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Research interests

Liesbeth Marian Veenhoff
Born 23-11-1972, NL
Partner of Jan Jacob Schuringa, mother of two born 2003 and 2005
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Training

Master: University of Groningen; August 1996; Biology (Biochemistry/Molecular Biology)
PhD: University of Groningen; 7 September 2001, supervisor Prof. Dr. Poolman; Cum Laude

Work experience since completing PhD

2002-2003 post doctoral HFSP fellow, Rockefeller University (New York, USA), 1fte
2004-2010 post doctoral veni & vidi fellow, University of Groningen (NL), 0.8fte
2010-2012 Assistant Prof, University Medical Center Groningen (NL), 1fte
2012-present Group leader European Research Institute for the Biology of Ageing (ERIBA), University Medical Center Groningen (NL)
(UHD/Associate Prof since 2015, ius promovendi since 2018),

Brief summary of research over the last five years

My group has made important contributions in the nuclear transport field studying the mechanism of transport of membrane proteins. Specifically, we discovered that, while the majority of membrane proteins simply reach the inner membrane by diffusion, a selective and energy-dependent transport mechanism exists for two yeast proteins, and likely for a third human protein. Intriguingly, these three proteins all act in nuclear pore complex (NPC) assembly and quality control, which led me to question whether this special transport mechanism may be important for NPC quality control.
In collaboration with others, my team developed new methods and generated a first system-wide inventory of the molecular changes in mitotic ageing yeast. We found that a major signature of ageing cells is an altered stoichiometry in protein complexes, which was particularly strong for the NPC.
To then answer the many unresolved questions with regard to the function of the NPCs in ageing cells, we follow nuclear transport in ageing yeast cells. Using microfluidic devices, we monitor cells over their entire life span under perfectly controlled environmental conditions. My team found that NPC quality control is compromised in ageing cells, and associated with reduced transport across the nuclear envelope.
Altogether, my research lines—related to the function of the NPC, on the one hand, and to understanding what cellular ageing is on a molecular level, on the other—have now converged and jointly point to the importance of NPC quality control.

Grants, scholarships and prizes

PI
2020 'Quality control of nuclear pores', NWO-Vici Science Domain
2020 'Guardians of protein disorder', NWO-XL Science Domain (previously ENW-GROOT) consortium grant, I act as project leader.
2017 'Unravelling the molecular mechanism of impaired nuclear transport in ALS' Netherlands Organization for Scientific Research (BBoL-NWO)
2016 Aspasia, Netherlands Organization for Scientific Reserach (NWO)
2015 'A mother's sacrifice: asymmetric inheritance of ageing factors' Netherlands Organization for Scientific Reserach (NWO-ALW)
2013 'Aging of the Nuclear Pore Complex: relating structure and function' Netherlands Organization for Scientific Research (ECHO-NWO).
2008 'Composition, function, and dynamics of the yeast nuclear envelope' financed by the Netherlands Organization for Scientific Research (Vidi-NWO)

2004 Veni-NWO
2002 Human Frontiers Fellowship long term fellowship
2001 My thesis 'Mechanistic aspects and structural organization of a secondary sugar transporter' was awarded with the honour 'Cum laude' representing the top 5 % of PhD theses.
1996 The Unilever Research Award 1996 for the best master student research project ‘Purification and reconstitution of transport proteins’.
Co-PI
2010 Co-author on the proposal for the Systems Biology Centre for Energy Metabolism and Ageing. Funding for 1 PhD student, project leader. (NWO)
2008 Co-author on collaborative project “transport through a polymer network”. Funding for 1 PhD student. (Zernike institute for Advanced Material)
2008 The Netherlands Proteomics Centre funds proteome research on the yeast nucleus. Funding for 1 PhD student.

Research output

A physicochemical perspective on cellular ageing
Mouton, S. N., Boersma, A. J. & Veenhoff, L. M., Nov-2023, In: Trends in Biochemical Sciences. 48, 11, p. 949-962 14 p.

Changing the guard—nuclear pore complex quality control
Veldsink, A. C., Gallardo, P., Lusk, C. P. & Veenhoff, L. M., Nov-2023, In: FEBS Letters. 597, 22, p. 2739-2749 11 p.

Dynamic molecular mechanism of the nuclear pore complex permeability barrier
Kozai, T., Fernandez-Martinez, J., van Eeuwen, T., Gallardo, P., Kapinos, L. E., Mazur, A., Zhang, W., Tempkin, J., Panatala, R., Delgado-Izquierdo, M., Raveh, B., Sali, A., Chait, B. T., Veenhoff, L. M., Rout, M. P. & Lim, R. Y. H., 14-Apr-2023, BioRxiv.

How to unravel a basket: NPC reorganization during meiosis
Veldsink, A. C. & Veenhoff, L. M., 6-Feb-2023, In: Journal of Cell Biology. 222, 2, 2 p., e202301044.

A survey of the specificity and mechanism of 1,6 hexanediol-induced disruption of nuclear transport
Barrientos, E. C. R., Otto, T. A., Mouton, S. N., Steen, A. & Veenhoff, L. M., 2023, In: Nucleus. 14, 1, 17 p., 2240139.

The chaperone DNAJB6 surveils FG-nucleoporins and is required for interphase nuclear pore complex biogenesis
Kuiper, E. F. E., Gallardo, P., Bergsma, T., Mari, M., Kolbe Musskopf, M., Kuipers, J., Giepmans, B. N. G., Steen, A., Kampinga, H. H., Veenhoff, L. M. & Bergink, S., Nov-2022, In: Nature Cell Biology. 24, p. 1584-1594 11 p.

A FRET-based method for monitoring structural transitions in protein self-organization
Wan, Q., Mouton, S. N., Veenhoff, L. M. & Boersma, A. J., Mar-2022, In: Cell reports methods. 2, 3, p. 100184 18 p.

Measuring and Interpreting Nuclear Transport in Neurodegenerative Disease-The Example of C9orf72 ALS
Semmelink, M. F. W., Steen, A. & Veenhoff, L. M., 26-Aug-2021, In: International Journal of Molecular Sciences. 22, 17, 21 p., 9217.

A precise and general FRET-based method for monitoring structural transitions in protein self-organization
Wan, Q., Mouton, S. N., Veenhoff, L. M. & Boersma, A. J., Jul-2021, In: European biophysics journal with biophysics letters. 50, SUPPL 1, p. 198 1 p.

De Novo Computational Design of Disordered Fg-Nucleoporins
De Vries, H., Fragasso, A., Otto, T., Klughammer, N., Andersson, J., Sluis, E. V. D., Steen, A., Dahlin, A., Veenhoff, L., Dekker, C., Giessen, E. V. D. & Onck, P., 12-Feb-2021, In: Biophysical Journal. 120, 3, p. 29a-30a

Erratum
Liu, B., Mavrova, S. N., van den Berg, J., Kristensen, S. K., Mantovanelli, L., Veenhoff, L. M., Poolman, B. & Boersma, A. J., 22-May-2020, In: ACS Sensors. 5, 5, p. 1500-1500 1 p.

Flexible and Extended Linker Domains Support Efficient Targeting of Heh2 to the Inner Nuclear Membrane
Rempel, I. L., Popken, P., Ghavami, A., Mishra, A., Hapsari, R. A., Wolters, A. H. G., Veldsink, A. C., Klaassens, M., Meinema, A. C., Poolman, B., Giepmans, B. N. G., Onck, P. R., Steen, A. & Veenhoff, L. M., 4-Feb-2020, In: Structure. 28

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A genome-wide screen identifies genes that suppress the accumulation of spontaneous mutations in young and aged yeast cells
Novarina, D., Janssens, G. E., Bokern, K., Schut, T., van Oerle, N. C., Kazemier, H. G., Veenhoff, L. M. & Chang, M., 1-Feb-2020, In: Aging Cell. 19, 2, 13 p., e13084.

Poor old pores-The challenge of making and maintaining nuclear pore complexes in aging
Rempel, I. L., Steen, A. & Veenhoff, L. M., 23-Jan-2020, In: The FEBS Journal. 287, 6, p. 1058-1075 18 p.

A physicochemical perspective of aging from single-cell analysis of pH, macromolecular and organellar crowding in yeast
Mouton, S. N., Thaller, D. J., Crane, M. M., Rempel, I. L., Terpstra, O. T., Steen, A., Kaeberlein, M., Lusk, C. P., Boersma, A. J. & Veenhoff, L. M., 2020, In: eLife. 9, p. 1-23 23 p., 54707.

Macromolecular Crowding Measurements with Genetically Encoded Probes Based on Förster Resonance Energy Transfer in Living Cells
Mouton, S., Veenhoff, L. M. & Boersma, A. J., 2020, In: Methods in Molecular Biology. 2175, p. 169-180 11 p.

A physicochemical roadmap of yeast replicative aging
Mouton, S. N., Thaller, D. J., Crane, M. M., Rempel, I. L., Steen, A., Kaeberlein, M., Lusk, C. P., Boersma, A. J. & Veenhoff, L. M., Nov-2019, BioRxiv, (bioRxiv).

Age-dependent deterioration of nuclear pore assembly in mitotic cells decreases transport dynamics
Rempel, I. L., Crane, M. M., Thaller, D. J., Mishra, A., Jansen, D. P. M., Janssens, G., Popken, P., Akşit, A., Kaeberlein, M., van der Giessen, E., Steen, A., Onck, P. R., Lusk, C. P. & Veenhoff, L. M., 3-Jun-2019, In: eLife. 8, 26 p., e48186.

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Mishra, A., Sipma, W., Veenhoff, L. M., Van der Giessen, E. & Onck, P. R., 1-Feb-2019, In: International Journal of Molecular Sciences. 20, 3, 18 p., 596.

The influence of fluorescent protein maturation on FRET measurements in living cells
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Increased genome instability is not accompanied by sensitivity to DNA damaging agents in aged yeast cells
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A simple microfluidic platform to study age-dependent protein abundance and localization changes in Saccharomyces cerevisiae
Cabrera, M., Novarina, D., Rempel, I. L., Veenhoff, L. M. & Chang, M., 13-Apr-2017, In: Microbial Cell. 4, 5, p. 169-174 6 p.

The Natural Variation in Lifespans of Single Yeast Cells Is Related to Variation in Cell Size, Ribosomal Protein, and Division Time
Janssens, G. E. & Veenhoff, L. M., 1-Dec-2016, In: PLoS ONE. 11, 12, 18 p., e0167394.

Evidence for the hallmarks of human aging in replicatively aging yeast
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Ghavami, A., Veenhoff, L. M., Van der Giessen, E. & Onck, P. R., 16-Feb-2016, In: Biophysical Journal. 110, 3, suppl. 1, p. 358A-358A 1 p.

Protein biogenesis machinery is a driver of replicative aging in yeast
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Conservation of inner nuclear membrane targeting sequences in mammalian Pom121 and yeast Heh2 membrane proteins
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Distinctive Properties of the Nuclear Localization Signals of Inner Nuclear Membrane Proteins Heh1 and Heh2
Lokareddy, R. K., Hapsari, R. A., van Rheenen, M., Pumroy, R. A., Bhardwaj, A., Steen, A., Veenhoff, L. M. & Cingolani, G., 7-Jul-2015, In: Structure. 23, 7, p. 1305-1316 12 p.

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Nuclear transport factor directs localization of protein synthesis during mitosis (Corrigendum; vol 11, pg 350, 2009)
van den Bogaart, G., Meinema, A. C., Krasnikov, V., Veenhoff, L. M. & Poolman, B., Apr-2013, In: Nature Cell Biology. 15 , 4, p. 441 1 p.

The transport of integral membrane proteins across the nuclear pore complex
Meinema, A. C., Poolman, B. & Veenhoff, L. M., 2012, In: Nucleus-Austin. 3, 4, p. 322-329 8 p.

Long Unfolded Linkers Facilitate Membrane Protein Import Through the Nuclear Pore Complex
Meinema, A. C., Laba, J. K., Hapsari, R. A., Otten, R., Mulder, F. A. A., Kralt, A., van den Bogaart, G., Lusk, C. P., Poolman, B. & Veenhoff, L. M., 1-Jul-2011, In: Science. 333, 6038, p. 90-93 4 p.

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Veenhoff, L. M., Meinema, A. C. & Poolman, B., 1-Apr-2010, In: Cell Cycle. 9, 7, p. 1281-1285 5 p.

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Correction to: Transport and Sorting of the Solanum tuberosum Sucrose Transporter SUT1 Is Affected by Posttranslational Modification (vol 20, pg 2497, 2008)
Kruegel, U., Veenhoff, L. M., Langbein, J., Wiederhold, E., Liesche, J., Friedrich, T., Grimm, B., Martinoia, E., Poolman, B. & Kuehn, C., Dec-2009, In: Plant Cell. 21, 12, p. 4059-4060 2 p.

Orthogonal Separation Techniques for the Characterization of the Yeast Nuclear Proteome
Gauci, S., Veenhoff, L. M., Heck, A. J. R. & Krijgsveld, J., Jul-2009, In: Journal of Proteome Research. 8, 7, p. 3451-3463 13 p.

Nuclear transport factor directs localization of protein synthesis during mitosis
Bogaart, G. V. D., Meinema, A. C., Krasnikov, V., Veenhoff, L. M. & Poolman, B., Mar-2009, In: Nature Cell Biology. 11, 3 , p. 350-U269 14 p.

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Determining the architectures of macromolecular assemblies
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The molecular architecture of the nuclear pore complex
Alber, F., Dokudovskaya, S., Veenhoff, L. M., Zhang, W., Kipper, J., Devos, D., Suprapto, A., Karni-Schmidt, O., Williams, R., Chait, B. T., Sali, A. & Rout, M. P., 29-Nov-2007, In: Nature. 450, 7170, p. 695-701 7 p.

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