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Tuning in to star-planet interactions at radio wavelengths

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List of publications

First-author works

- *Radio masers on WX UMa: hints of a Neptune-sized planet, or magnetospheric reconnection?*
Robert D. Kavanagh; Aline A. Vidotto; Harish K. Vedantham; Moira M. Jardine; Joe R. Callingham; Julien Morin; MNRAS, 514, 675 (2022)
- *Planet-induced radio emission from the coronae of M dwarfs: the case of Prox Cen and AU Mic*
Robert D. Kavanagh; Aline A. Vidotto; Baptiste Klein; Moira M. Jardine; Jean-François Donati; Dúalta Ó Fionnagáin; MNRAS, 504, 1511 (2021)
- *Radio eclipses of exoplanets by the winds of their host stars*
Robert D. Kavanagh; Aline A. Vidotto; MNRAS, 493, 1492 (2020)
- *MOVES – II. Tuning in to the radio environment of HD189733b*
Robert D. Kavanagh; Aline A. Vidotto; Dúalta Ó Fionnagáin; Vincent Bourrier; Rim Fares; Moira M. Jardine; Christiane Helling; Claire Moutou; Joe Llama; Peter J. Wheatley; MNRAS, 485, 4529 (2019)

Co-authored works

- *The strong suppression of galactic cosmic rays reaching AU Mic b, c, and Prox Cen b*
Amanda L. Mesquita; Donna Rodgers-Lee; Aline A. Vidotto; **Robert D. Kavanagh**; MNRAS, 515, 1218 (2022)
- *One year of AU Mic with HARPS – II. Stellar activity and star–planet interaction*
Baptiste Klein; Norbert Zicher; **Robert D. Kavanagh**; Louise D. Nielsen; Suzanne Aigrain; Aline A. Vidotto; Oscar Barragán; Antoine Strugarek; Belinda Nicholson; Jean-François Donati; Jérôme Bouvier; MNRAS, 512, 5067 (2022)
- *Coronal Mass Ejections and Type II Radio Emission Variability during a Magnetic Cycle on the Solar-type Star ε Eridani*

Dúalta Ó Fionnagáin; **Robert D. Kavanagh**; Aline A. Vidotto; Sandra V. Jeffers; Pascal Petit; Stephen Marsden; Julien Morin; Aaron Golden; ApJ, 924, 115 (2022)

- *PION: simulating bow shocks and circumstellar nebulae*
Jonathan Mackey; Samuel Green; Maria Moutzouri; Thomas J. Haworth; **Robert D. Kavanagh**; Davit Zargaryan; Maggie Celeste; MNRAS, 504, 983 (2021)

Curriculum vitae

I was born on November 2nd 1995 in Dublin, Ireland. As a child, my sights were never set on anything remotely academic. At that time, I was more interested in drawing and making LEGO. However, my endless list of questions that I posed to my parents about how things worked and why things are the way they are was maybe a bit of a hint as to where my future interests would lie.

It was not until I was around 15 that Mathematics began to click with me in school. At around the same time, I was becoming completely absorbed by the world of physics and astronomy through TV documentaries, with Brian Cox being a huge inspiration for me. To this day he remains a fantastic educator in my eyes! From this point on, I knew I wanted to do something related to these areas.

After finishing school in 2014, I was lucky enough to be admitted into the Science course at Trinity College Dublin (TCD), Ireland, with Mathematics, Physics, and Chemistry being the three areas I initially did my studies in. I quickly discovered that the life of a chemist was not for me, so the area I would graduate in was down to either Physics or Physics & Astrophysics. Towards the end of my second year of studies at TCD, I came across a press release for some work that Aline Vidotto was involved in, who at the time had just started a job there as an assistant professor. This work focussed on the stellar wind environment around a young and active analogue of the Sun known as κ^1 Ceti, and how it might affect an orbiting planet around the star. I was really fascinated by this, with the concept of interactions between stellar winds and exoplanets being completely new to me. So, I decided to reach out to her and see if it would be possible to gain some experience in her area of expertise.

After chatting with Aline, she agreed to take me on as a summer student in 2016. With her, I carried out my first real stint of astrophysical research, studying the effects of a massive Jupiter-like exoplanet on the magnetic cycles of another Sun-like star called τ Boo. This really cemented the decision for me to pursue astrophysics as a more long-term thing, and I went on to choose Physics & Astrophysics as my graduating degree. During the rest of my undergraduate, I carried out further research in the area of massive stars, which included an amazing trip to the European Southern Observatory's Very Large Telescope in the Atacama Desert in Chile.

By the time I was in the final year of my undergraduate, I was set on the area of interactions between stars and planets as being the primary area I wanted to go in to. Aline and I wrote a funding proposal for a PhD project in this area, which

I had the privilege of being awarded by the Irish Research Council. I started my PhD at TCD with Aline just after receiving my bachelor's degree in 2018. The main focus of my PhD was on modelling the stellar wind environments of planet-hosting stars, and developing models to tell us if and when star-planet interactions can occur. During my PhD, I developed a particular interest in predicting and interpreting signals of these interactions at radio wavelengths. My work has been used to guide recent observations of exoplanetary systems which show promise for producing such signatures.

In the middle of 2021, Aline started a new position at Leiden Observatory in the Netherlands, and I was given the option to move there to complete the final year of my PhD. After some thinking, I decided that I would move. How could I turn down a move to the land of radio astronomy? I am very glad with the decision, and I have met many new people here in both a social and academic context. I think anyone who has lived in Leiden can agree that they will be hard-pressed to find a nicer place to live.

After my PhD, I will be staying in the Netherlands for at least the next few years, where I will be starting a postdoctoral position at the Netherlands Institute for Radio Astronomy (ASTRON) in the group of Harish Vedantham. His team are at the forefront of leading observations in search of star-planet interactions in the radio regime. At ASTRON, I will continue to use and improve the theoretical models I developed in my PhD, both applying them to and guiding observations. I will also expand this work into radio emission from exoplanets themselves, as well as brown dwarfs.

Acknowledgements

I firstly want to express my gratitude and thanks to my supervisor Aline Vidotto. She was the first person to provide me with the opportunity to gain research experience back in 2016, and has always made sure to guide me in such a way that I get to where I want and need to be throughout my PhD. I would also like to thank all those who have provided me with advice and supervision along the way, specifically Jonathan Mackey, Jose Groh, Andrea Mehner, Moira Jardine, Joe Callingham, and Harish Vedantham.

In terms of this thesis and the defence itself, I want to thank my good friends and fellow Busan Boys Ciaran Rogers and Andrew Allan for acting as my paranymphs. I also want to thank Sill Verberne for his masterful handle on the Dutch language, without which the Samenvatting would not exist. I appreciate all the social connections that have come along with carrying out the end of my PhD in Leiden. I have made some great memories with everyone at the Friday evening borrels, and the subsequent pizza eating which I am still not tired of. The same goes for all the friends I made during my time at Trinity College Dublin in the rooftop of the SNIAM.

To my parents, thank you for always supporting my endeavours in life, even when you had no idea what I was doing. Finally, Aoife, I greatly appreciate all your love and support during this PhD. I will always have great memories of our biking adventures in Leiden and elsewhere, hunting for cute animals to pet (shoutout to pig park) and lucrative properties to invest in (in our dreams).