Geometric Constraints on Mouse Brain Function and Organisation

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INTRODUCTION

- Recent work[1] has shown that brain function can be modelled by **geometric eigenmodes**
- These **eigenmodes are derived only from brain surfaces** (modelling local curvature) but do not contain any connectivity information
- Nonetheless, geometric **eigenmodes can parsimoniously reconstruct various phenotypes**, including functional connectivity
- These geometric modes are more accurate than **connectome modes** models (derived from complex diffusion MRI/tractography procedures)

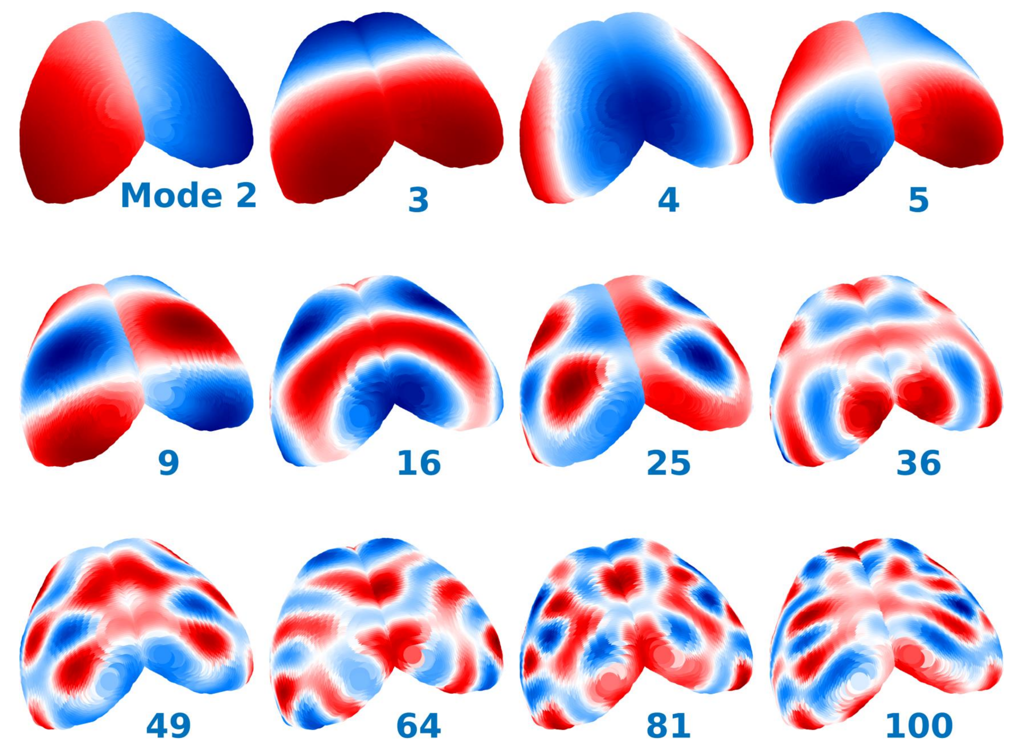
Will more accurate connectivity information (i.e. mouse tract tracing data) improve the accuracy of connectome models?

METHODS

We compare two eigenmode models:

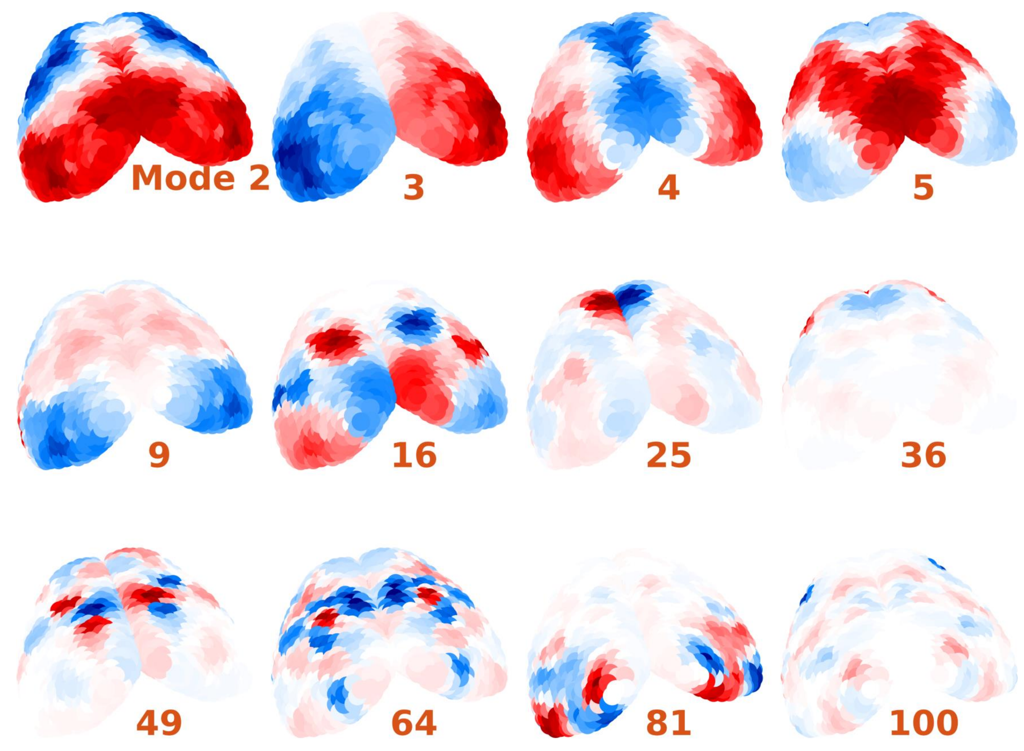
Geometric eigenmodes

derived only from the shape information of the isocortical volume



Connectome eigenmodes

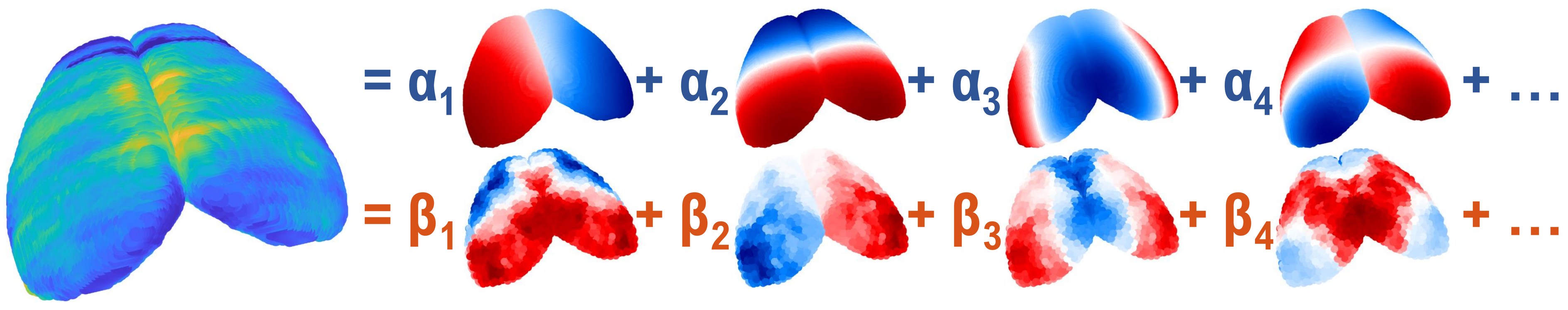
adding connectivity data from >1000 tract-tracing experiments[2-4]

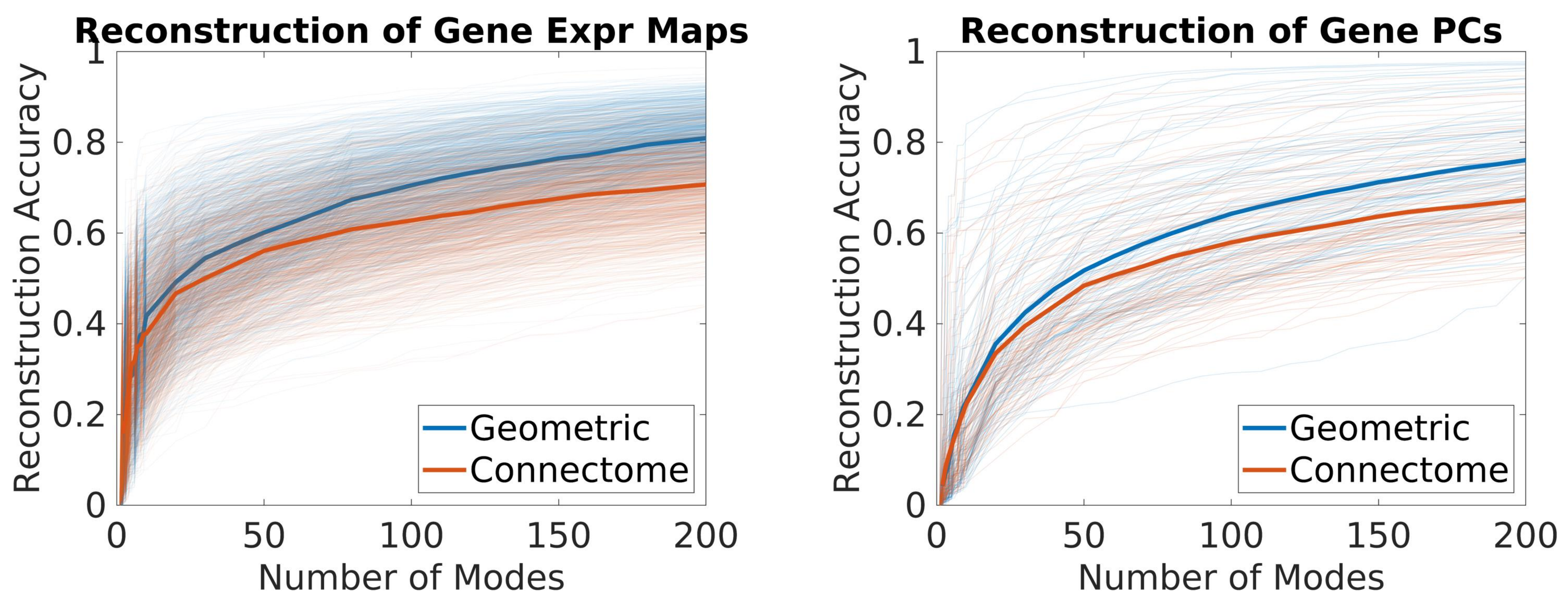


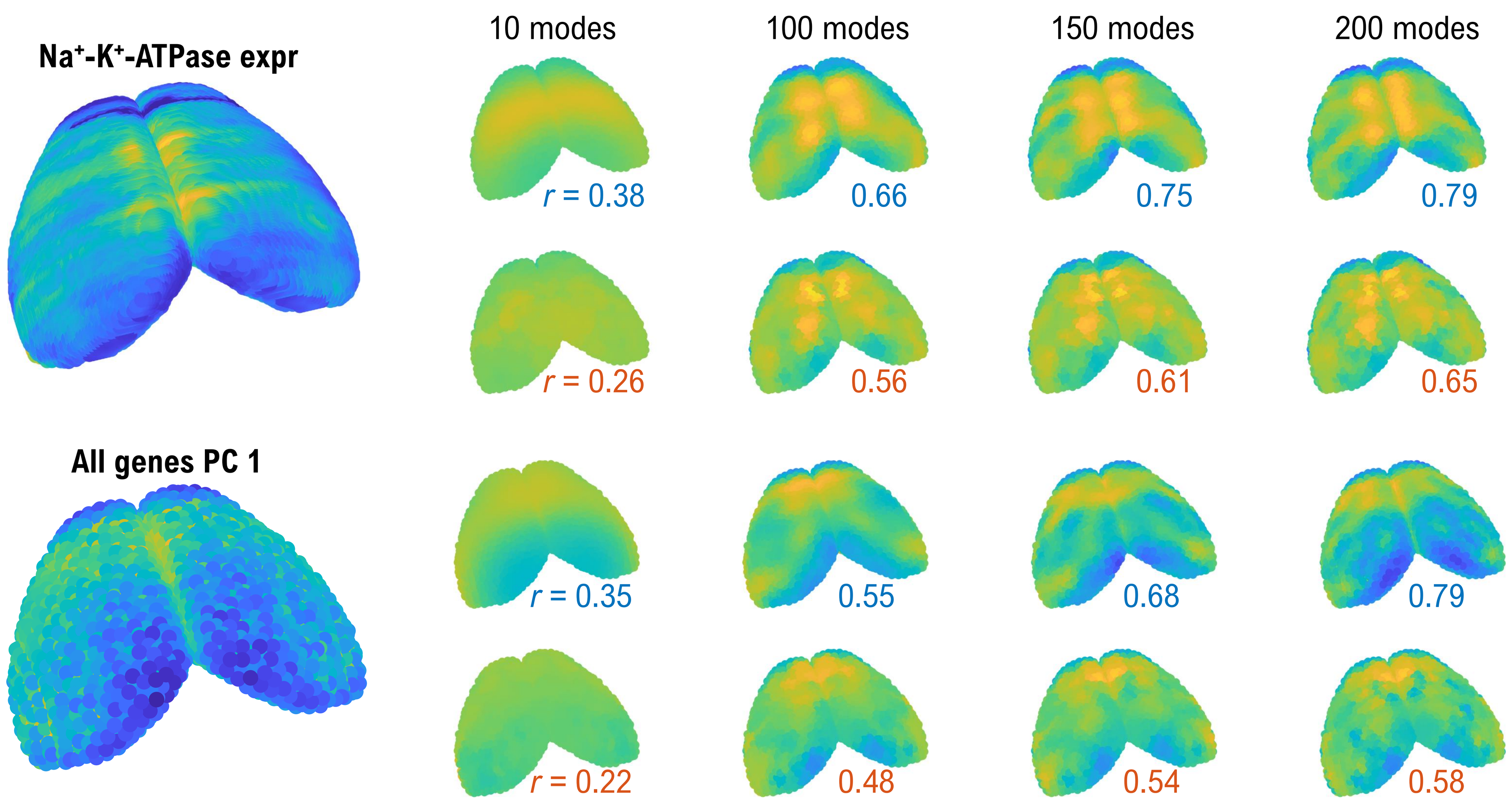
RESULTS

Reconstructing 1000 gene expression maps[5]

as a linear combination of eigenmodes



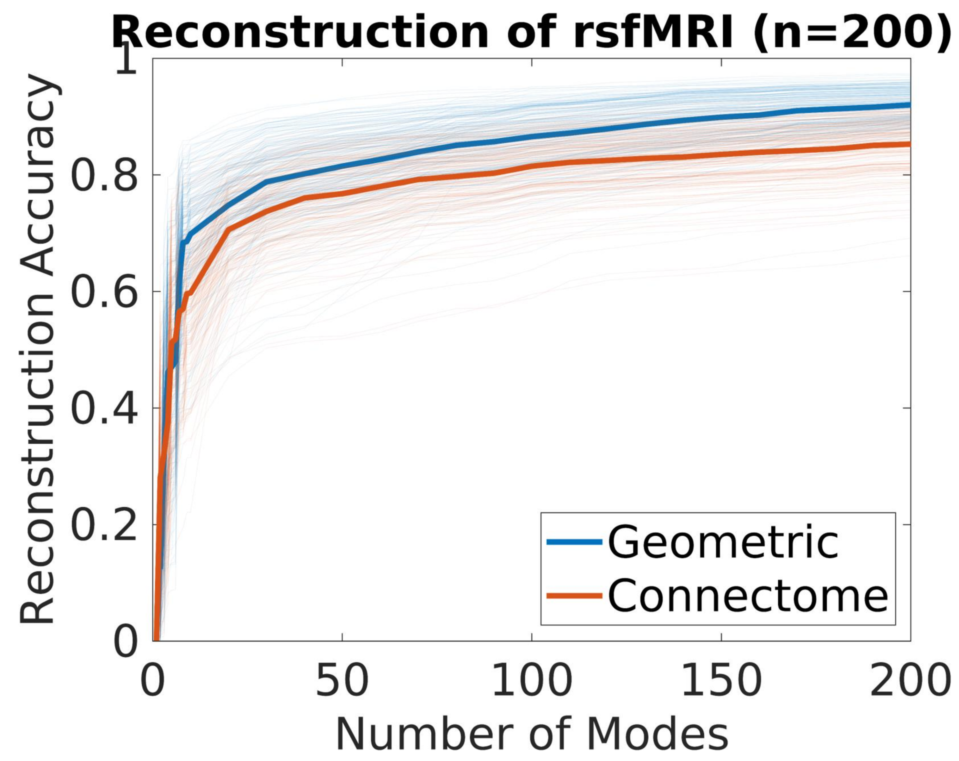


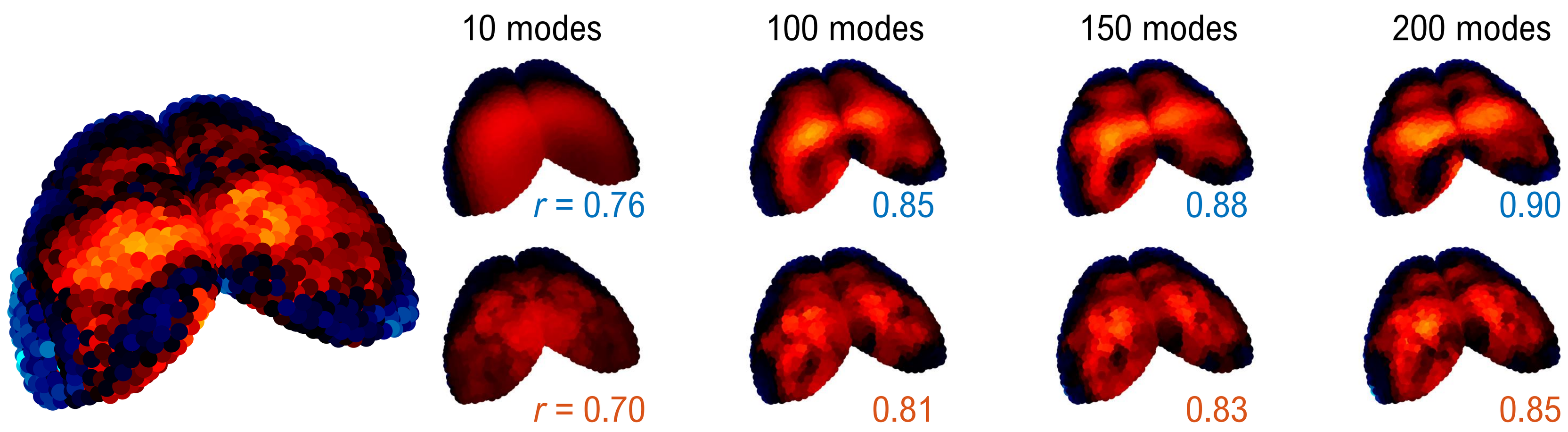


Reconstructing functional activity time series data

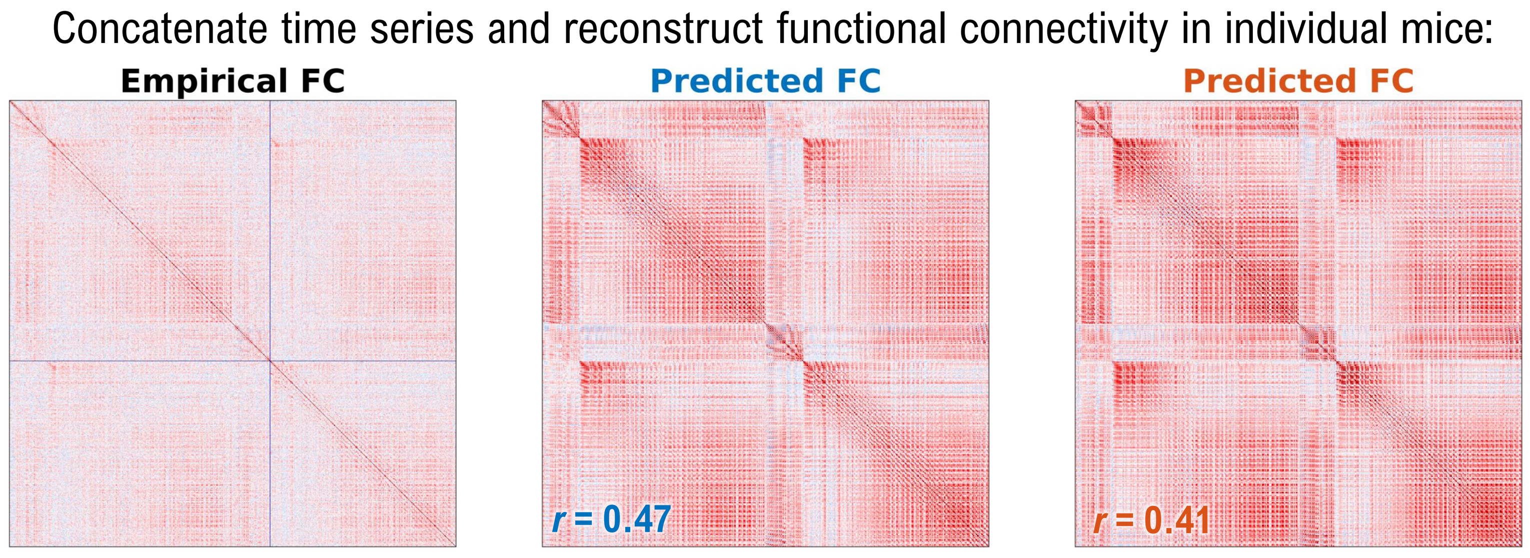
as a linear combination of eigenmodes

Reconstruct individual frames of resting activity in 200 mice:





Concatenate time series and reconstruct functional connectivity in individual mice:



CONCLUSIONS

- We use more invasive measurements of brain connectivity to recalculate connectome eigenmodes
- As in human diffusion MRI, geometric eigenmodes can reconstruct spatial phenotypes more parsimoniously than connectome eigenmodes
- Overall, geometric eigenmodes remain a promising avenue to brain mapping (alongside SC)
- Future work will include simulation of FC using wave-based models

REFERENCES

[1] Pang, Aquino et al., *Nature,* 2023
[2] Coletta et al., *Science Advances,* 2020
[3] Knox et al., *Network Neuroscience,* 2019
[4] Oh et al., *Nature,* 2014
[5] Fulcher et al., *PNAS*, 2019

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