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### How dark matter came to matter

*A history of missing mass, 1930-1974*

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*how*  
DARK  
MATTER  
*came to*  
MATTER  
*A History of Missing Mass, 1930-1974*

JACO DE SWART

## HOW DARK MATTER CAME TO MATTER



How Dark Matter Came to Matter  
A History of Missing Mass, 1930-1974

ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad van doctor  
aan de Universiteit van Amsterdam  
op gezag van de Rector Magnificus  
prof. dr. ir. Karen Maex

ten overstaan van een door het College voor Promoties ingestelde commissie,  
in het openbaar te verdedigen in de Aula der Universiteit  
op vrijdag 4 februari 2022, te 11.00 uur

door Jacobus Gerardus de Swart  
geboren te Groesbeek



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Whereas the role of science is to reveal what we do not see,  
the role of philosophy is to let us see what we see.

– Michel Foucault 1994: 3.540-541

A process cannot be understood by stopping it. Understanding  
must move with the flow of the process, must join it and flow  
with it.

– The First Law of Mentat (Frank Herbert 1984: 34)



# ACKNOWLEDGEMENTS

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This thesis is about things in the cosmos that we cannot see. But it is not only the cosmos that goes largely unseen. Much of what constitutes one's existence is often hidden from view, and so too are many things that helped constitute this thesis. Friends, family, colleagues, neighbours and others have supported, inspired and helped me in the writing of this manuscript over the past five years. They have my immense gratitude and deserve to be visible.

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I have been roaming around the Institute of Physics for over ten years. And although I was the odd philosopher out, I have always felt at home – not the least due to Joost and the lovely secretariat. Thank you! Thanks to the wonderful people at GRAPPA for having me around and letting me bother them with my many peculiar questions. And I am grateful to my former colleagues (and students!) at the Institute voor Interdisciplinaire Studies, the most warmhearted place on Science Park.

Academia has its strange ways, and along my path I have met three professors in unexpected places who have, willingly or unwillingly, inspired me and coached me – they formed me to be the academic I am today. Michael Gordin, who has been amazingly warm and helpful ever since I visited him at Princeton University; Piet Hut, who, after we met at the Institute for Advanced Study, unconditionally endorsed my unique development as a scientist and individual; and, Annemarie Mol, who, through her attitude and way of inquiry, showed me how fun and wholesome academia can truly be.

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Although this thesis is an academic product, I myself am not. For over a decade I have been in an amazing relationship with four of my best friends: Guus, Niek, Jeroen and Daniel, in our band *X Raiders*. Boys, you gave me the best excuse to be myself, and you opened a world for me that few people – let alone academics – will ever experience. I could write a book about all the things I owe to you guys – you and the band mean the world to me. The true muse in my life has been Kees, whom I one day will marry. Infinite love goes out to my DVNTR buddies, the Hombres, and Alma, who spiked my existence with their magic.

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I am writing this as a postdoc in anthropology at the University of Amsterdam, where I have been fortunate enough to start work with Annemarie Mol. This summer, I will move to the U.S., to start as a Helleman postdoctoral fellow at the Massachusetts Institute of Technology. Here, I will work with one of my academic heroes, David Kaiser. Following this amazing opportunity means that, for most of you, I myself will now be hidden from view for a while. Hidden, but not gone.

J.G. DE SWART

*Amsterdam*  
*January 2022*



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