Figure S1

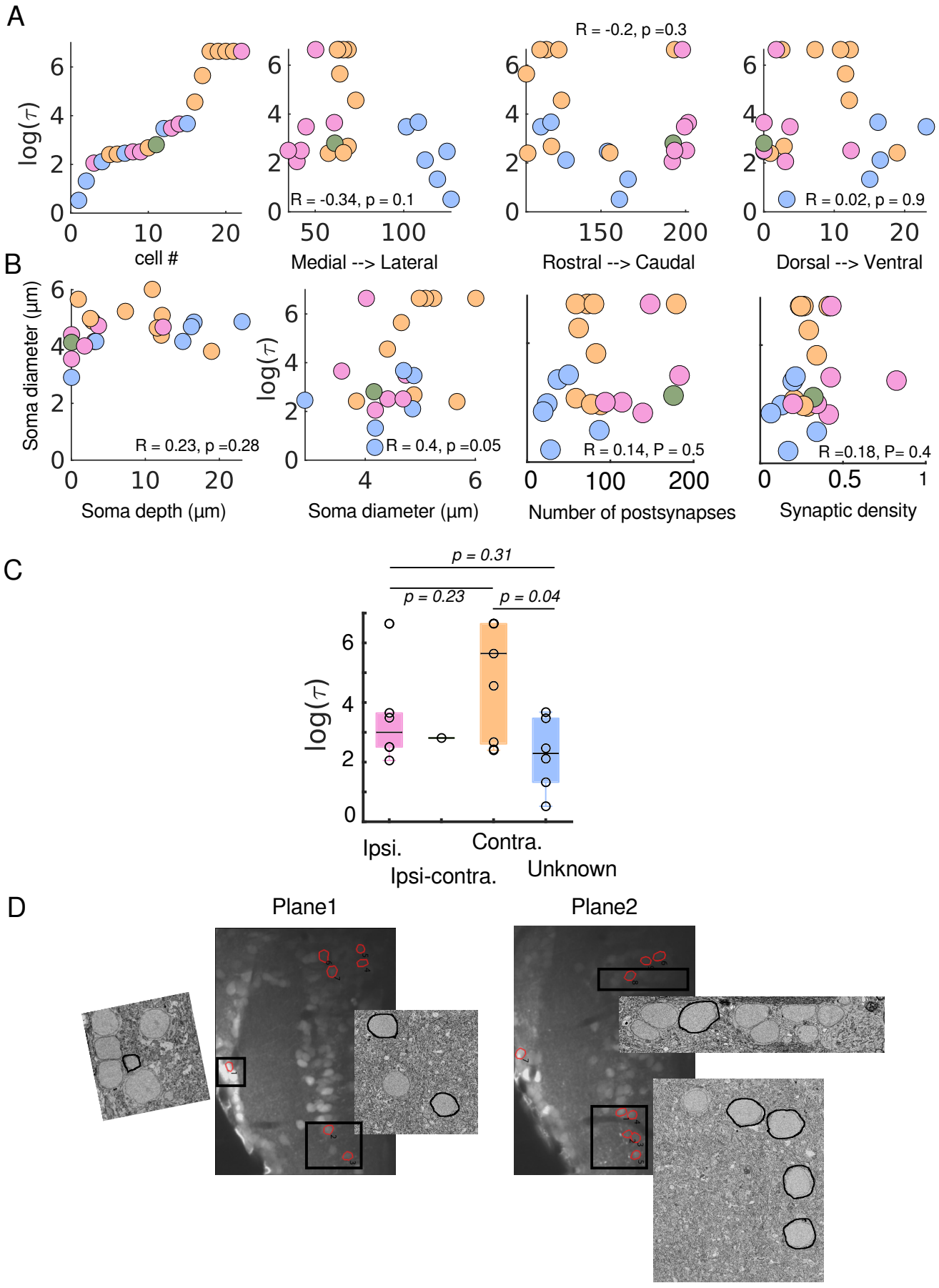
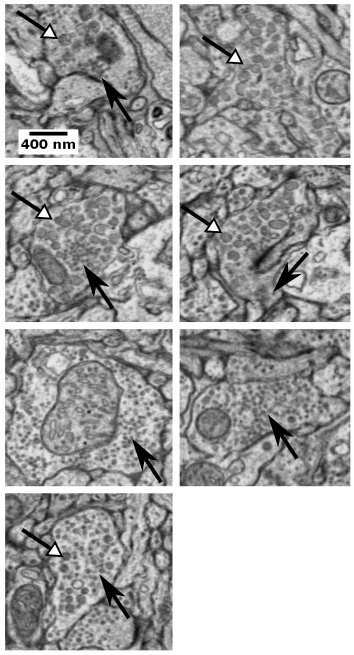
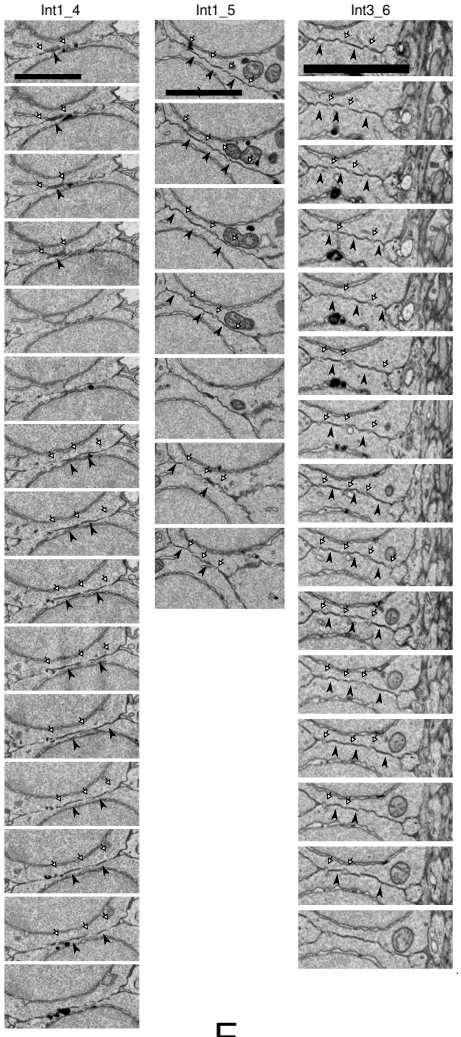

A
log(τ)
cell #
R = -0.34, p = 0.1
Medial --> Lateral
R = -0.2, p =0.3
Rostral --> Caudal
R = 0.02, p = 0.9
Dorsal --> Ventral
B
Soma diameter (µm)
R = 0.23, p =0.28
Soma depth (µm)
log(τ)
R = 0.4, p =0.05
Soma diameter (µm)
R = 0.14, P = 0.5
Number of postsynapses
R =0.18, P= 0.4
Synaptic density
C
p = 0.31
p = 0.23
p = 0.04
log(τ)
Ipsi.
Ipsi-contra.
Contra.
Unknown
D
Plane1
Plane2

Figure S2

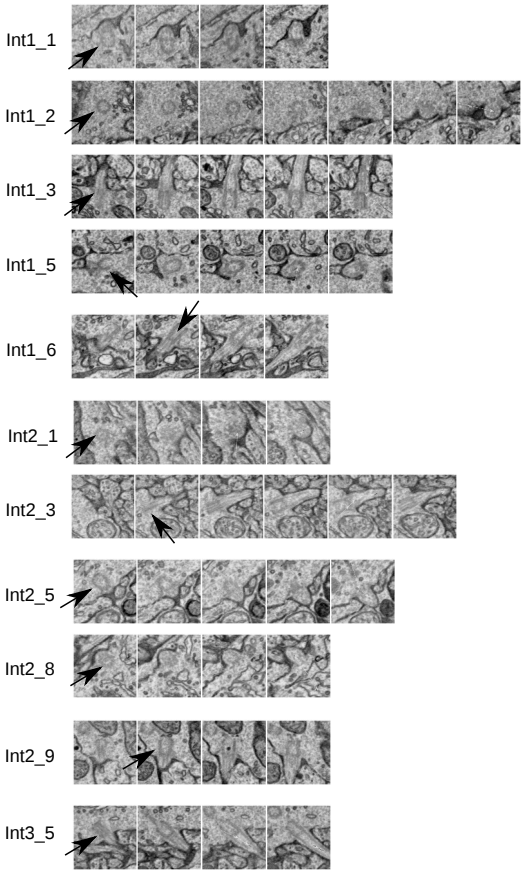
A Types of synapses



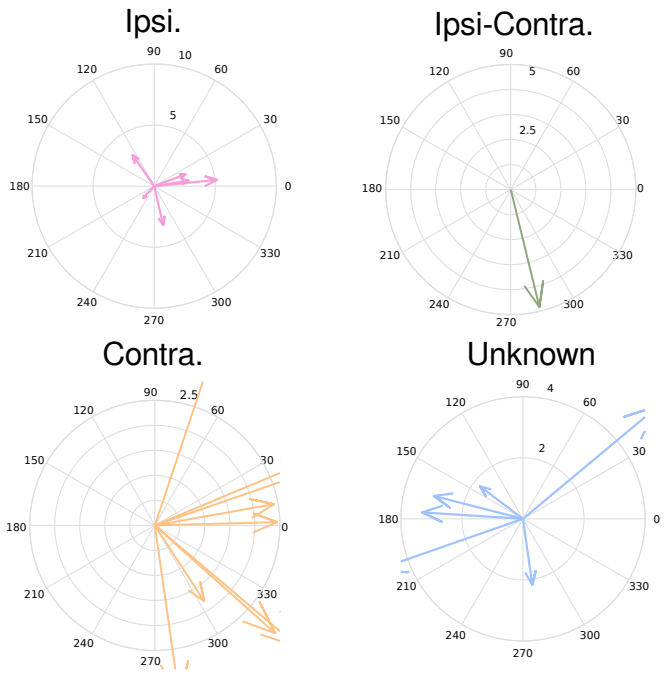
B Putative cellular junctions between somata



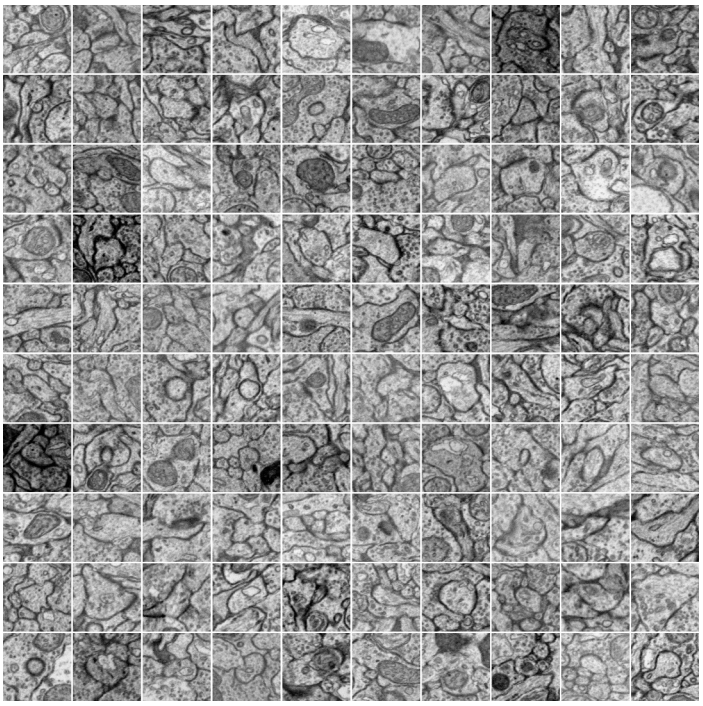
C Primiay cilia



D



E



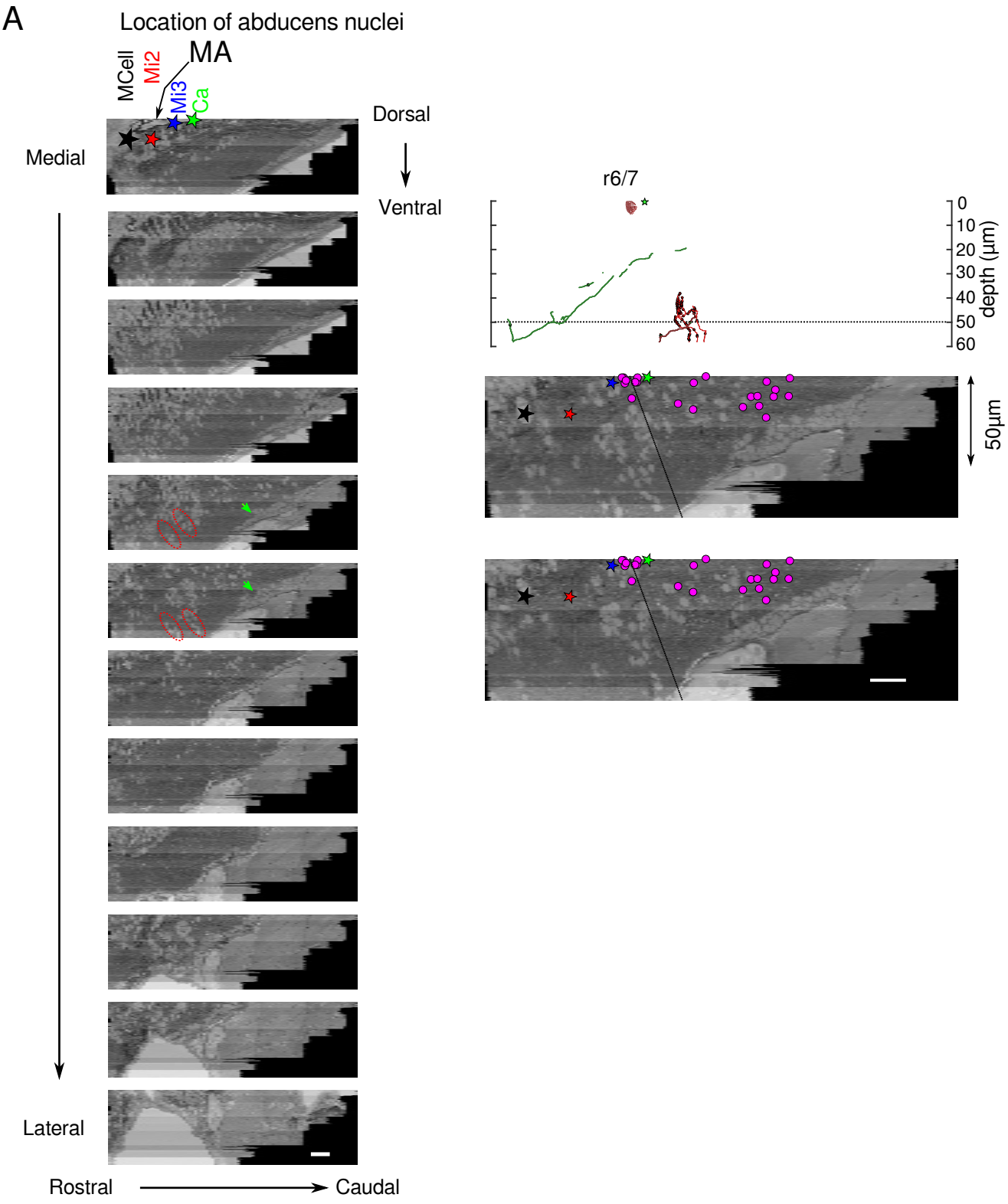
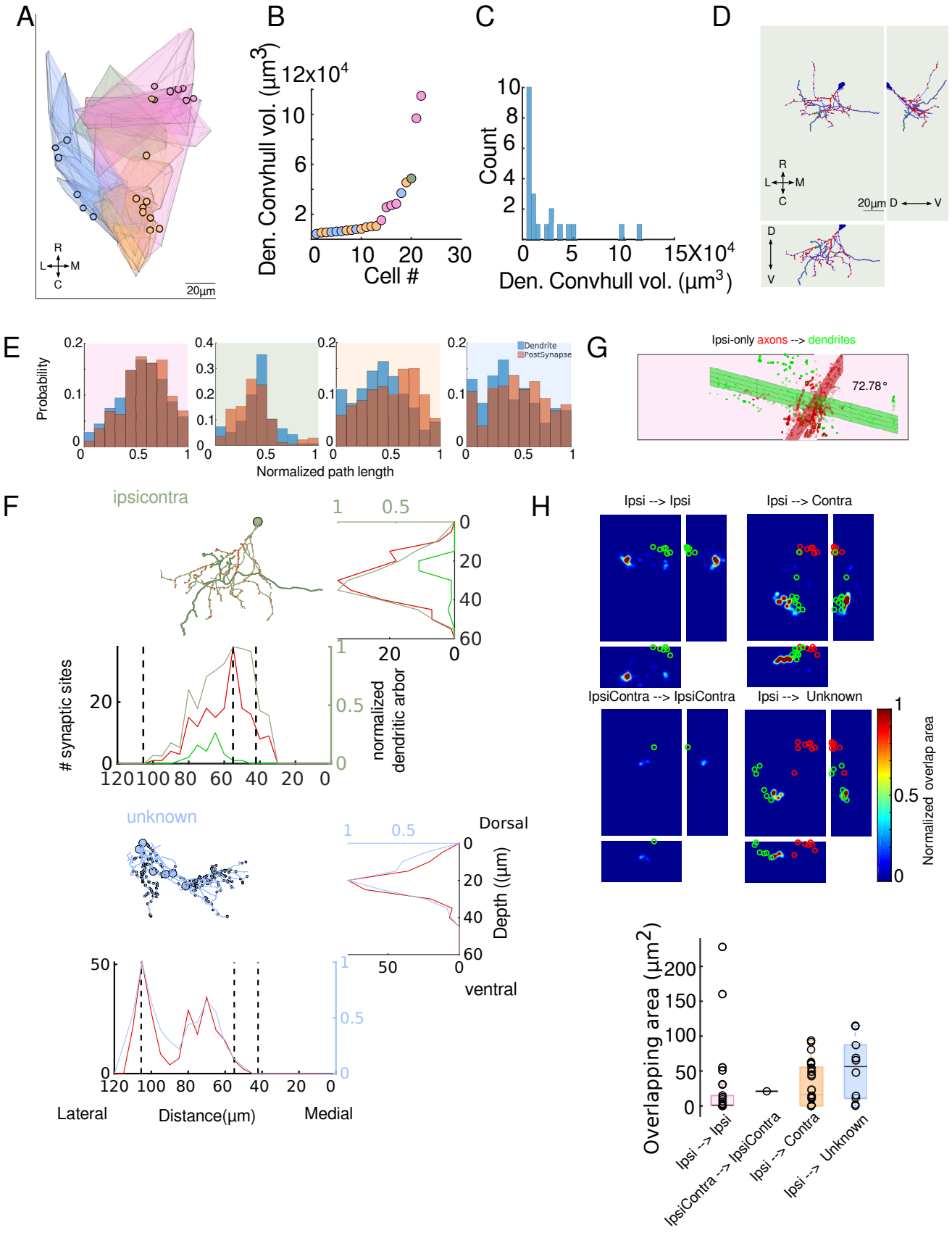

A
Location of abducens nuclei
MA
MCell
Mi2
Mi3
Ca
Dorsal
Ventral
Medial
Lateral
Rostral
Caudal
r6/7
0
10
20
30
40
50
60
depth (µm)
50µm

Figure S4


A
R
L
M
C
20µm
B
Den. Convhull vol. (µm3)
12x10^4
10
6
2
0
10
20
30
Cell #
C
Count
10
8
6
4
2
0
5
10
15X10^4
Den. Convhull vol. (µm3)
D
R
L
M
C
20µm D
V
D
V
E
Probability
0.2
0.1
0
0.4
0.3
0.2
0.1
0
0.5
1
Dendrite
PostSynapse
Normalized path length
G
Ipsi-only axons --> dendrites
72.78°
F
ipsicontra
1
0.5
0
20
40
60
synaptic sites
20
0
120 100 80 60 40 20 0
normalized dendritic arbor
unknown
Dorsal
Depth ((µm)
ventral
50
0
Lateral
Distance(µm)
Medial
H
Ipsi --> Ipsi
Ipsi --> Contra
IpsiContra --> IpsiContra
Ipsi --> Unknown
Normalized overlap area
Overlapping area (µm2)
200
150
100
50
0
Ipsi --> Ipsi
IpsiContra --> IpsiContra
Ipsi --> Contra
Ipsi --> Unknown

Cell group	# Cells	Average length (μm)	Average axonal length (μm)	Average dendritic length (μm)	Convex hull volume (μm^3)	Axon diameters (μm)	Dendrite diameter (μm)	Axon initiation site (μm)
Ipsi. only	6	648.8 ± 160.42	260.15 ± 146.1	388.65 ± 59.98	3.08×10^5	0.21 ± 0.15	0.25 ± 0.15	99.62 ± 54.83
Ipsi-contra.	1	838.66	292.89	545.76	0.486×10^5	0.2 ± 0.11	0.21 ± 0.12	63.31
Contra. only	9	359.59 ± 58.86	66.94 ± 14.71	292.65 ± 65.25	1.09×10^5	0.16 ± 0.08	0.22 ± 0.12	22.35 ± 21.69
unknown	6	221.47 ± 48.7	NA	221.47 ± 48.7	0.67×10^5	NA	0.22 ± 0.12	

Table S 1: Anatomical features of integrator neurons

Figure legends:

Figure S1: (A) (Left) Graded levels of persistent activity. (Right panels) Spatial distribution of integrator time constants along the rostro-caudal, mediolateral and dorsoventral axis respectively (r values are Pearson correlation coefficients). Colors represent the group that the neurons belong to. (Pink - ipsi only, Green - ipsi-contra, Orange - contra only and Blue - unknown).
(B) (Left) Variation of somata size of the integrator neurons. Effect of somata size on integrator time constants. (Right two) Correlations between number and density of postsynaptic (input) sites to integrator time constants. r values are Pearson correlation coefficients.
(C)Box plot of integrator time constants for all cells in assigned groups. Black line is the median. P values reported from KS test.
(D)Two functionally imaged planes with integrator neurons circled in red. Black boxes are representative areas where corresponding EM images are shown as insets. Insets are representative EM location, after registration, with the functionally identified cells circled in black.

Figure S2:(A) Examples of types of synapses in the imaged volume. Closed arrows show conventional synapses and open arrows shows dense core vesicles within the same bouton.
(B) Successive images of cellular junctions between cell somata. Closed arrow head shows cell junctions indicated by darkening of the membrane at the same location in multiple sections. Open arrows show the separation of the membrane by the lack of darkening. Scale bar = 500nm.
(C) Primary cilium of integrator neuron. The primary cilium is visible over multiple sections as seen by presence of ordered microtubules that emerges very close to the Golgi complex of the cells.
(D) Orientation of primary cilium, centered at the somata. Black arrow show the beginning of the cilium. Distance of concentric rings is in microns. Colors represent the group that the neuron belongs to. (Pink - ipsi only, Green - Ipsi-contra, Orange - contra only and Blue - unknown).
(E) One hundred representative synapses. The center pixel of each image is in the postsynaptic cell. The synapses do not show many flat vesicles and the density tends to extend into the presynaptic cell.

Figure S3: (A) Location of abducens nuclei from low-res EM images. The frames are ordered from medial to lateral, $10\mu m$ apart. Red circles (dotted line) show the potential location of both abducens nuclei. Green arrow shows the location of the inferior olive. MA -Mauthner Axon. Rhombomeres r4-7 were identified based on the location of the reticulo-spinal cells (Black star - MCell, red star - Mi2, blue star - Mi3 and green star - Ca). Scale bar $20\mu m$.
(B) (Top) Lateral view of two ipsilaterally projecting integrator neurons with axonal projections towards the abducens nuclei. The axons project to the same depth as the abducens nuclei (dotted horizontal black line). Black dotted line is the border between r6 and r7, with tilt calculated based on [S 1, 2]. (Bottom) Dotted white line is $50\mu m$ ventral to the Mauthner axon plane showing corresponding region from top panel. Potential abducens nerve was identified as dark myelinated axon exiting the volume ventrally. Scale bar = $20\mu m$.

Figure S4:(A) Convex hulls of all neurons color coded by the group. Colored circle is location of somata. (Pink - ipsi only, Green - ipsi-contra, Orange - contra only and Blue - unknown).
(B) Convex hull volume of dendrites of integrator neurons.
(C) Distribution of the convex hull volume of the integrator cells.
(D) Three views of one integrator neuron that had both ipsilateral and contralateral projections.
(E) Distribution of the normalized postsynaptic pathlength and the distribution of the normalized dendritic pathlength. Background color (Pink - ipsi only, Green - Ipsi-contra, Orange - contra only and Blue - unknown).
(F) Depth stratification of ipsi-contra and unknown projecting groups. For each panel, below the trace of all neurons is the stratification of the dendrites (red) and axons (green) along the mediolateral axis. To the right is the stratification along the dorsoventral axis. Black dotted line are the locations of the stripes from figure 1.
(G) Angle between best fit planes of axons (green) and dendrites (red) of ipsi-only neurons.
(H)Top - Spatial overlap of axons and dendrite from each group. Green circle - location of somata of presynaptic neuron (location of neuron with axon), red circle - location of somata of postsynaptic neuron.
Bottom - Box plot with actual overlapping area for neuron pairs from (H).

References

[S 1] Kayvon Daie, Mark S Goldman, and Emre R F Aksay. Spatial patterns of persistent neural activity vary with the behavioral context of short-term memory. *Neuron*, 85(4):847–860, February 2015.

[S 2] Melanie M Lee, Aristides B Arrenberg, and Emre R F Aksay. A Structural and Genotypic Scaffold Underlying Temporal Integration. *The journal of neuroscience*, 35(20):7903–7920, May 2015.