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UV Photodesorption and photoconversion of interstellar ices: the laboratory perspective

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LIST OF PUBLICATIONS

1. *Effect of molecular structure on the infrared signatures of astronomically relevant PAHs*
Bouwman, J., Castellanos, P., **Bulak, M.**, Terwisscha van Scheltinga, J., Cami, J., Linnartz, H., Tielens, A. G. G. M., 2019, A&A 621, A80
2. *Novel approach to distinguish between vacuum UV-induced ice photodesorption and photoconversion. Investigation of CH_4 , CH_3OH , and CH_3CN*
Bulak, M., Paardekooper, D.M., Fedoseev, G., Linnartz, H., 2020, A&A 636, A32
3. *Gas-phase infrared spectroscopy of the rubicene cation ($\text{C}_{26}\text{H}_{14}^{\bullet+}$). A case study for interstellar pentagons.*
Bouwman, J., Boersma, C., **Bulak, M.**, Tielens, A. G. G. M., Linnartz, H., 2020, A&A 636, A57
4. *Photolysis of acetonitrile in a water-rich ice as a source of complex organic molecules: CH_3CN and $\text{H}_2\text{O}:\text{CH}_3\text{CN}$ ices*
Bulak, M., Paardekooper, D.M., Fedoseev, G., Linnartz, H., A&A 647, (2021) A82
5. *Quantification of O_2 formation during UV photolysis of water ice - H_2O and $\text{H}_2\text{O}:\text{CO}_2$ ices*
Bulak, M., Paardekooper, D.M., Fedoseev, G., Chuang, K.-J., Terwisscha van Scheltinga, J., Eistrup, C., Linnartz, H., A&A, in press
6. *UV photodesorption and photoconversion rates of H_2O ice - measured with laser desorption post ionization mass spectrometry*
Bulak, M., Paardekooper, D.M., Fedoseev, G., Samarth, P., Linnartz, H., in preparation
7. *Inverse Kinetic Isotope Effect in Superdeuteration of Pentacene - A Possible Catalytic Pathway to Formation of Deuterium Enriched Interstellar Molecules*
Simonsen, F. D. S., Banhatti, S., **Bulak, M.**, Maddii Fabiani, L., Jaganathan, R., Wenzel, G., Thrower, J.D., Hornekær, L., in preparation
8. *Experimental toolbox of MATR²CES applied to interstellar ice analogues*
Bulak, M., Paardekooper, D.M., Fedoseev, G., Samarth, P., Bouwman, J., Chuang, K.-J., Linnartz, H., in preparation

ABOUT THE AUTHOR

Michał was born to Adam and Ewa Bulak on the 1st of January, 1992 in Zamość, Poland. Growing up, he spent most of the time between school and a local swimming pool. A decision to enroll into the I Społeczne Liceum Ogólnokształcące was made to accommodate for this duality. He continued to develop an inclination towards physics and mathematics as well as his passion for swimming. Upon high school graduation, both worlds, of science, and of sport, were equally exciting and promising. To continue the progress in both, he moved to the United States. At Missouri State University (MSU), he pursued a Bachelor degree in Science majoring in Applied Physics & Engineering, while being a member, and eventually a captain of a Division I swimming team. In 2015, as the swimming journey ran its course, he graduated with a Bachelor degree and science became his dominant passion, which has eventually turned into a career. Michał continued his education at MSU in the Master of Science program in Materials Science. During this period, he acquired experimental skills while working on a project with an astrophysical context. In his master's thesis he studied laboratory analogues of atmospheres of the hot rocky super-Earths. The acquired skillset combined with a thrill and satisfaction that comes from designing and running experiments, was a clear motivation to continue in this field. In 2017, Michał accepted a PhD position in the Laboratory for Astrophysics in Leiden, under supervision of Prof. dr. Harold Linnartz. The research project was focused on quantifying chemical and physical processes triggered upon an interaction of ultraviolet light with interstellar ice analogues. This thesis presents the PhD research results acquired over the last four years in Leiden. In his free time, Michał nurtures his connection to sports by coaching crossfit and weightlifting.



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Looking back at the last four years at the Laboratory for Astrophysics, it seems like the time flew by. Yet, so much has happened and just as much has changed. This has been a time of personal and professional growth which are typically triggered by challenges along the way. To overcome these challenges, write this thesis, and become who I am today would not be possible without an incredible net of support from colleagues, friends and family. Here, I would like to express my gratitude and acknowledge by name those involved. If there are omissions (and there will be), please forgive me, and know it is not out of disregard.

Let me begin with taking a step back. The skills and background which made me eligible to apply for a PhD position in the first place, were largely developed during my time as a research assistant with Dr. Dave Cornelison. His message was to apply the attitude I had for swimming to science and the fun and results would follow. To this day I go by that rule, and I do not expect that will ever change. Lyle, I know you are always there. You have been an inspiration. Please don't change.

My PhD supervisor and promotor Prof. dr. Harold Linnartz made me feel welcome and placed his trust in me. Within reasonable boundaries, I had the freedom to explore the lab and work on my own terms. It took me a while to understand that this is how one becomes independent. Harold patiently forged my writing skills, which are still far from great, but believe me, I have come a long way. My co-promotor, Prof. dr. Xander Tielens. Thanks to you there was a balance between the lab and everything else. Besides invaluable scientific feedback, I truly appreciate you checking on how I was currently feeling.

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includes: Jeroen, Ko-Ju, Niels, Danna, Vincent, Kirstin, Thanja, Andreas, Marina, Sanjana, Nicolas, Yugu, Pranjal, Tara, Will, Carlos, Julia, Helgi. Pranjal, I trust that you can take care of the baby and I hope you embrace all the successes and challenges that come with it. Jeroen, you have redefined a few things for me, including, tidiness and attention to detail. I am grateful for your company during all the ups and downs of living and working together. Keep you attitude, and make sure to enjoy life.

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Michał Bulak