Dark ice chemistry in interstellar clouds

Qasim, D.N.

List of publications

Publications

13. *A cryogenic ice setup to simulate carbon atom reactions in interstellar ices*
D. Qasim, M.J.A. Witlox, G. Fedoseev, K.-J. Chuang, T. Banu, S.A. Krasnokutski, S. Ioppolo, J. Kästner, E.F. van Dishoeck and H. Linnartz,
Rev. Sci. Instrum. 91 (2020) 054501

12. *An experimental study of the surface formation of methane in interstellar molecular clouds*
D. Qasim, G. Fedoseev, K.-J. Chuang, J. He, S. Ioppolo, E.F. van Dishoeck and H. Linnartz,
Nat. Astron. (2020), in press 10.1038/s41550-020-1054-y

11. *Formation of complex molecules in translucent clouds: Acetaldehyde, vinyl alcohol, ketene, and ethanol via "nonenergetic"processing of C_2H_2 ice*
K.-J. Chuang, G. Fedoseev, **D. Qasim**, S. Ioppolo, C. Jäger, T. Henning, M.E. Palumbo, E.F. van Dishoeck and H. Linnartz,
Astron. Astrophys. 635 (2020) A199

10. *Formation of interstellar propanal and 1-propanol ice: a pathway involving solid-state CO hydrogenation*
D. Qasim, G. Fedoseev, K.-J. Chuang, V. Taquet, T. Lamberts, J. He, S. Ioppolo, E.F. van Dishoeck and H. Linnartz,
Astron. Astrophys. 627 (2019) A1

9. *Extension of the HCOOH and CO_2 solid-state reaction network during the CO freeze-out stage: inclusion of H_2CO*
D. Qasim, T. Lamberts, J. He, K.-J. Chuang, G. Fedoseev, S. Ioppolo, A.C.A. Boogert and H. Linnartz,
Astron. Astrophys. 626 (2019) A118

8. *Alcohols on the rocks: solid-state formation in a $H_3CC{\equiv}CH$ + OH cocktail under dark cloud conditions*
D. Qasim, G. Fedoseev, T. Lamberts, K.-J. Chuang, J. He, S. Ioppolo, J. Kästner and H. Linnartz,
ACS Earth and Space Chemistry 3 (2019) 986–999

7. *H_2 chemistry in interstellar ices: The case of CO ice hydrogenation in UV irradiated CO:H_2 ice mixtures*
K.-J. Chuang, G. Fedoseev, **D. Qasim**, S. Ioppolo, E.F. van Dishoeck, and H. Linnartz,
Astron. Astrophys. 617 (2018) A87

6. *Formation of interstellar methanol ice prior to the heavy CO freeze-out stage*
D. Qasim, K.-J. Chuang, G. Fedoseev, S. Ioppolo, A.C.A. Boogert, and H. Linnartz,
Astron. Astrophys. 612 (2018) A83

5. *Reactive desorption of CO hydrogenation products under cold pre-stellar core conditions*
K.-J. Chuang, G. Fedoseev, **D. Qasim**, S. Ioppolo, E.F. van Dishoeck, and H. Linnartz,
Astrophys. J. 853 (2018) 102

4. *Adsorption of water, methanol, and formic acid on Fe_2NiP, a meteoritic mineral analogue*
D. Qasim, L. Vlasak, A. Pital, T. Beckman, N. Mutanda and H. Abbott-Lyon,
J. Phys. Chem. C. 121 (2017) 13645–13654

3. *Formation of glycerol through hydrogenation of CO ice under prestellar core conditions*
G. Fedoseev, K.-J. Chuang, S. Ioppolo, **D. Qasim**, E.F. van Dishoeck, and H. Linnartz,
Astrophys. J. 842 (2017) 52

2. *Production of complex organic molecules: atom addition versus UV irradiation*
K.-J. Chuang, G. Fedoseev, **D. Qasim**, S. Ioppolo, E.F. van Dishoeck, and H. Linnartz,
Mon. Not. R. Astron. Soc. 467 (2017) 2552–2565

1. *The evolution of the surface of the mineral schreibersite in prebiotic chemistry*
N.L. La Cruz, **D. Qasim**, H. Abbott-Lyon, C. Pirim, A.D. McKee, T. Orlando, M. Gull, D. Lindsay, and M.A. Pasek,
Phys. Chem. Chem. Phys. 18 (2016) 20160–20167

Curriculum Vitae

I was born in Kuwait City, Kuwait on December 29, 1989. My family returned to the US shortly after, where I spent most of my childhood and teenage years in Tucson, Arizona. In 2006, a high school friend forwarded me an application for the Women in Science and Engineering Program at the University of Arizona. I noted in the application that my two favorite classes were chemistry and astronomy, so they paired me with an astrochemist, graduate student Stefanie Milam (now Dr. Stefanie Milam at NASA Goddard Space Flight Center). From there, I developed a passion for astrochemistry. After high school, I enrolled in Northern Arizona University (NAU), where I majored in chemistry and minored in astronomy. During my university years, I participated in two Research Experience for Undergraduates internships: one at Arecibo Observatory and one at the National Radio Astronomy Observatory.

After graduating from NAU in May 2012, I accepted a PhD position at Emory University to specialize in astrochemistry. After a mere one year of enrollment, I was deemed unqualified to continue the graduate program and was immediately dismissed. Long story short, I did not agree with the way I was evaluated, and believed in myself that I could do better. Between the dismissal and entering a new graduate program, I worked at Kimberly-Clark Corporation as a microscopist, where I was trained in scanning electron microscopy and energy dispersive spectrometry. These skills would be later used towards my first publication in my master's.

For many reasons, I decided to enroll in a master's program, rather than a PhD program, at Kennesaw State University. There, I was supervised by Prof. Dr. Heather Abbott-Lyon to experimentally investigate the properties of a meteoritic mineral, schreibersite. This was part of a large collaborative effort with the Center for Chemical Evolution. During this period, I gained a lot of knowledge and within a friendly community, including how to perform ultrahigh vacuum science and how to share my research in public talks. I graduated with two publications – one first-author and one second-author. Such a positive experience gave me the motivation to try a PhD once again.

Dr. Stefanie Milam forwarded me the vacancy announcement for a PhD in the Leiden Laboratory for Astrophysics with Prof. Dr. Harold Linnartz. I was interviewed and then offered to work on SURFRESIDE. In the next years, I went on to publish 6 first-author papers and 5 co-author papers, including a first-author paper in the journal, *Nature Astronomy*. After the PhD, I will continue experimental astrochemistry research as a postdoctoral researcher at NASA Goddard Space Flight Center.

I am diagnosed with mixed receptive-expressive language disorder, which has somewhat impaired my ability to learn and communicate. It is my hope that this CV will motivate particularly those who have language disorders/learning disabilities and wish to pursue a higher education.

Acknowledgements

The Sterrewacht is a truly special place to be as a PhD student. We are encouraged to *work together* to solve problems, *help each other* become successful, and have a lot of fun while doing so! The faculty work hard to provide their students the resources they need to publish. These factors alone result in long-lasting collaborations, success, and friendships, and I will always be grateful to be part of such an exceptional community.

My particular success stands on the shoulders of Team SURFRESIDE within the Laboratory for Astrophysics. Our team is a prime example of those who collectively exploit their individual strengths to help one another achieve. Harold, words cannot express how much I have learned and gained from you as a rising professional in this field. I am a fortunate student to have had your 100% support in me from the beginning to the end. Ewine, you were always available to help me put my work into an astrochemical context, whether it was helping me dig through the literature or connecting me with someone in the field. I have also learned a lot from observing your leadership in astrochemistry on a global scale. Gleb, you were the catalyst to helping me finish my thesis well on time, as you tirelessly went through the details of the experiments, data analysis, and paper writing with me. Ko-Ju, you patiently trained me in experimental laboratory astrochemistry, and from this, I have grown to be confident as a laboratory astrochemist. Sergio, you helped me promote my research and myself as a researcher to the world by inviting and financially supporting me as a speaker to the events you held. Thanja, not only did you enhance my thesis work by contributing quantum chemical calculations, but you taught me theoretical concepts that I struggled to teach myself, and also how to join theory and experiments.

Aart and Martijn – you both were the people who made day-to-day life in the lab smoother. Aart, thank you for patiently helping me get through some very tedious and annoying issues that everyone encounters when working in the lab. Martijn, not only did you help me push through my most difficult (and rewarding) PhD project, but you did something I don't see often – you stood up for me in difficult situations, and I will always remember your courage. Marjan and the secretaries, thank you for being kind and helpful, especially in the beginning when I needed help transitioning from the US to Europe.

Adwin and Daniel – you both took on the very challenging task of training an experimentalist in ice observations, and the body of knowledge I acquired from working with both of you is priceless. Adwin, you went above and beyond as a collaborator, explaining every detail to me (usually halfway across the world), from mathematical derivations to programming in python to interpreting ice observational data. Daniel, you were always available to explain difficult concepts, and I always appreciated that I could ask you anything without feeling bad about it.

I am grateful to everyone in my first two years who made my transition to an entirely new environment welcoming, and to those in my last two years who

filled it with laughter and memories to last. This list is long, so I will just focus on a handful of people: Niels and Merel – I always felt I could approach you both with my thoughts and questions, so thank you for your warm personalities. Jiao, you were always willing to share your knowledge and patiently explain your point of view. Marina, you were like a sister to me, and I am fortunate to have someone like you be my friend. Morgan, thank you for letting me confide in you about Emory, and I know you will enjoy this PhD experience (with Jordy) as much as I did, if not more.

To my main office mates – the first people to hear my celebratory news and frustrations. Sierk, Łukasz, Michał, and Erik, thank you for being my office family, and your willingness to close the window for me more than you probably would have liked. I am also grateful to everyone I had the pleasure to eat lunch and drink coffee with on a daily basis.

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To the community at Overleaf, and specifically to LianTze, thank you so much for your TeXpert advice! I literally could not have finished my thesis without your assistance.

Before coming to Leiden, some special people from Atlanta taught me what I needed to know before entering the PhD: my master's advisor, Heather Abbott-Lyon; my collaborator, Chris Bennett; and my spectroscopy professor, Martina Kaledin. Thank you for speaking on my behalf, and believing in my scientific dreams during a time when it felt like many people did not. To the chemistry department at Kennesaw State University: I cannot thank you enough for nurturing me during a critical time of my career, and ultimately setting me up to succeed in Leiden. Stefanie, thank you for always thinking of me since I was 16, and forwarding me the link to the PhD vacancy in Leiden.

My dear Chiel. You can probably recite every talk I have given in Leiden, as you supportingly stood by my side through most of this process. Being a scientist takes a toll on one's personal life, and finding a partner who eagerly supports such a lifestyle is rare. Wherever life takes us, I will always deeply appreciate you.

To my sister, Layla, and my mother, Hae Suk Kim. No matter how far away we are from each other, we will always remain a family. Thank you for being there for me.

And to my late father, Nedal Ibrahim Qasim (December 2, 1961 - December 5, 2019). An American immigrant, veteran, and engineer – you truly achieved the American Dream. You left the Middle East for a better life for yourself and for your family. I have no doubt that your high ambitions and discipline resulted in both of your daughters to obtain PhDs in the physical sciences. Wherever you are, I know you are doing even better than you did in this life. Thank you for your unconditional love and support.