Curriculum Vitae: May-Britt Moser

Affiliation:
Kavli Institute for Systems Neuroscience and *Centre for Neural Computation*, Norwegian University of Science and Technology (NTNU), Trondheim, Norway

Contact:
Telephone: +47 73 59 82 77 /+47 450 02 514 (cell); fax +47 73 59 82 94; E-mail: maybm@ntnu.no; web: http://www.ntnu.edu/kavli/

Place and Date of Birth, Nationality: Fosnavåg, Norway, 4. Jan. 1963, Norwegian

Family: Married with Edvard Moser, 2 daughters: Isabel and Ailin (born 1991 and 1995)

Present positions:
Founding Director of Centre for Neural Computation (2013 – 2022)
Founding Co-Director of Kavli Institute for Systems Neuroscience (2007 –)
Professor of Neuroscience (2000 –)

Past positions:
Founding Co-Director of Centre for the Biology of Memory (2002 – 2012)
Head of Section for Biol. and Cognitive Psychology, NTNU (2001-2002)
Associate Professor of Biological Psychology (1996-2000)
Research Fellow, Dept. of Psychology, Univ. Oslo; Univ Edinburgh (1995-96)
Ph D student, Univ. Oslo (1991-95)

Education (all Univ. of Oslo):
Mathematics, chemistry, physics, statistics, neurobiology (1982-83, 1990)
Psychology (1984-90)
Neurobiology (1990)

Research

The neurobiology of learning, with a particular emphasis on the function of cortico-hippocampal subregions.

My main interest is in understanding how the brain computes and processes information and how this results in cognitive behavior and experience. Throughout my scientific career I have focused my research on spatial navigation and memory. This is a fundamental cognitive function that we share with all animals. Most of my research has been performed in collaboration with my husband and long-term collaborator Edvard Moser. With the combination of advanced inactivation techniques, anatomical approaches and recording methods, our efforts have resulted in several important discoveries. The most spectacular finding was probably the discovery of grid cells in the entorhinal cortex. The entorhinal cortex is a gold mine for studies of neural computation. The discovery of grid cells was succeeded by the identification of other functional cell types, including head direction cells, conjunctive cells and border cells and collectively the findings point to the entorhinal cortex as a hub for the brain network that makes us find our way. In combination with the place cells of the hippocampus, the entorhinal network is thought to provide a 'coordinate system' for on-line measurement of distance and direction within given constellations of landmarks. The findings have attracted the interest of experimentalists and modelers throughout the world and my lab has been characterized as a Mecca for single unit studies of spatial navigation and memory. This is not only because of our attempts to understand spatial representation but also because spatial representation is becoming one of the first functions to be characterized at a mechanistic level in neuronal networks.

Honours

1999: Prize for young scientists awarded by the Royal Norwegian Academy for Sciences and Letters
2003–: Elected member of The Royal Norwegian Society of Sciences and Letters
2005–: Elected member of The Norwegian Academy of Science
2005: 28th annual W. Alden Spencer Award (College of Physicians and Surgeons of Columbia University)
2006: 10th Prix "Liliane Bettencourt pour les Sciences du Vivant" (Fondation Bettencourt, Paris)
2006: 14th Betty and David Koetser Award for Brain Research (University of Zürich)
2008 : 30th Eric K. Fernström's Great Nordic Prize (Fernström Foundation, University of Lund)
2010–: Elected member of The Norwegian Academy of Technological Sciences (NTVA)
2011: 26th Louis-Jeantet Prize for Medicine (Louis-Jeantet Foundation)
2011: Anders Jahre's Great Nordic Prize for Medical Research (Univ. Oslo)
2011–: Elected member of Academia Europaea
2012–: Elected member of the European Molecular Biology Organization (EMBO)
2013: 13th Perl/UNC Neuroscience Prize (Univ. of North Carolina)
2013: 102nd annual Fridtjof Nansen Award of Outstanding Research in Science and Medicine, Norwegian Academy of Science
2013: 'Best female leader' award from Trondheim Business Society (Madame Beyer Award)
2013: 47th Louisa Gross Horwitz Prize for Biology or Biochemistry (Columbia University)
2014: 59th Karl Spencer Lashley Award (American Philosophical Society)

Memberships

Society for Neuroscience (1992 -), Royal Norwegian Society of Sciences and Letters (2003 -), Norwegian Academy of Science (2006 -), European Dana Alliance for Brain Research (2010 -), Norwegian Academy of Technological Sciences (2010 -).

International evaluations

2001-02: Centre of Excellence appointment by Norw. Res. Council. Thirteen centers from all fields of science were selected from 129 proposals through an extensive international review process.
2003: Evaluation by Norwegian Research Council Panel for Psychology /Psychiatry. Rated 'Excellent'.
2006: Centre for the Biology of Memory is rated "exceptionally good" at midterm evaluation by an international group of experts.
2007: Appointed Co-Director of Kavli Institute for Systems Neuroscience (4th Kavli institute in the field of Neuroscience in the world).
2011: National Research Council evaluation of biological disciplines: Rated 'Undoubtedly excellent'.
2012: Centre of Excellence appointment by Norw. Res. Council. I am Director; Edvard Moser is Co-Director. Thirteen centers from all fields of science were selected.

Selected invited lectures

1998: Cortical Plasticity Conference, Berlin.
2000: Spring Hippocampal Research Conference, Grand Cayman, British West Indies.
2001: Arctic Symposium on Memory and Memory Disorders, Saariselkä, Finland
2001: EU Advanced Course in Computational Neuroscience, Trieste, Italy
2002: Hippocampal memory networks: Between molecules and behaviour. FENS 2002, Paris.
2004: Second EURESCO conference on the Representation of the Memory Trace, May 14-19, Obernai, France.
2004: MIT, Picower Center for Learning and Memory, Boston (with Susumu Tonegawa).
2005: Rutgers University, Newark (with Gyuri Buzsaki).
2005: Learning & Memory meeting, Cold Spring Harbor, New York, USA, April 20-24.
2005: 28th annual W. Alden Spencer Award, given by the College of Physicians and Surgeons of Columbia University, New York
2006: Distinguished Visitor Lectureship, Kavli Institute for Brain and Mind, San Diego: Feb 14-27.

2006: 5th Picower-RIKEN Neuroscience Symposium "New Frontiers in Brain Science from molecules to mind", Picower Centre, MIT, March 26-28.
2006: Gatsby workshop on 'Principles of Neural Representation', London, May 10-12th.
2006: Shanghai Symposium in Neuroscience, Shanghai Inst. of Brain Functional Genomics, Oct 30th.
2007: July 1-6: plenary lecture at Gordon Research Conference on Neural Circuits and Plasticity, Newport RI.
2007: Seminar at McGill University, Montreal, Nov. 10.
2008: Seminar at Janelia Farm Research Campus, VA, March 12.
2008: Seminar at State Univ New York, Brooklyn, March 13.
2008: Monthly Lecture at Rockefeller University (for broad neuroscience community), April 18.
2008: Neuroscience seminar at the research Institutes in Basel, Oct 9th
2008: Lord Adrian Seminar, Cambridge, Oct. 13
2009: Plenary speaker at Hungarian Neuroscience meeting, Budapest, 22-24 Jan 2009.
2009: Univ Toronto lecture, 7 May
2009: Lectures at UC Berkely and UC San Fransisco, 13-14 May
2009: Keynote Lecture, European Psychology Conference, Oslo 7-10 July.
2009: Keynote Lecture at McKnight Conference in Neuroscience, Aspen, Colorado, 4-8 June
2009: Ernst Strüngmann Forum (former Dahlem Conference), Frankfurt, 16-21 Aug.
2009: Plenary Special Lecture at Society for Neuroscience, Chicago, Oct 17-21.
2010: 3rd Cold Spring Harbor Meeting "Neuronal circuits: from structure to function", NY, March 11-13
2010: 11th Sloan-Swartz Centers for Theoretical Neurobiology summer meeting at Yale Univ., June 29-30
2010: Gatsby meeting on grid cells, London, July 1-3
2010: Plenary Lecture at FENS biannual meeting in Amsterdam, July 3-7.
2010: Speaker at UCLA 2010 Neural Circuit Symposium, Oct 7
2010: Nansen Neuroscience Lectures 101010
2011: Neural Plasticity conference, Morea, Tahiti, 14-18 Feb
2011: Lecture at New York University, 14 March
2011: Lecture at Instituto De Neurociencias, Alicante, May 13
2011: Speaker at Nobel symposium on 'Machines, Molecules and Mind', Karolinska Institutet, Stockholm, May 25-28.
2011: Plenary lecture at EBBS biannual meeting, Sevilla, Sep 9-11.
2011: Plenary lecture at EMBO meeting, Vienna, 11-14 Sep.
2011: Lecture at Nobel Forum: symposium on Brain Circuits, 27-28 Oct.
2011: Kavli Lecture, Yale, 17 Nov
2011: Lecture at Ludwig-Maximilians-Universität München, 5 Dec
2012: Bauer Lectures, Brandeis University, Boston, 2-4 April
2012: Keynote Lecture, MBG Annual Meeting 2012 in Aarhus, DK, on 8 June
2012: Gordon conference on Neurobiology of Cognition, Il Ciocco, Lucca/Barga, Italy, July 8-13
2012: Kavli Popular Lecture (Kavli Prize Week, Norwegian Academy of Science)
2012: Plenary talk at the Annual Festival of the Research Council of Norway
2012: Keynote Lecture at University of Helsinki Research School conference, November 23rd
2013: Lecture at Neural Plasticity meeting, Curacao, February 15th
2013: First annual Jupiter Brain Sunposium, February 18-20th
2013: 8th Annual Eric M. Shooter Lecture, Stanford Univ Sch Med, 10 April
2013: Keynote Lecture, UT Austin Learning and Memory Conference, 12-14 April
2013: Perl/UNC Neuroscience Prize Lecture 17 April
2013: Royal Society scientific meeting, "Space in the Brain: Cells, Circuits, Codes and Cognition" May 1-3, London.
2013: ESF Neuroscience meeting Lago Maggiore, 20-23 Sept.
2013: Hungarian Academy of Science: Neuroscience Seminar Series, 5-6 Dec.
2014: Louisa Gross Horwitz Prize Lecture, 16 Jan
2014: Friday Lecture Series seminar at Rockefeller University, 17 Jan.
2014: Phillip A. Sharp Lecture in Neural Circuits, McGovern Institute, 5 Feb
2014: Lecture at UC Berkeley (student invited speaker), 7 Feb
2014: Lecture at Institute Pasteur, Paris, 26 March
2014: Lecture at NYU Med Ctr annual retreat, 10-12 April

2014: Lecture at Center for Theoretical Neuroscience, Columbia University, April.
2014: Neural Networks in the Arctic, Spitsbergen 5-10 June
2014: Lecture at 50th anniversary conference of FEBS and EMBO, 1 Sept.
2014: Keynote lecture at Cold Spring Harbor Meeting on Axon Guidance, Synapse Formation and Regeneration 17-19 Sept.
2014: Opening symposium for Max Planck Institute for Brain Research, 24-25 Sept.

Conference organizer:
2008: Fridtjof Nansen conference on Neural Networks and Memory, June 4-8.
2008: Kavli Prize symposium, Univ. of Oslo and NTNU, Sept 8-11, co-organizer.
2010: Kavli Prize symposium, Univ. of Oslo and NTNU, Sept 6-9, co-organizer.
2013: Kavli Community Symposium, organizer, 22-23 Aug.
2014: 'How to read a map' conference, Janelia Farm Res. Campus, 6-9 April
2014: Neural Networks in the Arctic, conference organizer, Spitsbergen 5-10 June.
2014: FENS Forum Milan, Italy, 59 July (member of programme committee).

Peer review

Editorial Boards
2007 -: *Hippocampus*

Referee tasks
Nature, Science, Nature Neuroscience, Neuron, Journal of Neuroscience, European Journal of Neuroscience, Behavioral Neuroscience, Hippocampus, and other journals. Grant proposals: The Welcome Trust, National Science Foundation, The Norwegian Res. Council.

Current research supervision (shared with E. Moser)

Postdoc: Kei Igarachi (2008 –), J Ye (2008 –), H Ito (2009 –), H Yamahachi (2011–), D Ledergerber (2011 –), D Rowland (2011 –), F Donato (2013 –), M Hägglund (2013 –).

PhD.:, E Henrikssen (2006 –), H Stensola (2008 –), C Alme (2009 –), A Tsao (2009 –), L Lu (2009 –), M Chenglin (2009 –), T Wernle (2010–), N Dagslott (2011 –), Ø Høydal (2013 –).

Completed postdocs: F. Sargolini (2004-06; now Associate Professor at Univ. Marseille), P Ganter (2002–06), S Leutgeb (2002–07; now Assistant Professor at UCSD), V Brun (2005-07; now Assoc. Professor at Univ. Tromsø), A Sale (2006 – 07), J Leutgeb (2003-08; now Assistant Professor at UCSD), M Fyhn (2005-08 ; now Assoc. Professor at Univ. Oslo), T Hafting (2005-08 ; now Assoc. Professor Univ. Oslo), J Angie (2007 –08; now Lecturer at Univ. St. Andrews), R Langston (2007 –10 ; now Lecturer at Univ. Dundee), K Jezek (2005-10 ; now Assoc. Professor at Czech Academy of Sciences), L Colgin (2005-10 ; now Assistant Professor at UT Austin)**, D Derdikman (2005-; now Assistant Professor at Technion in Haifa), A Tashiro (2006 –12 ; now Assistant Professor at Nanyang Technol. Univ., Singapore)*, E Kropff (2008-2011; now Assistant Professor at Neuronal Plasticity Laboratory, Leloir Institute, Buenos Aires, Argentina), L Giocomo (2009-2011; now Assistant Professor at Stanford Univ.)***, J Whitlock (2007 – 2013) ****, T van Cauter (2008 – 2013), S-J Zhang (2008 –2011 ; now a group leader at the Kavli Institute).

Completed PhDs: S Molden (2005), H-A Steffenach (2005), F Tuvnes (2005), M Fyhn (2005)*****, V Brun (2005), H-A Steffenach (2005), M K Otnæss (2006), T Solstad (2009) and Kirsten Gj Kjelstrup (2010), T Bonnevie (2014), Charlotte Boccara (2014), T Stensola (2014).

*Ayumu Tashiro received ERC Starting Grant in 2008 (at the Kavli Institute), also recipient of Gruber International Prize 2008 (awarded at Society for Neuroscience annual meeting); **Laura Colgin received the Gruber International Prize 2010; ***Lisa Giocomo received the Gruber International Prize 2012; she was offered an ERC Starting Grant in 2012: ****Jonathan Whitlock received an ERC Starting Grant in

2013 (Kavli Institute, 1.1.2014 –); *****Marianne Fyhn received the Donald B Lindsley Award for best PhD in behavioural neuroscience in 2005 and was a runner-up for the Science Eppendorff Prize in 2007.

Selected administrative experience

Chairman of Board for Physiology and Pharmacology of Medicine and Health Division of the Norwegian Research Council (2004–); Member of Board for Physiology and Pharmacology of Medicine and Health Division of the Norwegian Research Council (2000–); Member of Medical-Technology management team of NTNU 2001-; Member of National Board for neuroscience funding in Norway (NevroNor) 2002-.

2007 –2010: Panel Member for European Research Council Starting Grants (panel L S4 Neurosciences)
2012 –2014: Member of programme committee for FENS Forum 2014 in Milan.
2012 – : Member of Scientific Advisory Board (SAB) for the Department of Neuroscience at the Karolinska Institute.

Funding (selected)

2000 – 2003: *European Commission Framework V* 'Quality of Life and Management of Living Resources Work Program / Research and technological development activities of a generic nature': 15.4 million NOK (1.9 mill. Euro; 20% to M/E Moser).

2000 – 2003: *Norwegian Research Council (Science and Technology): Strategic University Programme*, 7.0 million NOK (3.5 mill. to M/E Moser).

2001 – 2005: *Norwegian Research Council (Medicine and Health): "Medicine and Health Group",* 12.5 million NOK over 5 years (8.5 mill. to M/E Moser

2002 – 2012: *Centre of Excellence Appointment by Norw. Res. Council:* Total budget 256 million NOK (35.5 mill Euro) over 10 years (100 MNOK from Research Council). See above.

2007 – 2009: *Norwegian Research Council (NevroNor):* 4.5 million NOK over 3 years.

2007 – 2010: *Functional Genomics Programme II of the Norwegian Research Council*: 10 MNOK.

2008 – 2010: *Norwegian Research Council (FRIBIOFYS):* 3 million NOK over 3 years.

2008 – 2010: *European Commission Framework VII*: Collaborative Project: Small or medium-scale focused research project: HEALTH-2007-2.2.1-2: Coding in neuronal assemblies. 22 million NOK (3 mill. Euro; 20% to M/E Moser).

2008 – 2012: *James McDonnell Foundation:* 3 million NOK over 5 years; collaborative grant with Fred Gage, Salk Institute, La Jolla.

2008 – : *Endowment from Kavli Foundation to establish Kavli Institute for Systems Neuroscience*; total of 7 million NOK per year, including supplementary funding from NTNU. Unlimited in time.

2011 – 2015: ***European Research Council Advanced Investigator Grant***; individual grant, total of 20 million NOK over 5 years (2.5 M Euro).

2013 – 2022: ***Centre of Excellence*** *Appointment by Norw. Res. Council:* Total budget 175 million NOK (24 mill Euro) over 10 years. See above.

Publications

Theses:

Moser, E.I. & Moser, M.-B. (1990). Spatial learning in a water maze following hippocampal lesions: Effects of the volume and the septo-temporal location of the lesion. Thesis (´hovedoppgave´) in Psychology, University of Oslo.

Moser, M.-B. (1995). Structural correlates of spatial learning in the hippocampus of adult rats. Doctoral thesis (dr.philos.).

Articles:

Skårdal, O., Lind, E., van der Welle Gjøen, J., Moser, E., Smørdal, T., Nyhus, S.T. & Moser, M.B. (1986). The interactional effects of personality and gender in small groups: A missing perspective in research**.** ***International Journal of Small Group Research,*** **2,** 172-185.

Moser, M.B., Moser, E.I., Wultz, B. & Sagvolden, T. (1988).Component analyses differentiate between exploratory behavior of SHR and WKY rats in a two-compartment free-exploration open field. ***Scandinavian Journal of Psychology,*** **29**, 200-206.

Wultz, B., Sagvolden, T., Moser, E.I. & Moser, M.B. (1990). The spontaneously hypertensive rat as an animal model of attention deficit hyperactivity disorder: Methylphenidate effects on the exploratory behavior of SHR and WKY rats in a two-compartment free-exploration open field. ***Behavioral and Neural Biology,*** **53**, 88-102.

Moser, E.I., Moser, M.B. & Andersen, P. (1993). Spatial learning impairment parallels the magnitude of dorsal hippocampal lesions, but is hardly present following ventral lesions. ***Journal of Neuroscience*** **13**, 3916-3925.

Moser, E.I., Moser, M.B. & Andersen, P. (1993). Synaptic potentiation in the rat dentate gyrus during exploratory learning. ***Neuroreport,*** **5**, 317-320.

Moser, E.I., Moser, M.B. & Andersen, P. (1994). Potentiation of dentate synapses initiated by exploratory learning in rats: Dissociation from brain temperature, motor activity and arousal. ***Learning & Memory,*** **1**, 55-73.

Moser, M.B., Trommald, M. & Andersen, P. (1994). An increase in dendritic spine density on hippocampal CA1 pyramidal cells following spatial learning in adult rats suggests the formation of new synapses. ***Proceedings of the National Academy of the Sciences of the U.S.A.,*** **91**, 12673-12675.

Moser, M.B., Moser, E.I., Forrest, E., Andersen, P. & Morris, R.G.M. (1995). Spatial learning with a minislab in the dorsal hippocampus. ***Proceedings of the National Academy of the Sciences USA,*** **92**, 9697-9701.

Moser, M.B., Trommald, M., Egeland, T. & Andersen, P. (1997). Spatial Training in a Complex Environment and Isolation Alter the Spine Distribution Differently in Rat CA1 Pyramidal Cells. ***Journal of Comparative Neurology,*** **379**, 1-9.

Moser, M.B. & Moser, E.I. (1998). Distributed encoding and retrieval of spatial memory in the hippocampus. ***Journal of Neuroscience,*** **18**, 7535-7542.

Moser, E.I., Krobert, K.A., Moser, M.B. & Morris, R.G.M. (1998). Impaired spatial learning after saturation of long-term potentiation. ***Science,*** **281**, 2038-2042.

Moser, M.B. & Moser, E.I. (1998). Functional differentiation in the hippocampus. ***Hippocampus,*** **8**, 608-619.

Moser, E.I. & Moser, M.B. (1999). Is learning blocked by saturation of synaptic weights in the hippocampus? ***Neuroscience and Biobehavioral Reviews,*** **23**, 661-672.

Moser, M.B. (1999). Making more synapses: a way to store information? ***Cellular and Molecular Life Sciences,*** **55**, 593-600.

Otnæss, M.K., Brun, V.H., Moser, M.B. & Moser, E.I. (1999). Pretraining prevents spatial learning impairment after saturation of hippocampal long-term potentiation. ***Journal of Neuroscience,*** **19**, RC49 (1-5).

Moser, M.B. & Moser, E.I. (2000). Pretraining and the function of hippocampal long-term potentiation. ***Neuron*** **26**, 559-561.

Brun, V.H., Ytterbø, K., Morris, R.G.M., Moser, M.B. & Moser, E.I. (2001). Retrograde amnesia for spatial memory induced by NMDA receptor-mediated long-term potentiation. ***Journal of Neuroscience,*** **21**, 356-362**.**

Hollup, S.A., Molden, S., Donnett, J.G., Moser, M.B. & Moser, E.I. (2001). Accumulation of hippocampal place fields at the goal location in an annular watermaze task. ***Journal of Neuroscience,*** **21**, 1635-1644.

Hollup, S.A., Molden, S., Donnett, J.G., Moser, M.B. & Moser, E.I. (2001). Place fields of rat hippocampal pyramidal cells and spatial learning in the watermaze. ***European Journal of Neuroscience,*** **13,** 1197-1208.

Hollup, S.A., Kjelstrup, K.G., Hoff, J., Moser, M.B. & Moser, E.I. (2001). Impaired recognition of the goal location during spatial navigation in rats with hippocampal lesions. ***Journal of Neuroscience,*** **21,** 4505-4513.

Steffenach, H.-A., Sloviter, R.S., Moser, E.I. & Moser, M.-B. (2002). Impaired retention of spatial memory after transection of longitudinally-oriented axons of hippocampal CA3 pyramidal cells. ***Proceedings of the National Academy of the Sciences USA,*** **99**, 3194-3198.

Fyhn, M., Molden, S., Hollup, S.A., Moser, M.-B. & Moser, E.I. (2002). Hippocampal neurons responding to unpredicted dislocation of a target object. ***Neuron,*** **35**, 555-566.

Brun, V.H., Otnæss, M.K., Molden, S., Steffenach, H.-A., Witter, M.P., Moser, M.-B., Moser, E.I. (2002). Place cells and place representation maintained by direct entorhinal-hippocampal circuitry. . ***Science,*** **296**, 2089-2284..

Kjelstrup, K.G., Tuvnes, F.A., Steffenach, H.-A., Murison, R., Moser, E.I., Moser, M.-B. (2002). Reduced fear expression after lesions of the ventral hippocampus. ***Proceedings of the National Academy of the Sciences USA***, **99**, 10825-10830.

Moser, E.I. & Moser, M.-B. (2003). One-shot memory in hippocampal CA3 neurons. ***Neuron,*** **38**, 147-148.

Tuvnes, F.A., Steffenach, H.-A., Murison, R., Moser, M.-B. & Moser, E.I. (2003). Selective hippocampal lesions do not increase adrenocortical activity. ***Journal of Neuroscience,*** **23**, 4345-4354.

Fyhn, M., Molden, S., Witter, M.P., Moser, E.I. and Moser, M.-B. (2004). Spatial representation in the entorhinal cortex (Research Article). ***Science,*** **305**, 1258-1264.

Leutgeb, S., Leutgeb, J.K., Treves, A., Moser, M.-B. and Moser, E.I. (2004). Distinct ensemble codes in hippocampal areas CA3 and CA1. ***Science*** **305**, 1295-1298.

Moser, E.I., Moser, M-B., Lipa, P., Newton, M., Houston, F.P., Barnes, C.A. and McNaughton, B.L. (2005). A test of the reverberatory activity hypothesis for hippocampal place cells. ***Neuroscience,*** **130**, 519-526.

Steffenach, H.-A., Witter, M.P., Moser, M.-B., and Moser, E.I. (2005). Spatial memory in the rat requires the dorsolateral band of the entorhinal cortex. ***Neuron,*** **45**, 301-313.

Hafting, T., Fyhn, M., Molden, S., Moser, M.-B., and Moser, E.I. (2005). Microstructure of a spatial map in the entorhinal cortex (Article). ***Nature,*** **436**,801-806.

Leutgeb, S., Leutgeb, J.K., Barnes, C.A., Moser, E.I., McNaughton, B.L., and Moser, M.-B (2005). Independent codes for spatial and episodic memory in the hippocampus. ***Science,*** **309**, 619-623.

Leutgeb, S., Leutgeb, J.K., Moser, M.-B., and Moser, E.I. (2005). Place cells, spatial maps and the population code for memory. ***Current Opinion in Neurobiology,*** **15** (6), 738-746.

Leutgeb, J.K., Leutgeb, S., Treves, A., Meyer, R., Barnes, C.A., McNaughton, B.L., Moser, M.-B., and Moser, E.I. (2005). Progressive transformation of hippocampal neuronal representations in 'morphed' environments. ***Neuron,*** **20**, 345-358.

Sargolini, F., Fyhn, M., Hafting, T., McNaughton, B.L., Witter, M.P., Moser, M.-B., and Moser, E.I. (2006). Conjunctive representation of position, direction and velocity in entorhinal cortex. ***Science,*** **312**, 754-758.

McNaughton, B.L., Battaglia, F.P., Jensen, O., Moser, E.I., and Moser, M.-B. (2006). Path-integration and the neural basis of the 'cognitive map'. ***Nature Reviews Neuroscience***, **7**, 663-678.

Leutgeb, S., Leutgeb, J.K., Moser, E.I., and Moser, M.-B (2006). Fast rate coding in hippocampal CA3 cell assemblies. ***Hippocampus***, **16**, 765-774.

Leutgeb, J.K., Leutgeb, S., Moser, M.-B., and Moser, E.I. (2007). Pattern separation in dentate gyrus and CA3 of the hippocampus. ***Science***, **315**, 961-966.

Fyhn, M., Hafting, T., Treves, A., Moser, M.-B., and Moser, E.I. (2007). Hippocampal remapping and grid realignment in entorhinal cortex. ***Nature***, 446, 190-194.

Moser, E.I. and Moser, M.-B (2007). Grid cells. Scholarpedia 2:3394.

Brun, V.H., Leutgeb, S., Wu, H.-Q., Schwarcz, R., Witter, M.P., Moser, E.I. and Moser, M.-B. (2008). Impaired spatial representation in CA1 after lesion of direct input from entorhinal cortex. **Neuron** 57, 290-302.

Moser, E.I., Kropff, E. and Moser, M.-B. (2008). Place cells, grid cells and the brain's spatial representation system. **Annual Reviews of Neuroscience**, 31, 69-89.

Hafting, T., Fyhn, M., Bonnevie, T., Moser, M.-B. and Moser, E.I. (2008). Hippocampus-independent phase precession in entorhinal grid cells. **Nature** 453, 1248-1252.

Kjelstrup, K.B., Solstad, T., Brun, V.H., Hafting, T., Leutgeb, S., Witter, M.P., Moser, E.I. and Moser, M.-B. (2008). Finite scales of spatial representation in the hippocampus. **Science**, 321, 140-143.

Colgin, L.L., Moser, E.I. and Moser, M.-B. (2008). Understanding memory through hippocampal remapping. **Trends in Neurosciences**, 31, 469-477.

Whitlock, J.R., Sutherland, R.J., Witter, M.P., Moser, M.-B. and Moser, E.I. (2008). Navigating from hippocampus to parietal cortex. **Proceedings of the National Academy of the Sciences USA** 105, 14755-14762.

Hasselmo, M.E., Moser, E.I. and Moser M.-B. (2008). Foreword: Special Issue on Grid Cells. **Hippocampus**, 18, 1141 (co-Editors).

Moser, E.I. and Moser, M.-B. (2008). A metric for space. **Hippocampus**, 18, 1142-1156 (lead article for grid cell special issue).

Fyhn, M., Hafting, T.H., Moser, E.I. and Moser, M.-B. (2008). Grid cells in mice. **Hippocampus**, 18, 1230-1238.

Brun, V.H., Solstad, T., Kjelstrup, K.B., Fyhn, M., Witter, M.P., Moser, E.I. and Moser, M.-B. (2008). Progressive increase in grid scale from dorsal to ventral medial entorhinal cortex. **Hippocampus**, 18, 1200-1212.

Solstad, T., Boccara, C.N., Kropff, E., Moser, M.-B. and Moser, E.I. (2008). Representation of geometric borders in the entorhinal cortex. **Science**, 322, 1865-1868.

Derdikman D, Whitlock JR, Tsao A, Fyhn M, Hafting T, Moser M-B and Moser EI (2009). Fragmentation of grid cell maps in a multicompartment environment. **Nature Neurosci**, 12, 1225-1232.

Colgin LL, Denninger T, Fyhn M, Hafting T, Bonnevie T, Jensen O, Moser M-B and Moser, EI (2009). Frequency of gamma oscillations routes flow of information in the hippocampus. **Nature**, 462, 353-357.

Derdikman D. and Moser M.-B. (2010). A dual role for hippocampal replay. **Neuron** 65, 582-584.

Colgin LL, Leutgeb S, Jezek K, Leutgeb JK, Moser EI, McNaughton BL and Moser M-B (2010). Attractor-map versus autoassociation based attractor dynamics in the hippocampal network**. J. Neurophysiol**., 104, 35-50.

* Langston RF, Ainge J, Cowey JJ, Canto CB, Bjerknes TL, Witter MP, Moser EI, Moser M-B (2010). Development of the spatial representation system in the rat. **Science**, 328, 1576-1580.

Boccara CB, Sargolini F, Hult V, Solstad T, Witter MP, Moser EI and Moser M-B (2010). Grid cells in pre- and parasubiculum. **Nature Neurosci**., 13, 987-994.

Alme CB, Buzzetti RA, Marrone DF, Leutgeb JK, Chawla MK, Schaner MJ, Bohanick JD, Khoboko T, Leutgeb S, Moser EI, Moser M-B, McNaughton BL and Barnes CA (2010). Hippocampal granule cells opt for early retirement. **Hippocampus**, 20, 1109-1123.

Henriksen EJ, Colgin LL, Barnes CA, Witter MP, Moser M-B, and Moser EI (2010). Spatial representation along the proximodistal axis of CA1. **Neuron**, 68, 127-137.

Moser EI, Moser M-B (2011). Seeing into the future. **Nature**, 469, 303-304.

Moser M-B, Moser EI (2011). Crystals of the brain. **EMBO Mol. Med.** 3, 1-4.

Giocomo LM, Moser M-B and Moser EI (2011). Computational models of grid cells. **Neuron**, 71, 589-603.

* Jezek K, Henriksen EJ, Treves A, Moser EI and Moser M-B (2011). Theta-paced flickering between place-cell maps in the hippocampus. **Nature**, 478, 246-249.

* Giocomo LM, Hussaini SA, Zheng F, Kandel ER, Moser M-B and Moser EI (2011). Grid cells use HCN1 channels for spatial scaling. **Cell**, 147, 1159-1170.

* Whitlock JR, Pfuhl G, Dagslott NC, Moser M-B and Moser EI (2012). Functional split between parietal and entorhinal cortices in the rat. **Neuron**, 73, 789-802.

* Stensola H, Stensola T, Solstad T, Frøland K, Moser M-B and Moser EI (2012). The entorhinal grid map is discretized. **Nature**, 492, 72-78 (Article).

* Couey JJ, Witoelar A, Zhang S-J, Zheng K, Ye J, Dunn B, Czajkowski R, Moser M-B, Moser EI, Roudi Y, Witter MP (2013). Recurrent inhibitory circuitry as a mechanism for grid formation. **Nature Neurosci**., 16, 318-324.

* Bonnevie T, Dunn B, Fyhn M, Hafting T, Derdikman D, Kubie JL, Roudi Y, Moser EI and Moser M-B (2013). Grid cells require excitatory drive from the hippocampus. **Nature Neurosci**., 16, 309-317.

* Tsao, A., Moser, M.-B. and Moser, E.I. (2013). Traces of experience in the lateral entorhinal cortex. **Current Biology**, 23, 399-405.

* Zhang S-J, Ye J, Miao C, Tsao A, Cerniauskas I, Ledergerber D, Moser M-B and Moser EI (2013). Optogenetic dissection of entorhinal-hippocampal functional connectivity. **Science**, 340, 1232627 (Enhanced Online Article).

Rowland, D.C. and Moser, M.-B. (2013). Time finds its place in the hippocampus. **Neuron**, 6, 953-954.

* Lu L, Leutgeb JK, Tsao A, Henriksen EJ, Leutgeb S, Barnes CA, Witter MP, Moser M-B and Moser EI (2013). Impaired hippocampal rate coding after lesions of the lateral entorhinal cortex. **Nature Neurosci**., 16, 1085-1093.

Yamahachi, H., Moser, M.-B., Moser, E.I. (2013). Map fragmentation in two- and three-dimensional environments. Comment on Jeffery et al.: Navigating in a three-dimensional world. **Behav. Brain Sci**., 36, 569-570.

Moser EI and Moser M-B (2013). Grid cells and neural coding in high-end cortices. **Neuron**, 80, 765-774.

Rowland, D.C. and Moser, M.-B. (20143). From cortical modules to memory. **Curr. Opin. Neurobiol**., in press.

Moser EI, Moser M-B and Roudi Y (2014). Network mechanisms of grid cells. **Phil. Trans. R. Soc. B Biol. Sci.**, 369, 20120511.

Zhang S-J, Ye J, Couey JJ, Witter MP, Moser EI and Moser M-B (2014). Functional connectivity of the entorhinal-hippocampal space circuit. **Phil. Trans. R. Soc. B Biol. Sci.**, 369, 20120516.

Giocomo LM, Stensola T, Bonnevie T, van Cauter T, Moser M-B and Moser EI (2014). Topography of head direction cells in medial entorhinal cortex. **Current Biology**, 24, 1-11.

Bjerknes TL, Moser EI, Moser M-B (2014). Representation of geometric borders in the developing rat. **Neuron**, in press.

Igarashi KM, Lu L, Colgin LL, Moser M-B, Moser EI (2014). Coordination of entorhinal-hippocampal ensemble activity during associative learning. **Nature**, in press.

Book chapters

Sagvolden, T., Wultz, B., Moser, E.I., **Moser, M.B.** & M¢rkrid, L. (1989). Results from a comparative neuro-psychological research programme indicate altered reinforcement mechanisms in children with ADD. In T. Sagvolden & T. Archer (Eds.): Attention Deficit Disorder: Clinical and Basic Research. Lawrence Erlbaum Associates, Hillsdale.

Moser, E.I., Hollup S.A. & **Moser, M.-B.** (2002). Representation of spatial information by dynamic neuronal circuits in the hippocampus. In L.R. Squire and D. Schacter: Neuropsychology of Memory, 3rd edition. New York: Guilford Publications.

Moser, E., **Moser, M.-B**., Brun, V.H. & Mustaparta, H. (2002). Den gåtefulle hukommelsen. Hvordan husker vi? Hvordan glemmer vi? I Skretting, K. Og Olstad, L.: Forskning på tvers: Tverrfaglige forskningsprosjekter ved NTNU. Tapir, Trondheim.

Moser, E.I. & Moser, M.-B. (2009). Hippocampus and Neural Representations. Encyclopedia of Neuroscience (L.R. Squire, Editor), Vol. 4, pp. 1129-1136. Oxford: Academic Press.

Moser EI, Witter MP, Moser M-B (2010). Entorhinal cortex. In Handbook of Brain Microcircuits (Eds Shepherd GM and Grillner S), Chapter 17, pp 175-189. Oxford: Oxford Univ. Press.

Mehta M, Buzsaki G, Kreiter A, Lansner A, Lucke J, Martin K, Moghaddam B, Moser M-B, Nicolic D, Sejnowski T (2010). Coordination in Circuits. In von der Malsburg, C, Phillips WA, and Singer W, eds.: Dynamic Coordination in the Brain: From Neurons to Mind. Strüngmann Forum Report, vol. 5. Cambridge, MA: MIT Press.

May-Britt Moser and Edvard I. Moser (2014). Understanding the cortex through grid cells. In Gary Marcus and Jeremy Freeman: The Future of The Brain: Essays By The World's Leading Neuroscientists. Princeton University Press.

Recent Society for Neuroscience abstracts (2011-)

Bonnevie, T., Fyhn, M., Hafting, T., Derdikman, D., Moser, E.I., Moser. M.-B. (2011). Preserved spatial correlation structure in grid cells after hippocampal inactivation. *Society for Neuroscience Abstracts* 37, 1.

Ito, H., Moser, E.I., Moser, M.-B. (2011). Representation of behavioral context in the nucleus reuniens. *Society for Neuroscience Abstracts* 37, 2.

Tsao, A.,Moser, M.-B., Moser, E. (2011). Object-by-place traces in lateral entorhinal cortex. *Society for Neuroscience Abstracts* 37, 3.

Giocomo, L.M., Bonnevie, T., Van Cauter, T., Moser, E.I., Moser, M.-B. (2011). Topographical organization of head direction and border cells in medial entorhinal cortex. *Society for Neuroscience Abstracts* 37, 4.

Kropff, E., Moser, M.-B., Moser, E.I. (2011). Running-speed modulation of neural activity in the Medial Entorhinal Cortex. *Society for Neuroscience Abstracts* 37, 5.

Zhang, S-J., Ye, J., Miao, C., Tsao, A., Moser, M.-B., Moser, E.I. (2011). Functional connectivity of the entorhinal-hippocampal space circuit. *Society for Neuroscience Abstracts* 37, 6.

Stensola, H., Stensola, T., Solstad, T., Frøland, K., Moser, M.-B., Moser, E.I. (2011). Modular organization of grid scale. *Society for Neuroscience Abstracts* 37, 7.

Stensola, T., Stensola, H., Moser., E.I., Moser, M.-B. (2011). Functional independence of grid cell modules. *Society for Neuroscience Abstracts* 37, 8.

Igarashi, K.M., Lu, L., Colgin, L.L., Moser, M.-B., Moser, E.I. (2011). Hippocampal beta/gamma oscillations in an odour-place association task. *Society for Neuroscience Abstracts* 37, 9.

Czajkowski, R., Couey, J.J., Girao, P.J.B., Zhang, S-J., Ye, J., Moser, M.-B., Moser, E.I., Witter, M.P. (2011). Optogenetic mapping reveals a functional input from retrosplenial cortex into deep layers of medial entorhinal cortex of the rat. *Society for Neuroscience Abstracts* 37, 10.

Van Cauter, T., Whitlock, J.R., Moser, M.-B., Moser, E.I. (2012). Impaired spatial periodicity of grid cells in a novel environment. *Society for Neuroscience Abstracts* 38, 702.01.

Igarashi, K.M., Lu, L., Colgin, L.L., Moser, M.-B., Moser, E.I. (2012). Olfactory learning-induced coherence between beta/slow-gamma oscillations in hippocampal area CA1 and lateral entorhinal cortex. *Society for Neuroscience Abstracts* 38, 702.03.

Ito, H.T. Witter, M.P., Moser, E.I., Moser, M.-B. (2012). Representation of behavioural context in the nucleus reuniens for CA1 place cells. *Society for Neuroscience Abstracts* 38, 702.04.

Giocomo, L.M., Bonnevie, T., van Cauter, T., Moser, E.I., Moser, M.-B. (2012). The topographical organization of head direction signals in medial entorhinal cortex. *Society for Neuroscience Abstracts* 38, 702.05.

Couey, J.J., Witoelar, A.W., Zhang, S.-J., Czajkowski, R., Dunn, B., Ye, J., Moser, M.-B., Moser, E.I., Roudi, Y., Witter, M.P. (2012). Medial entorhinal cortex layer ii stellate cells are embedded within a recurrent inhibitory network. *Society for Neuroscience Abstracts* 38, 702.06.

Lu, L., Leutgeb, J.K., Henriksen, E.J., Tsao, A., Leutgeb, S., Barnes, C.A., Witter, M.P., Moser, E.I., Moser, M.-B. (2012). The lateral entorhinal cortex and rate coding in the hippocampus. *Society for Neuroscience Abstracts* 38, 702.07.

Dunn, B., Witoelar, A., Couey, J.J., Bonnevie, T., Moser, M.-B., Moser, E.I., Witter, M.P., Roudi, Y. (2012). An inhibitory network of grid cells. *Society for Neuroscience Abstracts* 38, 702.08.

Bjerknes, T.L., Dagslott, N., Moser, E.I., Moser, M.-B. (2012). Representation of geometrical borders in the developing rat. *Society for Neuroscience Abstracts* 38, 702.09.

Stensola, T., Stensola, H., Solstad, T., Frøland, K., Moser, M.-B., Moser, E.I. (2012). The entorhinal grid map is discretized. *Society for Neuroscience Abstracts* 38, 702.10.

Miao, C., Moser, E.I., Moser, M.-B. (2012). Entorhinal excitation of inhibitory networks in CA3 of the hippocampus. *Society for Neuroscience Abstracts* 38, 702.11.

Bonnevie, T., Dunn, B., Fyhn, M., Hafting, T., Derdikman, D., Kubie, J.L., Roudi, Y., Moser, E.I., Moser, M.-B. (2012). Entorhinal grid cells require excitatory drive from the hippocampus. *Society for Neuroscience Abstracts* 38, 702.12.

Ye, J., Zhang, S.-J., Miao, C., Tsao, A., Ledergerber, D., Moser, M.-B., Moser, E.I. (2012). Optogenetic dissection of the entorhinal-hippocampal space circuit. *Society for Neuroscience Abstracts* 38, 702.13.

Chawla, M.K., Sekhadia, N., Olson, K., Alme, C.B., Moser, E.I., Moser, M.-B., McNaughton, B., Barnes, C.A. (2013). Massed trial induced under-expression of Arc mRNA in rat hippocampal neurons. *Society for Neuroscience Abstracts* 39, 390.17.

Igarashi, K.M., Lu, L., Colgin, L.L., Moser, M.-B., Moser, E.I. (2013). Oscillatory coupling between hippocampus and lateral entorhinal cortex predicts associative memory performance. *Society for Neuroscience Abstracts* 39, 769.05.

Miao, C., Moser, E.I., Moser, M.-B. (2013). Dorsoventral gradients in entorhinal-hippocampal inhibitory networks. *Society for Neuroscience Abstracts* 39, 769.06.

Lu, L., Leutgeb, J.K., Tsao, A., Henriksen, E.J., Leutgeb, S., Barnes, C.A., Witter, M.P., Moser, M.-B., Moser, E.I. (2013). Impaired hippocampal rate remapping following lesions in the lateral entorhinal cortex. *Society for Neuroscience Abstracts* 39, 769.07.

Stensola, H., Stensola, T., Moser, E.I., Moser, M.-B. (2013). Functional dissociation of grid modules in a nested environment. *Society for Neuroscience Abstracts* 39, 769.08.

Kropff Causa, E., Carmichael, J.E., Baldi, R., Moser, M.-B., Moser, E.I. (2013). Modulation of hippocampal and entorhinal theta frequency by running speed and acceleration. *Society for Neuroscience Abstracts* 39, 769.09.

Giocomo, L.M., Bonnevie, T., Stensola, T., van Cauter, T., Moser, E.I., Moser, M.-B. (2013). Topographical organization of head direction signals in medial entorhinal cortex. *Society for Neuroscience Abstracts* 39, 769.10.

Ito, H.T., Zhang, S.-J., Witter, M.P., Moser, E.I., Moser, M.-B. (2013). Trajectory-dependent firing in hippocampal place cells reflects thalamically-mediated input from the medial prefrontal cortex. *Society for Neuroscience Abstracts* 39, 769.11.

Alme, C.B., Miao, C., Jezek, K., Treves, A., Moser, E.I., Moser, M.-B. (2013). Independent place-cell maps for 10 environments with overlapping properties. *Society for Neuroscience Abstracts* 39, 769.12.

Ye, J., Zhang, S.-J., Cerniasukas, I., Sørlie Wågan, R., Moser, M.-B., Moser, E.I. (2013). Functional dissection of principal cell populations in layers II and III of medial entorhinal cortex. *Society for Neuroscience Abstracts* 39, 769.13.

Kruge, I.U., Wernle, T., Moser, E.I., Moser, M.-B. (2013). Grid cells of animals raised in spherical environments. *Society for Neuroscience Abstracts* 39, 769.14.

Stensola, T., Stensola, H., Moser, M.-B., Moser, E.I. (2013). Environmental constraints on grid cell orientation. *Society for Neuroscience Abstracts* 39, 769.15.

Tsao, A., Keller, G., Zmarz, P., Moser, M.-B., Moser, E.I., Huebener, M., Bonhoeffer, T. (2013). Representation of odor in the lateral entorhinal cortex. *Society for Neuroscience Abstracts* 39, 769.16.