# Neural oscillations in sensorimotor processing

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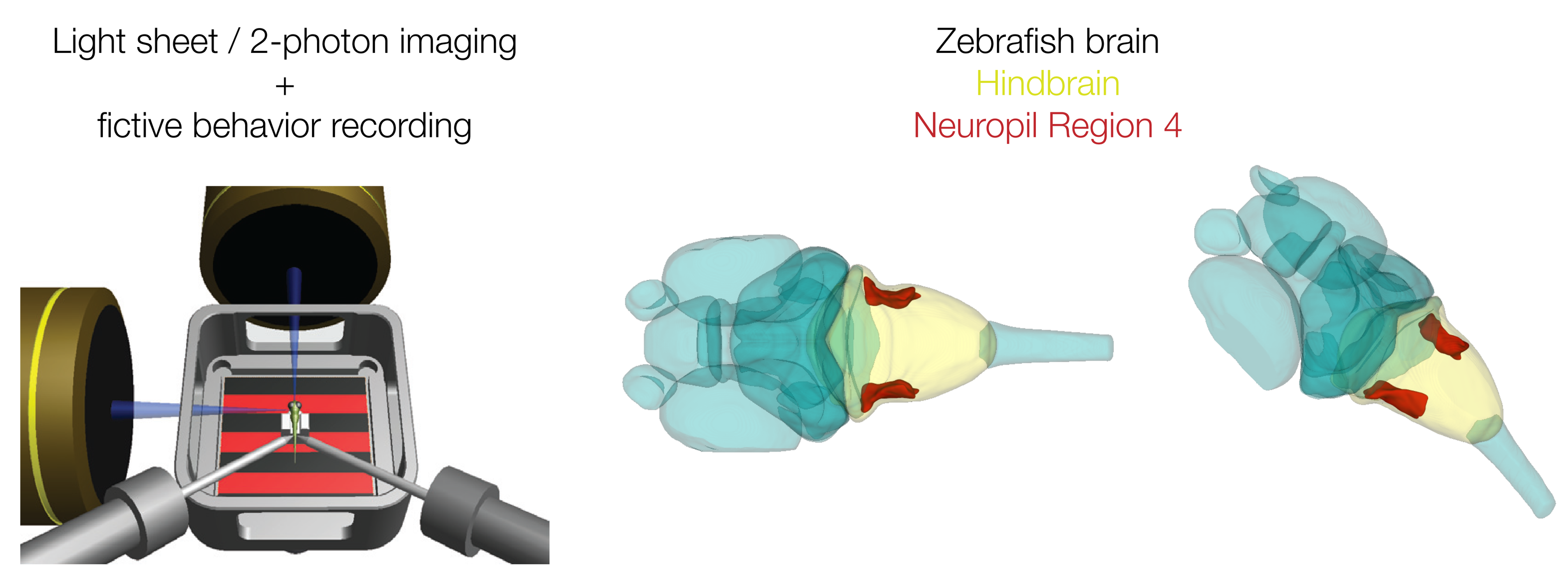
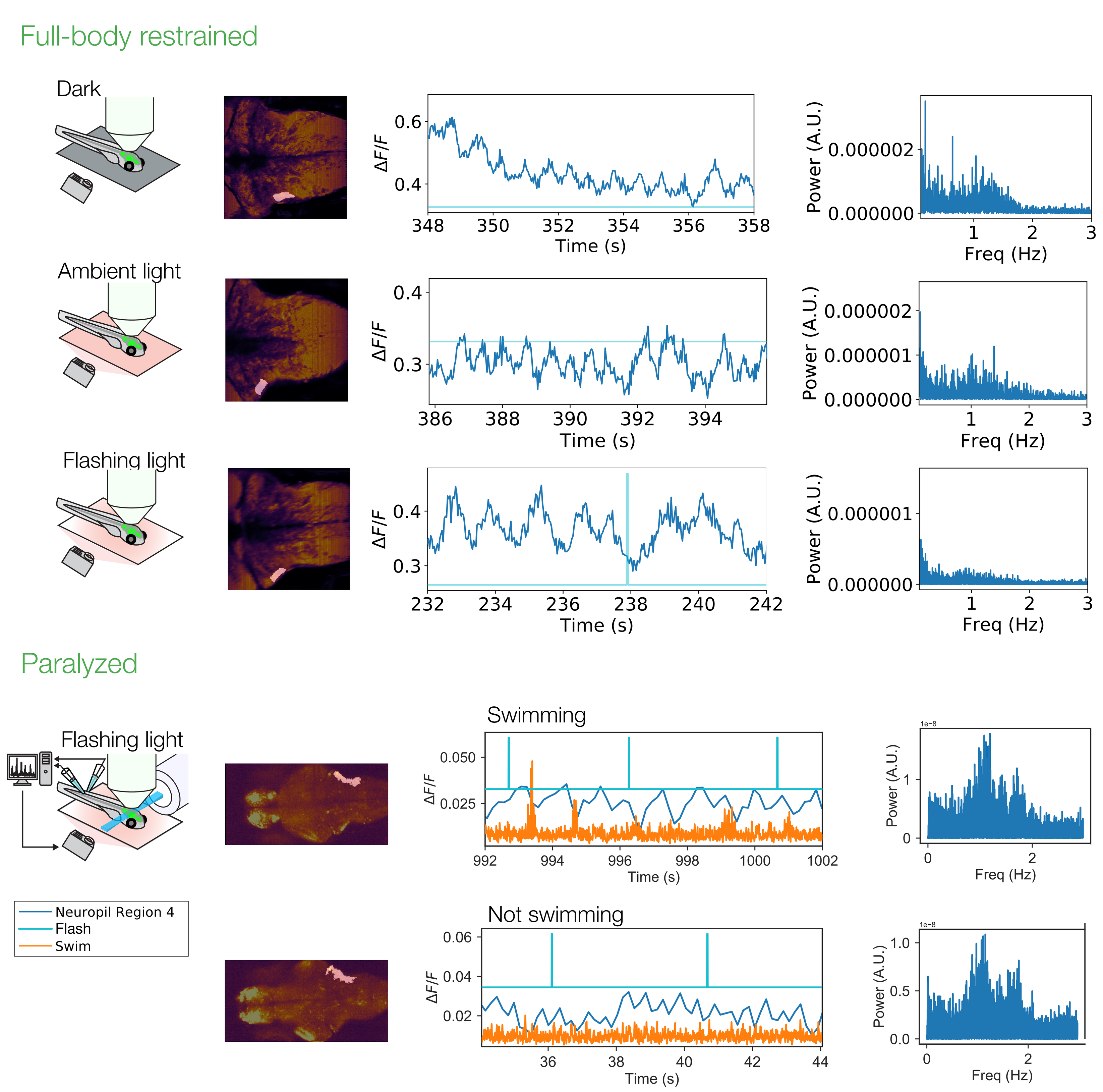
## Introduction

Brain oscillations have been observed across species and across a wide range of behaviors and brain states. We found oscillations in the hindbrain of the zebrafish brain. Here, we explore their possible role in gating locomotion.

## Methods

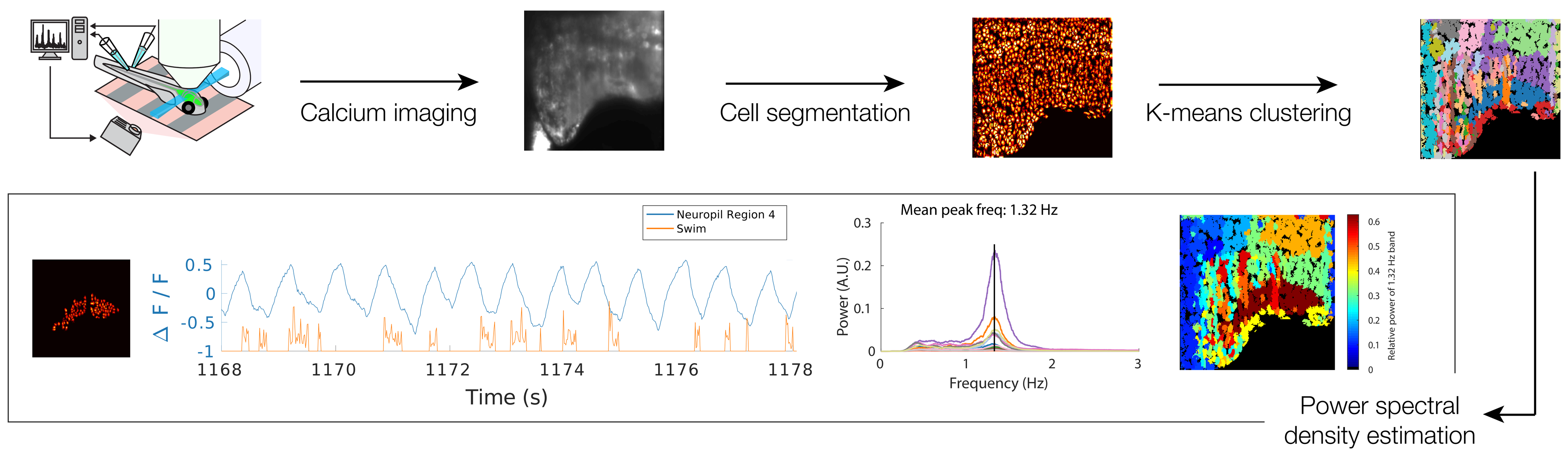



## Neuropil Region 4 oscillates across various sensory stimuli and swimming behavior



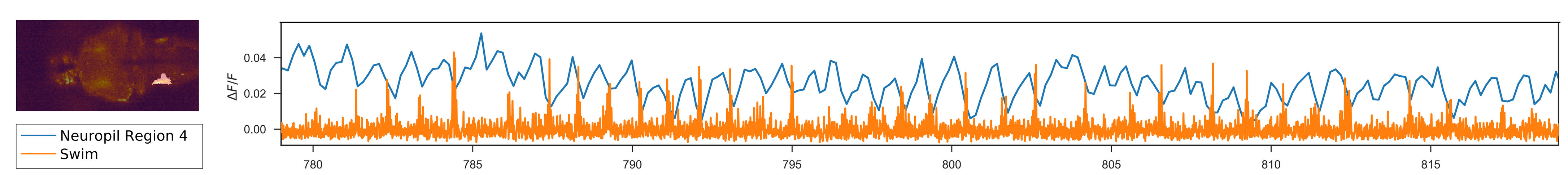

Oscillations were observed during the presentation of various visual stimuli. They were not disrupted during paralysis, even during periods when the fish was not swimming.

## Neuropil Region 4 oscillates strongly at 0.8 - 2 Hz

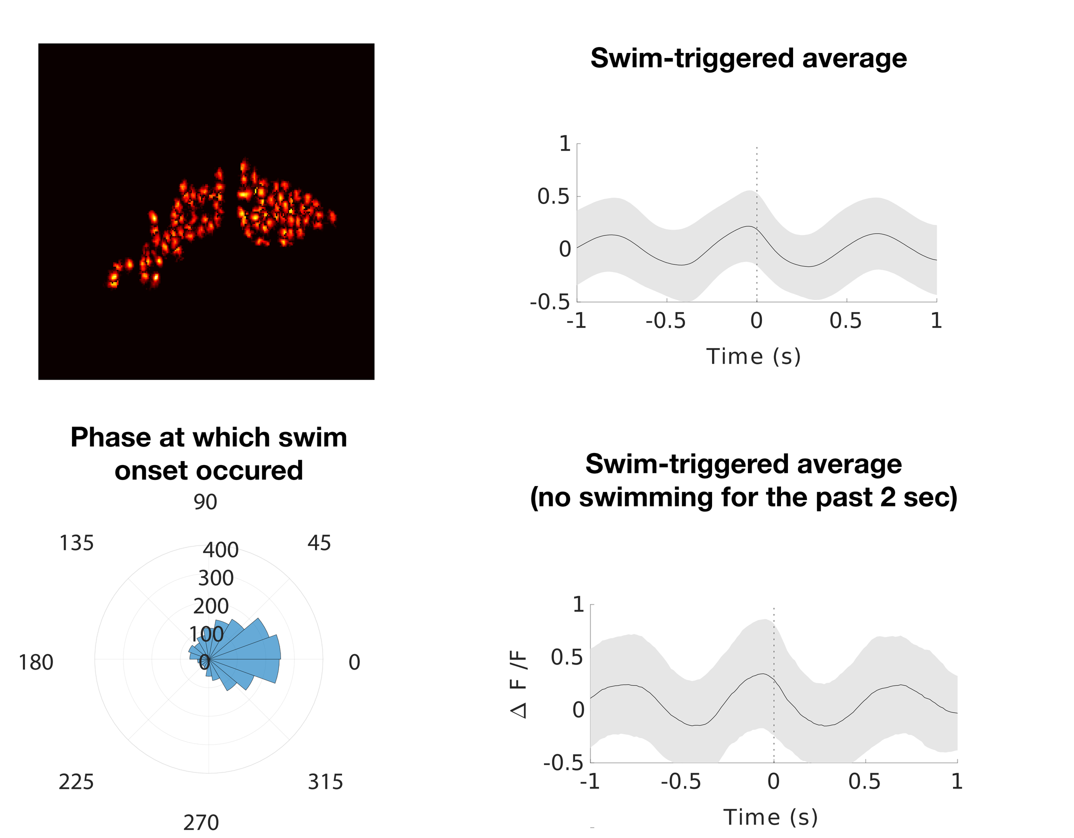



Across fishes, we observed oscillatory activity at frequencies in the range of 0.8 - 2 Hz in Neuropil Region 4 (data not shown). In this fish, this oscillation was present at 1.32 Hz. Oscillations in this band were the strongest in Neuropil Region 4 as compared to regions in its vincinity.

## That swim onset is time-locked to a narrow range of phases of Neuropil Region 4 activity is consistent with a model in which the oscillations gate swimming

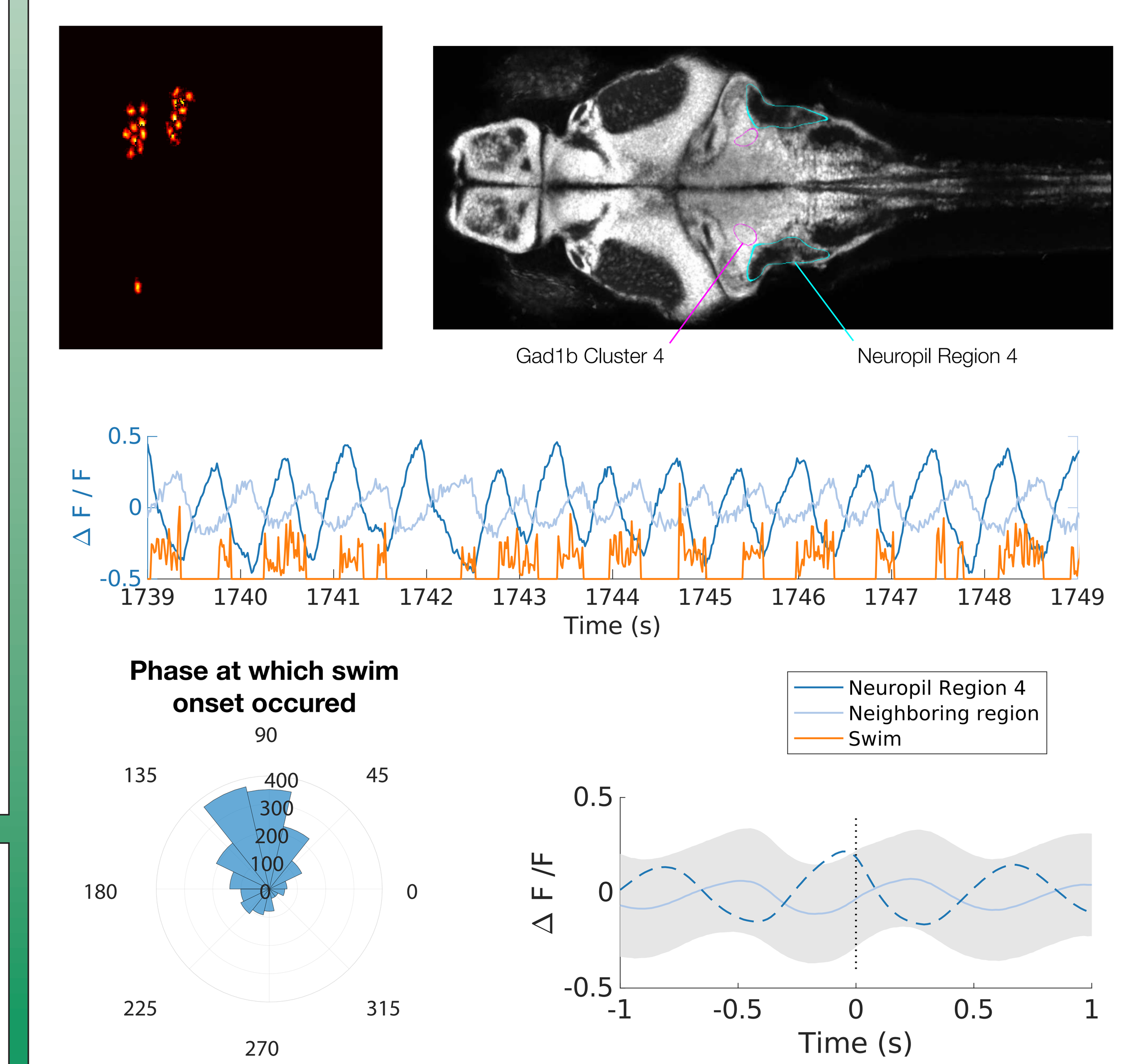



Swim bouts consistently occur at a particular phase of the oscillations in Neuropil Region 4. What is the relationship between swim bouts and oscillations?



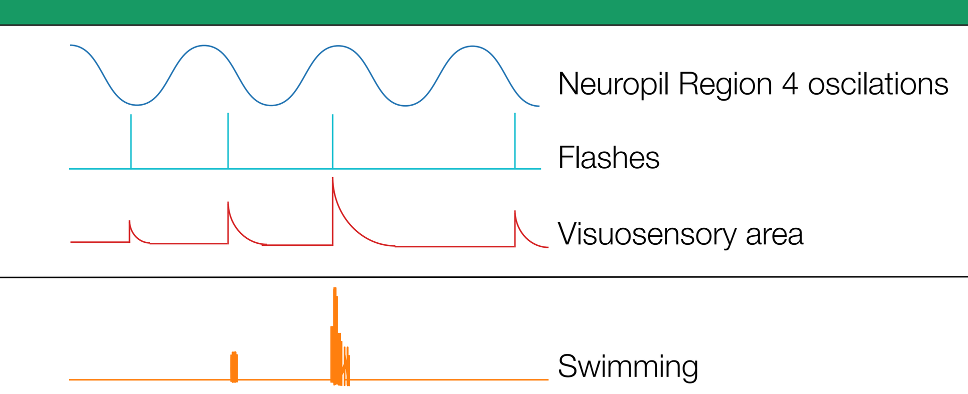

- Swim onset seems to be phase-locked to a narrow range of phases surrounding 0 deg.
- Activity in Neuropil Region 4 rises ~0.5 seconds before onset of swim, suggesting that the oscillations are predictive of swim onset.
- Activity continues to predict swim even when no swimming occurs 2 seconds prior, suggesting that swimming does not drive oscillatory activity.

## Strongly oscillatory cluster with phase-shifted activity




We observed a second region with strong oscillatory activity in the same frequency band. Activity in this region is phase-shifted by ~90 deg relative to that in Neuropil Region 4. This region anatomically corresponds to a known region containing GABAergic neurons.

## Possible role of oscillations in gating sensory input?




We are also curious about the relationship of these oscillations with visual input. One hypothesis would be that the oscillations are actually gating sensory input, which might then drive swimming. We are now testing this hypothesis by presenting visual input at different phases of the oscillations and looking for evidence that the input is modulated by the oscillations.

## Summary

- We found oscillations in several hindbrain regions of the zebrafish brain.
- In particular, oscillatory activity in Neuropil Region 4 seem to be important for locomotion and might play a role in gating swimming.
- We're exploring the idea that these oscillations might gate sensory input, which might in turn drive swimming.

## Acknowledgements


Alireza Sheikhattar | Ziqiang Wei | Takashi Kawashima | Mikail Rubinov

## References

- Siegel, M., Warden, M.R., and Miller, E.K. (2009). Phase-dependent neuronal coding of objects in short-term memory. Proc. Natl. Acad. Sci. 106, 21341–21346.