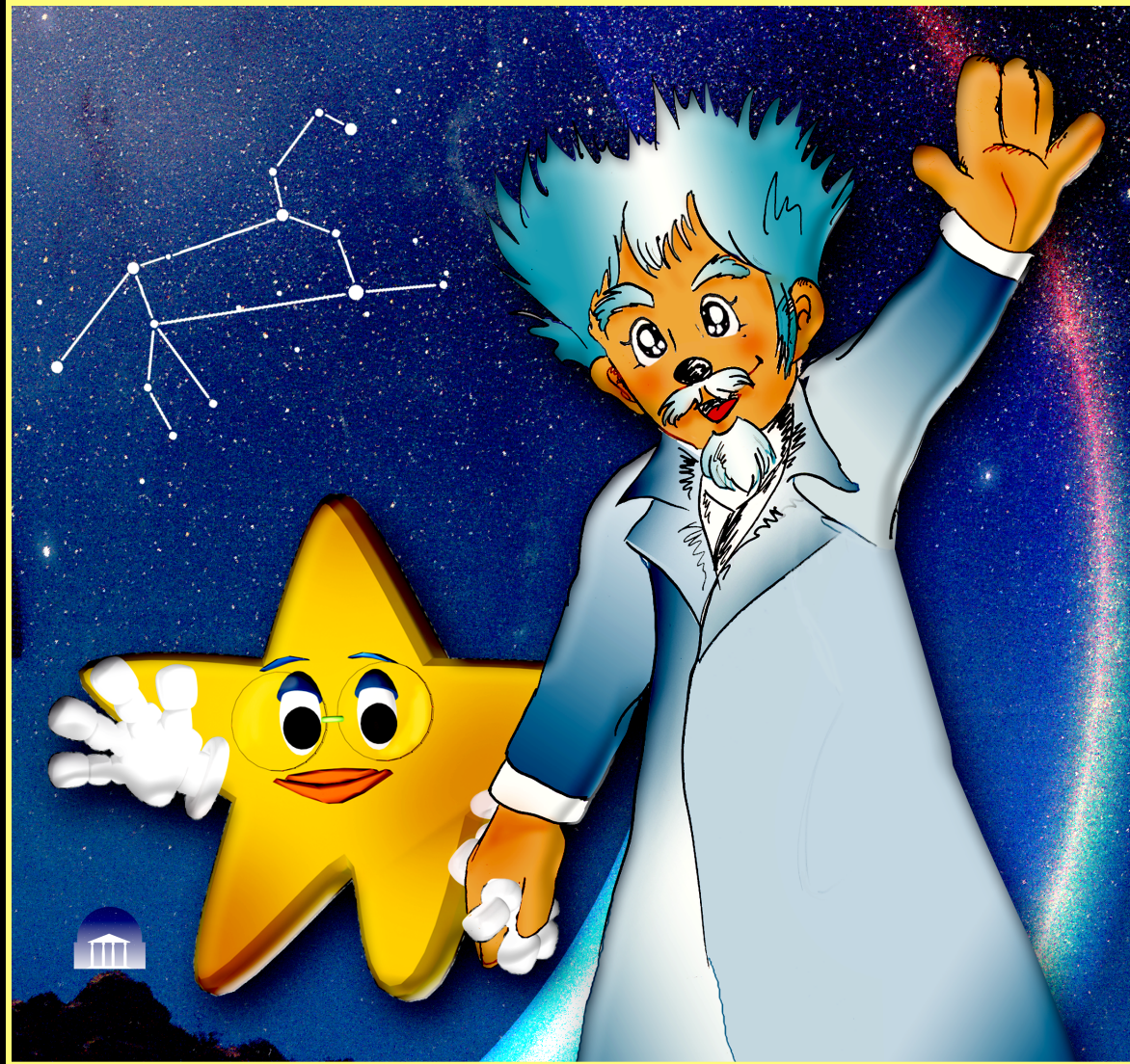






Mark Whittle (University of Virginia) **Big Bang Acoustic**

CIAO A TUTTI !



Fabio Peri

Fonti, approfondimenti, ringraziamenti...

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www.esa.int

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