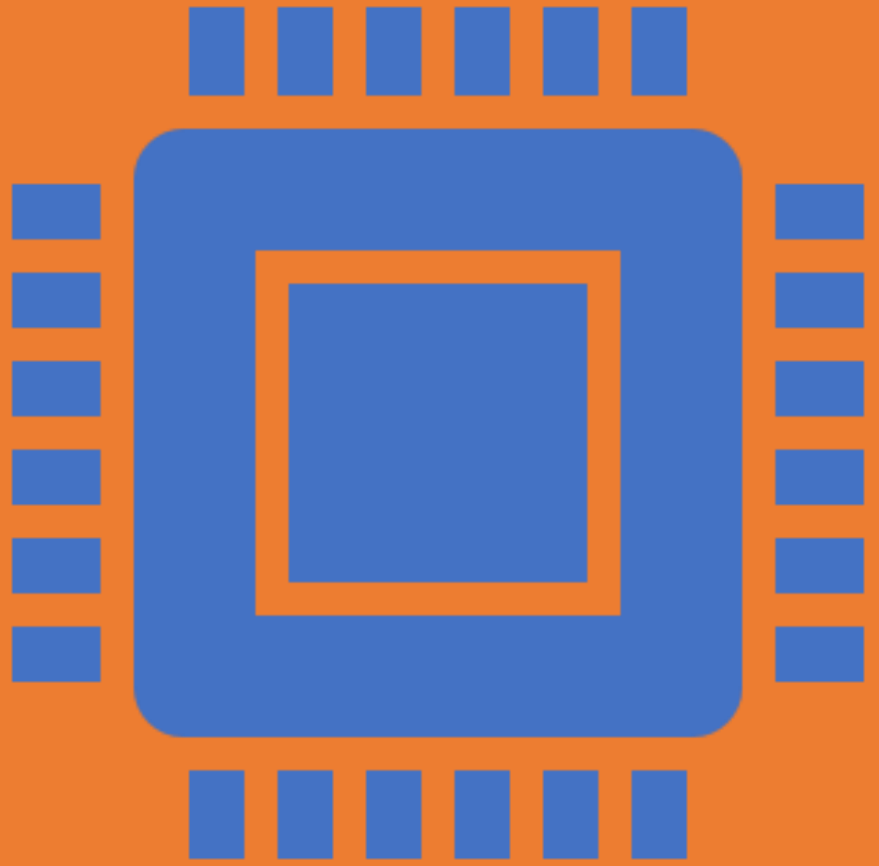
Multidisciplinary integrated research on biological quantum artificial intelligence

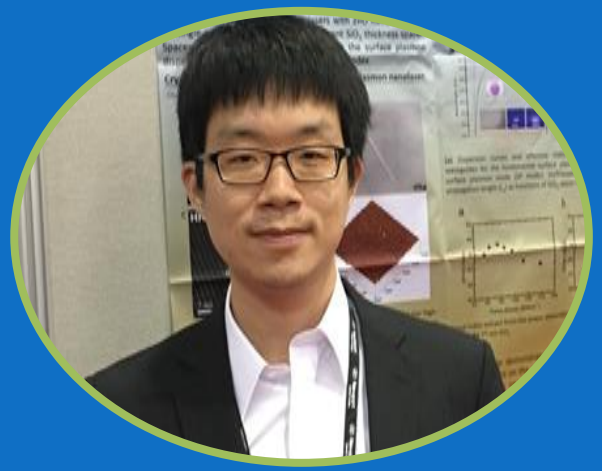


Timothy Chou

Department of Photonics

National Cheng Kung University

BIO



Dr. Timothy Chou

MOST YSG SCHOLAR

Educational qualification

Ph.D. degree: Institute of Lighting and Energy Photonics, National Chiao-Tung University, Tainan, Taiwan (2010~2016).

B.S. degree: Department of Physics, National Cheng-Kung University, Tainan, Taiwan (2006~2010).

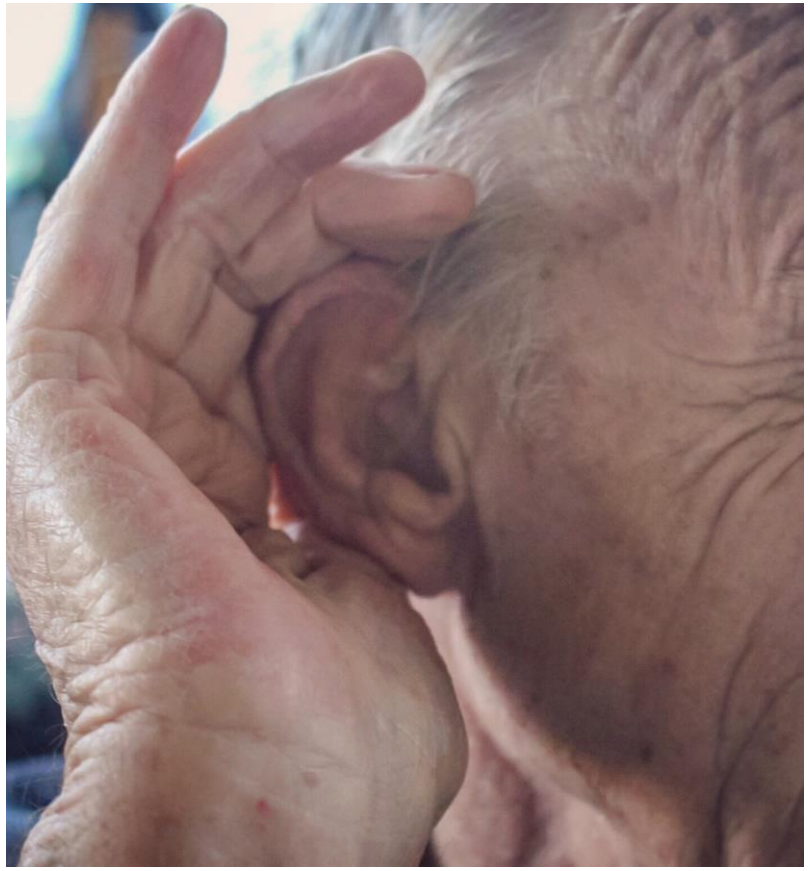
Work Experiences

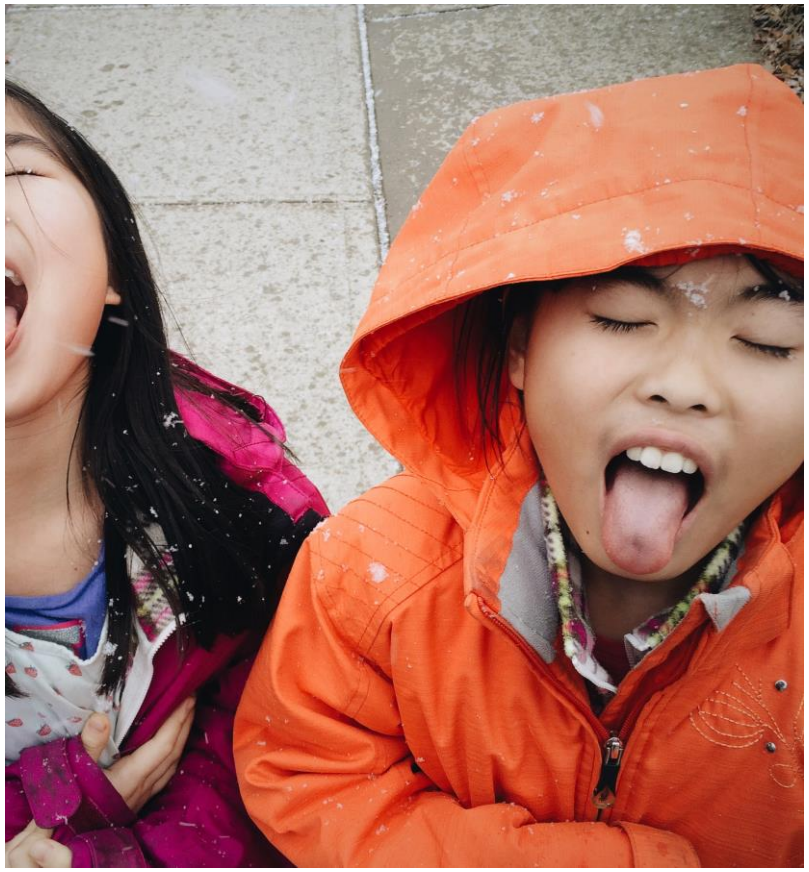
Assistant professor at department of photonics, National Cheng Kung University (2019~present)

Postdoc at The Hebrew University of Jerusalem (2018~2019)
Research Topic: Manipulating quantum fluids in ultra-high-quality microcavities via electrical control

Postdoc at Department of Physics, University of Michigan (2017~2018)
Research Topic: Study on TMDC based Tamm plasmon-polariton microcavity

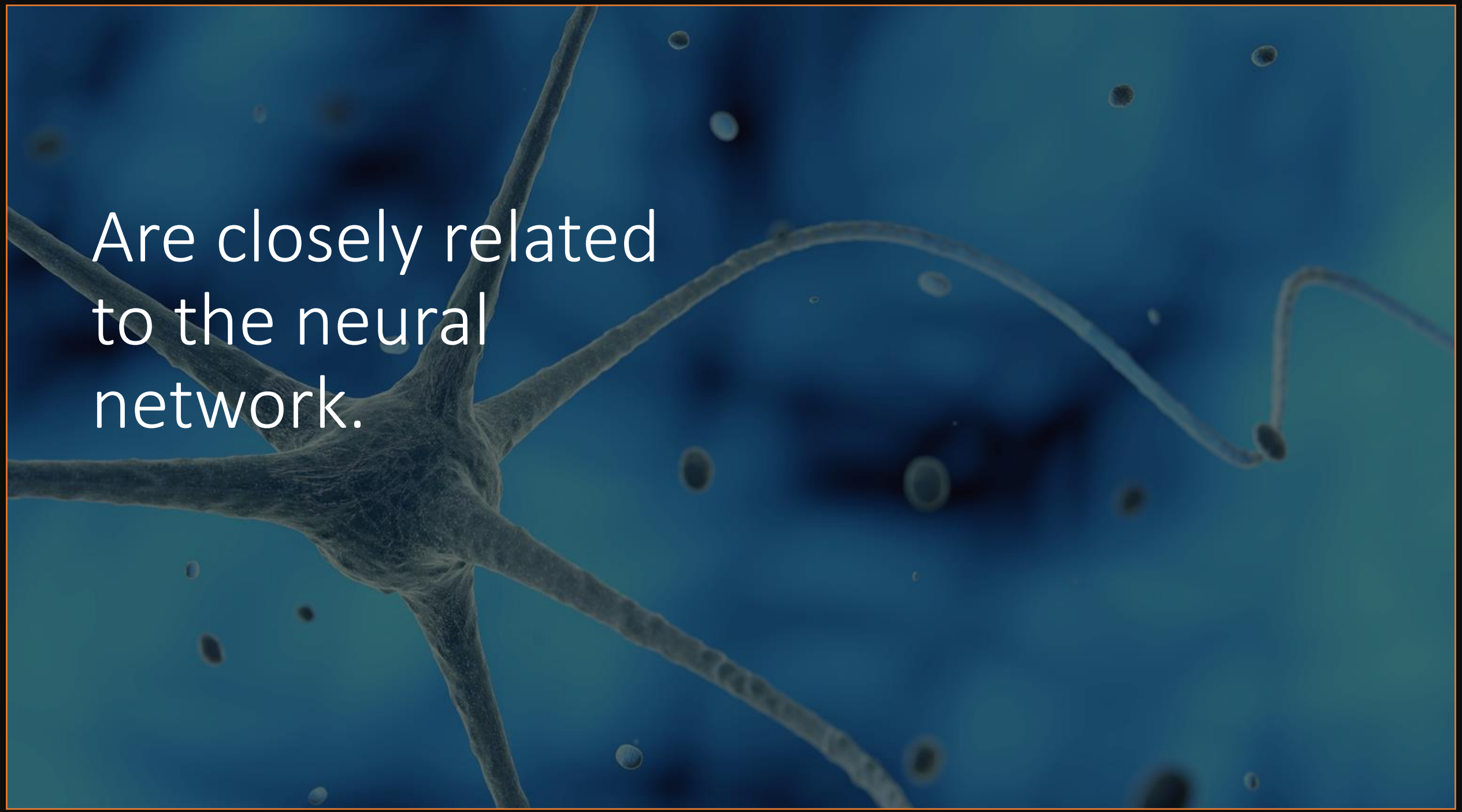
Postdoc at Department of Photonics, National Chiao Tung University (2016~2017)
Research Topic: Ultra-compact plasmonic lasers and laser arrays





How we feel

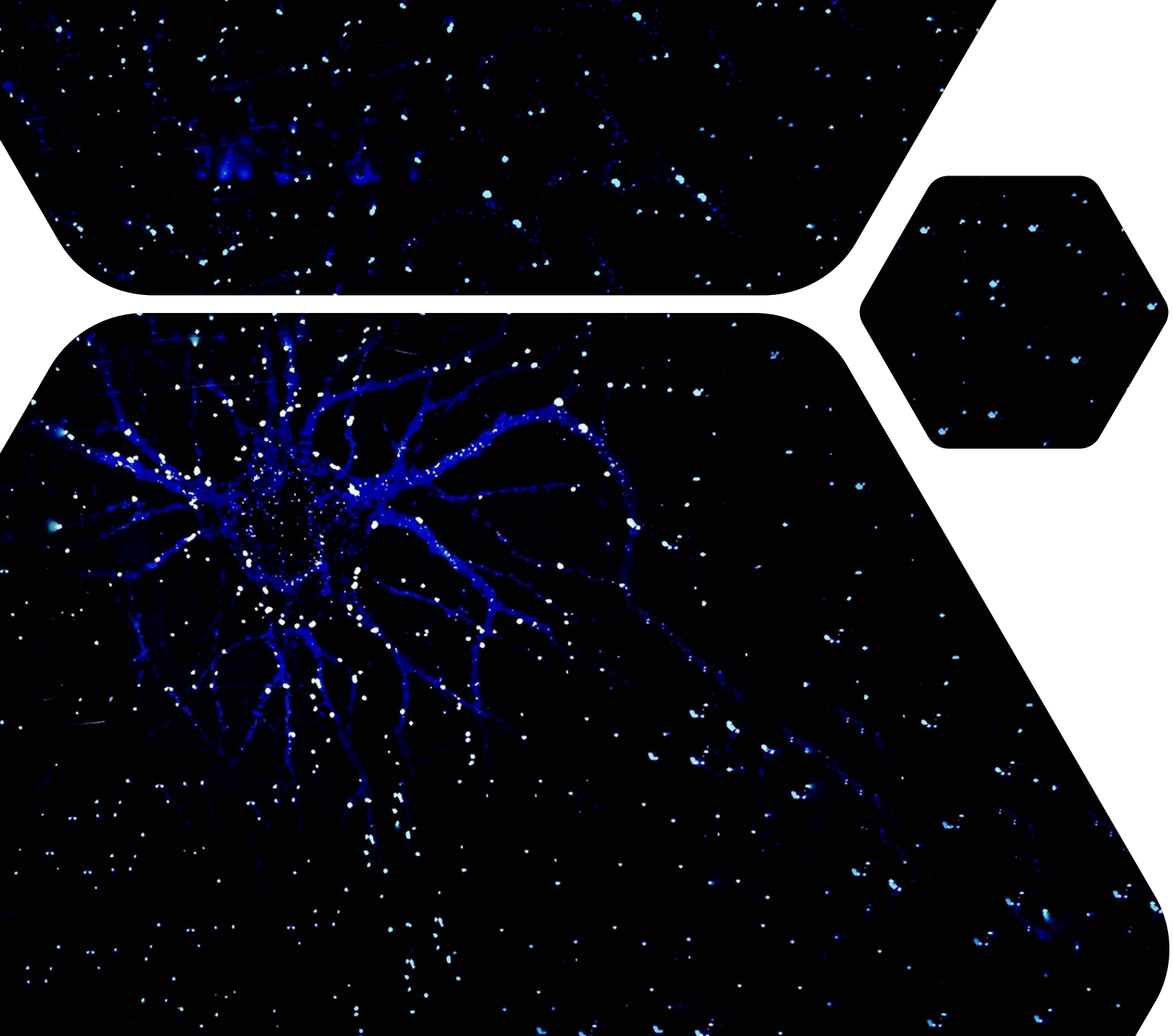
How we thought


Are closely related
to the neural
network.

Which inspires…

- Cell therapy
- Neuropharmacology
- Neuroimaging
- A.I. (ANN)
- etc.

However



- In human’s (or animals)body, different genes are expressed in migrating neurons at various locations, implying the existence of mixed signals (or information?) along the migratory path. This detail is still ***unknown***[7]

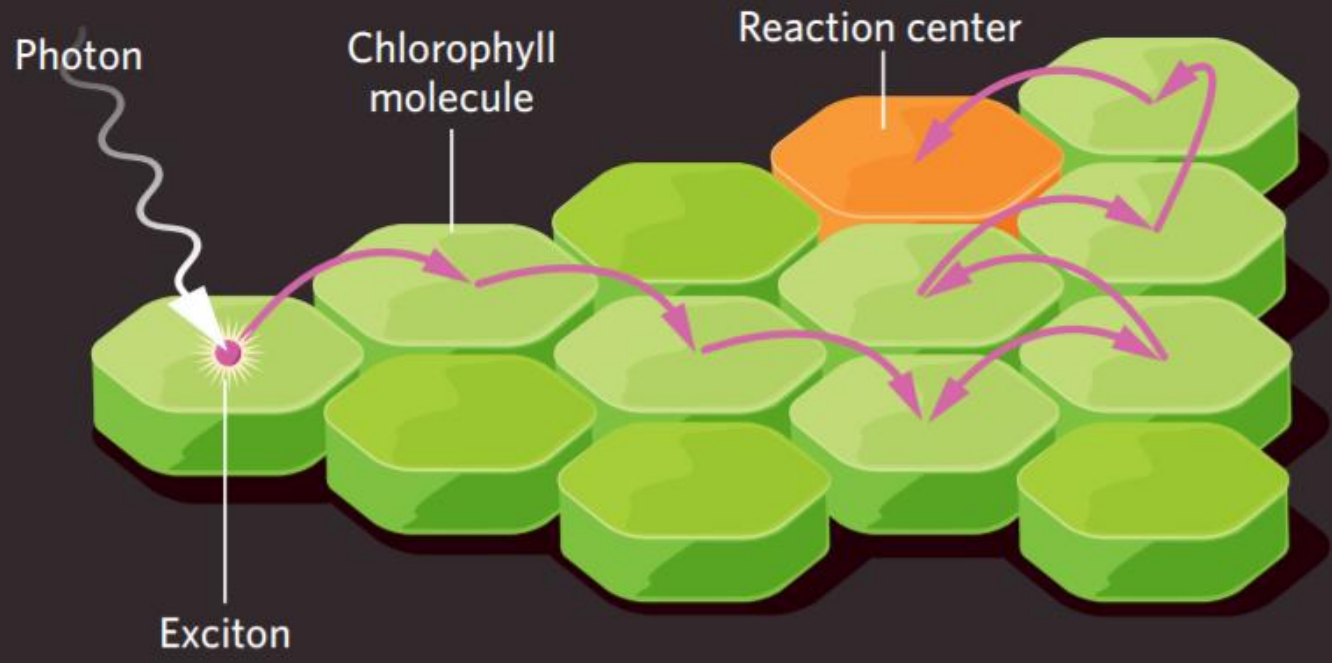
Also, what's inside the black box of ANN computation?

Could we explain by physics?

...living matter, while not eluding the **"laws of physics"** as established up to date, is likely to involve "other laws of physics" hitherto unknown, which however, once they have been revealed, will form just as integral a part of science as the former.-**Erwin Schrödinger**[r6]

Traditional Model

According to the traditional, or "incoherent," model of this process, the exciton's route to the reaction center is more or less random. Because energy can be lost during the transfer process, such a path can end up being wasteful.



PHOTOSYNTHESIS

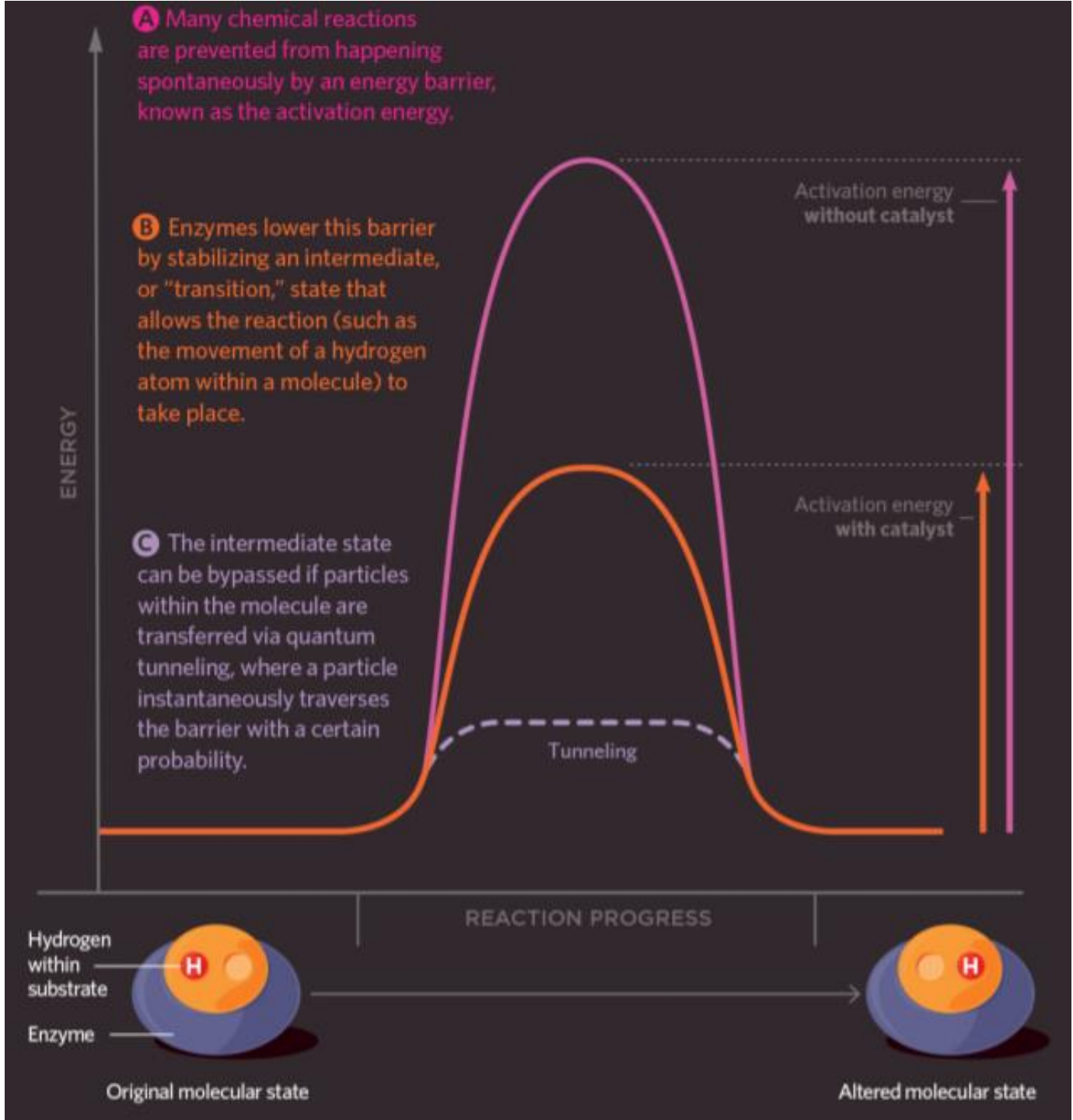
ALL PATHS TRAVELED*2

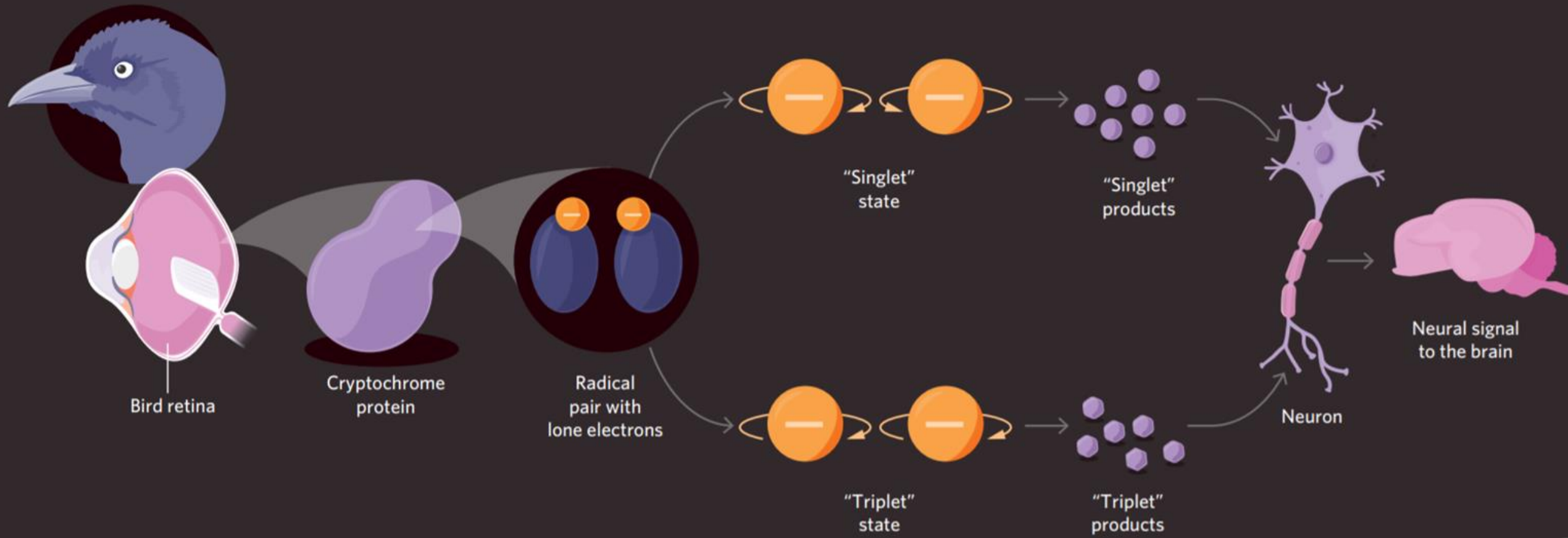
Quantum Model

By contrast, if the energy transfer process is "quantum coherent" such that the exciton travels like a wave, it can explore all possible paths simultaneously and only take the most efficient route.

Enzyme Catalysis

A Tunnel Through the Barrier [*2]



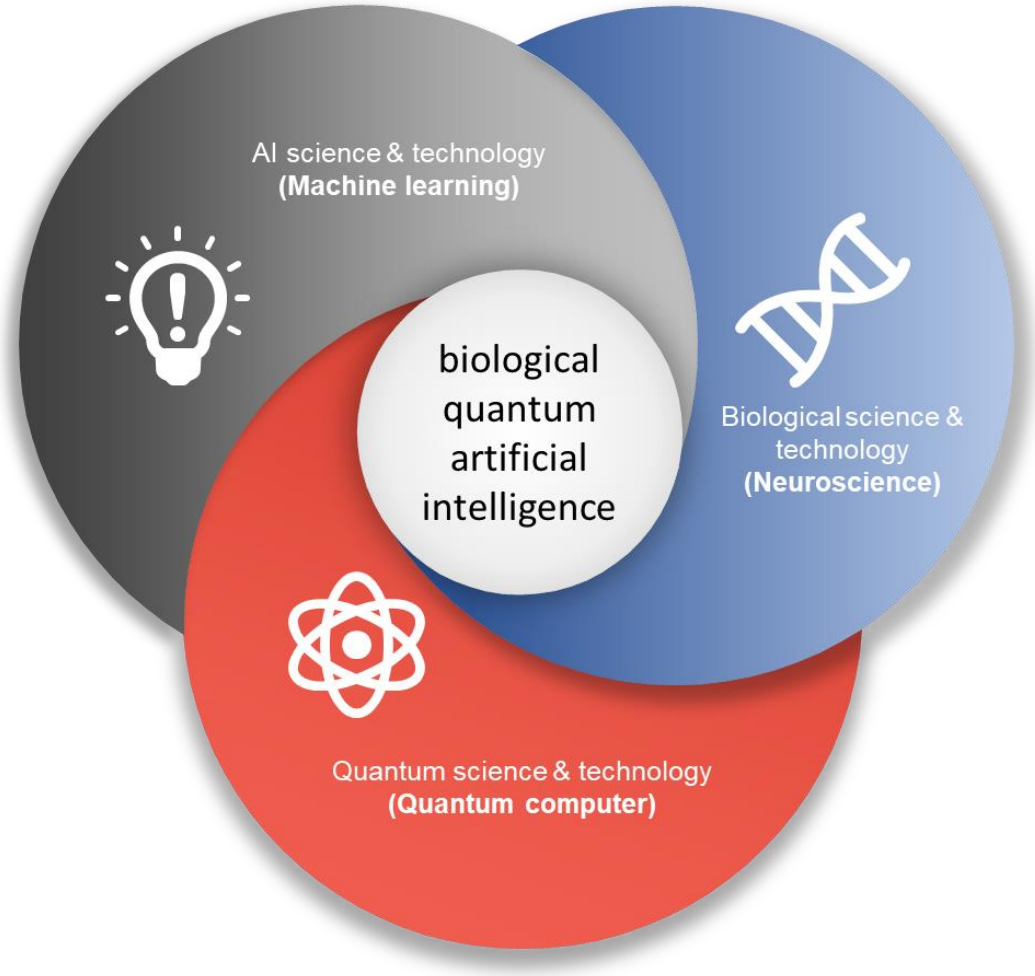


MAGNETORECEPTION

- SPINNING SENSORS *2

What else can we *PLAY?*

Interdisciplinary Research Forum



https://collegeofscience.bookmark.com/

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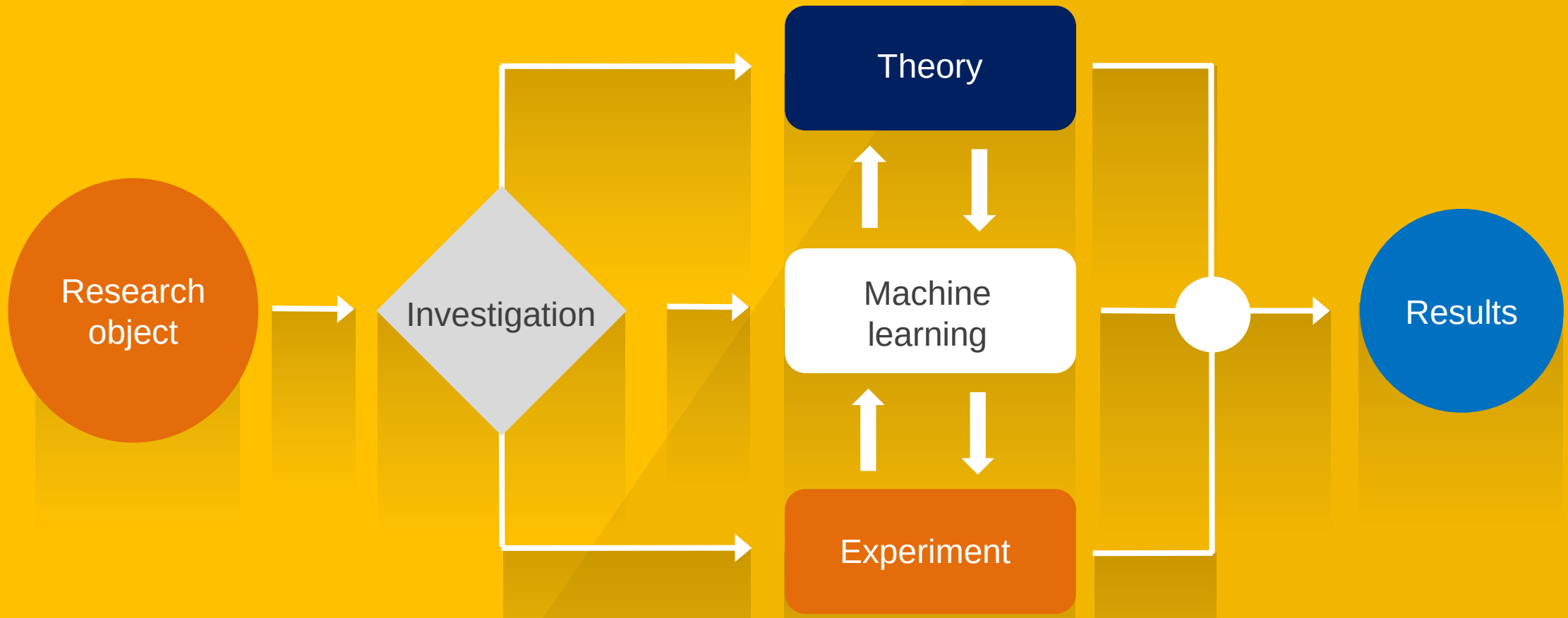
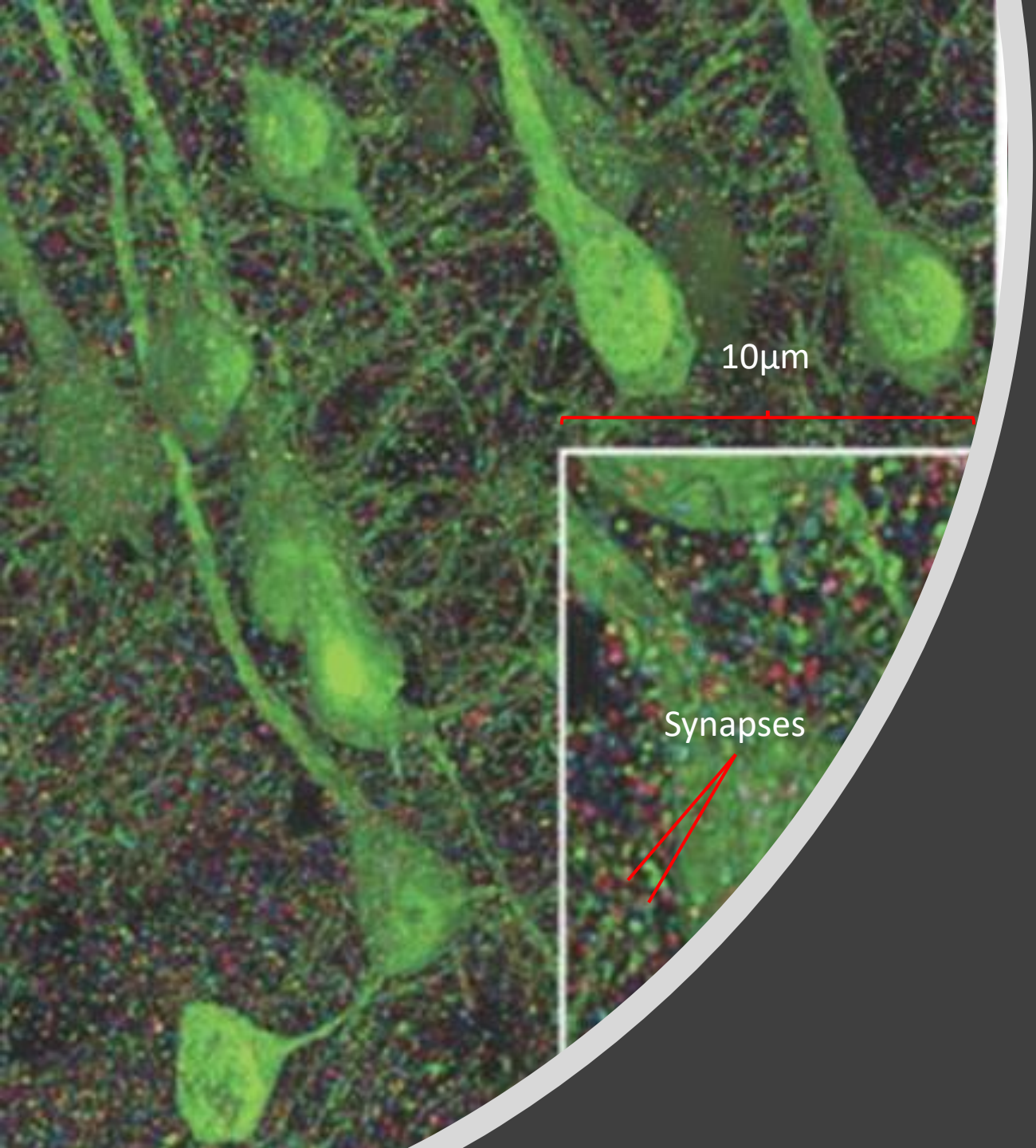
奈米醫學研究中心
NCKU CAN
National Cheng Kung University
Center of Applied Nanomedicine

NCKU MiinWu
School of Computing

前沿量子科技研究中心
Center for Quantum Frontiers of Research & Technology
國立成功大學
National Cheng Kung University

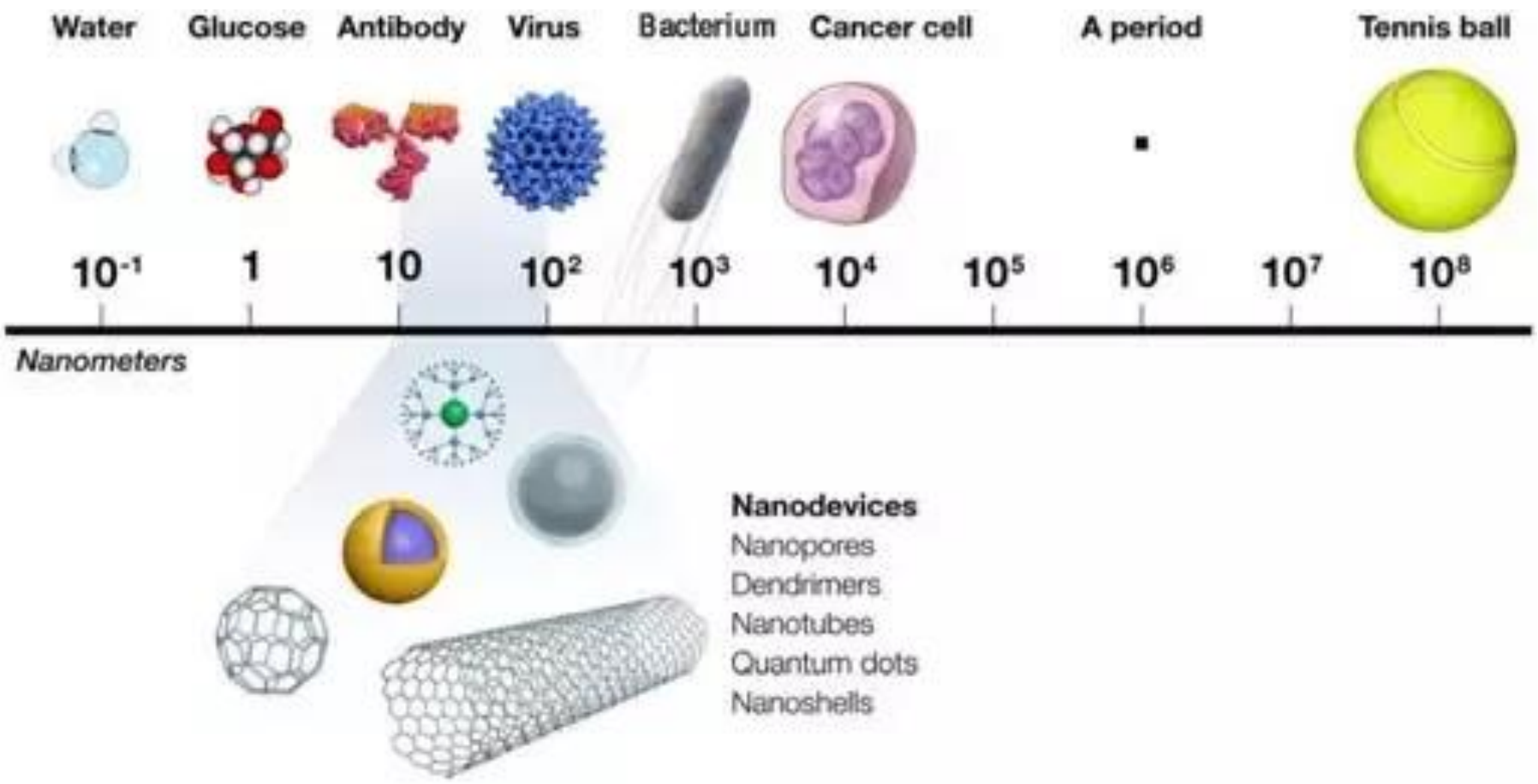
Bionic quantum-neural network: How we work?



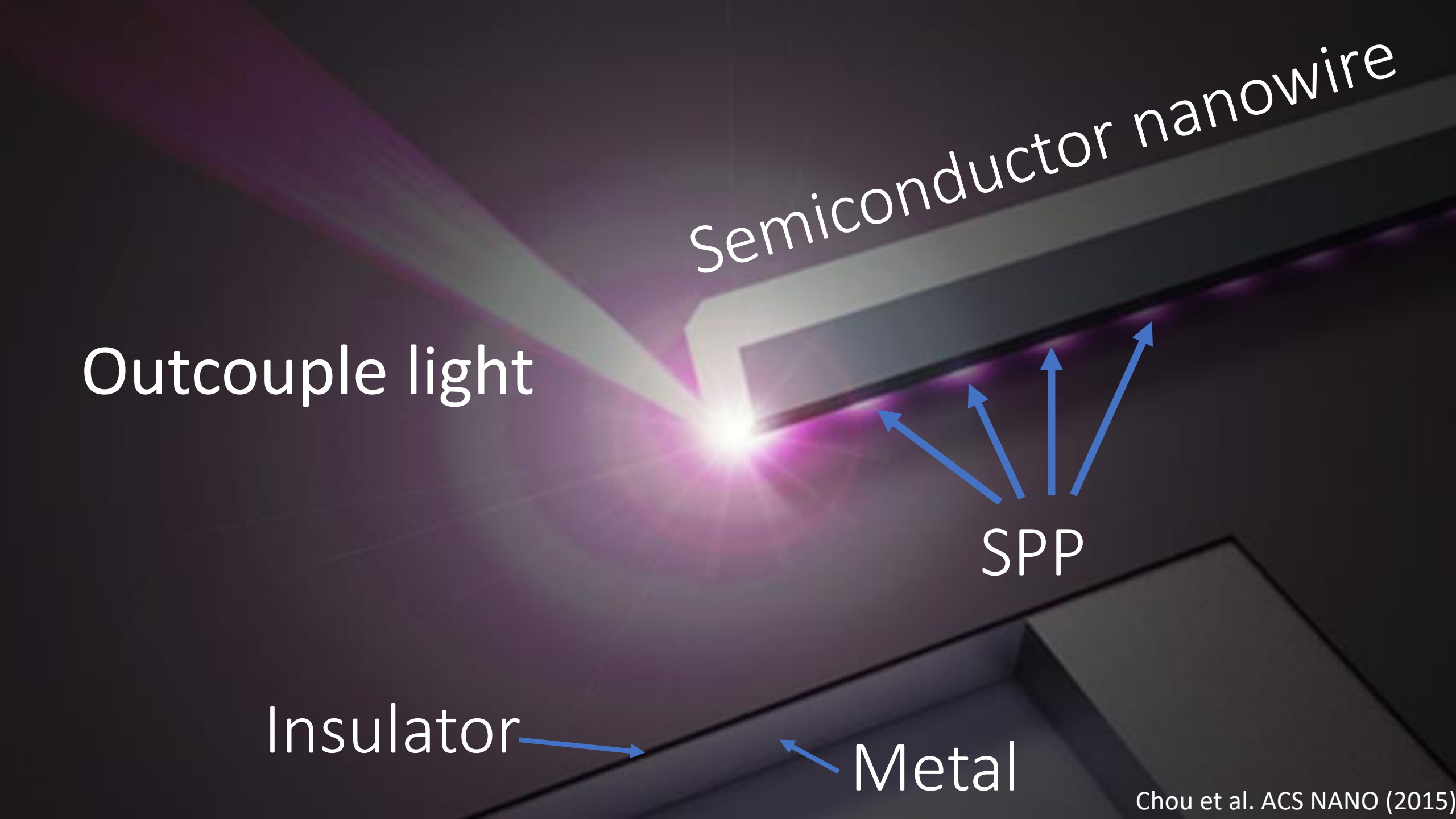


Synapses are very small(~1 μm^3)*[3]. This narrow gap of extracellular space is approximately 20-40 nanometers (nm) wide.*[4]

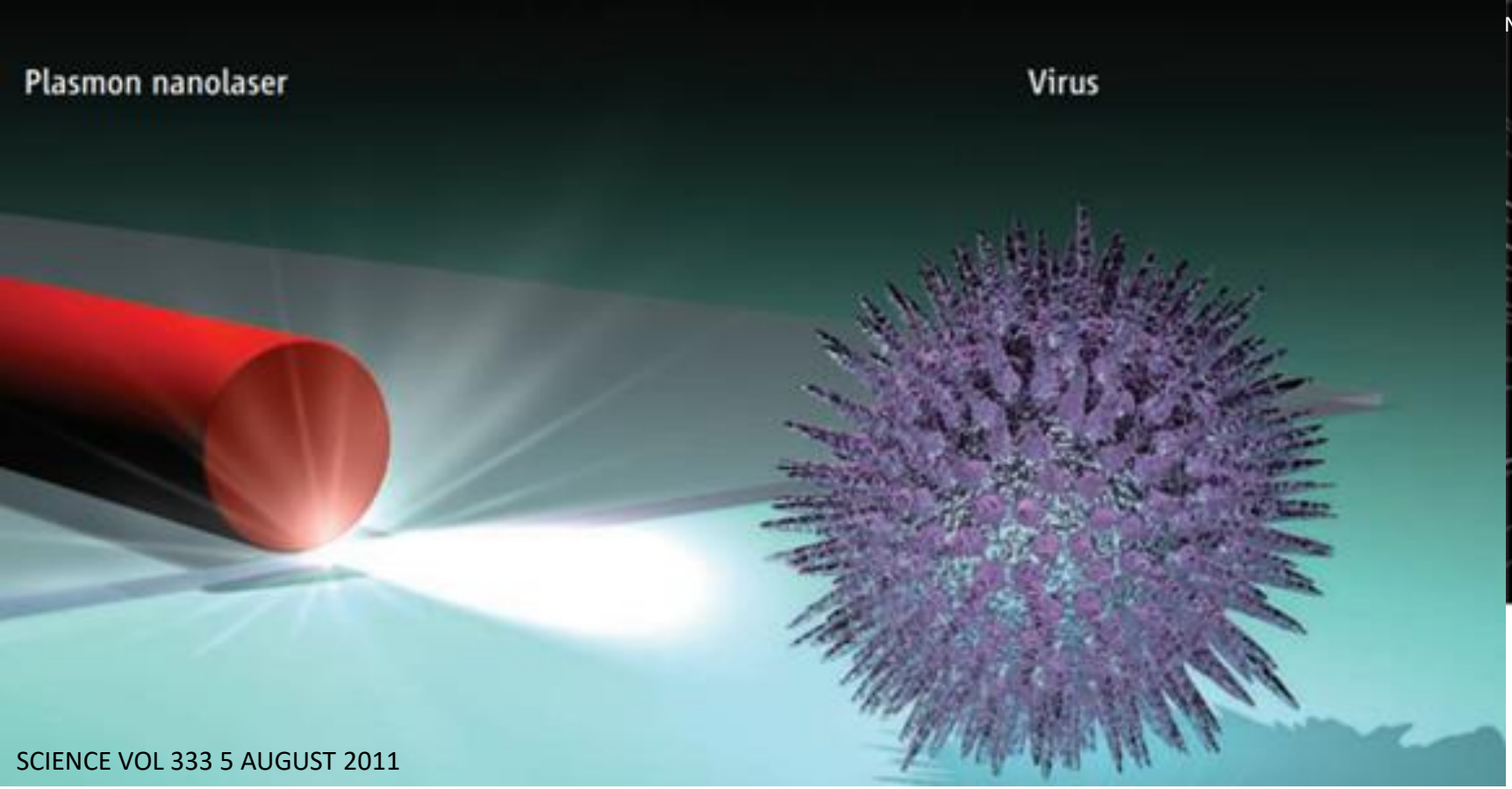
Small enough to investigate by quantum physics!



Large enough to be manipulate by nano-tech!



Chou et al. ACS NANO (2015)



SCIENCE VOL 333 5 AUGUST 2011

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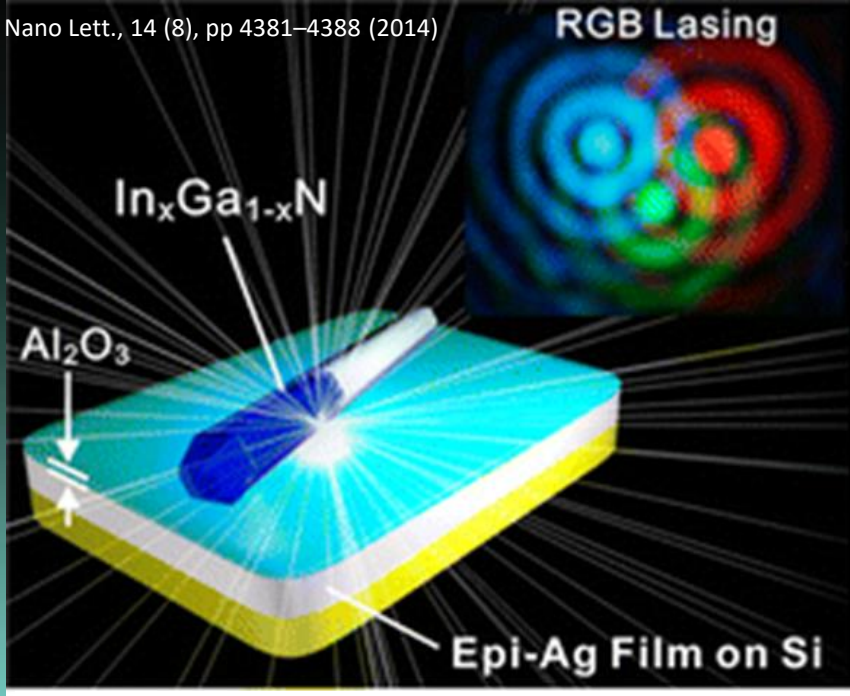
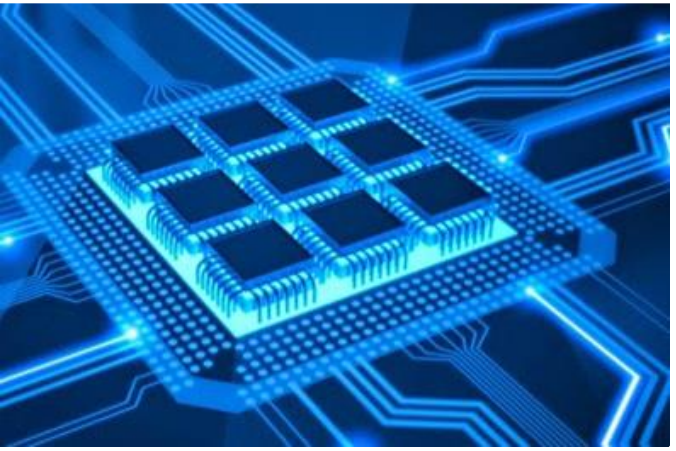
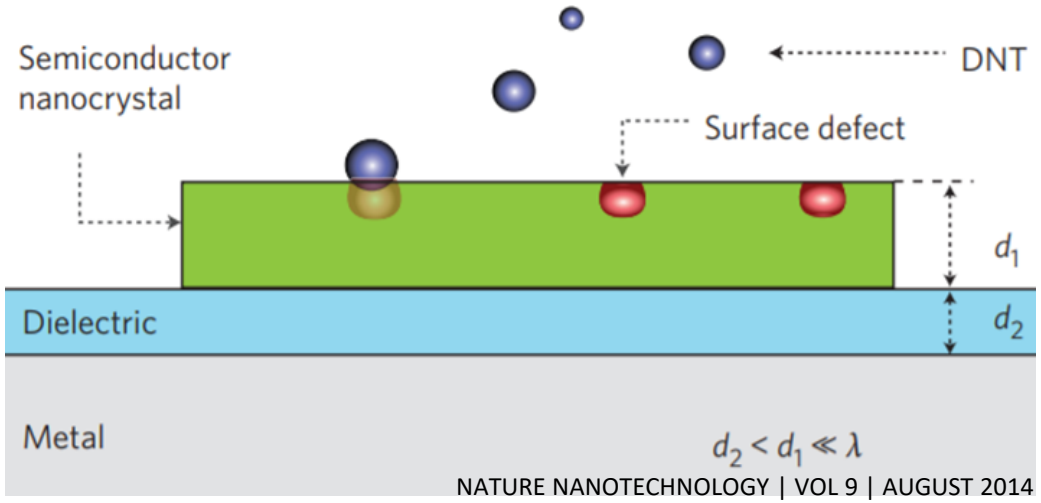
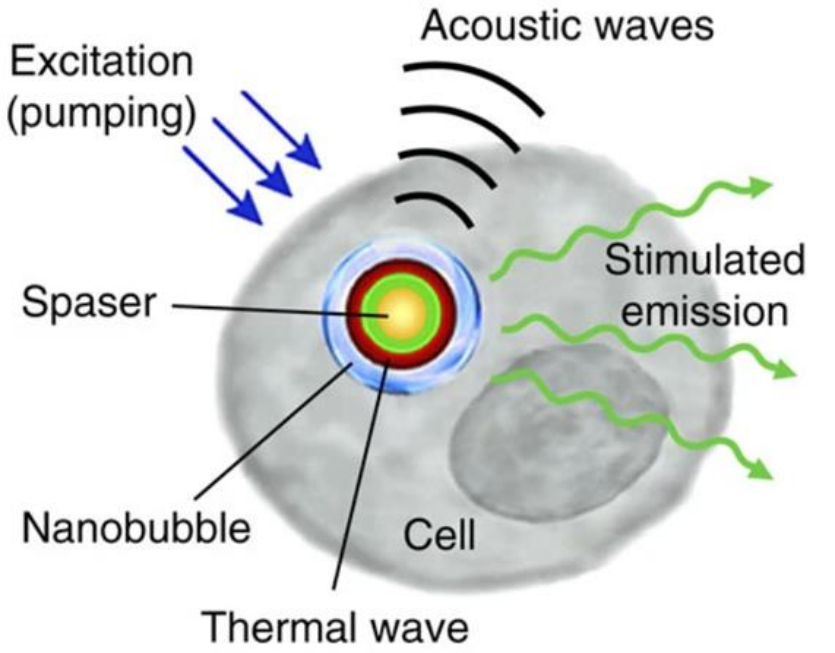




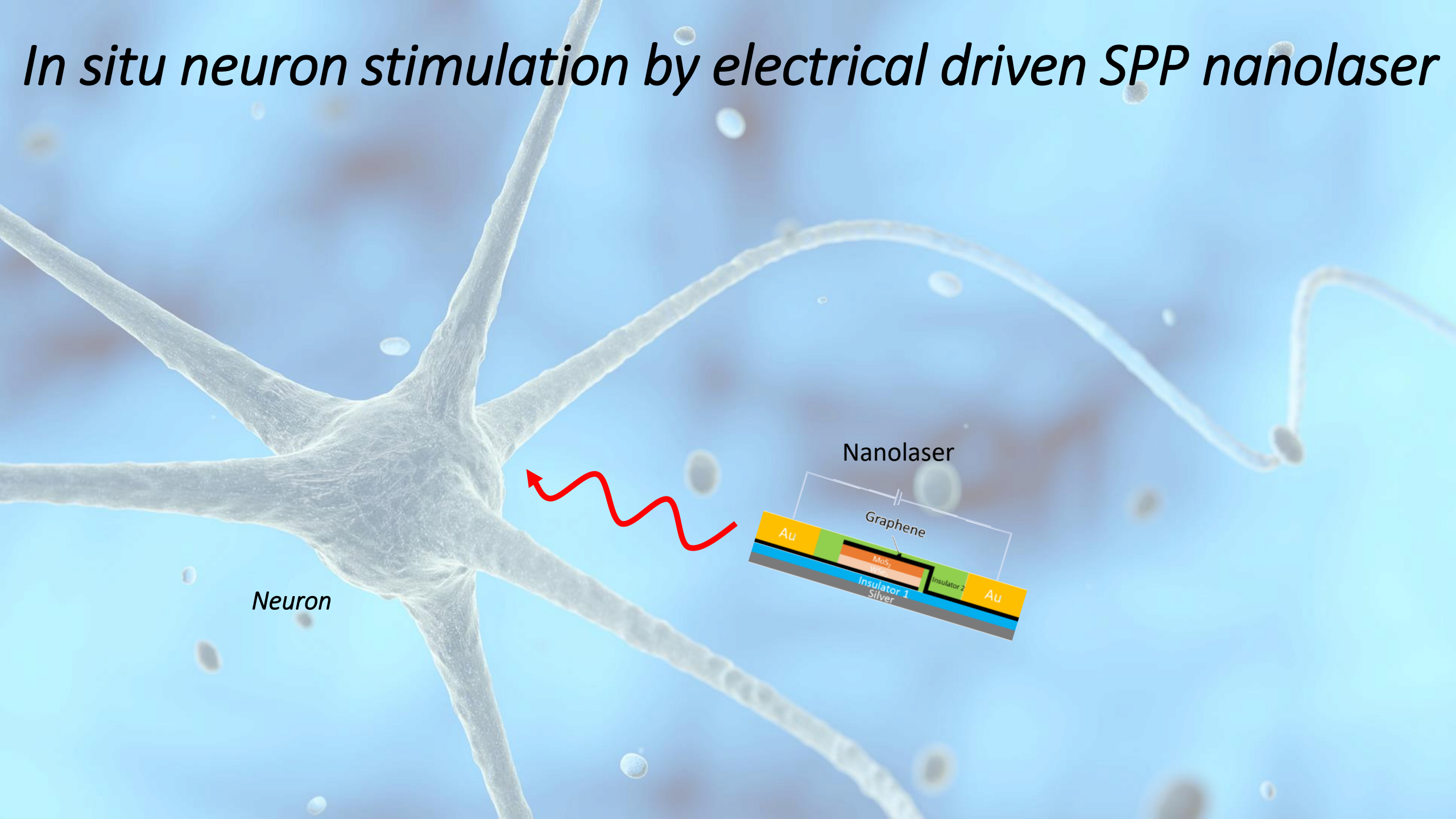


NATURE NANOTECHNOLOGY | VOL 9 | AUGUST 2014



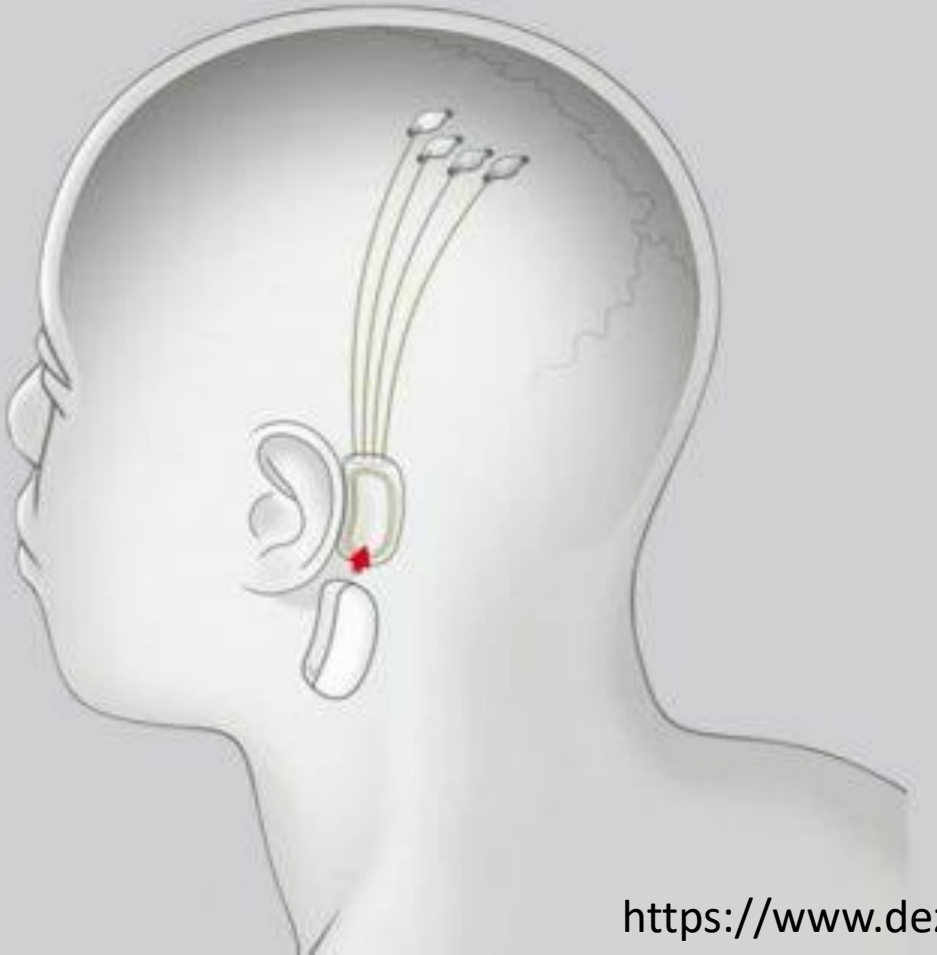
Nature Communications volume 8, Article number: 15528 (2017)

In situ neuron stimulation by electrical driven SPP nanolaser



NEURALINK ARCHITECTURE

Last Summer

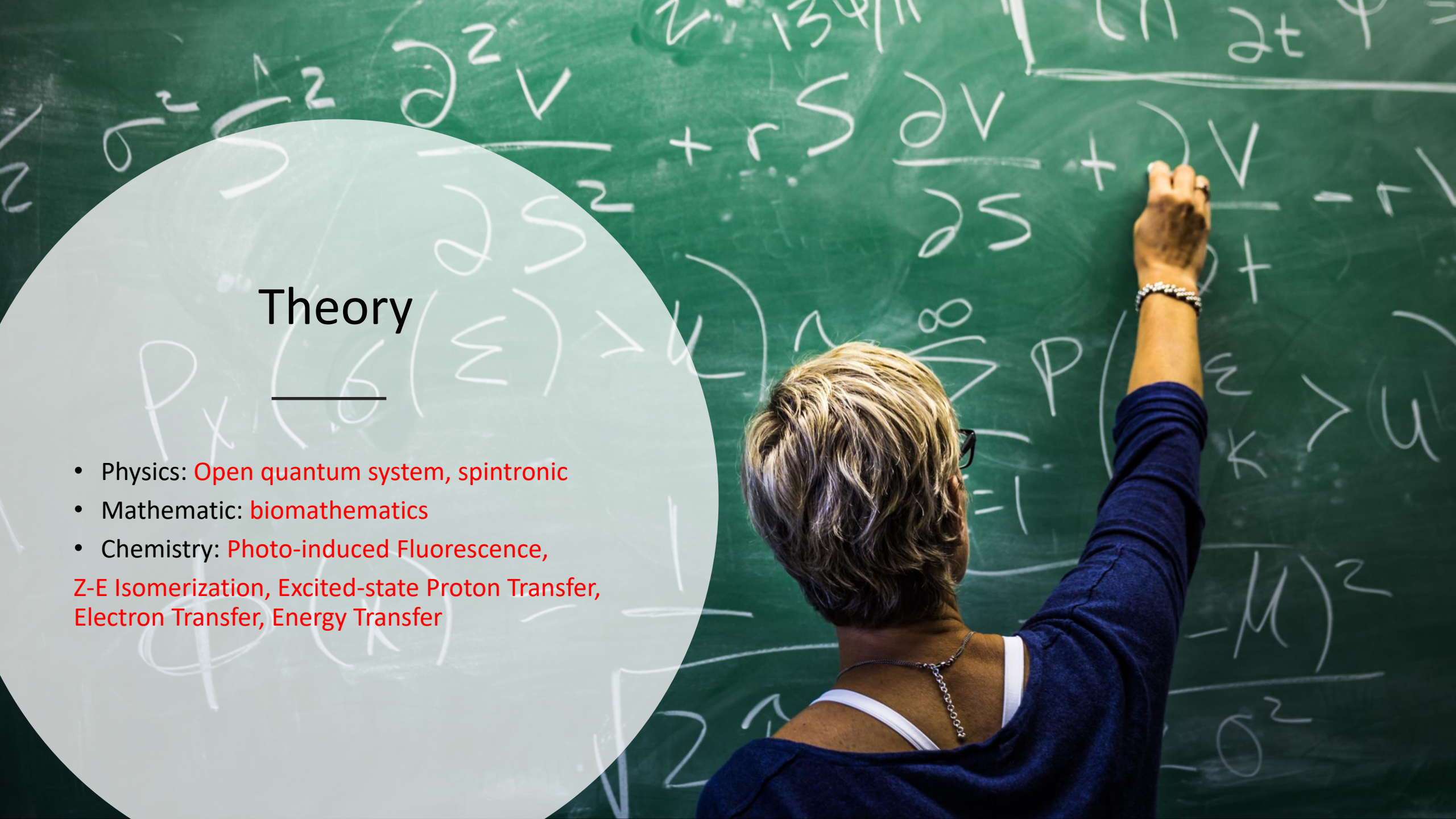


Today

https://www.dezeen.com/2020/09/02/neuralink-elon-musk-brain-implant-technology/

Research object

- Medical: Neuron, physiological data
- Bio: Fluorescent Protein, Neuron
- Chemistry: O-Chem stuff
- Photonics: Opto-electronic devices



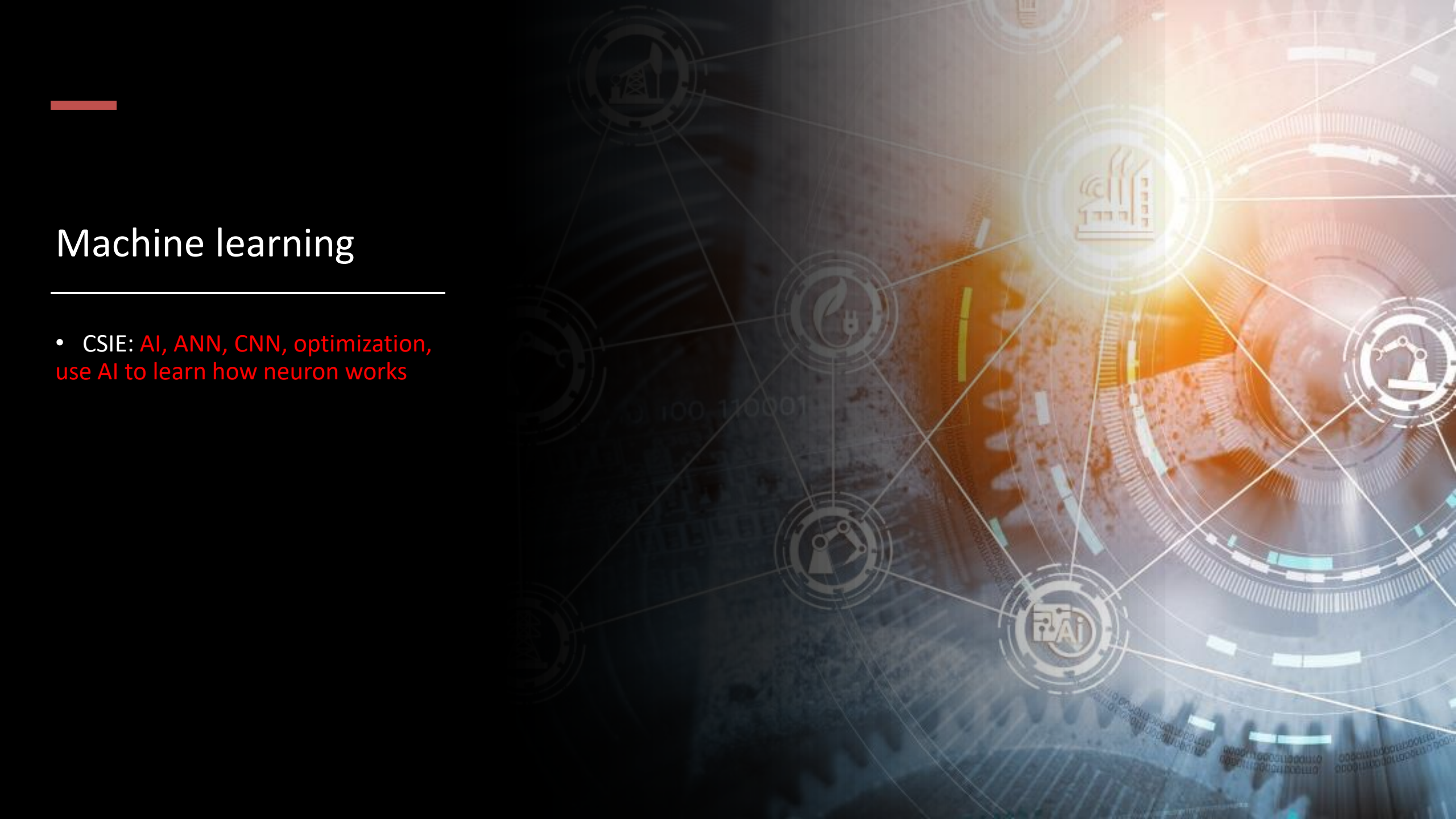
Theory

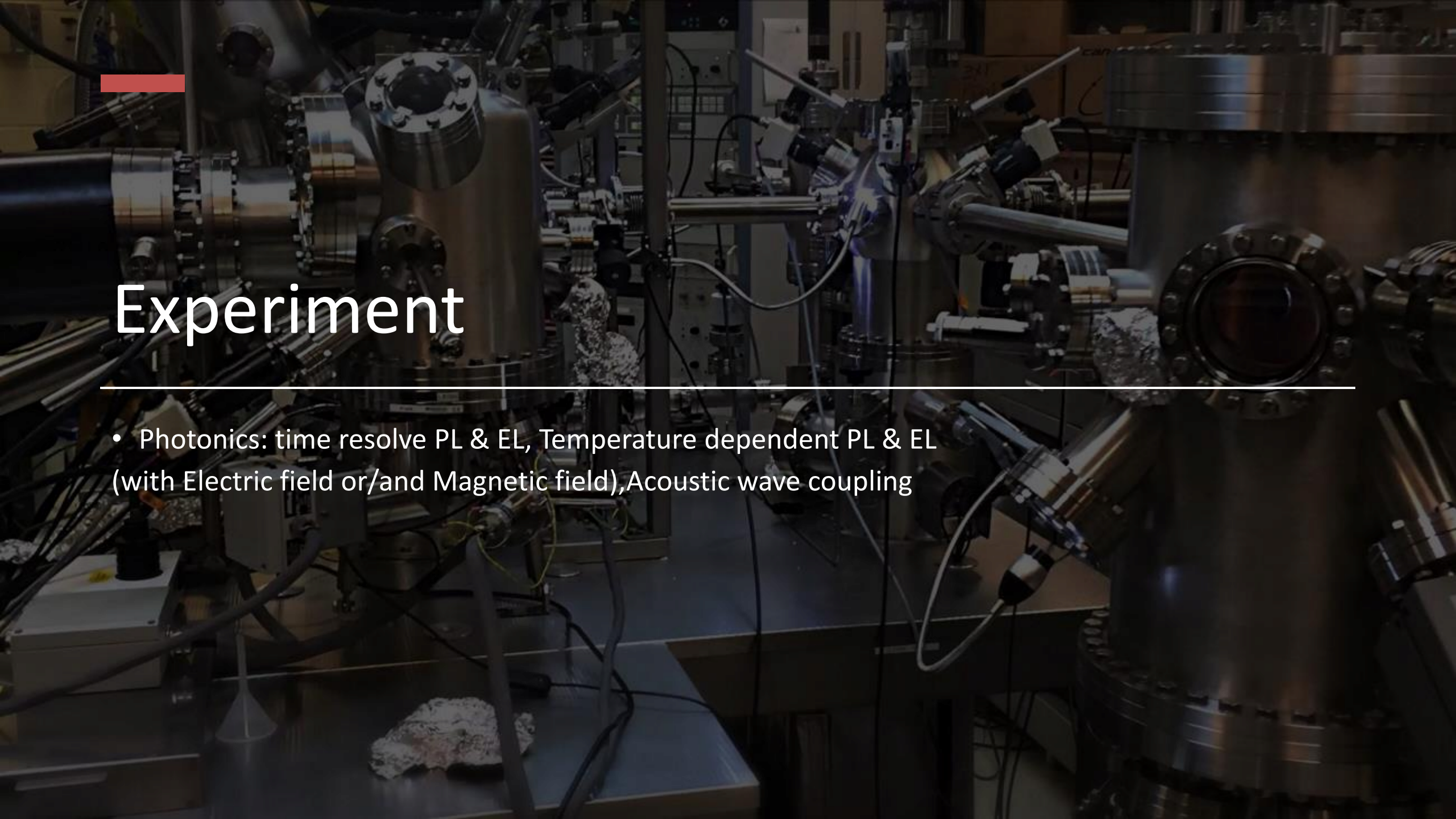
- Physics: Open quantum system, spintronic
- Mathematic: biomathematics
- Chemistry: Photo-induced Fluorescence,

Z-E Isomerization, Excited-state Proton Transfer, Electron Transfer, Energy Transfer

Machine learning

- CSIE: AI, ANN, CNN, optimization, use AI to learn how neuron works





Experiment

- Photonics: time resolve PL & EL, Temperature dependent PL & EL (with Electric field or/and Magnetic field),Acoustic wave coupling

Results could be…

1. A creation of new field
2. Biomimicry application
3. Novel Medical treatment
4. New tools for machine learning
5. New tools for measurement
6. New tools for fabrication
7. New industry
8. ????

Where the figures come from (with*)

Wikipedia

https://www.the-scientist.com/features/quantum-biology-may-help-solve-some-of-lifes-greatest-mysteries-65873

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https://www.quora.com/Can-there-be-a-virus-of-the-size-of-an-atom-or-only-a-few-atoms

Others are from: Envato and twenty 20

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- Adapt: How Humans Are Tapping into Nature's Secrets to Design and Build a Better Future
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- 仿生計算— 以大自然為師
- **Can something be fully quantum and alive at the same time?**
- **wikipedia**

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Eunice Paik

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Yu-Pin Lan (NCTU)
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Chien-Chung Lin (NCTU)
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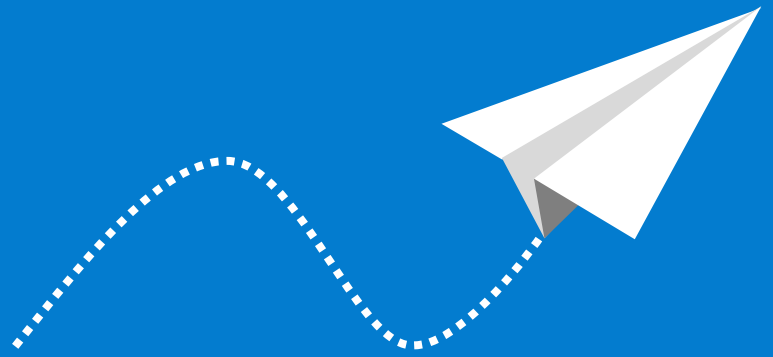
Thank You



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