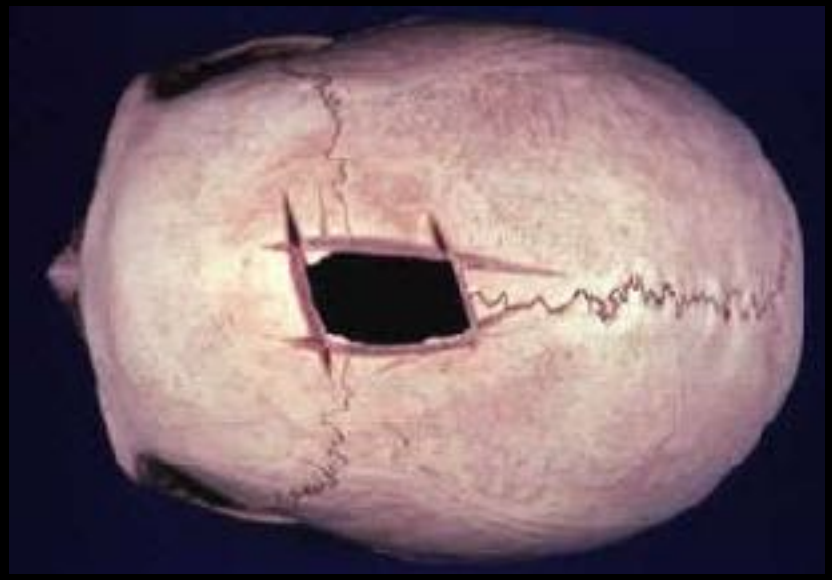
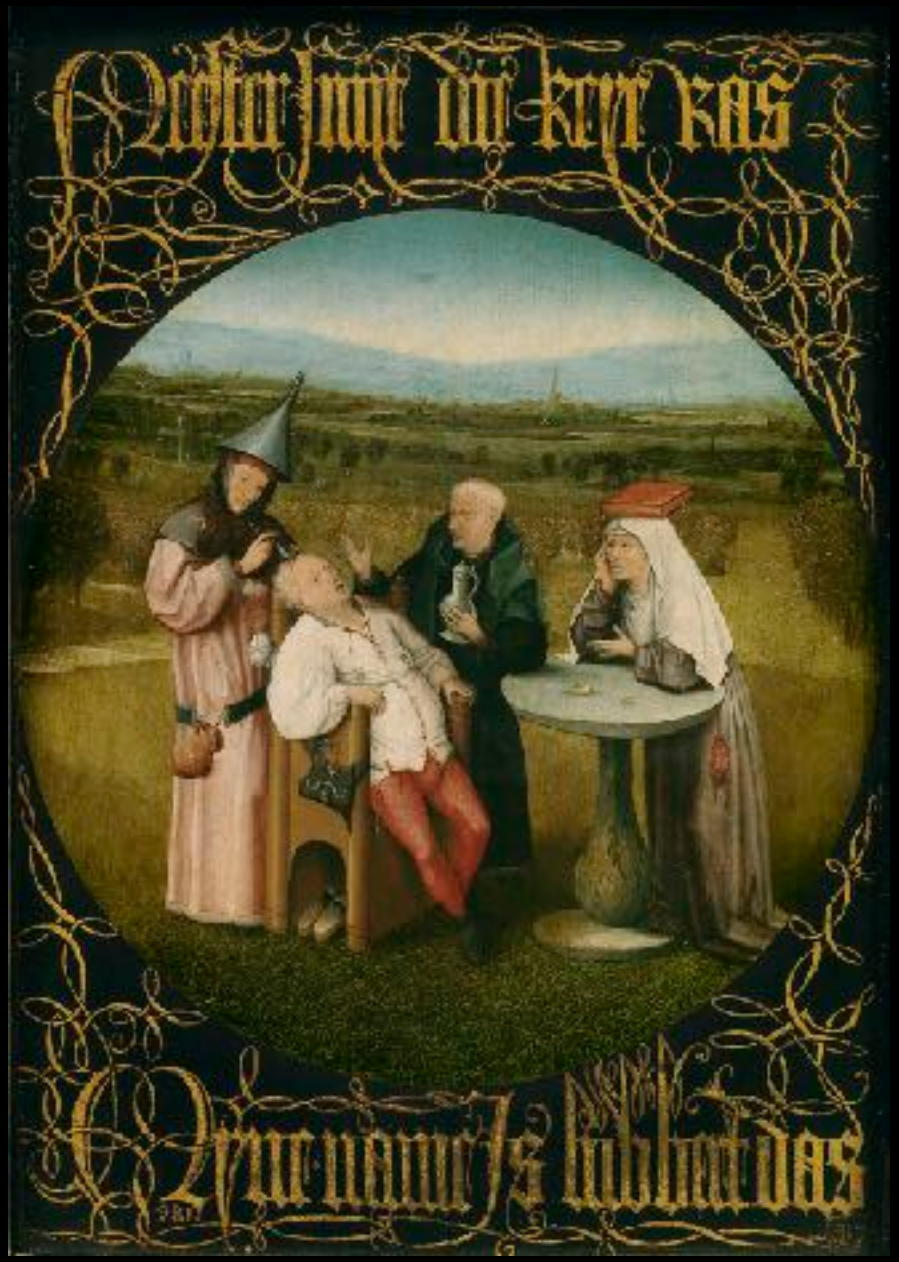
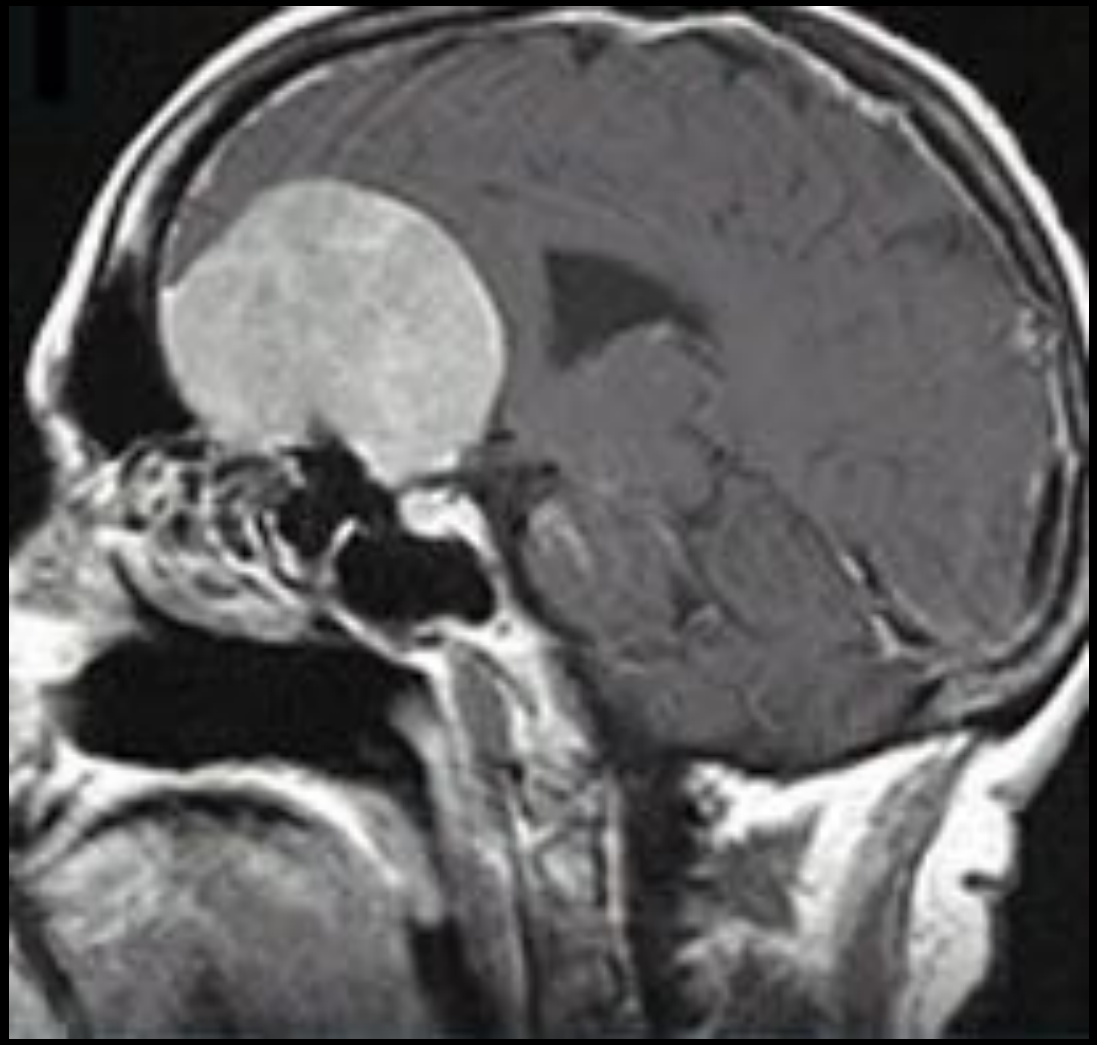
Ancient Egyptians Description &Treatment of Head Injuries
XVII century B.C.
“Edwin Smith Papyrus”

Trapanazione del cranio Maya (Sud America)







Management of Subarachnoid Hemorrhage in Two Important Italian Political Leaders: A Paradigm of Ethical and Technological Evolution of Neurosurgery During the Past Half-Century

Pierluigi Longatti[1], Ermanno Giombelli[2], Giacomo Pavesi[3], Alessandro Carteri[1], Alberto Feletti[3]

Key words
- Cerebral aneurysm
- History of neurosurgery
- Italian
- Neurosurgery evolution
- Political leaders
- SAH

Abbreviations and Acronyms
MCA: Middle cerebral artery
SAH: Subarachnoid hemorrhage

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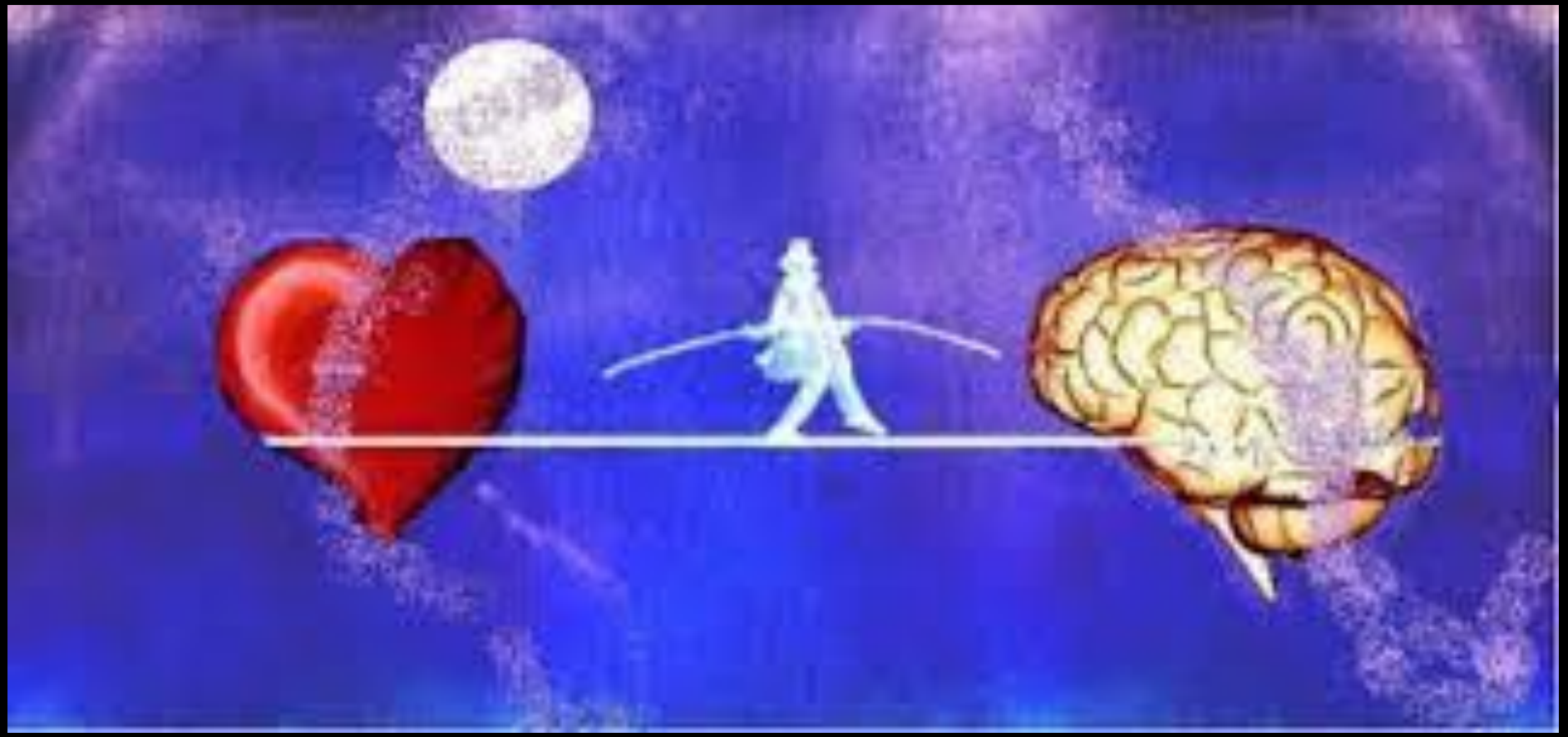
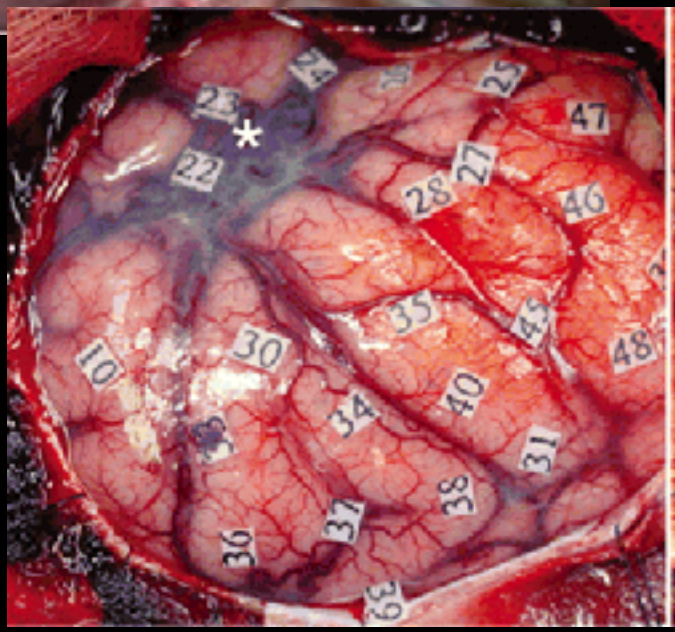
Alberto Feletti, M.D., Ph.D.
(E-mail: alberto.feletti@gmail.com)

For a curious and extraordinary coincidence, 5 of the 7 most relevant leaders of the Italian Communist Party (Partito Comunista Italiano, which was established in 1921, has been the biggest Communist Party in Western Countries) suffered a cerebral stroke. Cerebrovascular diseases afflicted also Stalin and Lenin, and a number of Presidents of the United States.

We present the stories of 2 important Italian political leaders who shared both the leadership role of the major left Italian Party and the dramatic experience of a subarachnoid hemorrhage. Retracing their medical incidents, separated by 50 years of history, we show how a fatal medical disease has become neurosurgical and successfully cured thanks to the advances of neurosurgery, neuroradiology, and hospital organization. A neurologic disease that was disgraceful 50 years ago has lost any disquieting and embarrassing significance in the present time to the light of evolution of vascular neurosurgery.

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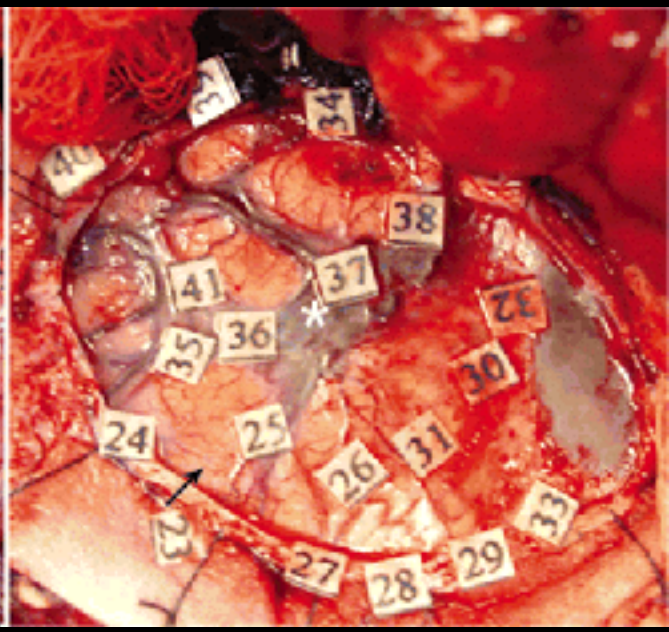
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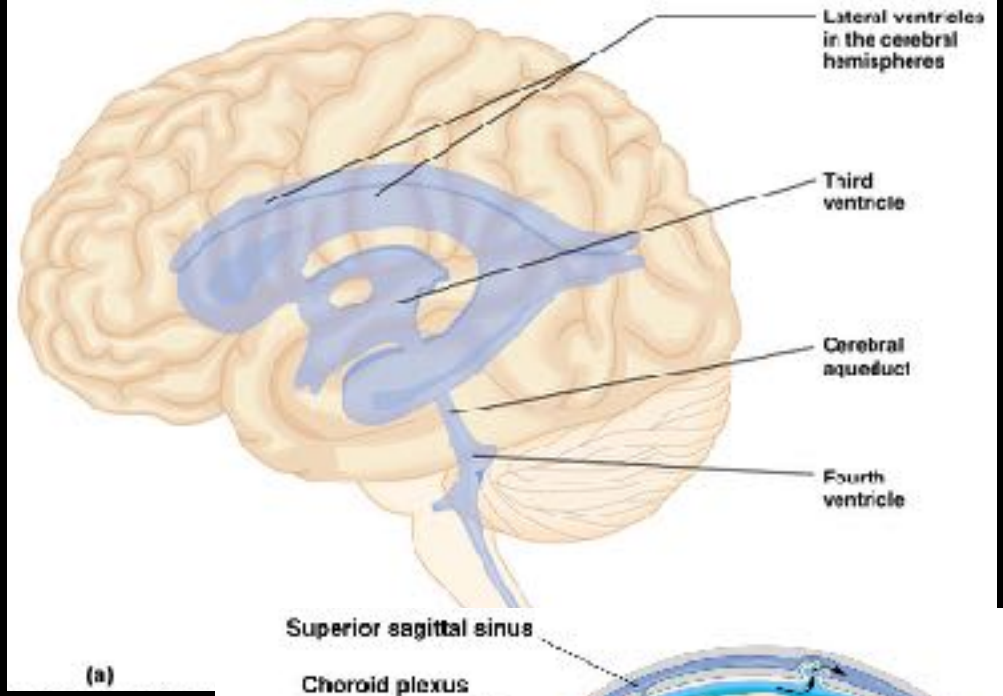
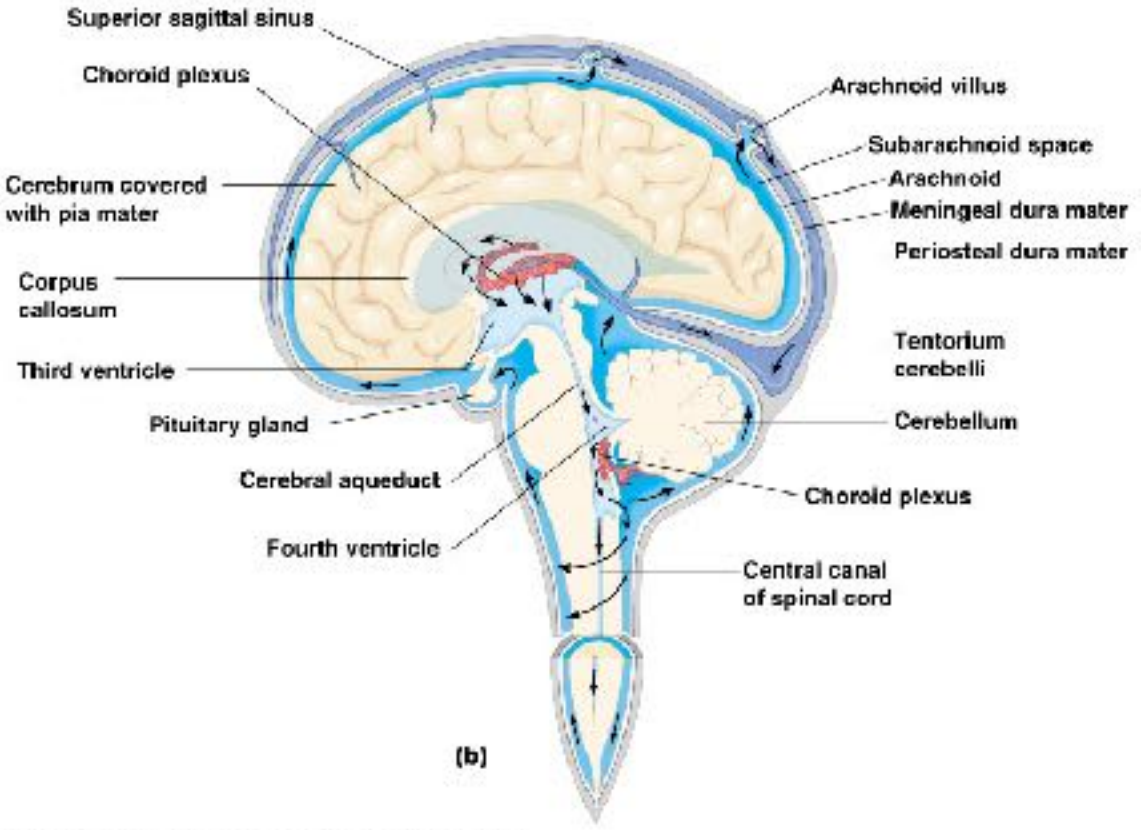
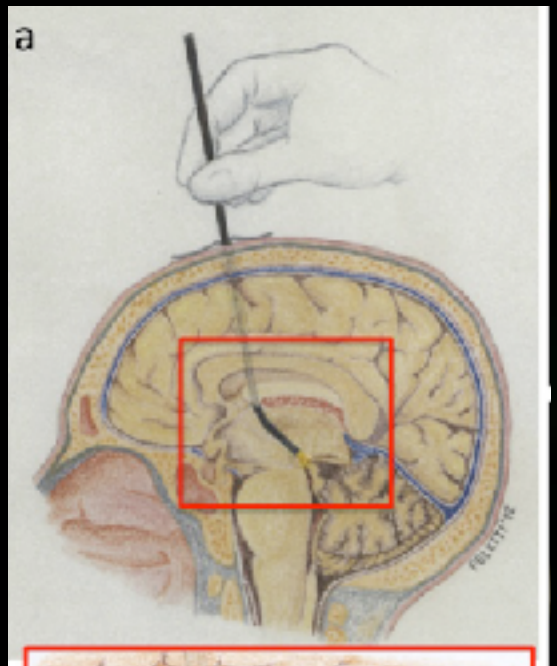
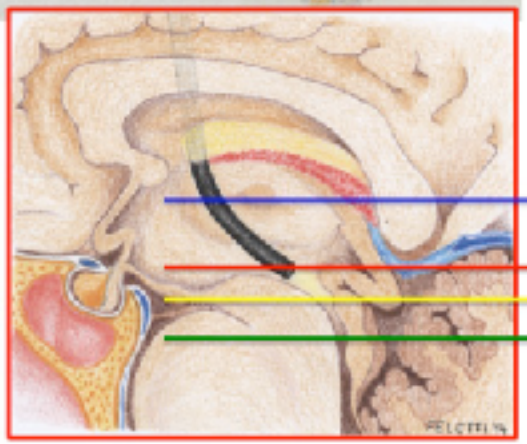

Lateral ventricles in the cerebral hemispheres
Third ventricle
Cerebral aqueduct
Fourth ventricle
(a)

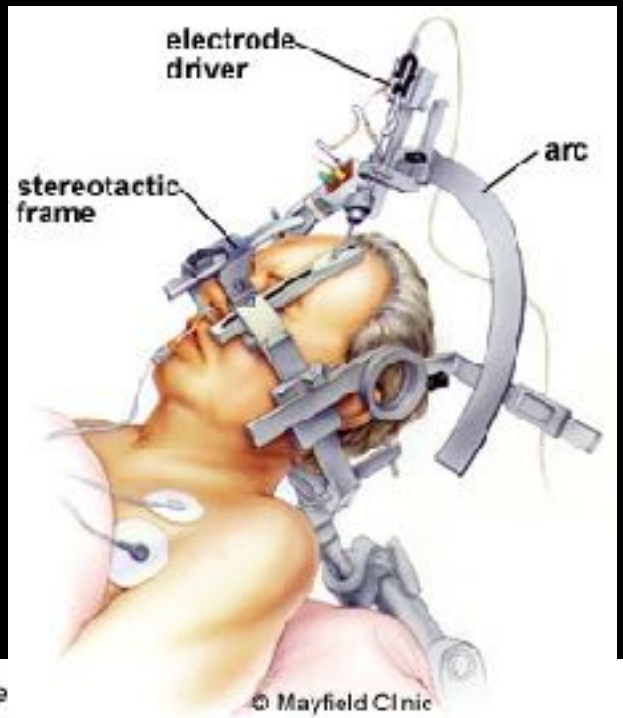

Superior sagittal sinus
Choroid plexus
Arachnoid villus
Subarachnoid space
Arachnoid
Meningeal dura mater
Periosteal dura mater
Cerebrum covered with pia mater
Corpus callosum
Tentorium cerebelli
Third ventricle
Pituitary gland
Cerebellum
Cerebral aqueduct
Choroid plexus
Fourth ventricle
Central canal of spinal cord
(b)

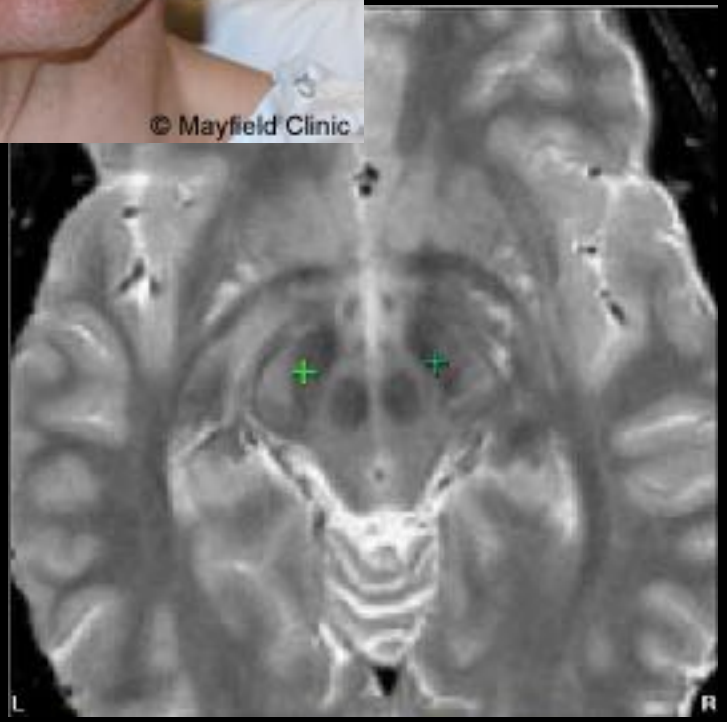

a

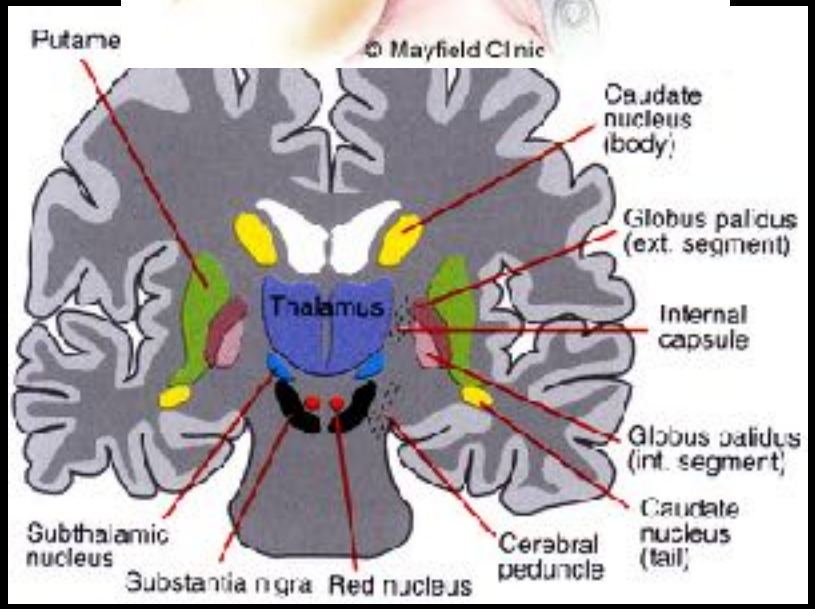

b
c
d
e


Neurochirurgia
Funzionale

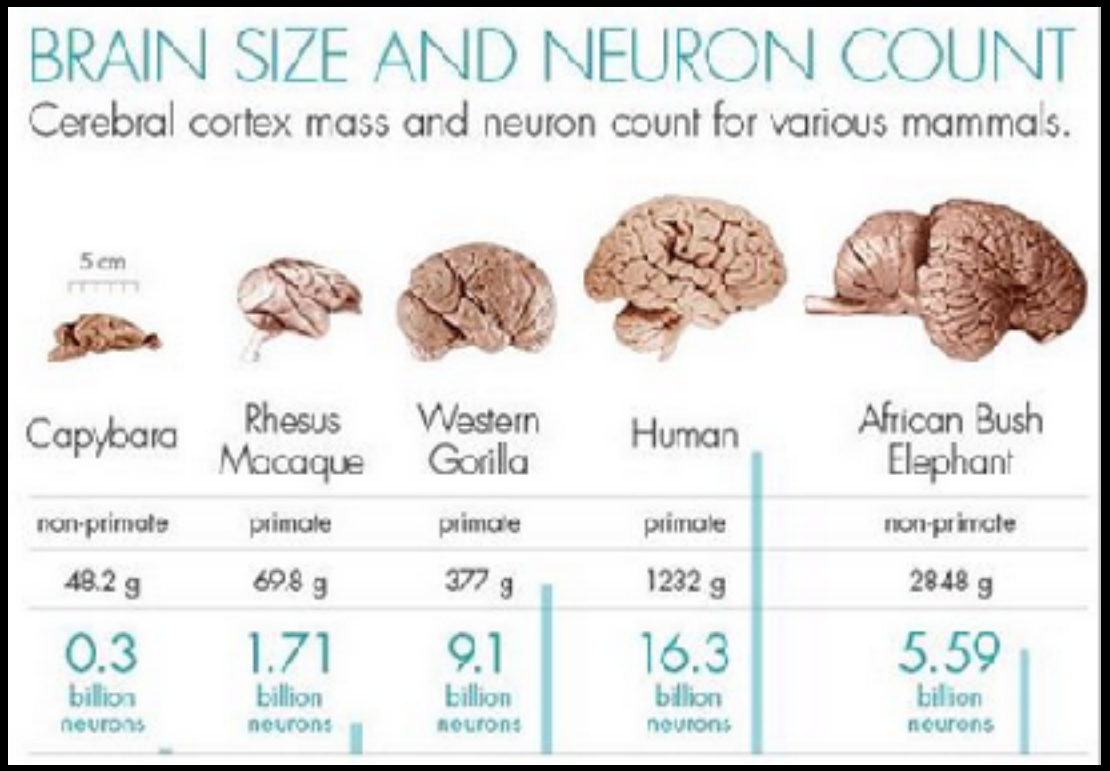

© Mayfield Clinic


electrode driver
arc
stereotactic frame
© Mayfield Clinic


L
R

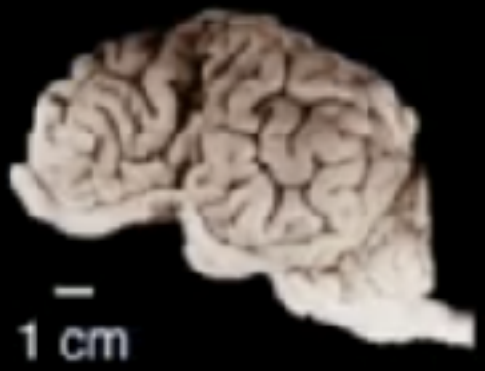

Putame
Caudate nucleus (body)
Globus pallidus (ext. segment)
Thalamus
Internal capsule
Globus pallidus (int. segment)
Caudate nucleus (tail)
Subthalamic nucleus
Substantia nigra
Red nucleus
Cerebral peduncle

I cervelli dei mammiferi sono fatti allo stesso modo?



Numero di neuroni proporzionale alle dimensioni del cervello

I cervelli dei mammiferi sono fatti allo stesso modo?

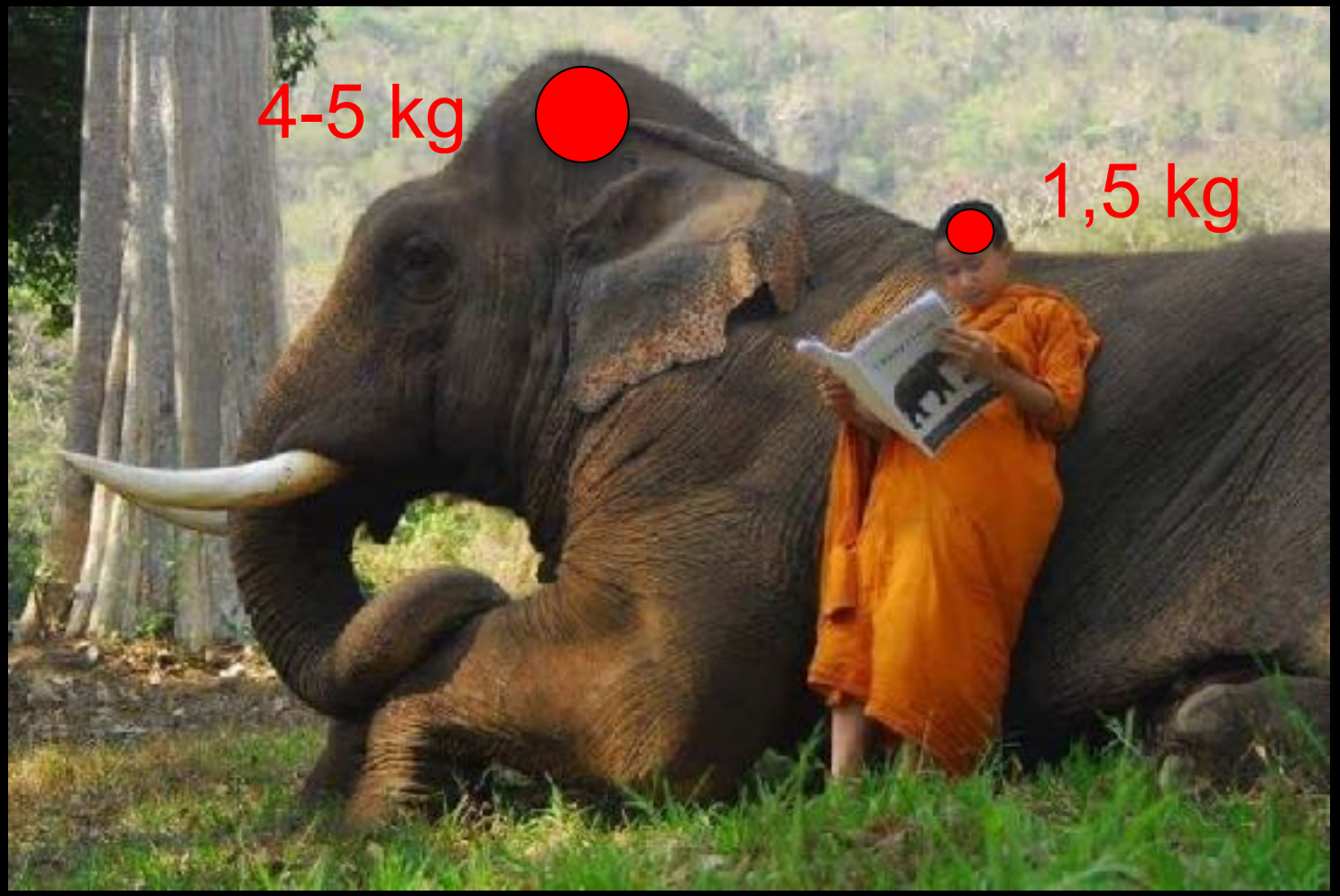


400g

I cervelli dei mammiferi sono fatti allo stesso modo?

NON CORRETTO

I cervelli dei mammiferi sono fatti allo stesso modo?



Uomo: corpo 70 kg

cervello 1,5 kg

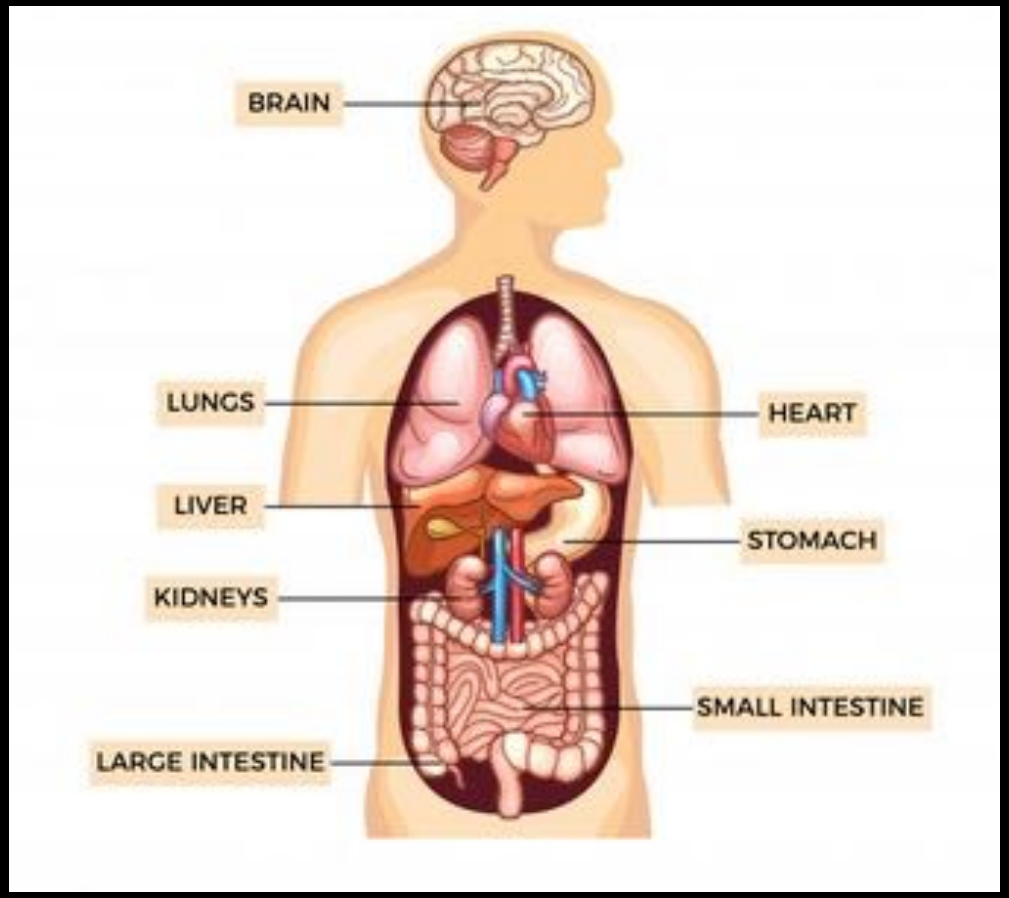
Gorilla: corpo 140-210 kg

cervello 0,5 kg

Cervello e energia

Peso: 2% del peso corporeo

Energia: 25% dell'energia corporea (500kCal/giorno)



I cervelli dei mammiferi NON sono fatti allo stesso modo

Grandi roditori

Primati

Il cervello umano

86 miliardi di neuroni

16 miliardi nella corteccia cerebrale

Herculano-Houzel S.

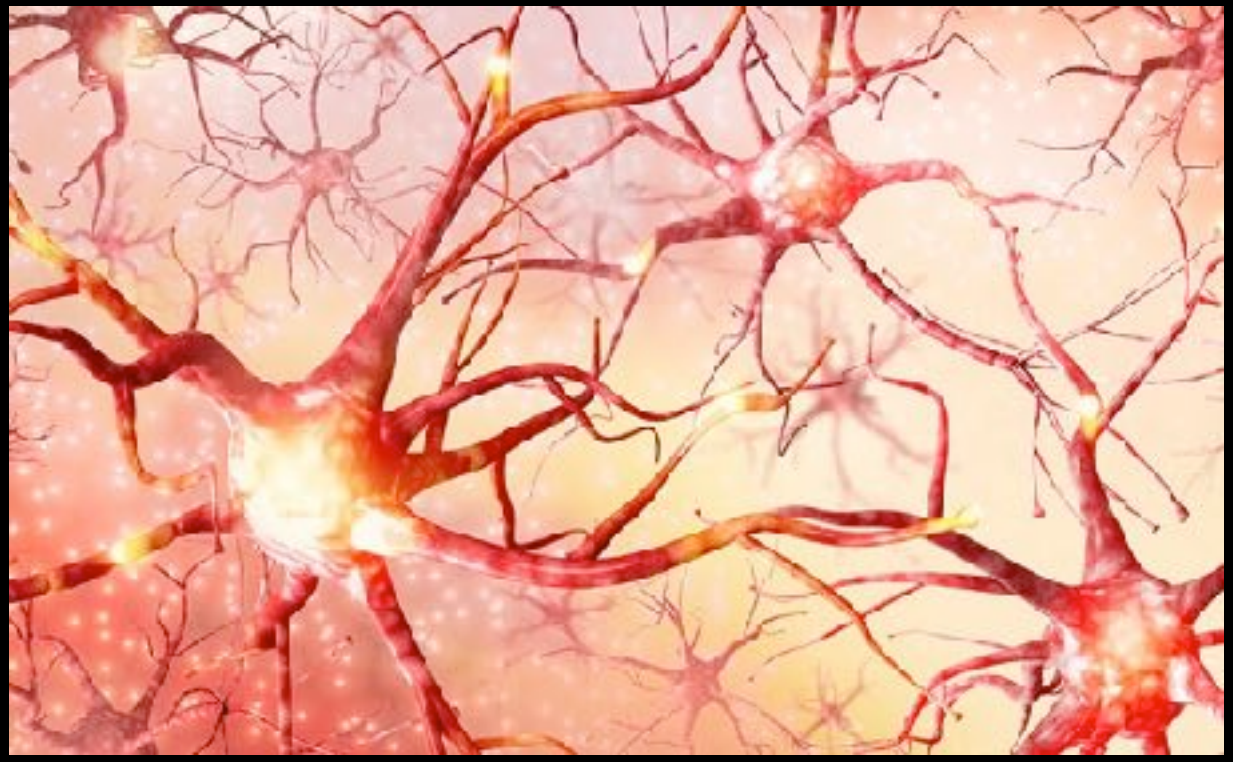
Cervello di roditore con 86 miliardi di neuroni

Cervello di 36 kg


Cervello di 36 kg
Corpo di 89 T

Cervello di 1,24 kg

Corpo di 66 kg



Energia / numero di neuroni

1 miliardo di neuroni = 6 kCal/die

86 miliardi x 6 kCal/die = 516 kCal/die

Costo per il corpo + Costo per il cervello < Energia assunta

Dimensione corporea Numero di neuroni
Alimentazione

86 M neuroni

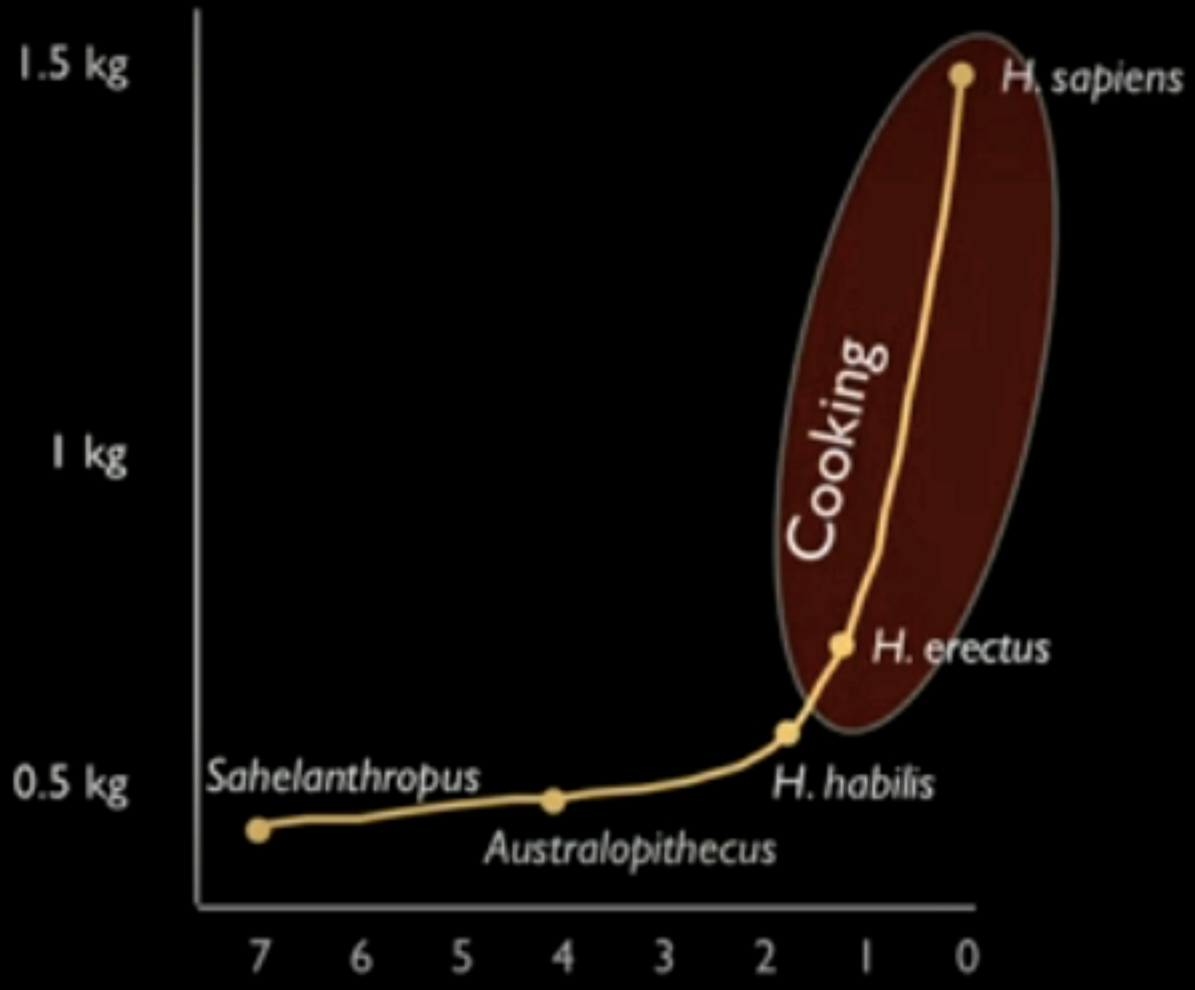
54 M neuroni 25 kg

45 M neuroni 50 kg

30 M neuroni 75 kg ← Orango, Gorilla

12 M neuroni 100 kg

rapid increase in brain size after cooking

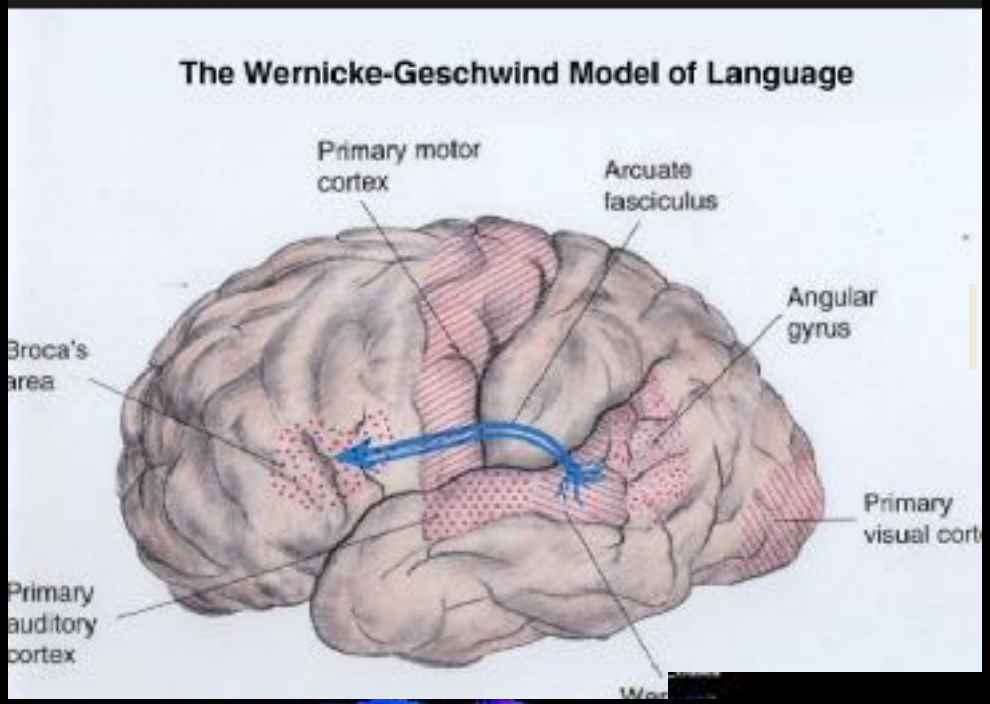


Cosa abbiamo di diverso?

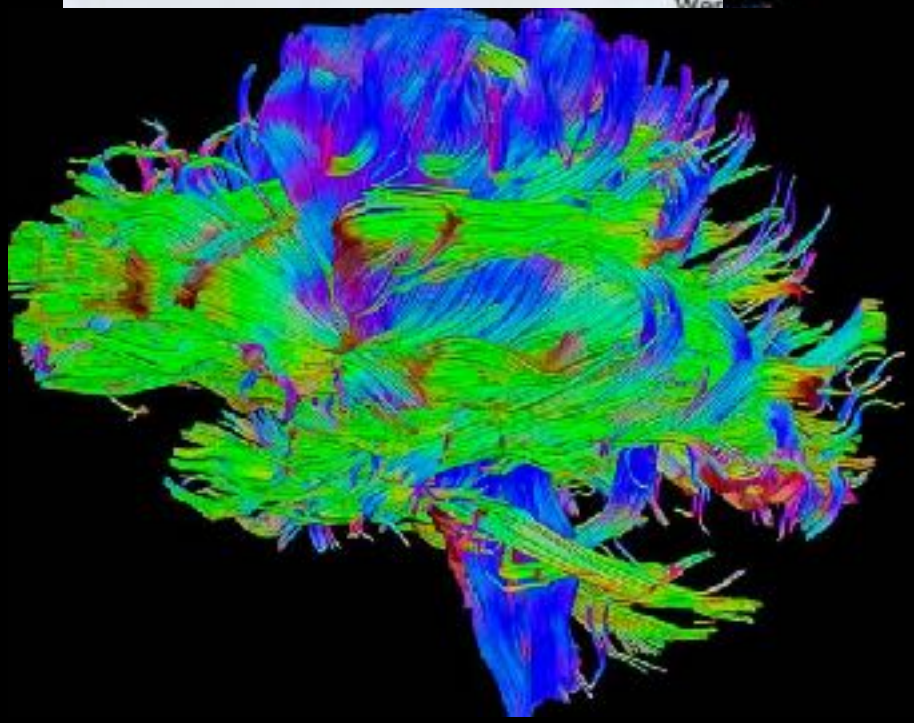
Abbiamo il numero più alto di neuroni nella corteccia

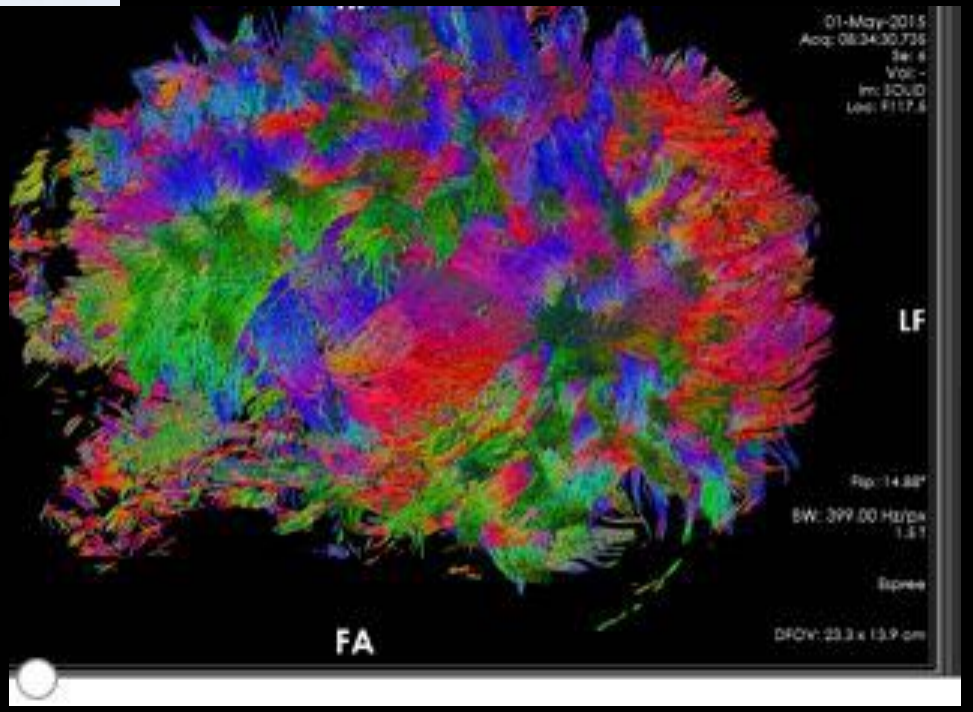
Sappiamo cucinare

Abbiamo il numero più alto di connessioni tra neuroni

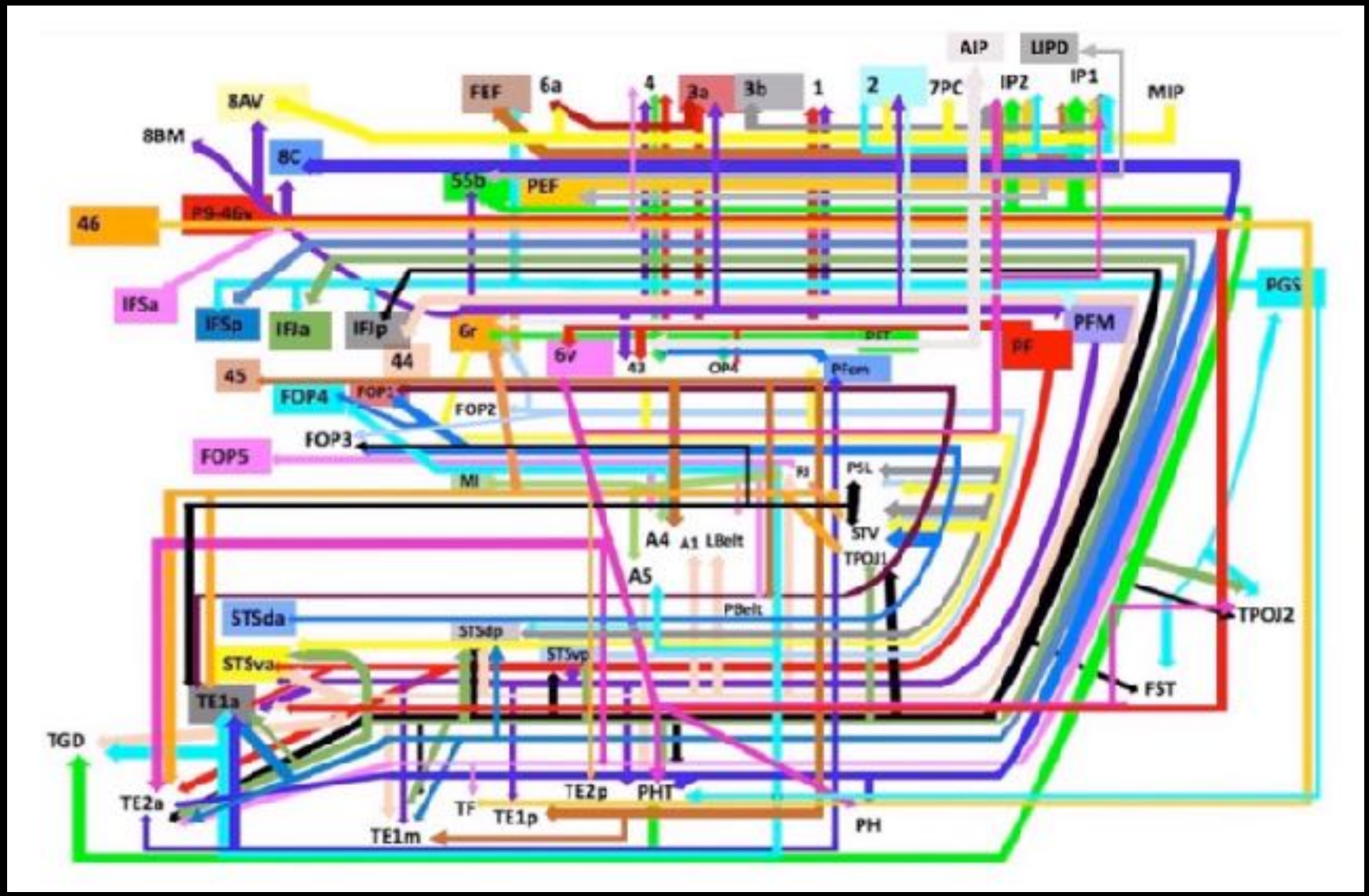


Il dispositivo più complesso



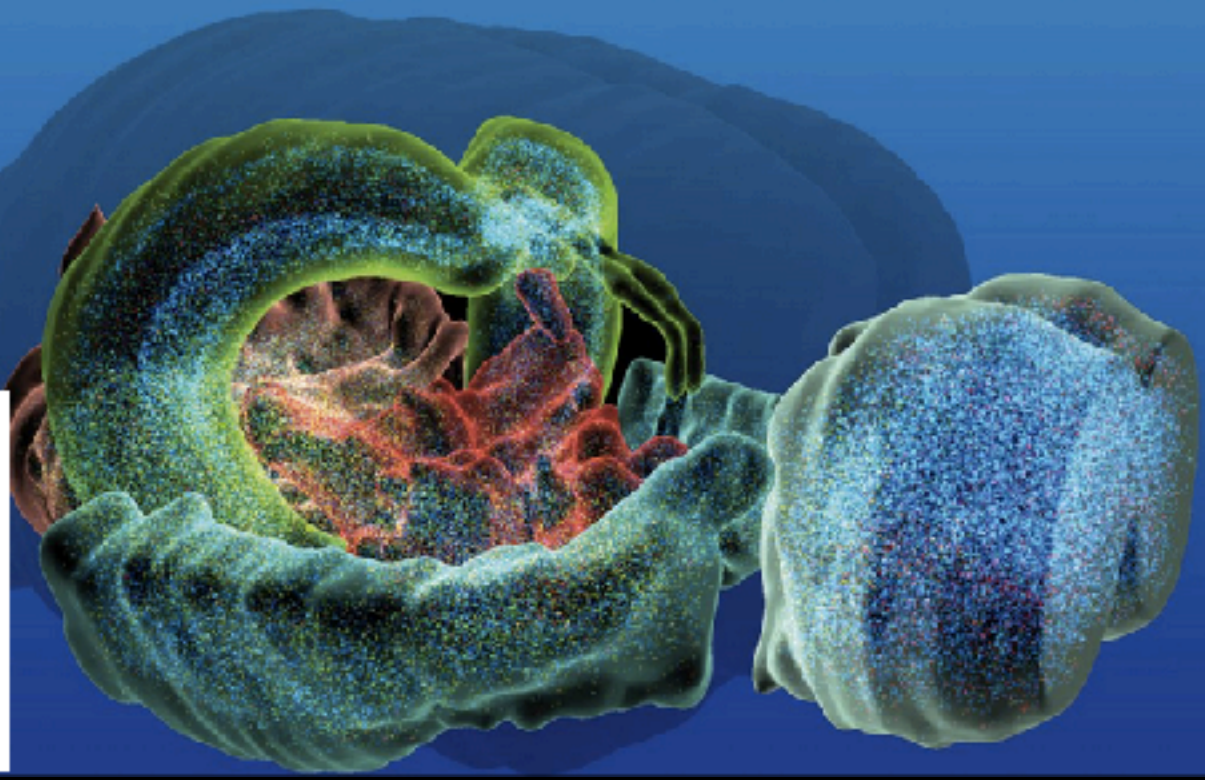


Connettomica



Blue Brain Project

The goal of the Blue Brain Project is to build biologically detailed digital reconstructions and simulations of the rodent, and ultimately the human brain.



THE LANCET

DEPARTMENT OF MEDICAL HISTORY | VOLUME 353, ISSUE 9170, P2149-2153, JUNE 19, 1999

The exceptional brain of Albert Einstein

Dr Sandra F Witelson, PhD • Debra L Kigar • Thomas Harvey, MD

Published: June 19, 1999 • DOI: https://doi.org

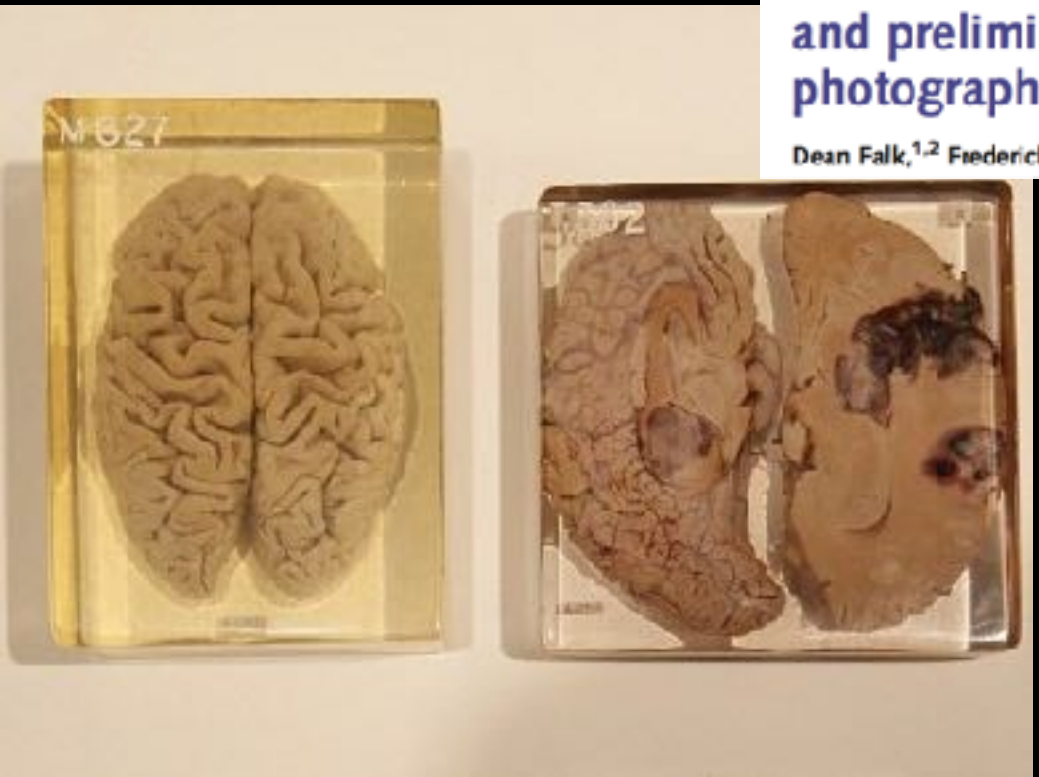
doi:10.1093/brain/aws295 Brain 2013: 136; 1304–1327 | 1304

BRAIN
A JOURNAL OF NEUROLOGY

OCCASIONAL PAPER

The cerebral cortex of Albert Einstein: a description and preliminary analysis of unpublished photographs

Dean Falk,[1,2] Frederick E. Lepore[3,4] and Adrianne Noe[5]



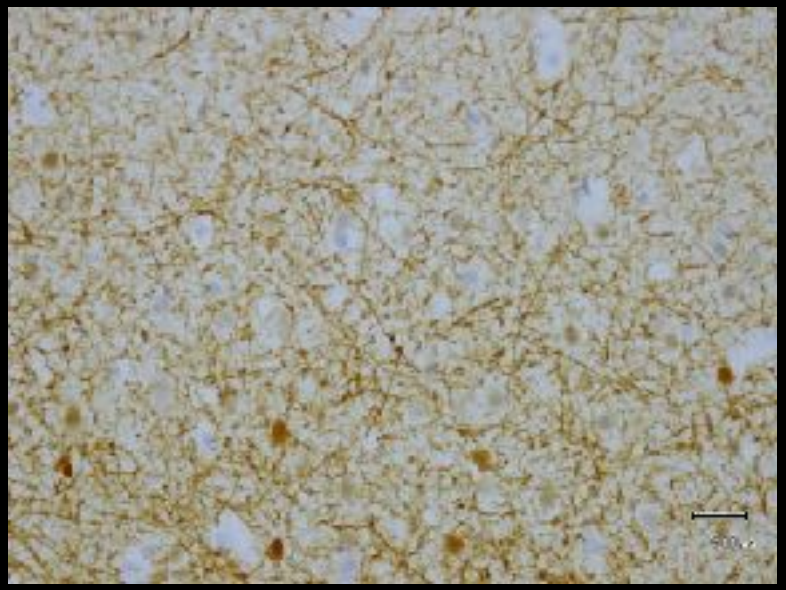
Corteccia prefrontale
Lobo parietale
Circonvoluzioni
Rapporto neuro-gliale

Organizzazione corticale

Corteccia cerebrale

16 miliardi di neuroni (19% dei neuroni del SNC)

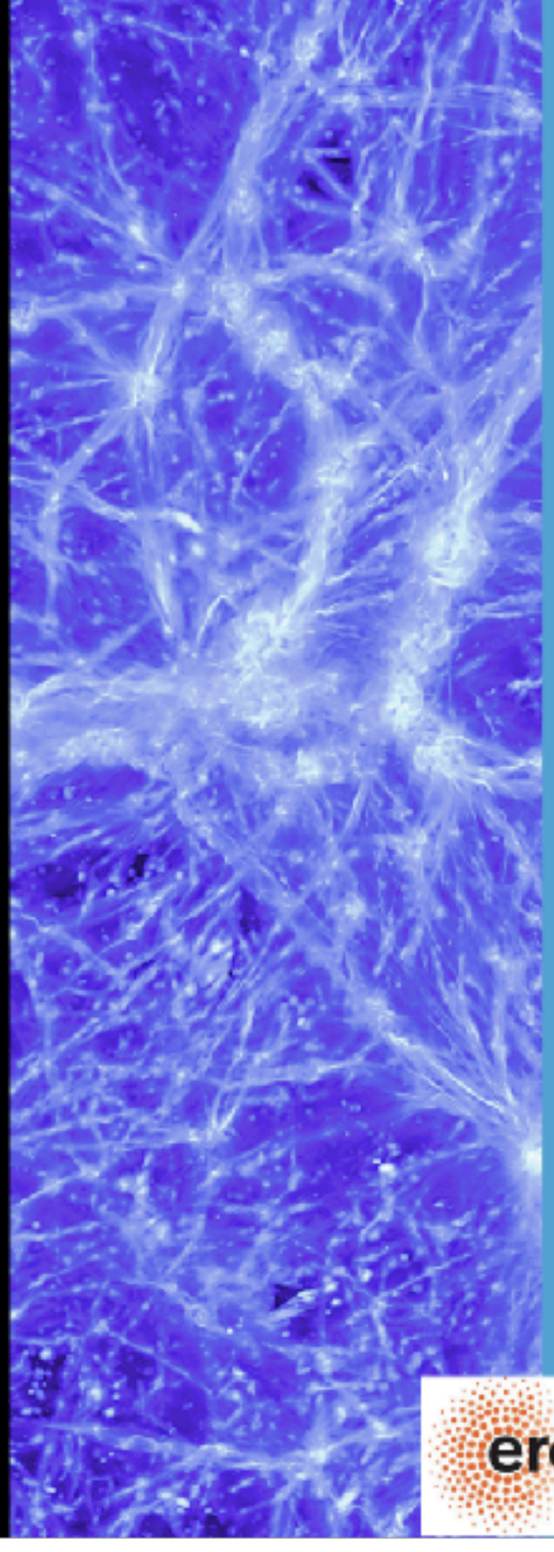
60 miliardi di cellule gliali



Corteccia cerebellare

69 miliardi di neuroni (82% dei neuroni del SNC)

16 miliardi di cellule gliali

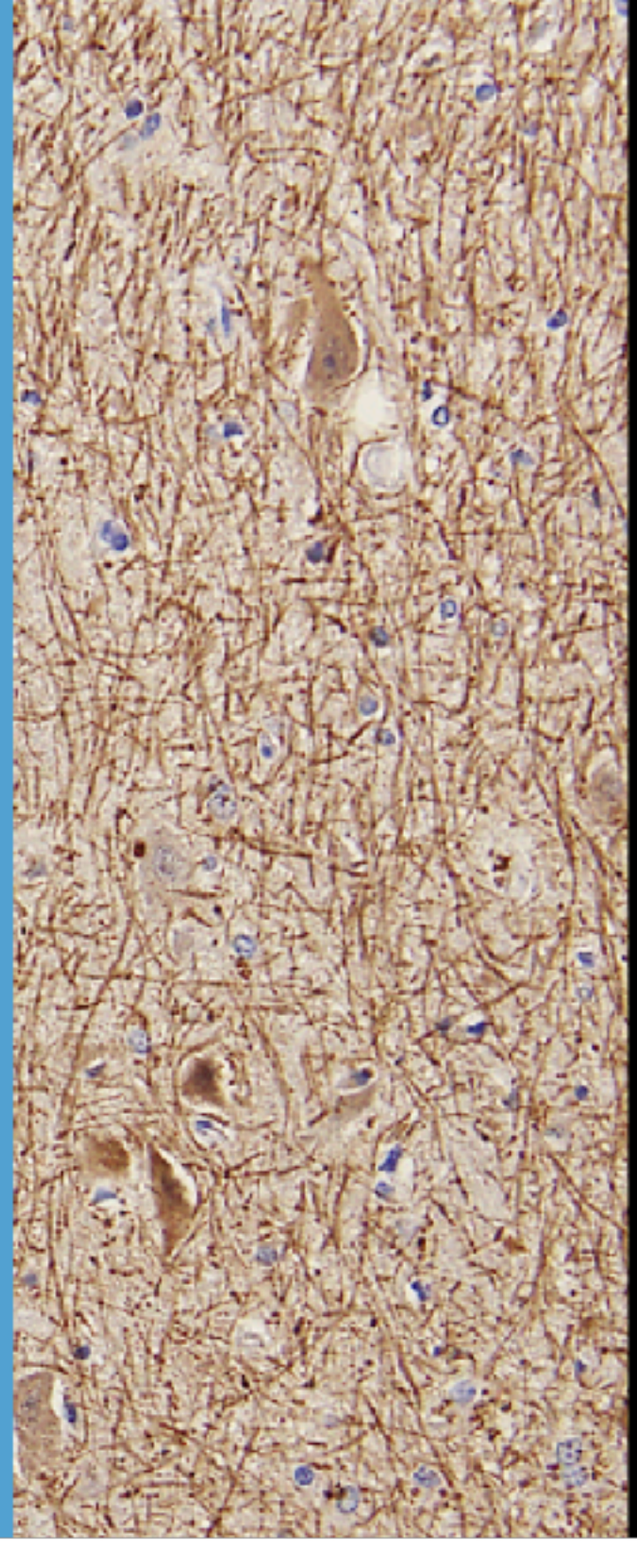


COINCIDENZE COSMICHE:

le inaspettate similarità strutturali e dinamiche tra la rete cosmica e quella neuronale.

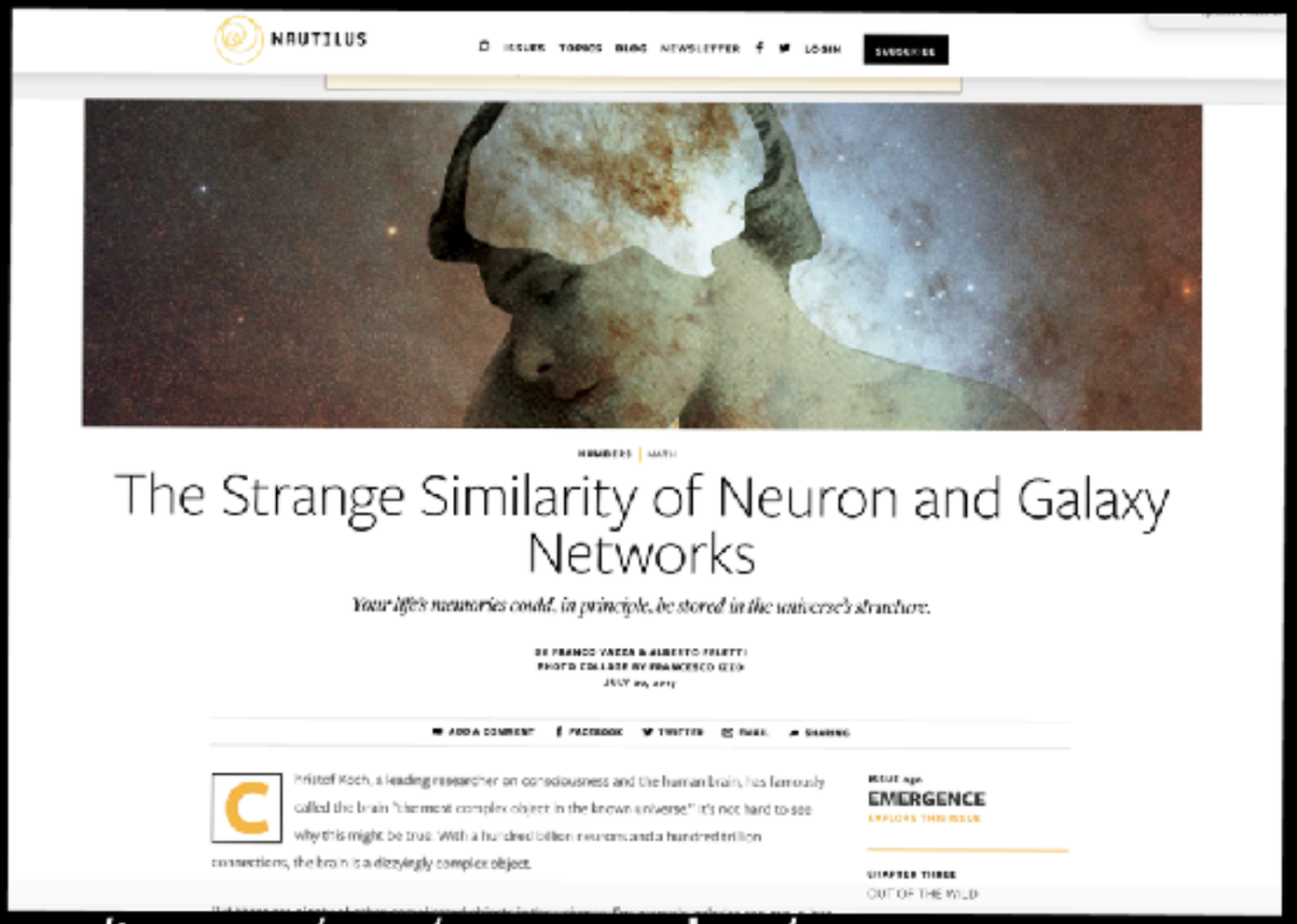
Alberto Feletti Verona Univ.

Franco Vazza Bologna Univ.
Hamburg Univ.
IRA/INAF



Di che cosa parleremo:

- com'è organizzata la rete cosmica?
- com'è organizzata la rete neurale?
- quanto si somigliano?



http://nautil.us/issue/74/networks/

La Via Lattea (dal pianeta Terra):
~6000 stelle visibili ad occhio nudo

La Via Lattea col telescopio ~qualche milione di stelle


Tutto il cielo in Infrarosso
(2Mass survey)
Prezi

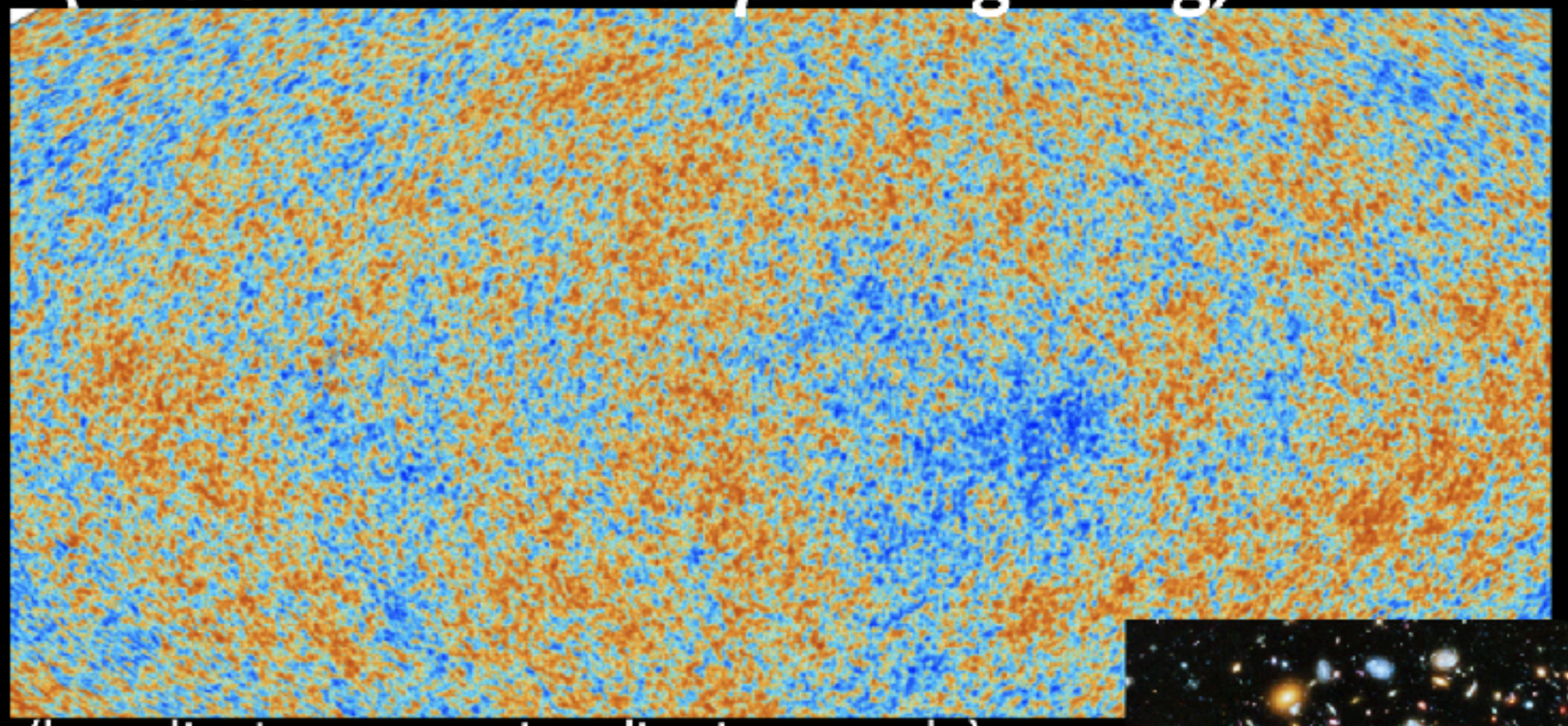
Una "vicina di casa" galattica: la galassia M51

Prezi

Uno scontro (o un matrimonio?) galattico: "Le Antenne"

Prezi

Come siamo arrivati da qui
(~300 mila anni dopo il Big Bang)

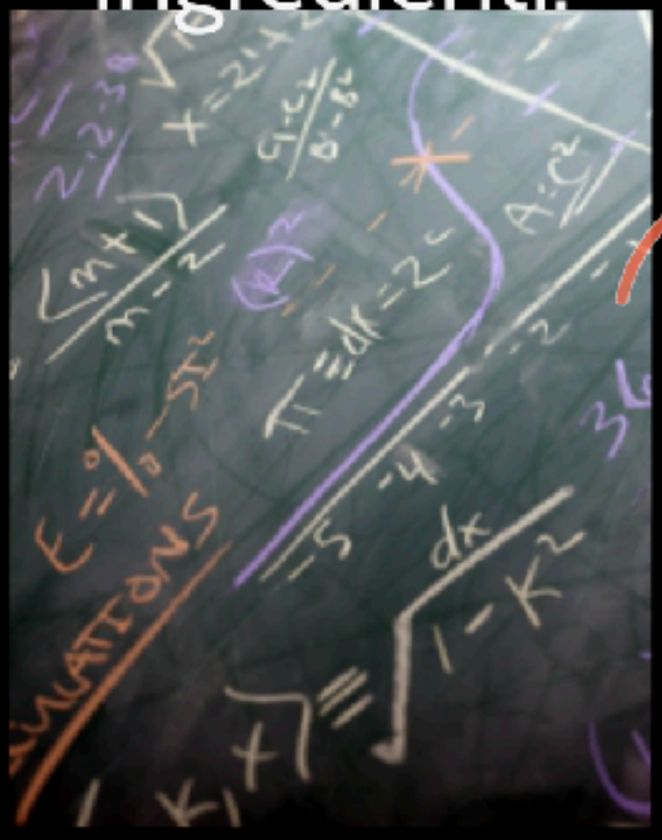


(la radiazione cosmica di micro-onde)

..a qui? (~oggi)

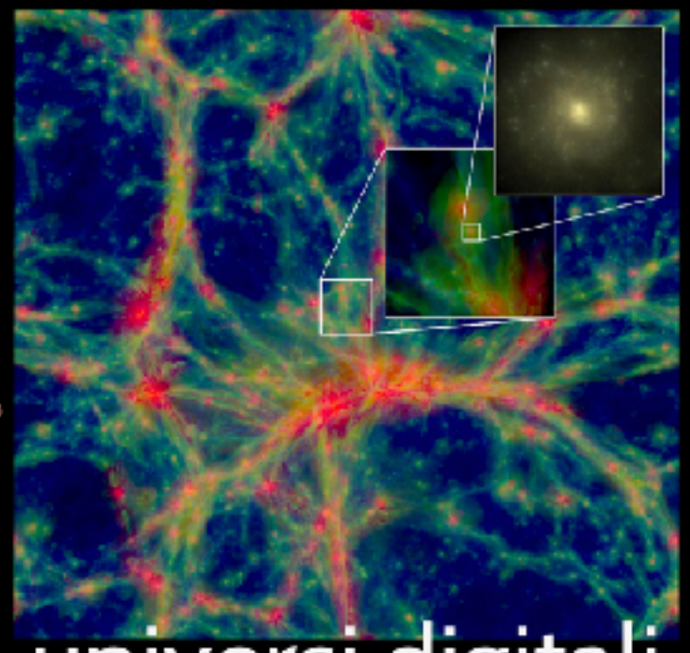
Astrofisica e Simulazioni Numeriche

Ingredienti:



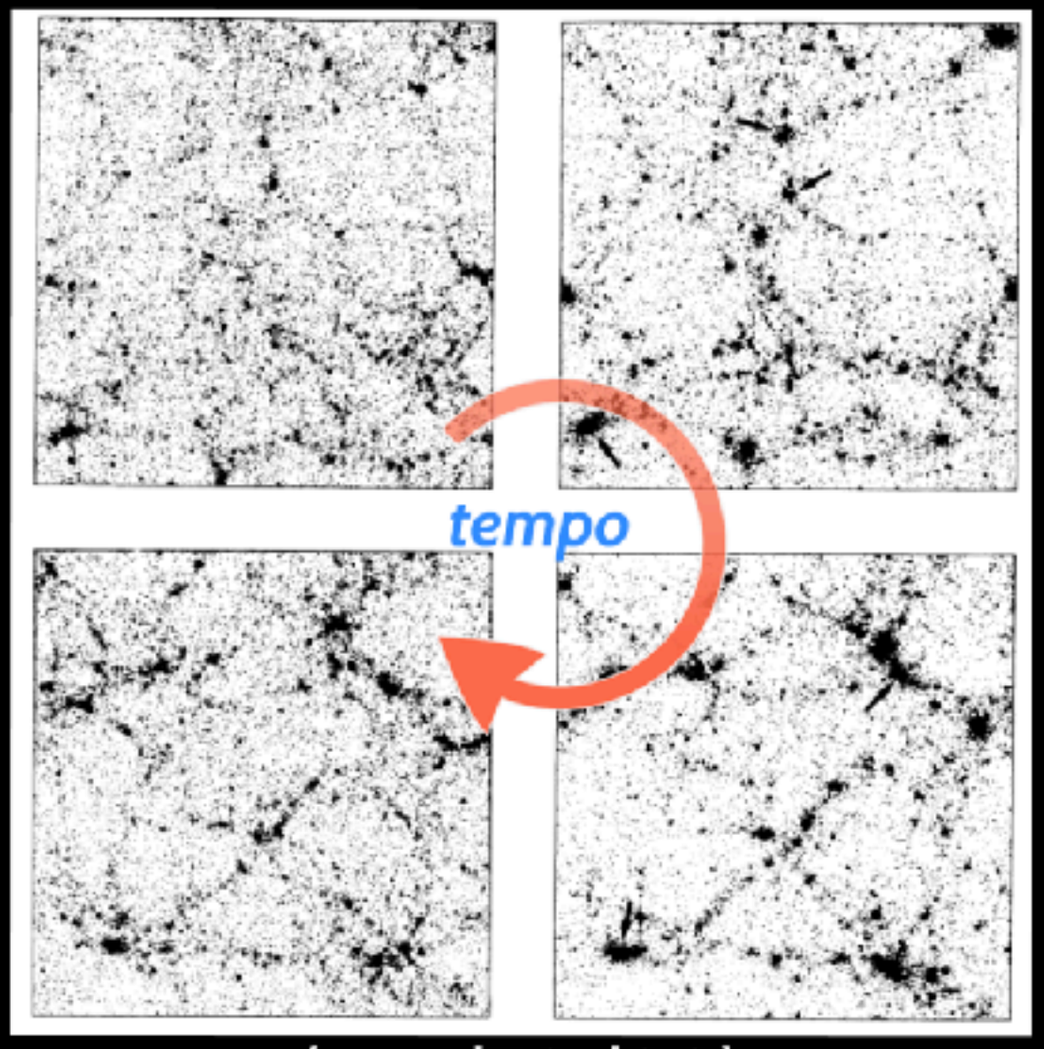
- componenti di materia/energia +
- gravità (collasso) +
- fluido-dinamica (termalizzazione) +
- espansione spazio-tempo (metrica)

"supercalcolo"



universi digitali

osservazioni

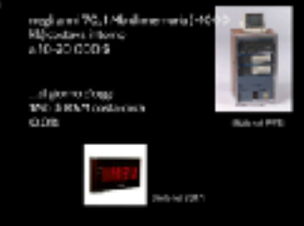


(anni '70-'80)

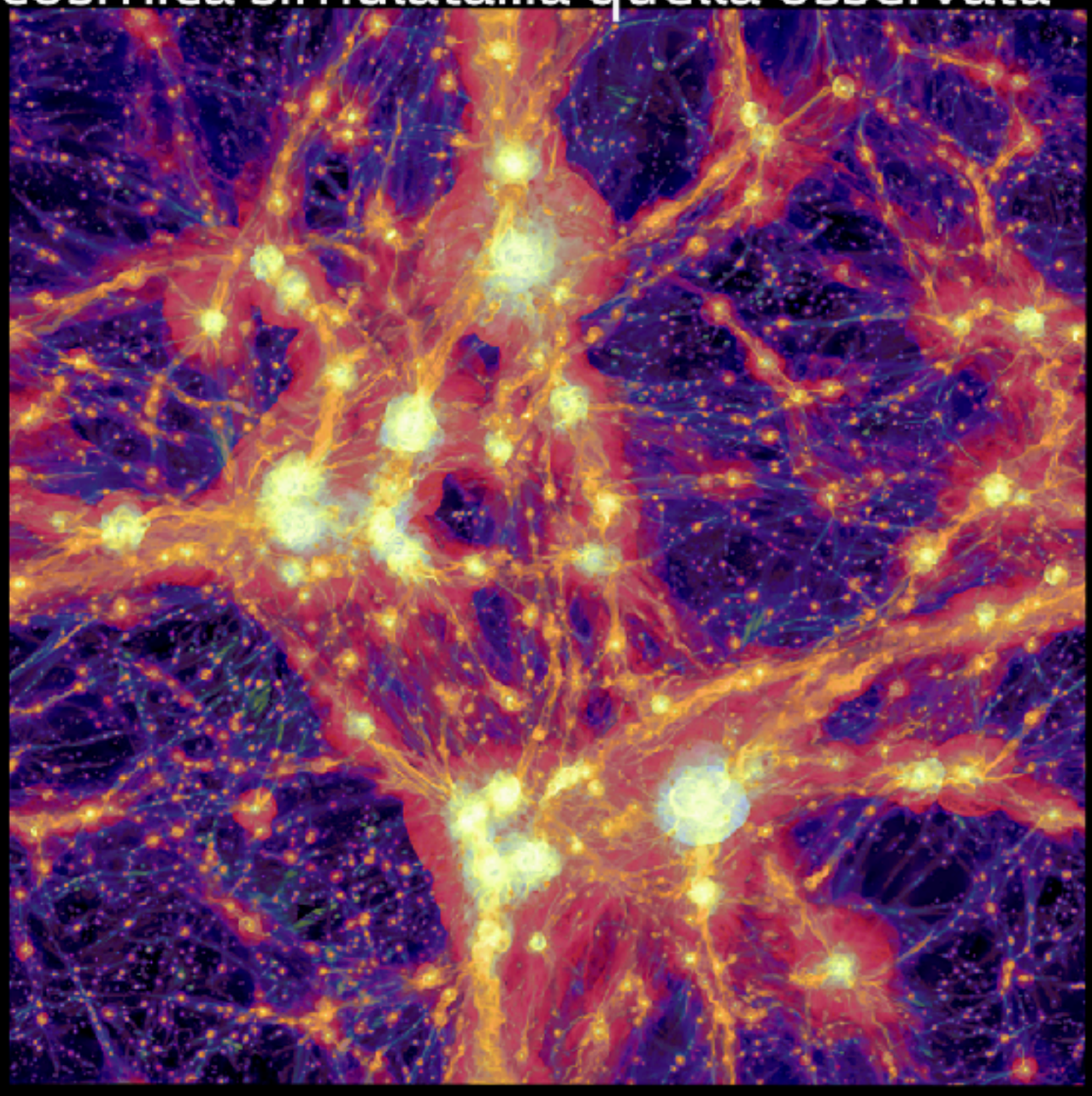
Idee chiave:

- piccole fluttuazioni di massa prodotte dal Big Bang, che "collassano" sotto l'effetto della loro stessa gravità
- la pressione del gas cresce fino a bilanciare globalmente il collasso

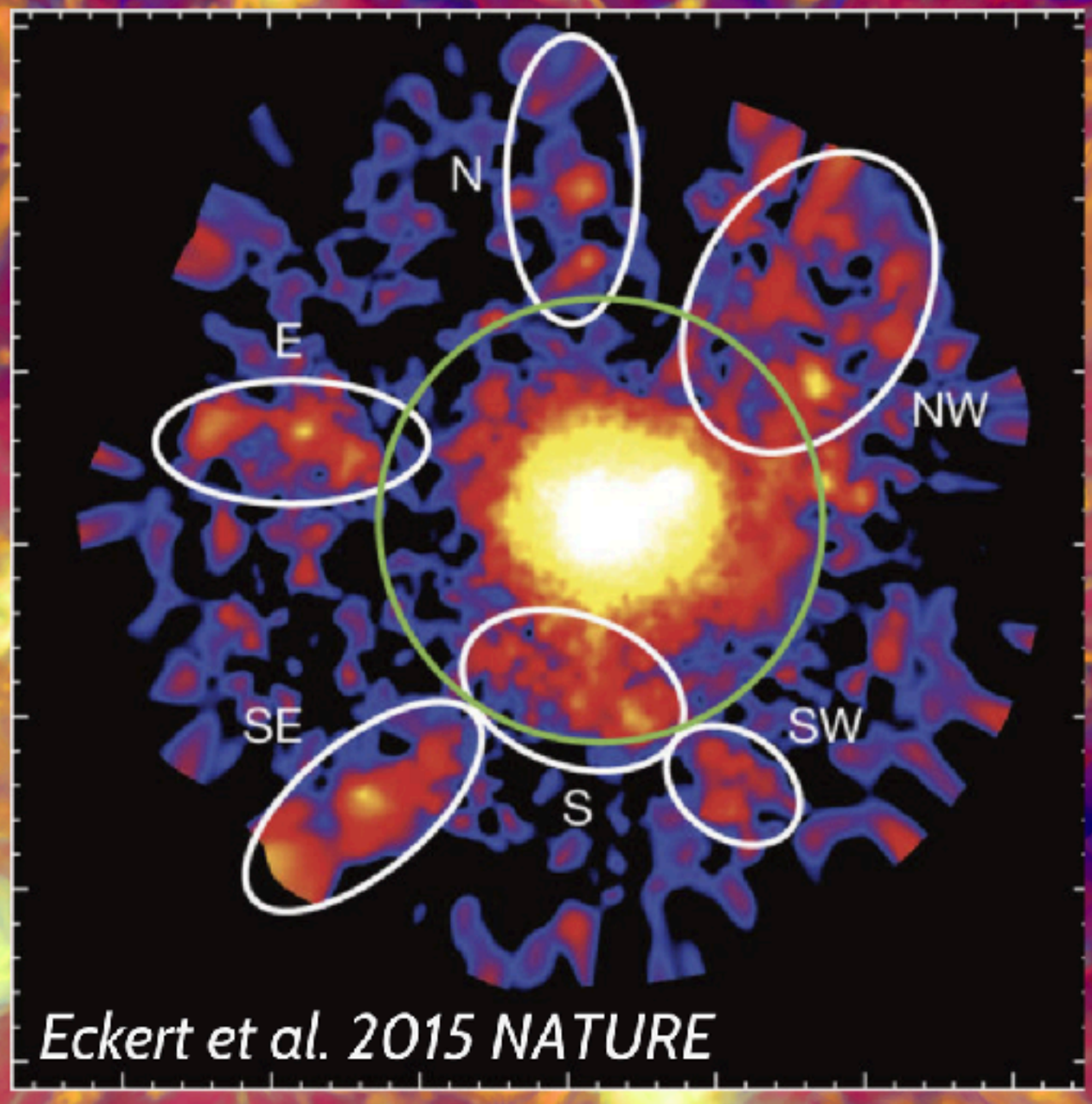
Prime simulazioni:
- singoli computer
- memoria RAM: qualche kilobyte



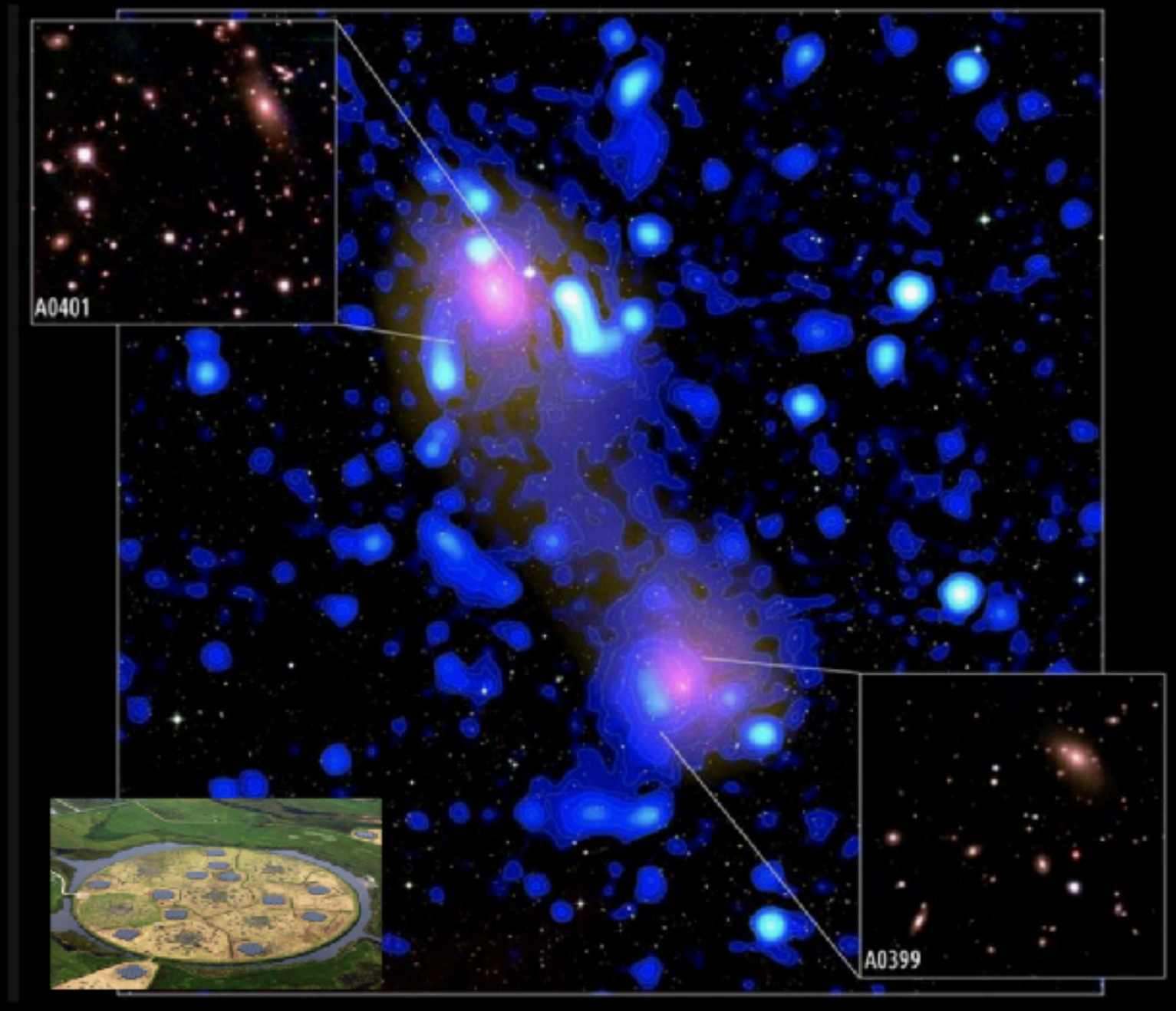
Dalla rete cosmica simulata...a quella osservata



Vazza+15
2 milioni di ore di calcolo

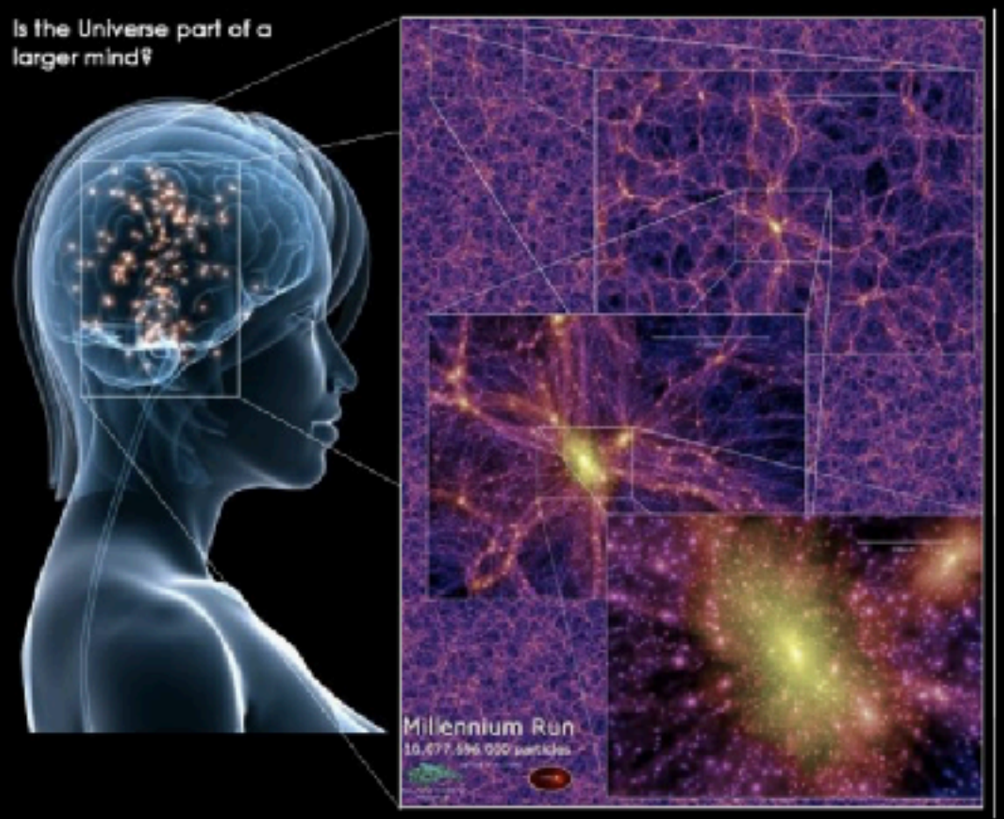

N
E
NW
SE
S
SW
Eckert et al. 2015 NATURE

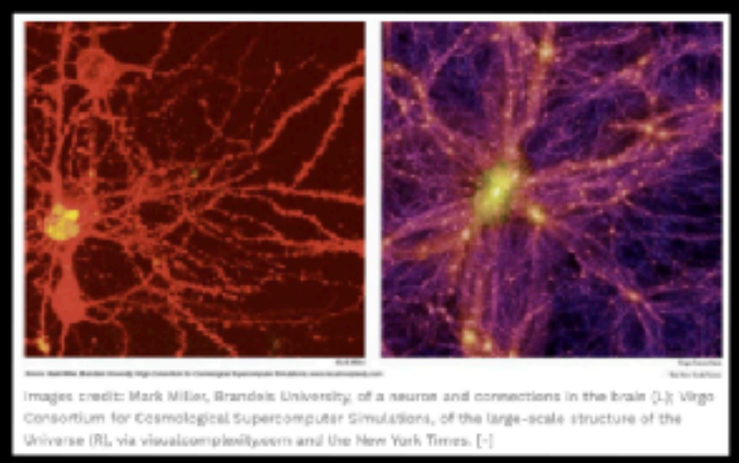
Un ponte cosmico di campo magnetico tra ammassi:
Govoni et al. 2019 Science



Lo Square Kilometer Array (SKA): la più grande impresa del prossimo decennio

Similutidini cosmiche...?



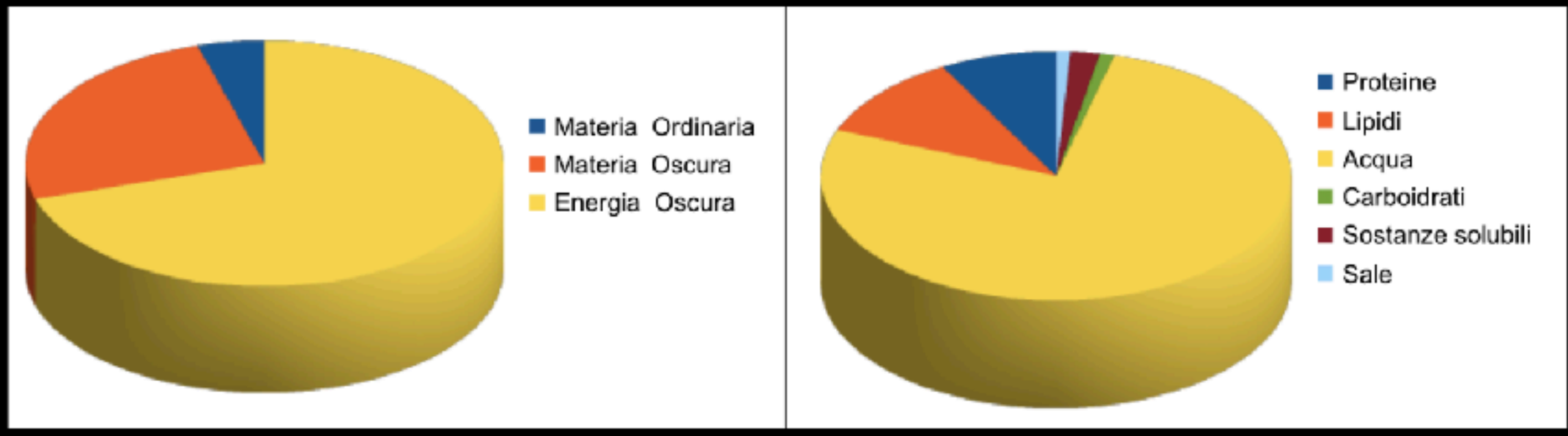


Images credit: Mark Miller, Brandeis University, of a neuron and connections in the brain (L); Virgo Consortium for Cosmological Supercomputer Simulations, of the large-scale structure of the Universe (R), via visualcomplexity.com and the New York Times. [+]

- Sul web si trovano molte elucubrazioni (spesso poco accurate) su questo tema.
- Qui tenteremo un approccio più quantitativo

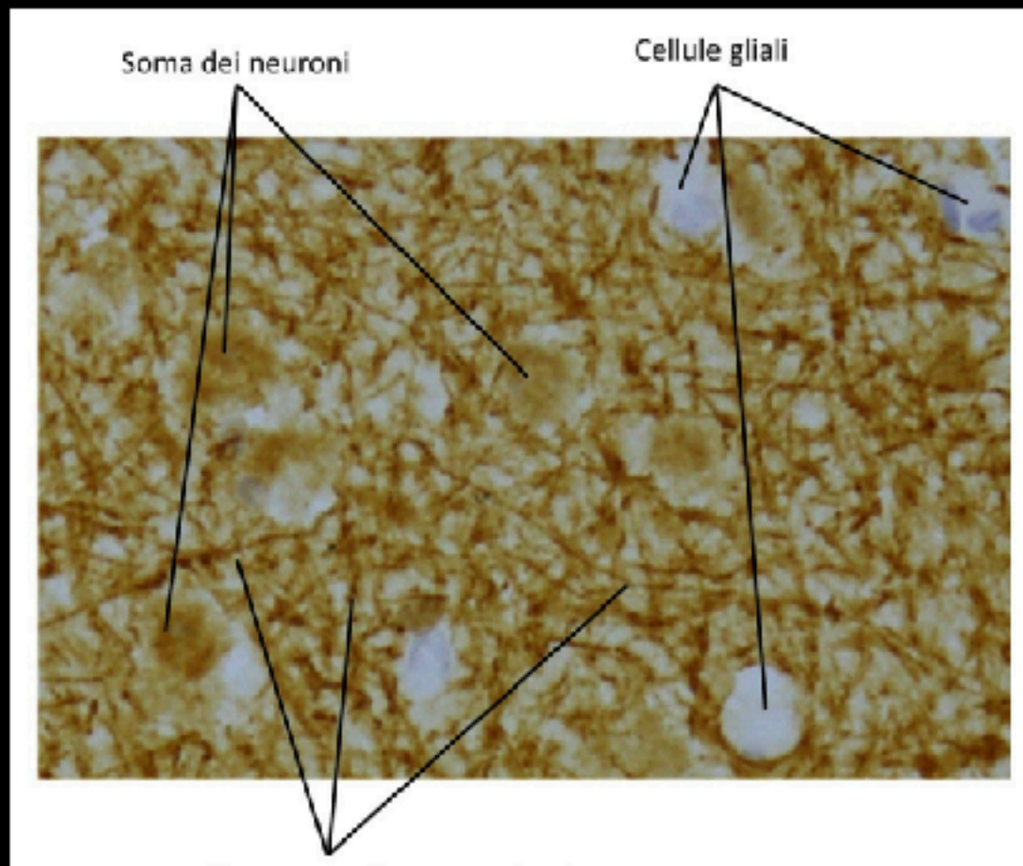
Composizioni di materia & energia

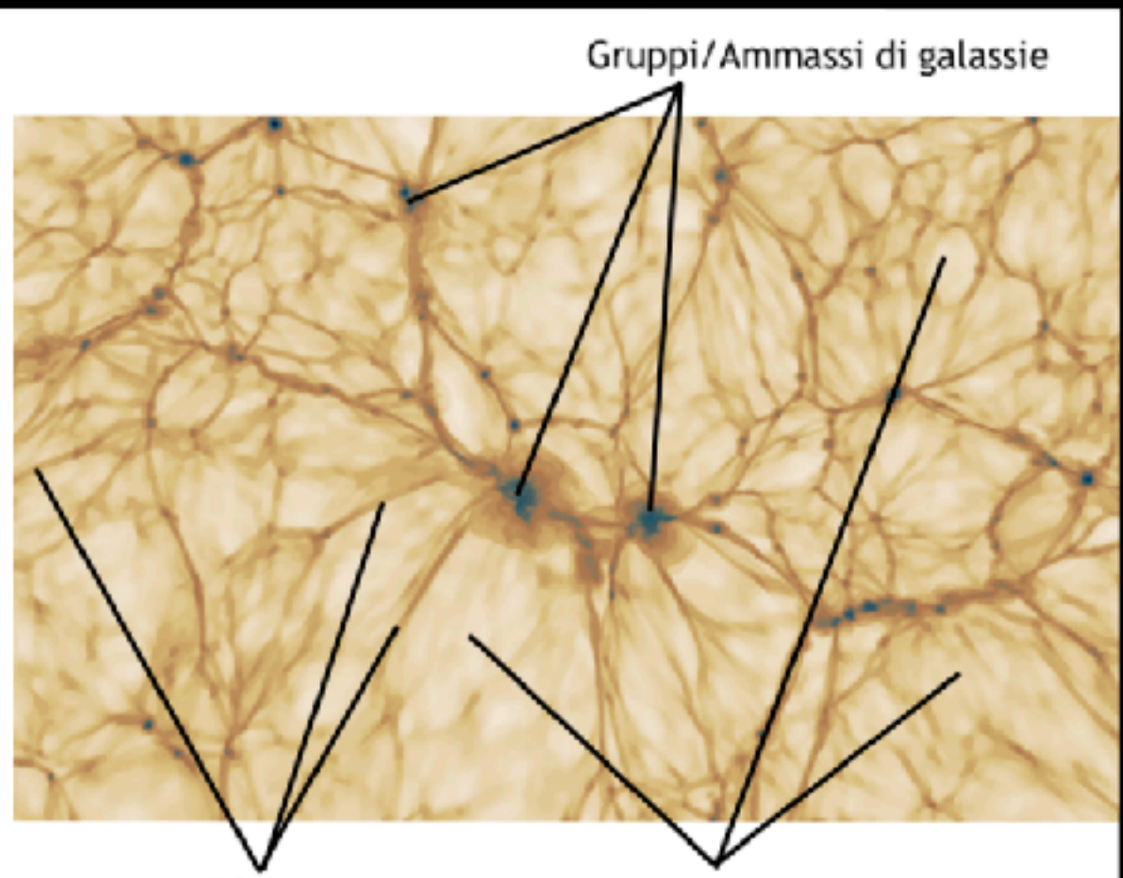
- Nel cervello, pesiamo massa delle componenti
- Nel caso del cosmic web, usiamo E=mc^2 per "pesare" il contributo di ogni componente



- il ~70% in entrambi i casi è di "materiale di supporto", ovvero inerte
- la dinamica dei due sistemi dipende dal restante ~30%

Scale e strutture





raggio ~15 cm

~86 miliardi di neuroni

L(filamenti)/D(neuroni)~10^2-10^4

R(cervello) / L(filamenti) 10^2-10^4

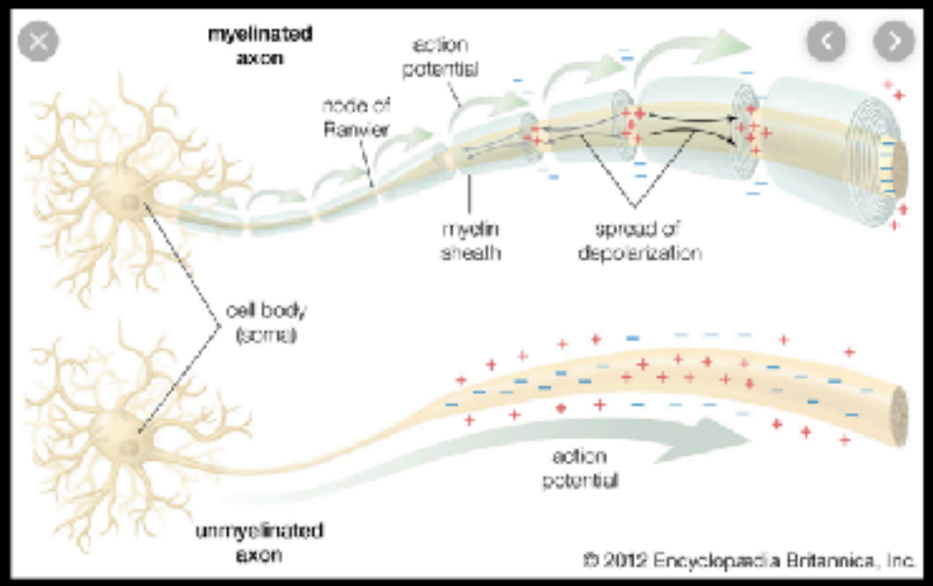
raggio ~ 1.35 10^48 cm

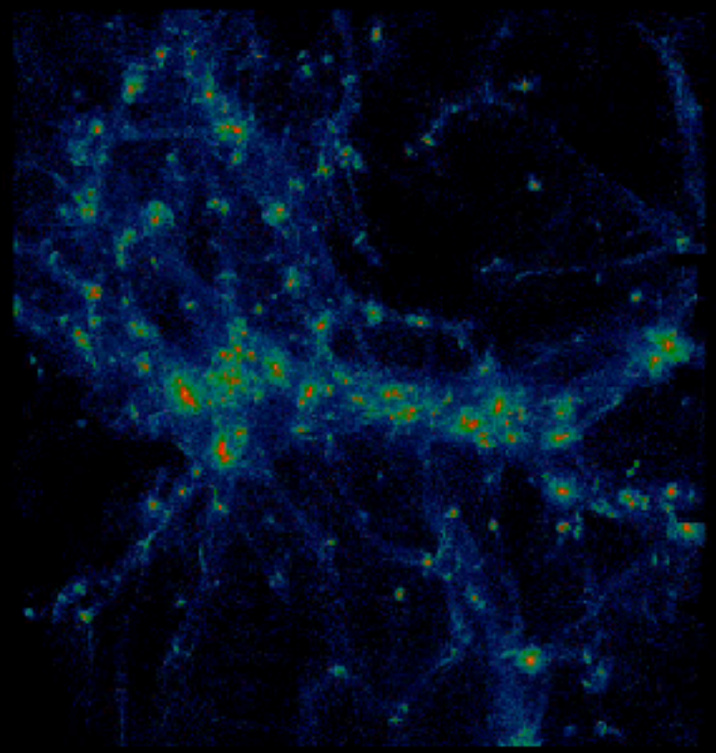
~50-100 miliardi di galassie

L(filamenti)/R(galassie)~10^4-10^5

R(web) / L(filamenti)~10^4-10^6

Meccanismi di evoluzione





potenziale d'azione/
feedback/"masse/lesioni"

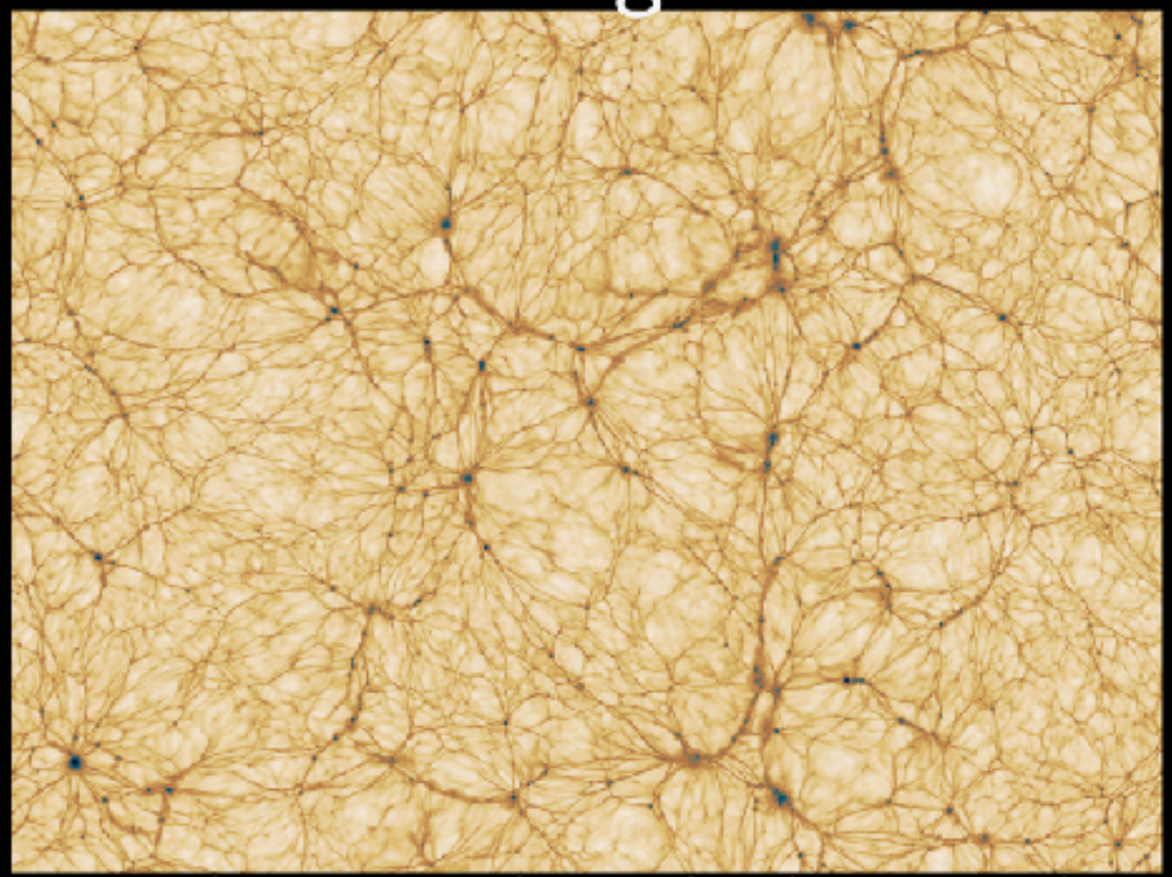
- *plasticità* = capacità modificare funzioni per reagire a stimoli

gravità/espansione spazio tempo/idrodinamica...

- collisioni tra galassie
- interazioni su grande scala

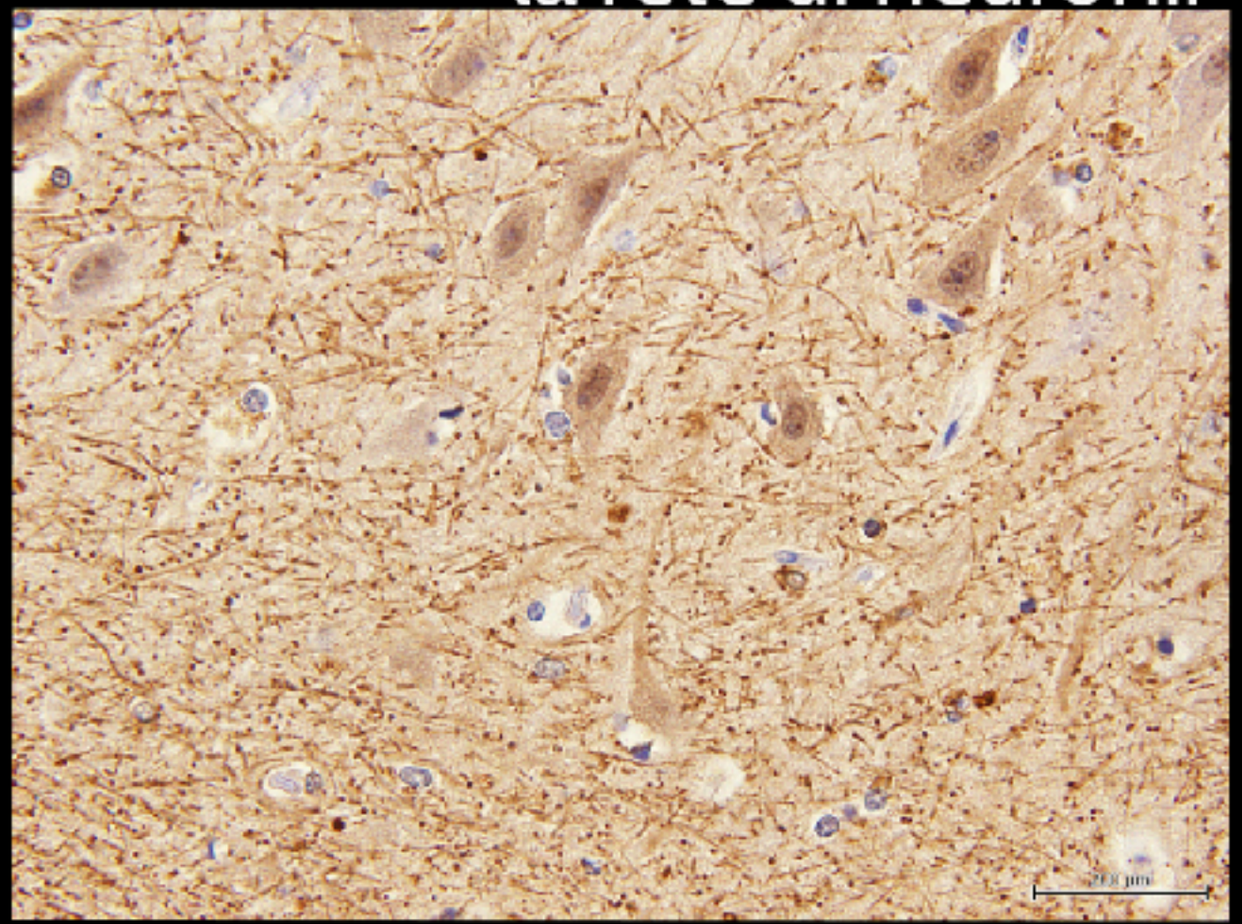
Confronto quantitativo

la rete di galassie



Simulazione cosmologica (2 milioni ore CPU)
sezione di ~1 x 600 x 600 milioni anni-luce.

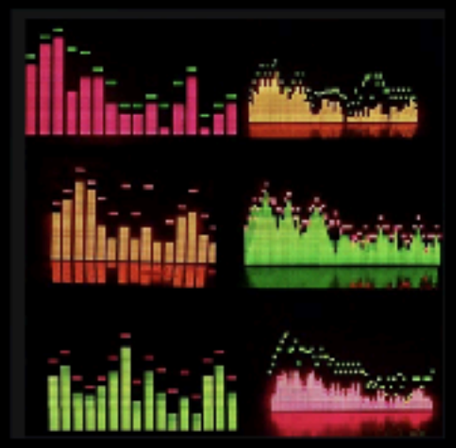
la rete di neuroni:



Sezione di spessore 4 µm del cervelletto umano.
(cortesia di Dr. Elena Zunarelli -Policlinico Ospedaliero-Universitario di Modena).

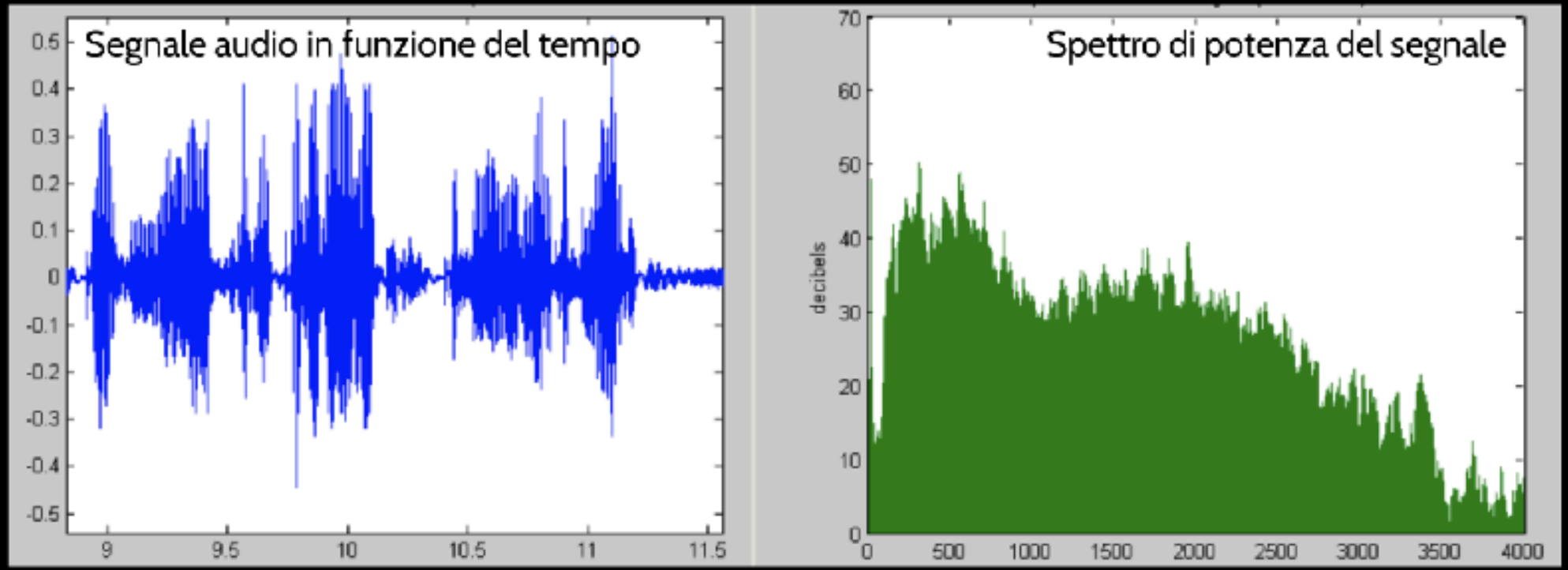
Prezi

Vazza & Feletti, Nautilus 2017

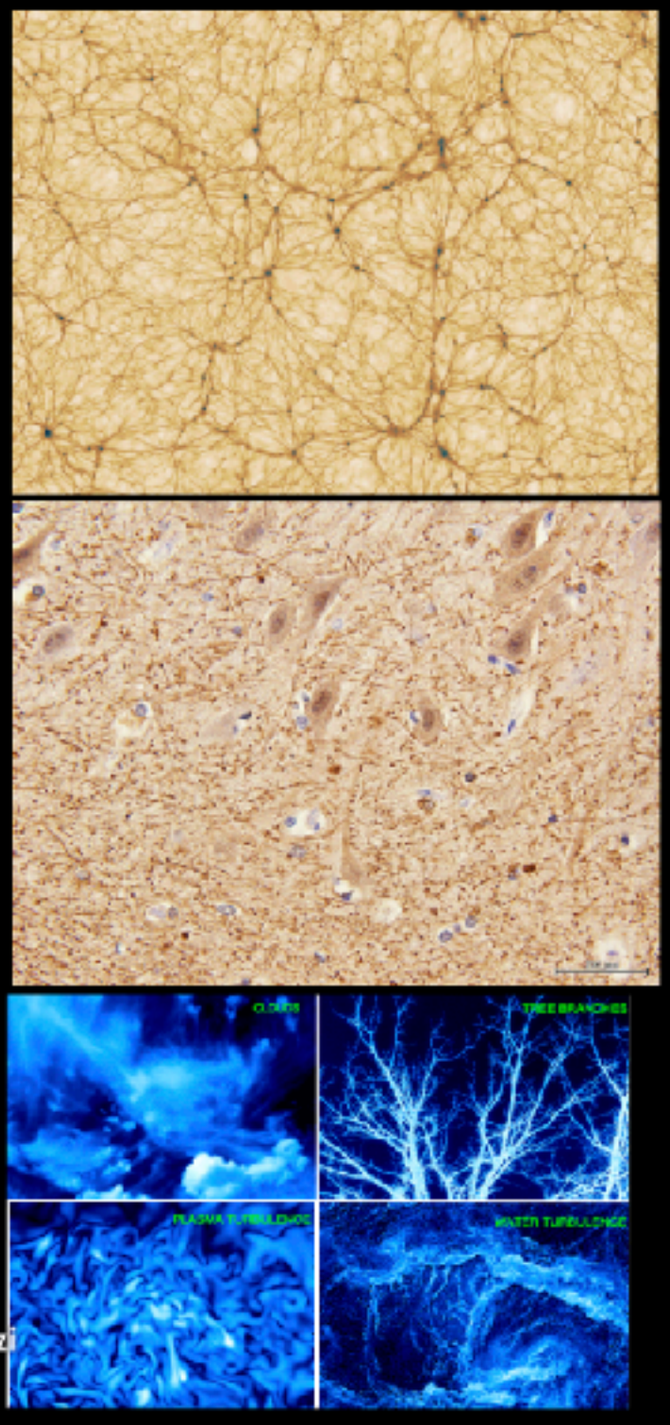


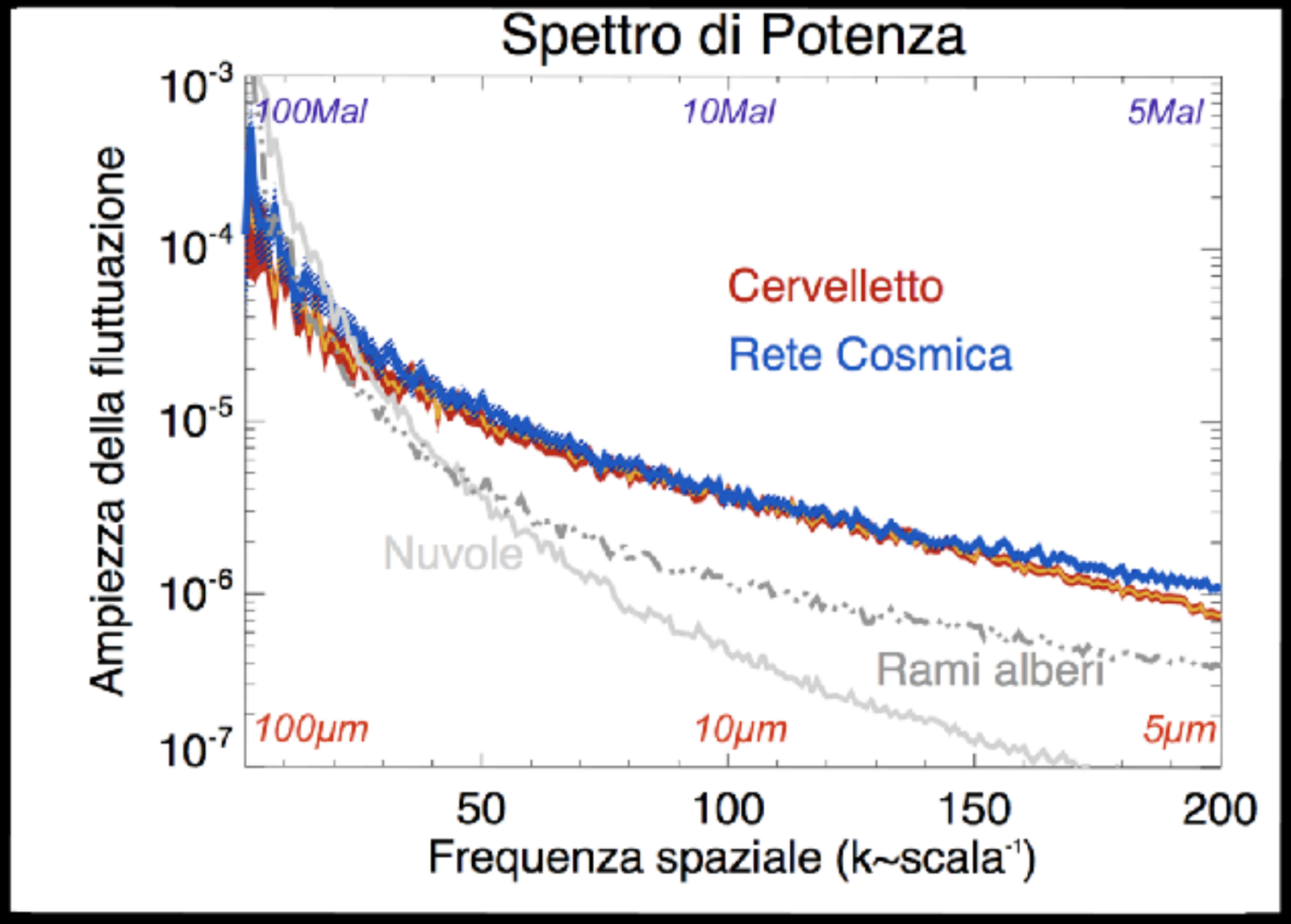
Lo "spettro di potenza"

- E' uno strumento matematico per misurare in quali frequenze (spaziali o temporali) si concentra la fluttuazione di un segnale
- grandi applicazioni in telecomunicazioni, analisi segnale, cosmologia...



Lo "spettro di potenza"





- spettri simili su ~2 ordini di grandezza!
- distribuzioni *non frattali*

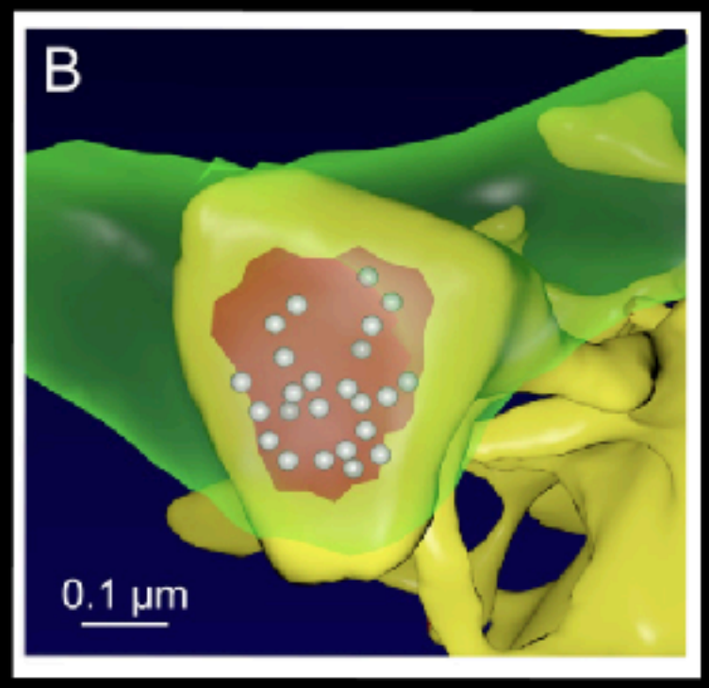
Capacità di memoria

- La capacità di memoria è misurata in *bits* (0/1)

- 1 neurone ha in media 26 sinapsi -> 4.7 bits/neurone

Moltiplicando per l'intera rete neuronale (~86 miliardi neuroni) deriviamo la capacità di **memoria totale:**

2.5Pbyte = 2.5 10^15 bytes
(1 byte = 8 bits)

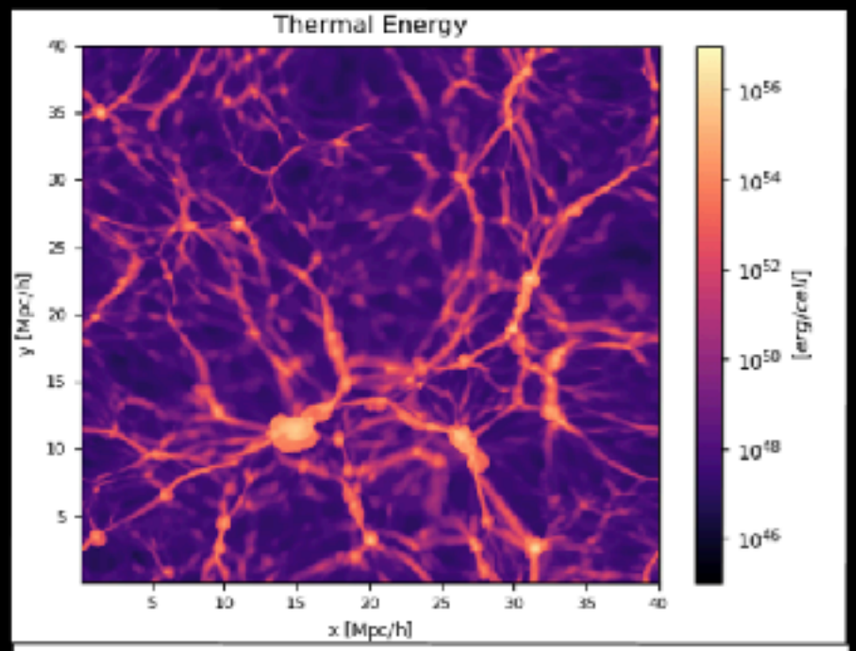


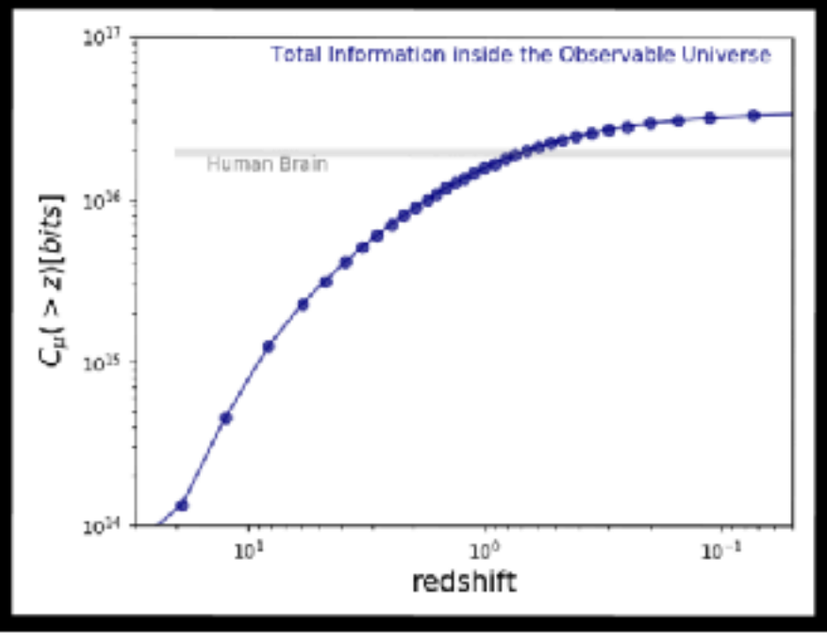
(Bartol+15)

Capacità di memoria

Dall' evoluzione del cosmic web simulato possiamo estrapolare la memoria computazionale necessaria per simulare l'intero Universo (R~45 miliardi a.l.)

4.3Pbyte = 4.3 10^15 bytes

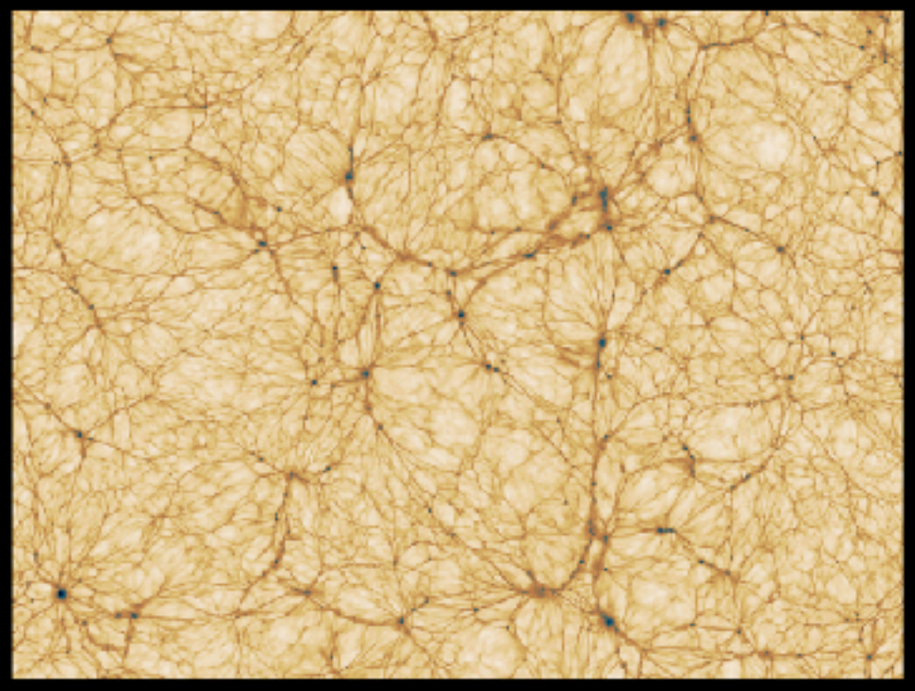




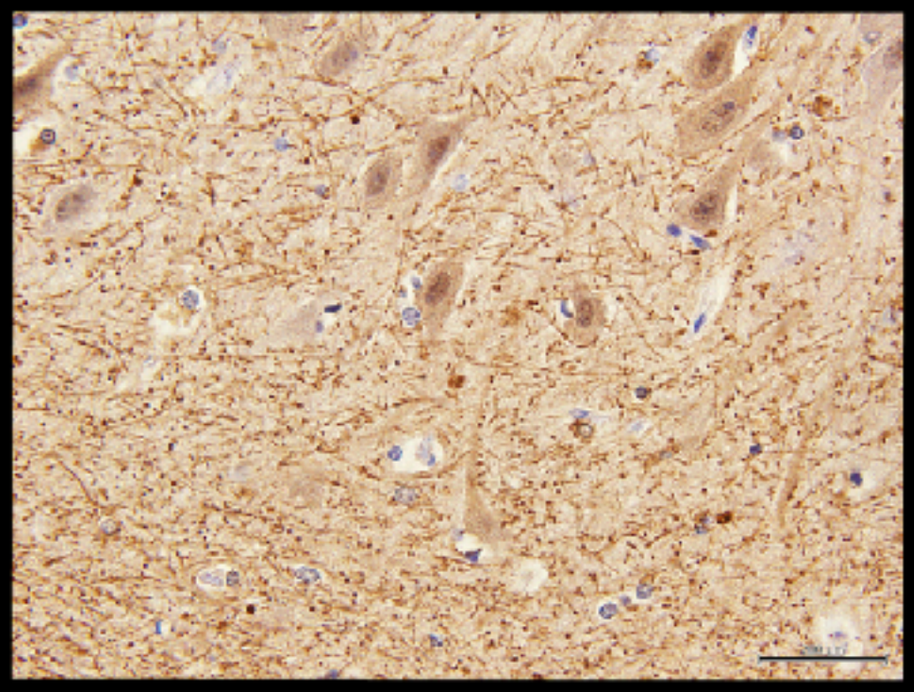
Prezi

Capacità di memoria

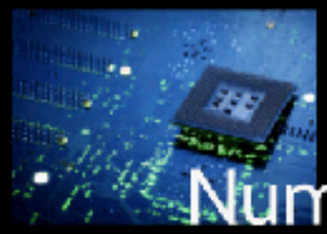
4.3Pbyte ~ 2.5 Pbyte



la capacità di memoria di un cervello basta per simulare la rete cosmica



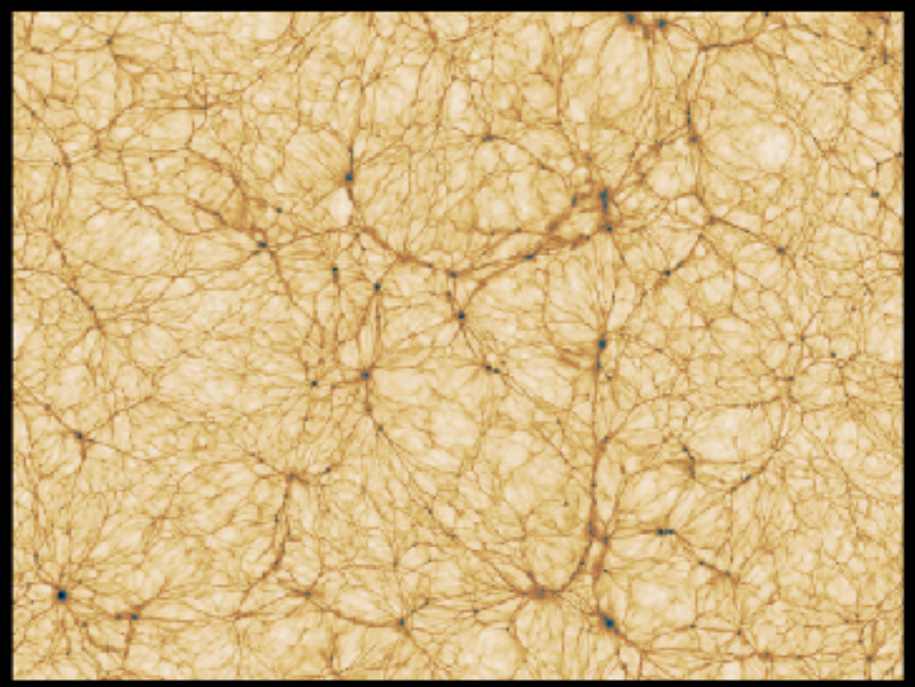
l'intera rete cosmica potrebbe essere usata per simulare un solo cervello umano

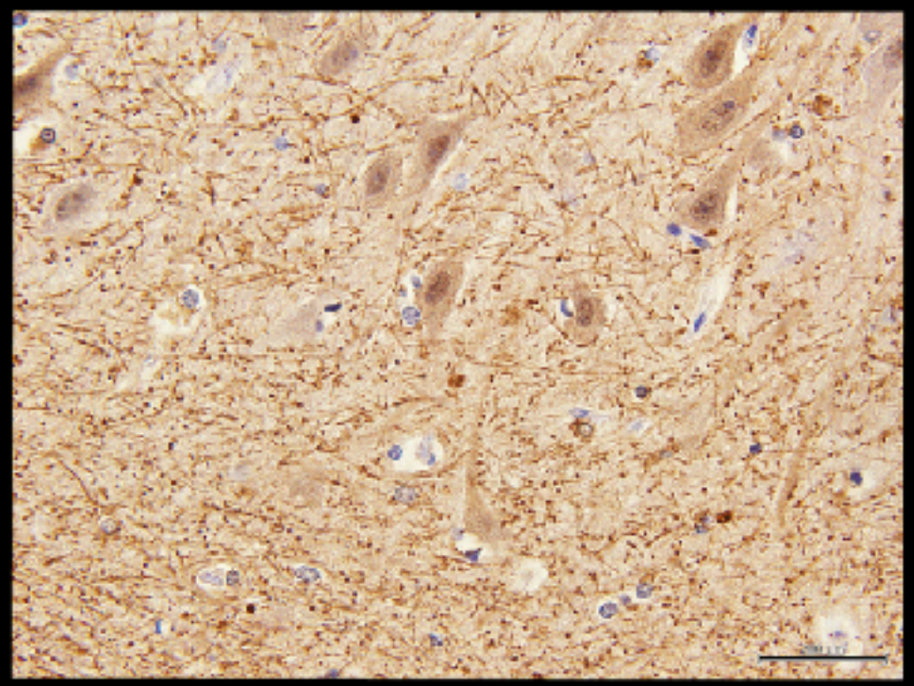


Potenza di calcolo

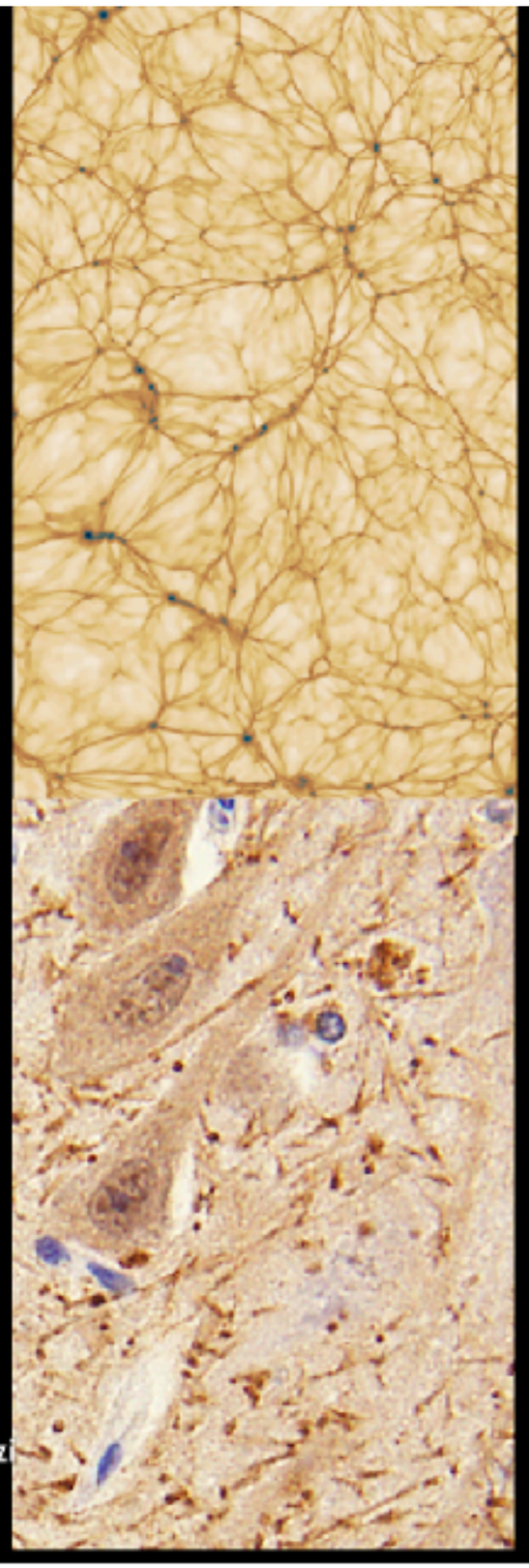
Numero totale di "comunicazioni" tra galassie/neuroni

10^15 <<< 10^24





In 0.1 secondi, i neuroni del cervello umano scambiano più informazioni di quante tutte le galassie del cosmic web in 13.7 miliardi di anni!



Conclusioni (?)

- Allo stato dell'arte, cervello umano e cosmic web appaiono come due reti molto complesse.
- Le loro proprietà morfologiche, topologiche e funzionali appaiono sorprendentemente simili.

- questo NON SIGNIFICA che siano lo stesso oggetto, o che siano manifestazioni della medesima legge fisica (sconosciuta).

- Tuttavia, la fisica ci sta insegnando che reti estremamente diverse si possono auto-regolare in base a principi soprendentemente simili.

- *L'esplorazione del flusso di informazione attraverso la rete neurale e cosmica è appena iniziata!*