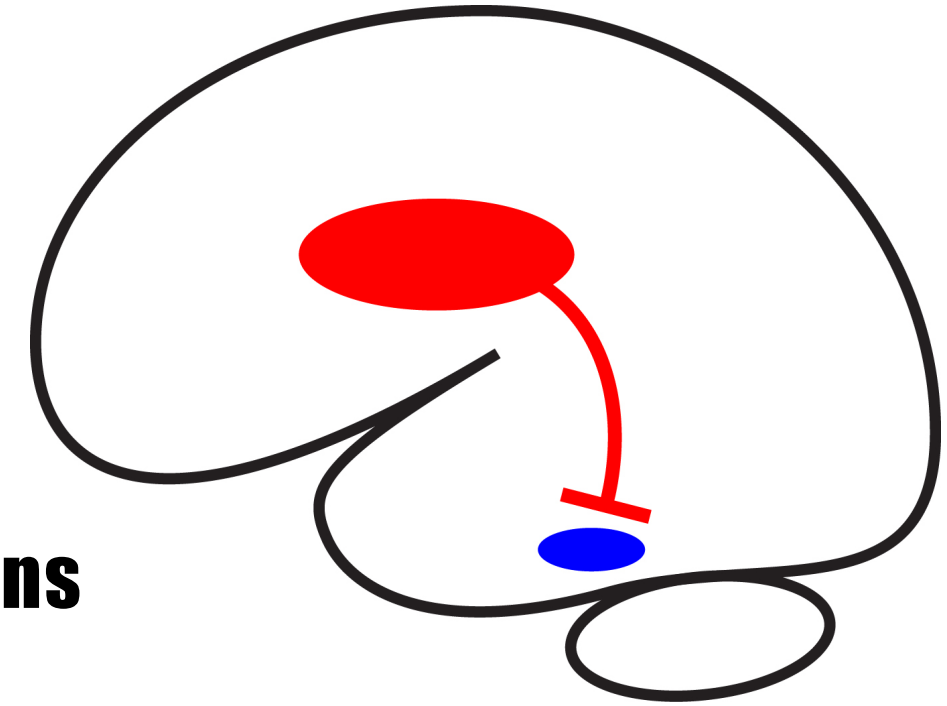
ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE



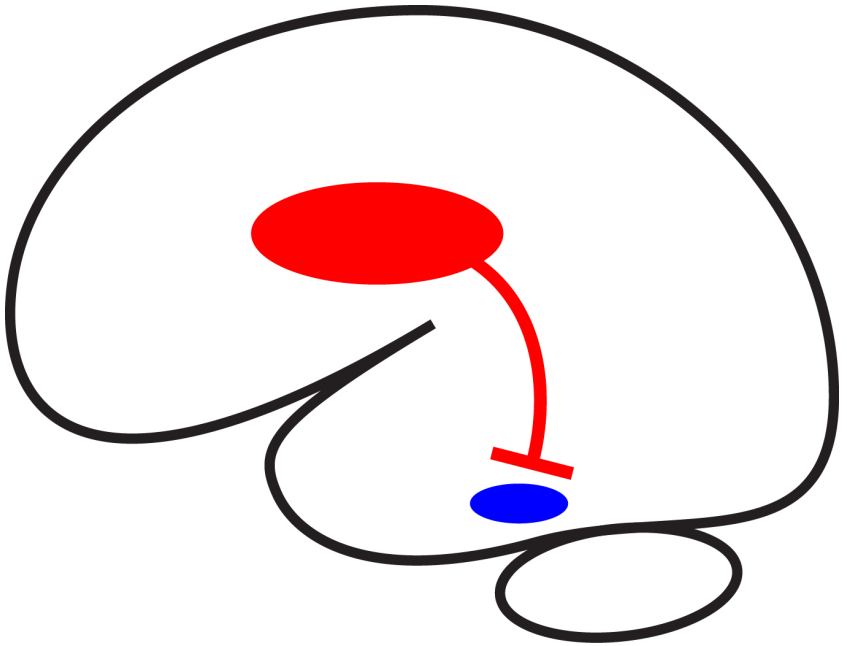
5.4 GABAergic projections

Cellular Mechanisms of Brain Function

Prof. Carl Petersen

Long-range inhibition

GABAergic projections

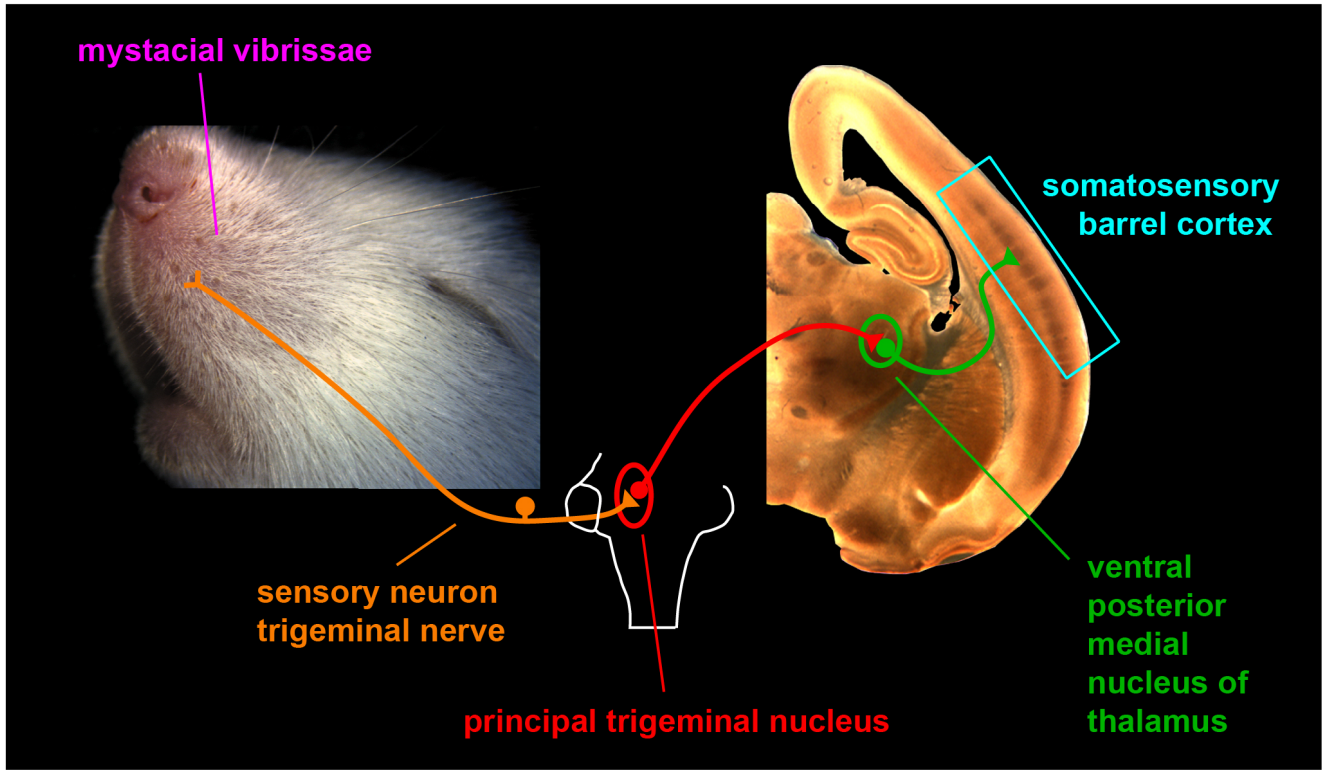


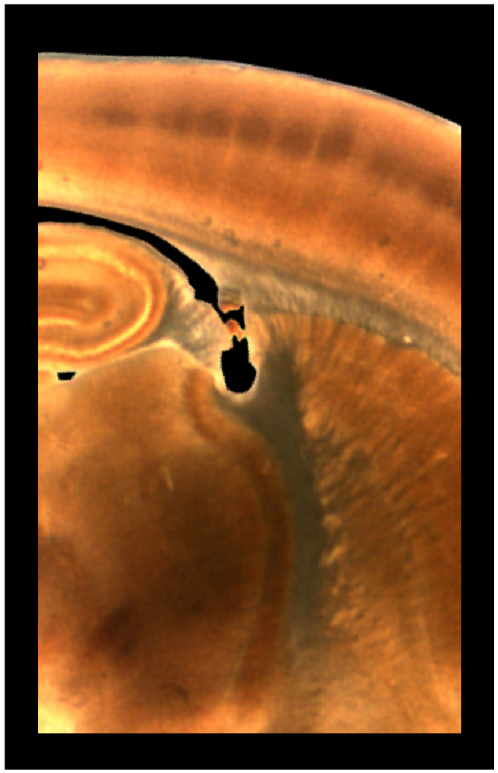
Three examples of GABAergic projection neurons

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

1. Neurons in the reticular nucleus of the thalamus
2. Striatal projection neurons of the basal ganglia
3. Purkinje cells of the cerebellum

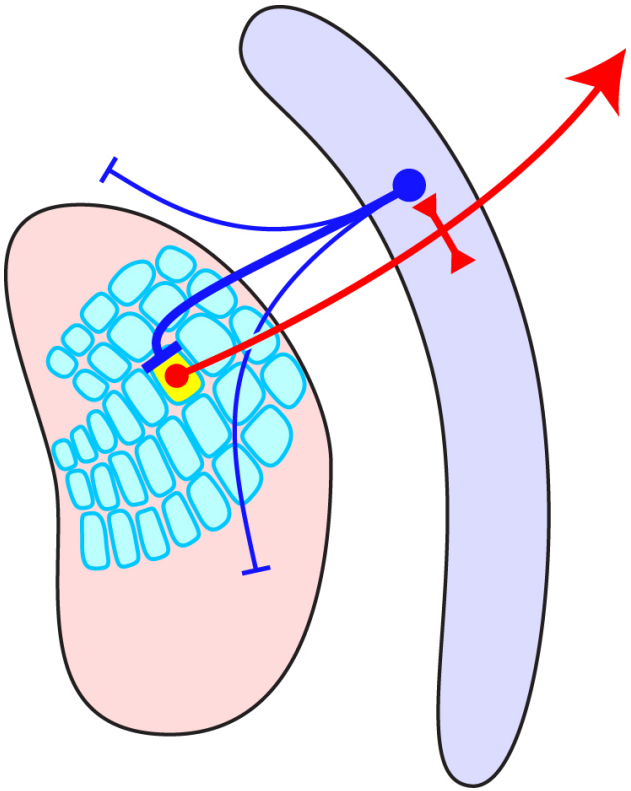
1. The reticular nucleus of the thalamus



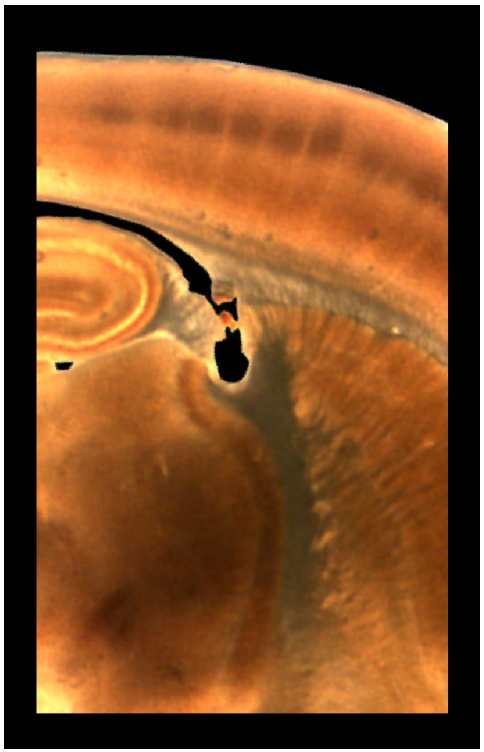


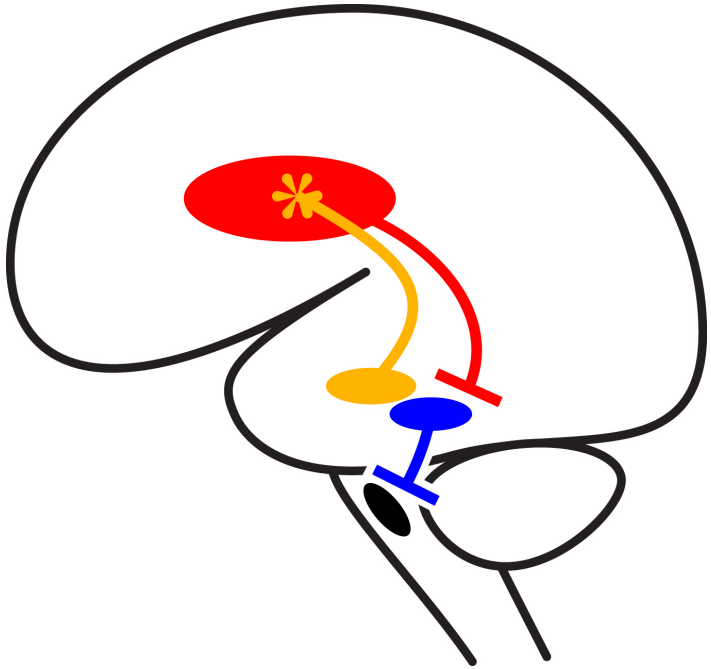
Petersen, 2003

Fast GABAergic feedback inhibition



2. Striatum and substantia nigra

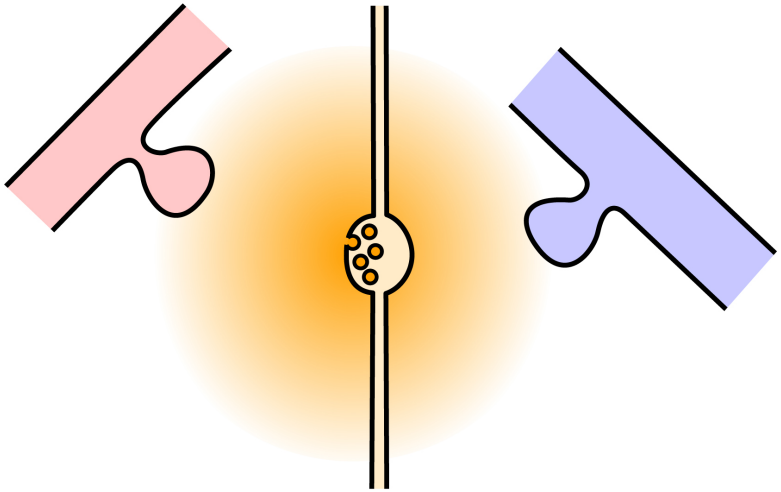




GABAergic striatal projection neurons inhibit tonically active GABAergic neurons in substantia nigra (SNr).

Dopaminergic neurons in a different part of the substantia nigra (SNc) project strongly to the striatum.

Basal ganglia, dopamine and Parkinson's disease



In the striatum, dopamine acts at D1 and D2 receptors, which are expressed in different subtypes of GABA striatal projection neurons.

Dopamine may serve as an important reward signal, useful for learning and synaptic plasticity.

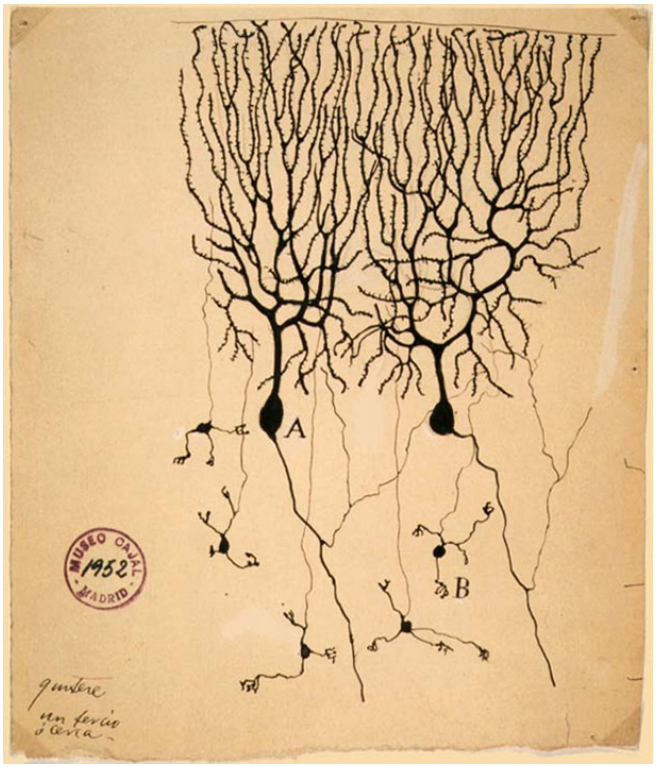
Degeneration of dopaminergic neurons is thought to underlie Parkinson's disease.

3. The cerebellum

The cerebellum (‘*little brain*’) is thought to play an important role in sensorimotor learning and perhaps also in higher cognitive functions.

The cerebellum receives sensory information and uses it to fine tune motor output.

Purkinje cells of the cerebellum



Santiago Ramón y Cajal 1899

The output neurons of the cerebellar cortex are the Purkinje cells.

Purkinje cells are GABAergic projection neurons, which inhibit deep cerebellar nuclei.

Long-range GABAergic projections

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

- Some GABAergic neurons have long-range axonal projections.
- Reticular nucleus of the thalamus drives fast feedback inhibition.
- Inhibitory basal ganglia circuits help drive goal-directed behavior.
- Purkinje cells inhibit deep nuclei helping fine sensorimotor skills.