Fostering independent academic research and forging new academic/pharma partnerships

Case studies and outcomes from Boehringer Ingelheim's opnMe platform

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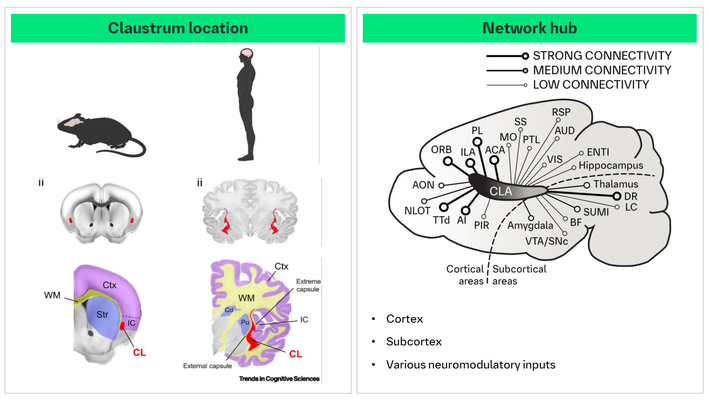
Introduction

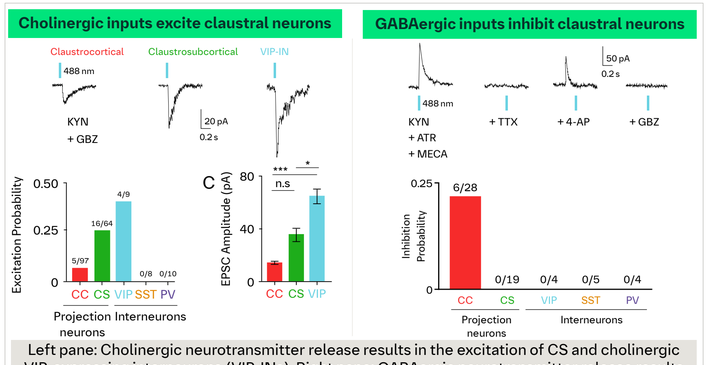
From December 2017 until November 2024, Boehringer Ingelheim's open innovation portal opnMe has received >2.400 collaborative research proposals and enabled >140 partnerships with scientists worldwide. We present opnMe's impact in fostering novel insights by highlighting research examples covering independent use of molecules, as well as collaborative research partnerships.

Mapping claustrum neuronal circuits using optogenetics[1]

- **The claustrum** is a structure implicated in the control of attention, salience detection, associative learning, premotor optimization, pain processing, and sleep/memory formation

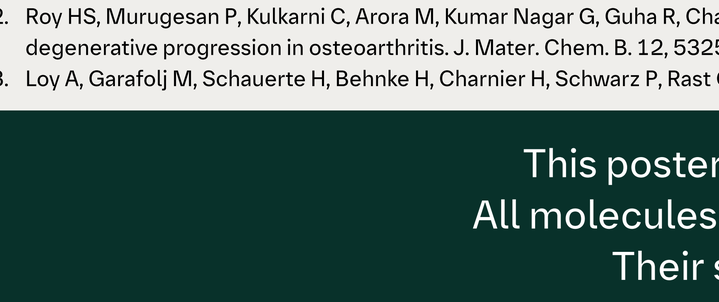


- **Corelease of ACh and GABA** by cholinergic inputs has opposing effects on the electrical activity of GABAergic vs cholinergic claustrum neurons that project to cortical vs. subcortical targets



Left pane: Cholinergic neurotransmitter release results in the excitation of CS and cholinergic VIP-expressing interneurons (VIP-INs). Right pane: GABAergic neurotransmitter release results in the inhibition of claustrocortical projection neurons (CS)

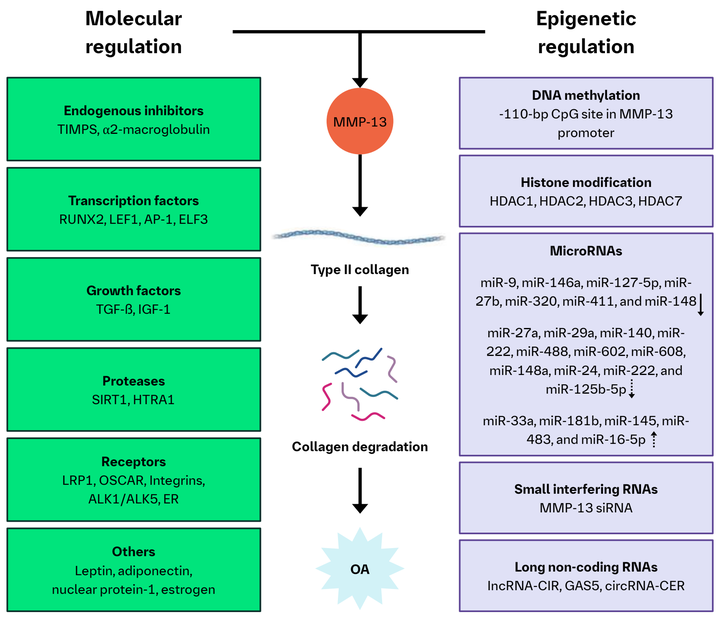
- The differential effects of ACh and GABA toggle network efficiency and the impact of noise on population dynamics between two different projection subcircuits



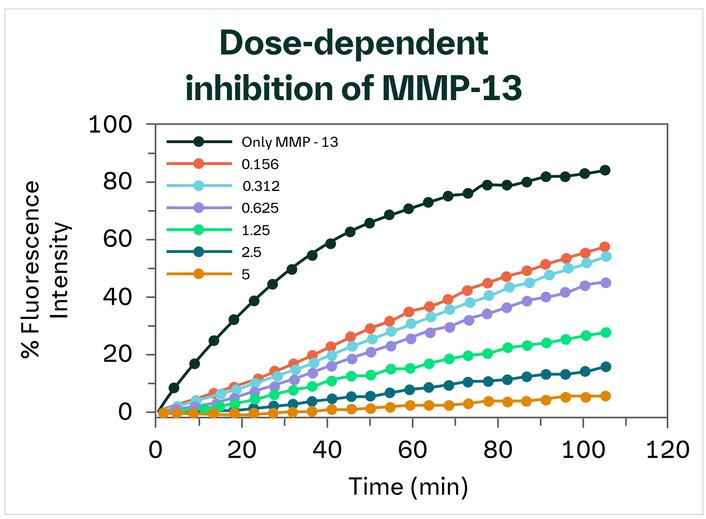
This switching between the claustral subcircuits may optimize cognitive processes, e.g., working memory, and act as a kind of noise filter on local and broader brain circuits

Assessing MMP-13 functions in osteoarthritis through inhibition with BI-4394[2]

- **Cartilage degradation**, the major driver of osteoarthritis, is mainly driven by MMP-13



- **The stability and solubility** of BI-4394 was improved by formulating the molecule in a self-assembling amphiphilic hydrogelator made with triglycerol monostearate
- **A dose-responsive** release was observed from the hydrogel in presence of esterase and MMP-13

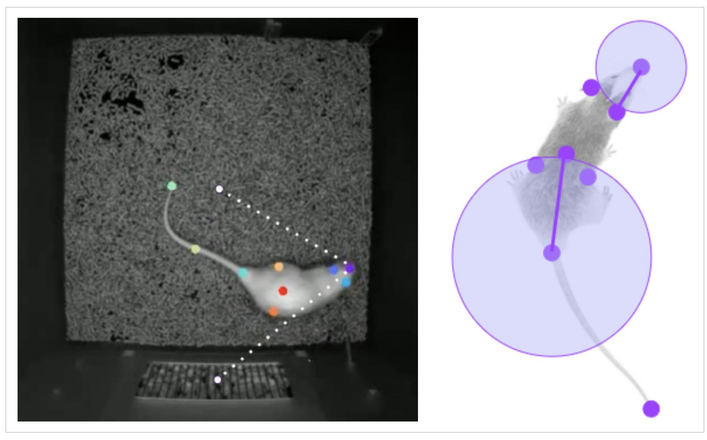


- **Intra-articular** administration of BI-4394 prevented the degenerative progression of cartilage in ACLT model as compared to untreated control

The hydrogel increased collagen-2 and aggrecan levels while reducing MMP-13, indicating effective cartilage degradation prevention

DeepRod, a computational system for rodent behavior analysis[3]

- Video of **rodent motor behavior** recorded during preclinical drug safety trials comprises large datasets which are not amenable to manual analysis
- DeepRod is a **UX-optimized platform** for behavior labelling and analysis
- It employs **active learning and machine learning** to identify and classify complex behavior, as well as find rare events and propose candidates for new behavioral categories



- DeepRod uses a **two-staged machine learning pipeline** to classify the behavior of rodents:
  1. The first stage extracts visual information from the video stream by localizing nine anatomical landmarks ("keypoints" in the above images) of the rodent
  2. The second stage is a classifier that uses features based on the keypoints
- To enable **automatic rodent behavior classification**, DeepRod implements a labeling assistant that uses an active learning method to suggest areas to label across the whole video material.
- It also supports users in observing unusual behavior to enable them to possibly categorize it as a new behavior class, referred to as "**novel behavior recognition**"

The system has already proven effective in discovering and annotating rare behavior types, improving model accuracy, and broadening the spectrum of detectable behaviors

Impact of opnMe

Initiatives such as opnMe foster an environment that accelerates innovation and discovery. A wide spectrum of research fields benefitted from this approach and may translate into novel therapeutic options.

1. Nair A, Teo YY, George J. Augustine GJ, Graf M (2023) A functional logic for neurotransmitter corelease in the cholinergic forebrain pathway. PNAS 120 (28) e2218830120 DOI: 10.1073/pnas.2218830120
2. Roy HS, Murugesan P, Kulkarni C, Arora M, Kumar Nagar G, Guha R, Chattopadhyay N, Ghosh D (2024) On-demand release of a selective MMP-13 blocker from an enzyme-responsive injectable hydrogel protects cartilage from degenerative progression in osteoarthritis. J. Mater. Chem. B. 12, 5325. DOI: 10.1039/d3tb02871b
3. Loy A, Garafolj M, Schauerte H, Behnke H, Charnier H, Schwarz P, Rast G, Wollmann T (2024) DeepRod: A human-in-the-loop system for automatic rodent behaviour analysis. bioRxiv preprint article, DOI: 10.1101/2024.01.04.572506