

# The Fruit Fly Brain Observatory

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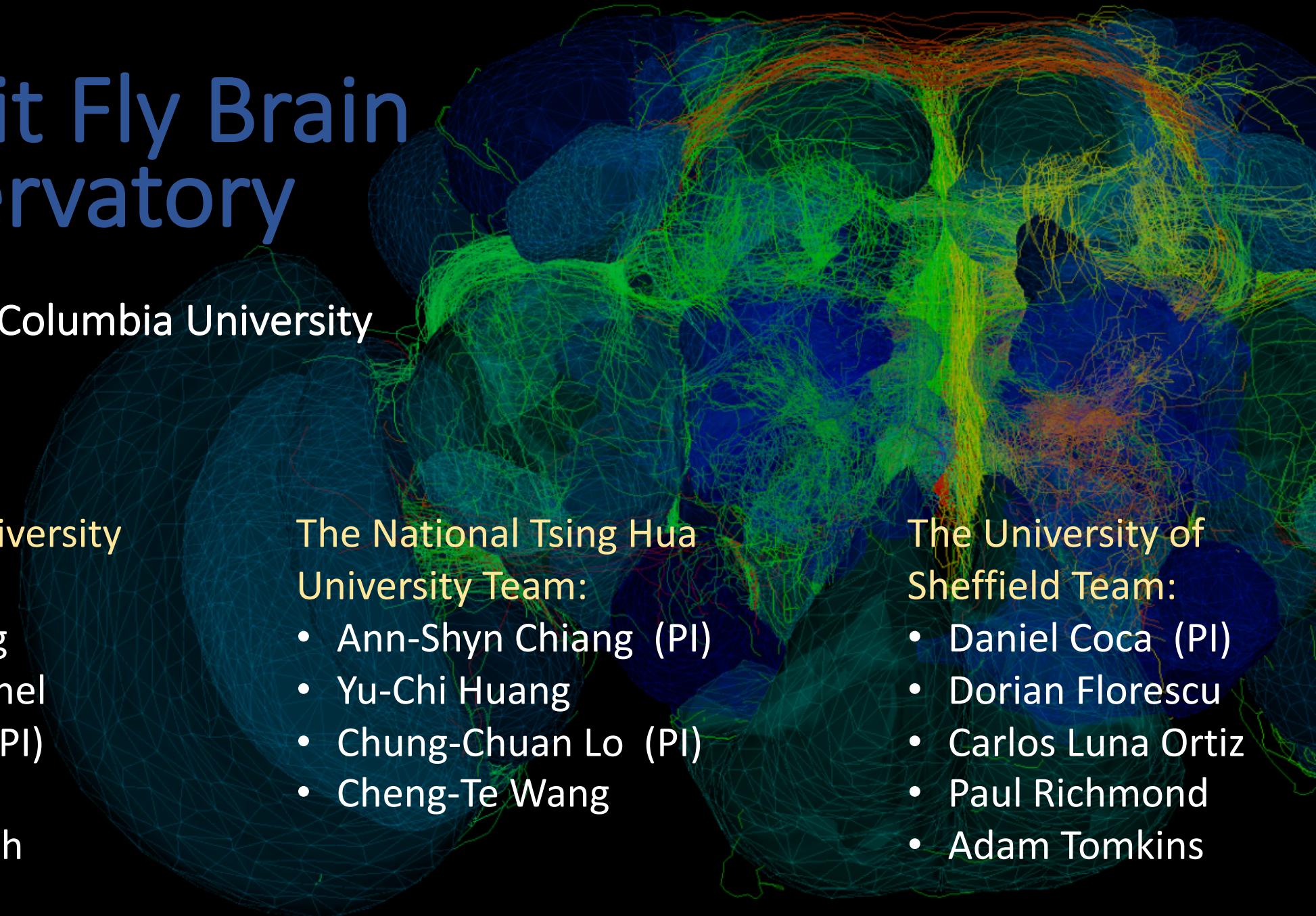
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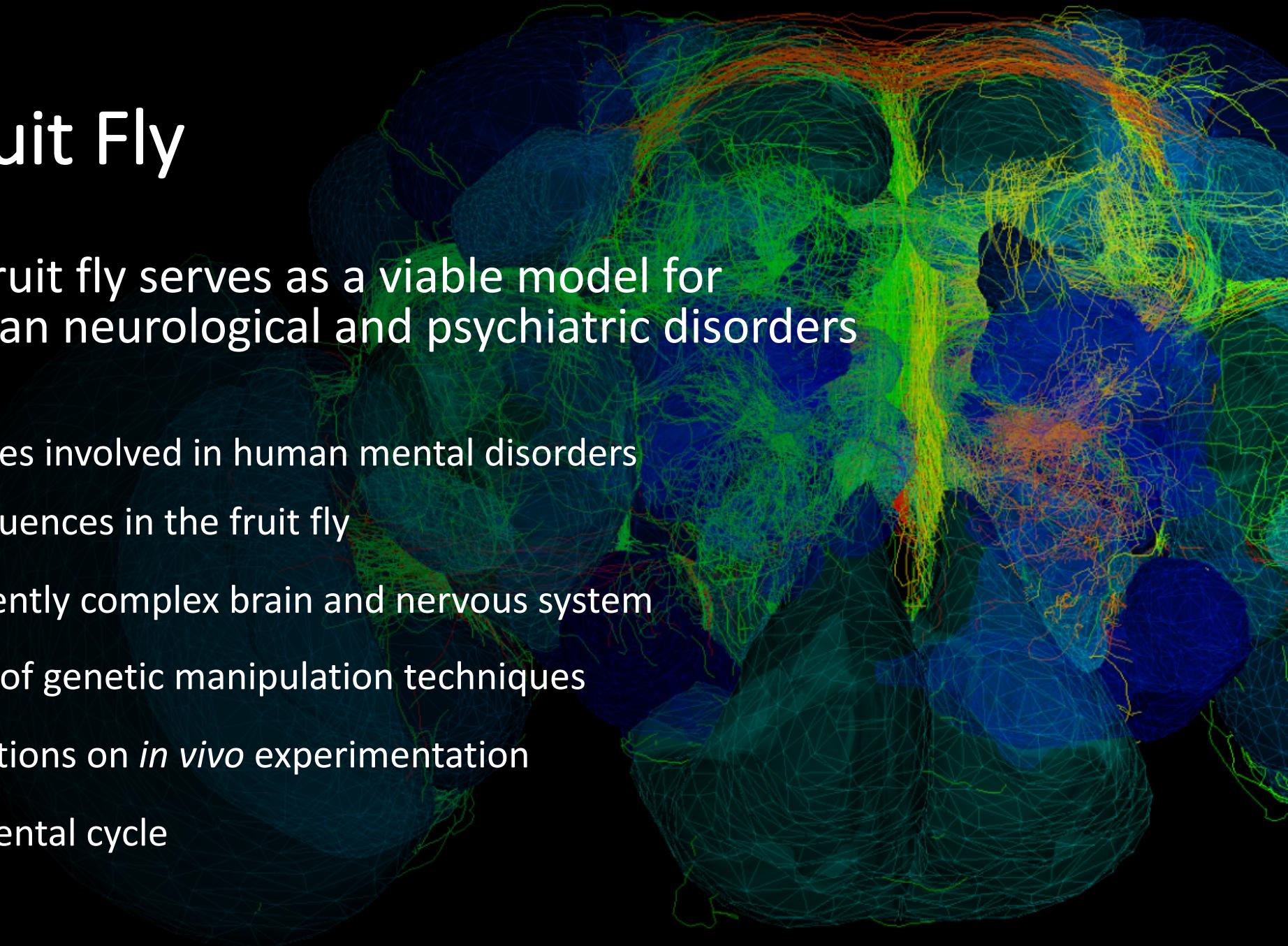
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- Paul Richmond
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# Why the Fruit Fly

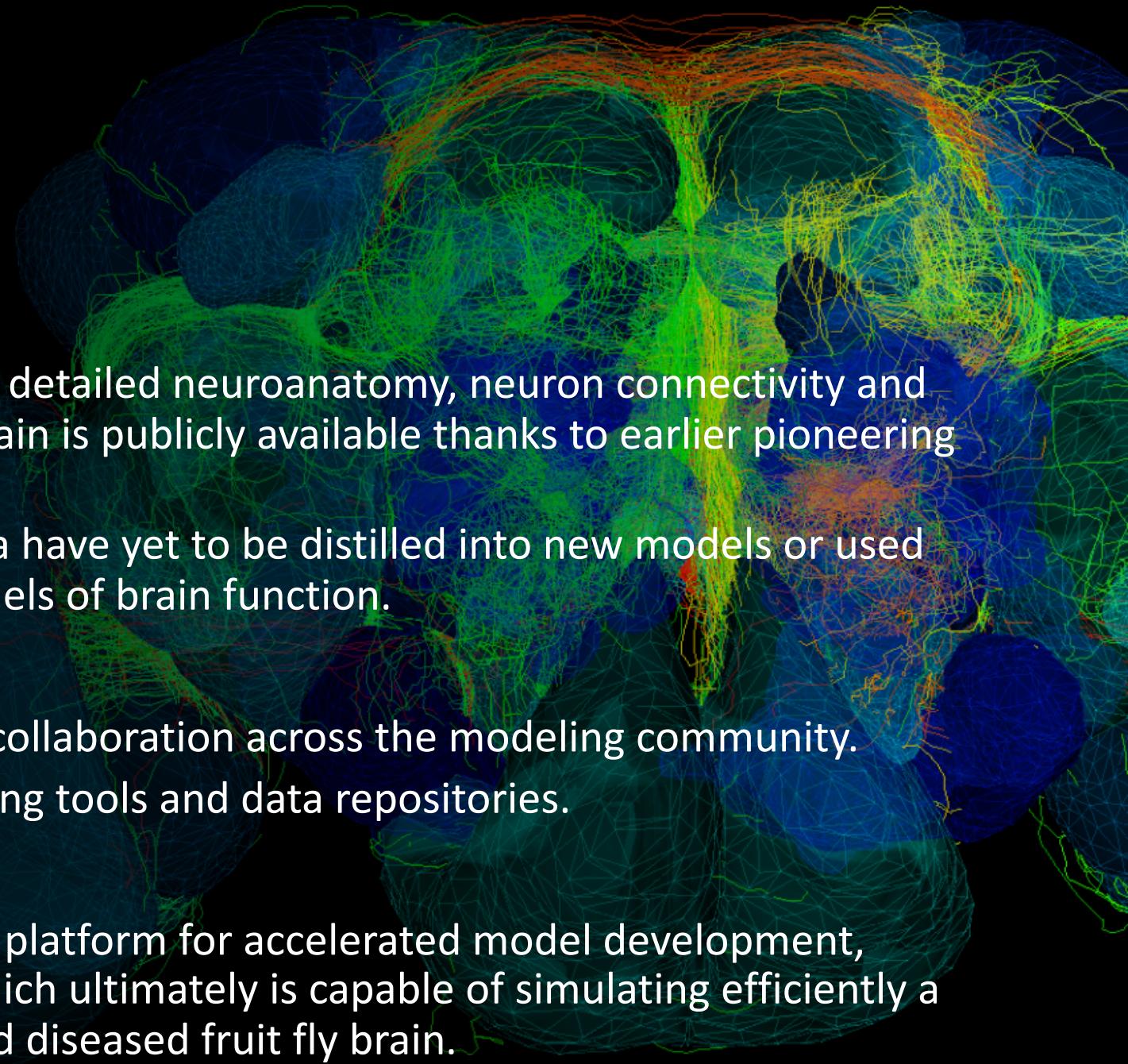
The brain of the fruit fly serves as a viable model for investigating human neurological and psychiatric disorders

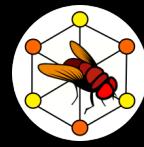
- Over 70% of genes involved in human mental disorders have related sequences in the fruit fly
- Small but sufficiently complex brain and nervous system
- Powerful toolkit of genetic manipulation techniques
- No ethical limitations on *in vivo* experimentation
- Rapid developmental cycle



# Where We Are At

- Current Status
  - ✓ Knowledge and information of the detailed neuroanatomy, neuron connectivity and gene expression of the adult fly brain is publicly available thanks to earlier pioneering efforts.
  - ✓ Vast amounts of experimental data have yet to be distilled into new models or used to validate and refine existing models of brain function.
- Major Obstacles
  - ❖ The lack of open communication/collaboration across the modeling community.
  - ❖ The lack of shared models, modeling tools and data repositories.
- What's Needed
  - an *open source*, modular software platform for accelerated model development, simulation, sharing and review, which ultimately is capable of simulating efficiently a complete model of the healthy and diseased fruit fly brain.





# Fruit Fly Brain Observatory (FFBO)

World's first science platform specifically developed for

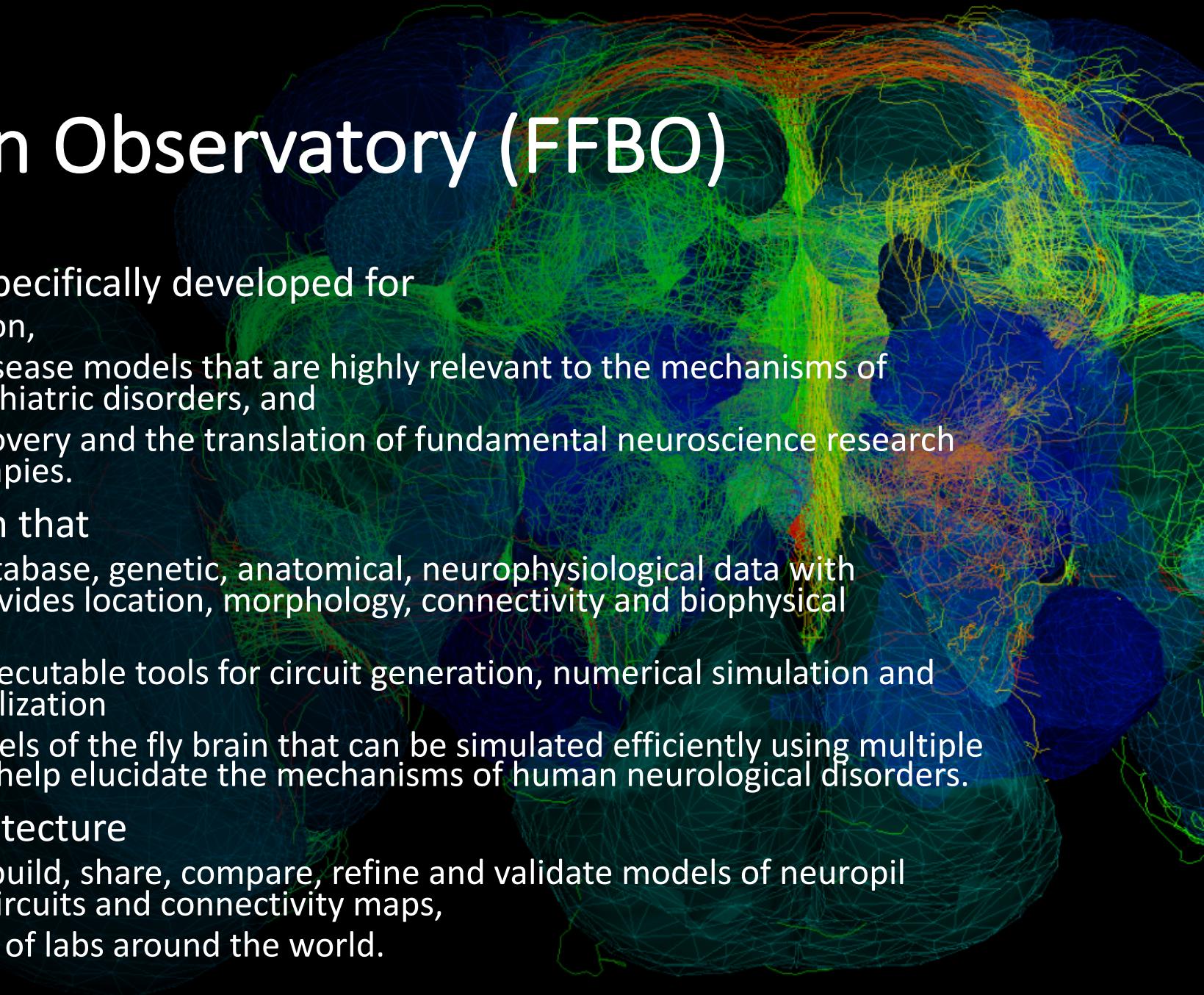
- studying fruit fly brain function,
- investigating fruit fly brain disease models that are highly relevant to the mechanisms of human neurological and psychiatric disorders, and
- accelerating the pace of discovery and the translation of fundamental neuroscience research into drug, cell and gene therapies.

A unique open science platform that

- integrates, within a single database, genetic, anatomical, neurophysiological data with computational models. It provides location, morphology, connectivity and biophysical properties of every neuron
- is equipped with powerful executable tools for circuit generation, numerical simulation and user-friendly query and visualization
- automatically generates models of the fly brain that can be simulated efficiently using multiple Graphics Processing Units to help elucidate the mechanisms of human neurological disorders.

FFBO is built upon a novel architecture

- whereupon researchers can build, share, compare, refine and validate models of neuropil compartments, constituent circuits and connectivity maps,
- supports the research efforts of labs around the world.

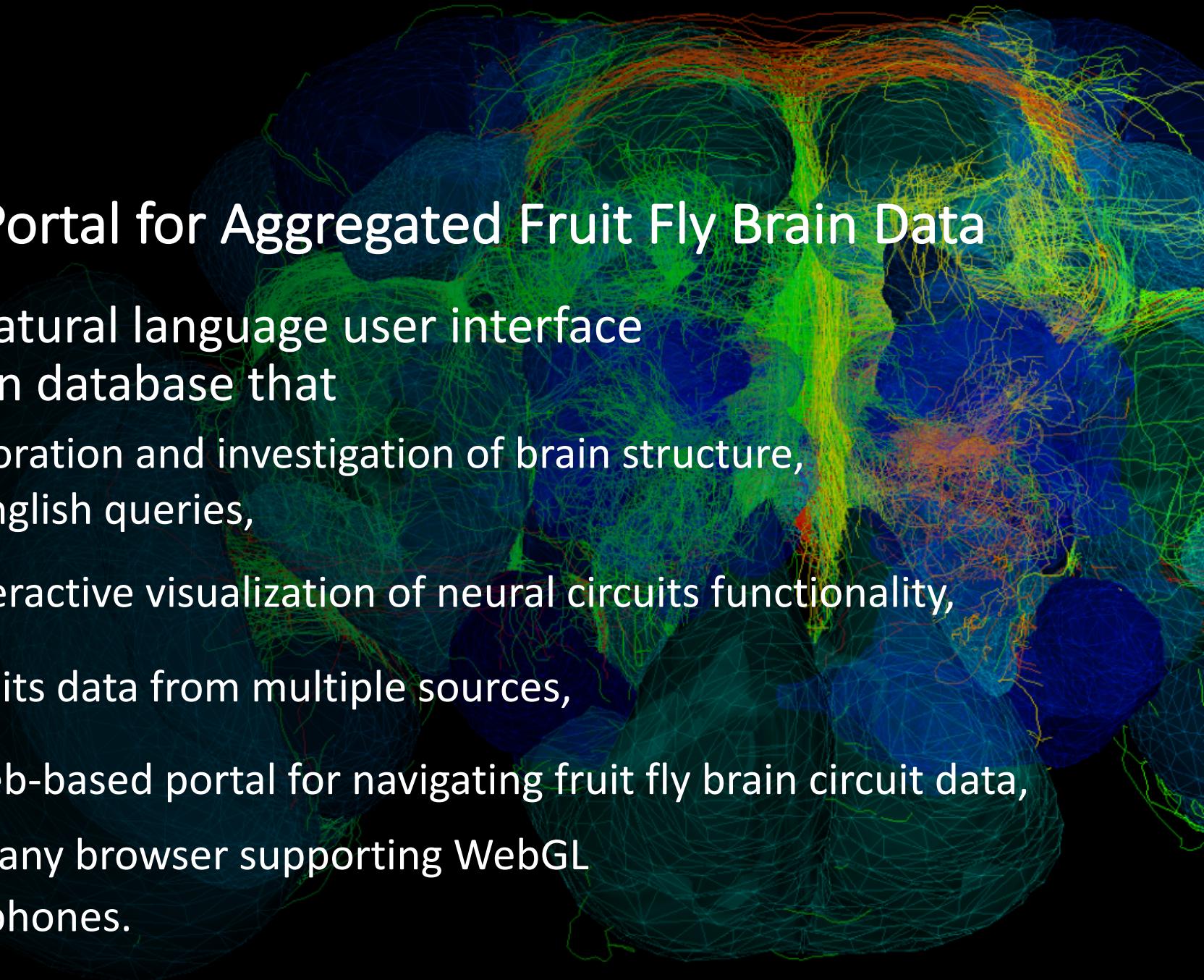


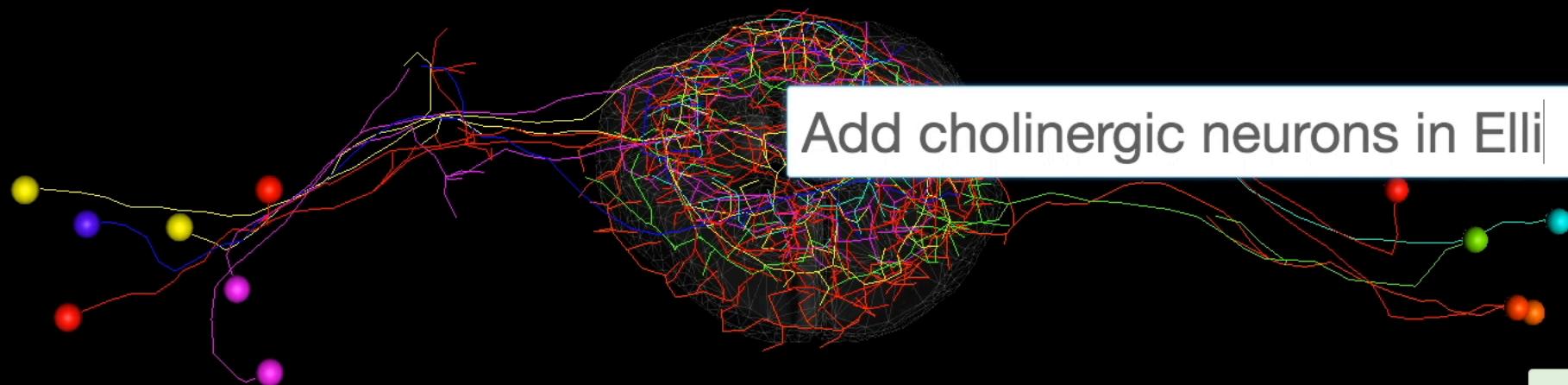
# NeuroNLP:

## A Natural Language Portal for Aggregated Fruit Fly Brain Data

NeuroNLP is a unique natural language user interface for querying the fly brain database that

- enables in-depth exploration and investigation of brain structure, using intuitive plain English queries,
- provides powerful interactive visualization of neural circuits functionality,
- integrates neural circuits data from multiple sources,
- provides a modern web-based portal for navigating fruit fly brain circuit data,
- can be accessed from any browser supporting WebGL on laptops and smartphones.





Add cholinergic neurons in Elli

Query

Finished fetching all results from  
NeuroArch X

Fetching results from NeuroArch X

NLP module successfully parsed your  
input X



# NeuroGFX:

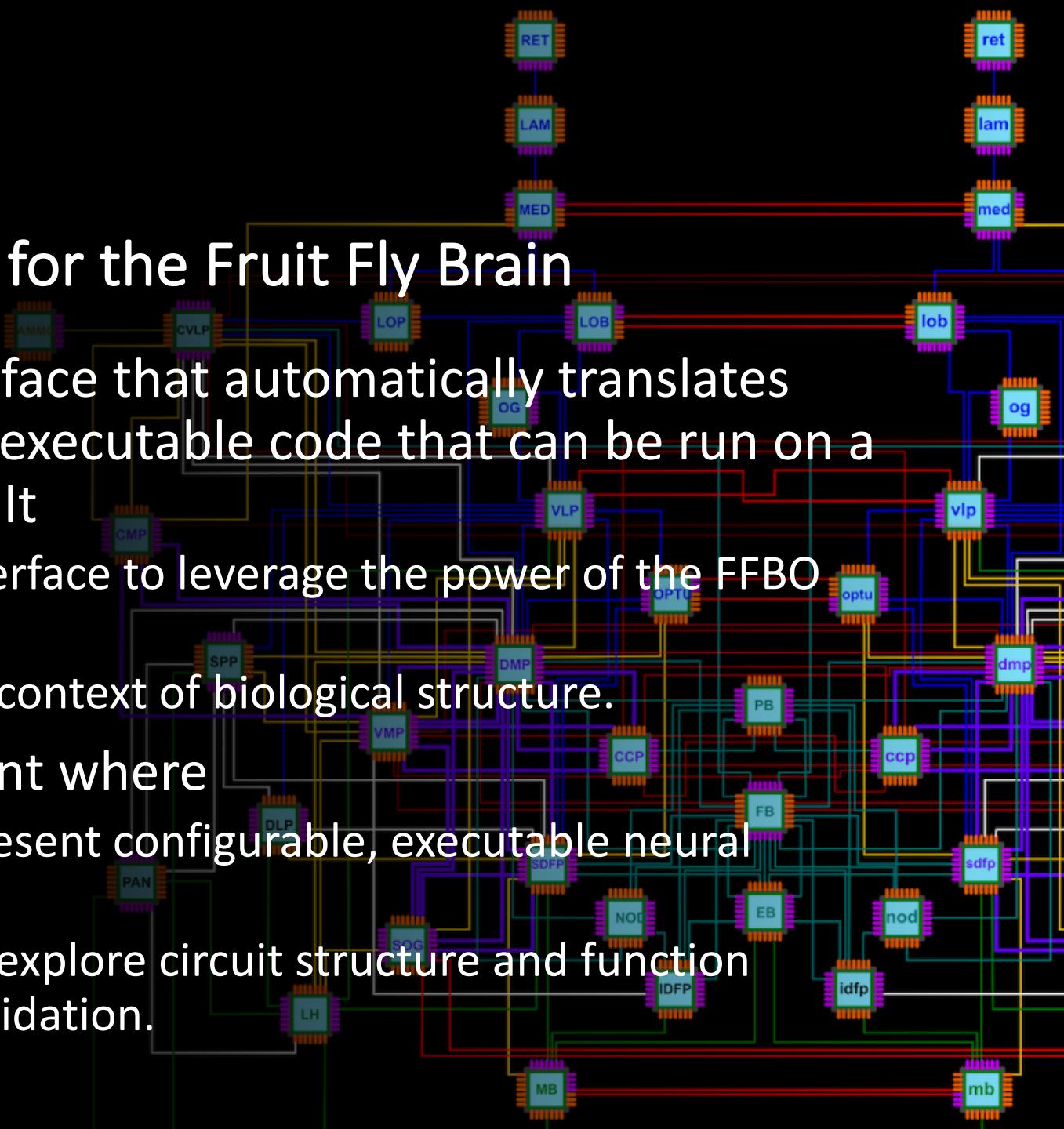
## A Graphic Functional Explorer for the Fruit Fly Brain

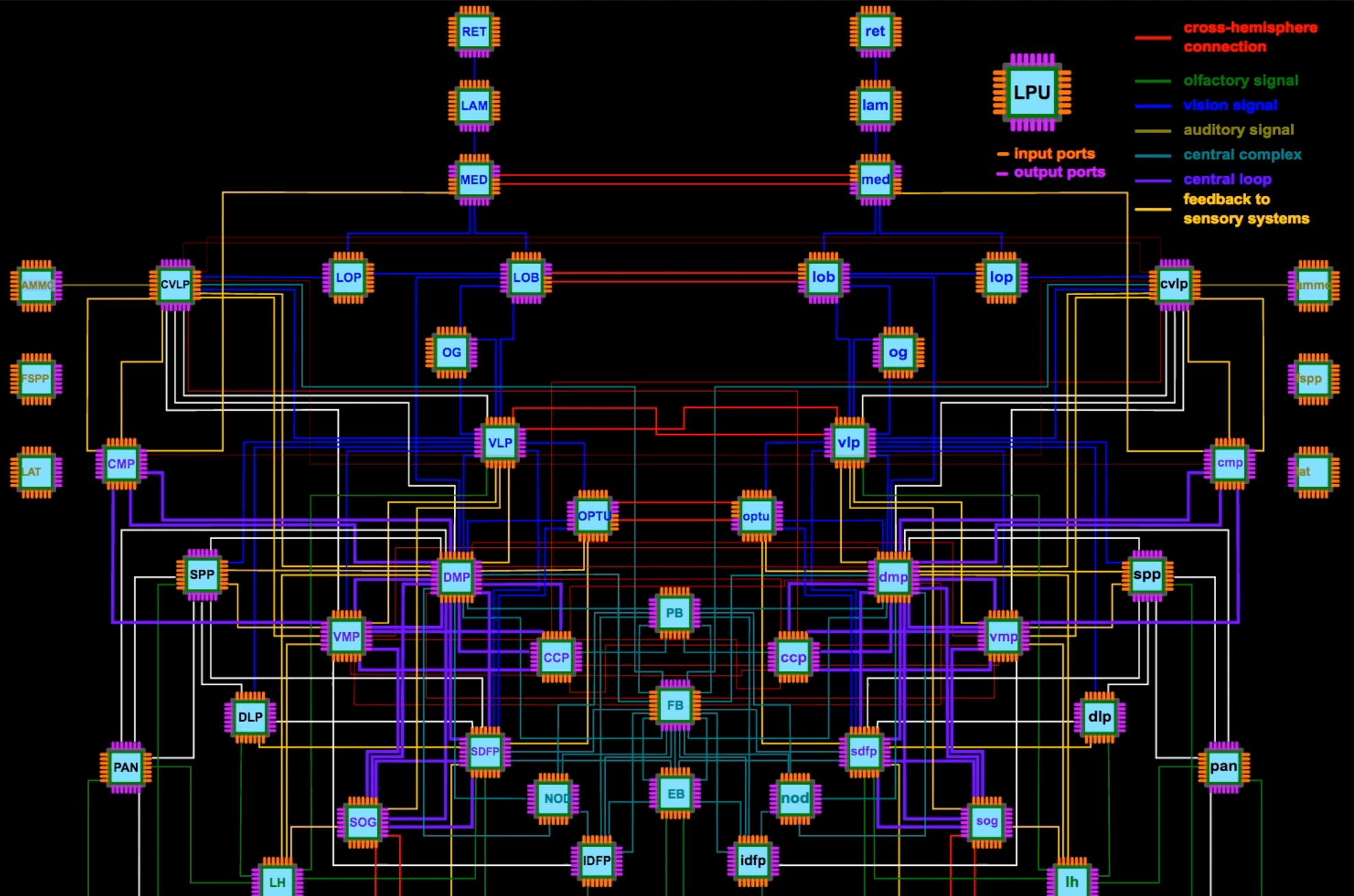
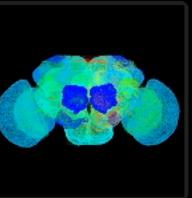
NeuroGFX is a programming interface that automatically translates biological and modeling data into executable code that can be run on a local or cloud-based GPU servers. It

- provides an intuitive graphical interface to leverage the power of the FFBO computational infrastructure,
- visualizes execution results in the context of biological structure.

NeuroGFX provides an environment where

- computational researchers can present configurable, executable neural circuits, and
- experimental scientists can easily explore circuit structure and function ultimately leading to biological validation.





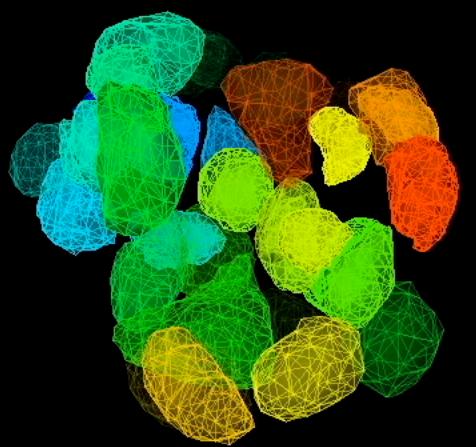
# NeuroAPPs: Apps for Healthy and Diseased Models of the Fruit Fly Brain

NeuroAPPs host integrated healthy and diseased models applications of the fruit fly brain. Early examples:

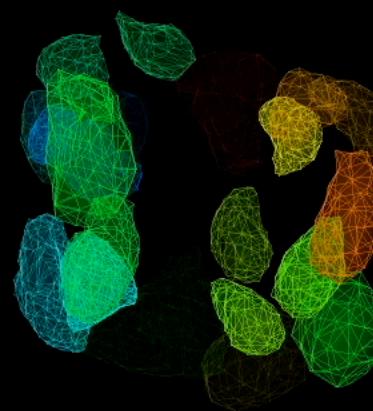
- **Parkinson's Disease: Olfaction**
  - an emulation of pathological states of the olfactory system due to excess release of the GABA neurotransmitter, a phenomenon observed in Parkinson's disease.
- **Parkinson's Disease: Vision**
  - an interactive demonstration of the poorly-understood effect of the retinal degeneration seen in Parkinson's disease.

- **Epilepsy Model**
  - a model which can be used to reproduce experimental observations and to verify working hypotheses.
- **Retinal Degeneration**
  - a retina app to study the potential of rescuing retinal degeneration by optogenetic means.

Healthy Model



Diseased Model

[unpin](#) [2D](#)[unpin](#) [2D](#)