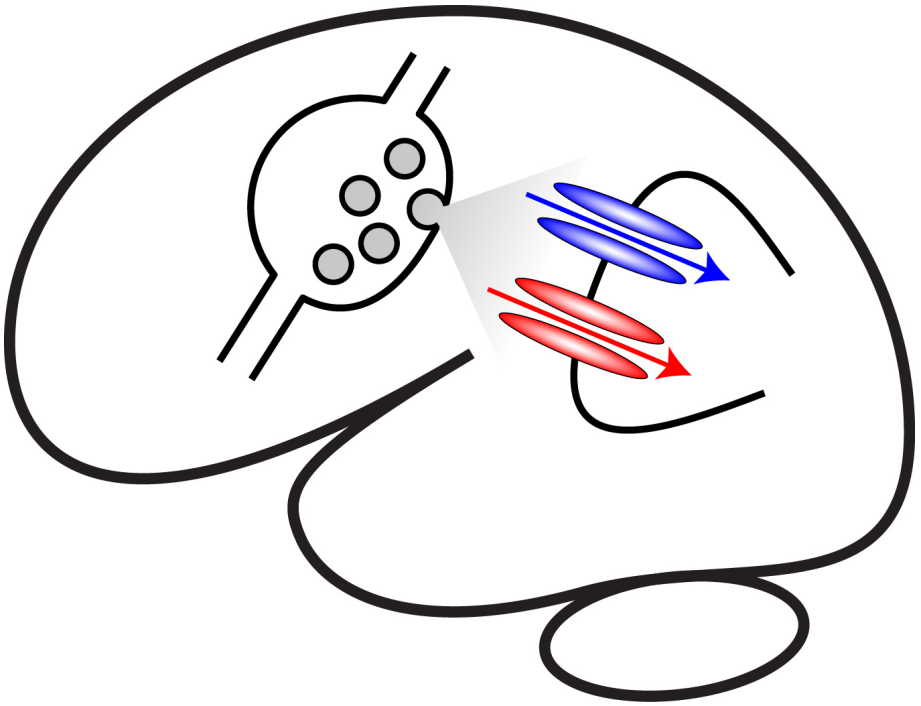
ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE



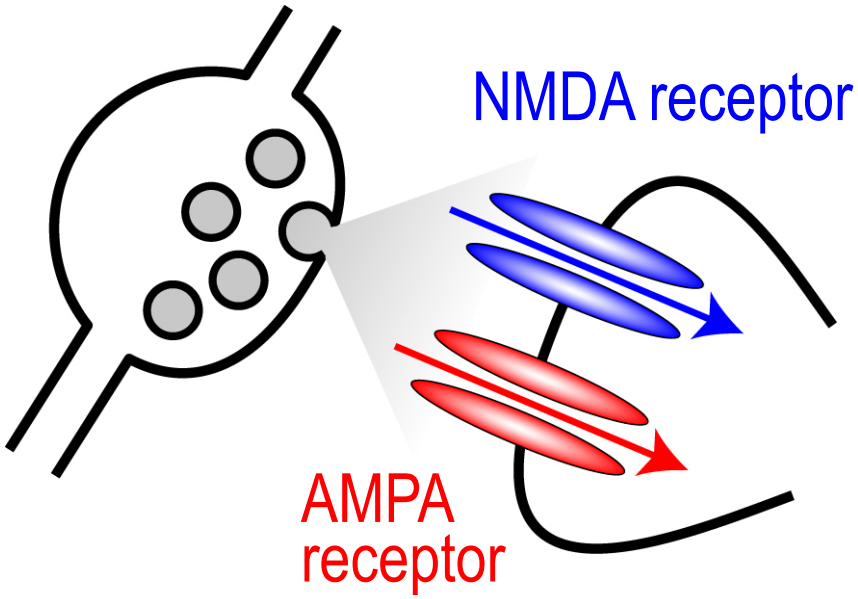
4.1 Glutamate receptors

Cellular Mechanisms of Brain Function

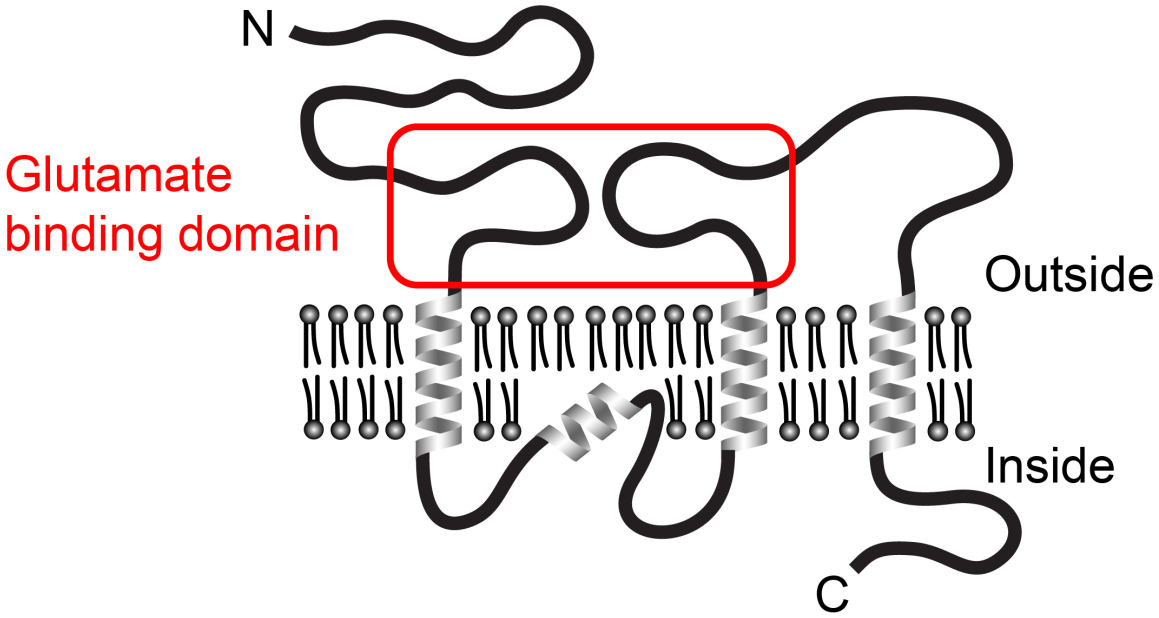
Prof. Carl Petersen

Glutamatergic excitatory synaptic transmission

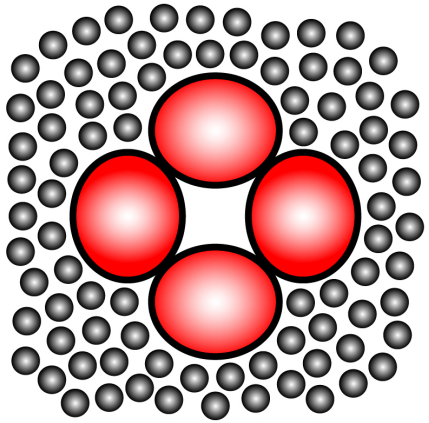
Ionotropic glutamate receptors



Ionotropic glutamate receptors: structure



Glutamate receptors have 4 subunits.



Ionotropic glutamate receptors: ion permeability

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AMPA receptors

Na^+ and K^+
Reversal potential ~0 mV

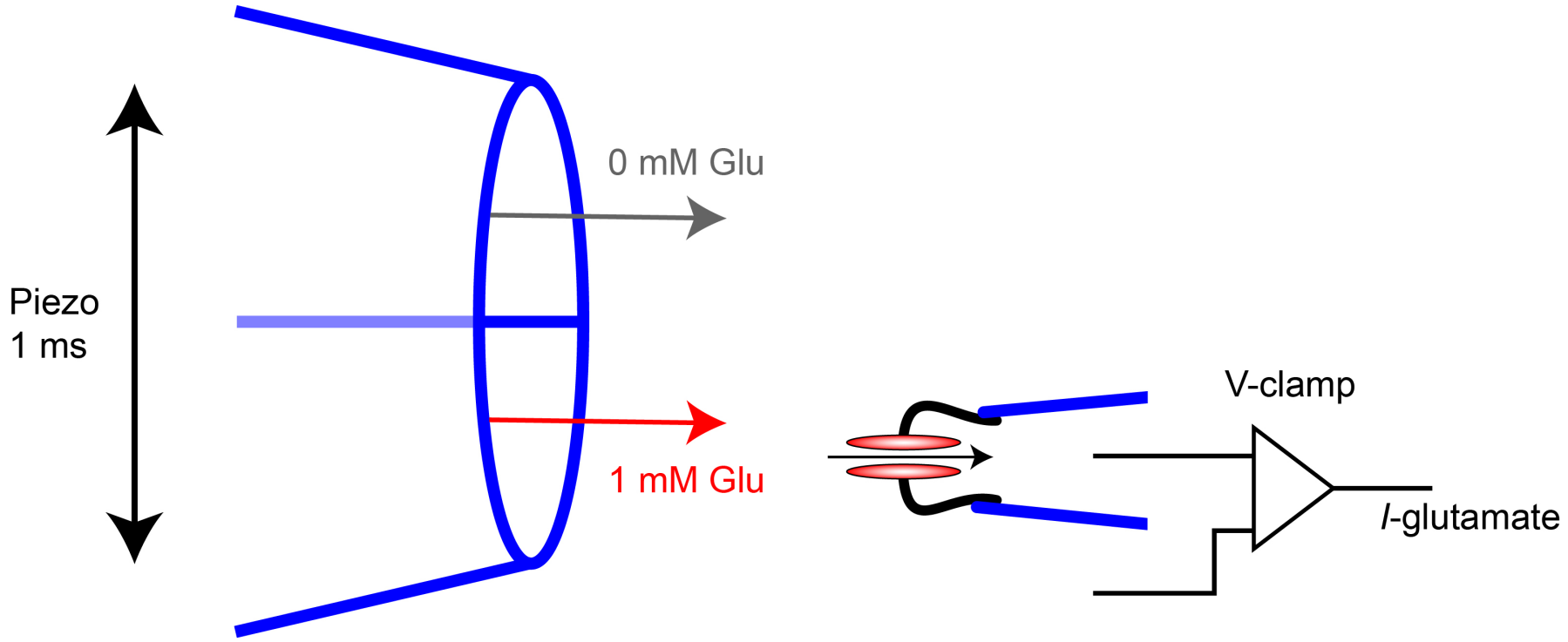
Single channel
conductance ~ 5 pS

NMDA receptors

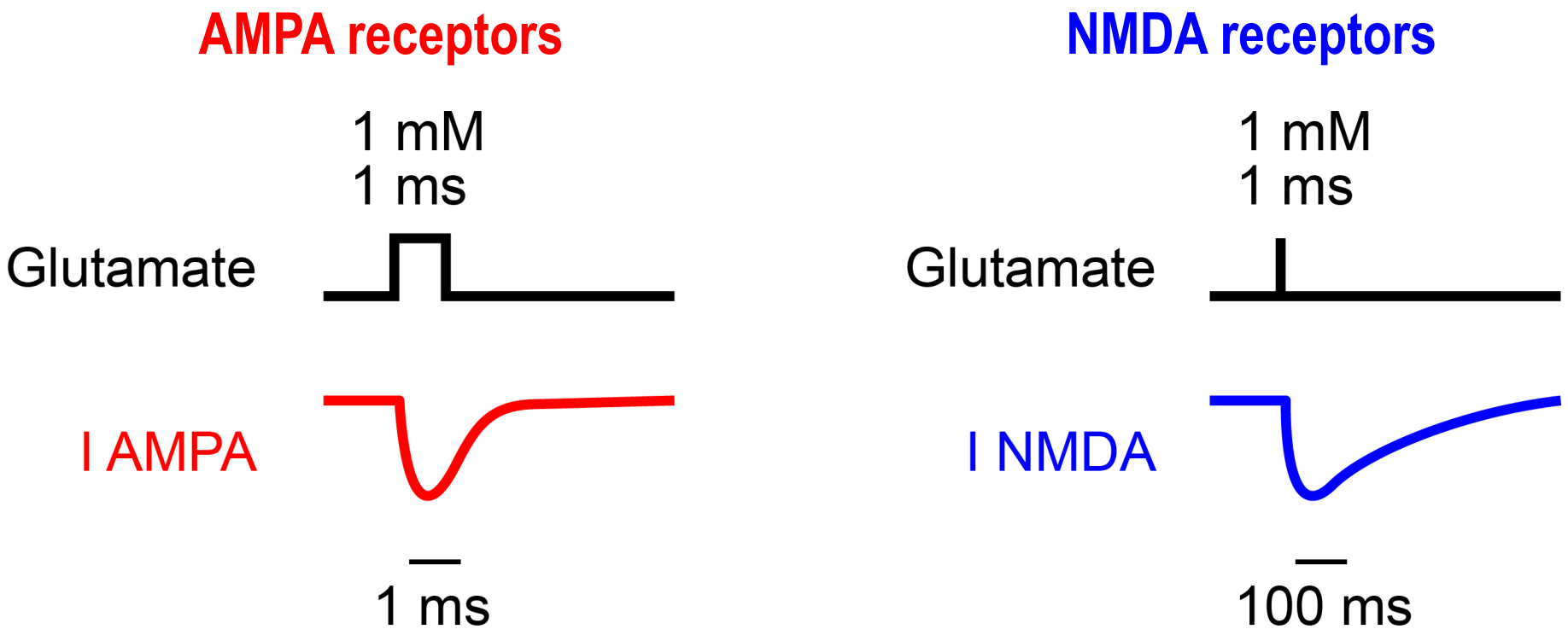
Na^+, K^+ and Ca^{2+}
Reversal potential ~0 mV

Single channel
conductance ~ 50 pS

Measuring kinetics of ligand-gated ion channels



Ionotropic glutamate receptors: kinetics



Ionotropic glutamate receptors: *I–V* relationship

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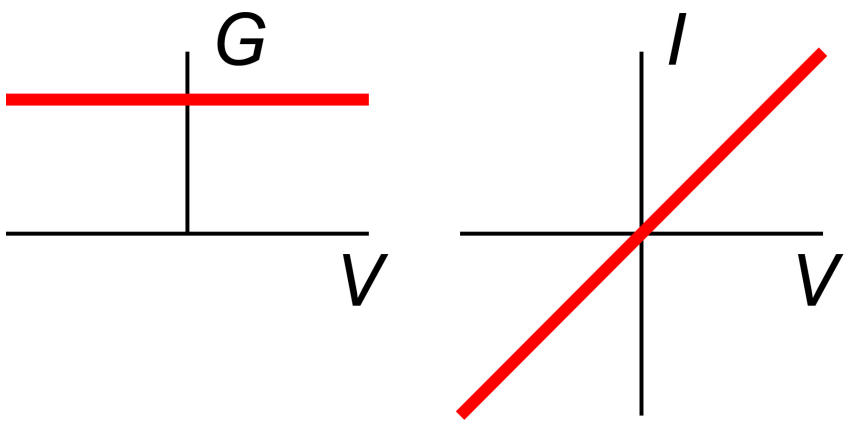
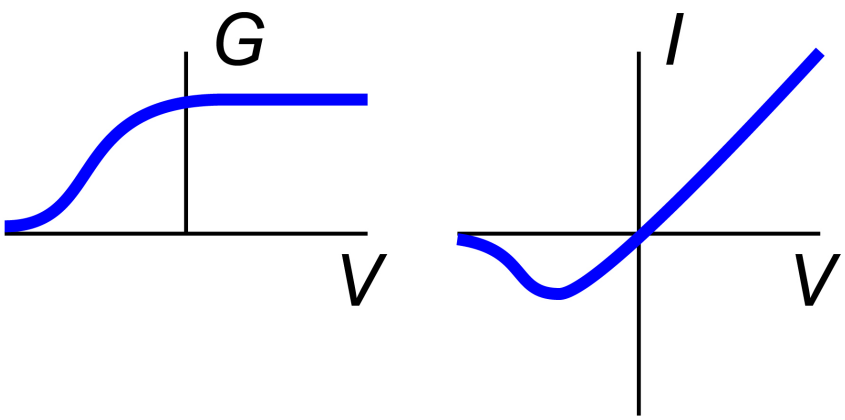
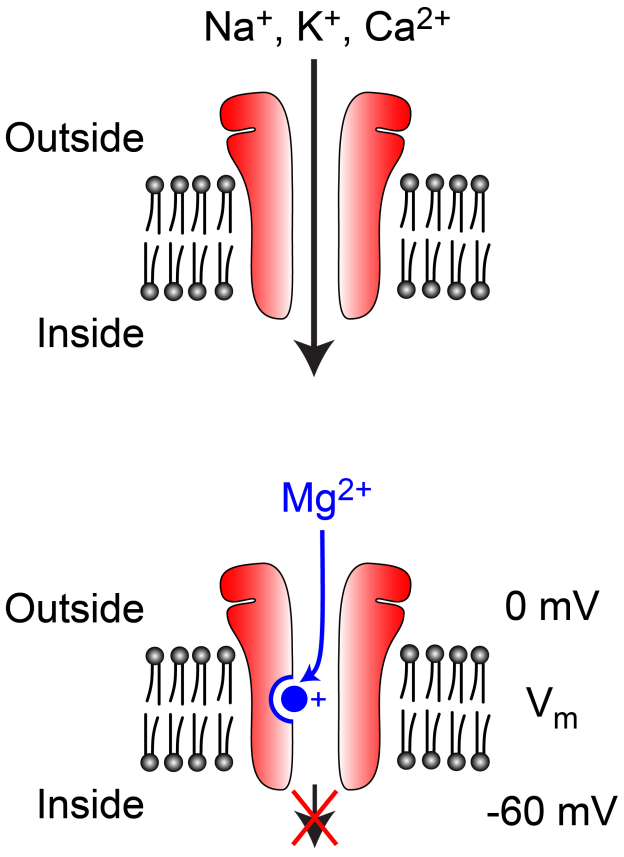
AMPA receptors



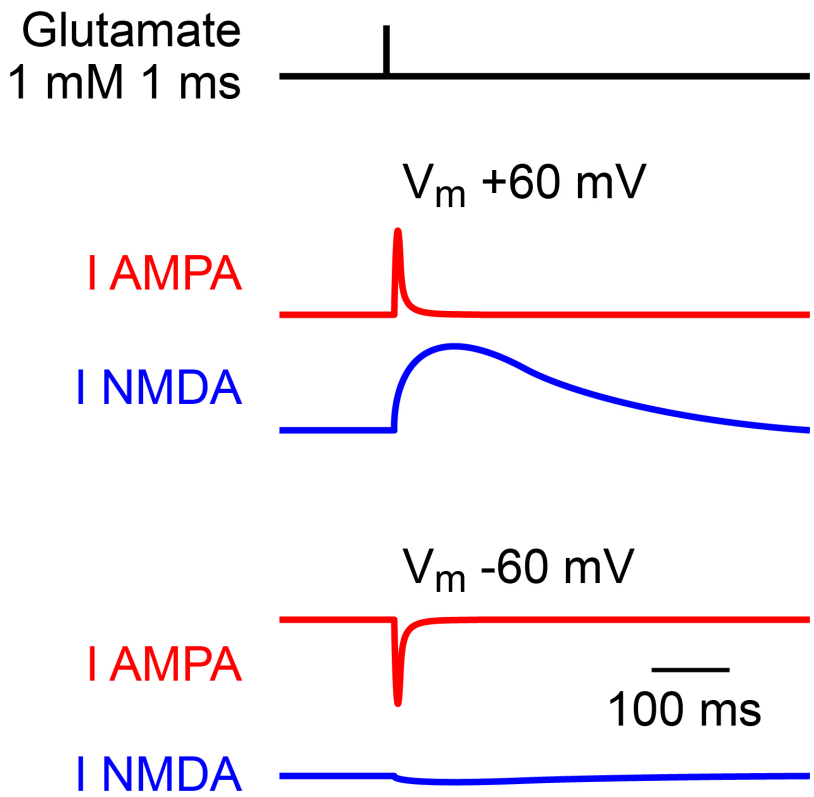
NMDA receptors



Voltage-dependent Mg^{2+} block of NMDA receptors



AMPA and NMDA receptors



AMPA receptor diversity

GluA1-4 *gria1-4* (GluR1-4; GluRA-D)

GluA2 is a subunit of most AMPA receptors.

AMPA receptors containing the GluA2 subunit have linear IV relationships and lack calcium permeability.

AMPA receptors lacking the GluA2 subunit are inwardly rectifying and are calcium permeable.

Kainate receptors

GluK1-5 *grik1-5* (GluR5-7; KA1,2)

NMDA receptor diversity

GluN1	*grin1*	(NR1)
GluN2A-D	*grin2A-D*	(NR2A-D)
GluN3A,B	*grin3A,B*	(NR3A,B)

GluN2A,B	strong Mg^{2+} block
GluN2C,D	weak Mg^{2+} block
GluN2A	fast (~100 ms)
GluN2B,C	medium (~300 ms)
GluN2D	slow (~1 s)
GluN3	

Metabotropic glutamate receptors

mGluR1-8 *grm1-8*

7 transmembrane, G-protein coupled receptors (GPCRs)

Group 1 (mGluR1,5) – couple to PLC, Ca^{2+} signalling
Group 2 (mGluR2,3) and group 3 (mGluR4,6,7,8) – inhibit AC

AMPA and NMDA receptors

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There two main types of ionotropic glutamate receptors:

AMPA receptors

fast

Na^+/K^+ permeable

NMDA receptors

slow

$Na^+/K^+/Ca^{2+}$ permeable

voltage-dependent Mg^{2+} block