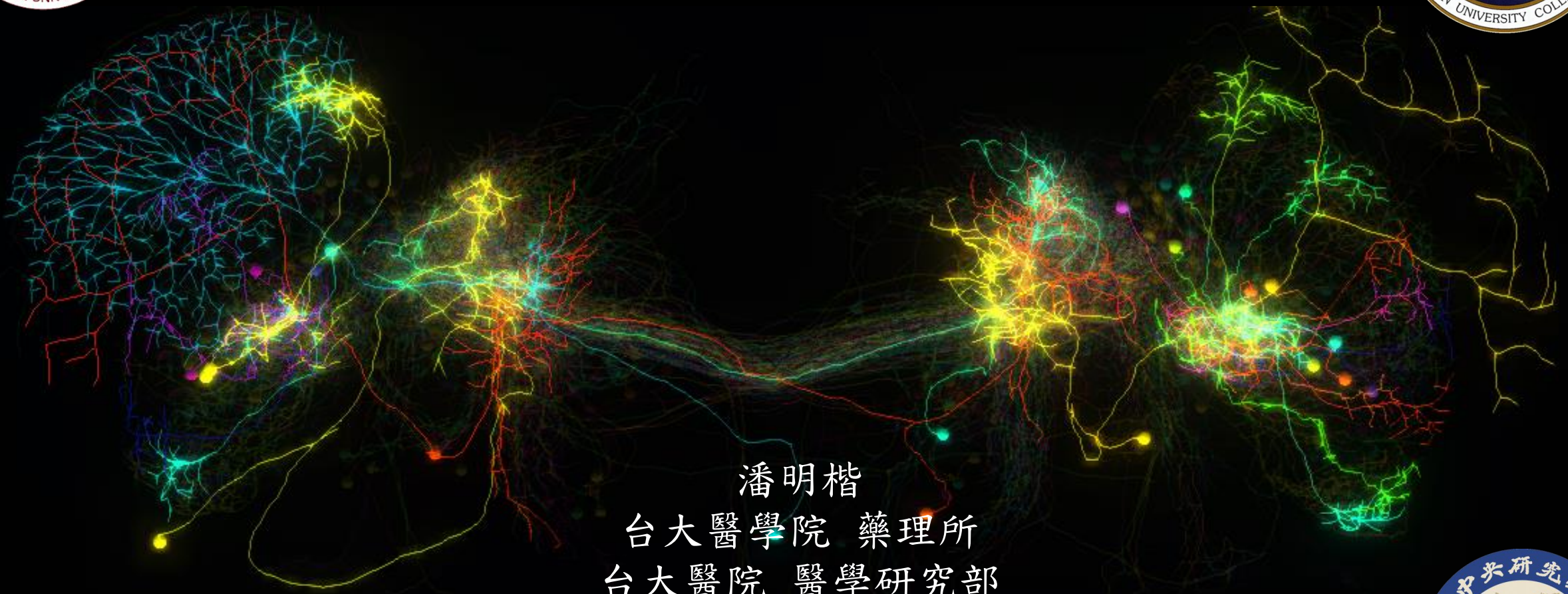


光電科技於神經醫學領域之應用及潛力



潘明楷

台大醫學院 藥理所

台大醫院 醫學研究部

台大醫院雲林分院 小腦研究中心

臺灣大學 分子影像中心

中研院 生醫所






如何思考?
如何控制動作?
如何對外界作出即時反應?

即時神經解碼/神經調控
Real-time neuronal dynamics




即時神經解碼/神經調控

Real-time neuronal dynamics




ALLEN INSTITUTE *for*
NEURAL DYNAMICS




Institute Launch
November 4, 2021




PRESS RELEASE



NEURALINK



NEURALINK VIDEO



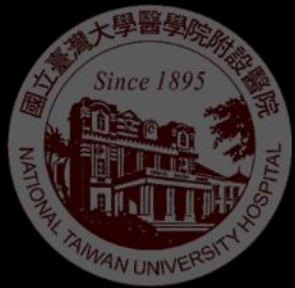
PRO ROBOTS
ELON MUSK'S
BRAIN CHIP
SPACE MISSIONS
TECHNOLOGY NEWS



COLUMBIA UNIVERSITY

Initiative for Columbia Ataxia and Tremor





即時神經解碼/神經調控
Real-time neuronal dynamics

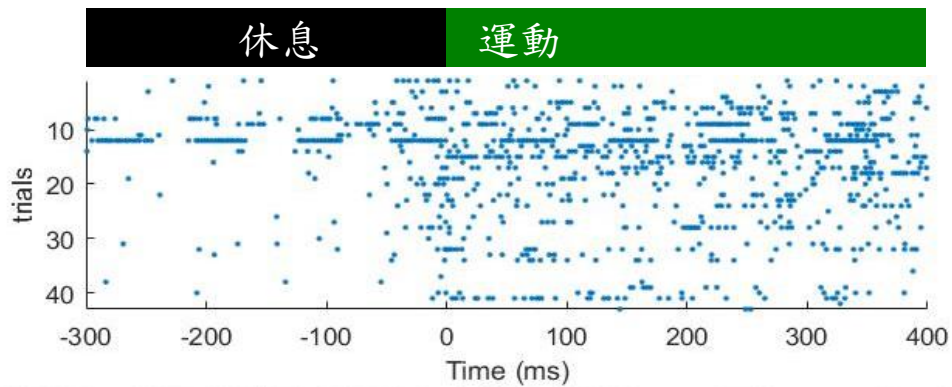
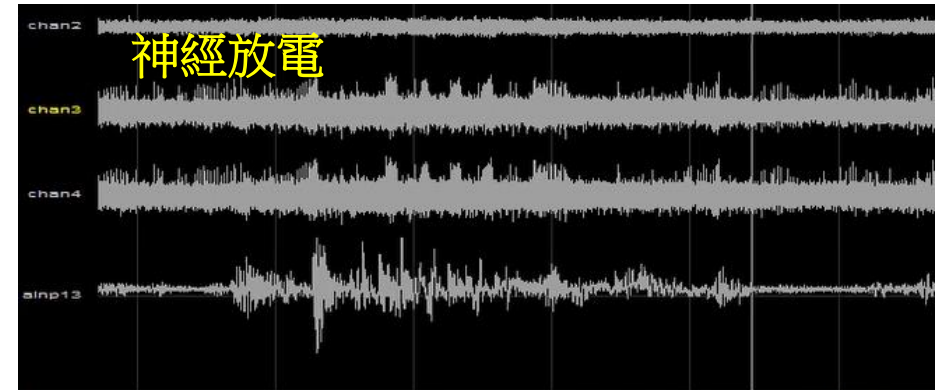
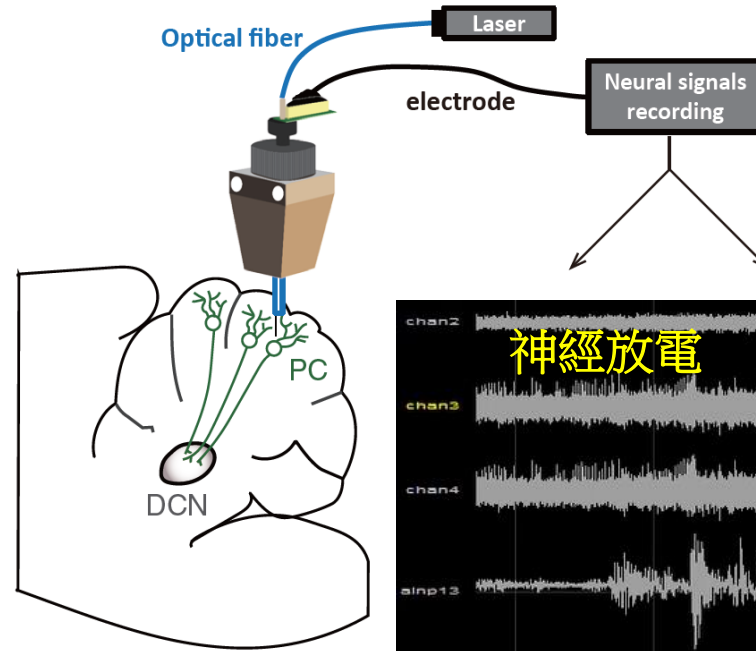
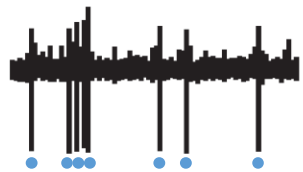
我們如何**記錄**神經活動?

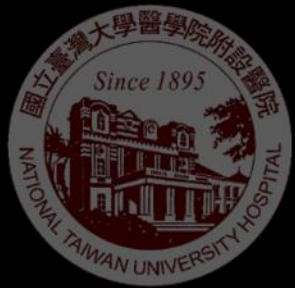


即時(real-time)記錄神經活性



神經放電





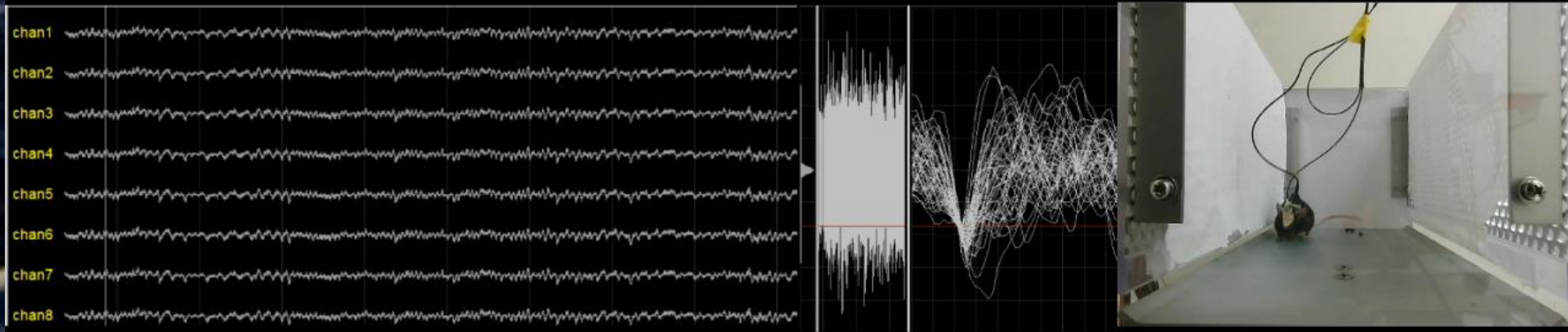
神經放電影響行為？
行為影響神經放電？

我們如何即時操控神經活性？



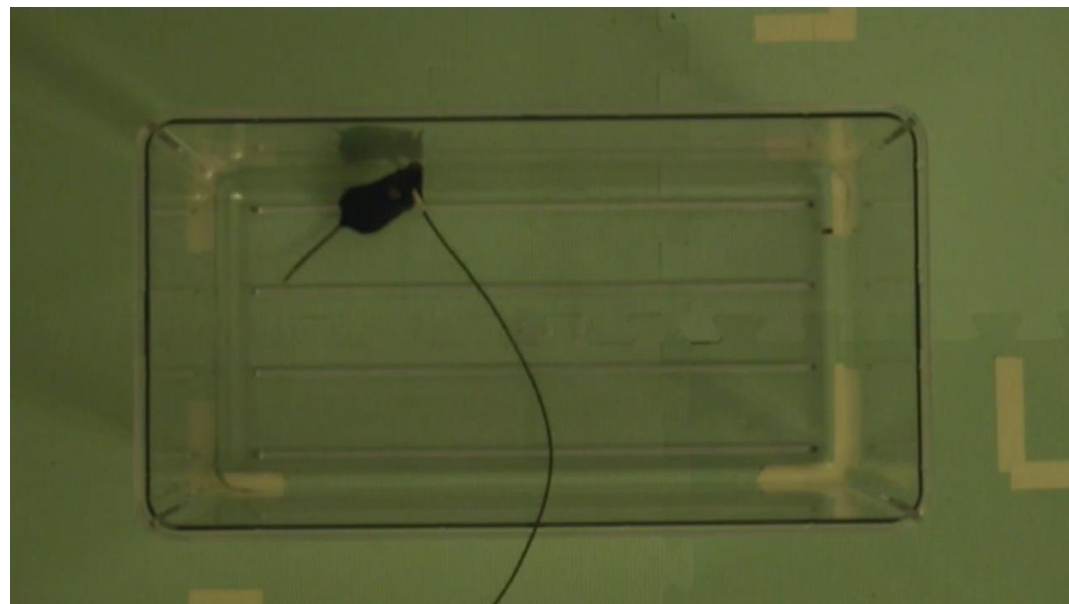
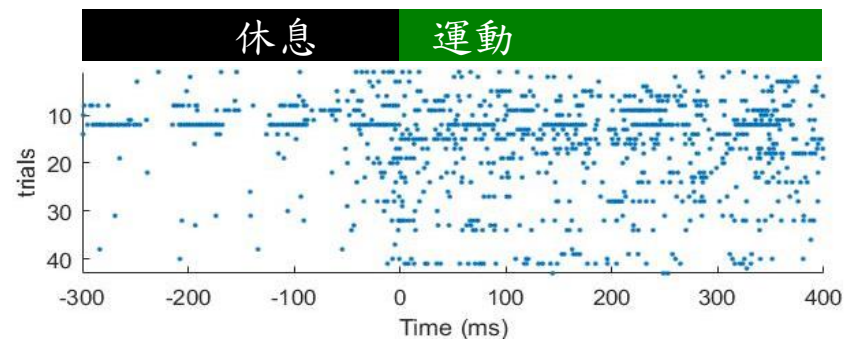
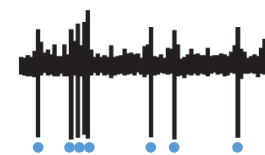
光遺傳學

讓神經看得見光，以光控制神經



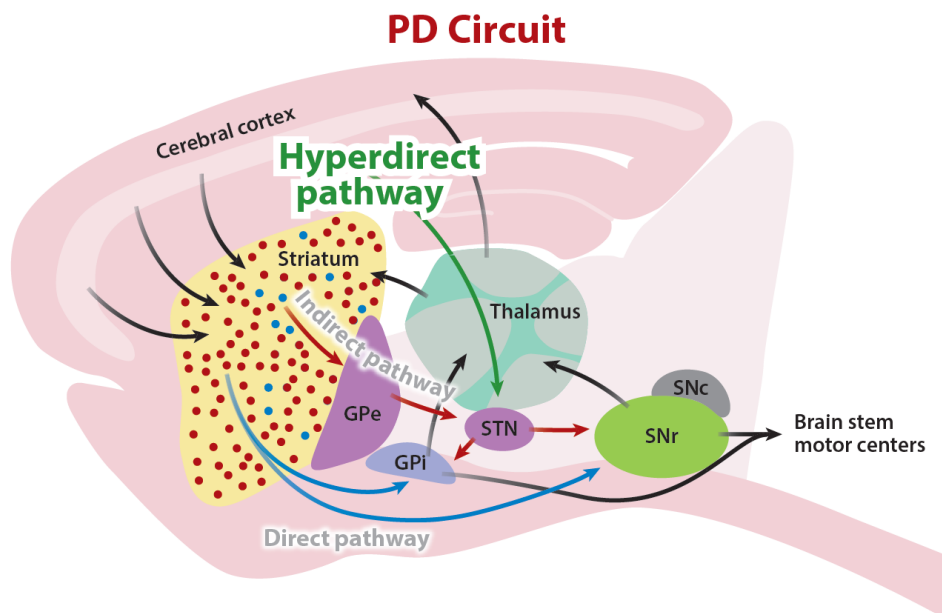
巴金森式病 動作遲緩的機轉

神經放電



Deranged NMDAergic cortico-subthalamic transmission underlies parkinsonian motor deficits

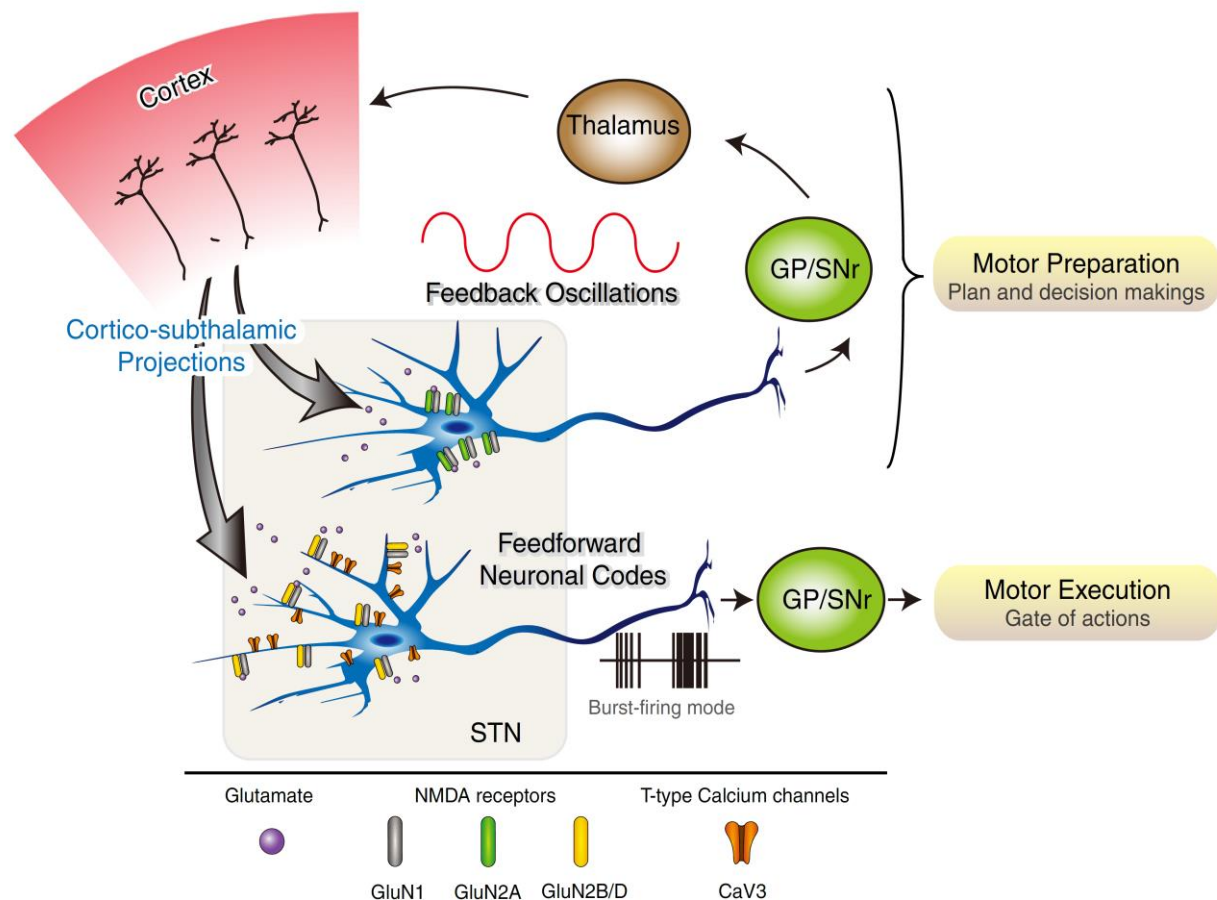
Ming-Kai Pan,^{1,2,3} Chun-Hwei Tai,² Wen-Chuan Liu,² Ju-Chun Pei,⁴ Wen-Sung Lai,⁴ and Chung-Chin Kuo^{1,2}

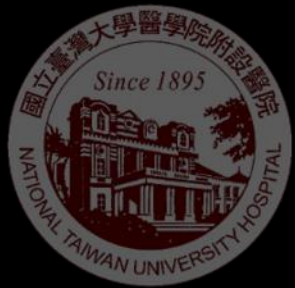


Pathologically dominant **hyperdirect pathway** overwrites direct and indirect pathways and causes PD motor deficits

Neuronal firing patterns outweigh circuitry oscillations in parkinsonian motor control

Ming-Kai Pan,^{1,2,3} Sheng-Han Kuo,⁴ Chun-Hwei Tai,² Jyun-You Liou,⁵ Ju-Chun Pei,⁶ Chia-Yuan Chang,⁶ Yi-Mei Wang,³ Wen-Chuan Liu,² Tien-Rei Wang,² Wen-Sung Lai,^{6,7} and Chung-Chin Kuo^{2,7,8}



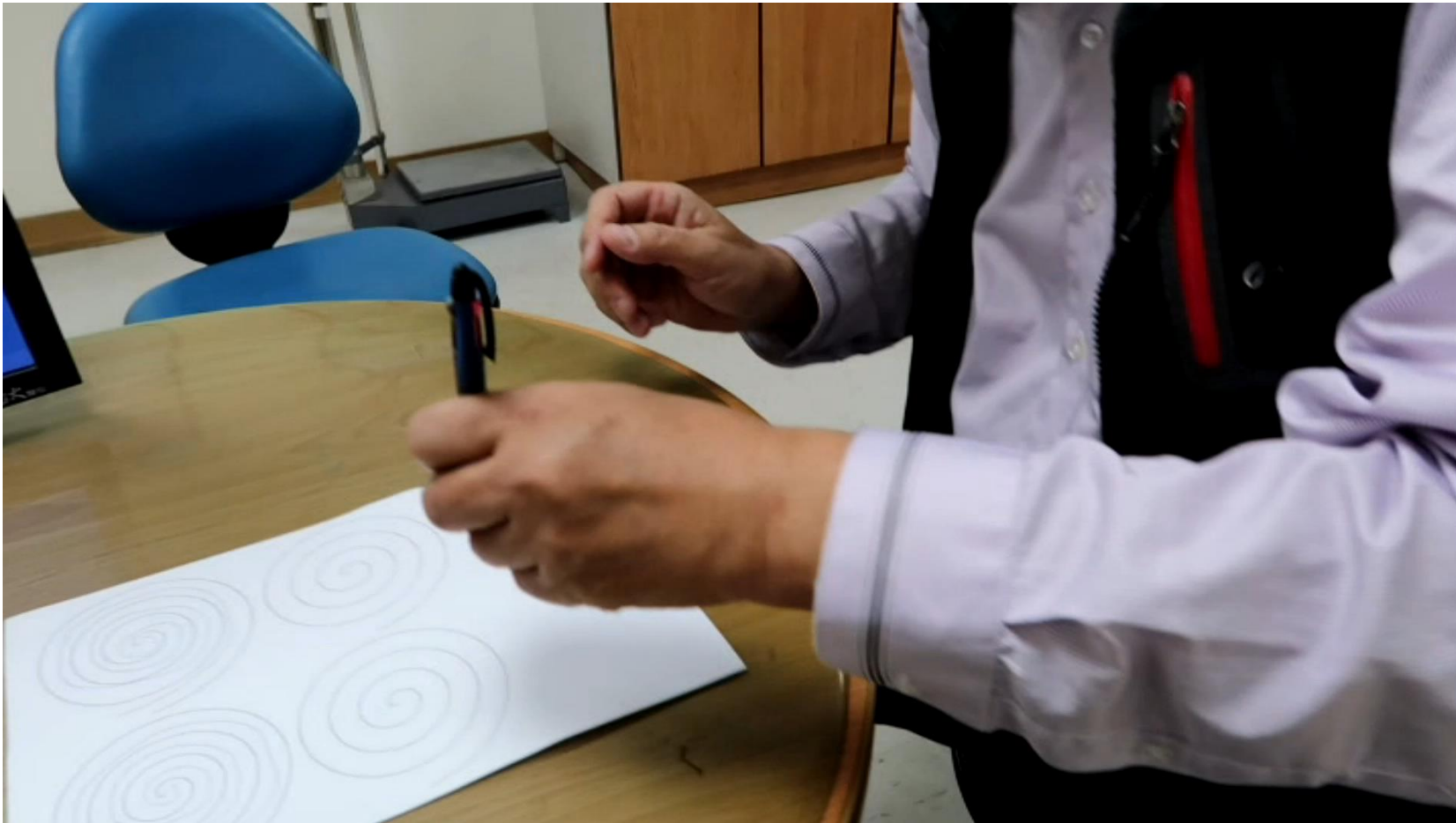


由動物實驗進入臨床電生理 顫抖症 研究



原發性顫抖症 (Essential Tremor, ET)

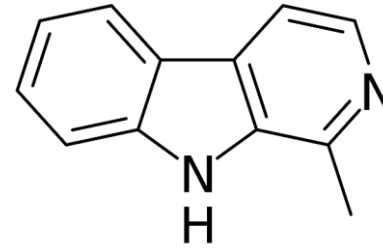
- 最常見的動作障礙疾病。
- 佔成人的 4%，老年人更可高達 20%，是巴金森氏病(Parkinson's disease)的 5 倍。
- 以動作型顫抖來表現。（有動作的時候會抖）



原發性顫抖症

常見，成因不明

1. 全基因研究 (Genome-wide association studies (GWAS))：在不同的研究中，找到的基因並不一致。
2. 有明顯的環境因子。
 - Harmane & other beta alkaloid



原發性顫抖症

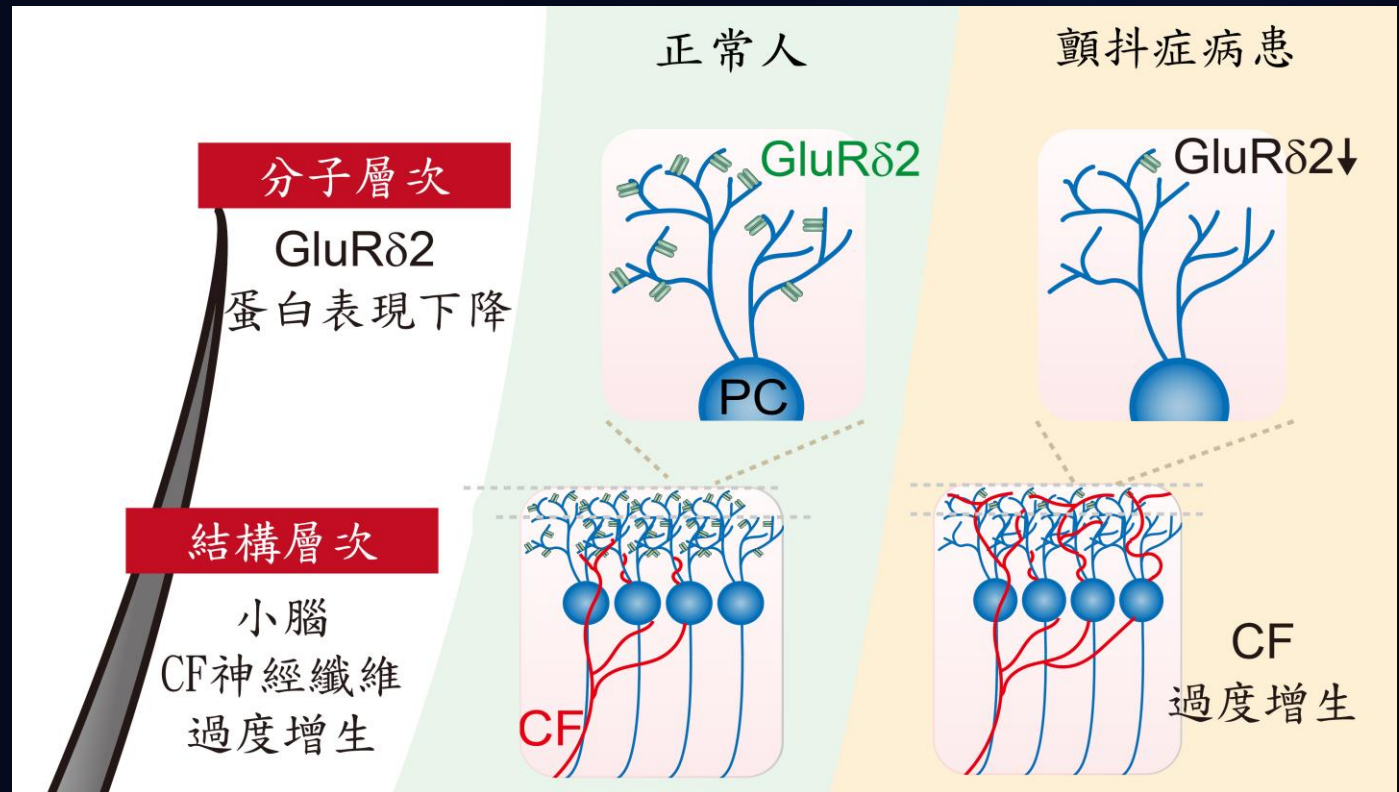
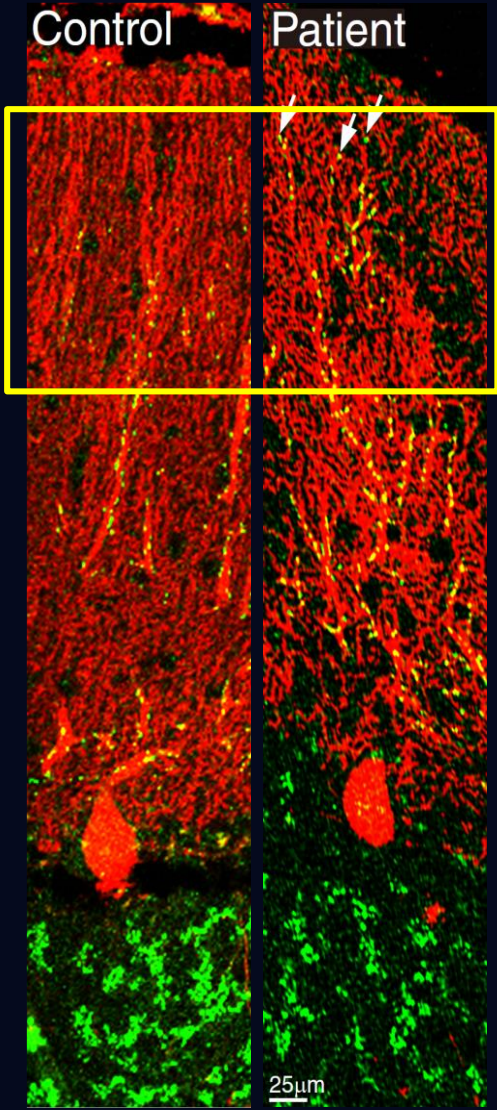
臨床診斷治療上的困境

- 確定診斷的困難
- 治療上的困難
- 美國FDA核准的唯二藥物，有效率<50%





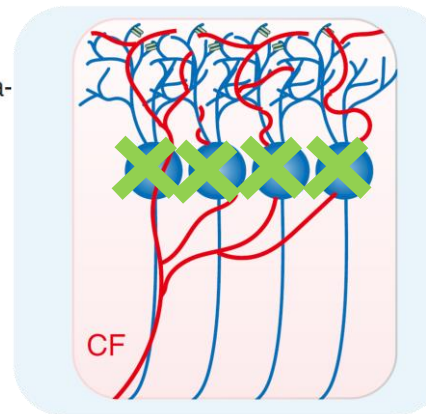
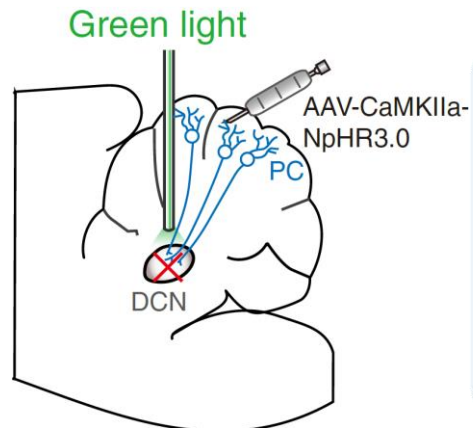
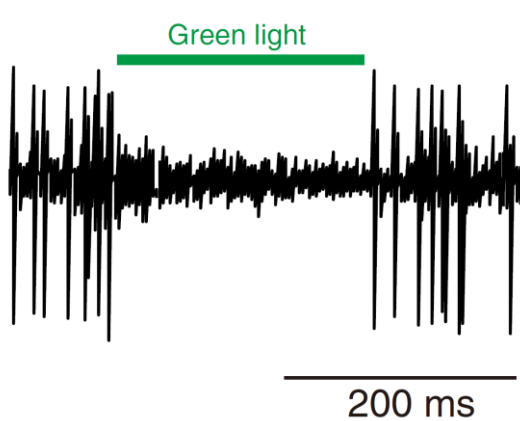
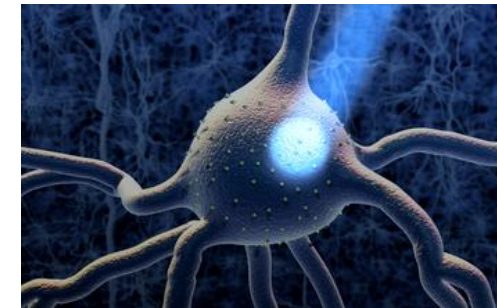
人類病理觀察





光遺傳學

抑制小腦共振，顫抖消失

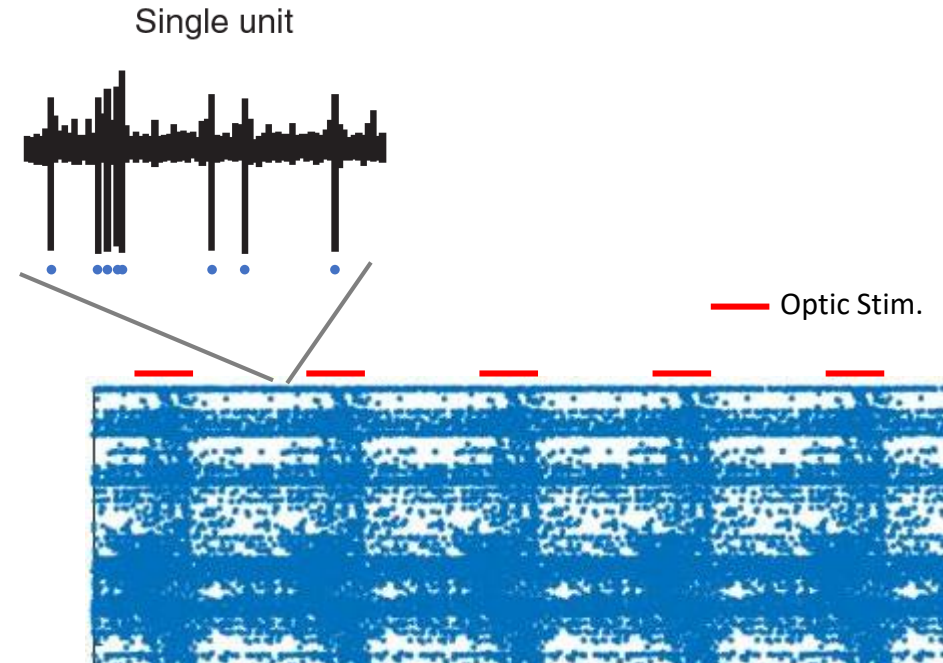
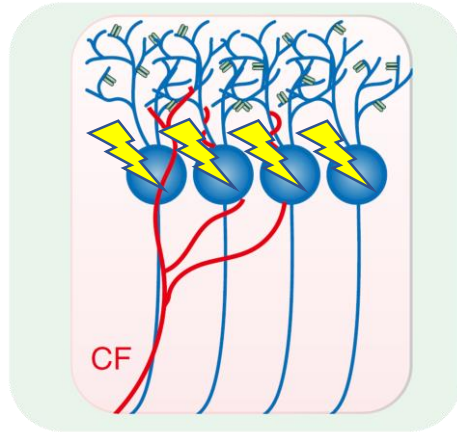
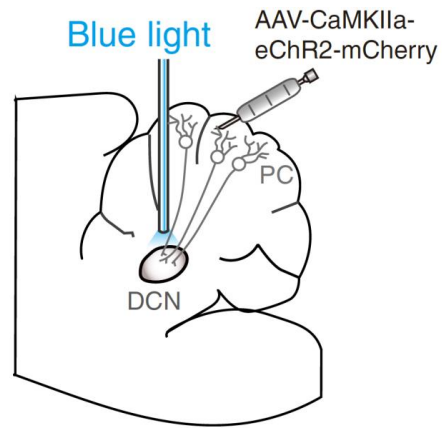


Optogenetics

Light off: tremor

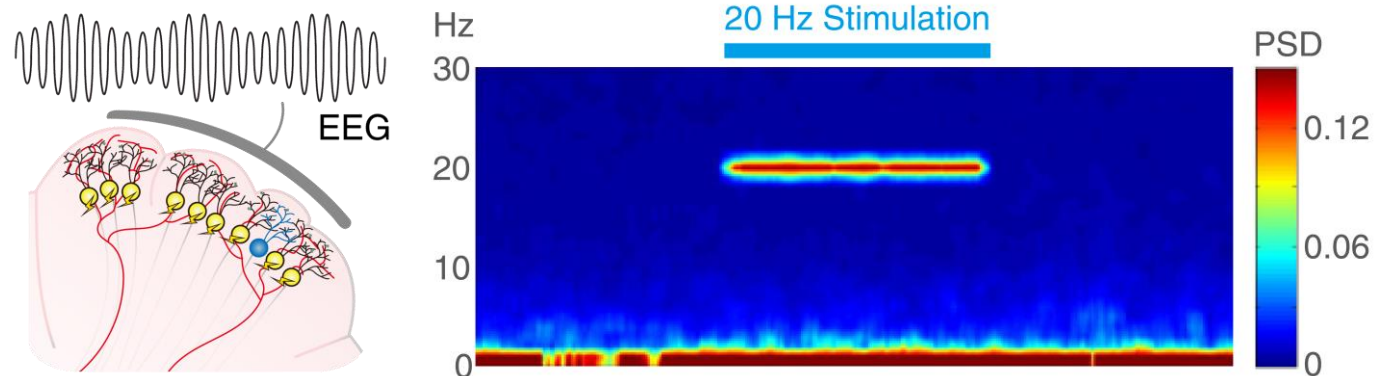
光遺傳學

製造小腦共振，正常鼠也顫抖



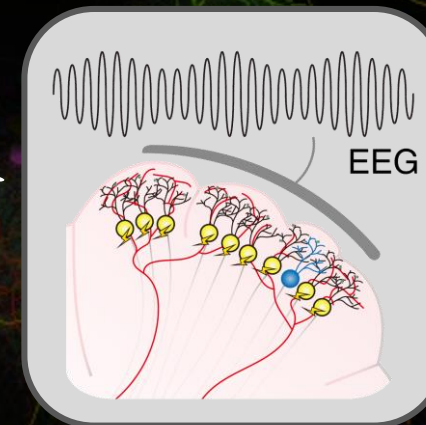
光遺傳學

製造小腦共振，正常鼠也顫抖



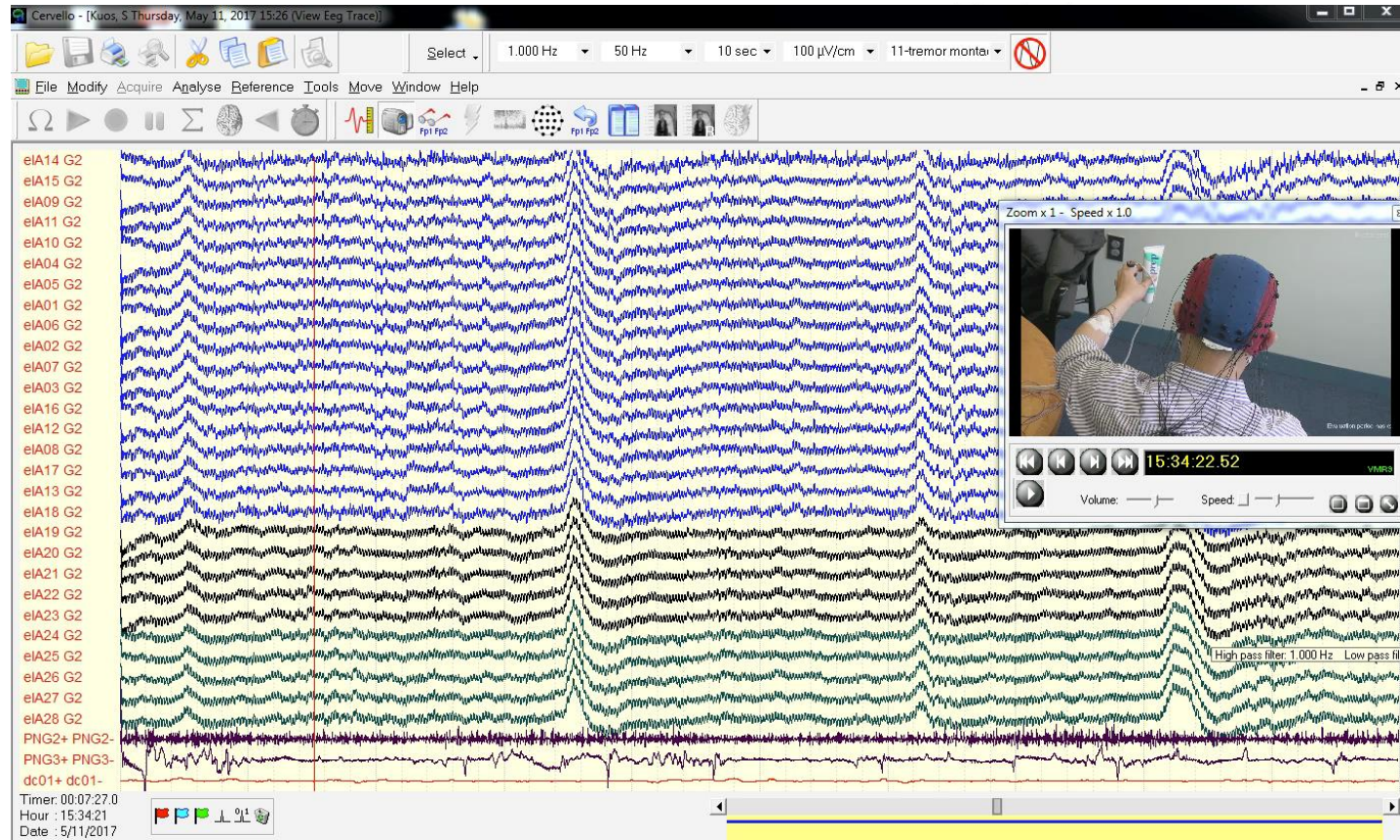
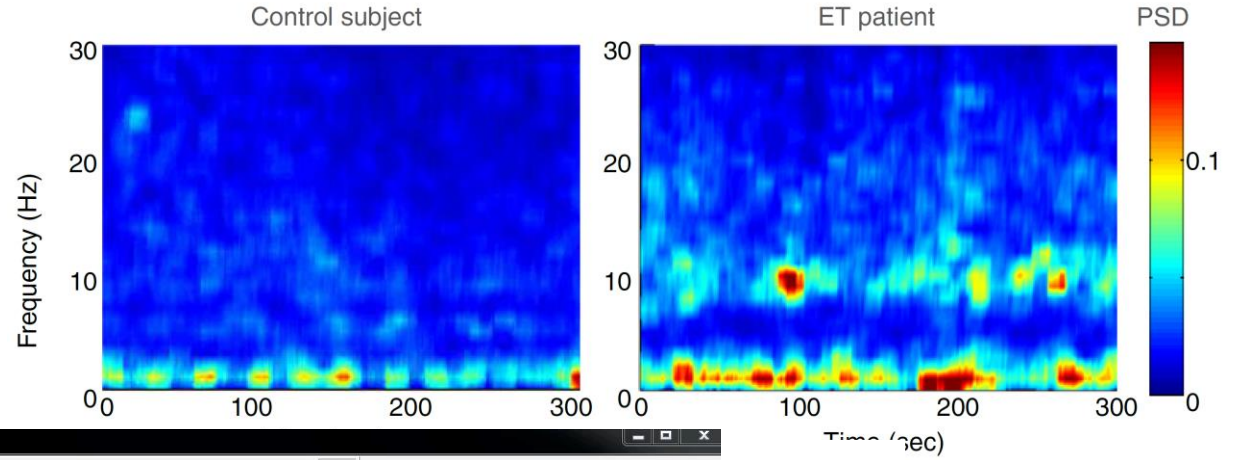
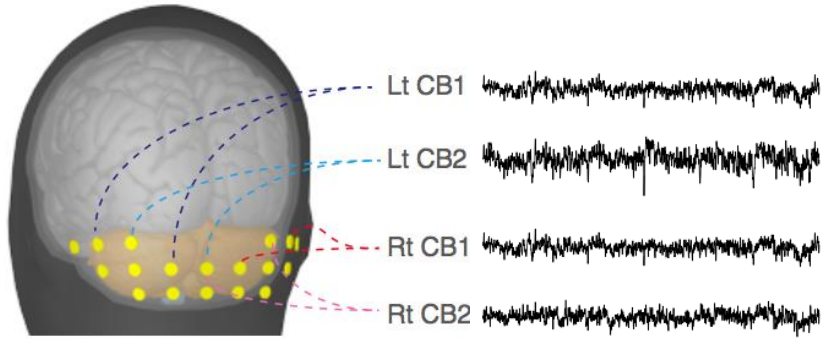


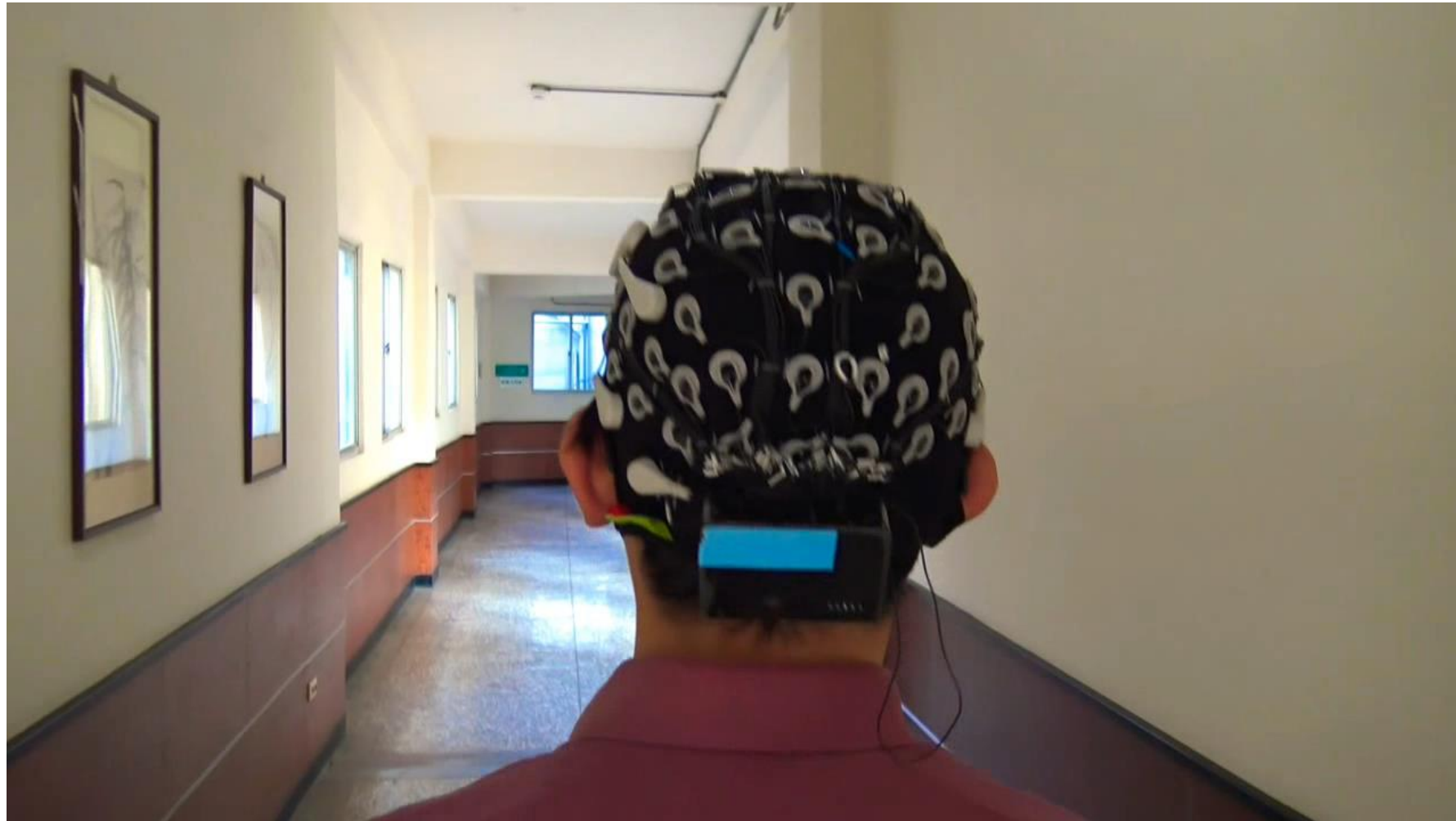
小鼠的小腦不正常共振會產生顫抖
那病人呢？





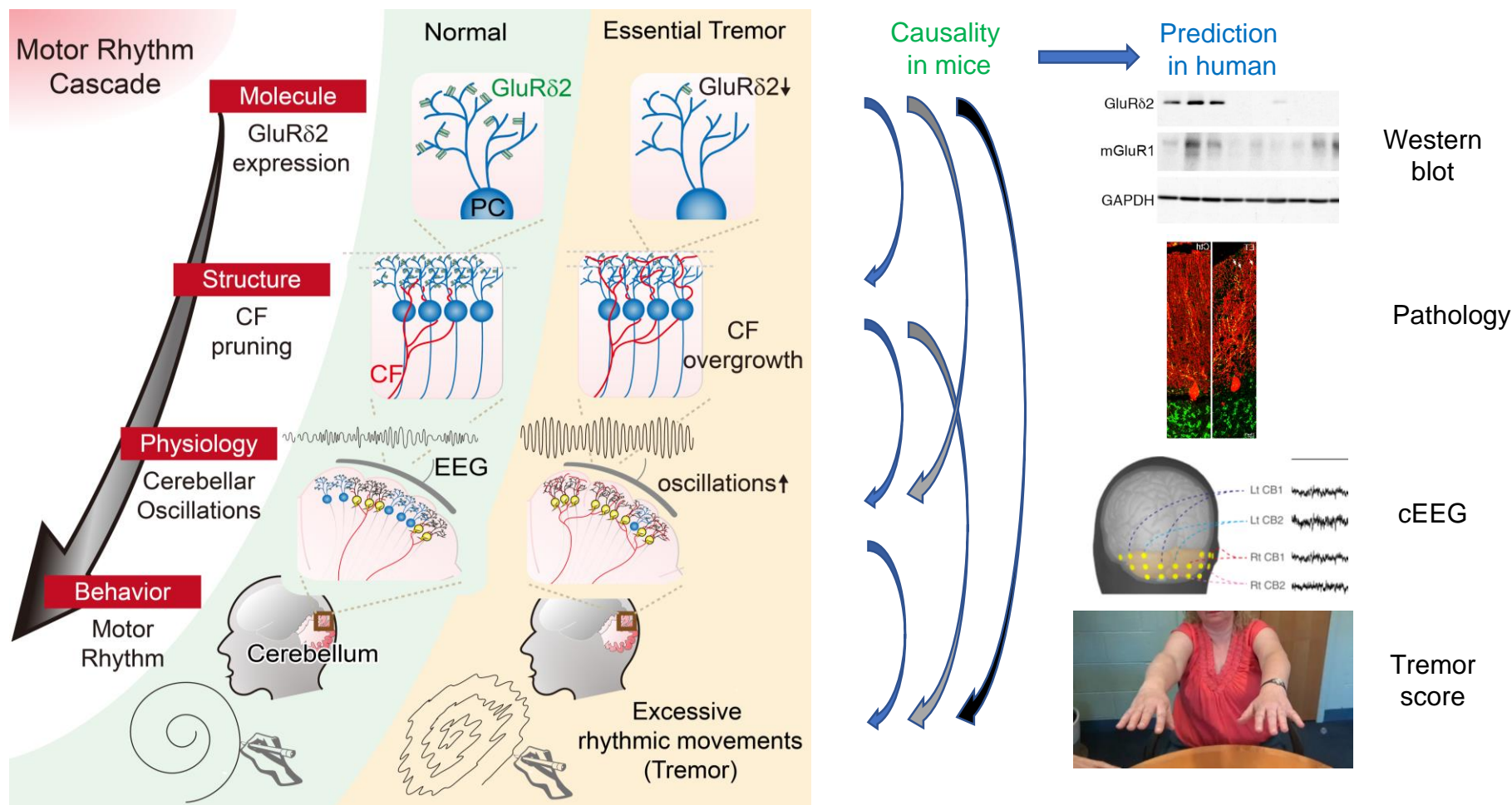
小腦腦波





<https://www.eurekalert.org/multimedia/pub/221726.php>

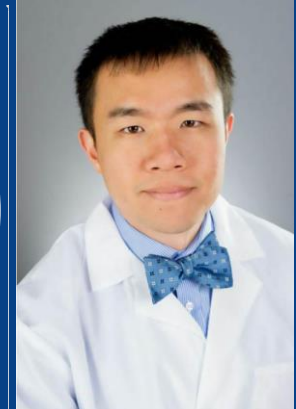
Cerebellar oscillations driven by synaptic pruning deficits of cerebellar climbing fibers contribute to tremor pathophysiology





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National Institutes
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NATIONAL INSTITUTE OF
NEUROLOGICAL
DISORDERS AND STROKE

NINDS R01 NS104423

NINDS R01 NS118179

NINDS R03 NS114871



MOST 107-2321-B-002-020 (腦科學專案)

MOST 108-2321-B-002-011 (腦科學專案)

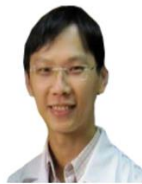
MOST 108-2321-002-059-MY2 (腦科技專案)

MOST 109-2326-B-002-013-MY4 (吳大猷獎助)

13 Health Tech Innovators Changing the World


Port Moresby, Papua New Guinea | 10 July 2018

Issued by the APEC Policy Partnership on Science, Innovation and Technology



Chinese Taipei
 Dr Ming-Kai Pan
 Physician Principle Investigator, NTUH
 Field of research: Neurology—movement disorders

Dr Pan specializes in human physiology and mouse models of neurological disorders. His work is focused on discovering novel ways to measure brain physiology for movements which have implications for Parkinson's disease, essential tremors and cerebellar ataxic disorders. Dr Pan has also invented smart technology to identify the most common movement disorders affecting 20 per cent of the elderly population.



International Parkinson and Movement Disorder Society

[About Us](#) [International Congress](#) [Education](#) [MDS Journals](#) [Resources](#) [Membership](#) [News](#)

About Us

Who We Are

About Movement Disorders

MDS Leadership

MDS Policies

MDS Organizational Chart

Committees, Task Forces, SIGs, Study Groups, Affiliate Member Societies

- MDS Committees
- MDS Task Forces
- MDS Special Interest Groups (SIG)

Tremor Study Group

MDS / About Us / Committees, Task Forces, SIGs, Study Groups, Affiliate Member Societies / MDS Study Groups / Tremor Study Group

Members

Giovanni Abbruzzese	Mark Hallett	William Ondo
Alberto Albanese	Anhar Hassan	Ming-Kai Pan
Peter Bain	Dietrich Haubenberger	Sanjay Pandey
Nin Bajaj	Rich Helmich	Shweta Prasad
Jos Becktepe	Franziska Hopfner	Jan Raethjen
Bettina Balint	Hyder Jinnah	Evžen Růžička
Julián Benito-León	Maria Joao Forjaz	Maria Stamelou
Kaillash Bhatia	Norbert Kovacs	Glenn Stebbins
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BMJ Best Practice

Essential tremor

[OVERVIEW](#) [THEORY](#) [DIAGNOSIS](#) [MANAGEMENT](#) [FOLLOW UP](#) [RESOURCES](#)

// **Authors:**

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 DISCLOSURES: S-HK is an author of a number of references cited in this monograph.

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 Assistant Professor of Neurology
 College of Medicine, National Taiwan University, Tapei, Taiwan
 DISCLOSURES: M.K.P declares that he has no competing interests.



International Parkinson and Movement Disorder Society

LEAP 2018

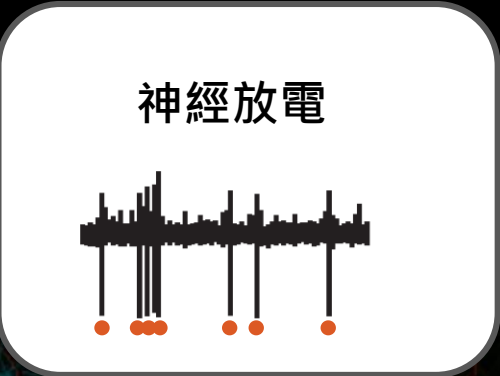


International Parkinson and Movement Disorder Society

SYNERGIES

SYNERGIES 2021: Mentor
SYNERGIES 2018: Junior faculty award

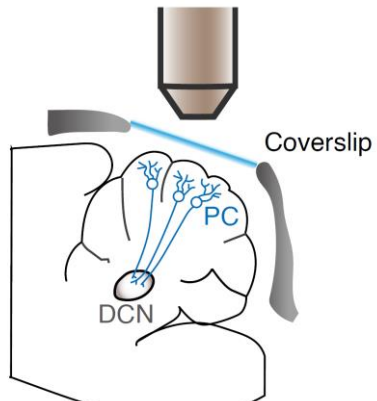
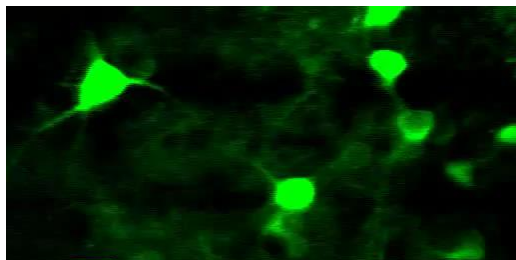
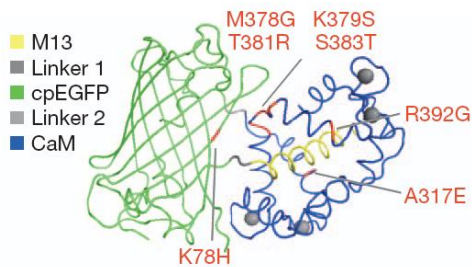




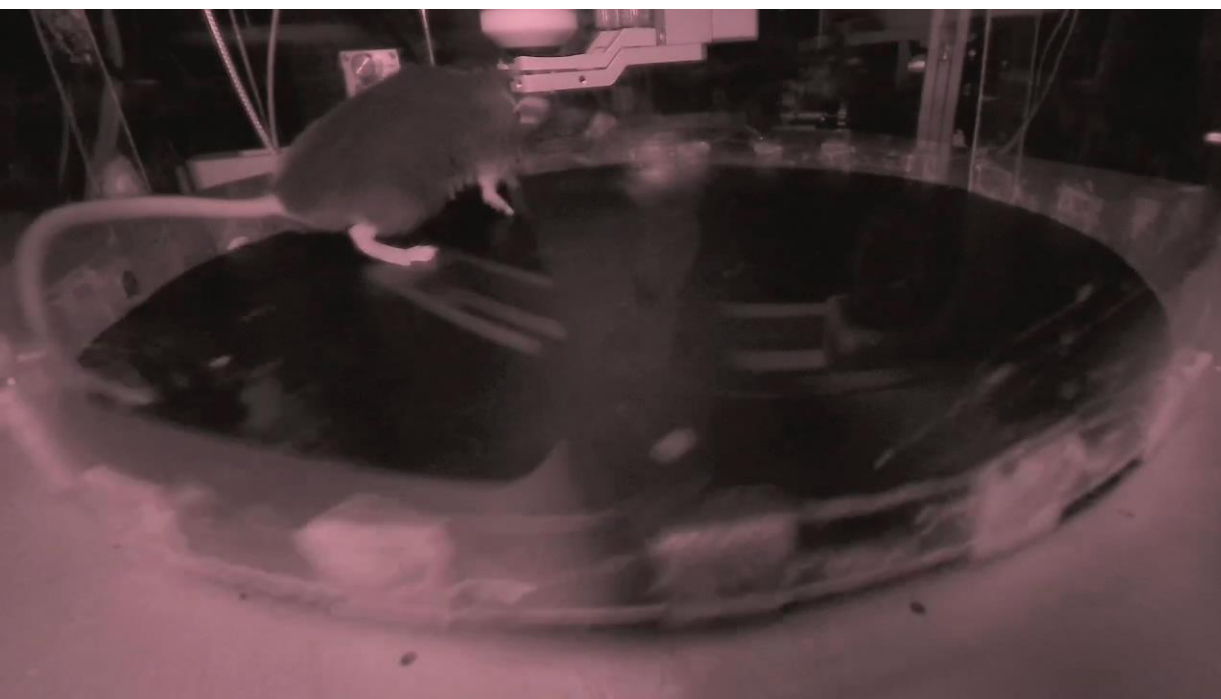
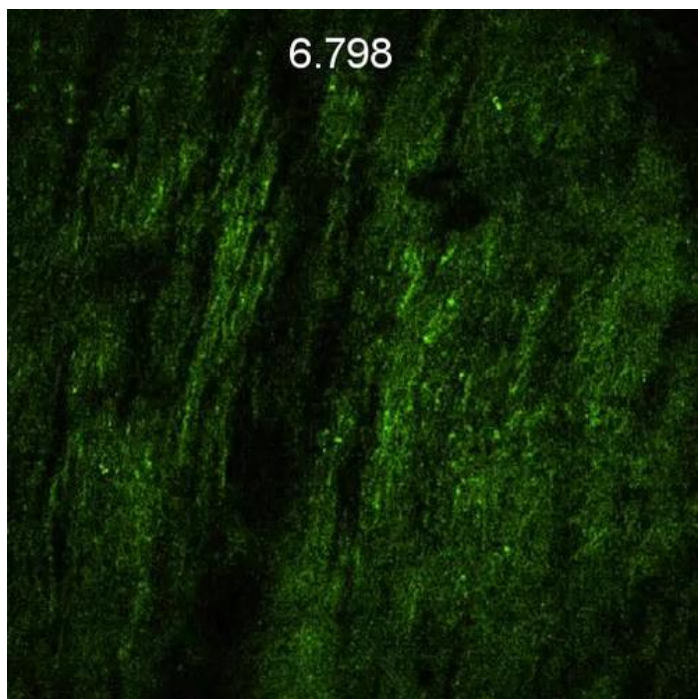
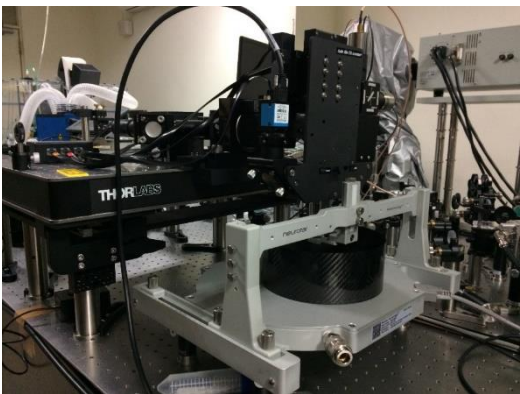
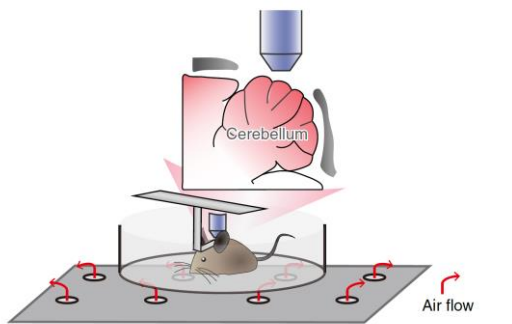
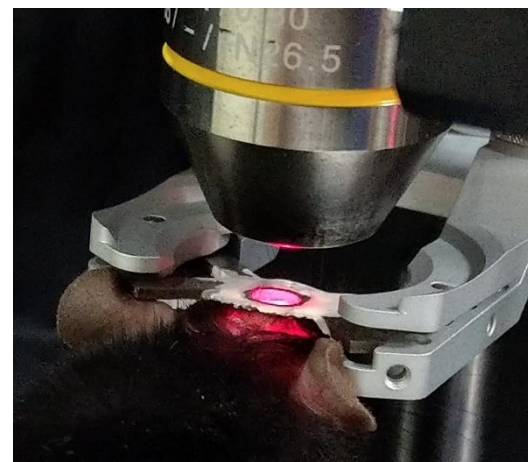
記錄到**空間**中各神經的**時間**動態
由時間到空間
神經系統的**時空**動態



多光子影像： 看到一群神經細胞的時空變化



pcp2-cre x LoxP-GCaMP6f mouse



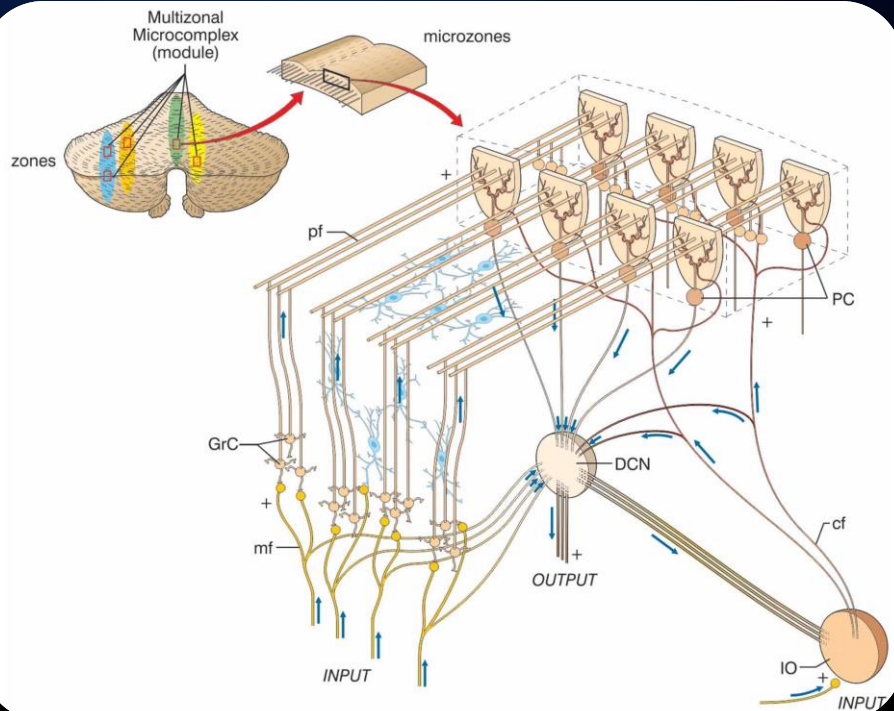


為什麼研究小腦?

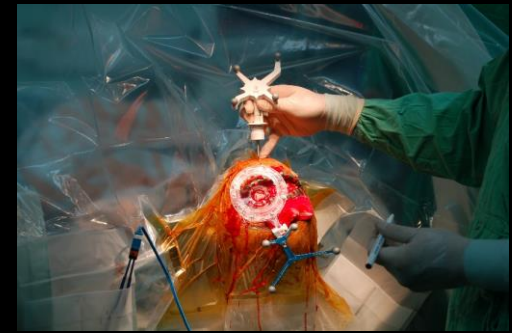
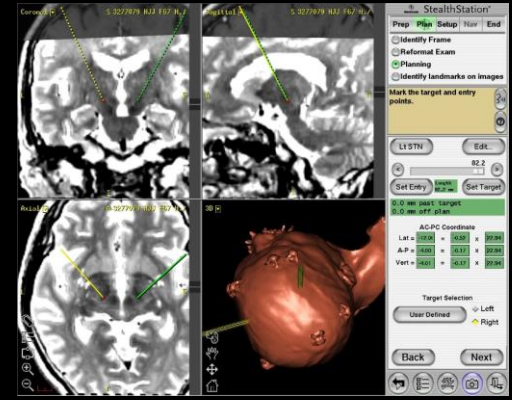
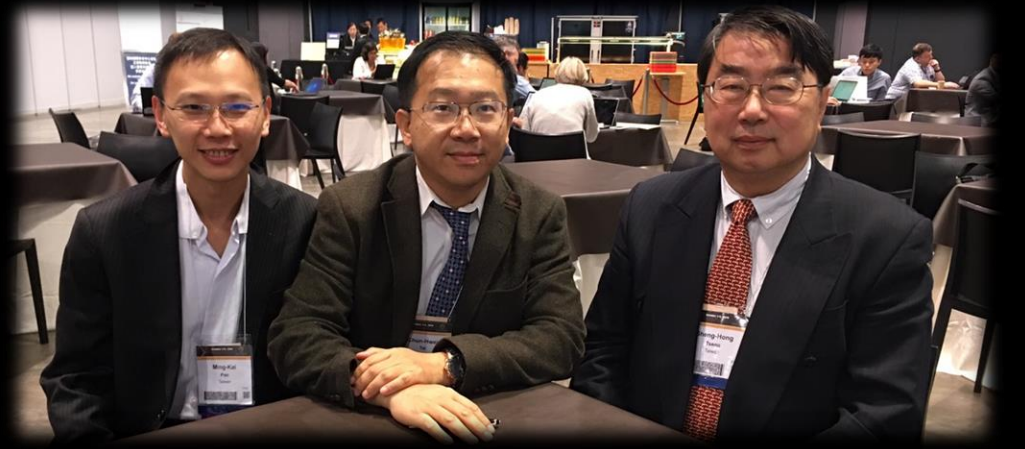
- 神經細胞是大腦的 **3.5 倍**
- **平行運算** 的結構
- 人類 **"AI"** 的所在地

- 和各種腦功能均相關

- 動作
- 認知
- 學習
- 記憶



術中電生理





National Institutes
of Health



Spatiotemporal mapping of brain functions

Shi-Wei Chu^{1,2,3}, Ming-Kai Pan^{4,5}

¹Department of Physics, National Taiwan University

²Molecular Imaging Center, National Taiwan University

³Brain Research Center, National Tsinghua University

⁴Department and Graduate Institute of Pharmacology, National Taiwan University

⁵Institute of Biomedical Sciences, Academia Sinica

