



ASSOCIAZIONE ITALIANA  
**DONNE MEDICO**

# Neuroimaging e Genere



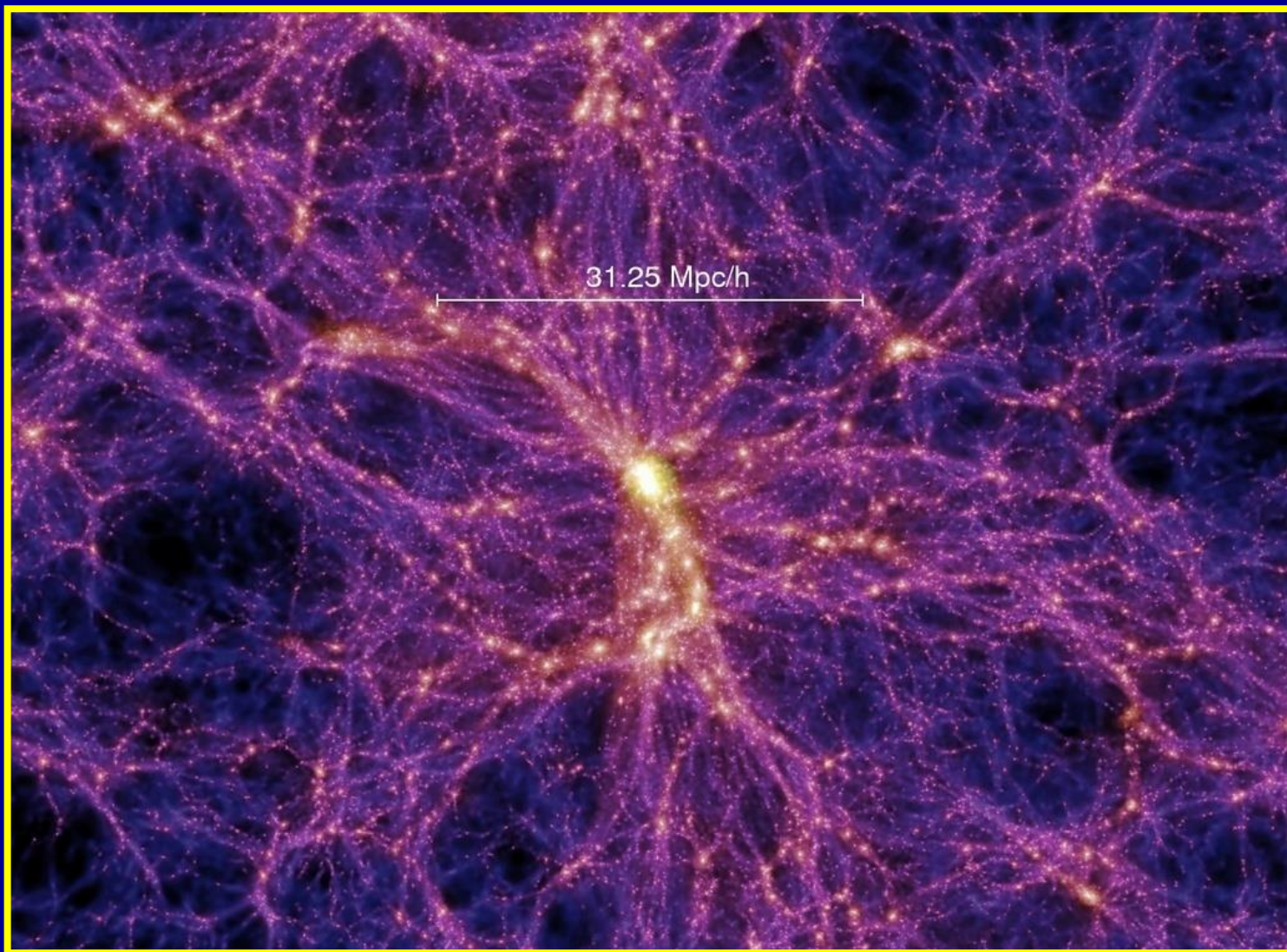
Regina Barbò

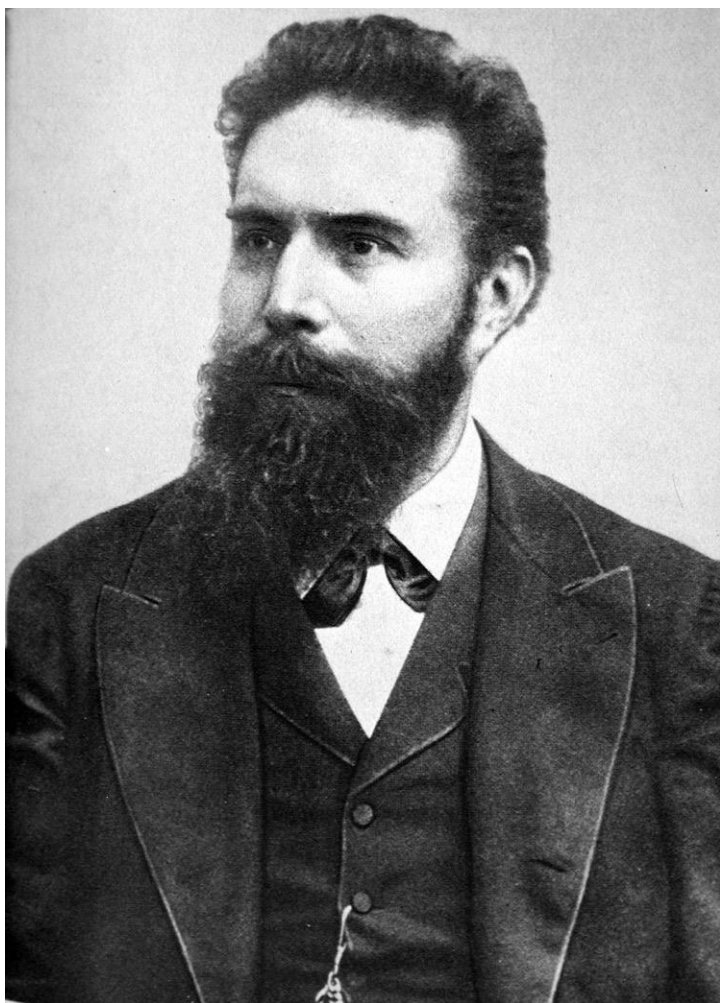
23 ottobre 2021

100 miliardi  
di neuroni

connessi tra loro attraverso

oltre 100.000 miliardi  
di sinapsi





La prima radiografia della mano di Frau Bertha, moglie di Röntgen, eseguita il 22 dicembre 1895.

1895



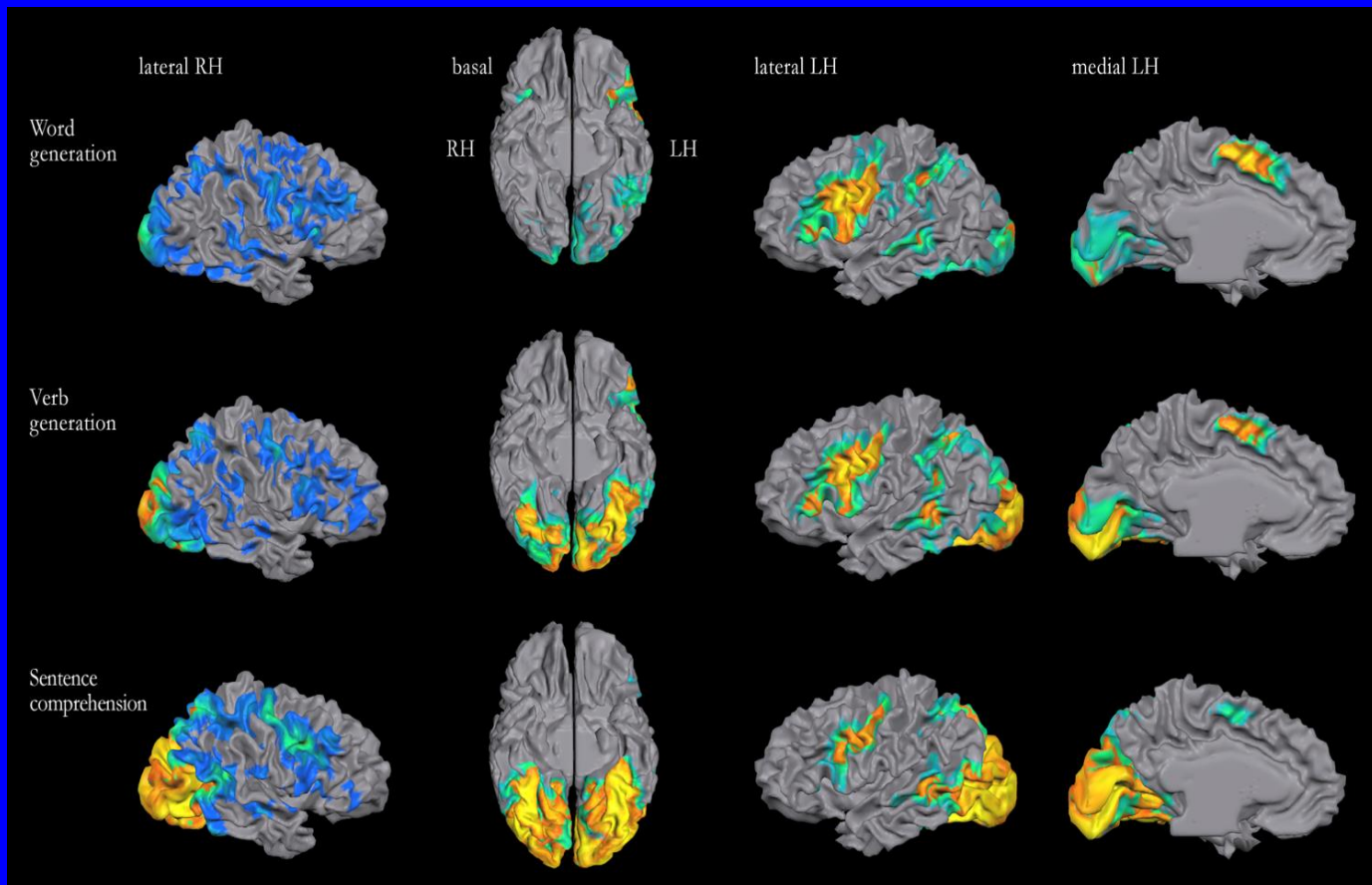
La prima radiografia della mano di Frau Bertha, moglie di Röntgen, eseguita il 22 dicembre 1895.

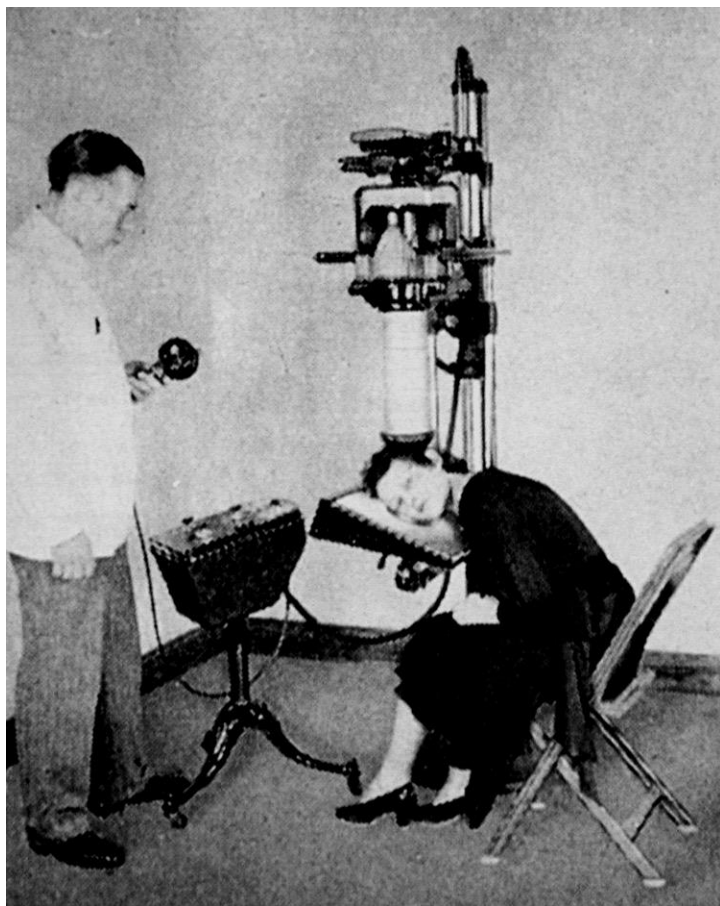
2021



Ricostruzione Trattografica  
delle connessioni neurali via DTI

# fMRI of language (n=21 subjects)





# DIAGNOSTICA PER IMMAGINI

## METODICHE

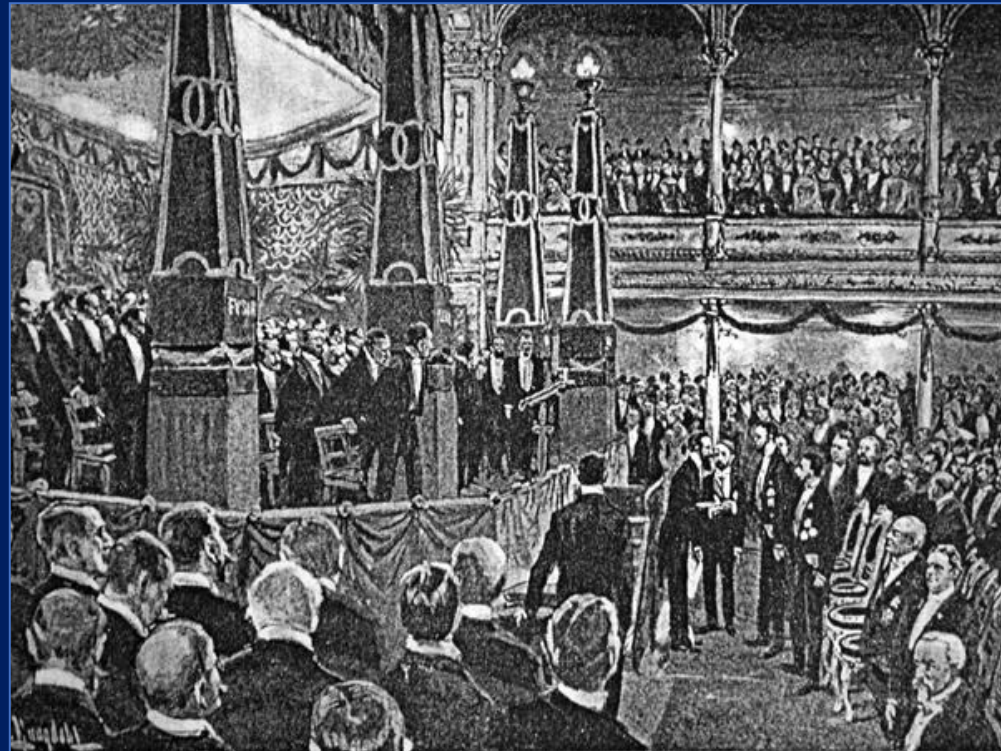
- **RX**
- **TC**
- **ANGIOGRAFIA**
- **RADIOLOGIA INTERVENTISTICA**
- **RM**
- **ECOGRAFIA**
- **MEDICINA NUCLEARE**



# DIAGNOSTICA PER IMMAGINI

## PREMI NOBEL

<b>Rx</b> Rontgen	1901
Fisica della <b>RM</b> Bloch e Purcell	1952
<b>TC</b> Hounsfield e Cormack	1979
<b>RM</b> Lauterbur e Mansfield	2003



# TECNICHE AVANZATE in Risonanza Magnetica



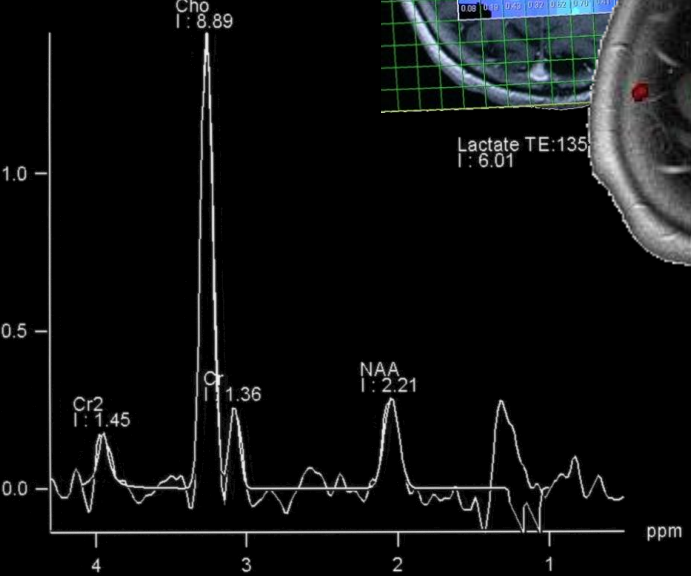
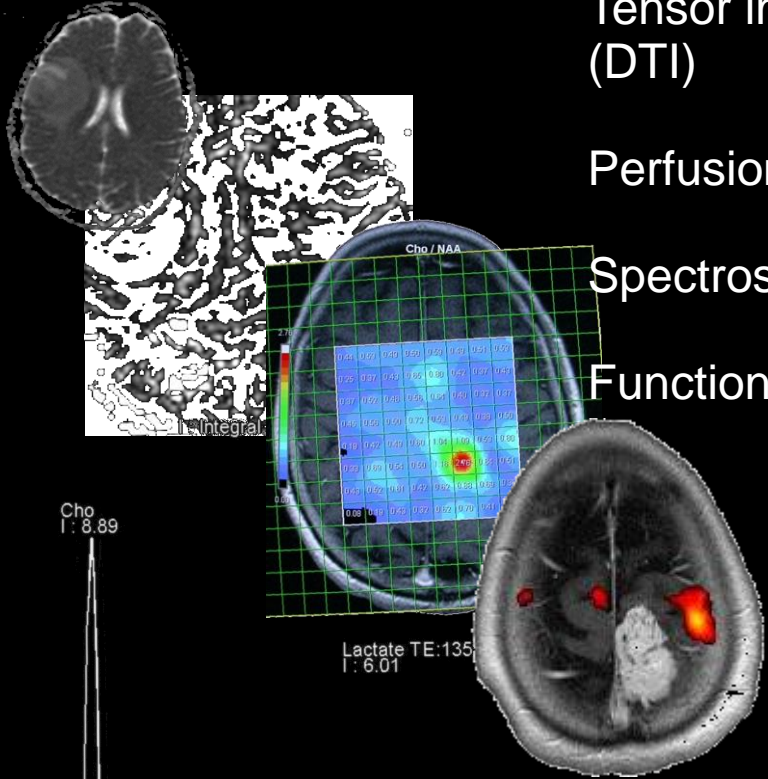
Diffusion (DWI)

Tensor imaging (DTI)

Perfusion (PWI)

Spectroscopy MR

Functional MR



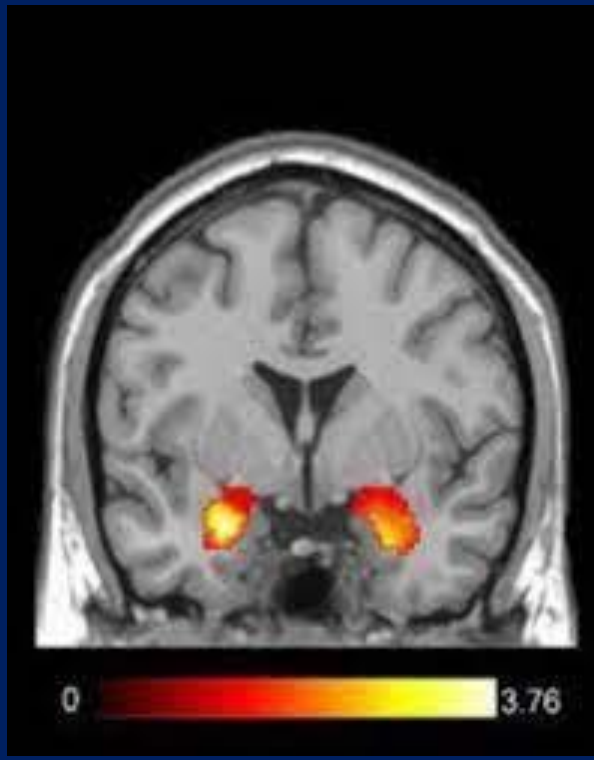
# IMAGING MORFOLOGICO



uomo 1350 grammi

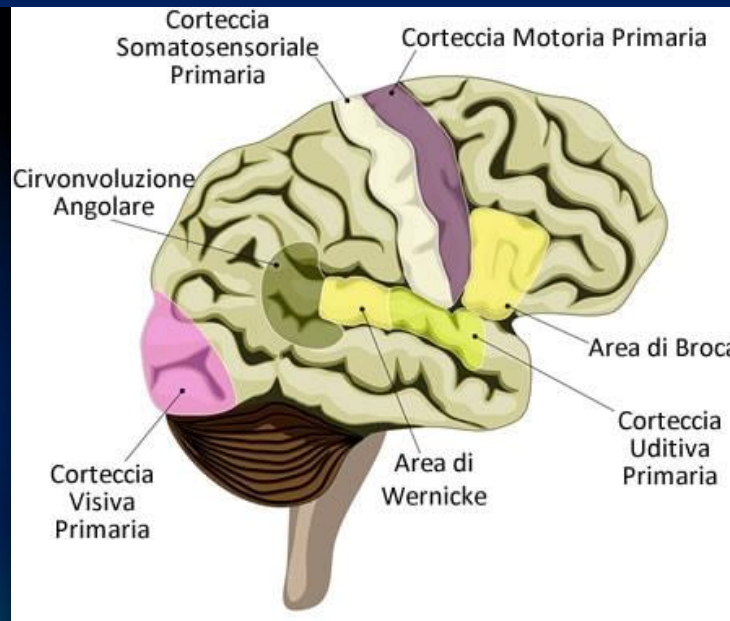
donna 1200 grammi

# NEUROIMAGING MORFOLOGICO



- Amigdala
- Ipotalamo

# NEUROIMAGING MORFOLOGICO

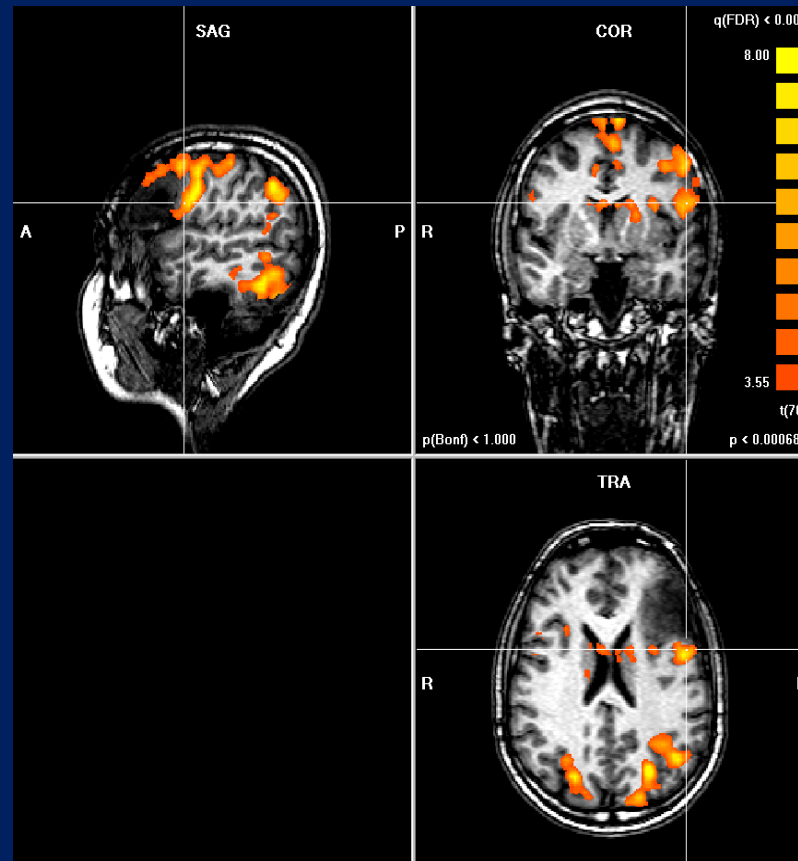


- Corteccia prefrontale
- Ippocampo
- Aree del linguaggio



# NEUROIMAGING FUNZIONALE fMR

fMR: Verb generation



ossiHB: diamagnetica

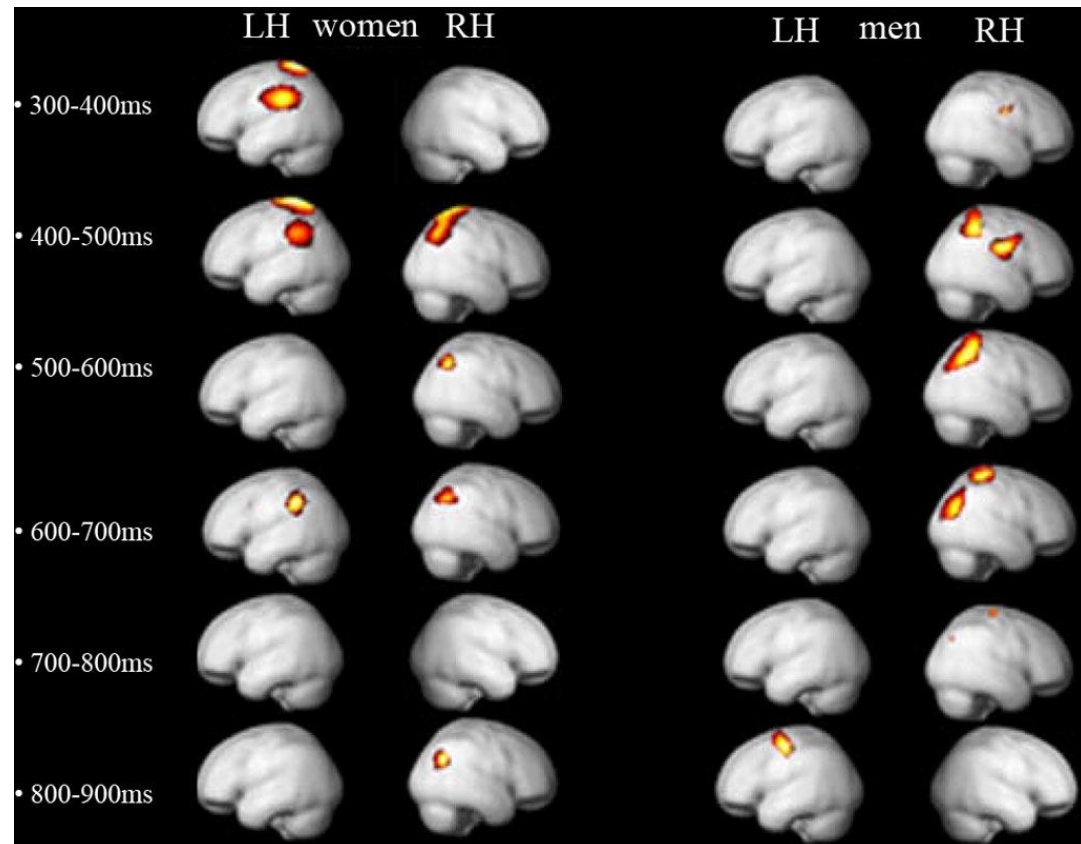
deossiHB: paramagnetica

# Sex-related similarities and differences in the neural correlates of beauty

Camilo J. Cela-Conde<sup>a,1</sup>, Francisco J. Ayala<sup>b,1</sup>, Enric Munar<sup>a</sup>, Fernando Maestú<sup>c</sup>, Marcos Nadal<sup>a</sup>, Miguel A. Capó<sup>a</sup>, David del Río<sup>c</sup>, Juan J. López-Ibor<sup>d</sup>, Tomás Ortiz<sup>c</sup>, Claudio Mirasso<sup>e</sup>, and Gisèle Marty<sup>a</sup>

<sup>a</sup>Laboratory of Human Systematics, Universidad de las Islas Baleares, 07122 Palma de Mallorca, Spain; <sup>b</sup>Department of Ecology and Evolutionary Biology, University of California, Irvine, CA 92697; <sup>c</sup>Centro de Magnetoencefalografía Dr. Pérez Modrego, Universidad Complutense, 28040 Madrid, Spain; <sup>d</sup>Instituto de Psiquiatría y Mental Health, San Carlos Clinical Hospital, Universidad Complutense, 28040 Madrid, Spain; and <sup>e</sup>Instituto de Física Interdisciplinaria y Sistemas Complejos, Consejo Superior de Investigaciones Científicas (CSIC), 07122 Palma de Mallorca, Spain

Contributed by Francisco J. Ayala, January 12, 2009 (sent for review January 9, 2008)

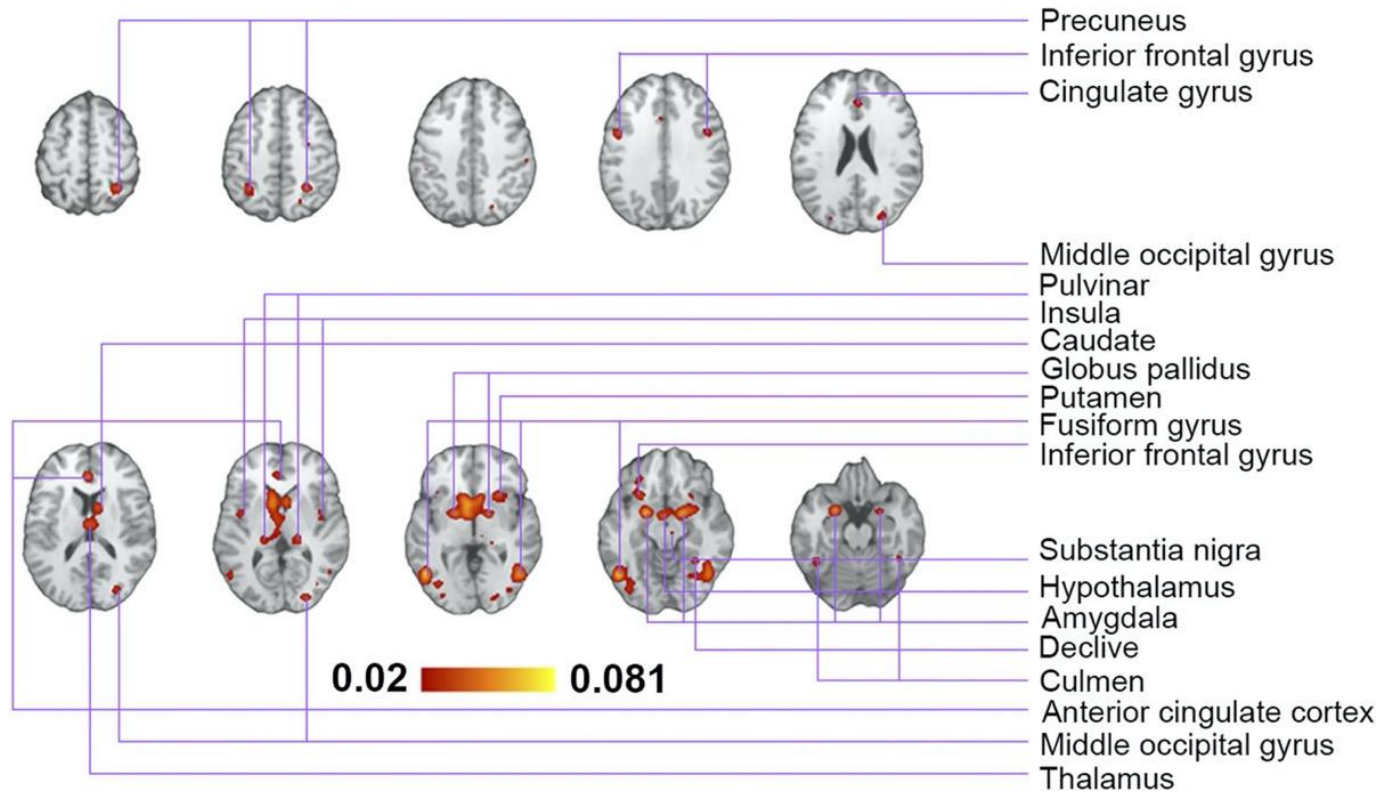


# Neural substrates of sexual arousal are not sex dependent

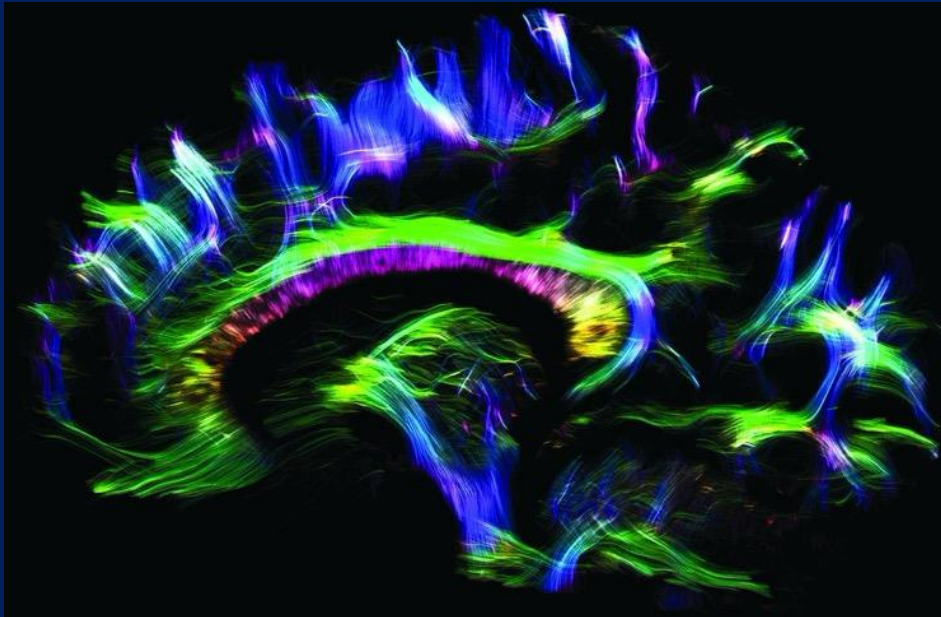
Ekaterina Mitricheva<sup>a</sup>, Rui Kimura<sup>a</sup>, Nikos K. Logothetis<sup>a,b,1</sup>, and Hamid R. Noori<sup>a,1</sup>

<sup>a</sup>Department of Physiology of Cognitive Processes, Max Planck Institute for Biological Cybernetics, 72076 Tübingen, Germany; and <sup>b</sup>Imaging Science and Biomedical Engineering, University of Manchester, Manchester M13 9PL, United Kingdom

Contributed by Nikos K. Logothetis, June 4, 2019 (sent for review March 22, 2019; reviewed by Georg Juckel and Gunter Schumann)



# NEUROIMAGING FUNZIONALE: TRATTOGRAFIA



Utilizzando il tensore di diffusione, parametro matematico e algoritmi di elaborazione specifici, si può ottenere una **mappa anatomica tridimensionale** dei fasci di sostanza bianca.

Una rete mirabile di assoni preposta a convogliare gli impulsi nervosi e a coordinare e modulare le risposte ai diversi stimoli.

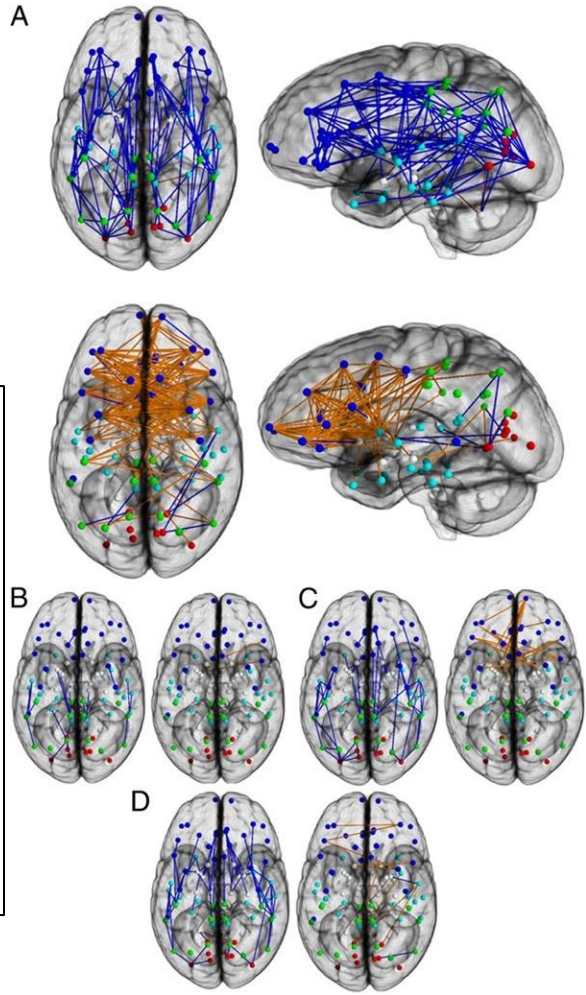
# Sex differences in the structural connectome of the human brain

Madhura Ingalhalikar<sup>a,1</sup>, Alex Smith<sup>a,1</sup>, Drew Parker<sup>a</sup>, Theodore D. Satterthwaite<sup>b</sup>, Mark A. Elliott<sup>c</sup>, Kosha Ruparel<sup>b</sup>, Hakon Hakonarson<sup>d</sup>, Raquel E. Gur<sup>b</sup>, Ruben C. Gur<sup>b</sup>, and Ragini Verma<sup>a,2</sup>

<sup>a</sup>Section of Biomedical Image Analysis and <sup>c</sup>Center for Magnetic Resonance and Optical Imaging, Department of Radiology, and <sup>b</sup>Department of Neuropsychiatry, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA 19104; and <sup>d</sup>Center for Applied Genomics, Children's Hospital of Philadelphia, Philadelphia, PA 19104

**Cervello dell'uomo**  
La maggior parte delle connessioni si sviluppano tra la parte anteriore e la parte posteriore del medesimo emisfero. Questo si traduce in miglior capacità spaziali e motorie di controllo nell'uomo

**Cervello della donna**  
Le connessioni neurali si sviluppano da un lato all'altro degli emisferi del cervello. Questo potrebbe spiegare le migliori competenze femminili per quanto riguarda la capacità verbale e quella intuitiva.



# Sex differences in the structural connectome of the human brain

Madhura Ingalhalikar<sup>a,1</sup>, Alex Smith<sup>a,1</sup>, Drew Parker<sup>a</sup>, Theodore D. Satterthwaite<sup>b</sup>, Mark A. Elliott<sup>c</sup>, Kosha Ruparel<sup>b</sup>, Hakon Hakonarson<sup>d</sup>, Raquel E. Gur<sup>b</sup>, Ruben C. Gur<sup>b</sup>, and Ragini Verma<sup>a,2</sup>

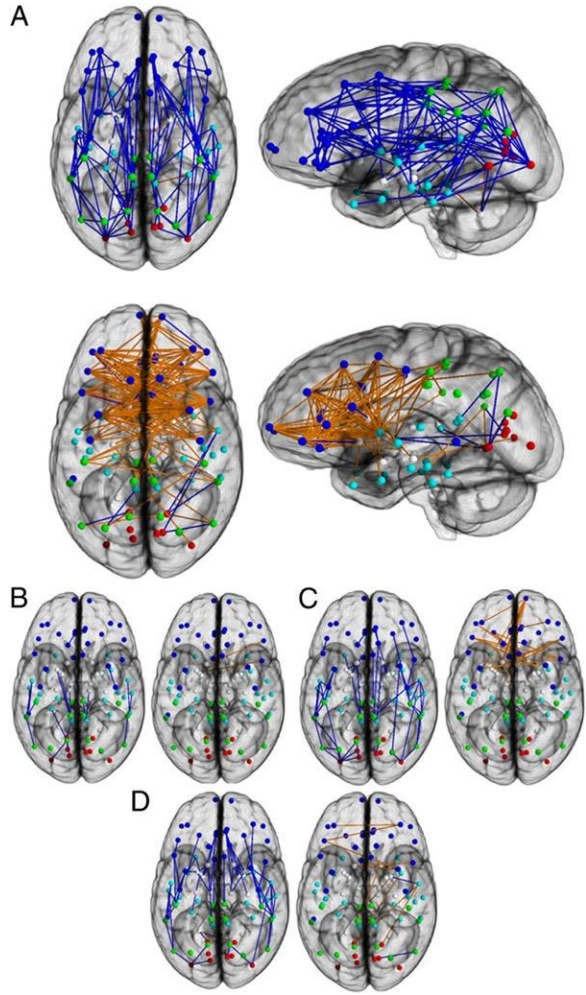
<sup>a</sup>Section of Biomedical Image Analysis and <sup>c</sup>Center for Magnetic Resonance and Optical Imaging, Department of Radiology, and <sup>b</sup>Department of Neuropsychiatry, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA 19104; and <sup>d</sup>Center for Applied Genomics, Children's Hospital of Philadelphia, Philadelphia, PA 19104

## Cervello dell'uomo

Connessione tra  
PERCEZIONE e  
AZIONE COORDINATA

## Cervello della donna

Elaborazione delle informazioni a  
LIVELLO ANALITICO emisferoSX  
ANALISI INTUITIVA emisferoDX





Uomini e donne appaiono sempre più diversi per la scienza e lo sono anche rispetto alla sensibilità a certe malattie e alla risposta a determinate terapie

# LE DEMENZE



- Cancellazione anatomica e funzionale di aree cerebrali differenti

## Diagnosi

- Clinica
- Radiologica

# NEUROIMAGING

## MORFOLOGICO e FUNZIONALE

importante soprattutto nelle fasi iniziali della malattia, per supportare una diagnosi ed impostare una condotta terapeutica specifica.

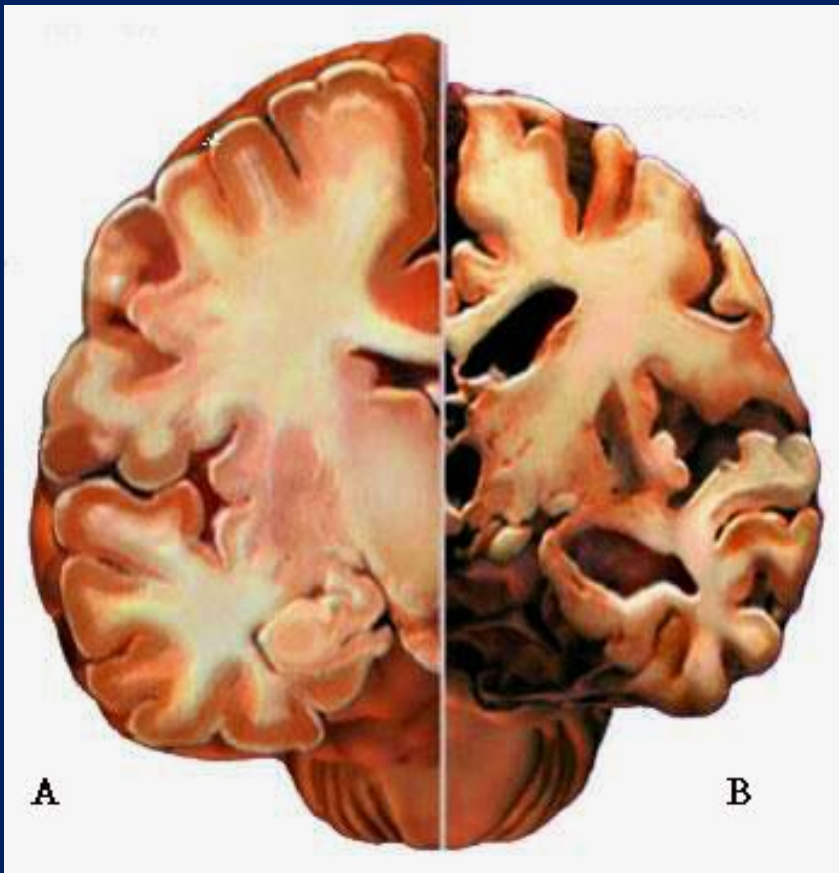
TC e RM

- **Atrofia** con ampliamento degli spazi liquorali

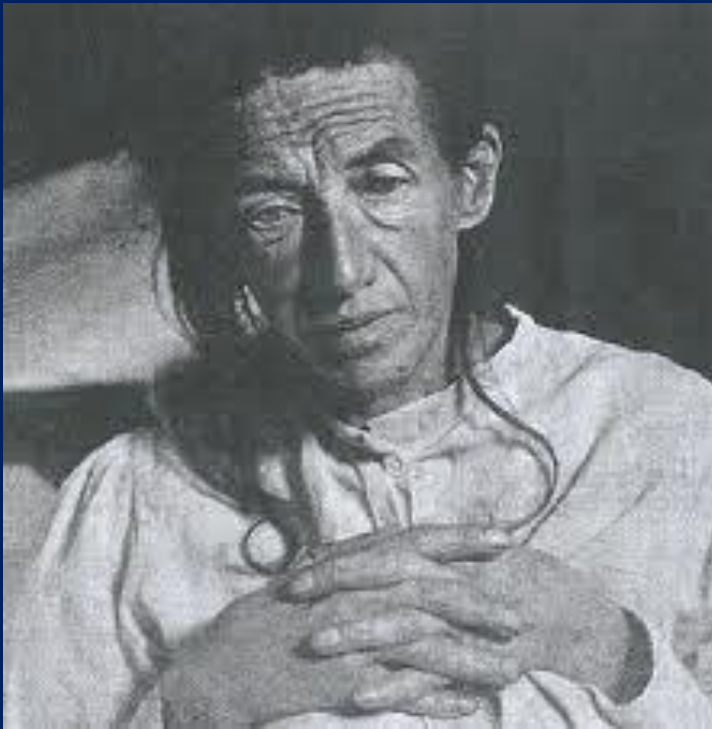
- **PET e fRM**

Attivazione più elevata

funzioni compensatorie



# Demenza di Alzheimer



**Più frequente tra le demenze  
progressiva ed irreversibile**

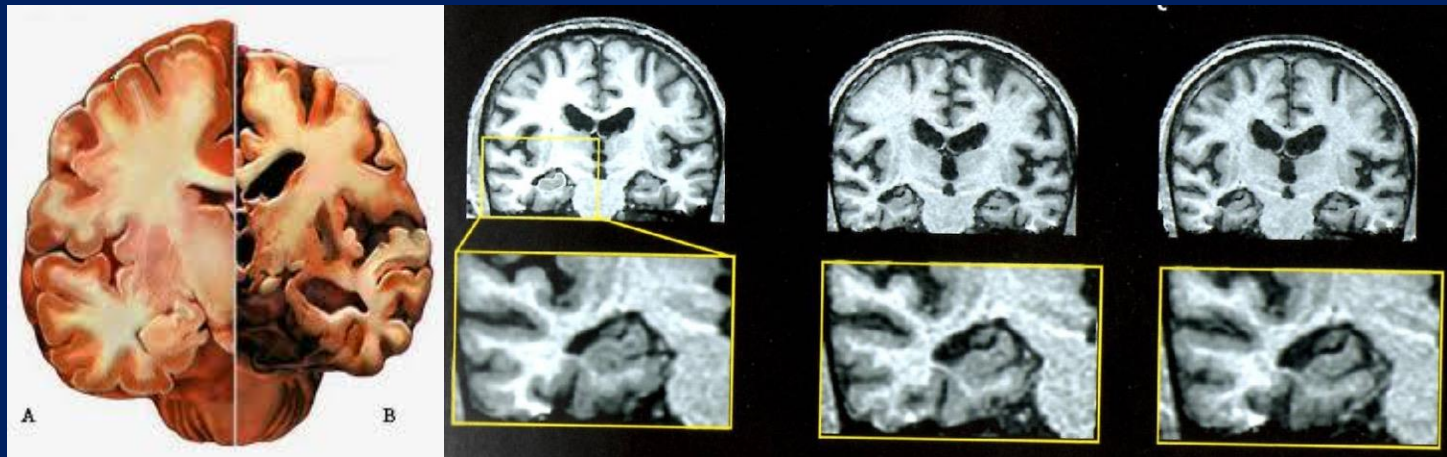
**Prevalente nelle femmine**

**1° causa di invalidità  
neurologica nei paesi occidentali**

**Problema di salute pubblica**



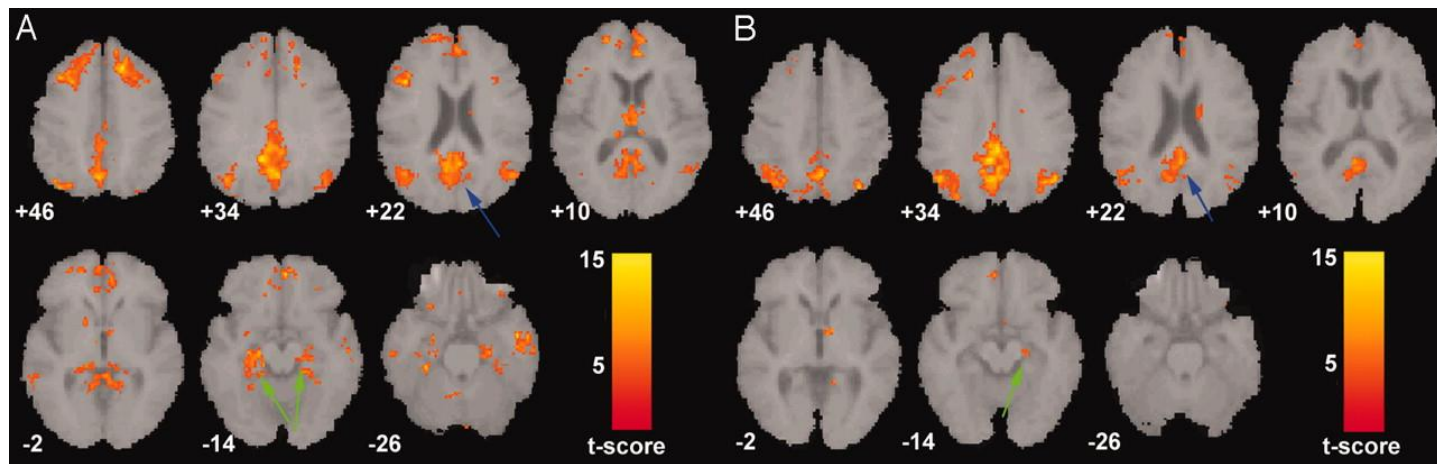
# RM morfologica-VOLUMETRICA



Serve ad identificare i casi precoci

Definire i diversi tipi di demenza

Monitorare l'evoluzione

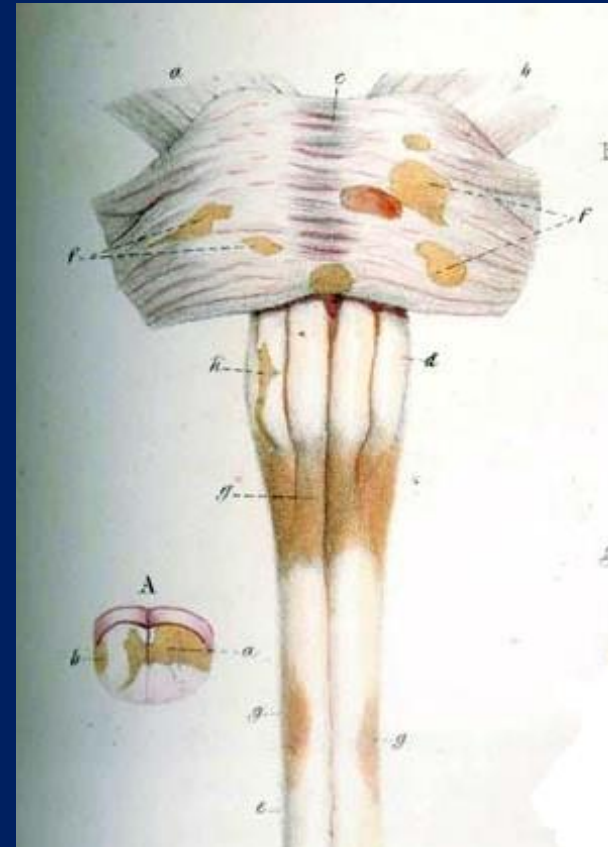
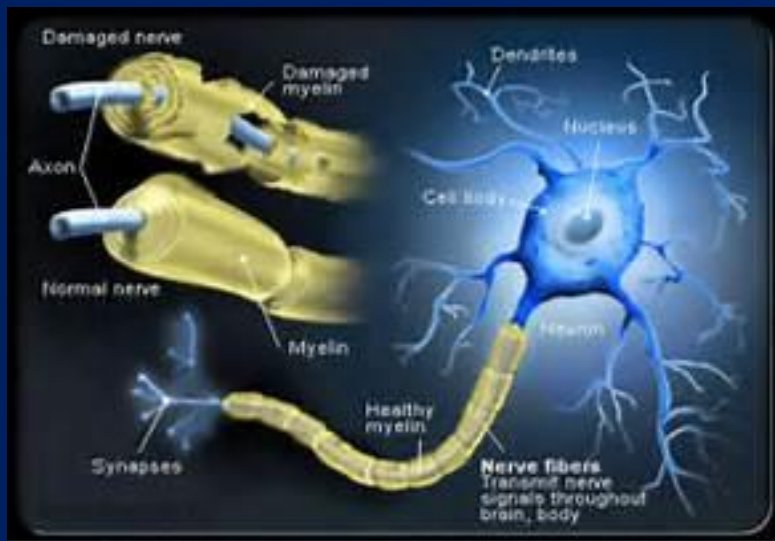


Greicius M D et al. PNAS 2004;101:4637-4642

©2004 by National Academy of Sciences

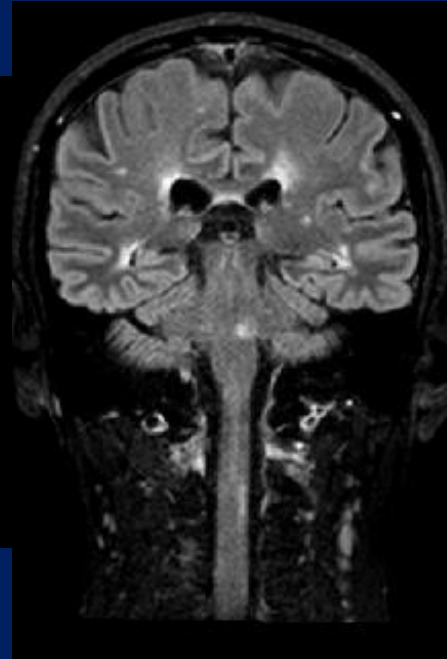
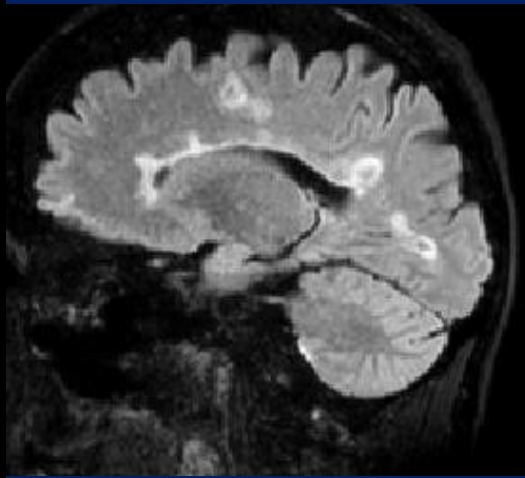
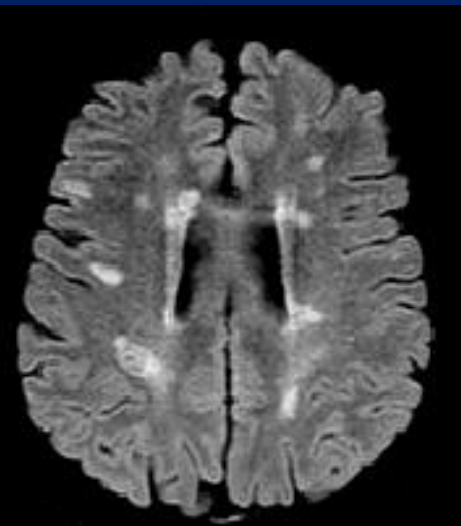
PNAS

# SCLEROSI MULTIPLA



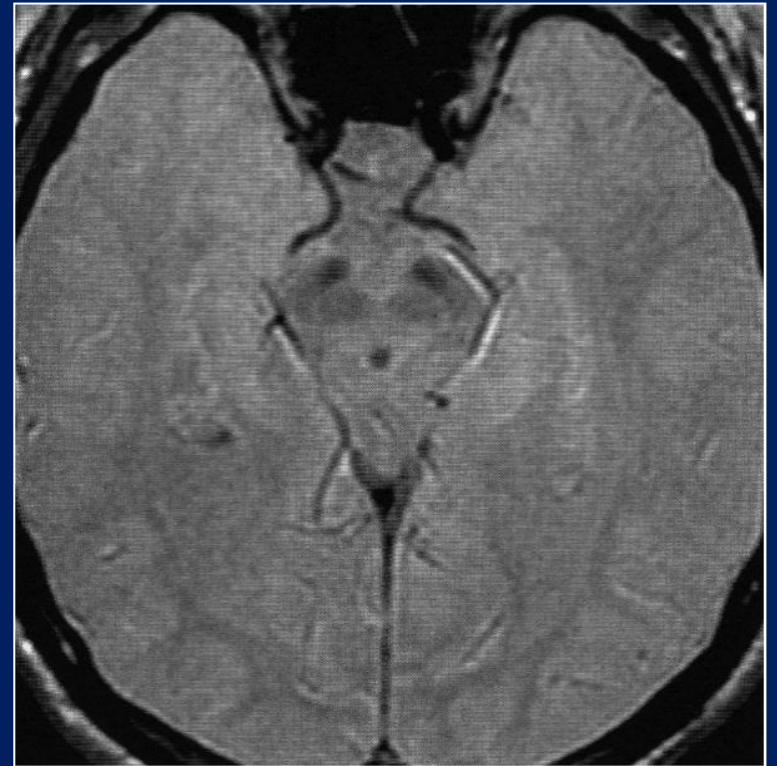
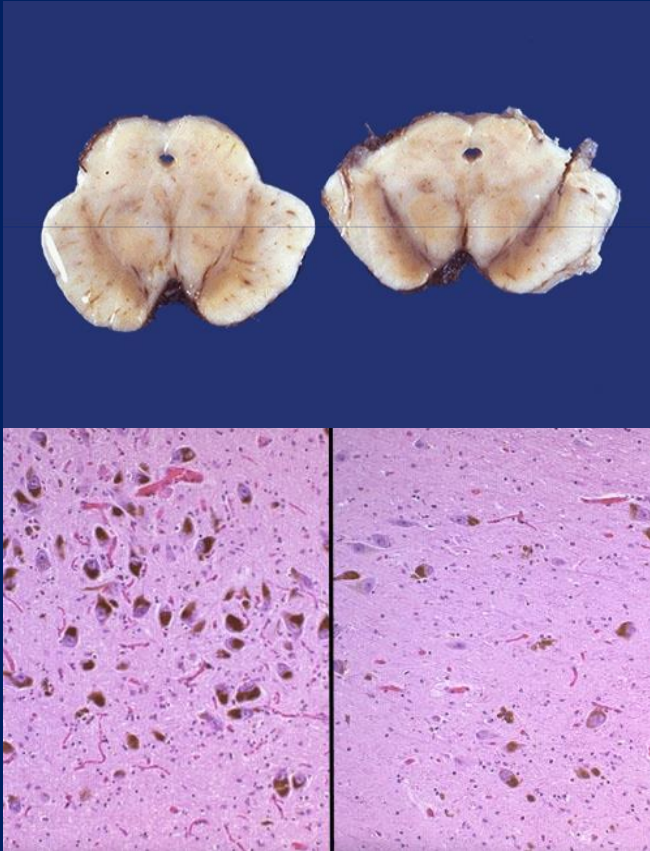
La **sclerosi multipla** è una malattia autoimmune a carattere neurodegenerativo, per la quale abbiamo delle **differenze di genere**, sia in termini di suscettibilità alla malattia, sia in termini di risposta terapeutica e progressione della patologia.

# NEUROIMAGING MORFOLOGICO



Una diagnosi precoce può impattare sulla storia della malattia e rallentare in maniera significativa la sua progressione.

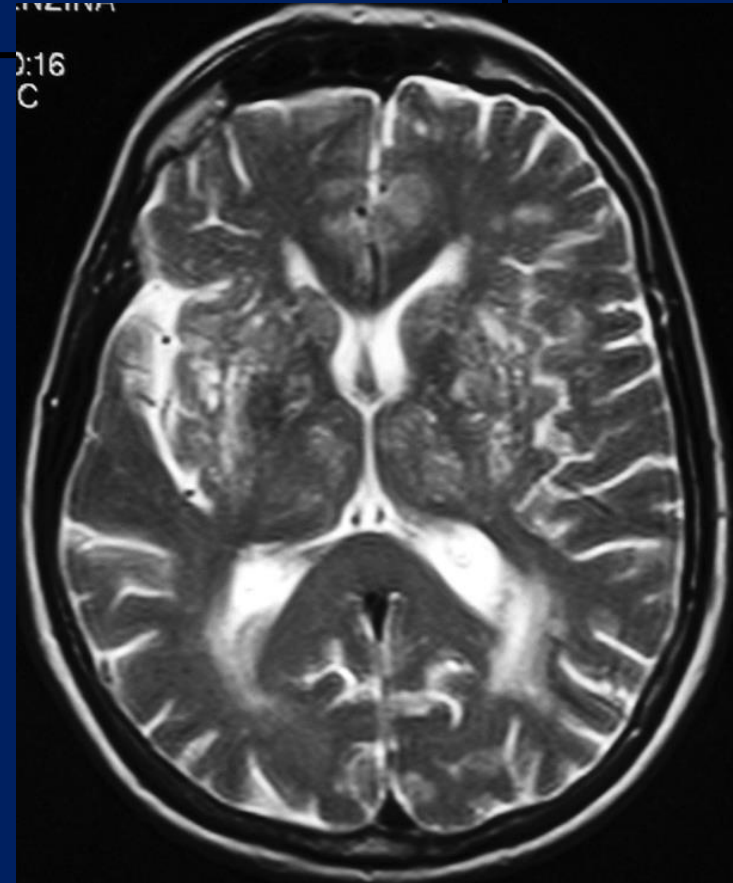
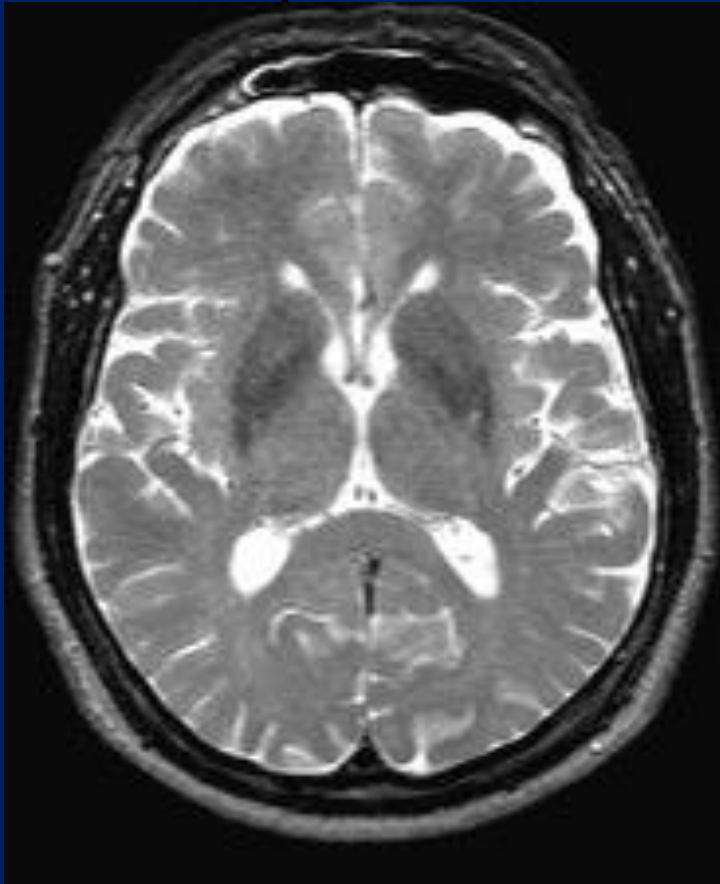
# MALATTIA di PARKINSON



# NEUROIMAGING MORFOLOGICO



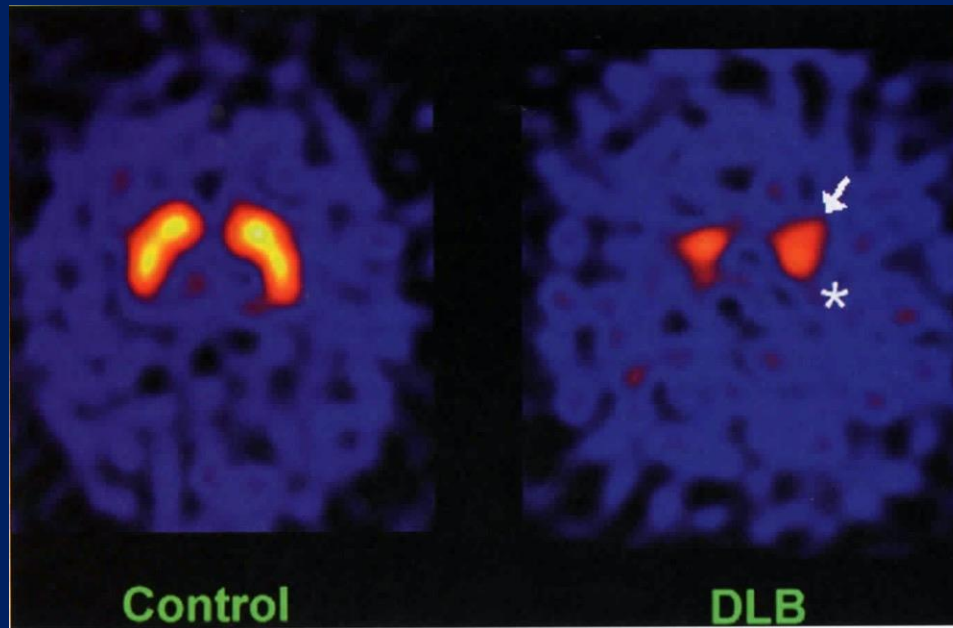
MALATTIA di PARKINSON  
IDIOPATICA e VASCOLARE





# IMAGING di MEDICINA NUCLEARE

## DATSCAN/SPECT $6\text{-}[^{18}\text{F}]\text{FLUORO-L-DOPA}$



Marcata riduzione della densità dei neuroni dopaminergici  
nei nuclei caudato e putamen

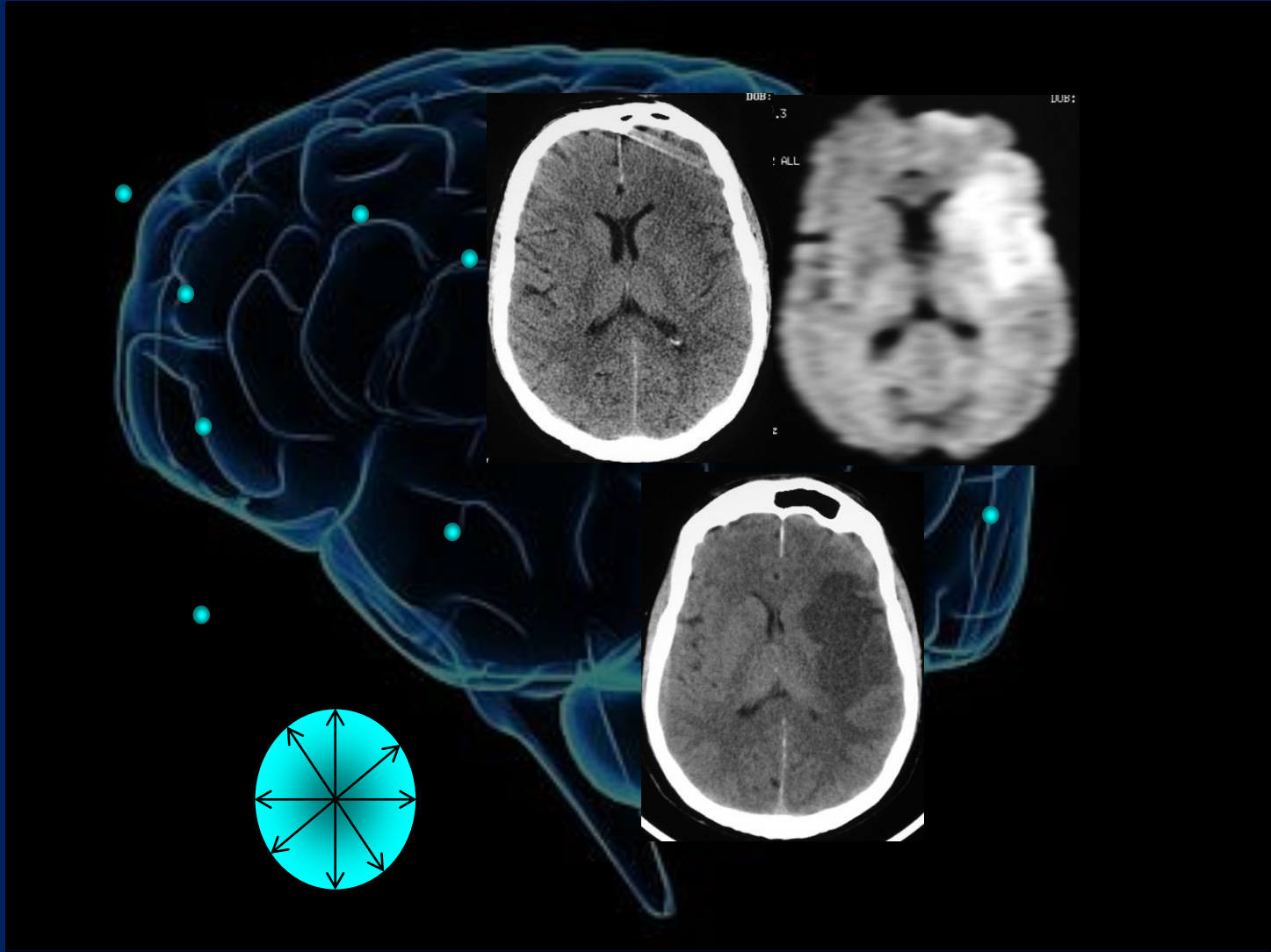
# NEUROIMAGING MORFOLOGICO



## ICTUS EMORRAGICO ACUTO: TC



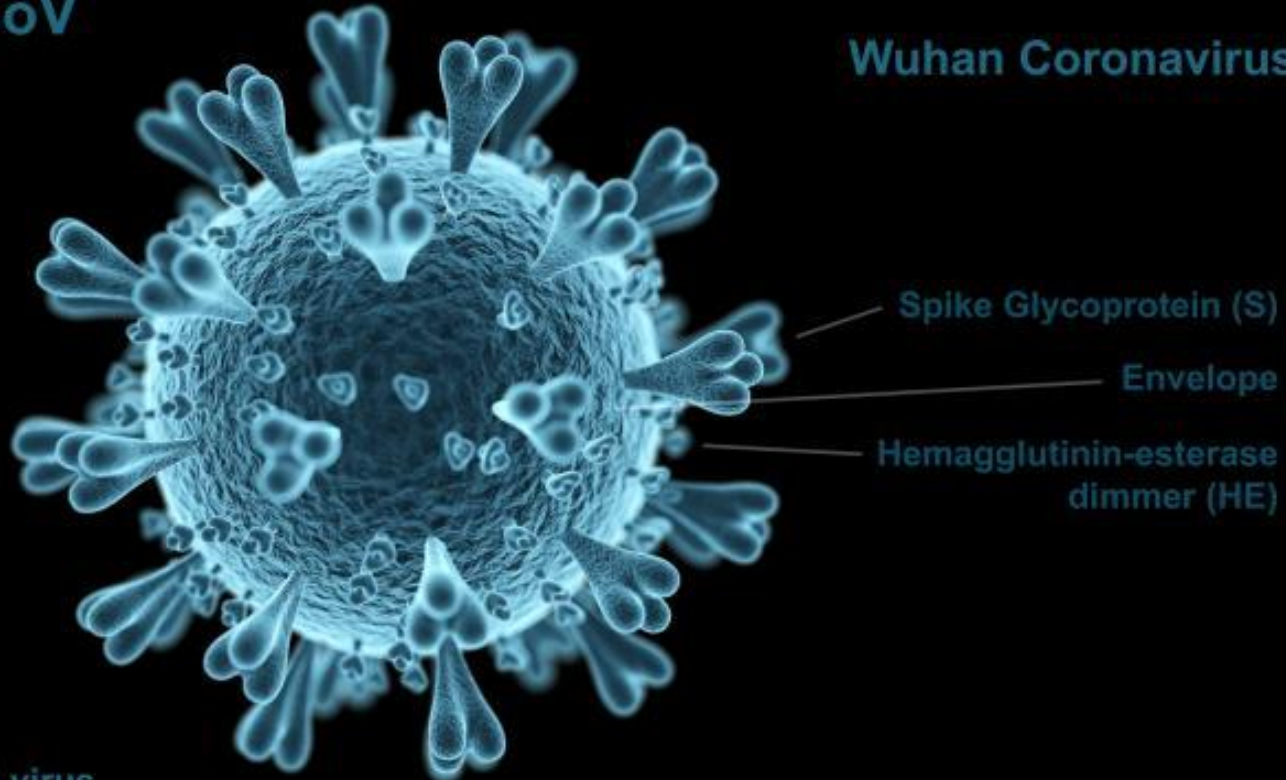
# ICTUS ISCHEMICO-TC e RM: diffusione isotropica



# RISONANZA MAGNETICA e COVID-19

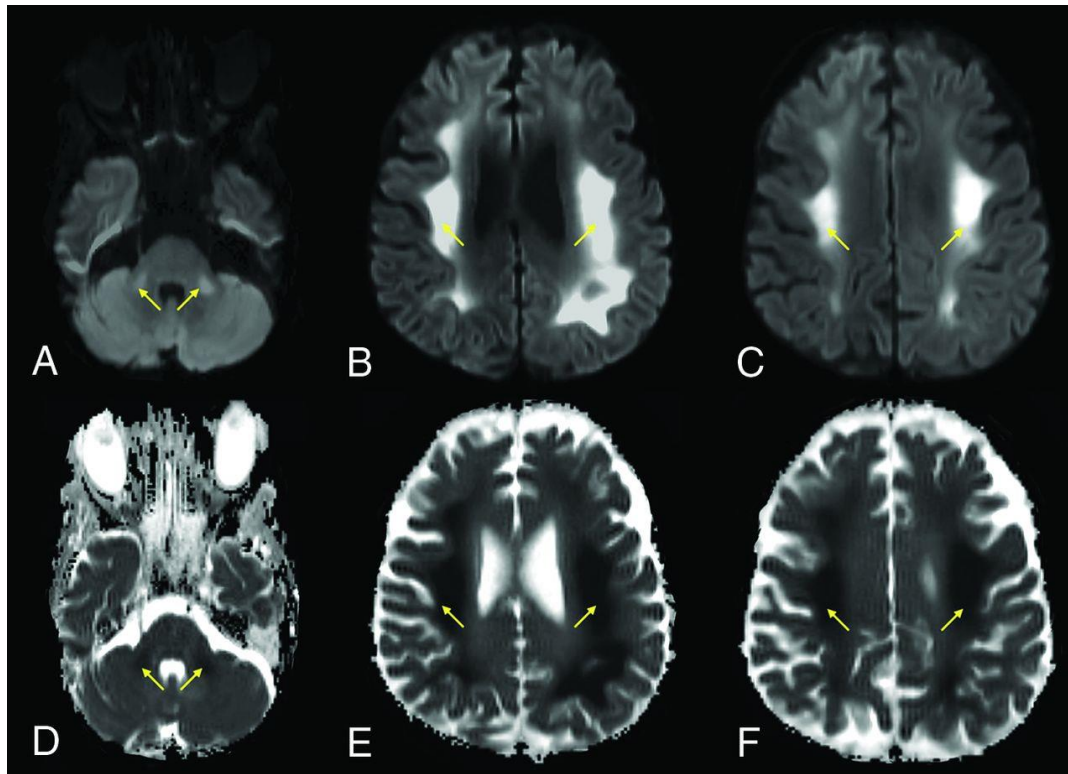
2019-nCoV

Wuhan Coronavirus



RNA virus

**A 64-year-old man with a history of diabetes and hyperlipidemia, admitted with COVID-19–related hypoxemic respiratory failure and worsening septic shock.**



O. Rapalino et al. AJNR Am J Neuroradiol 2021;42:632-638



# MESSAGGIO FINALE



Ogni PERSONA  
è

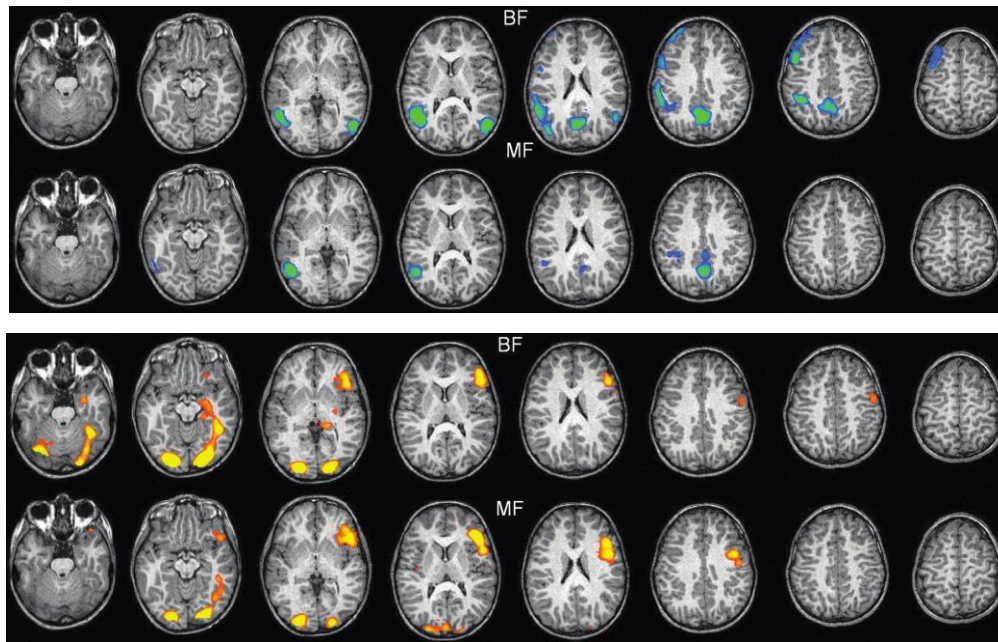
un piccolo

grande universo

Grazie dell'attenzione!

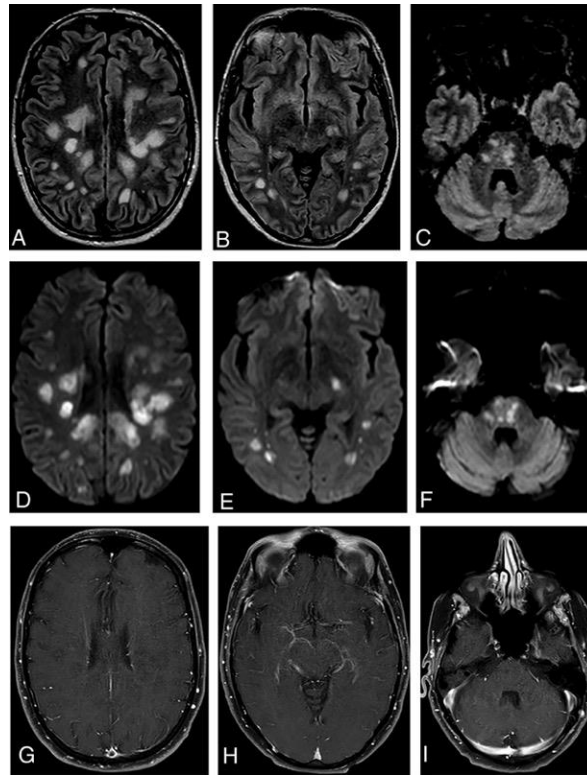
## Voxel-Based Morphometry and fMRI Revealed Differences in Brain Gray Matter in Breastfed and Milk Formula–Fed Children

X. Ou, A. Andres, R.T. Pivik, M.A. Cleves, J.H. Snow, Z. Ding, and T.M. Badger



**FIG 4.** Average activation maps for the fMRI language task for BF (top row) and MF (bottom row) children. Activated regions are highlighted in yellow/orange. The threshold was set at  $P < .001$  after Bonferroni correction and a cluster size of  $\geq 30$  voxels. All images are displayed in radiologic convention (left/right flipped). BF children had more extensive activation in the left temporal lobe.

**FLAIR images (A–C) depict multiple nodular/oval hyperintensities that involve the deep and periventricular cerebral white matter, splenium of the corpus callosum, and pons.**



F.B. Assunção et al. AJNR Am J Neuroradiol 2021;42:E21-E23

# Sex beyond the genitalia: The human brain mosaic

Daphna Joel<sup>a,b,1</sup>, Zohar Berman<sup>b</sup>, Ido Tavor<sup>c</sup>, Nadav Wexler<sup>d</sup>, Olga Gaber<sup>a</sup>, Yaniv Stein<sup>d</sup>, Nisan Shefi<sup>a,b</sup>, Jared Pool<sup>e</sup>, Sebastian Urchs<sup>e</sup>, Daniel S. Margulies<sup>e</sup>, Franziskus Liem<sup>e,f</sup>, Jürgen Hänggi<sup>f</sup>, Lutz Jäncke<sup>f</sup>, and Yaniv Assaf<sup>b,c</sup>

<sup>a</sup>School of Psychological Sciences, Tel-Aviv University, Ramat Aviv, Tel-Aviv 6997801, Israel; <sup>b</sup>Sagol School of Neuroscience, Tel-Aviv University, Ramat Aviv, Tel-Aviv 6997801, Israel; <sup>c</sup>Department of Neurobiology, Faculty of Life Sciences, Tel-Aviv University, Ramat Aviv, Tel-Aviv 6997801, Israel; <sup>d</sup>School of Mathematical Sciences, Tel-Aviv University, Ramat Aviv, Tel-Aviv 6997801, Israel; <sup>e</sup>Max Planck Research Group for Neuroanatomy & Connectivity, Max Planck Institute for Human Cognitive and Brain Sciences, 04103 Leipzig, Germany; and <sup>f</sup>Division Neuropsychology, Department of Psychology, University of Zurich, 8050 Zurich, Switzerland

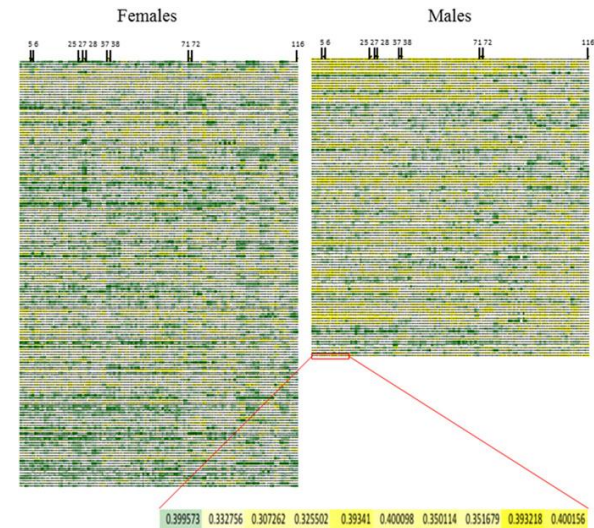
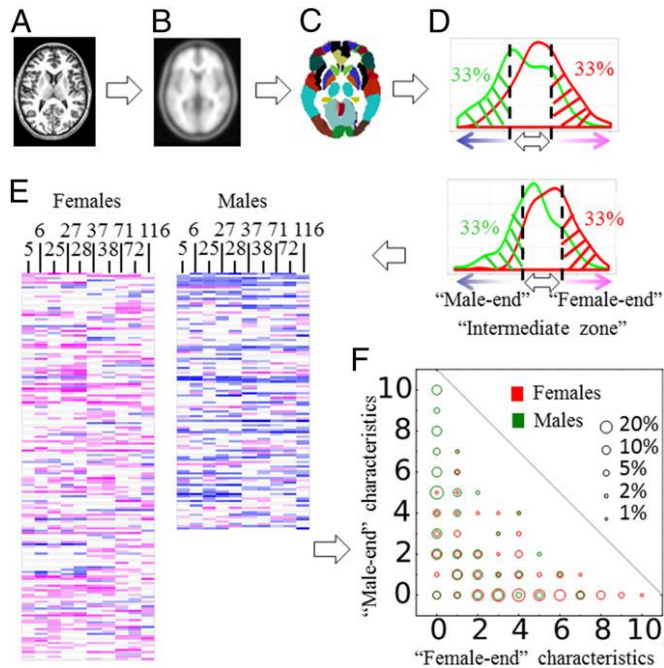


Fig. 3. The human brain mosaic. The gray matter volume of all 116 regions of gray matter in females (Left) and in males (Right) from the first sample is represented using a continuous high-low (green-white-yellow) scale. Each