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Title: From ice to gas : constraining the desorption processes of interstellar ices

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Curriculum vitae

I was born on the 9th of July 1986 in Clermont-Ferrand, France. I grew up with my parents at the foot of the massif central mountains in Royat, a small town renowned for its roman spa. After receiving my middle school certificate from Collège Theillard de Chardin (Chamalières) and discovering a passion for physics and chemistry, I obtained a high school degree in science from Lycée Polyvant de Chamalières. Following advice from school teachers, I applied successfully for a 2-year post-high school selective training in Physics and Chemistry (Classe préparatoire pour les Grandes Ecoles section Physique Chimie) at Lycée Blaise Pascal de Clermont-Ferrand in order to prepare for the famous French Grandes Ecoles. I moved in with my grandfather who took great care of me and I owe him my success in this highly competitive program. I was accepted into the joint physical chemistry program of Université Paris-Sud and Ecole Normale Supérieure de Cachan as a university student to get a magister degree in molecular physical chemistry ; a combined bachelor and master degree with additional courses. The stimulating multidisciplinary research performed here inspired me to exchange my carrier choice as a teacher for the exciting world of research. Astrochemistry came up as the natural field of study for me as it ties together my fascination for interstellar space and my chemical physics background. I left France for the first time to perform my master internship at the Sackler Laboratory for Astrophysics, Leiden Observatory in April 2008. This life changing experience exposed me to new scientific approaches, cultures and personal challenges. I greatly enjoyed this international experience and accepted a PhD position at the same institute in the group of Prof. Harold Linnartz starting August 2009. I carried out my research at the Sackler Laboratory for Astrophysics in Leiden, in the group of Prof. Jean-Hugues Fillion and with Dr. Mathieu Bertin at Université Pierre et Marie Curie in Paris, and with Dr. Karin Öberg in Cambridge, MA and Charlottesville, VA. Over the last four years, I have presented my PhD research at various national and international meetings in Kerkrade (NL), Glasgow (UK), Gothenburg (Sweden), Groningen (NL), Grenoble (France), Toledo (Spain), Paris (France), Leiden (NL) and at several institutes in Paris (France), Cambridge (USA), Charlottesville (USA), Münster (Germany), Milton Keynes (UK), Pasadena (USA), Mountain View (USA), Stanford (USA), and Berkeley (USA). After the defense of this thesis, I will continue to pursue my research in astrochemistry as a postdoctoral scholar at the Harvard Smithsonian Center for Astrophysics in Cambridge, Massachusetts.

Publications

Peer-reviewed articles

E. C. Fayolle, K. I. Öberg, S. E. Bisschop, R. T. Garrod, E. F. van Dishoeck, "Organic molecules around high-mass protostars : linking gas observations to the initial ice content", in preparation

M. Bertin, **E. C. Fayolle**, C. Romanzin, H. A. M. Poderoso, X. Michaut, L. Philippe, P. Jeseck, K. I. Öberg, H. Linnartz, J.-H. Fillion, "Indirect UV photodesorption from CO :N₂ binary ices - an efficient grain-gas process", submitted to The Astrophysical Journal

E. C. Fayolle, M. Bertin, C. Romanzin, H. A. M. Poderoso, L. Philippe, X. Michaut, P. Jeseck, H. Linnartz, K. I. Öberg, J.-H. Fillion, "Wavelength-dependent UV photodesorption of pure N₂ and O₂ ices", *Astronomy and Astrophysics*, 556, A122, 2013

K. I. Öberg, M. Dufie Boamah, **E. C. Fayolle**, R. T. Garrod, C. Cyganowski, F. van der Tak, The Spatial Distribution of Organics toward the High-Mass YSO NGC 7538 IRS9, *The Astrophysical Journal*, 771, 95, 2013

M. Bertin, **E. C. Fayolle**, C. Romanzin, K. I. Öberg, X. Michaut, A. Moudens, L. Philippe, P. Jeseck, H. Linnartz, J.-H. Fillion, "UV photodesorption of interstellar CO ice analogues : from subsurface excitation to surface desorption", *Physical Chemistry Chemical Physics*, 14, 9929, 2012

E. C. Fayolle, M. Bertin, C. Romanzin, X. Michaut, K. I. Öberg, H. Linnartz, J.-H. Fillion, "CO Ice Photodesorption : A Wavelength-dependent Study", *The Astrophysical Journal Letters*, 739, L36, 2011

E. C. Fayolle, K. I. Öberg, H. M. Cuppen, R. Visser, H. Linnartz, "Laboratory H₂O :CO₂ ice desorption data : entrapment dependencies and its parameterization with an extended three-phase model", *Astronomy and Astrophysics*, 529, A74, 2011

K. I. Öberg, **E. C. Fayolle**, H. M. Cuppen, E. F. van Dishoeck, H. Linnartz, "Quantification of segregation dynamics in ice mixtures", *Astronomy and Astrophysics*, 505, 183-194, 2009

Proceedings

E.C. Fayolle, K.I. Öberg, H.M.Cuppen, R.Visser, H.Linnartz,
"Laboratory H₂O :CO₂ ice desorption data : entrapment dependencies and its parameterization with an extended three-phase model", in *Proceedings* EAS Publications Series, 58, 327-331 2012

H. Linnartz, J.-B. Bossa, J. Bouwman, H. M. Cuppen, S. H. Cuyllle, E. F. van Dishoeck, E. C. Fayolle, G. Fedoseev, G. W. Fuchs, S. Ioppolo, K. Isokoski, T. Lamberts, K.I. Öberg, C. Romanzin, E. Tenenbaum, J. Zhen, "Solid State Pathways towards Molecular Complexity in Space", in *Proceedings* of IAU Symposium, vol. 280 of IAU Symposium, pp. 390-404, Dec. 2011.

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