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Davide Bosello (Master Student)
Ludovica Cipressi (Bachelor Student)

Synaptic Neurophysiology

Lorenzo Cingolani

University of Trieste - Italy



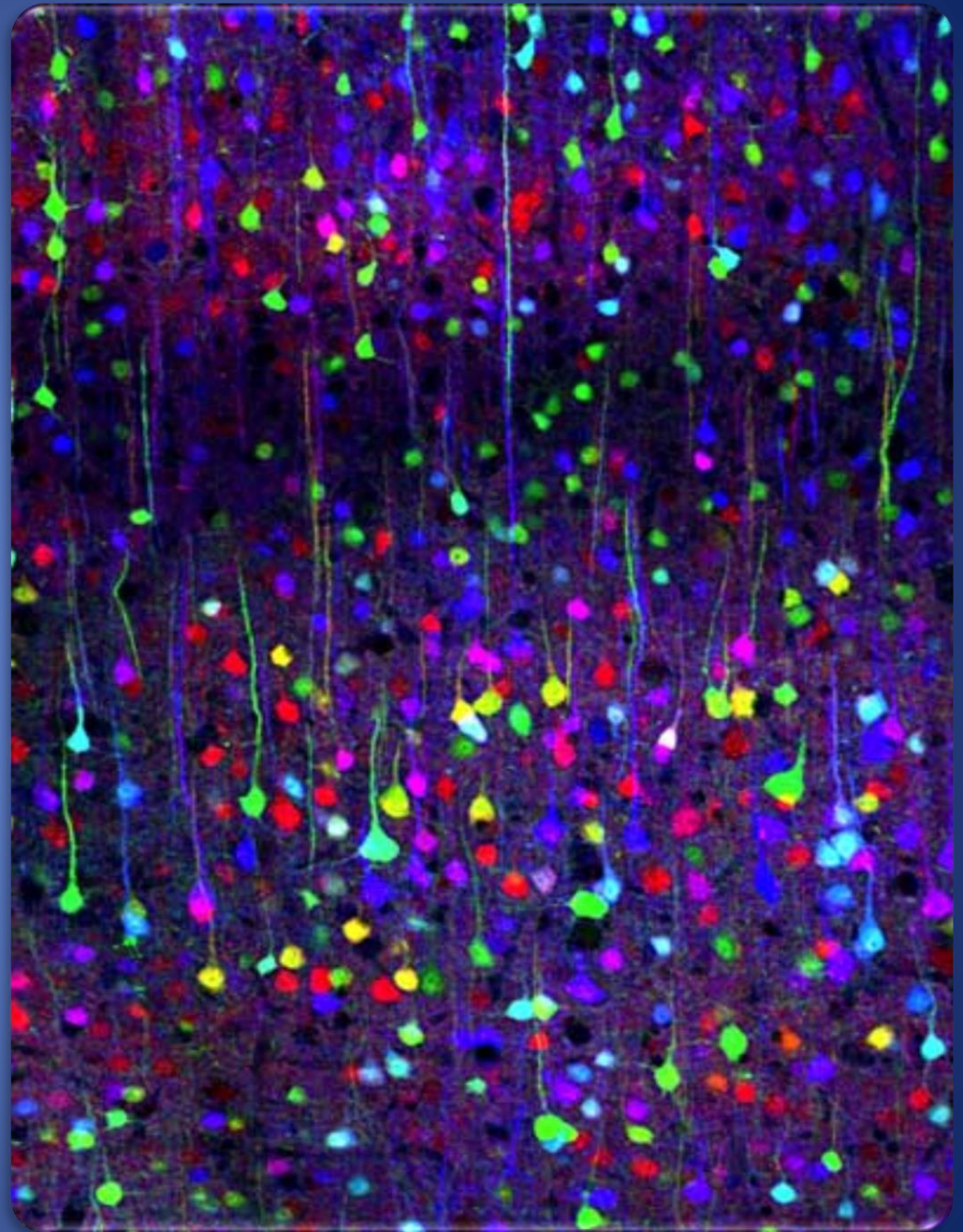
Lab Presentation day

22 April 2026

Can we repair brain connectivity?

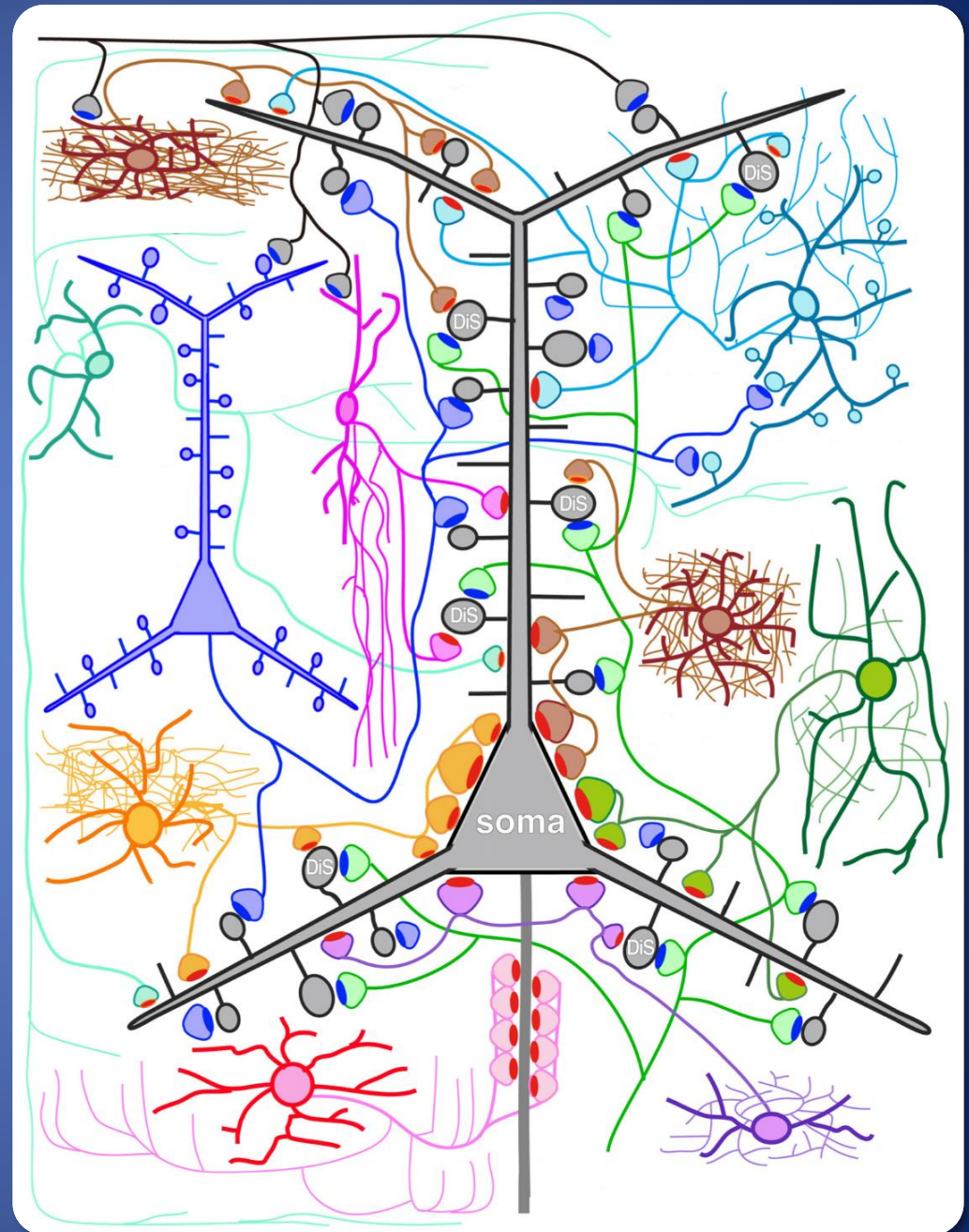
Many brain disorders are not about cell death but about incorrect connections

Autism / epilepsy / stroke

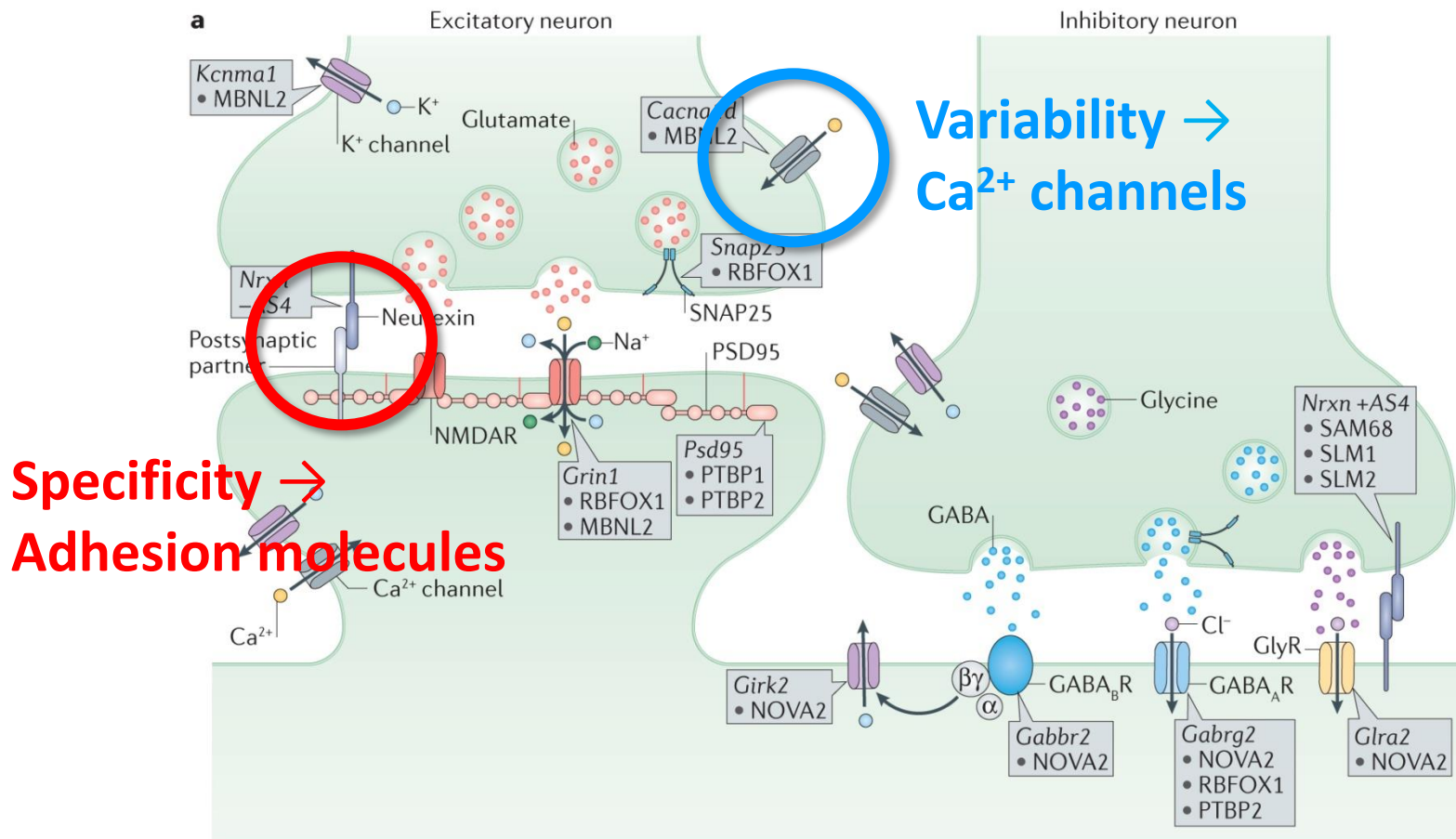


The brain fails at the level of synapses

Connectopathies
Synaptopathies

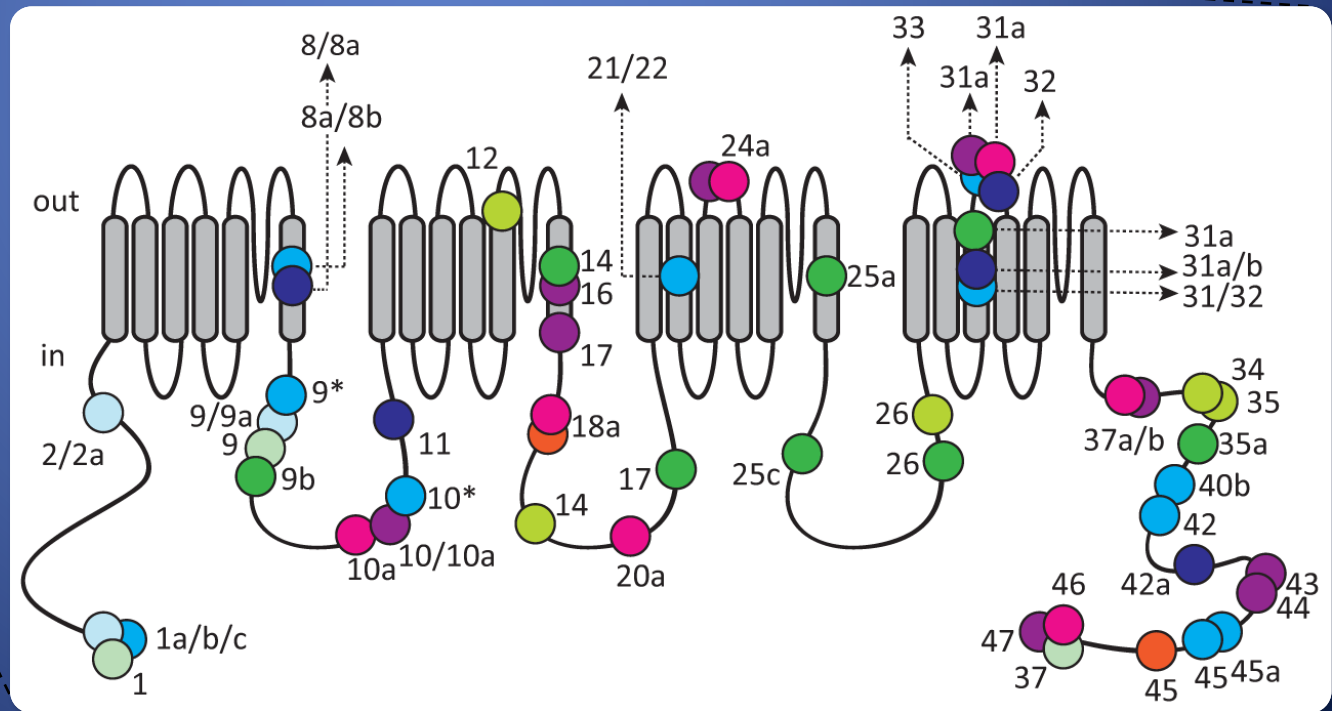
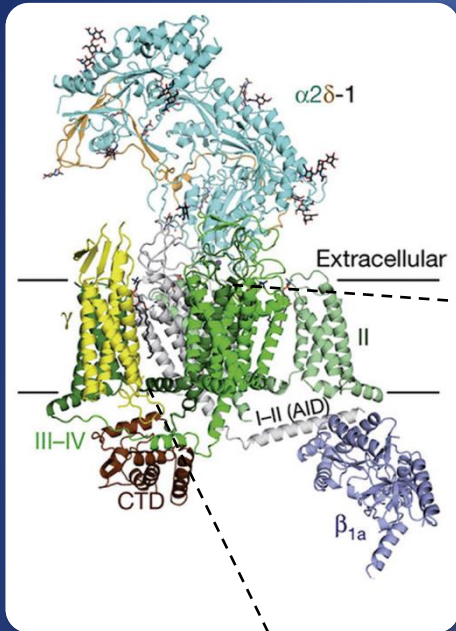


Two levers control synapses



Calcium channel:

One gene → thousands of channel variants



Can we reprogram calcium channel variability to treat *CACNA1A* disorders?

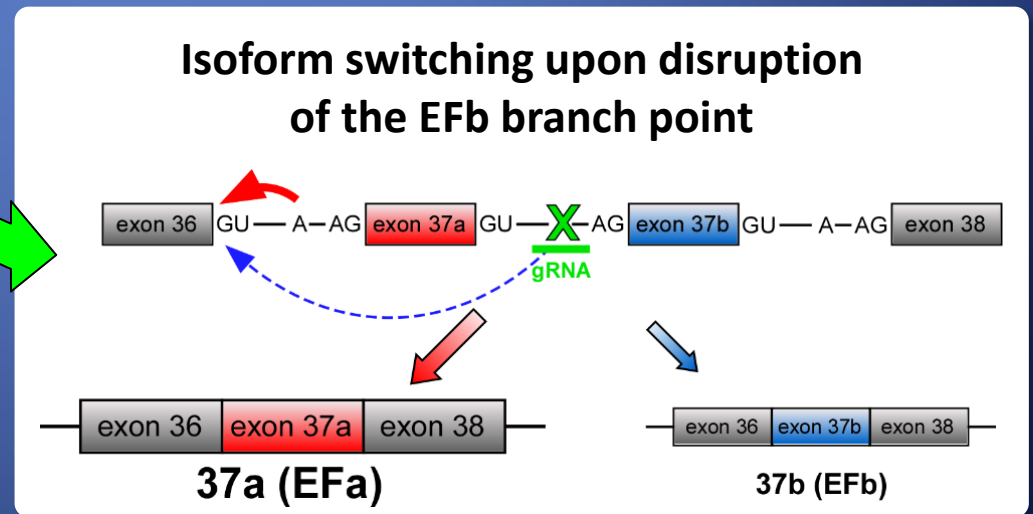
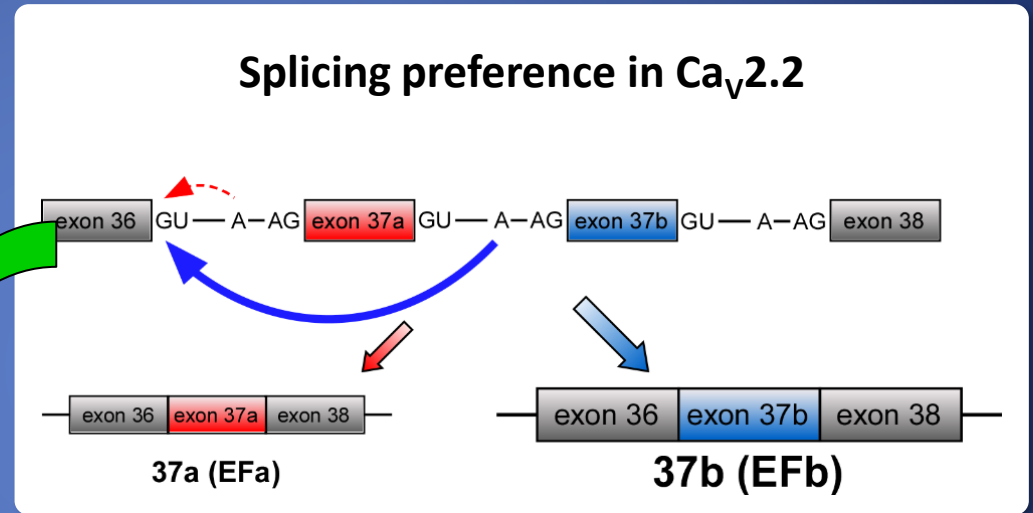
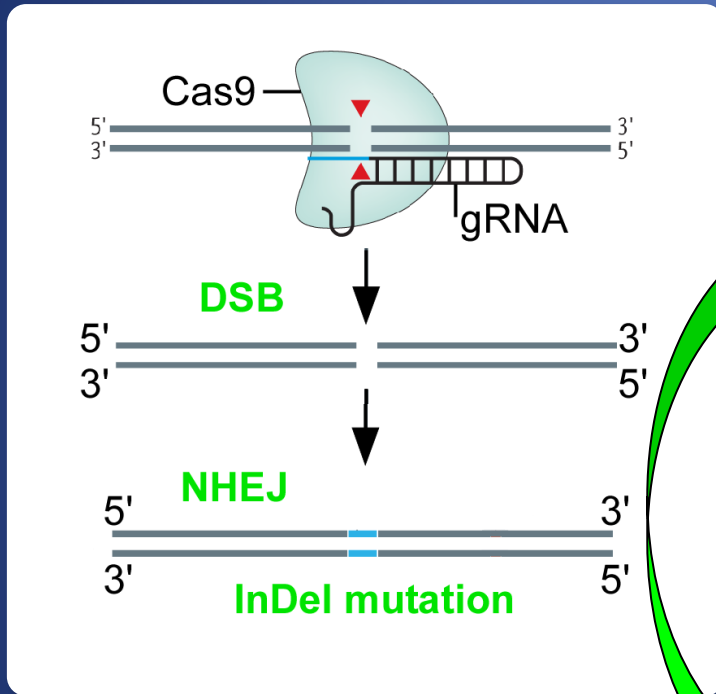
How Changes on the *CACNA1A* Gene Can Affect People:

CACNA1A variants are associated with multiple neurological disorders. Individuals exhibit a variety of symptoms that fall on a spectrum from mild to severe.



<p>Neurodevelopmental Differences</p> <ul style="list-style-type: none"> • Global Developmental Delay • Cognitive Impairment • Intellectual Disability • Autism Spectrum Disorder • Hypotonia 	<p>Ataxia</p> <ul style="list-style-type: none"> • Congenital Ataxia/Tremors • Episodic Ataxia Type 2 (EA2) • Spinocerebellar Ataxia Type 6 (SCA6) 	<p>Epilepsy</p> <ul style="list-style-type: none"> • Mild to Severe Seizure Disorders • Severe: Developmental & Epileptic Encephalopathy
<p>Migraine</p> <ul style="list-style-type: none"> • Migraine with or without Aura • Sporadic Hemiplegic (temporary weakness or paralysis) Migraine • Familial Hemiplegic Migraine Type 1 (FHM1) 	<p>Cerebellar Atrophy</p> <ul style="list-style-type: none"> • Can be Congenital, Early Onset or Late Onset • Progressive • Can cause Dystonia 	<p>Eye Disorders</p> <ul style="list-style-type: none"> • Nystagmus • Paroxymal Tonic Upgaze • Cortical Vision Impairment

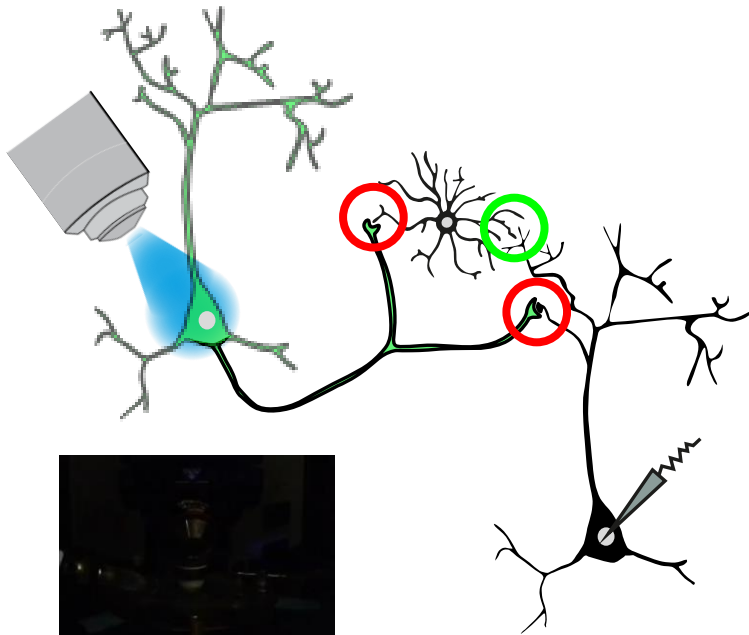
We use CRISPR to reprogram calcium channel variability and correct disease mechanisms



Students can design and test these strategies

What can you do in the lab

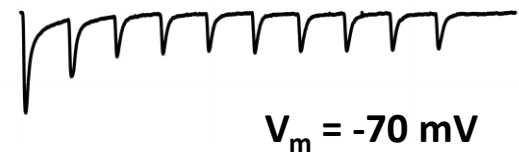
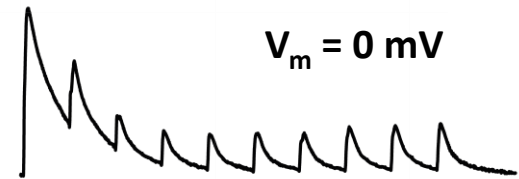
Control circuits
(optogenetics)



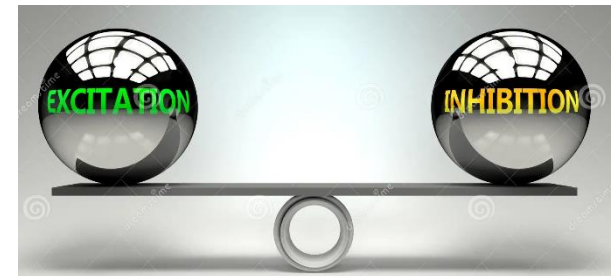
Inhibitory
currents

Optical
pulses

Excitatory
currents



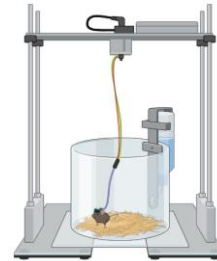
Record neurons
(patch-clamp)



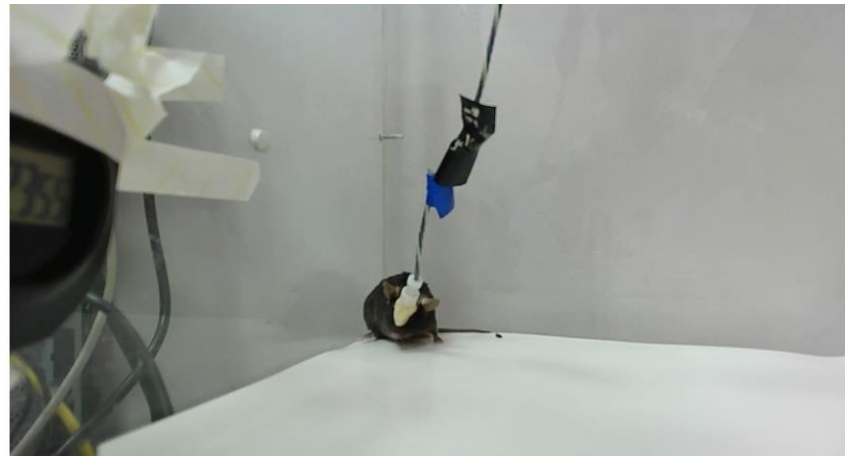
What can you do in the lab



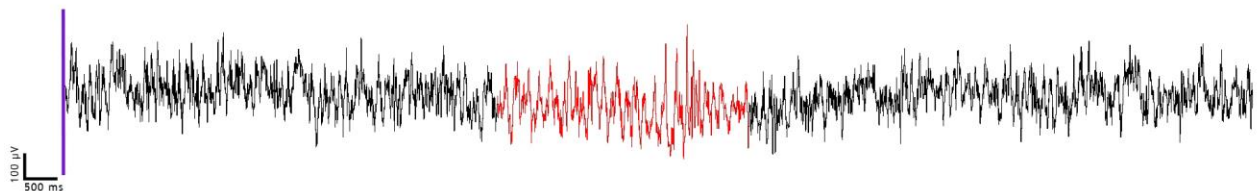
Electrodes
implantation



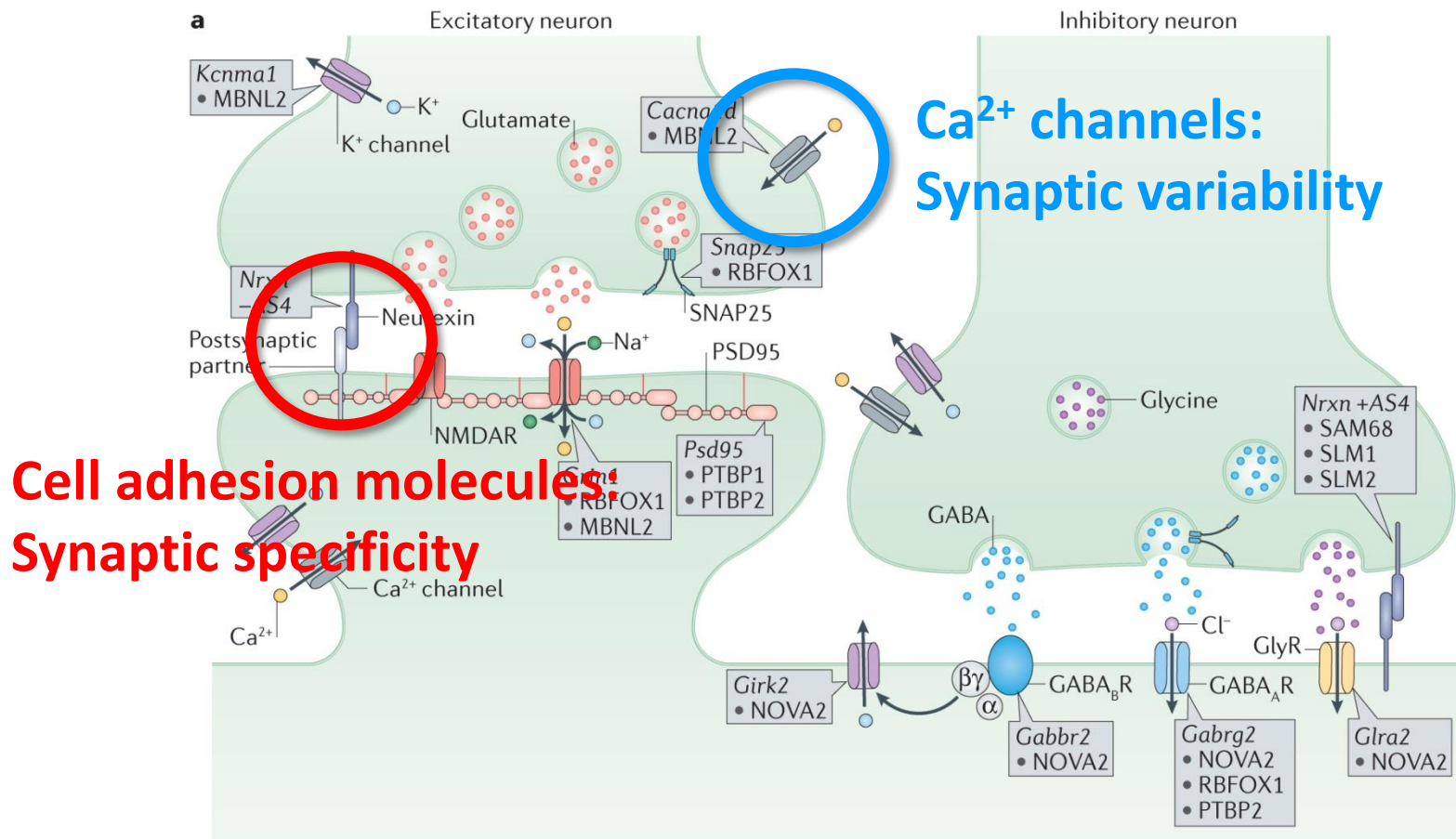
Open arena



**Study behaviour
(EEG, epilepsy models...)**



Two levers control synapses





European
Innovation
Council



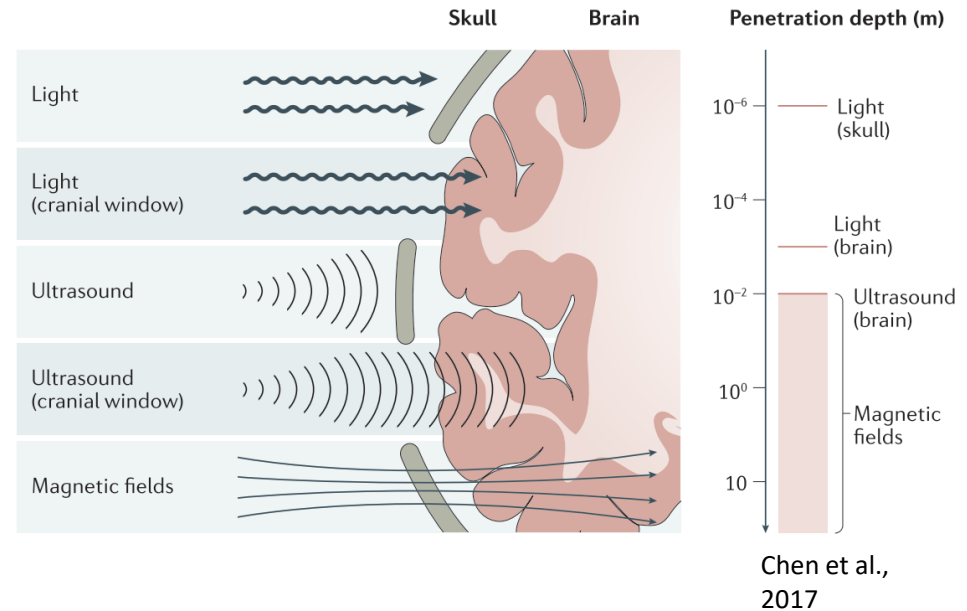
Funded by
the European Union



We are building wireless control of brain circuits

Magnetogenetics

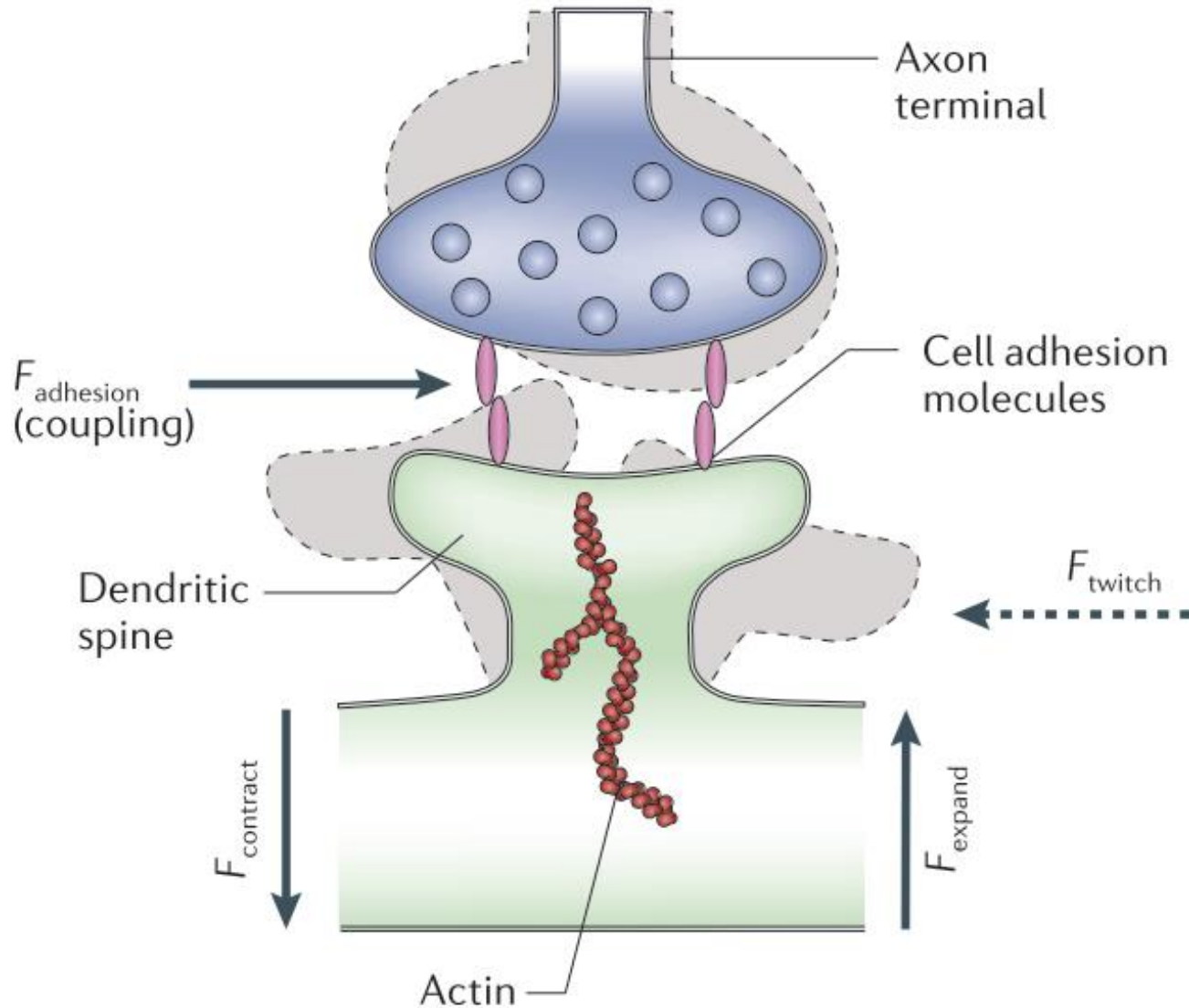
- It can achieve brain **circuit specificity** because it is based on **genetic actuators**
- It is **minimally invasive** because it exploits **magnetic fields**





Synaptic magneto-genetics:

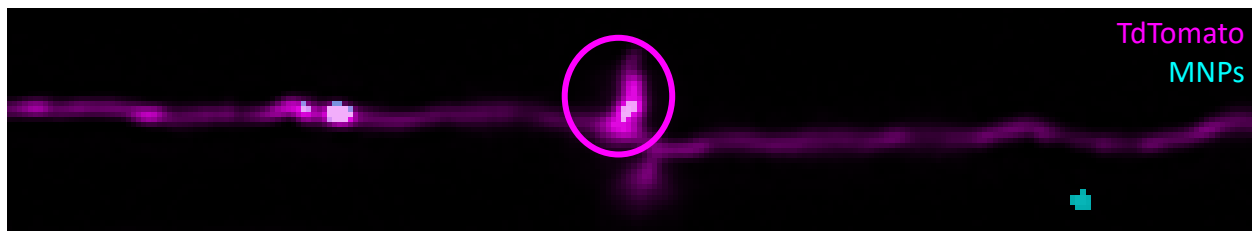
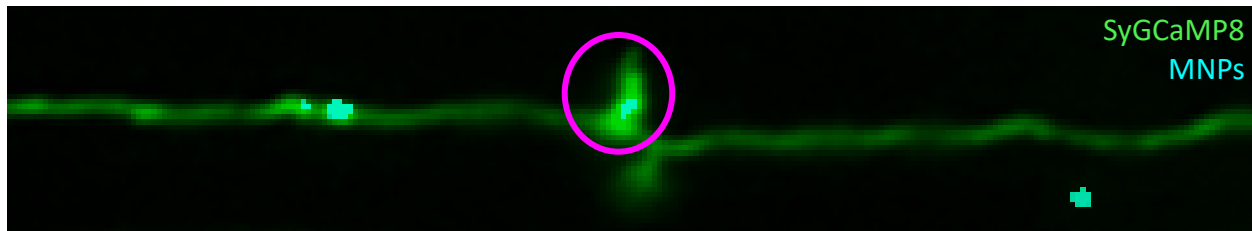
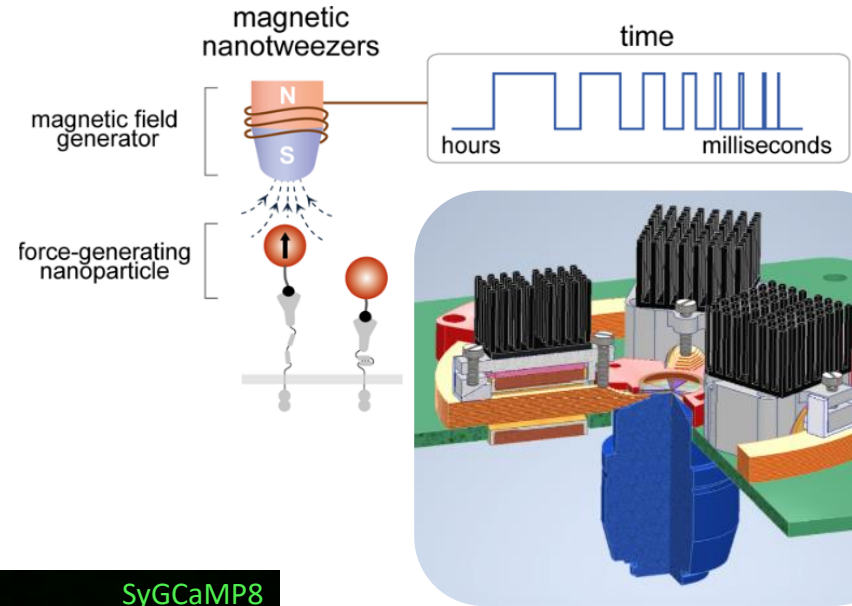
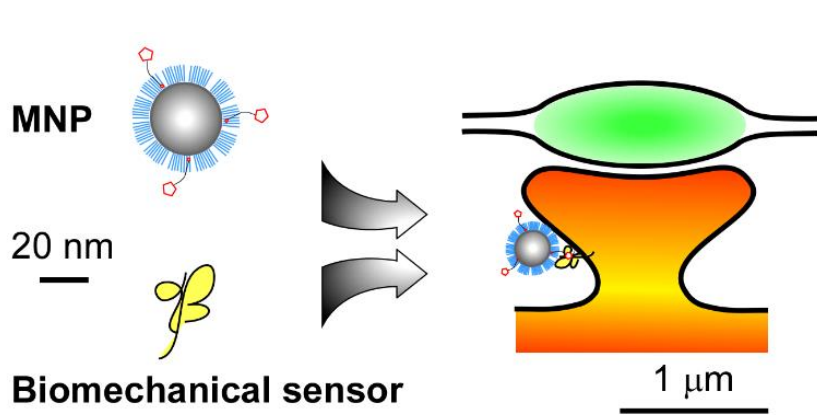
a new technology we are developing





Synaptic magneto-genetics:

a new technology we are developing

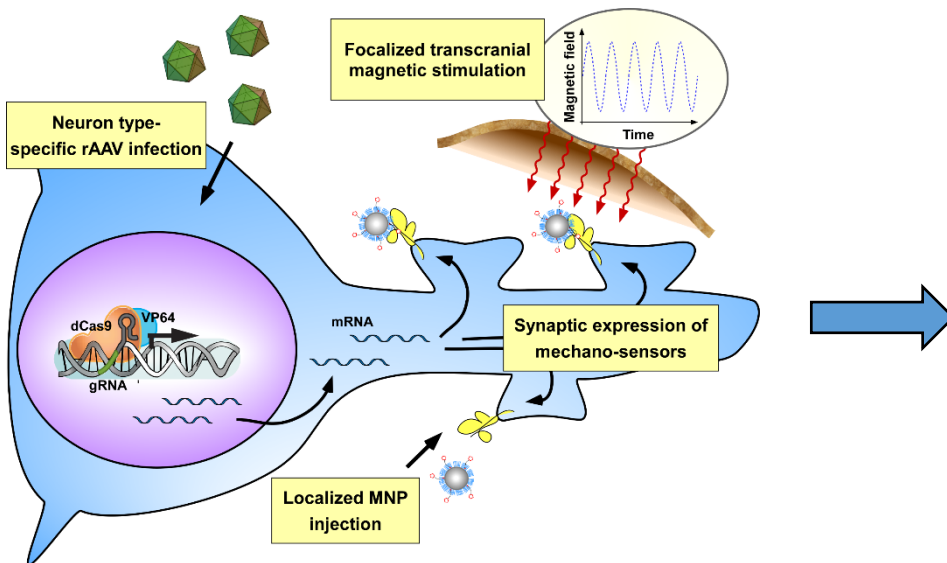


**Control circuits
(magnetogenetics)**

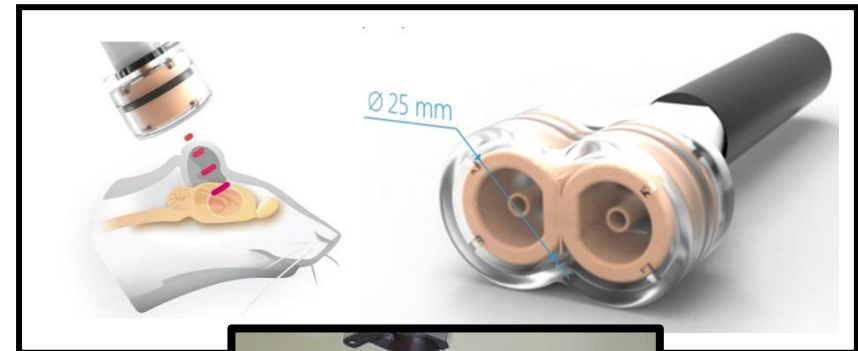


Where this can make a difference?

- Focal epilepsy
- Stroke
- Wireless circuit repair

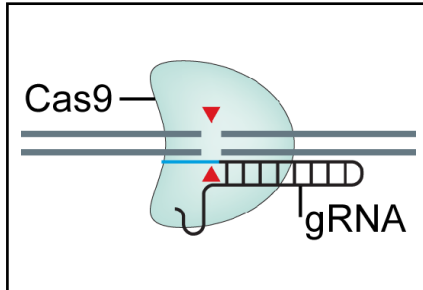


Transcranial magnetic stimulator (TMS)

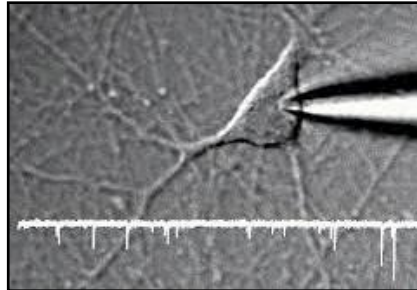


Synaptic Toolbox

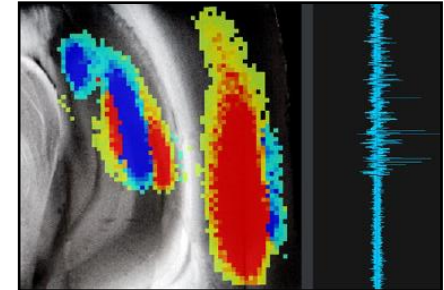
Genome-editing



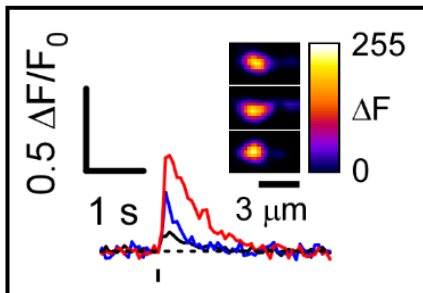
Patch-clamp



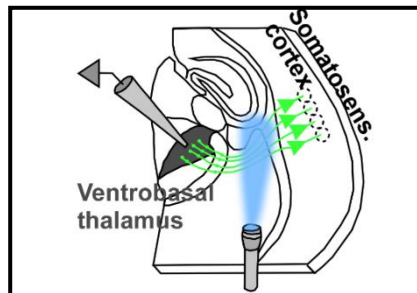
Multi-electrode array



Live imaging



Opto-genetics



Behavior



Magneto-genetics



What you gain by joining the lab

- Hands-on training
- Interdisciplinary work
- International collaborations (Germany, NL,...)

Icingolani@units.it



A screenshot of the European Innovation Council website. The top navigation bar is dark blue with white text: Home, About, Get funding (with a dropdown arrow), Get support, Invest with us, EIC Prizes, Events, News. Below the navigation bar is a breadcrumb trail: European Commission > European Innovation Council > Get funding > EIC Pathfinder. The main content area features a blurred background image of a modern transit station with blue and white tones. On the right side, the text "European Innovation Council" is displayed in white, next to the European Union flag. On the left side, a white box contains the text "EIC Pathfinder" in bold, followed by "Support to research teams to research or develop an emerging breakthrough technology".