

Curriculum Vitae

CONTACT DETAILS

Name Ole Paulsen
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EDUCATION

1996 Ph.D. in Neurophysiology (Oslo)
1995 M.A. (Oxon)
1987 B.M./M.D. (Oslo)

CURRENT ACADEMIC POSITION

01/2010 – Present Professor of Physiology (1883), University of Cambridge,
Department of Physiology, Development and Neuroscience.

PREVIOUS ACADEMIC POSITIONS

04/2000 – 12/2009 University Lecturer in Neurosciences, Dept of Physiology, Anatomy and Genetics (DPAG; University Laboratory of Physiology until 2006), and Tutorial Fellow at Keble College, Oxford.
09/1994 – 03/2000 Departmental Lecturer, University Department of Pharmacology, Oxford.
04/1994 – 09/2000 Research Assistant, Institute of Neurophysiology, University of Oslo.
01/1990 – 03/1994 Ph.D. student, Institute of Neurophysiology, University of Oslo, in the group of Professor Per Andersen.

HONOURS AND AWARDS

04/2006 – Present Honorary Distinguished Professorship, VU University, Amsterdam, The Netherlands.
01/2003 – Present Visiting Professorship, Norwegian University of Science and Technology, Trondheim, Norway.
10/1995 – 03/2000 The Christopher Welch Junior Research Fellow in Biological Sciences at Wadham College, Oxford.

MAIN SCIENTIFIC ACHIEVEMENTS

1994 First determination of the quantal size at a central excitatory synapse based on combined measurement of spontaneous and evoked events (with Heggelund [P5]).
1995 First demonstration that individual GABAergic interneurons can synchronize neuronal oscillations in hippocampus (with Cobb, Buhl, Halasy, Somogyi [P6]).
1998 First demonstration of cholinergically induced 40 Hz oscillations in hippocampus (with Fisahn, Pike, Buhl [P11]).
1999 Recognition of postsynaptic bursts as fundamental signal in synaptic plasticity (with Pike, Meredith et al. [P12, P16]).
2004 Dissociation of experience-dependent and -independent components of development of AMPA and NMDA receptor-mediated synaptic currents (with Mierau et al. [P20]).
2005 Identification of perisomatic-targeting interneurons as the source of gamma-frequency network oscillations in the hippocampus (with Mann, Oren, Hajos et al. [P21, P22, P25]).
2005 Phase response curves as optimal memory retrieval functions in hippocampal neurons (with Lengyel, Kwag, Dayan [P24]).
2008 First demonstration that synaptic long-term depression requires presynaptic NMDA receptors (with Rodriguez-Moreno [P26]).
2009 First cellular analysis of rate-to-phase transform in individual neurons (with McLelland [P29]).
2009 First dissociation of GABA_A and GABA_B receptor-mediated inhibition in controlling cortical Up-Down states (with Mann, Kohl [P32]).
2009 Novel synaptic learning mechanism in by which timing information in afferent input is stored in the synaptic weight matrix of the local hippocampal network (with Kwag [P35]).

PUBLICATION LIST

Full peer-reviewed research papers [P]:

P1. Hansen TWR, **Paulsen O**, Gjerstad L and Bratlid D (1988) Short-term exposure to bilirubin reduces synaptic activation in rat transverse hippocampal slices. *Pediatr Res* **23**: 453-456.

P2. Øye I, **Paulsen O** and Maurset A (1992) Effects of ketamine on sensory perception: Evidence for a role of N-methyl-D-aspartate receptors. *J Pharmacol Exp Ther* **260**: 1209-1213.

P3. **Paulsen O**, Li Y-G, Hvalby Ø, Andersen P and Bliss TVP (1993) Failure to induce long-term depression by an anti-correlation procedure in area CA1 of the rat hippocampal slice. *Eur J Neurosci* **5**: 1241-1246.

P4. Hvalby Ø, Hemmings HC Jr, **Paulsen O**, Czernik AJ, Nairn AC, Godfraind J-M, Jensen V, Raastad M, Storm JF, Andersen P and Greengard P (1994) Specificity of protein kinase inhibitor peptides and the induction of long-term potentiation. *Proc Natl Acad Sci USA* **91**: 4761-4765.

* P5. **Paulsen O** and Heggelund P (1994) The quantal size at retinogeniculate synapses determined from spontaneous and evoked EPSCs in guinea-pig thalamic slices. *J Physiol* **480**: 505-511.

* P6. Cobb SR, Buhl EH, Halasy K, **Paulsen O** and Somogyi P (1995) Synchronization of neuronal activity in hippocampus by individual GABAergic interneurons. *Nature* **378**: 75-78.

P7. **Paulsen O** and Heggelund P (1996) Quantal properties of spontaneous EPSCs in neurones of the guinea-pig dorsal lateral geniculate nucleus. *J Physiol* **496**: 759-772.

P8. Buhl EH, Tamás G, Szilágyi T, Stricker C, **Paulsen O** and Somogyi P (1997) Effect, number and location of synapses made by single pyramidal cells onto aspiny interneurons of cat visual cortex. *J Physiol* **500**: 689-713.

P9. Sprengel R, Suchanek B, Amico C, Brusa R, Burnashev N, Rozov A, Hvalby Ø, Jensen V, **Paulsen O**, Andersen P, Kim JJ, Thompson RF, Sun W, Webster LC, Grant SGN, Eilers J, Konnerth A, Li J, McNamara JO and Seeburg PH (1998) Importance of the intracellular domain of NR2 subunits for NMDA receptor function in vivo. *Cell* **92**: 279-289.

P10. Bon CLM, **Paulsen O** and Greenfield SA (1998) Association between the low threshold calcium spike and activation of NMDA receptors in guinea-pig substantia nigra pars compacta neurones. *Eur J Neurosci* **10**: 2009-2015.

* P11. Fisahn A, Pike FG, Buhl E and **Paulsen O** (1998) Cholinergic induction of network oscillations at 40 Hz in the hippocampus *in vitro*. *Nature* **394**: 186-189.

* P12. Pike FG, Meredith RM, Olding AWA and **Paulsen O** (1999) Postsynaptic bursting is essential for 'Hebbian' induction of associative long-term potentiation at excitatory synapses in rat hippocampus. *J Physiol* **518**: 571-576.

P13. Pike FG, Goddard RS, Suckling JM, Ganter P, Kasthuri N and **Paulsen O** (2000) Distinct frequency preferences of different types of rat hippocampal neurones in response to oscillatory input currents. *J Physiol* **529**: 205-213.

P14. Lopez-Bendito G, Shigemoto R, Kulik A, **Paulsen O**, Fairen A and Lujan R (2002) Expression and distribution of metabotropic GABA receptor subtypes GABA_BR1 and GABA_BR2 during rat neocortical development. *Eur J Neurosci* **15**: 1766-1778.

P15. Lopez-Bendito G, Lujan R, Shigemoto R, Ganter P, **Paulsen O** and Molnar Z (2003) Blockade of GABAB receptors alters the tangential migration of cortical neurons. *Cereb Cortex* **13**: 932-942.

- * P16. Meredith RM, Floyer-Lea AM and **Paulsen O** (2003) Maturation of long-term potentiation induction rules in rodent hippocampus: Role of GABAergic inhibition. *J Neurosci* **23**: 11142-11146.
- P17. Ganter P, Szűcs P, **Paulsen O** and Somogyi P (2004) Properties of horizontal axo-axonic cells in stratum oriens of the hippocampal CA1 area of rats *in vitro*. *Hippocampus* **14**: 232-243.
- P18. Palhalmi J, **Paulsen O**, Freund TF and Hajos N (2004) Distinct properties of carbachol- and DHPG-induced network oscillations in hippocampal slices. *Neuropharmacology* **47**: 381-389.
- P19. López-Bendito G, Sturgess K, Erdélyi F, Szabó G, Molnár Z and **Paulsen O** (2004) Preferential origin and layer destination of GAD65-GFP cortical interneurons. *Cereb Cortex* **14**: 1122-1133.
- * P20. Mierau SB, Meredith RM, Upton AL and **Paulsen O** (2004) Dissociation of experience-dependent and -independent changes in excitatory synaptic transmission during development of barrel cortex. *Proc Natl Acad Sci USA* **101**: 15518-15523.
- * P21. Hajos N, Palhalmi J, Mann EO, Nemeth B, **Paulsen O** and Freund TF (2004) Spike timing of distinct types of GABAergic interneuron during hippocampal gamma oscillations *in vitro*. *J Neurosci* **24**: 9127-9137.
- * P22. Mann EO, Suckling JM, Hajos N, Greenfield S and **Paulsen O** (2005) Perisomatic feedback inhibition underlies cholinergically-induced fast network oscillations in the rat hippocampus *in vitro*. *Neuron* **45**: 105-117.
- P23. Mann EO, Radcliffe CA and **Paulsen O** (2005) Hippocampal gamma-frequency oscillations: from interneurons to pyramidal cells, and back. *J Physiol* **562**: 57-65.
- * P24. Lengyel M, Kwag J, **Paulsen O** and Dayan P (2005) Matching storage and recall: STDP and phase response curves in the hippocampus. *Nat Neurosci* **8**: 1677-1683.
- * P25. Oren I, Mann EO, **Paulsen O** and Hajos N (2006) Synaptic currents in anatomically-identified CA3 neurons during hippocampal gamma oscillations *in vitro*. *J Neurosci* **26**: 9923-9934.
- * P26. Rodriguez-Moreno A and **Paulsen O** (2008) Spike timing-dependent long-term depression requires presynaptic NMDA receptors. *Nat Neurosci* **11**: 744-745.
- P27. Hoerder-Suabedissen A, **Paulsen O** and Molnar Z (2008) Thalamocortical maturation in mice is influenced by body weight. *J Comp Neurol* **511**: 415-420.
- P28. Hajos N, Ellender TJ, Zemankovics R, Mann EO, Exley R, Cragg SJ, Freund TF and **Paulsen O** (2009) Maintaining network activity in submerged hippocampal slices: importance of oxygen supply. *Eur J Neurosci* **29**: 319-327.
- * P29. McLelland D and **Paulsen O** (2009) Neuronal oscillations and the rate-to-phase transform: mechanism, model and mutual information. *J Physiol* **587**: 769-785.
- P30. Romberg C, Raffel, J, Martin L, Sprengel R, Seeburg PH, Rawlins JNP, Bannerman DM and **Paulsen O** (2009) Induction and expression of GluA1 (GluR-A)-independent LTP in the hippocampus. *Eur J Neurosci* **29**: 1141-1152.
- P31. Reeve JE, Collins HA, De Mey K, Kohl MM, Thorley KJ, **Paulsen O**, Clays K, Anderson HL (2009) Amphiphilic porphyrins for second harmonic generation imaging. *J Amer Chem Soc* **131**: 2758-2759. [Featured in Nature N&V: Therien (2009) *Nature* **458**, 716-717.]
- * P32. Mann EO, Kohl MM and **Paulsen O** (2009) Distinct roles of GABA_A and GABA_B receptors in balancing and terminating persistent cortical activity. *J Neurosci* **29**: 7513-7518.

- P33. Hoerder-Suabedissen A, Wang WZ, Lee S, Davies KE, Goffinet AM, Rakic S, Parnavelas J, Reim K, **Paulsen O** and Molnar Z (2009) Novel markers reveal subpopulations of subplate neurons in the murine cerebral cortex. *Cereb Cortex* **19**: 1738-1750. (doi:10.1093/cercor/bhn195).
- P34. Kwag J and **Paulsen O** (2009) Bidirectional control of spike timing by GABA_A receptor-mediated inhibition during theta oscillation in CA1 pyramidal neurons. *NeuroReport* **20**: 1209-1213. (doi:10.1097/wnr.0b013e32832f5cc7).
- * P35. Kwag J and **Paulsen O** (2009) The timing of external input controls the sign of plasticity at local synapses. *Nat Neurosci* **12**: 1219-1221. (doi:10.1038/nn.2388)
- P36. van Aerde KI, Mann EO, Canto CB, Heistek TS, Linkenkaer-Hansen K, van der Roest M, Mulder AB, **Paulsen O**, Brussaard AB and Mansvelder HD (2009) Flexible spike timing of layer 5 neurons during dynamic beta-oscillation shifts in rat prefrontal cortex. *J Physiol* **587**: 5177-5196. (doi:10.1113/jphysiol.2009.178384).
- P37. Banerjee A, Meredith RM, Rodriguez-Moreno A, Mierau SB, Auberson YP and **Paulsen O** (2009) Double dissociation of spike timing-dependent potentiation and depression by subunit-preferring NMDA receptor antagonists. *Cereb Cortex* **19**: 2959-2969. (doi:10.1093/cercor/bhp067).
- P38. Vargas-Caballero M, Martin LJ, Salter MW, Orser BA and **Paulsen O** (2010) $\alpha 5$ subunit-containing GABA_A receptors mediate a slowly decaying inhibitory synaptic current in CA1 pyramidal neurons following Schaffer collateral activation. *Neuropharmacology* **58**: 668-675. (doi:10.1016/j.neuropharm.2009.11.005).
- P39. Oren I, Hajos N and **Paulsen O** (2010) Identification of the current generator underlying cholinergically-induced gamma frequency field potential oscillations in the hippocampal CA3 region. *J Physiol* **588**: 785-797. (doi:10.1113/jphysiol.2009.180851).
- P40. Ellender TJ, Nissen W, Colgin LL, Mann EO and **Paulsen O** (2010) Priming of hippocampal population bursts by individual perisomatic-targeting interneurons. *J Neurosci* **30**: 5979–5991. (doi:10.1523/jneurosci.3962-09.2010).
- P41. Zemankovics R, Káli S, **Paulsen O**, Freund TF and Hájos N (2010) Differences in subthreshold resonance of hippocampal pyramidal cells and interneurons: the role of h-current and passive membrane characteristics. *J Physiol* **588**: 2109-2132. (doi:10.1113/jphysiol.2009.185975).
- P42. Shipton OA, Leitz JR, Dworzak J, Acton CEJ, Tunbridge EM, Denk F, Dawson HN, Vitek MP, Wade-Martins R, **Paulsen O** and Vargas-Caballero M (2011) Tau protein is required for amyloid β -induced impairment of hippocampal long-term potentiation. *J Neurosci* **31**: 1688-1692. (doi:10.1523/jneurosci.2610-10.2011).
- P43. Lyon L, Borel M, Carrión M, Kew JNC, Corti C, Harrison PJ, Burnet PWJ, **Paulsen O** and Rodriguez-Moreno (2011) Hippocampal mossy fiber LTD in Grm2/3 double knockout mice. *Synapse* (in press).

Reviews and Previews [R]:

R1. **Paulsen O** and Moser EI (1998) A model of hippocampal memory encoding and retrieval: GABAergic control of synaptic plasticity. *Trends Neurosci* **21**: 273-278.

R2. **Paulsen O** and Sejnowski TJ (2000) Natural patterns of activity and long-term synaptic plasticity. *Curr Opin Neurobiol* **10**: 172-179.

R3. Moser EI and **Paulsen O** (2001) New excitement in cognitive space: Between place cells and spatial memory. *Curr Opin Neurobiol* **11**: 745-751.

R4. **Paulsen O** and Morris RGM (2002) Flies put the buzz back into long-term potentiation. *Nat Neurosci* **5**: 289-290.

R5. Mann EO and **Paulsen O** (2005) Mechanisms underlying gamma ('40 Hz') network oscillations in the hippocampus – a mini-review. *Prog Biophys Mol Biol* **87**: 67-76.

R6. Mann EO and **Paulsen O** (2006) Keeping inhibition timely. *Neuron* **49**: 8-9.

R7. **Paulsen O** and Sejnowski TJ (2006) From invertebrate olfaction to human cognition: emerging computational functions of synchronized oscillatory activity. *J Neurosci* **26**: 1661-1662.

R8. Sejnowski TJ and **Paulsen O** (2006) Network oscillations: emerging computational principles. *J Neurosci* **26**: 1673-1676.

R9. McLelland D and **Paulsen O** (2007) Cortical songs revisited: A lesson in statistics. *Neuron* **53**: 319-321.

R10. Mann EO and **Paulsen O** (2007) Role of GABAergic inhibition in hippocampal network oscillations. *Trends Neurosci* **30**: 343-349.

R11. Hajos N and **Paulsen O** (2009) Network mechanisms of gamma oscillations in the CA3 region of the hippocampus. *Neural Networks* **22**: 1113-1119.

R12. Oren I and **Paulsen O** (2010) Currents in space: understanding inhibitory field potentials. *J Physiol* **588**: 2015-2016.

R13. Rodriguez-Moreno A, Banerjee A and **Paulsen O** (2010) Presynaptic NMDA receptors and spike timing-dependent depression at cortical synapses. *Frontiers Synapt Neurosci* **2**: 18. (doi: 10.3389/fnsyn.2010.00018).

R14. Mann EO and **Paulsen O** (2010) Local field potential oscillations as a cortical soliloquy. *Neuron* **67**: 3-5.

R15. Ellender T and **Paulsen O** (2010) The many tunes of perisomatic targeting interneurons in the hippocampal network. *Frontiers Cell Neurosci* **4**: 26. (doi: 10.3389/fncel.2010.00026).

R16. Kwag J, McLelland D and **Paulsen O** (2011) Phase of firing as a local window for efficient neuronal computation: tonic and phasic mechanisms in the control of theta spike phase. *Frontiers Human Neurosci* **5**: 3. (doi: 10.3389/fnhum.2011.00003).

Books [B]:

B1. Andersen P, Hvalby Ø, **Paulsen O** and Hökfelt B (eds). Memory Concepts 1993 - Basic and clinical aspects. Elsevier, Amsterdam 1993.

B2. **Paulsen O**. Central excitatory synapses: Properties of importance for their efficacy. Thesis. Oslo 1995.

Book chapters [BC]:

BC1. Øye I, Hustveit O, Maurset A, Moberg ER, **Paulsen O** and Skoglund LA (1991) The chiral forms of ketamine as probes for NMDA receptor functions in humans. *In: Kameyama T et al. (eds.) NMDA receptor related agents: biochemistry, pharmacology and behavior.* NPP Books, Ann Arbor. Pp. 381-389.

BC2. **Paulsen O**, Buhl EH, Heggelund P, Somogyi P, Stricker C and Tamás G (1998) The importance of independent estimates of quantal parameters. *In: Faber DS et al. (eds.) Central synapses: quantal mechanisms and plasticity.* HFSP, Strasbourg. Pp. 47-55.

BC3. Pike F, Molden S, **Paulsen O** and Moser EI (2001) Synaptic potentiation by natural patterns of activity in the hippocampus: Implications for memory formation. *In: Hölscher C (ed.) Neuronal mechanisms of memory formation.* Cambridge University Press, New York. Pp. 125-136.

BC4. Mann EO and **Paulsen O** (2006) Exploring fast hippocampal network oscillations: combining multielectrode recordings with optical imaging and patch-clamp techniques. *In: Taketani M and Baudry M (eds.) Advances in network electrophysiology using multi-electrode arrays.* Kluwer, New York. Pp. 457-472.

BC5. Mann EO and **Paulsen O** (2008) Cellular mechanisms underlying network synchrony in the medial temporal lobe. *In: Holscher C and Munk M (eds.) Information processing by neuronal populations.* Cambridge University Press, New York. Pp. 21-48.

BC6. Kohl MM and **Paulsen O** (2010) The roles of GABA_B receptors in cortical network activity. *In: Blackburn TP and Enna SJ (eds.) GABA_B receptor pharmacology: A tribute to Norman Bowery (Volume 58).* Academic Press, New York. Pp. 205-229.