KRAB-ZNFs: controllers of transposable element activity and safeguards of genome integrity

Roels, J.R.E.

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PhD portfolio

PUBLICATIONS

Roels, **J.R.E.**, Brandorff, J.E., de Geus M. & Jacobs, F.M.J. (*in preparation*) ZNF90 controls the expression of a subset of HERVH retrotransposons in human pluripotent stem cells.

Partiot, E., Hirschler, A., Colomb, S., Lutz, W., Claeys, T., Delalande, F., Deffieu, M.S., **Roels, J.R.E.**, ... & Gaudin, R. (2022). Trans-synaptic dwelling of SARS-CoV-2 particles perturbs neural synapse organization and function. bioRxiv, 2022-09.

Haring, N.L., van Bree, E.J., Jordaan, W.S., **Roels, J.R.E.**, Sotomayor, G.C., Hey, T.M., ... & Jacobs, F.M.J. (2021). ZNF91 deletion in human embryonic stem cells leads to ectopic activation of SVA retrotransposons and up-regulation of KRAB zinc finger gene clusters. Genome Research, 31(4), 551-563.

Ayala-Nunez, N.V., Follain, G., Delalande, F., Hirschler, A., Partiot, E., Hale, G.L., Bollweg, B., **Roels, J.** ... & Gaudin, R. (2019). Zika virus enhances monocyte adhesion and transmigration favoring viral dissemination to neural cells. Nature communications, 10(1), 4430.

PRESENTATIONS

Poster presentation Amsterdam Neuroscience Meeting - Amsterdam, The Netherlands	2022
Poster presentation FASEB Dynamic DNA conference - Nova Scotia, Cannada	2022
Poster presentation ONWAR PhD Meeting - Zeist, The Netherlands	2019
Poster presentation ONWAR PhD Meeting - Zeist, The Netherlands	2018

GRANTS

Travel grant recipient from FASEB Dynamic DNA conference - Nova Scotia, Cannada	2022

TRAINING

Introduction to programming in Python, the Shell, and Git version control *Amsterdam Science Park Study Group summer school*	2021
Introduction to RNA-seq data analysis *Amsterdam Science Park Study Group summer school*	2021
Basics in Fluorescence Microscopy and Confocal training *van Leeuwenhoek Centre for Advanced Microscopy (LCAM-FNWI)*	2019
Teaching course for PhD candidates	2019
Mastering your PhD	2019

TEACHING

Teaching assistant and guest lecturer - Human Genome Biology & Evolution	2020
Teaching assistant and guest lecturer - Human Genome Biology & Evolution	2019
MSc internship supervision	
Anouk Janssen *Generating a PRDM9 knockout for a meiotic in vitro model to explore the role of PRDM9 in a sex-specific context*	01/2021 - 09/2021
Finn Edwards *Explorimg a functional interaction between PRDM9 and KRAB-ZNFs - discontinued due to COVID-19*	01/2020 - 04/2020
MSc literature review supervision	
Tessa van Bergen *The diversity of the epigeneitc landscape in determining the meiotic recombination landscape*	02/2022 - 11/2022

COLLABORATIONS

dr. Martijs Jonker - SILS, University of Amsterdam *Development of a simulation model to study inheritance of recombination patterns across human populations.*	11/2023 - 11/2024
Stijn Robben - SILS, University of Amsterdam *Design of an automated workflow for ChIPexo data processing, including peak calling and binding-site ranking, to explore KRAB-ZNF and PRDM9 binding relationships.*	07/2020 - 07/2021
Emma Partiot (PhD candidate) and dr. Raphaël Gaudin (PI) - IRIM, France *Generating and analysing RNA-seq data from cortical organoids to investigate the effects of SARS-CoV-2 on the central nervous system.*	04/2020 - 09/2020
dr. Nilda Vanesa Ayala-Nunez (post-doc) and dr. Raphaël Gaudin (PI) - IRIM, France *Providing cortical organoid material to study Zika virus dissemination to the central nervous system.*	03/2019 - 06/2019

About the Author

From an early age, Judith Roels (1994) has been fascinated by human nature - wondering why we look and act the way we do. This curiosity led her to study the brain as the biological foundation of human behavior. In 2015, she obtained a Bachelor's degree in Psychobiology at the University of Amsterdam, where she discovered that understanding human cognition requires insight into the fundamental mechanisms of neuronal function.

She continued exploring these mechanisms in the Molecular Neurosciences track of the Biomedical Sciences Master's program at the University of Amsterdam. During this time, she conducted research in the lab of dr. Frank Jacobs at the Swammerdam Institute for Life Sciences under the supervision of Gerrald Lodewijk, studying the role of retroviral-derived RNA in neurological development and disease. For her second internship, she traveled to Milan to work in the lab of dr. Raffaella di Micco at the San Raffaele Telethon Institute. Here, she investigated sensing mechanisms of cytosolic DNA and activation of the innate immune system in hematopoietic cell lines, addressing challenges associated with the application of genome editing technologies. She also wrote a literature review on the molecular mechanisms that shape the 3D architecture of the human genome at the Netherlands Cancer Institute under the supervision of dr. Elzo de Wit. These diverse research experiences deepened her interest in DNA and the regulatory systems that shape human biology.

In 2018, she returned to the lab of dr. Frank Jacobs as a PhD candidate, diving deeper into the question of what makes us human at the smallest scale: our DNA. Her doctoral research focused on non-coding viral elements and their genomic regulators, exploring how these "genomic invaders" may serve both as drivers of evolutionary innovation and as sources of genomic instability. The results of this research are presented in this thesis. Alongside her research, she contributed to teaching in the Master's course Human Genome Biology & Evolution and supervised students during internships and literature reviews.

Beyond academia, she has engaged with science in broader contexts: assisting municipalities in policy development as a social researcher at Reiger Research, volunteering at a patient-centered hackathon at the Radboudumc, and being a loyal audience member at the Science & Cocktails lecture series hosted at Paradiso in Amsterdam.

As of April 2025, she works as a Clinical Genetics Laboratory Specialist Staff Assistant at Leiden University Medical Center (LUMC), where she applies her expertise in DNA analysis to help uncover hereditary causes of disease. In this role, she continues her quest to understand how our genetic code shapes human lives - now with direct clinical impact.

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Finishing this thesis feels surreal. For years, it's been such a big part of my life that it's both strange and exciting to see it take its final shape. I want to take this opportunity to thank all the kind, brilliant, and generous people who shared part of this road with me. Thank you for keeping me going and making these years more than just work!

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Marten, thank you for being my second promoter. You're unapologetically yourself, fiercely dedicated to good science and never afraid to call out "bullshit" when you see it. Your comments were critical but always useful, and it was clear they came from genuine care for both the work and the people doing it. Despite your many responsibilities, you always found time for a chat, some advice, or a beer after work or the volleyball- and squash tournaments. Thank you for looking out for me throughout my PhD and supporting me in so many ways. It meant a lot knowing I could always turn to you for help. Even if I'll never give up my Apple habits, I'll try to approach my work with the same sense of humor and honesty you've shown.

I would like to thank the members of my **thesis committee** for taking the time to read and evaluate my work. I look forward to continuing our discussions with some of you, and to exploring new perspectives with others. A special thank-you to **dr. Raphael Gaudin** for making the trip from France to attend the defense. After collaborating on two papers just before and during the pandemic, it will be a pleasure to finally exchange ideas in person.

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Reinofke, we go way back! You've been my partner in crime since my very first day in Amsterdam, all the way back in 2012. Our studies and lives have followed a remarkably similar path - even if not always side by side. However, the fact that your PhD desk ended up in the same office as mine was hardly a coincidence. Having your support throughout these years has meant the world to me. Our *uitwaai* walks were the best therapy during stressful times. They never failed to put things back into perspective. I'm so grateful to have shared both the fun and the not-so-fun moments with you over all these years. You're an incredibly caring and loyal friend, more than is probably good for you at times, or than you give yourself credit for. As my fellow Science Park dinosaur, it was never in question that you'd be one of my paranymphs.

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Also, a big thanks to **Anton** for his help with the amazing design for the cover and chapter pages!

My time in the Jacobs lab was made infinitely better by the people who filled it with science and fun. **Gerrald**, thank you for introducing me to the complex world of jumping genes and for helping me find my footing in the molecular lab, first as your intern and later during my first year as a PhD student. Your strongly brewed "cocaine" coffee was always a powerful start of the day. **Nina**, you laid the foundations of the stem cell lab and the CRISPR-Cas9 protocols, which became fundamental for much of my work. **Elise**, your attention to detail in the lab, in your bioinformatics scripts, and in your data organisation set a standard I often tried to follow. I'm also glad you convinced me to join the ABC beach volleyball club, which turned out to be a great way to let off some steam after work.

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Elias, dr. Brandorff! It still feels like yesterday that we celebrated your PhD defense and the completion of the ambitious G4 project - me proudly serving as your paranymph. Your positivity and open-mindedness made it a real pleasure to work alongside you in the lab and to collaborate on the ZNF90 story featured in this thesis. We also had a great time dressing up and listening to bad music on our way to Texel or the La Chouffe brewery as part of the infamous lab outings.

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I was lucky to work together and supervise several talented students that contributed to this work. **Anouk**, from our very first meeting, you impressed me with your enthusiasm, dedication, independence, and positivity. Your perspective and critical questions helped me think more deeply about my own work. We spent countless hours together in our stem cell house, sometimes staying so late we'd have to sprint home before the police noticed it was past the COVID curfew. Wishing you all the best as you wrap up your own PhD. Also, a big thanks to **Finn**, **Stijn** and **Matthijs** for their input to the projects and for contributing to the fun outside of the lab.

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"...from so simple a beginning endless forms
most beautiful and most wonderful have been,
and are being, evolved."

- Charles Darwin, On the Origin of Species, 1859