The evolutionary tale of gaseous exoplanets: a brief history of time - exoplanet edition

Louca, A.J.

Publications

First-author

A.J. Louca, S.-M. Tsai, Y. Miguel, Can the Long-Term Impact of Stellar Flares Alter the Spectral Features of Exoplanet Atmospheres?, in prep.

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Co-author

E. Kleisioti, D. Dirkx, **A.J. Louca**, M. Rovira-Navarro, M. A. Kenworth, Interior structures of the Trappist-1f,g,h water-rich planets and prospects for observing cryovolcanic activity, submitted to Astronomy & Astrophysics

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Caroline Piaulet-Ghorayeb et al. +31 authors. NIRISS/SOSS reveals the water-rich 'steam world' atmosphere of GJ 9827 d, Accepted for publication in ApJL

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S.-M. Tsai et al. +85 authors, Direct Evidence of Photochemistry in an Exoplanet Atmosphere, 2023, Nature, 617(7961): 483-487.

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M. Zilinskas, C. van Buchem, Y. Miguel, **A.J. Louca**, R. Lupu, S. Zieba, W. van Westrenen, Observability of Evaporating Lava Worlds, 2022, Astronomy & Astrophysics, 661: A126.

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Curriculum Vitae

My journey to becoming an astrophysicist did not start when I was born on the 12th of February, 1997, but evolved later—unexpectedly sparked by a broken leg in the summer of 2013. Immobilised, I had little to do but watch documentaries like How the Universe Works on Discovery Channel. As one of the most beloved Dutch football players would say: "*Each disadvantage has an advantage*" (Johan Cruijf).

However, the full story begins earlier, with my family (1997 - 2009). Around our dinner table, philosophical discussions often filled the air, inspiring my early curiosity about astronomy. Despite this interest, I was more of a social butterfly at school, which made my path to becoming an astronomer less straightforward. I had to repeatedly prove to my teachers that I was capable of pursuing university studies.

In my final year of primary school, I buckled down and worked hard to ensure my academic future. Yet, as I transitioned to high school, my social tendencies returned, leading to lower grades and diminished confidence from my teachers. In my fourth year, I even dropped physics entirely, only to be urged by my biology teacher to reconsider. Hesitant but trusting his advice (thank you, Mr. See), I picked physics back up—though without any intention of pursuing it further.

This brings us to the pivotal summer of 2013. On the first day of the holiday, I broke my leg. Stuck at home, I began binge-watching science documentaries. That summer reignited my fascination with the universe's mysteries, and by the end, I was determined to study physics at Leiden University.

Through hard work, I achieved the grades I needed and began a bachelor's in Physics and Astronomy at Leiden in 2015. The start was intimidating, and I doubted whether I could keep up. But as the year progressed, I realised this field was a perfect fit for me, and I passed all my courses. In my second year, I joined the Astronomy Lab and Observing Project (ALOP) course, which included an observing trip to La Palma. This experience deepened my love for the observational side of astronomy.

For my bachelor's project, I joined Prof. Dorothea Samtleben's group at Nikhef, investigating how Earth's magnetic field affects KM3NeT detectors used for neutrino detection. This project introduced me to the experimental aspects of physics and astronomy, which I found equally fascinating.

However, by the time I needed to choose a master's direction, I faced a dilemma. Tempted by the Astronomy & Business track, my parents convinced me to stick with the scientific route, arguing that I could always explore the corporate world

later. They were right, as usual (if a thirteenth proposition was allowed it would be of the form of *experience beats teenage confidence every time*). I chose the Astronomy & Data Science track, which turned out to be a critical decision for my future career.

In my first year of the master's in 2018, I joined Dr. Yamila Miguel's group and worked on simulating planetary atmospheres to study the effects of stellar flares detected by the MUSCLES collaboration. I loved collaborating with Yamila and her PhD student, Mantas, and began to see myself pursuing a PhD in this field. Despite this, I was still leaning toward leaving astronomy after finishing my degree.

In 2019, during my second year, I joined Dr. Elena Sellentin's group and studied how signal-to-noise ratios, redshifts, and angular ranges affect biases in weak lensing two-point functions. This statistical approach to cosmology was vastly different from my earlier work but equally captivating. During this master's project, Elena motivated me even more to pursue a PhD in astronomy, and I felt very recognised for my work in her group.

Toward the end of my master's, professors began encouraging me to consider a PhD. This was the first time I truly felt recognised and motivated for my potential (outside of my family). Encouraged, I applied for PhD positions in Leiden and Amsterdam. To my surprise, I received offers from both. Though the Anton Pannekoek Institute in Amsterdam was tempting, I chose Leiden, where I felt at home among the students and faculty. Yamila offered me a PhD position in her group to continue studying the evolution of gas giants, which I was thrilled about.

Unfortunately, my PhD began during the COVID-19 pandemic, with lockdowns confining me to my small 10m^2 room for the first 1.5 years. It was an isolating experience, and I struggled to find joy in my work. When restrictions eased, I realised my perception of academia during the lockdown had been skewed. Reconnecting with colleagues helped me understand I wasn't alone in my struggles (see proposition 12).

By the end of my second PhD year, in-person conferences resumed. I attended the Exoplanets IV conference in Las Vegas with the Leiden exoplanets group, which rekindled my passion for science. Presenting my work and building connections with the broader community made me feel re-energised.

Determined to continue in academia, I applied for postdoc positions worldwide in the fall of 2023. This process highlighted how competitive the field is due to limited funding for science. After several rejections, I began to lose hope. Thankfully, Yamila offered me a one-year postdoc in Leiden to explore my next steps.

Now, in the middle of this postdoc, I'm still uncertain about my long-term future. What I do know is that I want to make a positive impact on the world—whether through science or another path. Wherever I end up, I trust I'll find my way.

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Although I looked forward to writing this part of my thesis, it was also the hardest part. Over the past four years—and even before that—I have been surrounded by people who supported me in ways they may not even realise. Expressing my gratitude in just a few words feels nearly impossible.

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