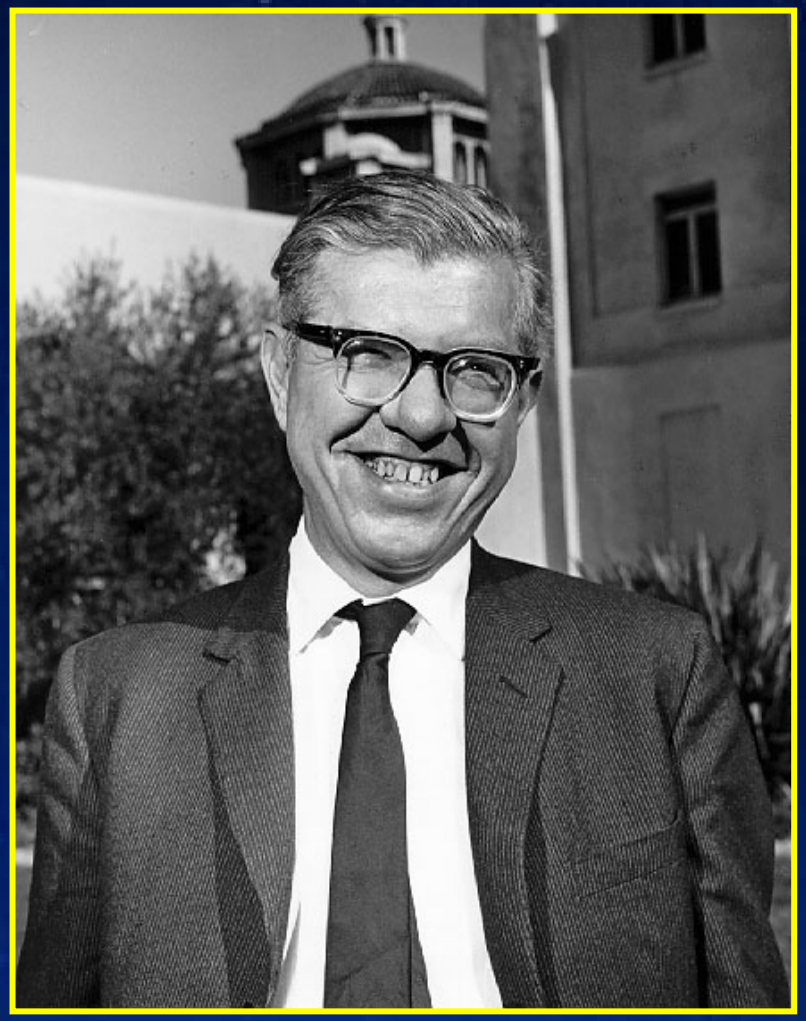
alla difficoltà di conciliare la sua teoria con le leggi di conservazione della fisica, Hoyle replicava:

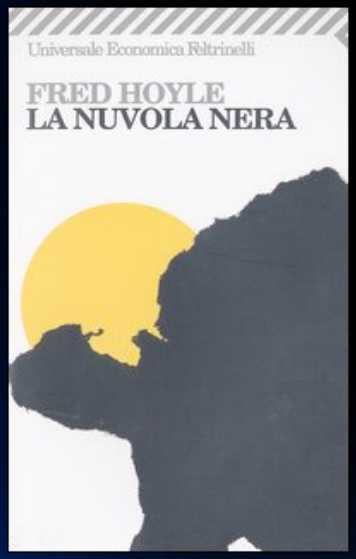
"Forse è paradossale. Ma non è ancora più paradossale l'idea che un bel sacco di roba, l'intero Universo, sia nato, in un attimo, dal niente?"

Elogio dello Stato Stazionario: Fred Hoyle e la sua Cosmologia

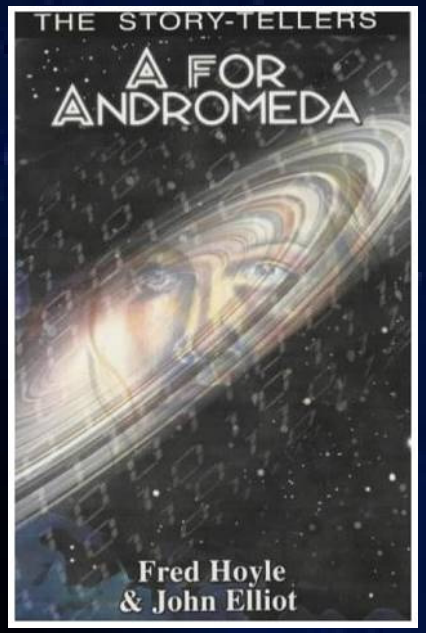
Alberto Buzzoni
INAF – Oss. Astronomico di Bologna



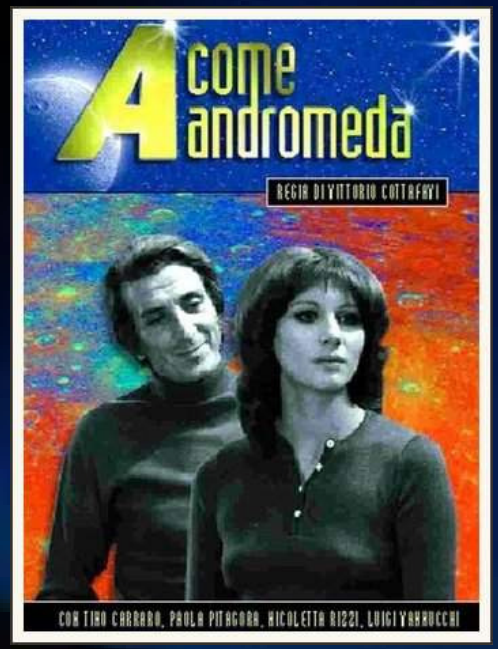
1957

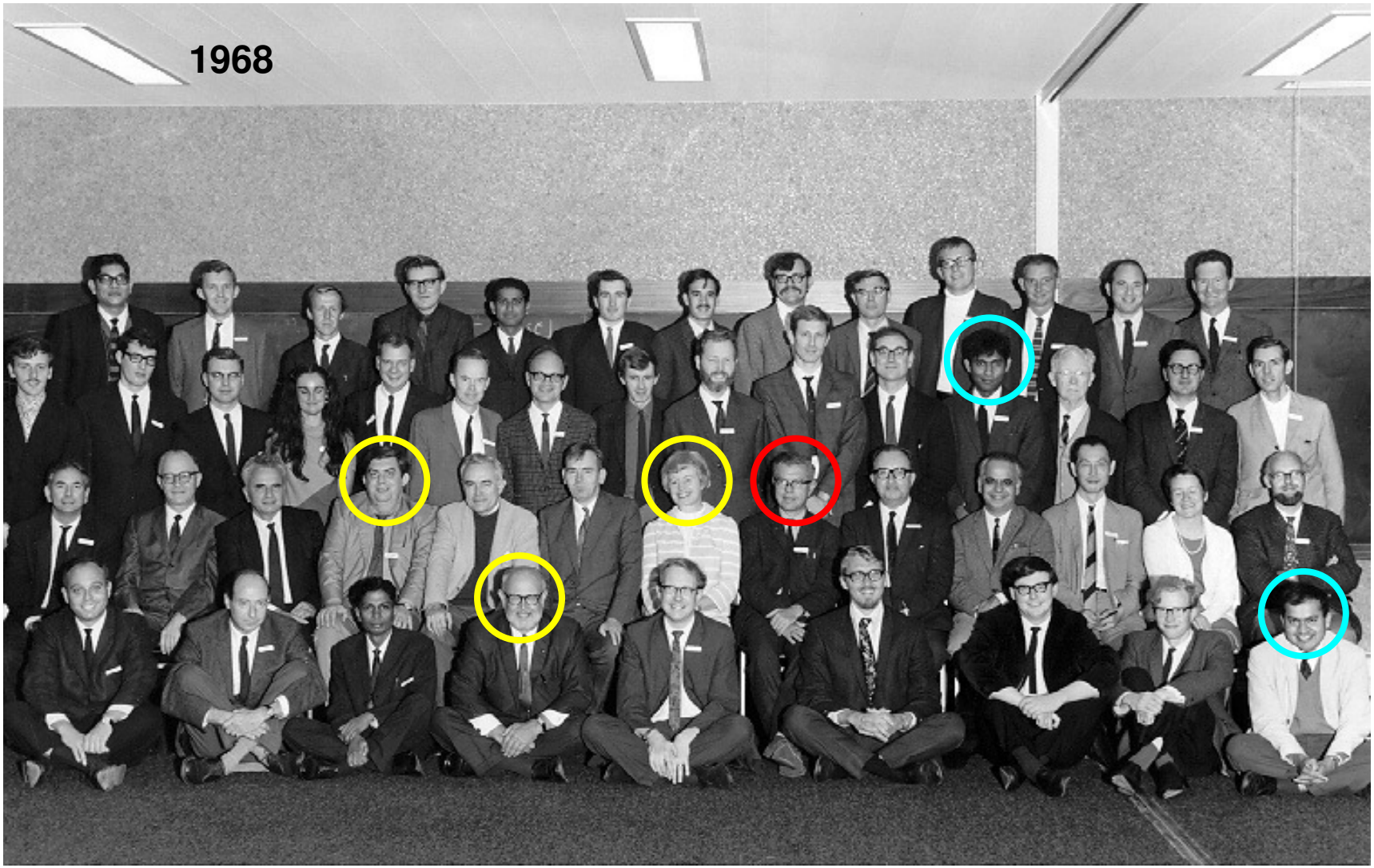


1962



1972





The Institute of Theoretical Astronomy summer conference in 1968 was on cosmic rays, and Hoyle drew many famous physicists to it. July 1968 in the IOTA conference room, Cambridge. Among the many famous faces are: Row 1: Ramaty (left); Meyer (2); Fowler (4); Clayton (6);Narlikar (right). Row 2: Sciama (left); Shapiro (2); Peters (3); Burbidge (4); Simpson (5), P. Fowler (6); Burbidge; Hoyle; McCrea(9); Hayakawa (11). Row 3: Fichtel (3rd); Trimble (4); Walker (5); Parker (6); Taylor (9); Pagel (11); Wickramasinghe (12); Wolfendale (14). Top Row: Price (2); Reeves (3); Rees (6); Arnett (8); Sargent (9); Wagoner (10); Bolton (11); Solomon (12).

B^{2}FH (1956)

5 October 1956, Volume 124, Number 3223 **SCIENCE**

Origin of the Elements in Stars

F. Hoyle, William A. Fowler,
G. R. Burbidge, E. M. Burbidge

Experimental (*1, 1a*) and observational (*2–6*) evidence has continued to accumulate in recent years in support of the theory (*7–10*) that the elements have been and are still being synthesized in stars. Since the appearance of a new and remarkable analysis by Suess and Urey (*11*) of the abundances of the elements, we have found it possible to explain, in a general way, the abundances of practically all the isotopes of the elements from hydrogen through uranium by synthesis in stars and supernovae. In this article we wish to outline in a qualitative fashion the essentially separate mechanisms which are required in stellar synthesis (*12*).

Thermal Conversion of Pure Hydrogen through Helium to Iron

As long as extremely high temperatures in excess of 5×10^9 degrees Kelvin are not under consideration, the general tendency of nuclear reactions inside stars is to increase the average binding energy per nucleon. For a given temperature and density and for a given time scale of op- in some cases by resonance penetration. Since barrier effects become less severe as the temperature increases, it follows that the binding energies increase with temperature. This will become clear from the following examples.

At temperatures from about 10^7 to 5×10^7 degrees in main-sequence stars, hydrogen is transformed to helium, $4H^1 \rightarrow He^4$, with an average binding energy of 7.07 million electron volts (Mev) per nucleon. We emphasize that the proton-proton sequence of reactions makes possible the production of helium starting only with hydrogen. The recent discovery of the free neutrino as reported by Cowan *et al.* (*1a*) leads to increased confidence in the existence of the primary proton-proton interaction which proceeds through prompt electron-neutrino emission. At temperatures from 10^8 to 2×10^8 degrees in red giant stars, He^4 is transformed principally to C^{12}, O^{16}, and Ne^{20} with an average binding energy of 7.98 Mev per nucleon. The important roles of the ground state of Be^8 and of the second excited state of C^{12} in expediting the primary process of helium fusion, $3He^4 \rightarrow C^{12}$, have recently been

appreciably greater atomic weight than Fe^{56}.

The situation, then, is that a thermal "cooking" of pure hydrogen yields principally He^4 and the α-particle nuclei with $A = 4n$, $Z = 2n$, $n = 3, 4, 5, 6, 7, 8, 9$, and 10 (C^{12} to Ca^{40}), to
centered around Fe^{56}.
abundant nuclei. Mor
abundances that hav
for these nuclei, and p
20-odd isotopes of tit
chromium, manganese
nickel, show good ag
served abundances. Th
rium calculations by
been considerably im
into account the low-l
of the iron-group nucle
active nuclei which u
them, and by statistica
state according to its
that expected on nu
Typical results for the
dances of the chro
3.8×10^9 degrees are in

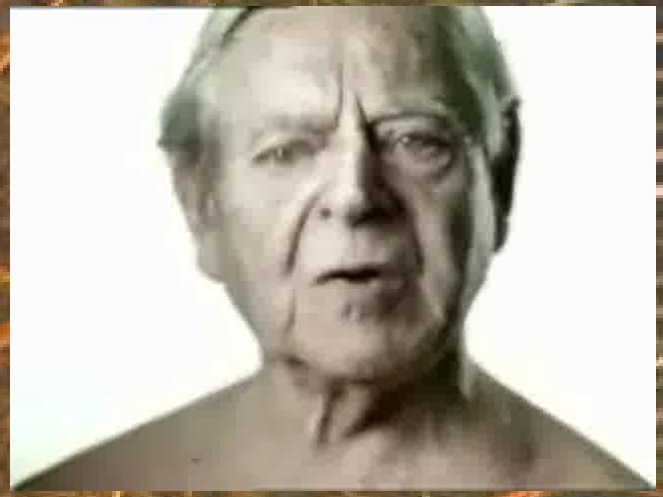
We regard results si
sented in Table 1 as giv
to the view that the el
sideration were synth
and that they became
tributed in space, eithe
from late-type giants
explosion, as for insta


Scanned at the American Institute of Physics

Thermal Reactions of ... and Helium with Lig...

More complicated ... the thermal cooking is considered, not of completely pure hydrogen, but of hydrogen adulterated with a small proportion of the elements mentioned in the previous paragraphs. When a second-genera-

Big Bang



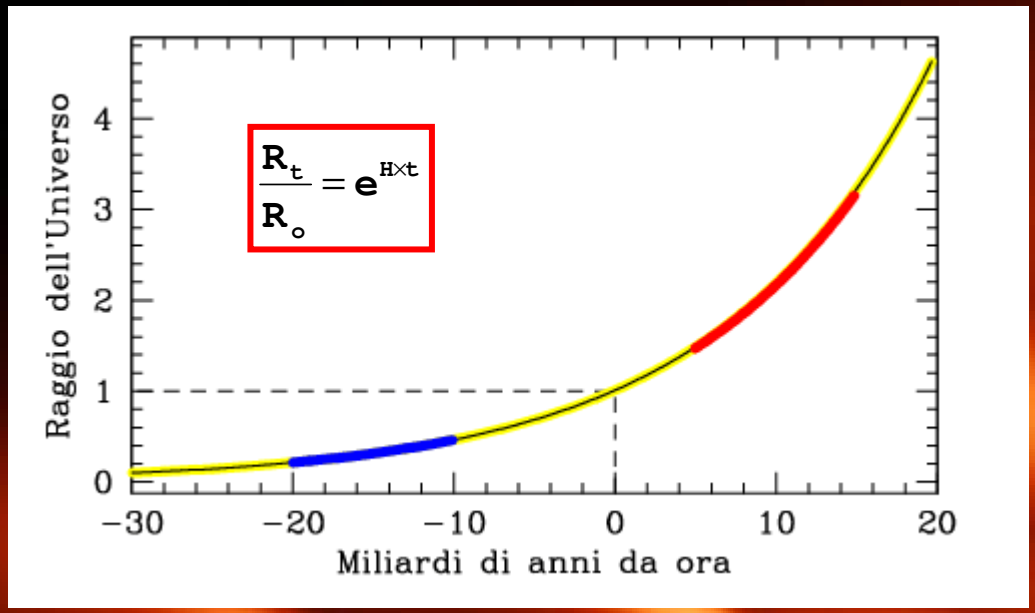
Hoyle

Time

"Every cluster of galaxies, every star, every atom had a beginning, but the universe itself did not"

"Ogni ammasso di galassie, ogni stella, ogni atomo ha avuto un inizio, ma non l'Universo"

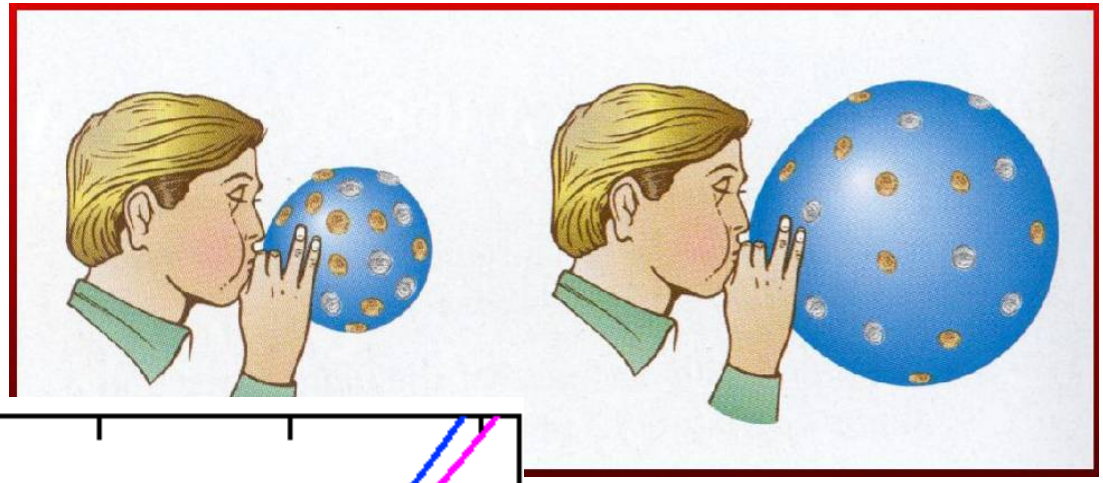
F. Hoyle

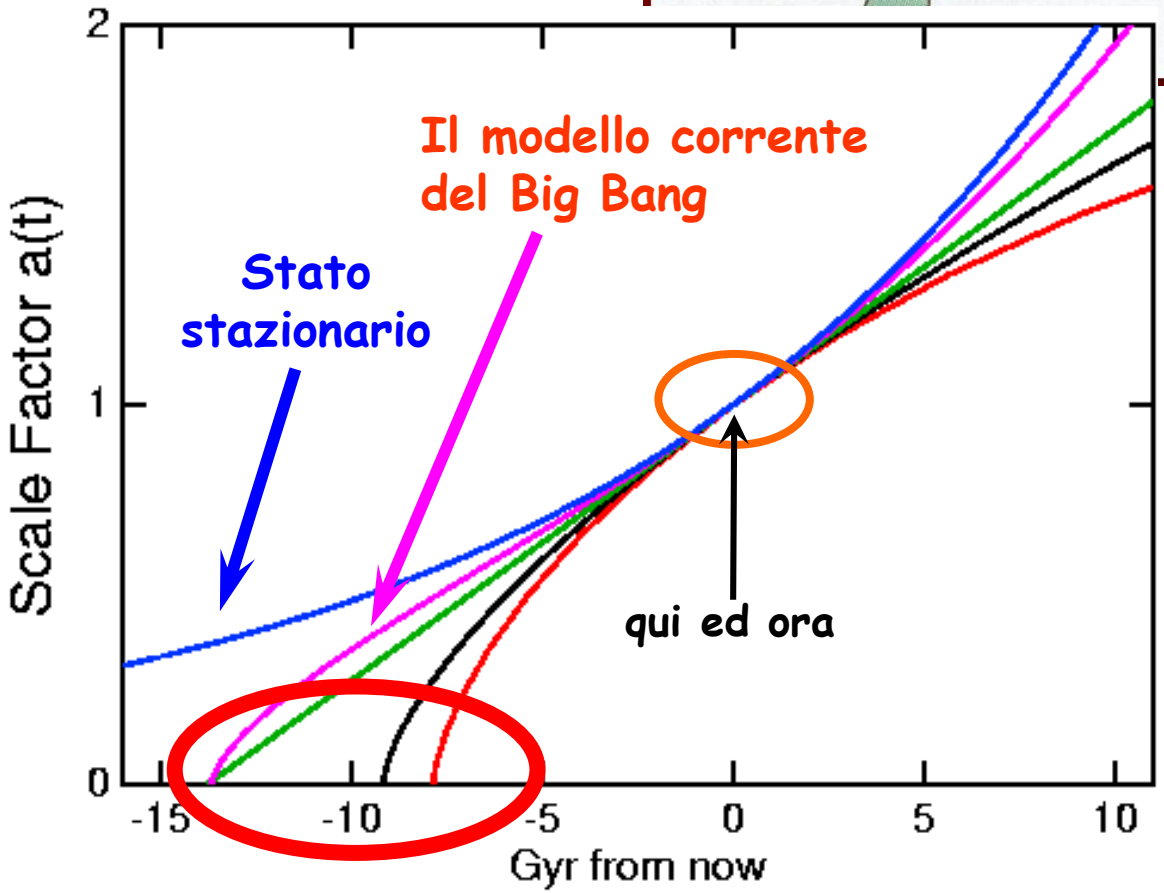


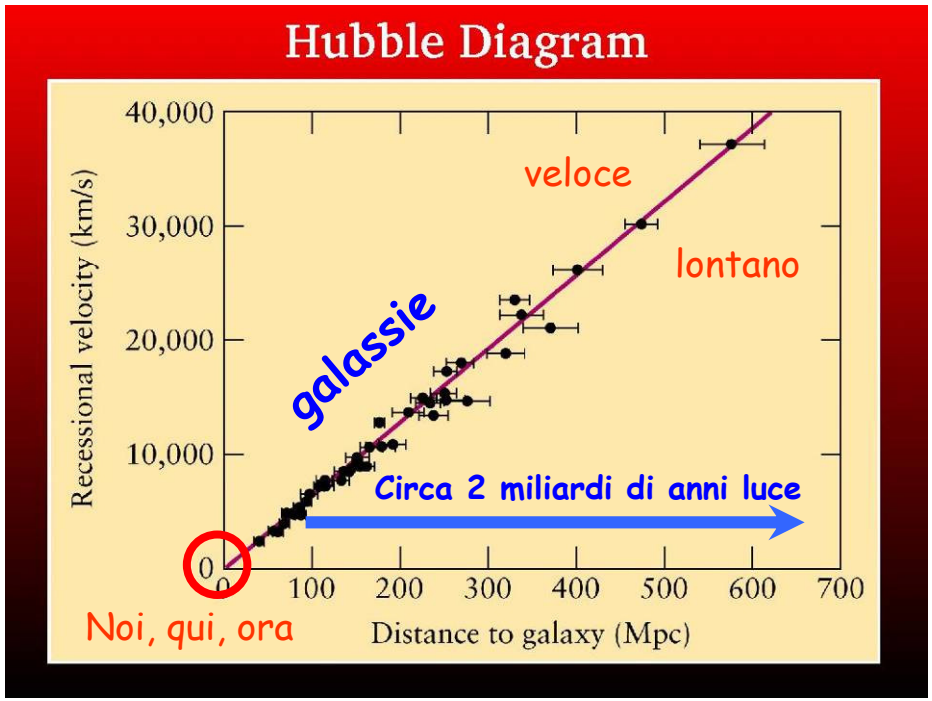
L'Universo "autoreplicante"

I cosmologi sono spesso in errore,…ma mai in dubbio.

Lev Landau







Il problema della metrica

H e' costante?

Hoyle: Si!

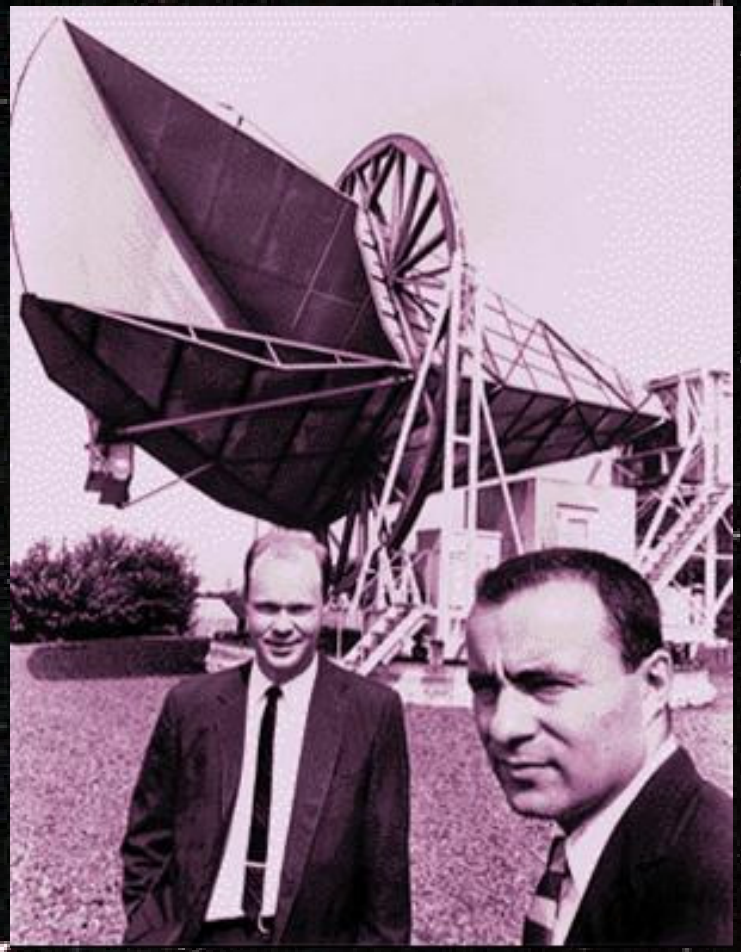
"gli altri": Nooo!

La radiazione di fondo (1964)

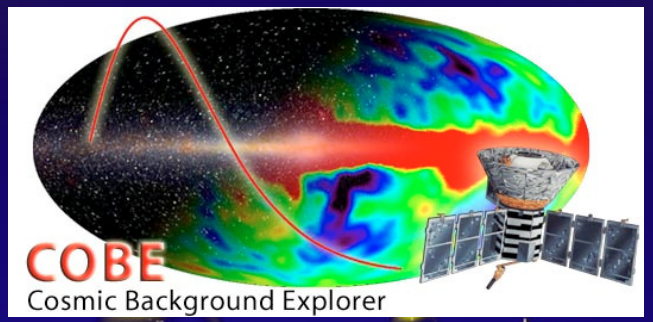
"Philosophically, I liked the steady-state cosmology. So I thought that we should report our results as a simple measurement; the measurement might be true after the cosmology was no longer true !"

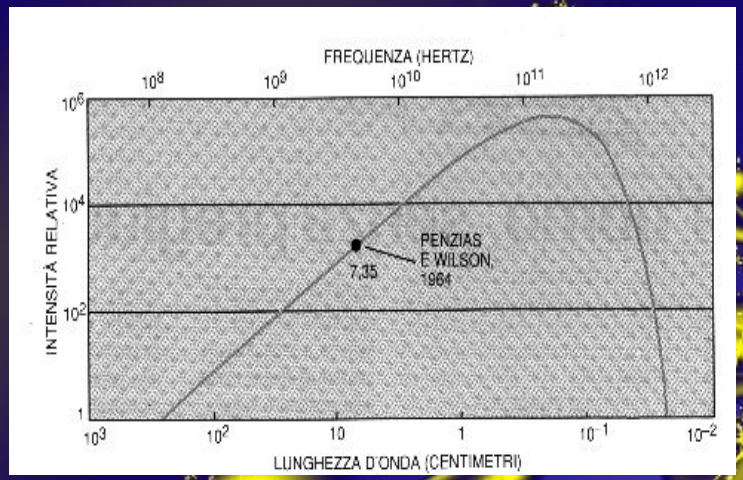
"Dal punto di vista filosofico, io ho sempre amato la cosmologia dello stato stazionario. Per questo ho sempre pensato che dovremmo considerare il nostro risultato semplicemente come una misura: dopotutto, una misura può essere corretta anche se la cosmologia finisse per non esserlo!"

R.W. Wilson (1990)

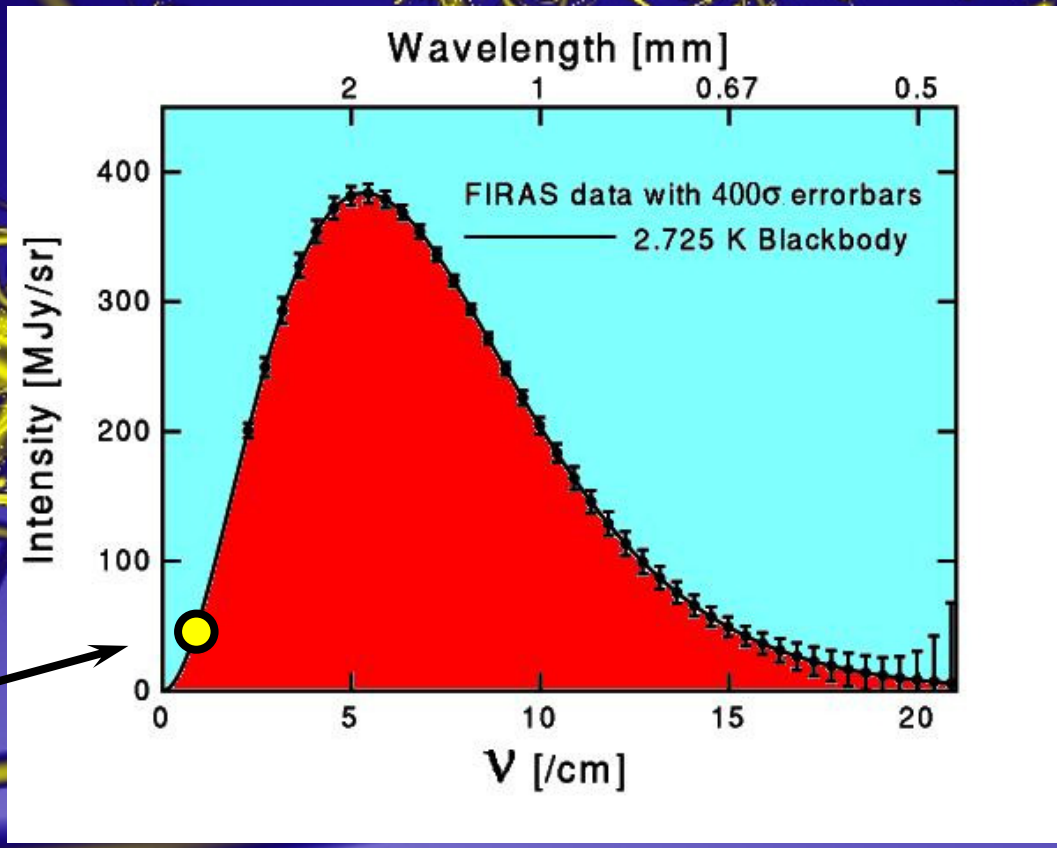


COBE
Cosmic Background Explorer (1989)



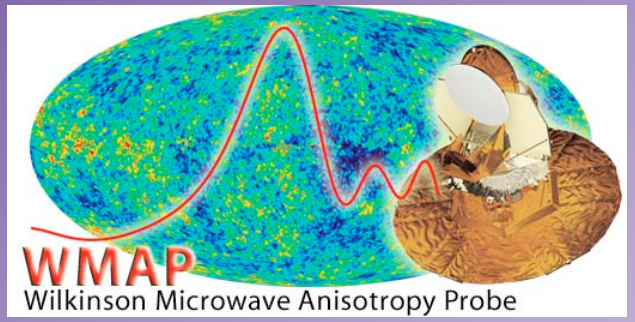


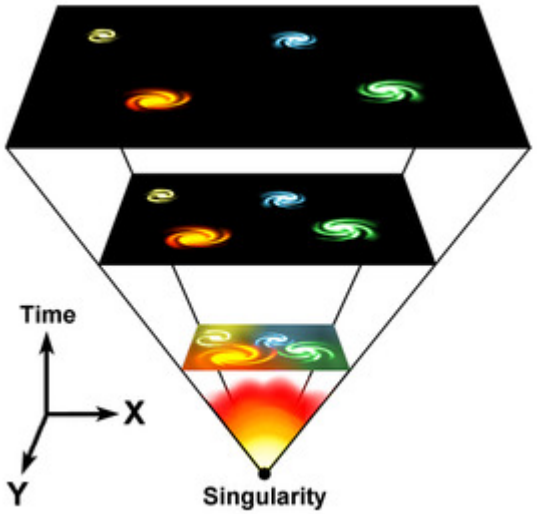
Penzias & Wilson

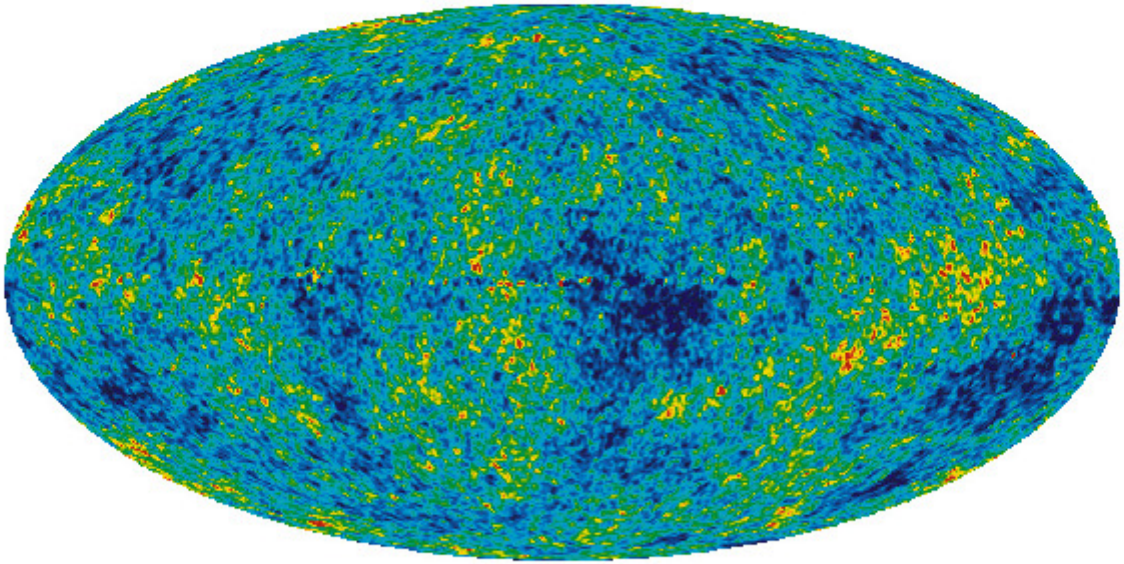


WMAP

Wilkinson Microwave Anisotropy Probe (2001)

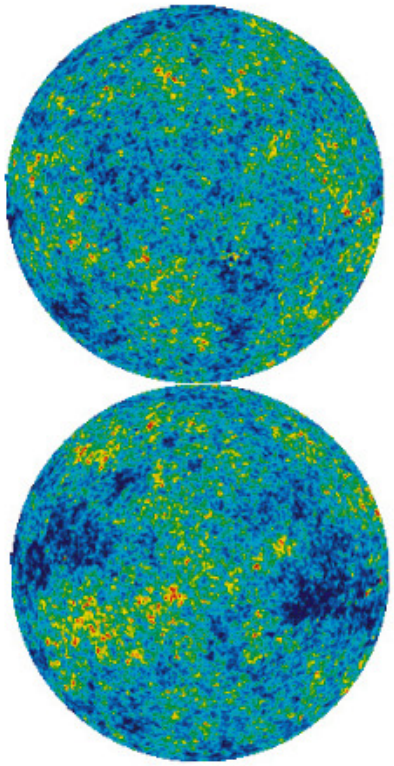




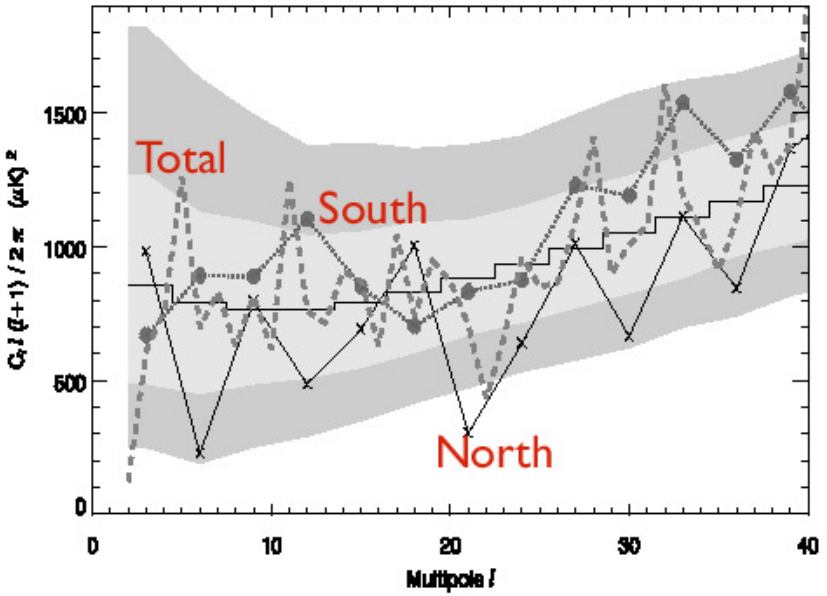


ILC map, WMAP collaboration

Strane (a)simmetrie...

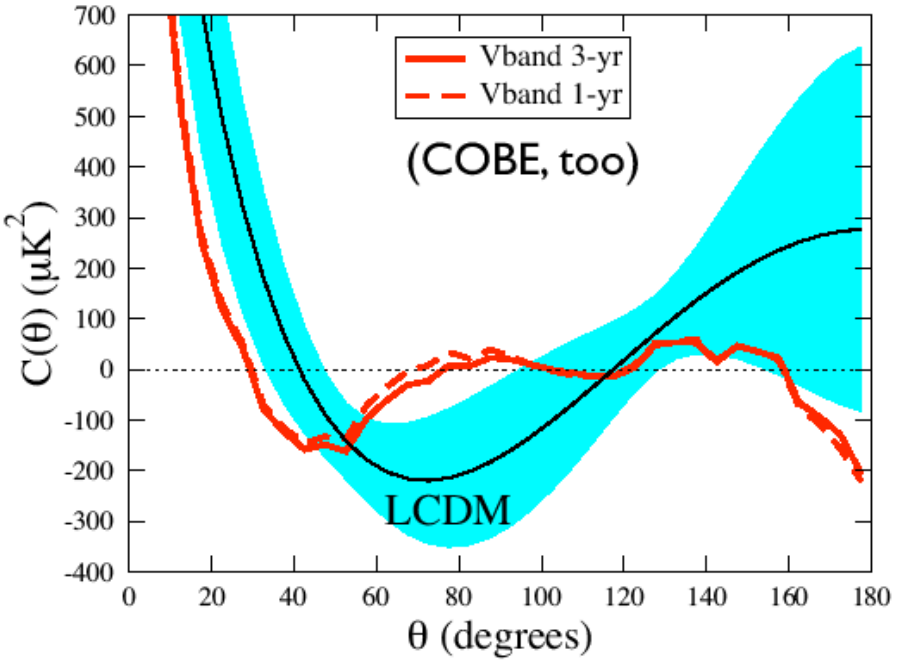


South (ecliptic) has more power than north



Eriksen et al 2004;
Hansen, Banday and Gorski 2004

Le strutture cosmiche su larga scala



Spergel et al 2003:
0.2% of simulations have less power at angles >60 deg

I primi dubbi... (2004)

PRL 93, 221301 (2004) PHYSICAL REVIEW LETTERS week ending 26 NOVEMBER 2004

Is the Low-ℓ Microwave Background Cosmic?

Dominik J. Schwarz,[1] Glenn D. Starkman,[1,2] Dragan Huterer,[2] and Craig J. Copi[2]
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(Received 26 March 2004; revised manuscript received 14 September 2004; published 23 November 2004)

The large-angle (low-ℓ) correlations of the cosmic microwave background exhibit several statistically significant anomalies compared to the standard inflationary cosmology. We show that the quadrupole plane and the three octopole planes are far more aligned than previously thought (99.9% C.L.). Three of these planes are orthogonal to the ecliptic at 99.1% C.L., and the normals to these planes are aligned at 99.6% C.L. with the direction of the cosmological dipole and with the equinoxes. The remaining octopole plane is orthogonal to the supergalactic plane at 99.6% C.L.

DOI: 10.1103/PhysRevLett.93.221301 PACS numbers: 98.70.Vc

Much effort is currently being devoted to examining the cosmic microwave background (CMB) temperature anisotropies measured with the Wilkinson Microwave Anisotropy Probe (WMAP) [1–4] and other CMB experiments [5]. While the data are regarded as a dramatic confirmation of standard inflationary cosmology, anomalies exist. In particular the correlations at large angular separations, or low ℓ, exhibit several peculiarities.

Most prominent among the "low-ℓ anomalies" is the near vanishing of the two-point angular correlation function $C(\theta)$ at angular separations greater than about 60 degrees. This was first measured using the Cosmic Background Explorer's differential microwave radiometer [6] and recently confirmed by observations with WMAP [4]. This anomalous lack of large-angle correlation is connected to the low value of the quadrupole contribution C_2 in a spherical harmonic expansion of the CMB sky—

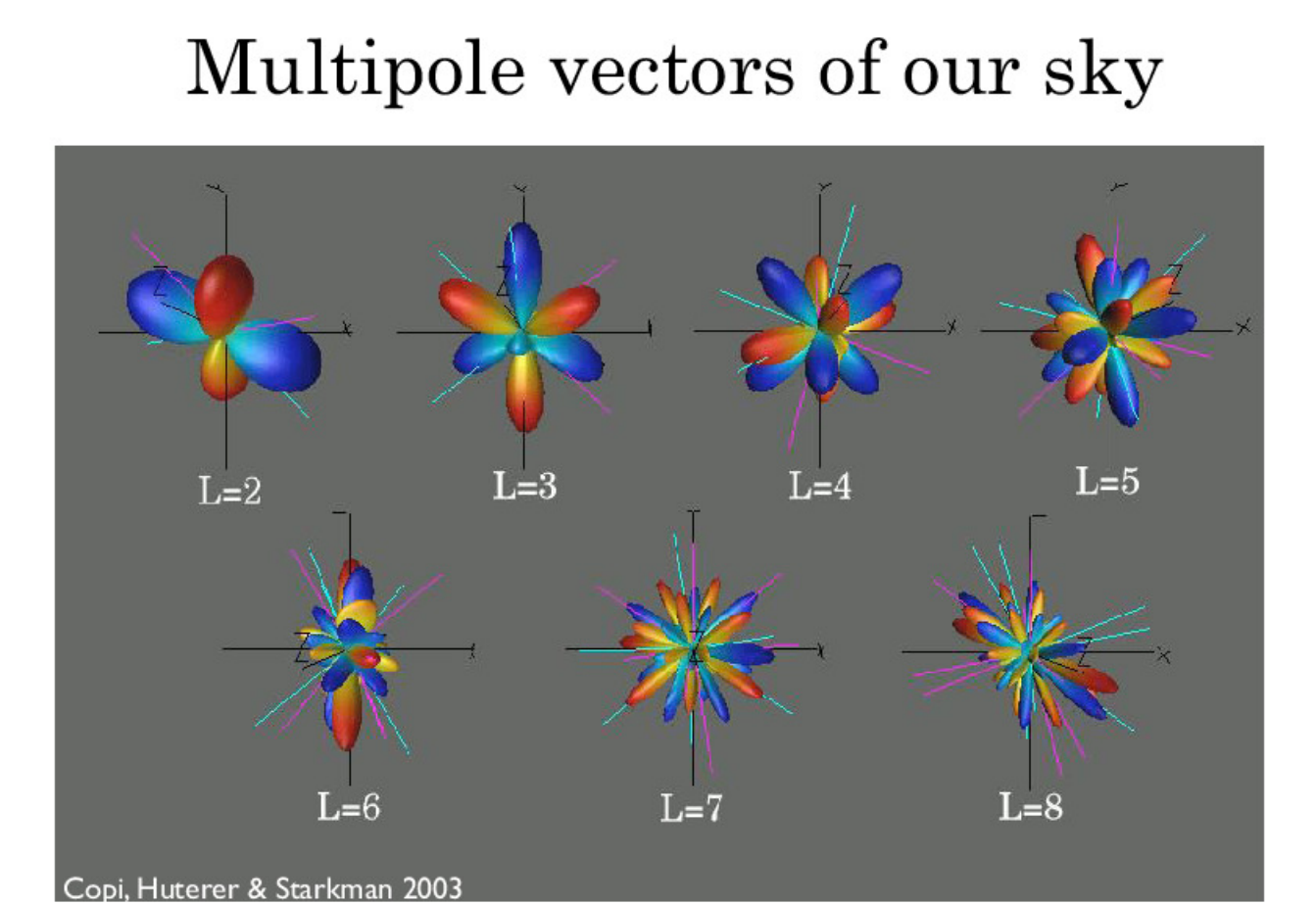
$$\Delta T(\theta,\phi) \equiv \sum_{\ell=1}^{\infty} T_\ell \equiv \sum_{\ell=1}^{\infty} \sum_{m=-\ell}^{\ell} a_{\ell m} Y_{\ell m}(\theta,\phi) \quad (1)$$

[with $(2\ell+1)C_\ell = \sum_m |a_{\ell m}|^2$]—although the smallness of C_2 does not fully account for the shape of $C(\theta)$. The and octopole are maximized are unusually aligned, $|\mathbf{n_2}\cdot\mathbf{n_3}| = 0.9838$. Eriksen *et al.* [11] found that the deficit in large-scale power is due to a systematic deficit in power between $\ell = 2$ and 40 in the north ecliptic hemisphere compared to the south ecliptic hemisphere. Some of us [12] have shown that the $\ell = 4$ to 8 multipoles exhibit an odd, but very unlikely (~1% probability), correlation with $\ell = 2$ and $\ell = 3$. These low-ℓ anomalies (and others [13]) have all been pointed out before, but no simple connection has been made between them. Here we remedy that situation.

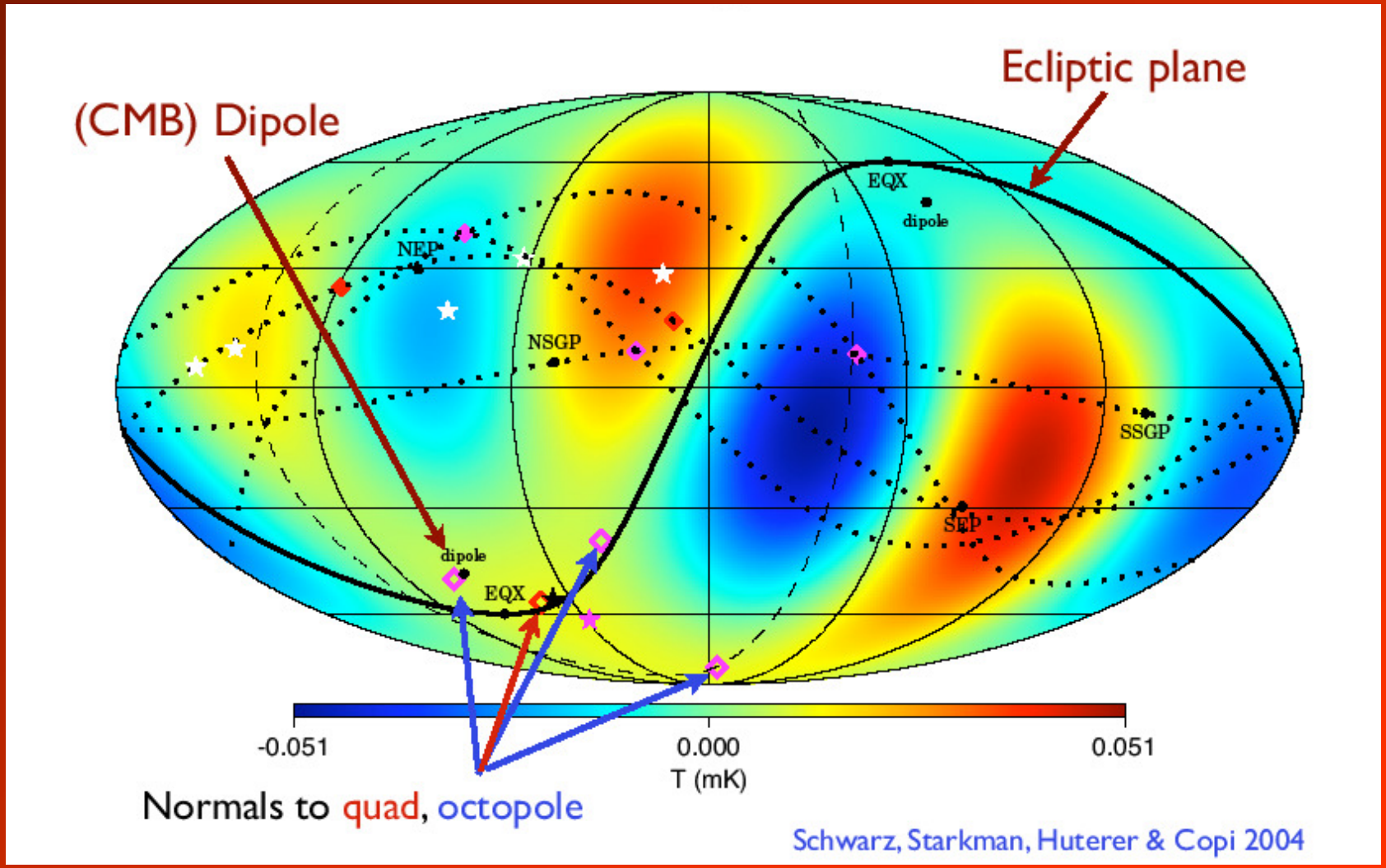
By far the largest signal in the CMB anisotropy is the dipole, recently measured by WMAP [1] to be (3.346 ± 0.017) mK in the direction $(l = 263.85° \pm 0.1°,\ b = 48.25° \pm 0.04°)$ in galactic coordinates. This is caused by the motion of the Sun with respect to the rest frame defined by the CMB. As shown by Peebles and Wilkinson [14], the dipole induced by a velocity v is $\bar{T}(v/c)\cos\theta$, where θ is measured from the direction of motion. Given $\bar{T} = (2.725 \pm 0.002)$ K [15], one infers that $v \simeq 370$ km/s.

The solar motion also implies [14,16,17] the presence of a kinematically induced Doppler quadrupole (DQ). To second order in $\beta \equiv v/c \simeq 10^{-3}$, an observer moving with respect to the CMB rest frame sees the usual mono-

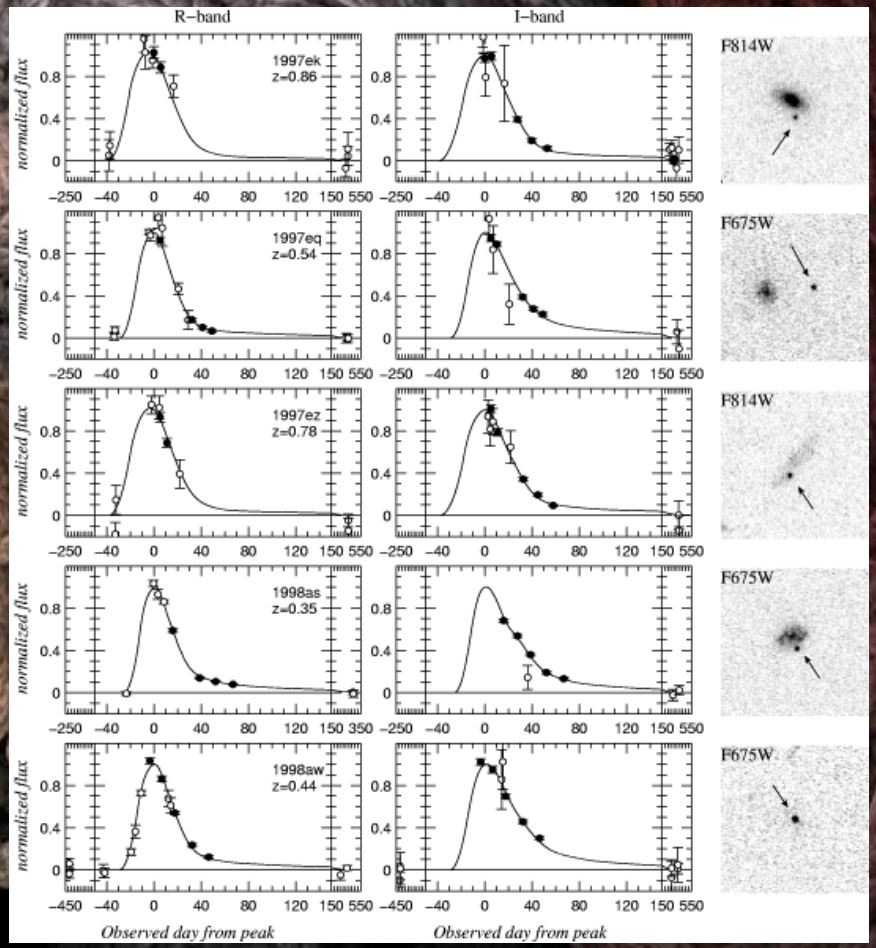
Il problema dei Multipoli e il loro orientamento



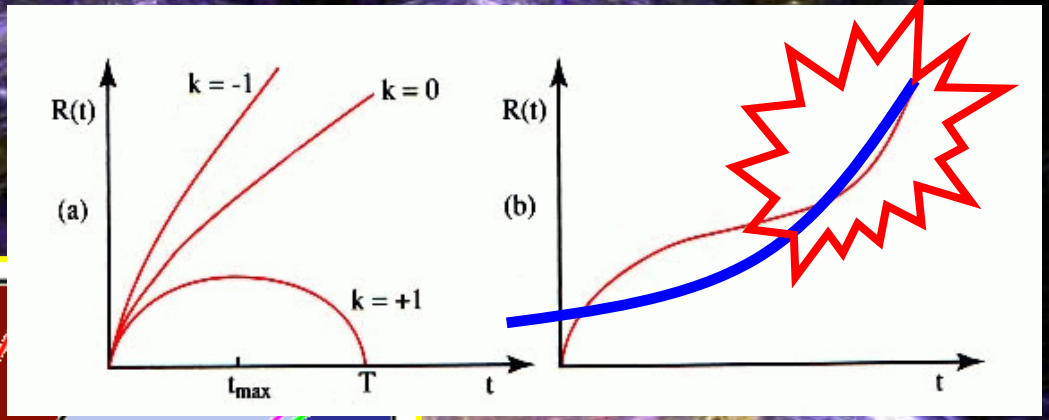
Congiura "cosmica"?



Le Supernovae e l'Universo "accelerato" (2003)



I risultati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k = 0
k = +1
(a)
t_{max}
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t
R(t)
(b)
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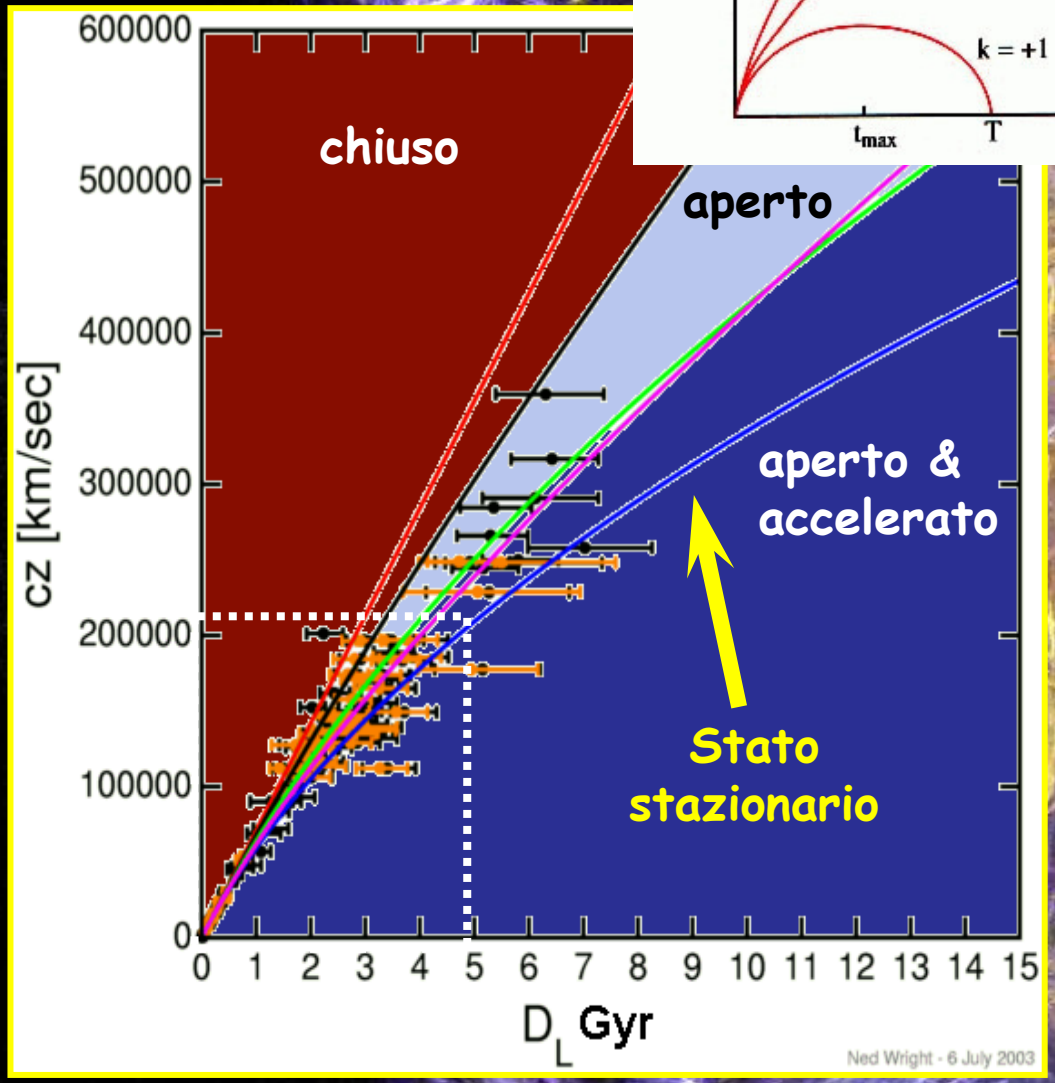
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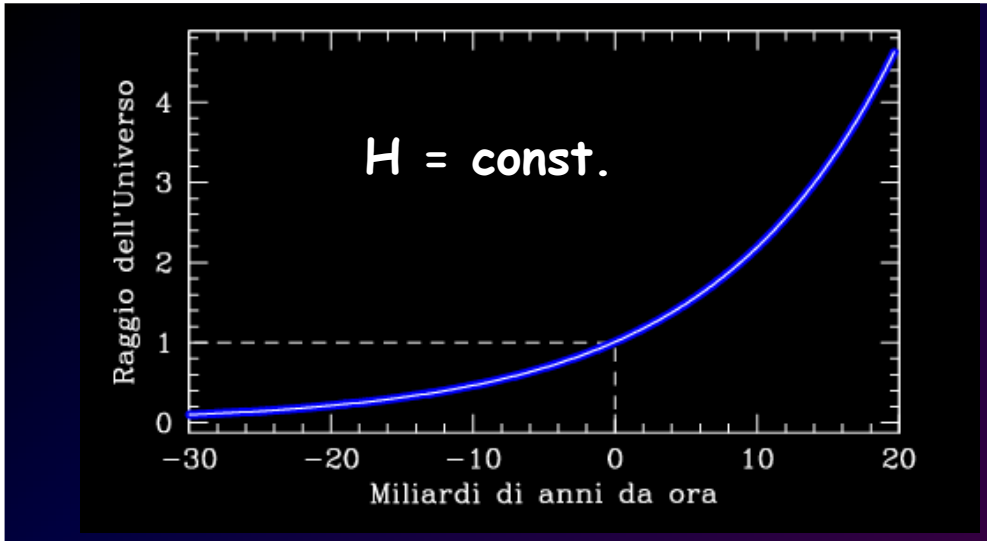
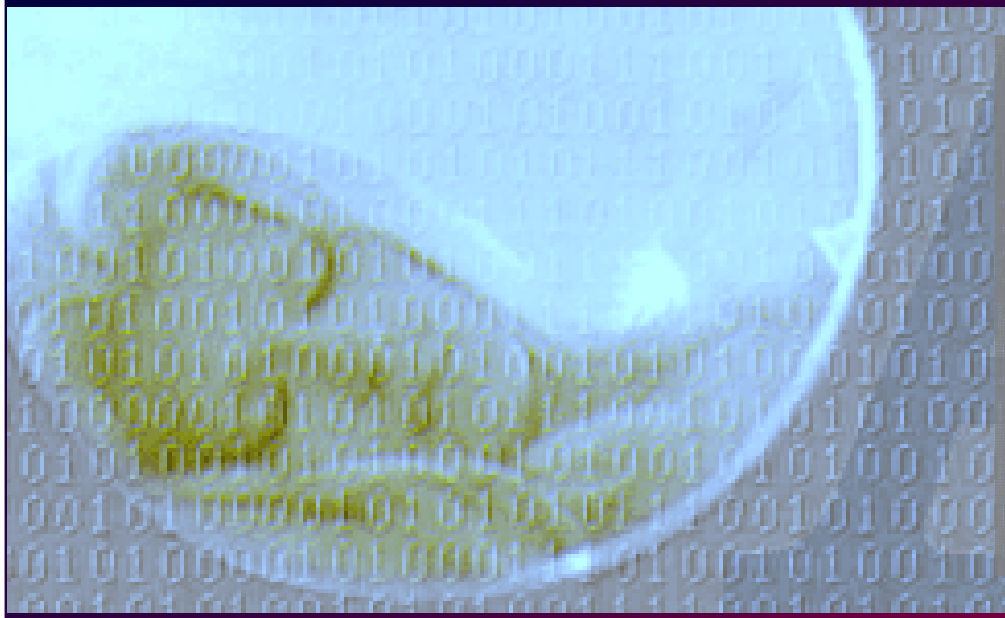
Ned Wright - 6 July 2003





"Lo spazio non e' poi cosi' remoto. E' giusto a un'ora di macchina da qui,... se solo la vostra auto potesse scalare il cielo"

F. Hoyle

Credits:

·La musica di "A come Andromeda" e' del Mo. Mario Migliardi

·Fonti iconografiche: Hoyle's commemorative site at www.hoyle.org.uk, Clemson University photo archive (USA) at www.astro.clemson.edu, Emilio Segre' visual archive at photos.aip.org