

Virtual Fly Brain Web Resource & API

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VFB data/metadata integration

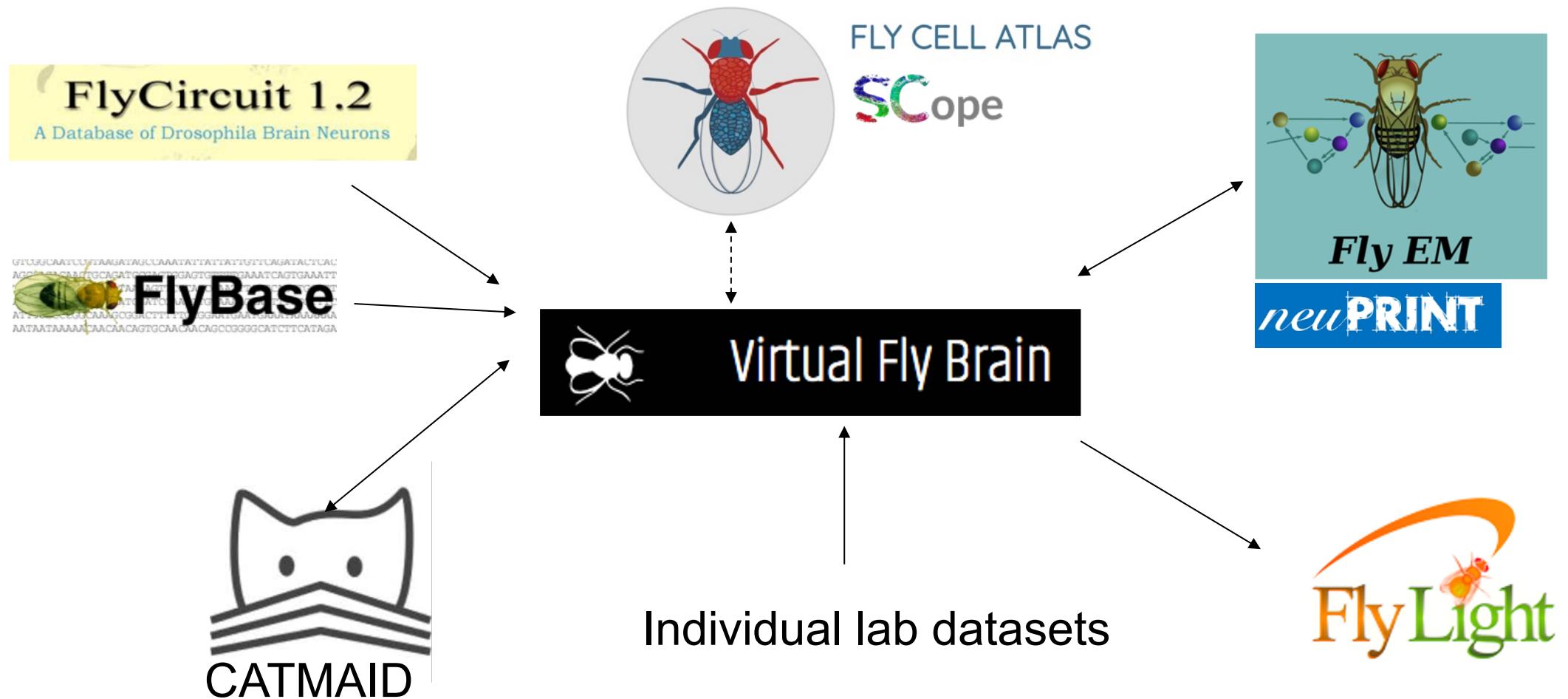
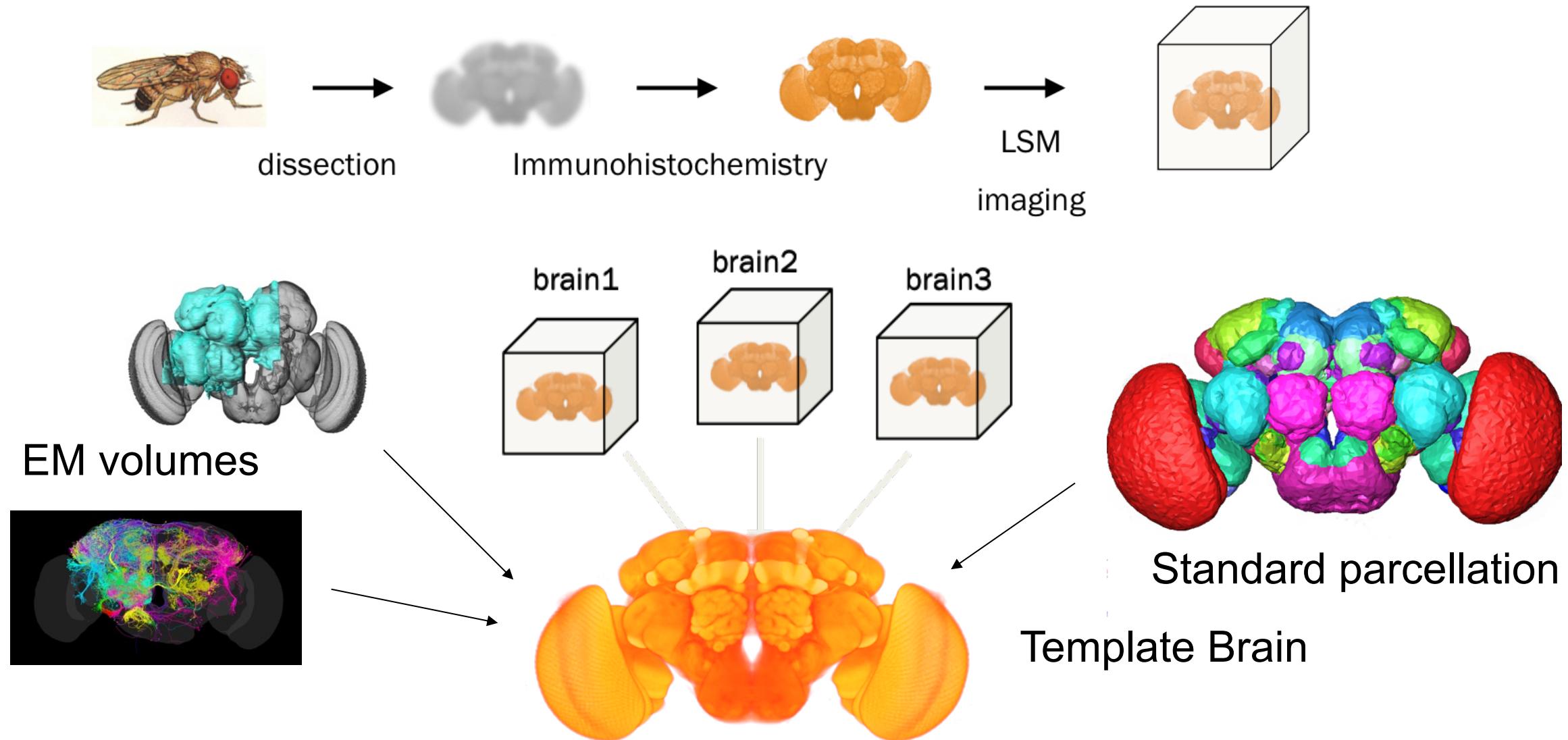
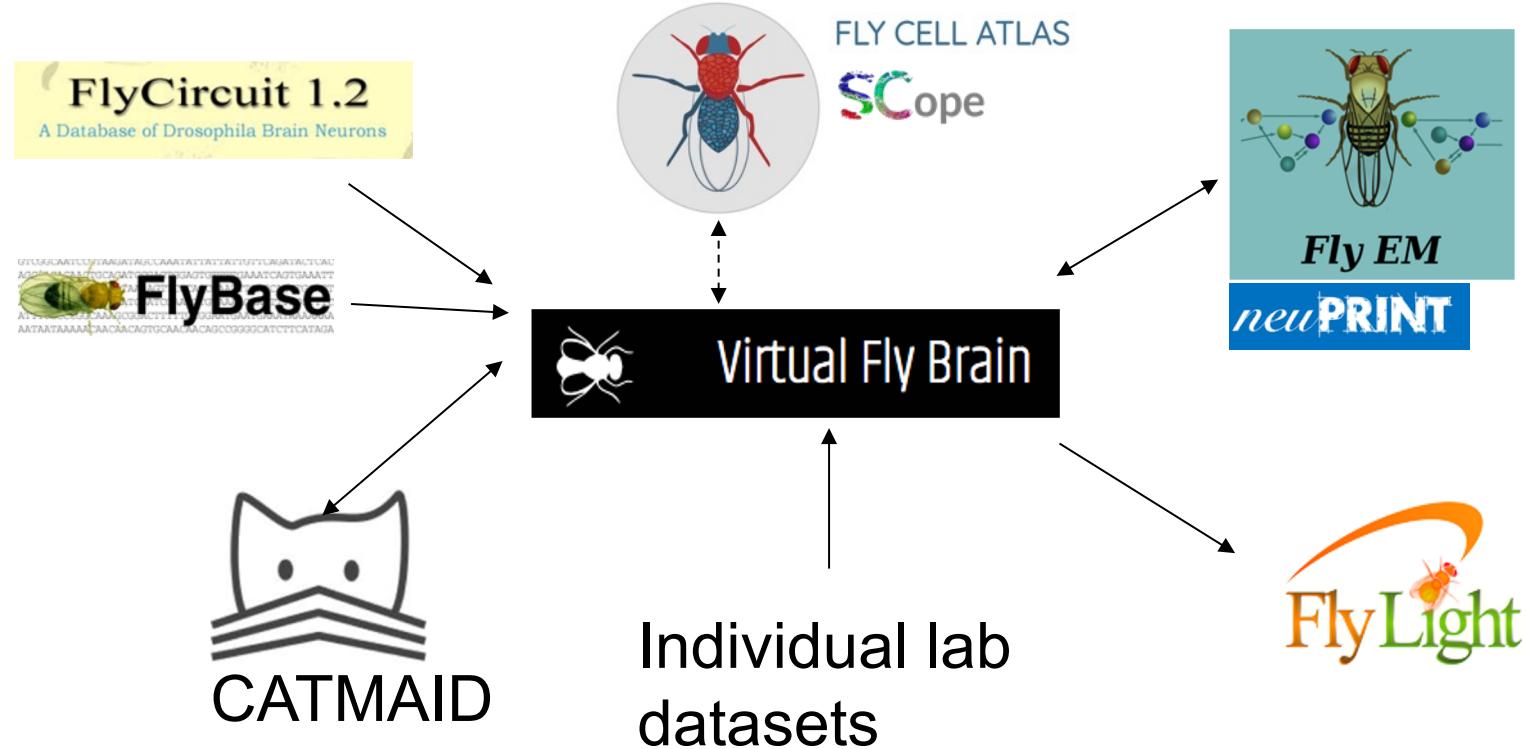


Image – based data integration



The nomenclature problem

- Given that different resources/papers use different names for neuron types/classes (DA1_vPN; GABAergic) how can we cross query resources?



Drosophila Anatomy Ontology (neural component)

- **What is it?**
 - A curated, query-able classification of *Drosophila* neurons and neuroanatomy covering all stages of development
 - Standard nomenclature with symbols, synonyms and references for all terms
- **Composition**
 - 8637 neuron types
 - 4,937 curated from 631 papers
 - 3,734 provisional types (from hemibrain)
 - 1374 nervous system regions
 - ~17k **queryable** statements about neuron location, Innervation, fasciculation; synaptic connections; lineage; function

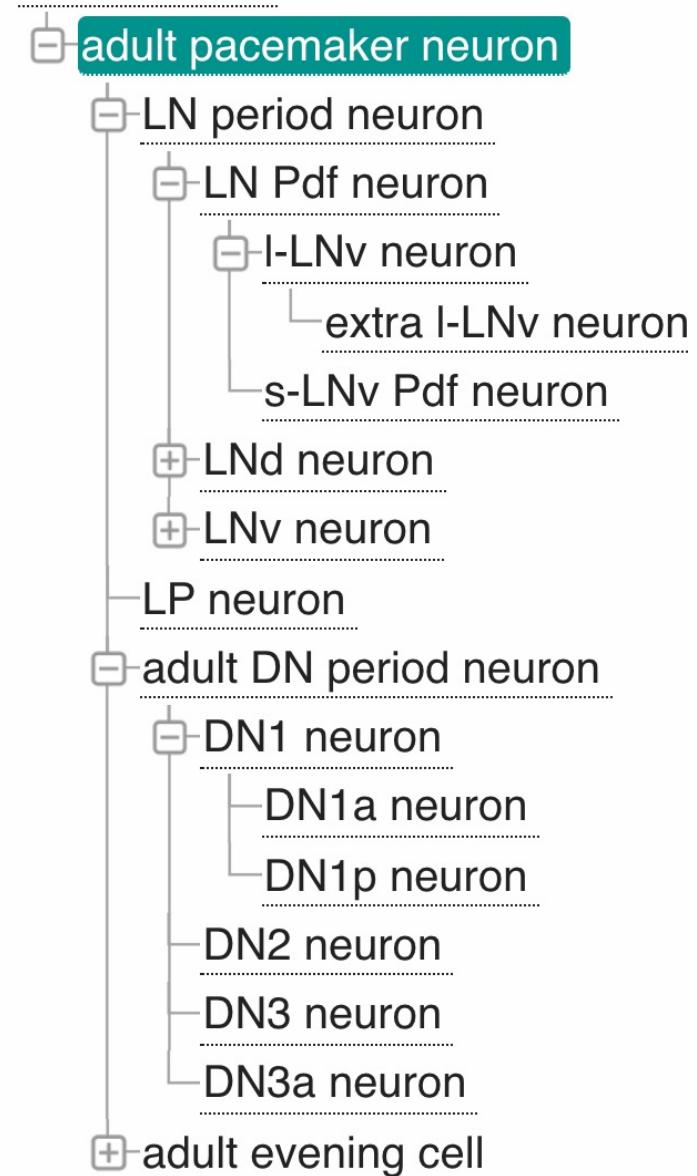
VFB knows about lots of types (classes) of pacemaker neuron & their classification relationships

Fly Brain Tools History Templates Datasets Help

44 Subclasses of pacemaker neuron

Filter Results

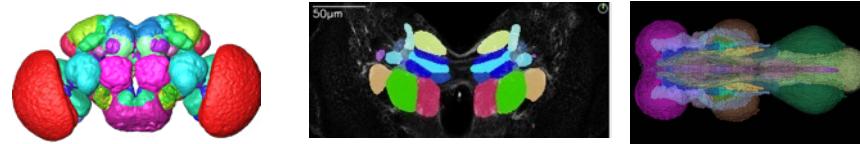
Name	Gross_Type
s-LNv neuron	Adult; Neuron
LN Pdf neuron	Adult; Sensory_neuron
I-LNv neuron	Adult; Sensory_neuron
LNv neuron	Adult; Neuron



VFB semantic integration: we use the DAO to annotate

- **Images (~117k)**

- ~ 67k single neuron images covering ~5k types, ~24.7k with associated connectomics data
- >900 nervous system regions
- ~48k images of expression patterns covering 17k drivers
- ~4.7k images of 602 split combinations



multiple stages & regions

- **Connectomics**

- ~3.5m synaptic connections between ~24.7k neurons (From CATMAID & Neuprint)

- **Where drivers are expressed**

- ~3,7k expression patterns: ~27.6k statements about expression in 1.7k neuron types
- 890 split combinations: ~2k statements about expression in 464 neuron types

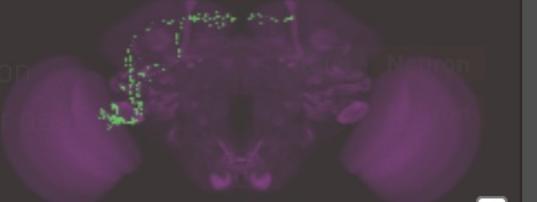
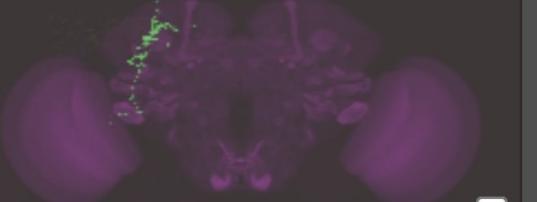
VFB has images and data for many individual pacemaker neurons (AKA instances), of different types & from different sources

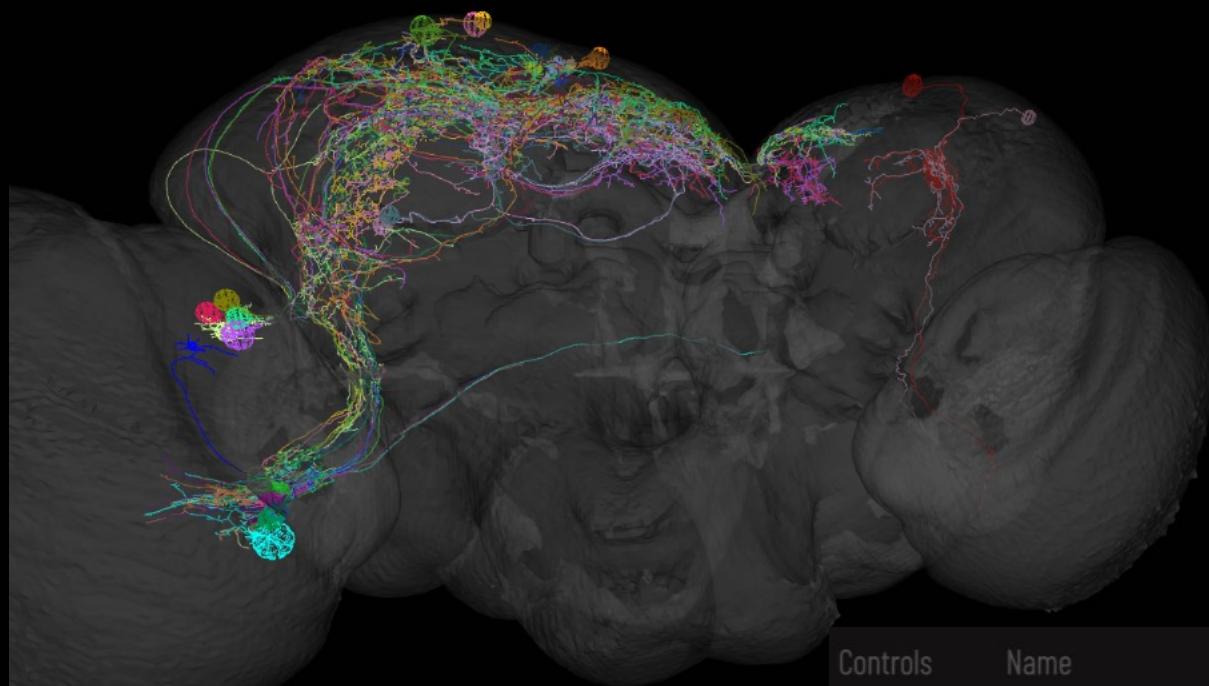
Abstract classes
are useful when
searching for
individual neurons

Virtual Fly Brain Tools History Templates Datasets Help

2018Unisex 31 List all available images of adult pacemaker neuron Queries for adult pacemaker neuron > 🔍

Filter Results

Name ▲	Type	Gross_Type	Template_Space	Imaging_Technique	Images
5th s-LNv - 511051477	s-LNv neuron	Adult; Neuron	JRC2018U also in: HemiBrain	FIB-SEM	 Classification: <ul style="list-style-type: none">adult neuronpacemaker neuron Available Images LPN_R-356816951
DN1a#1 (FAFB:4129363)	DN1a neuron	Adult; Neuron	JRC2018U	TEM	



Controls	Name	Type ▼	
	s-LNv - 1975347348	s-LNv neuron	
	s-LNv - 2007068523	s-LNv neuron	
	s-LNv - 1664980698	s-LNv neuron	
	s-LNv - 2068801704	s-LNv neuron	
	5th s-LNv - 511051477	s-LNv neuron	
	I-LNv - 1884625521	I-LNv neuron	



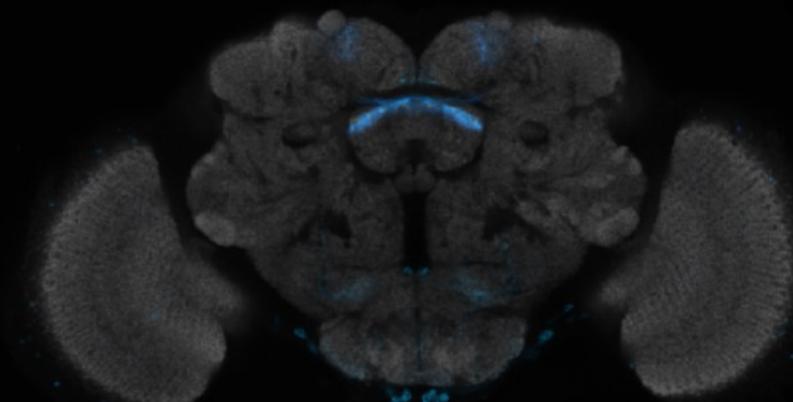
adult brain template JFRC2

+

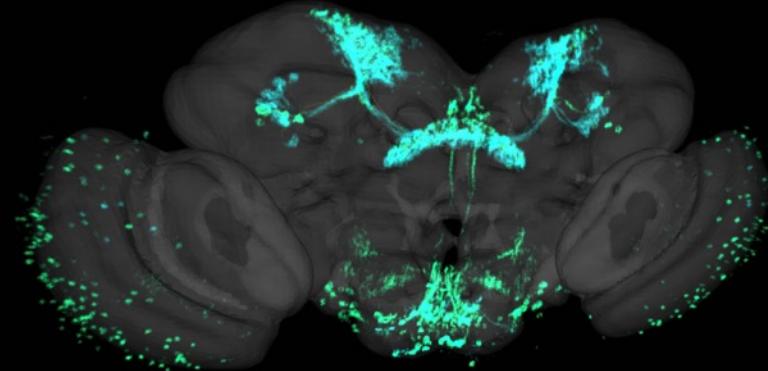
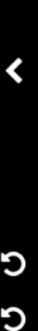


Trh-M-300037

Slice Viewer x



3D Viewer x



Term Info x

dFB neuron of the dopaminergic PPL1 cluster (FBbt_00110322)Neuron Dopaminergic

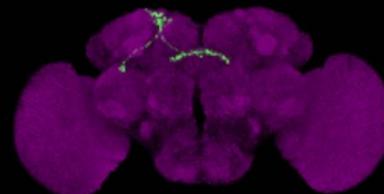
Classification

- dopaminergic PPL1 neuron

Neuron Dopaminergic

Examples

Trh-M-300037



Relationships

- part of adult brain
- has_synaptic_terminals_in fan-shaped body

AnatomyAnatomy Synaptic neuropil

Query For

Q List all example images of dFB neuron of the dopaminergic PPL1 cluster**Q** Transgenes expressed in the dFB neuron of the dopaminergic PPL1 cluster

Search with any name from the literature



IVLP-IVLP local

- inferior ventrolateral protocerebrum commissural IVLP-IVLP neuron (inferior ventrolateral protocerebrum local IVLP-IVLP neuron)
- inferior ventrolateral protocerebrum local IVLP neuron
- inferior ventrolateral protocerebrum local IVLP-IVLP neuron
- wedge-wedge PN (inferior ventrolateral protocerebrum local IVLP-IVLP neuron)

Name

inferior ventrolateral protocerebrum local IVLP-IVLP neuron [FBbt_00110125]

Adult GABAergic Neuron

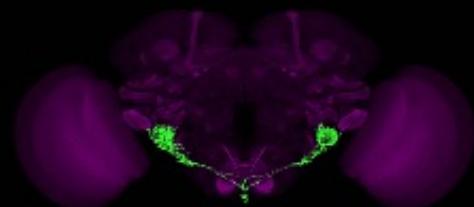
Alternative Names

- has_exact_synonym: inferior ventrolateral protocerebrum commissural IVLP-IVLP neuron (Lai et al., 2012)
- has_exact_synonym: wedge-wedge PN (Clemens et al., 2015)
- has_exact_synonym: IVLP-IVLP PN (Lai et al., 2012)
- has_exact_synonym: AV4 neuron (Clemens et al., 2015)
- has_exact_synonym: AMMC-VLP4 neuron (Clemens et al., 2015)

Classification

Available Images

Trh-M-000088



Description

Neuron whose cell body is located in the ventromedial subesophageal region and innervates the ipsilateral inferior ventrolateral protocerebrum (IVLP) in both hemispheres, with pre- and postsynaptic sites found in this region. These neurons receive input from AMMC-B1b projection neurons in the IVLP. IVLP-IVLP are GABAergic neurons and are activated by an acoustic stimuli of 100Hz, 300Hz or pulse song stimuli (Lai et al., 2012).

Comment

Auditory function was determined measuring GCaMP activation in these cells in response to an acoustic stimuli in a subset of neurons labeled with VT50245-GAL4. Presence of pre- and postsynaptic sites was determined by immunoreactivity to Dscam- and synaptotagmin-GFP localization, respectively. Connectivity between IVLP-IVLP and AMMC-B1b neurons in the IVLP and was assessed using GFP reconstitution across synaptic membranes (GRASP) in IVLP-IVLP neurons labeled with VT50245-GAL4 and AMMC-B1b neurons labeled with L5055-LexA. Neurotransmitter was determined by immunostaining with an anti-GABA antibody in neurons labeled with VT50245-GAL4 (Lai et al., 2012).
(Lai et al., 2012)

References

- Lai et al., 2012, Proc. Natl. Acad. Sci. U.S.A. 109(7): 2607–2612 doi M
- Clemens et al., 2015, Neuron 87(6): 1332–1343 doi M

Publication

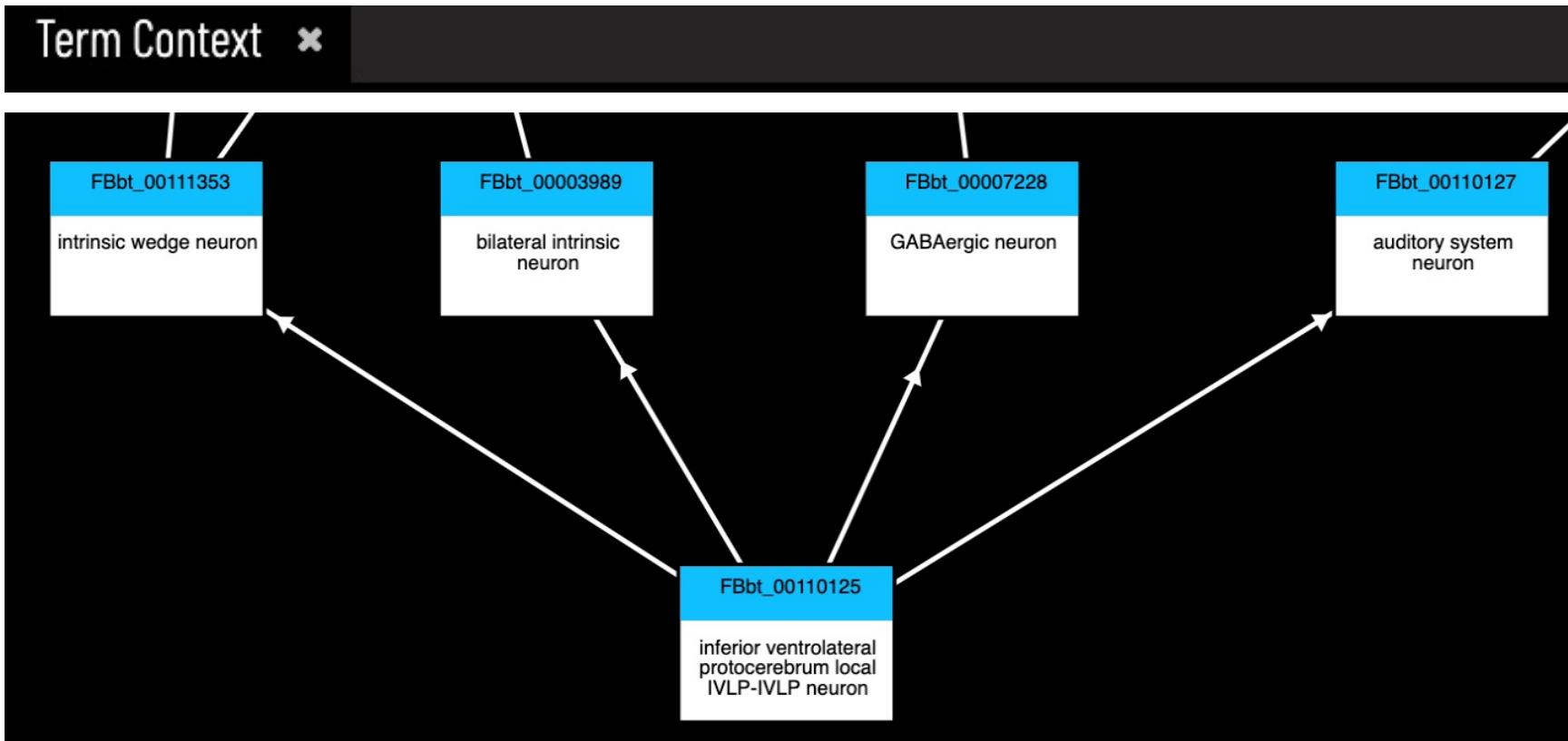
Publication



Browse to find more general terms

Graphs For

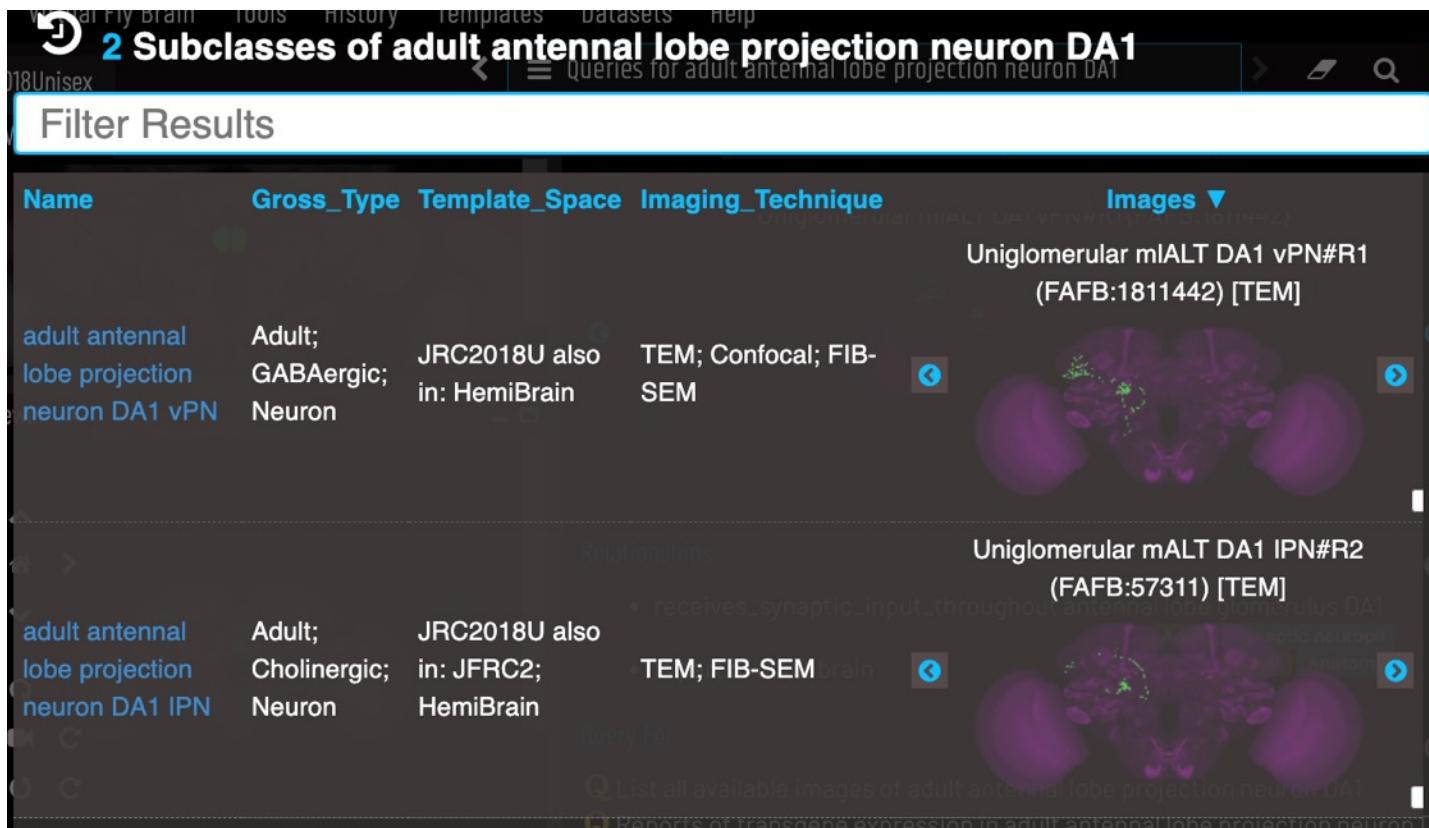
- Show location of inferior ventrolateral protocerebrum local IVLP-IVLP neuron
- Show classification of inferior ventrolateral protocerebrum local IVLP-IVLP neuron



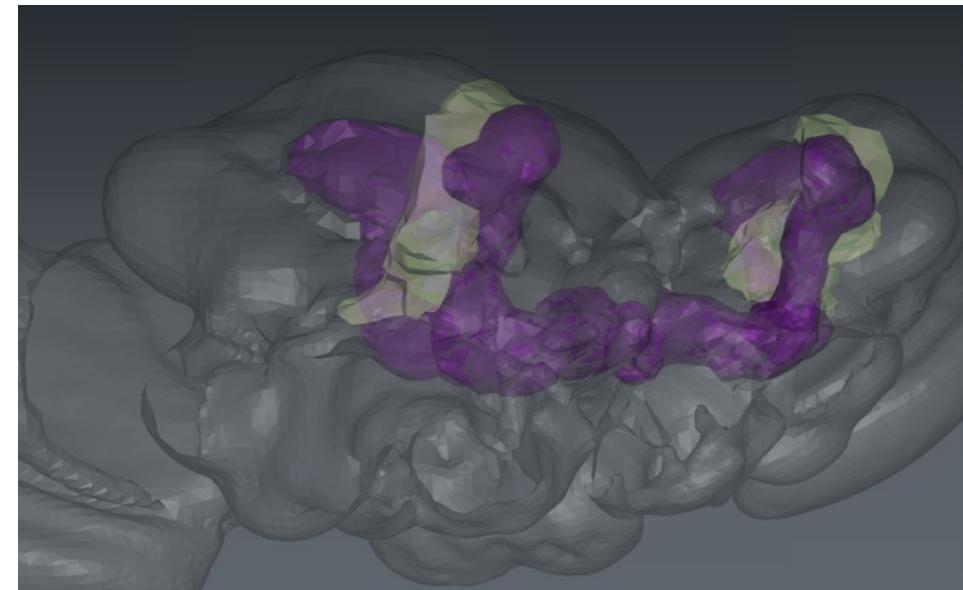
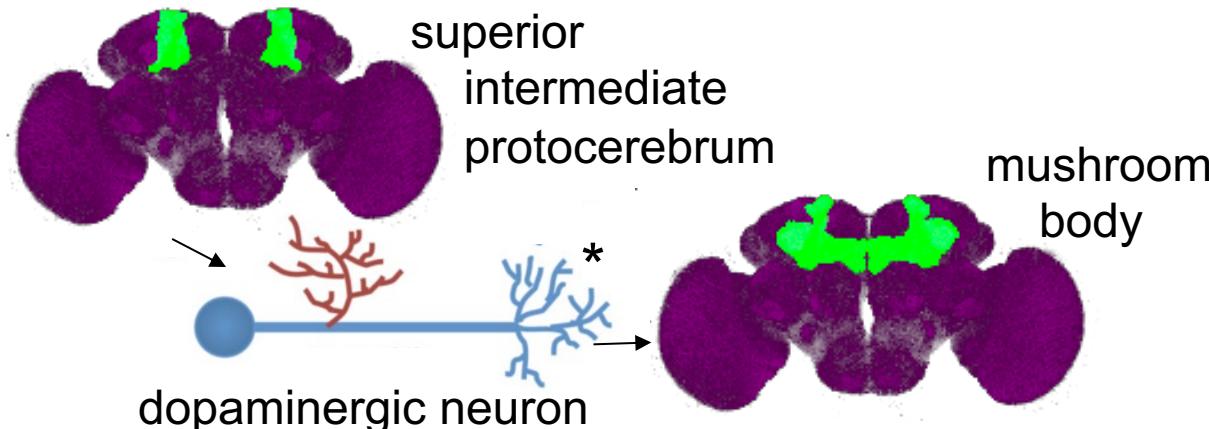
Query for more specific terms

Query For

- Q List all available images of adult antennal lobe projection neuron DA1
- Q Reports of transgene expression in adult antennal lobe projection neuron DA1
- Q Parts of adult antennal lobe projection neuron DA1
- Q Subclasses of adult antennal lobe projection neuron DA1



VFB queries



10 Subclasses of dopaminergic neuron AND Neurons with presynaptic terminals in adult mushroom body AND
Neurons with postsynaptic terminals in superior intermediate protocerebrum

SIP - painted domain JFRC2
(VFB_00030628)

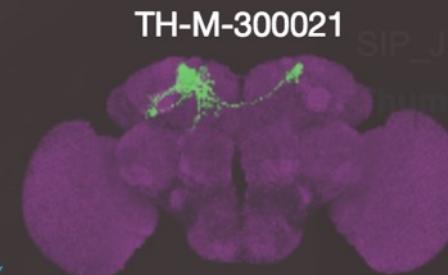
Depicts

Filter Results

MB-alpha' neuron of the dopaminergic PPL1 cluster

A neuron whose main axon terminates in the tip of the mushroom body alpha' lobe (segment 3). Dendritic arborizations are found in the superior medial, intermediate and lateral protocerebrum and lateral horn. It is part of the dopaminergic PPL1 cluster. There is one neuron of this type in each hemisphere.

dopaminergic PPL1 neuron



standard terms for annotating data

* Splindler & Hartenstein 2011 DOI10.1186/1749-8104-6-16

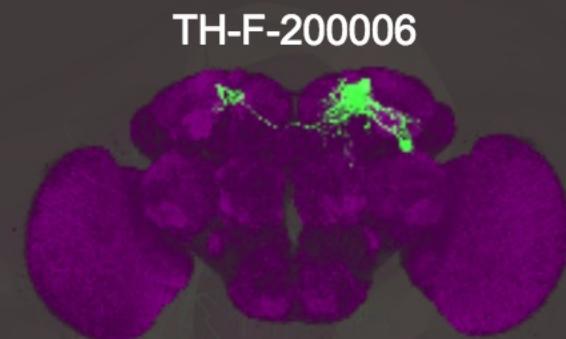
Name

MB-alpha' neuron of the dopaminergic PPL1 cluster (FBbt_00110321)

Alternative Names

PPL1-04, PPL1-alpha'3

Examples

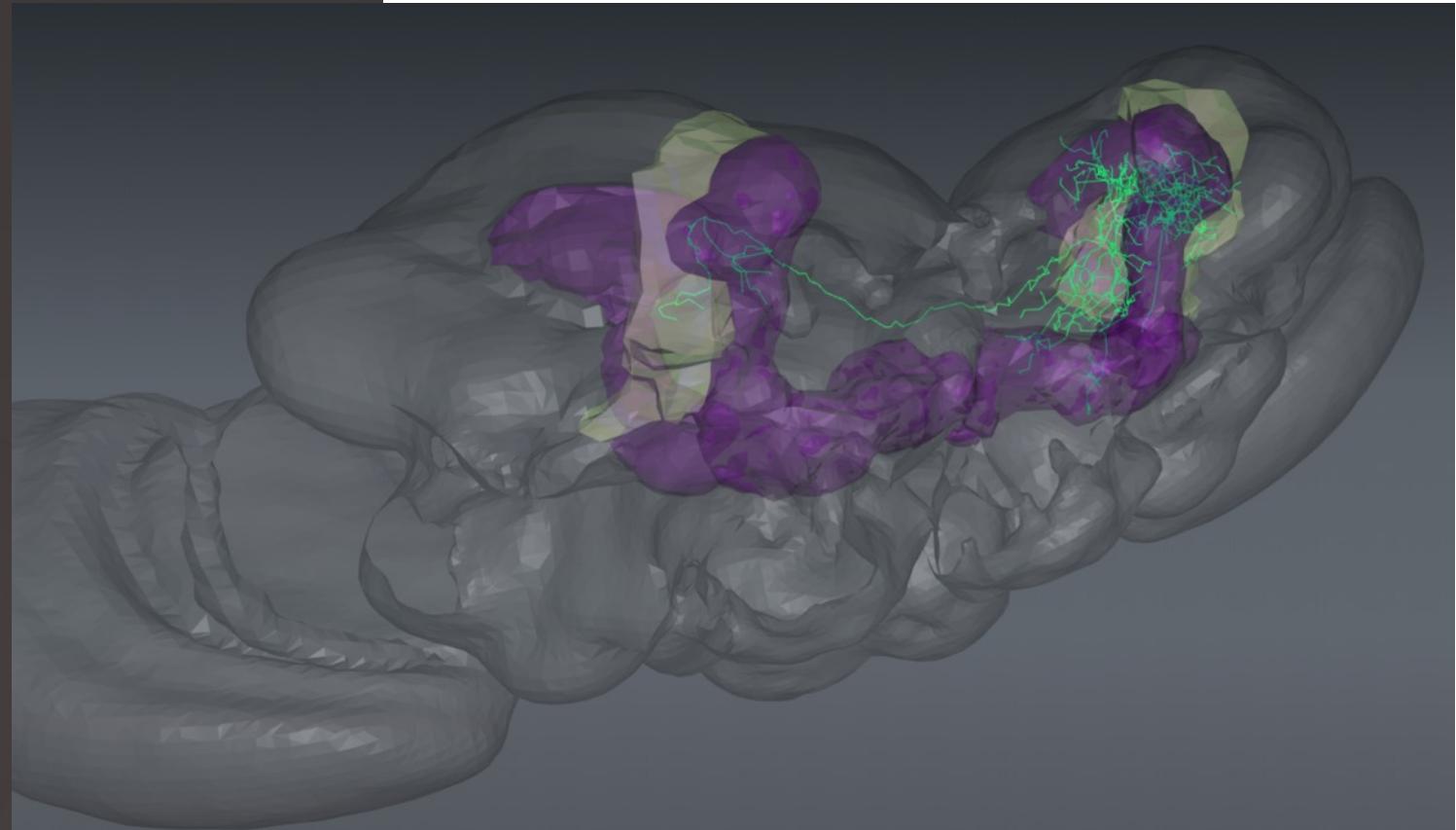


Type

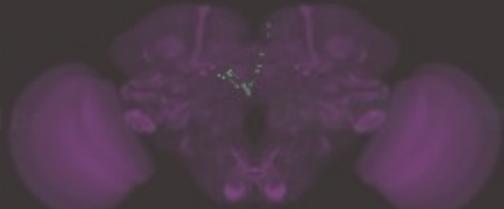
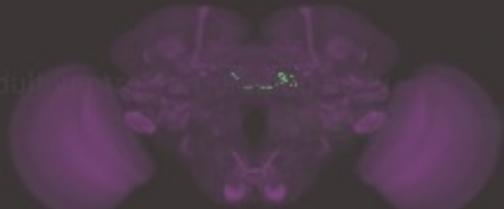
dopaminergic PPL1 neuron

Relationships

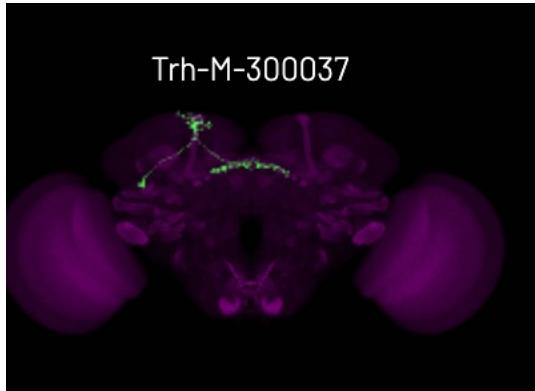
has presynaptic terminal in **mushroom body alpha' lobe slice 3**
has postsynaptic terminal in **superior intermediate protocerebrum**
has postsynaptic terminal in **lateral horn**
has postsynaptic terminal in **superior medial protocerebrum**
has postsynaptic terminal in **superior lateral protocerebrum**
part of **adult brain**



Query finds neurons with
Presynaptic terminals in parts of
the mushroom body

1710 Images of neurons with some part in fan-shaped body layer 1						
Filter Results						
Name	Type	Gross_Type	Template_Space	Imaging_Technique	Images ▾	
vDeltaM_C0 (FlyEM-HB:1217385603)	fan-shaped body intrinsic unicolumnar neuron	Adult; Neuron	JRC2018U also in: HemiBrain	FIB-SEM	<p>fan-shaped body layer 1 [FBCell:000748]</p>  <ul style="list-style-type: none"> has_exact_synonym: fan shaped body has_broad_synonym: fan shaped body layer 1 (Line 2010) 	
vDeltaM_C1 (FlyEM-HB:1415877516)	fan-shaped body intrinsic unicolumnar neuron	Adult; Neuron	JRC2018U also in: HemiBrain	FIB-SEM	<p>Classification</p> <ul style="list-style-type: none"> fan-shaped <p>Available Images</p> 	
vDeltaM_C9 (FlyEM-HB:1445992562)	fan-shaped body intrinsic unicolumnar neuron	Adult; Neuron	JRC2018U also in: HemiBrain	FIB-SEM	<p>Relationships</p> <ul style="list-style-type: none"> is part of adult fly brain <p>Query For</p> <p>Types of neurons with...</p> 	

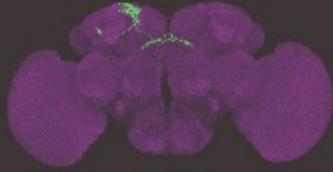
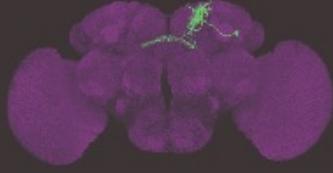
NBLAST – find neurons by morphology



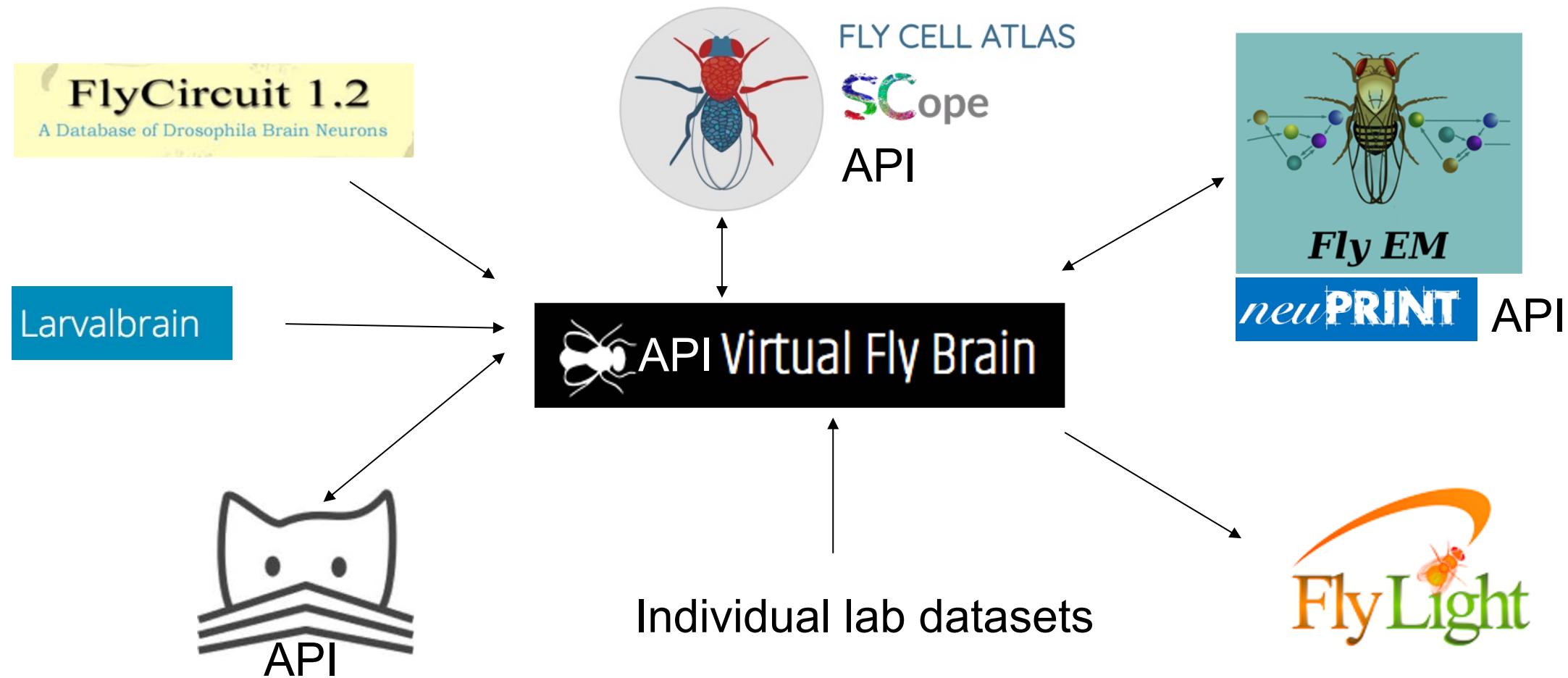
Virtual Fly Brain Tools History Templates Help

25 NBLAST Similar to Trh-M-300037

Filter Results

Name	Definition	Type	Images	Name	Score
TH-M-300032	A(n) neuron expressing P{ple-GAL4,F} that is part of a male P{ple-GAL4,F} expression pattern. Synonym(s): THMARCM-348M_seg1.	male-specific neuron, dFB neuron of the dopaminergic PPL1 cluster		Trh-M-300037 (VFB_00003534)	0.6367
TH-M-300024	A(n) neuron expressing P{ple-GAL4,F} that is part of a male P{ple-GAL4,F} expression pattern. Synonym(s): THMARCM-253M_seg1.	male-specific neuron			Classification • male-specific • dFB neuron • PPL1 cluster • Dopaminergic • Neuron

Facilitating programmatic usage



Use data directly from VFB, or use VFB to connect APIs to query data provider sites

The abstraction provided by the class graph is useful for connectomics queries

```
# Get connections between pacemaker neurons
vc.get_connected_neurons_by_type(upstream_type='pacemaker neuron',
                                 downstream_type='pacemaker neuron',
                                 weight=10).sort_values('weight', ascending=False)
```

upstream_neuron_id	object	upstream_neuron_na...	obje...	weight	int64	downstream_neuron_...	obje...	downstream_neuron_...	obje...
VFB_jrchkjzxy	21.9%	LNd_R - 5813069648	21.9%	10 - 79		VFB_jrchkjzxy	28.1%	LNd_R - 5813069648	28.1%
VFB_jrchk8e0	15.6%	5th s-LNv - 511051...	15.6%			VFB_jrchk8e0	25%	5th s-LNv - 511051...	25%
10 others	62.5%	10 others	62.5%			10 others	46.9%	10 others	46.9%
<hr/>									
28	VFB_jrchkjtex	DN1a_R - 264083994		79		VFB_jrchkjzxy		LNd_R - 5813069648	
25	VFB_jrchkjtey	DN1a_R - 5813022274		75		VFB_jrchkjzxy		LNd_R - 5813069648	
22	VFB_jrchkjtey	DN1a_R - 5813022274		63		VFB_jrchk8e0		5th s-LNv - 511051477	
23	VFB_jrchkjtex	DN1a_R - 264083994		55		VFB_jrchk8e0		5th s-LNv - 511051477	
3	VFB_jrchk089	LPN_R - 480029788		43		VFB_jrchk08a		LPN_R - 450034902	

Acknowledgments

Virtual Fly Brain Project

wellcome WT105023MA

- **David Osumi-Sutherland**, Robert Court, Marta Costa, Clare Pligrim, Aoife Larkin, Gillian Milburn, Alex McLachlan, Nico Matentzoglu, Huseyin Kir, J. Douglas Armstrong, Greg Jefferis, Helen Parkinson, Cahir O’Kane



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informatics



<http://www.virtualflybrain.org>