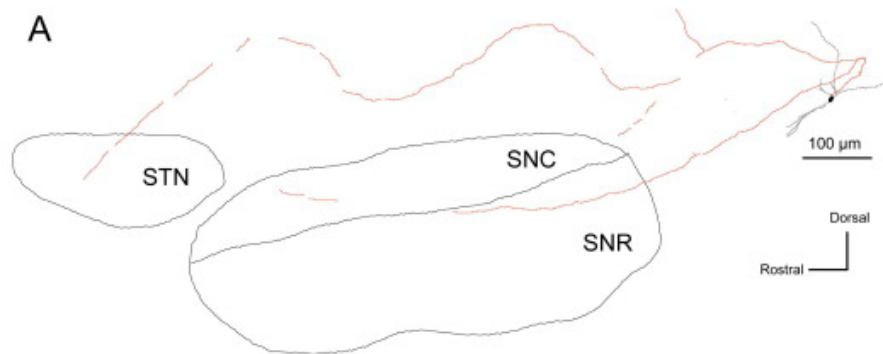
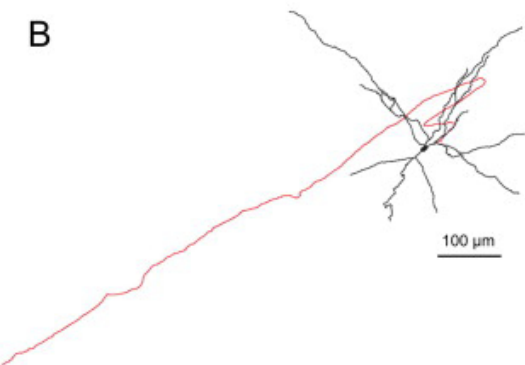


# Quiescent neurons

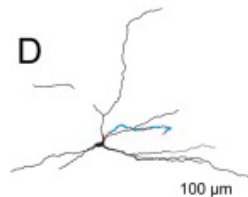
A



B



D

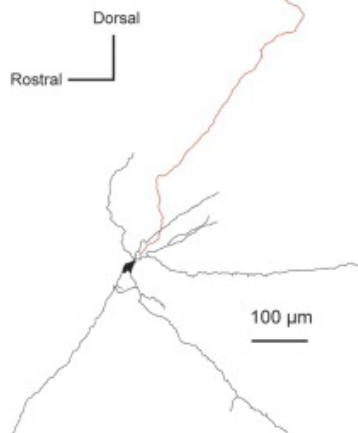


C

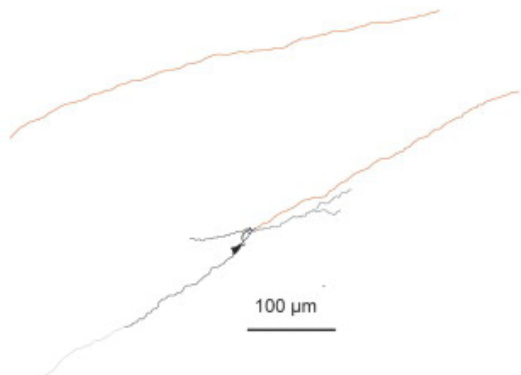


# Tonic firing neurons

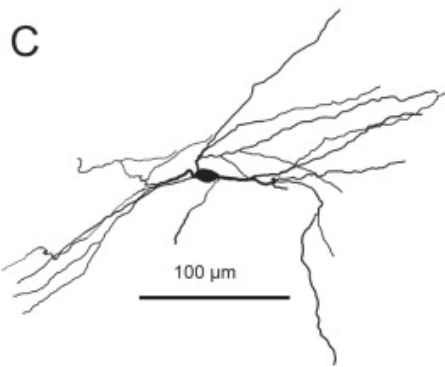
A



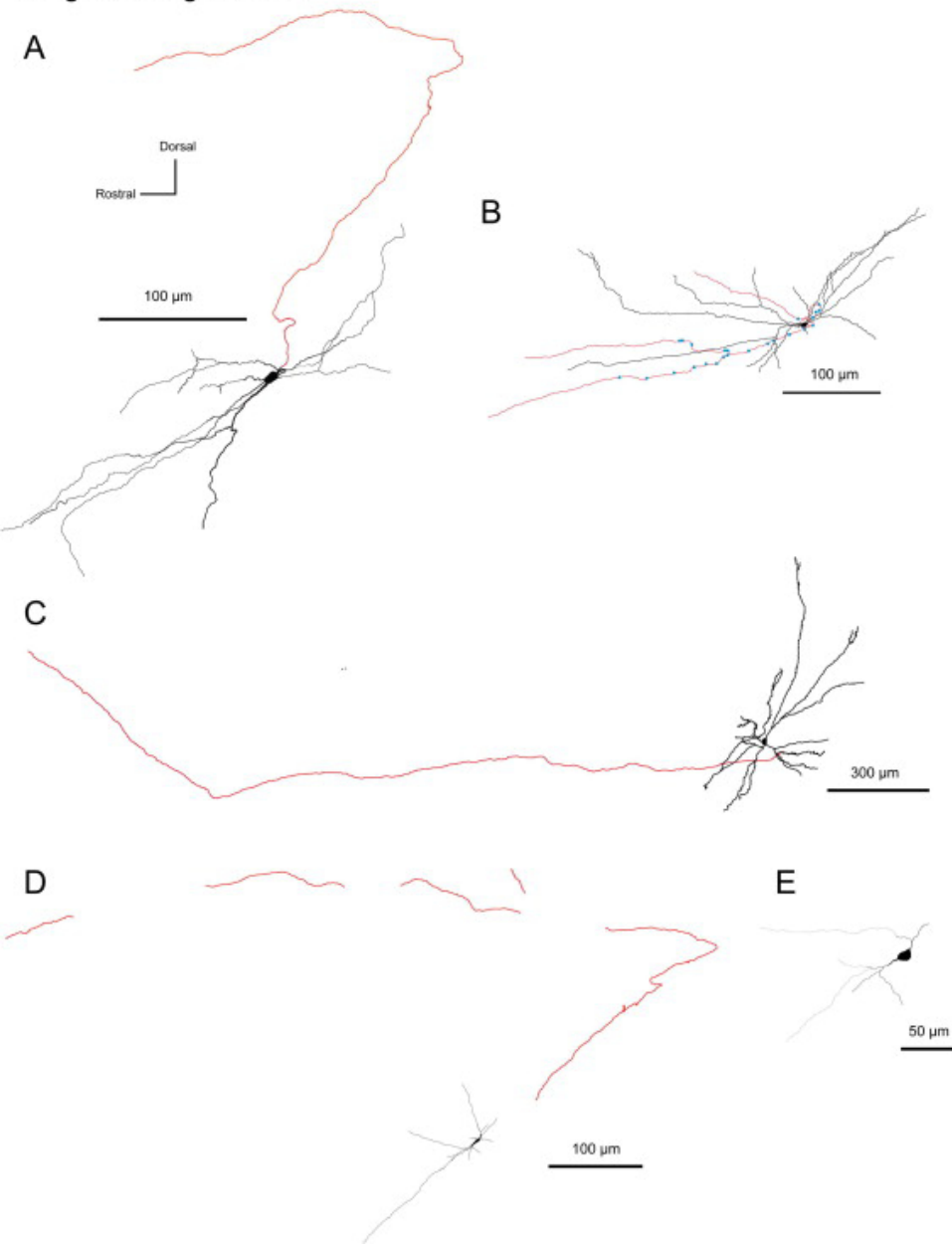
B



C



# Irregular firing neurons



# Bidirectional projecting PPN neuron

A



## Supplementary Figures

### Supplementary Figure 1. Quiescent PPN neurons.

Reconstruction of the cell body, dendrites (*black*) and axon (*red*) of individual quiescent PPN neurons (varicosities shown in *blue*). These neurons typically gave rise to an axon that emerged caudally from the cell body, formed a 'loop', branched and travelled rostrally (**A, B**). Some neurons had incomplete labeling (**C, D**). SNR, substantia nigra pars reticulata; SNC, substantia nigra pars compacta; STN, subthalamic nucleus.

### Supplementary Figure 2. Tonic firing PPN neurons.

Reconstruction of the cell body, dendrites (*black*) and axon (*red*) of individual tonic firing PPN neurons. These neurons typically emitted a single branch directed caudally and then turning and travelling rostrally along the superior cerebellar peduncle fibres (**A, B**). One neuron did not show any axon (**C**).

### Supplementary Figure 3. Irregular firing PPN neurons.

Reconstruction of the cell body, dendrites (*black*) and axon (*red*) of individual irregular firing PPN neurons (varicosities shown in *blue*). Neurons in this group were more heterogeneous than in the previous two, but most of the axons showed an ascending trajectory (**A-E**). Some neurons had incomplete labeling (**F, G**).

**Supplementary Figure 4. Bidirectional projecting PPN neuron.**

Reconstruction of the cell body, dendrites (*black*) and axon (*red*) of an individual irregular firing PPN neuron that had both ascending and descending axon collaterals. The physiological properties of this neuron resembled those of the also descending neuron depicted in Figure 5.