

IGSN - SYMPOSIUM

Monday, May 26th 2025 • 15.00 (3 pm)

FNO – 01 / 117

Catecholaminergic control of hippocampal function, tau pathology and cortex

NELSON TOTAH

Helsinki Institute of Life Science HiLIFE, University of Helsinki, Helsinki, Finland

Diversity of ancestral brainstem noradrenergic neurons

The brainstem cell group, locus coeruleus (LC), is present in all vertebrates, and influences arousal and cognition, as well as autonomic, metabolic, and immune functions via broad projections throughout the central nervous system (CNS). The LC has been thought to affect such wide-ranging functions by synchronous activity of its neurons releasing norepinephrine globally throughout the CNS. In this talk, I will show our recent work demonstrating that LC neurons fire together in small groups (ensembles), and that distinct cell type-specific ensembles contribute to different cortical activity states in the urethane-anesthetized rat. This paradigm shift to a modular LC is opening new questions and perspectives. However, LC research is still hampered by recordings from awake animals (monkey or rodent) yielding no more than one (or exceptionally two) single neurons for less than one week. I will show new data that attempts to solve these problems through different means. First, I will show that ultra-flexible nanoelectronic threads overcome brainstem motion to enable recording up to 60 brainstem single neurons simultaneously and permits recordings for 2 months. Second, I will that show boosting sample size by openly sharing data across 20 laboratories and comparing LC activity across species, sexes, and ages reveals unexpected divergence in the evolution of this ancestral vertebrate neuromodulatory system.

Key papers:

1.Kelberman MA *, Rodberg E *, Munn BR, Arabzadeh E, Bair-Marshall CJ, Berridge CW, Berrocoso E, Breton-Provencher V, Chandler DJ, Che A, Davy O, Devilbiss DM, Downs AM, Drummond G, Dvorkin R, Fazlali Z, Froemke RC, Glennon E, Gold JI, Ito H, Jiang X, Johansen JP, Kaye AP, Kim JR, Kuo C-C, Liu R-J, Liu Y, Llorca-Torralba M, McCall JG, McElligott ZA, McKinney AM, Miguelez C, Min M-Y, Nowlan AC, Omrani M, Poe GR, Pickering AE, Ranjbar-Slamloo Y, Razquin J, Rodenkirch C, Sales AC, Satyasambit R, Shea SD, Sur M, Tkaczynski JA, Torres-Sanchez S, Uematsu A, Vazquez CR, Vreven A, Wang Q, Waterhouse BD, Yang H-W, Yang J-H, Zhao L, Zouridis IS, Shine JM, Weinshenker D, Vazey E, Totah NK †. (2024) "Diversity of ancestral brainstem noradrenergic neurons across species and multiple biological factors." bioRxiv. https://doi.org/10.1101/2024.10.14.618224

2.Vreven A, Aston-Jones G, Pickering AE, Poe GR, Waterhouse B, Totah NK †. (2024) "In search of the locus coeruleus: guidelines for identifying anatomical boundaries and electrophysiological properties of the blue spot in mice, fish, finches and beyond." Journal of Neurophysiology 132(1):226-239.

3.Noei S, Zouridis I, Logothetis NK, Panzeri S †, Totah NK †. (2022). "Distinct ensembles in the noradrenergic locus coeruleus are associated with diverse cortical states." PNAS 119 (18) e2116507119

4.Chandler DJ, Jensen P, McCall JG, Pickering AE, Schwarz LA, Totah NK †. (2019). "Redefining noradrenergic neuromodulation of behavior: impacts of a modular locus coeruleus architecture." Journal of Neuroscience 39(42):8239-8249.

5.Totah NK, Neves RN, Panzeri S, Logothetis NK, Eschenko, O. (2018). "The locus coeruleus is a complex and differentiated neuromodulatory system." Neuron 99:1-14.

Host: CELINA BÖSE

Department of Neurophysiology, Faculty of Medicine, Ruhr Universität Bochum



