



## *Physics Colloquium*

Thursday, 13 November 2025 | 17:00 – 18:00, Seminar Room 3<sup>rd</sup> Floor

### **How dendrites empower learning in biological and artificial brains**

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#### **ABSTRACT**

In this presentation I will discuss recent findings from my lab that highlight how dendrites can provide important benefits to both biological and artificial neural networks. I will start with an overview of key dendritic properties, including anatomical, biophysical and plasticity features and their impact on neuronal computations [1,2,3]. I will then discuss our latest experimental study, whereby we investigate the role of structural plasticity in dendrites -i.e., spine turnover dynamics- in learning a flexible behaviour in head-fixed mice. Finally, I will provide examples of how we use such dendritic properties to build Artificial Neural Networks with enhanced learning capabilities on image classification [4]. I will discuss how and why incorporating dendritic features in these models can lead to accurate and faster learning, resilience to overfitting and learning with orders of magnitude fewer trainable parameters.

#### **References**

- (1) Poirazi and Papoutsis, *Nat. Rev. Neurosc.*, 2020
- (2) Makarov et al, *Cur. Opinion in Neurobiol.*, 2023
- (3) Pagkalos et al, *Cur. Opinion in Neurobiol.*, 2024
- (4) Chavlis and Poirazi, *Nat. Commun.*, 2025