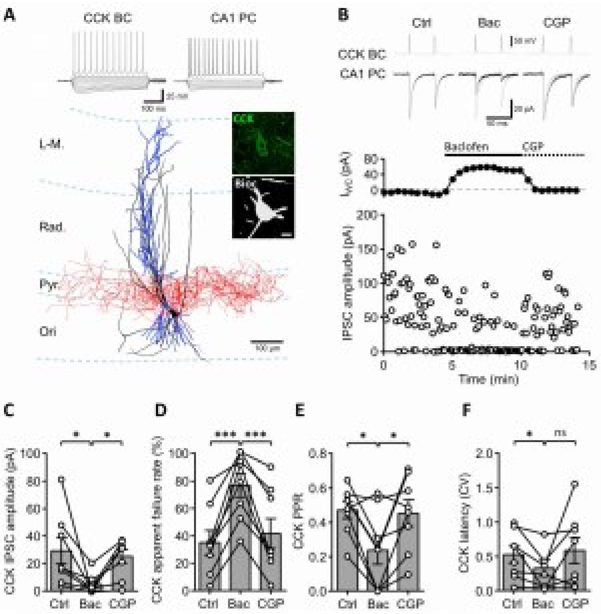
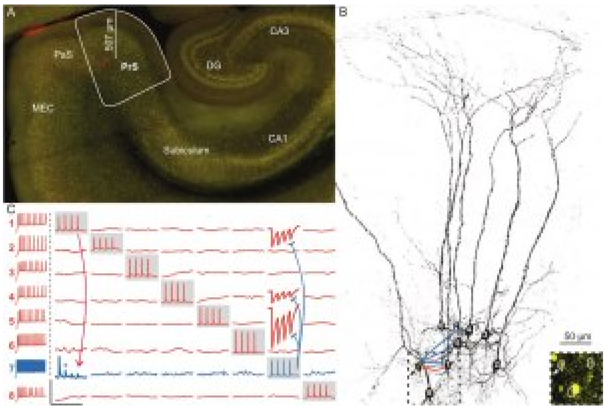


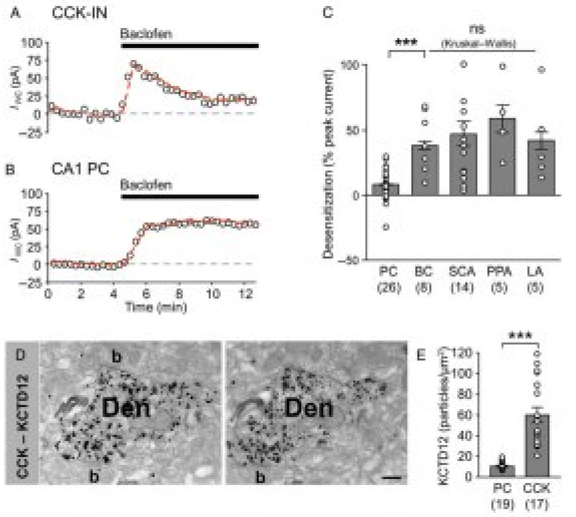
GABA-B receptors control CCK basket cell output

A, A synaptically-coupled CCK BC and CA1 PC pair. B, Unitary IPSCs in the post-synaptic CA1 PC were suppressed by baclofen (10 µM) C-F, Summary bar charts of synaptic parameters for CCK BC - CA1 PC pairs. (Booker et al., 2017, Brain Struct & Funct)



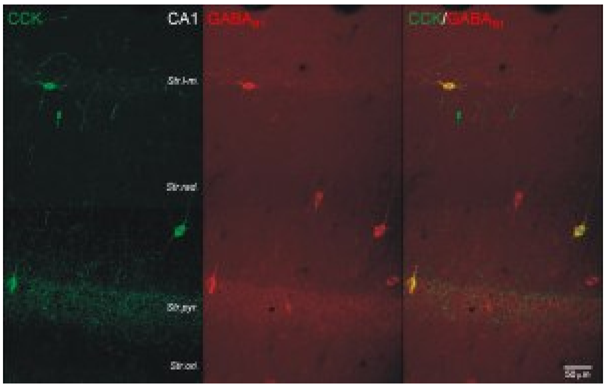
Synaptic connectivity in the presubiculum

Multiple simultaneous whole-cell recordings from pyramidal cells and inhibitorry interneurons in the presubiculum. (Peng et al. 2017 Cer. Cor.)



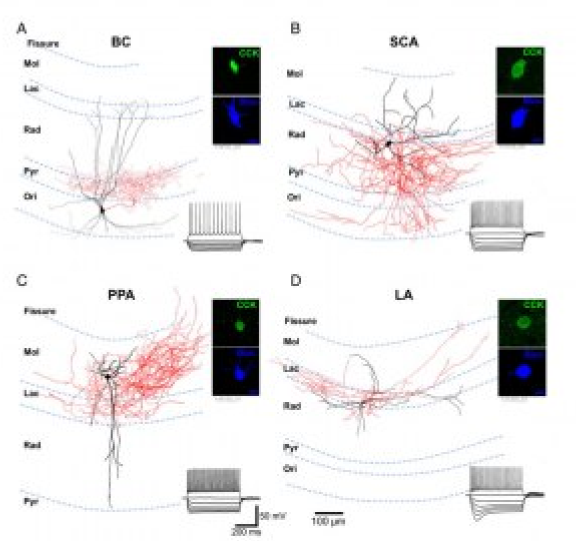
Desensitization of GABA-B currents in CCK interneurons

Strong desensitization of GABA-B receptor-mediated currents (A) correlates with high expression of KCTD12 in CCK-IN dendrites (D,E). (Booker et al., 2016, Cer. Cor.)



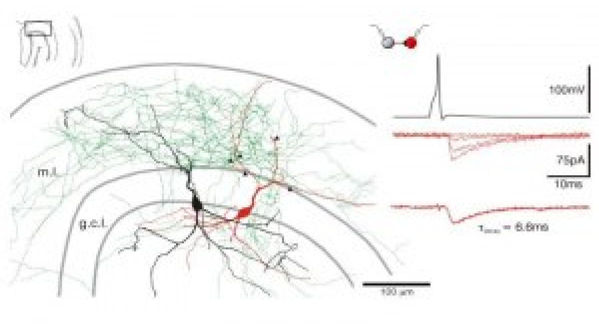
High GABA-B receptor expression in CCK interneurons

Images of the CA1 area of the rat hippocampus showing immunoreactivity for CCK (green, left) and GABAB1 (red, middle). Note the strong labeling for GABA-B1 in CCK somata. (Booker et al., 2016 CerCtx)



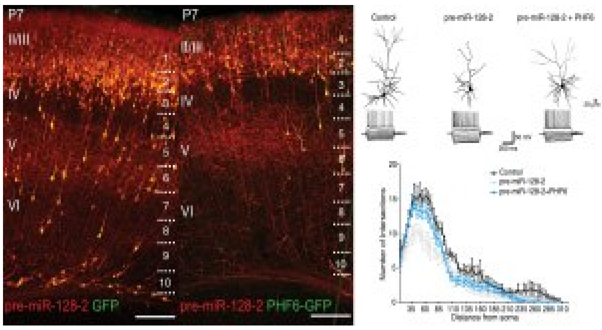
Diversity of CCK interrneurons in the hippocampus

Distinct morphological subtypes of CCK interneurons provide perisomatic and dendritic inhibition in the CA1 area of the hippocampus. Reconstructions of a basket cell (A), an SCA cell (B), a PPA cell and a novel Lacunosum-Associated interneuron (LA, C). (Booker et al., 2016 CerCtx)



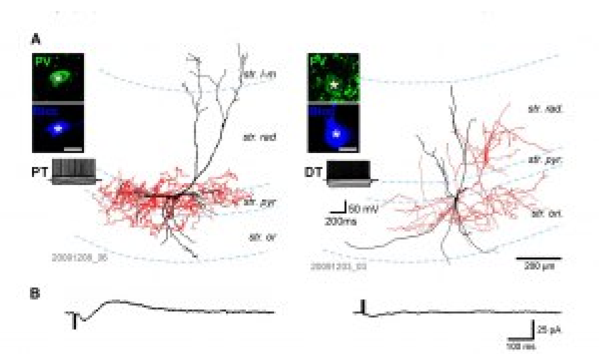
Dendritic inhibitory interneurons in the dentate gyrus

Reconstruction of a synaptically-connected interneuron pair. Right: Action potentials in the DI cell (top, black) elicited slow and small IPSCs in the other cell (bottom, red). (Savanthrapadian et al., 2014 J Neurosci)



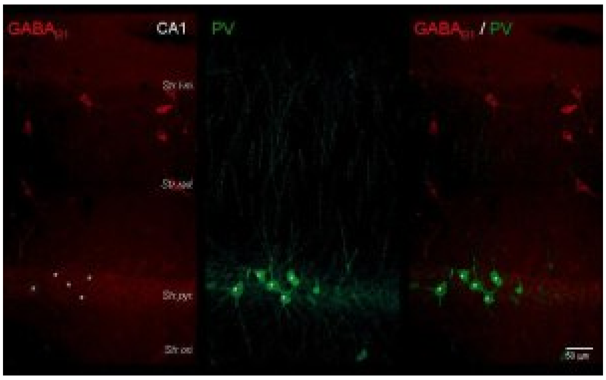
miR-128 regulates migration and properties of cortical neurons

Overexpression of miR-128-2 results in migration defect in the cortex (left). PHF6 rescues these defects (middle). miR-128 and PHF6 regulate dendritic complexity in a complementary manner (right). (Franzoni et al., 2015. eLife)



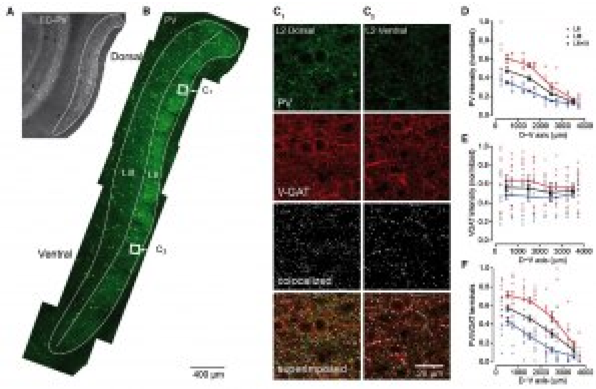
Slow GABA-B receptor-mediated inhibition in PV interneurons

Differential expression of GABA-B receptor-mediated synaptic inhibition in PV basket cells (left) and dendrite-targeting bistratified cells (right). (Booker et al., 2013 J Neurosci)



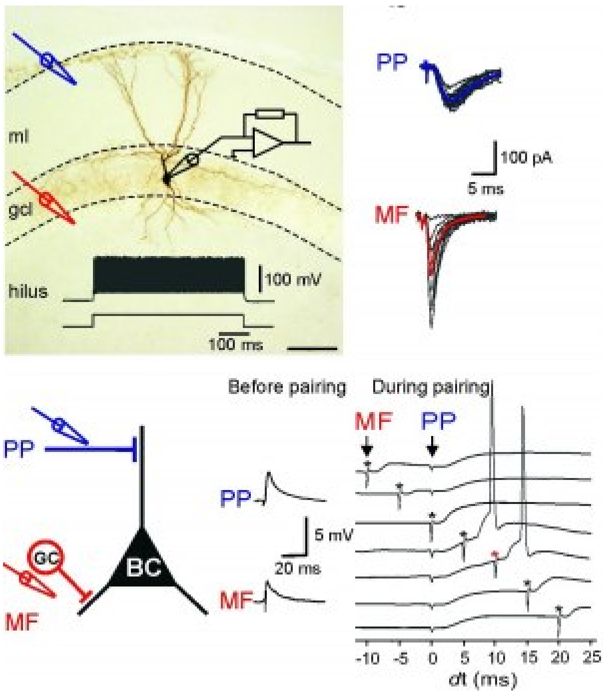
Low GABA-B receptor expression in PV interneuron somata

Double immunostaining for parvalbumin (green) and GABA-B1 receptor subunit (red) in the CA1 area. (Booker et al., 2013 J Neurosci)



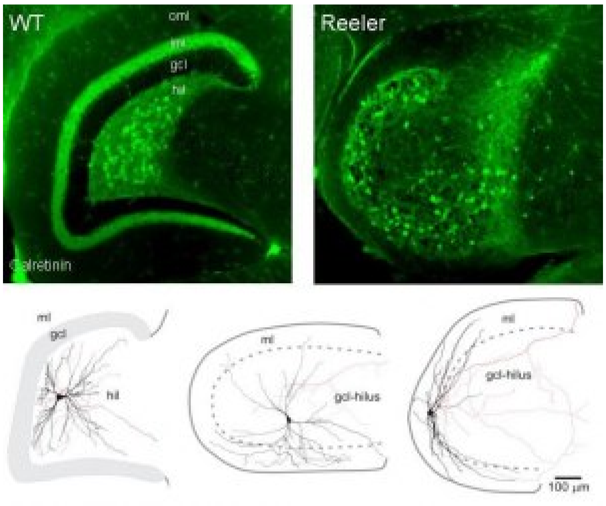
Inhibitory gradient in the medial entorhinal cortex

Gradient of PV immunoreactive axon terminals along the dorso-ventral axis of the medial entorhinal cortex. (Beed et al. 2013 Neuron)



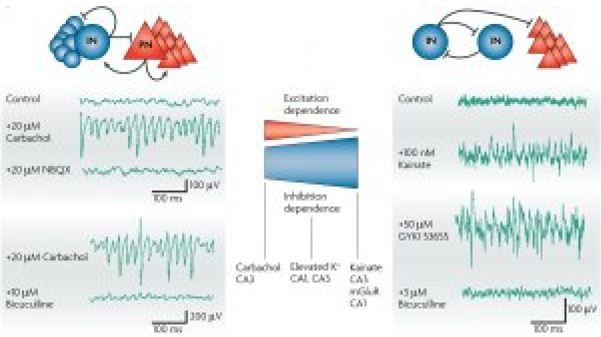
Synaptic plasticity in dentate basket cells

Convergent excitatory inputs onto dentate basket cells result in efficient recruitment and induction of associative plasticity. (Sambandan et al., 2010 J Neurosci)



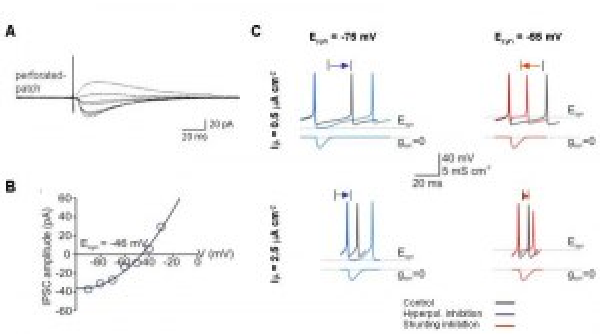
Disrupted hippocampal layering in the 'reeler' mouse

Disrupted layering of the dentate gyrus [top] is associated with altered morphology [bottom] and synaptic activation of hilar mossy cells in 'reeler' mice. (Kowalski et al., 2010 CerCtx)



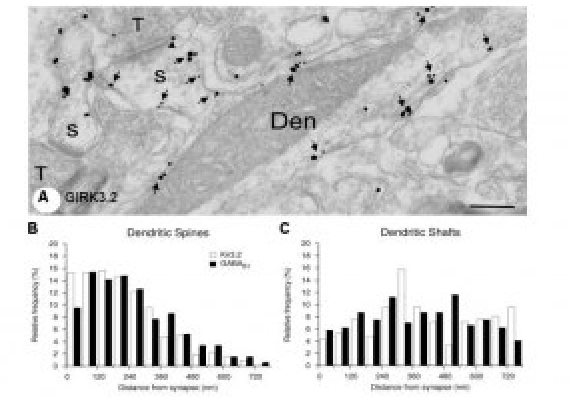
Microcircuit mechanisms of gamma oscillations

Feedback inhibition [left] and mutual inhibition among basket cells [right] support the generation of gamma oscillations in cortical networks. (Bartos et al., 2007 Nat Rev Neurosci)



Shunting inhibition in basket cells

A,B: The reversal potential of IPSCs is near the resting membrane potential in basket cells. C: Shunting inhibition (in red) results in differential frequency modulation during strong and weak excitation. (Vida et al., 2006 Neuron)

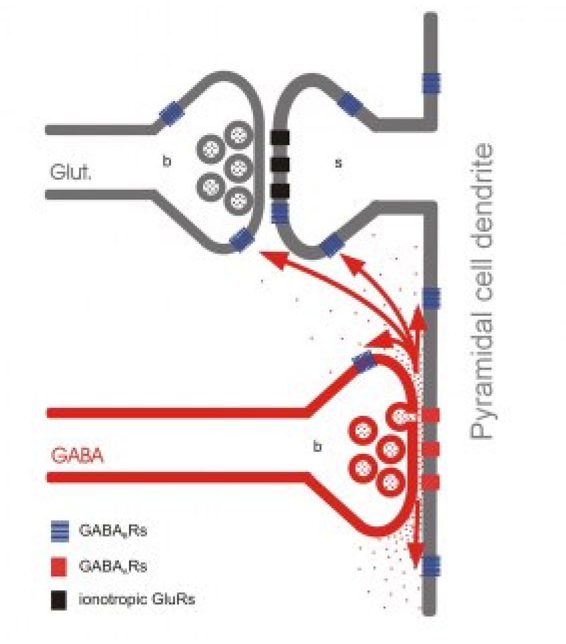


Co-clustering of GABA-B receptors and Kir3 channels

Top: Immunogold staining for Kir3 potassium channels on CA1 pyramidal cell dendrites. Bottom: Co-distribution of GABA-B receptors and Kir3 potassium channels on the extrasynaptic membrane. (Kulik et al., 2006 J Neurosci)

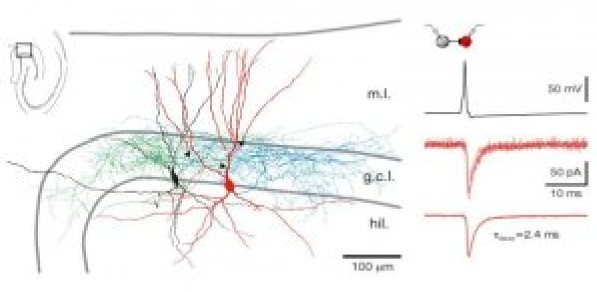
GABA-B receptor expression in the hippocampus

Immunostaning for the GABA-B1 receptor subunit in the hippocampus. Note the strong labeling of scattered interneurons. (see Kulik et al., 2003)



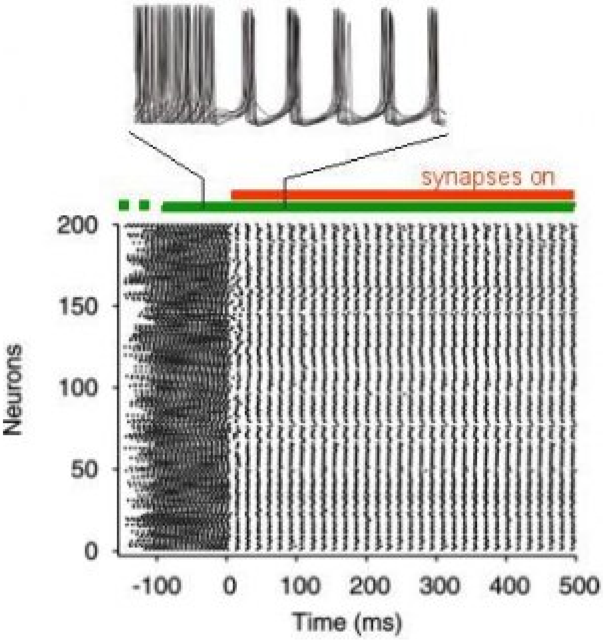
Extrasynaptic localization of GABA-B receptors

Metabotropic GABAB receptors (stripped boxes), localized to the extrasynaptic plasma mem- brane of GABAergic and glutamatergic terminals (b), spines (s), and dendritic shafts (D), are activated by spilled-over GABA (dots), whereas the synaptic ionotropic GABAA receptors (gray boxes) are directly exposed to the neurotransmitter. (Kulik et al., 2003 JNeurosci)



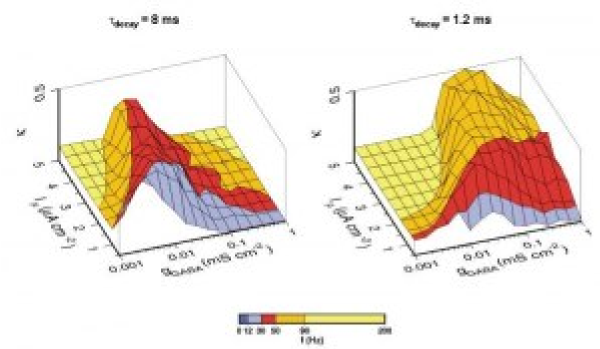
Fast and strong mutual inhibition between basket cells

Reconstruction of the synaptically connected BC-BC pair. Right: Action potentials in one BC (black trace) elicited fast and large IPSCs in the other BC (red traces). (Bartos et al. 2001 J. Neurosci.)



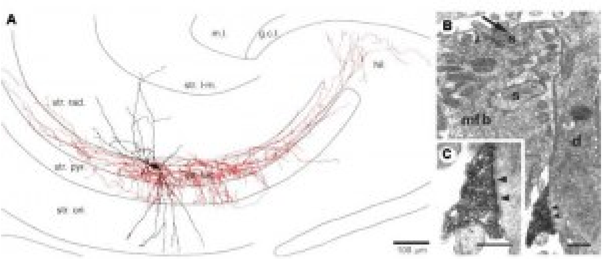
Rapid synchronization in a basket cell network model

Raster plot illustrates the rapid synchronization at gamma frequencies in a BC network model with fast and strong mutual inhibitory synapses (Bartos et al., 2002 PNAS).



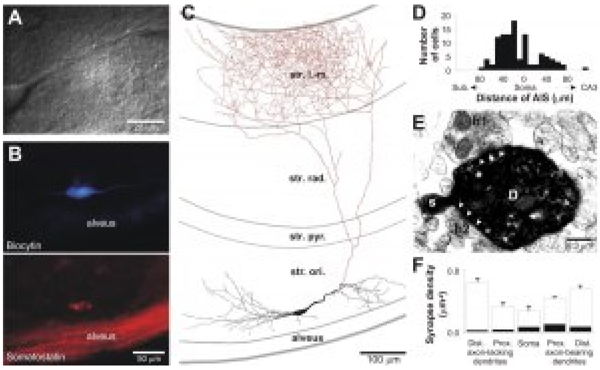
Properties of oscillations in a basket cell network model

The 3D plots show the frequency (color code) and coherence (k) of oscillations in a basket cell network with slow and fast mutual inhibitory synapses. (Bartos et al., 2002 PNAS)



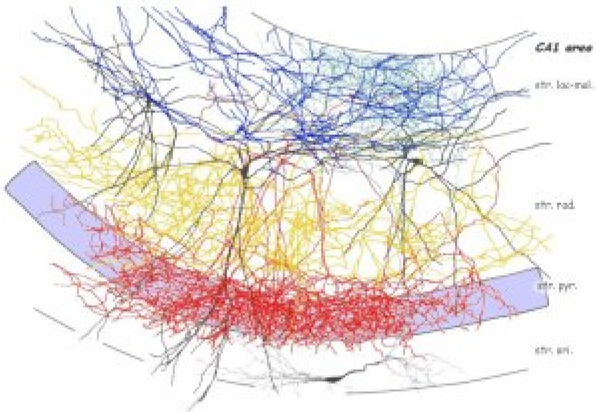
Mossy fiber-associated interneuron in the hippocampus

Reconstruction of the interneuron with its axon in the startum lucidum of the hippocampal CA3, co-aligned with the mossy fibers. Right: Electron micrograph of a synapse onto a CA3 pyramidal cell dendrite. (Vida and Frotscher, 2000 PNAS)



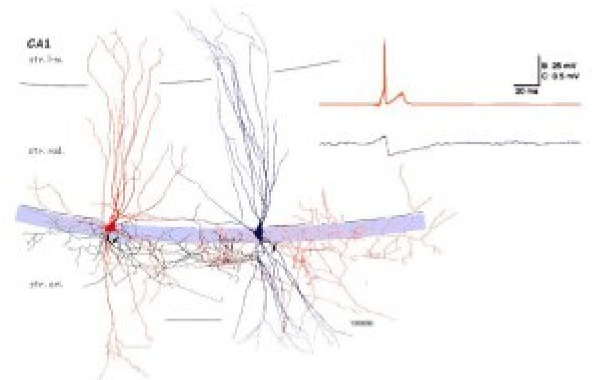
Active properties of CA1 O-LM interneuron dendrites

Immunocytochemical [left] and morphological identification [middle] of an O-LM interneuron. (Martina et al., 2000, Science)



Layered organization of inhibitory axons in the hippocampus

Axons of the diverse interneuron types show layer-specific distribution and provide compartmental innervation to pyramidal cells in the hippocampal CA1 area. (Vida et al., 1998 J Phyiol)



Inhibitory synaptic coupling between basket cells

Reconstruction of the synaptically-connected BC-BC pair in the CA1 area. Inset: Action potentials in one BC elicited short latency fast IPSCs in the other BC. (Cobb et al. 1997 Neurosci)

Selected publications (2006 - 2018)

(Full list of publications is available at ORCID, ResearchID, Google Scholar or ResearchGate.)

1. Booker SA, Loreth D, Gee AL, Watanabe M, Kind PC, Wyllie DJA, Kulik A, Vida I (2018) Postsynaptic GABABRs inhibit L-type calcium channels and abolish long-term potentiation in hippocampal somatostatin interneurons. Cell Reports 22: 36-43. doi: 10.1016/j.celrep.2017.12.021.
2. Turko P, Groberman K, Browa F, Cobb S, Vida I (2018) Differential Dependence of GABAergic and Glutamatergic Neurons on Glia for the Establishment of Synaptic Transmission. Cereb Cortex. doi: 10.1093/cercor/bhy029. [Epub: 2018 Feb 7]
3. Booker SA, Vida I (2018) Morphological diversity and connectivity of hippocampal interneurons. Cell Tissue Res 373: 619-641. doi: 10.1007/s00441-018-2882-2. [Epub ahead of print 2018 Aug 6]
4. Rehfeld F, Maticzka D, Grosser S, Knauff P, Eravci M, Vida I, Backofen R, Wulczyn FG (2018) The RNA-binding protein ARPP21 controls dendritic branching by functionally opposing the miRNA it hosts. Nat Commun 9: 1235. doi: 10.1038/s41467-018-03681-3.
5. Kulik Á, Booker SA, Vida I (2017) Differential distribution and function of GABA(B)Rs in somato-dendritic and axonal compartments of principal cells and interneurons in cortical circuits. Neuropharmacology 136: 80-91. doi: 10.1016/j.neuropharm.2017.10.018. [Epub: 2017 Oct 14]
6. Booker SA, Althof D, CE Degro, Watanabe M, Kulik A, Vida I (2017) Differential surface density and modulatory effects of presynaptic GABAB receptors in hippocampal cholecystokinin and parvalbumin basket cells. Brain Struct Funct. doi: 10.1007/s00429-017-1427-x. [Epub: 2017 May 2]
7. Peng Y, Barreda Tomás FJ, Klisch C, Vida I, Geiger JRP (2017) Layer-Specific Organization of Local Excitatory and Inhibitory Synaptic Connectivity in the Rat Presubiculum. Cereb Cortex. 27: 2435-2452. doi: 10.1093/cercor/bhx049.
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9. Booker SA, Althof D, Gross A, Loreth D, Müller J, Unger A, Fakler B, Varro A, Watanabe M, Gassmann M, Bettler B, Shigemoto R, Vida I, Kulik Á. (2017) KCTD12 Auxiliary Proteins Modulate Kinetics of GABAB Receptor-Mediated Inhibition in Cholecystokinin-Containing Interneurons. Cereb Cortex 27: 2318-2334. doi: 10.1093/cercor/bhw090.[Epub: 2016]
10. Booker SA, Pires N, Cobb S, Soares-da-Silva P, Vida I. (2015) Carbamazepine and oxcarbazepine, but not eslicarbazepine, enhance excitatory synaptic transmission onto hippocampal CA1 pyramidal cells through an antagonist action at adenosine A1 receptors. Neuropharmacology 93C: 103-115.
11. Degro CE, Kulik A, Booker SA, Vida I. (2015) Compartmental distribution of GABAB receptor-mediated currents along the somatodendritic axis of hippocampal principal cells. Front Synaptic Neurosci 7: 6. doi: 10.3389/fnsyn.2015.00006.
12. Singec I, Knoth R, Vida I, Frotscher M.(2015) The rostral migratory stream generates hippocampal CA1 pyramidal-like neurons in a novel organotypic slice co-culture model. Biology Open 09/2015; 4(10). DOI:10.1242/bio.012096.
13. Franzoni E, Booker SA, Parthasarathy S, Rehfeld F, Grosser S, Srivatsa S, Fuchs HR, Tarabykin V, Vida I, Wulczyn FG. (2015) miR-128 regulates neuronal migration, outgrowth and intrinsic excitability via the intellectual disability gene Phf6. Elife. 2015 Jan 3;4. doi: 10.7554/eLife.04263.
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15. Savanthrapadian S, Meyer T, Elgueta C, Booker SA, Vida I, Bartos M. (2014) Synaptic properties of SOM- and CCK-expressing cells in dentate gyrus interneuron networks. J Neurosci 34:8197-8209.
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17. Beed P, Gundlfinger A, Schneiderbauer S, Song J, Böhm C, Burgalossi A, Brecht M, Vida I, Schmitz D (2013) Inhibitory gradient along the dorsoventral axis in the medial entorhinal cortex. Neuron 79: 1197-1207.
18. Dugladze T, Maziashvili N, Börgers C, Gurgenidze S, Häussler U, Winkelmann A, Haas CA, Meier JC, Vida I, Kopell NJ, Gloveli T (2013) GABA(B) autoreceptor-mediated cell type-specific reduction of inhibition in epileptic mice. Proc Natl Acad Sci U S A 110: 15073-15078.
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23. Nörenberg A, Hu H, Vida I, Bartos M, Jonas P (2010) Distinct nonuniform cable properties optimize rapid and efficient activation of fast-spiking GABAergic interneurons. Proc Natl Acad Sci USA 107: 894-899.
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26. Bartos M, Vida I, Jonas P (2007) Synaptic mechanisms of synchronized gamma oscillations in inhibitory interneuron networks Nat Rev Neurosci 8: 45-56.
27. Vida I, Bartos M, Jonas P (2006) Shunting inhibition improves robustness of gamma oscillations in hippocampal interneuron networks by homogenizing firing rates. Neuron 49: 107-117.
28. Kulik Á, Vida I, Fukazawa Y, Guetg N, Kasugai Y, Marker CL, Rigato F, Bettler B, Wickman K, Frotscher M, Shigemoto R (2006) Compartment-dependent co-localization of Kir3.2-containing K+ channels and GABAB receptors in hippocampal pyramidal cells. J Neurosci 26: 4289-4297.

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1. Matthiae A, Bartos M, Vida I (2014) Role of Non-uniform Dendrite Properties on Input Processing by GABAergic Interneurons, in ‘Springer Series in Computational Neuroscience, Volume 11: The Computing Dendrite’, eds. Cuntz H., Remme M.W.H., Torben-Nielsen B, Springer, New York.
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Book

Hippocampal Microcircuits: A Computational Modeler's Resource Book.
Springer Series in Computational Neuroscience
Editors: Cutsuridis, V., Graham, B.P., Cobb, S., Vida, I.
Publisher: Springer-Verlag New York, 2010.