

# Edith Fayolle's Curriculum Vitae

## Current position

Scientist in the Laboratory Studies group, Planetary Science section, Science division (October 2020 - )  
Discipline Program Manager for Planetary Science R&A programs (November 2021 - )  
Jet Propulsion Laboratory, California Institute of Technology  
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## Education

**Postdoc at the Jet Propulsion Laboratory** Pasadena, CA, USA

*September 2017 - September 2020*

Outer Solar System ice analog spectroscopy. Bacterial spores survivability under icy worlds conditions.  
Planetary science section, laboratory studies group. Mentor: Dr. Paul Johnson.

**Postdoc at the Harvard-Smithsonian Center for Astrophysics** Cambridge, MA, USA

*December 2013 - August 2017*

Experiments on interstellar ice analogs and observations of organic molecules around protostars.  
Astrochemistry group of Prof. Karin Öberg - Rubicon Fellow (2/14 - 1/16).

**PhD from Leiden Observatory** Leiden, The Netherlands

*August 2009 - September 2013*

Doctorate in astrochemistry on molecular gas-solid interactions pertaining to interstellar ices.  
PhD Advisors: Prof. Harold Linnartz (Leiden Obs.), Prof. Jean-Hugues Fillion (Sorbonne Univ.).

**Paris Sud University & Ecole Normale Supérieure de Cachan** Orsay & Cachan, FRANCE

*September 2006 - July 2009*

Combined BSc & MSc in physical chemistry (Magistère de Physico-Chimie Moléculaire).

## Technical skills

### *Laboratory experience*

Ice film growth, processing, and monitoring using ultra-high vacuum systems (design and assembly), cryogenic technology, temperature sensors & controllers, quadrupole mass spectrometry, Fourier-transform IR spectroscopy (transmission and reflection), UV spectroscopy, temperature desorption spectroscopy, microgravimetry, matrix isolation studies, and VUV photon and electron sources.

Experience with large instruments (SOLEIL synchrotron).

Microbiology basics, including bacterial spore handling and culturing.

General laboratory equipment maintenance, ordering, and safety guidelines implementation.

### *Observational experience*

Acquisition and analysis of millimeter line data from the JCMT, analysis of IRAM 30m data and interferometric data from the SMA and ALMA.

*Computing skills* Python, IDL, L<sup>A</sup>T<sub>E</sub>X, LabVIEW.

## Service

**Referee for** Nature, Nature Astronomy, ACS Earth and Space Chemistry, The Journal of Physical Chemistry, Chemical Physics Letters, The Astrophysical Journal, Astronomy & Astrophysics, and Monthly

Edith Carine Fayolle

Notices of the Royal Astronomical Society

**Editor** for the Astrochemical Newsletter

**Panel chief, panelist, and external reviewer** for NASA ROSES programs.

**Reviewer** for the Deutsche Forschungsgemeinschaft (German Research Foundation) **Elected Dust&Ice member at large** on the Laboratory for Astrophysics Division (LAD) executive committee of the American Astronomical Society (AAS).

Member of the AAS and its LAD, the American Chemical Society and its astrochemistry division.

## Awards, prizes, and fellowships

**JPL Voyager award** March 2022

**Rubicon fellowship** for a postdoctoral position awarded by the Netherlands Organisation for Scientific Research (Nederlandse Organisatie voor Wetenschappelijk Onderzoek), February 2014 - January 2016.

**Poster prize** at the International Astronomical Union symposium "The molecular universe", May 2011.

**Scholarship** from the Paris region and the higher education ministry for 6-month and 4-month internships abroad. January 2008, 2009.

**Prix de la vocation scientifique et technique des filles**, prize awarded by the French equality of chances ministry. September 2004.

## Mentoring

**Jet Propulsion Laboratory, Summer 2018 - 2020** Pasadena, CA, USA

Mentor of summer interns Isabelle Muise, Madeleine Braun, and Pierce van Mulbregt.

**Harvard University, 2014-2017** Cambridge, MA, USA

Lab training and co-mentoring of summer students and undergraduate students Zoe Peeler, Aida Behmard, Jyoti Campbell, Chris Merchantz, and Jodi Balfe.

## Teaching experience

**Wellesley College** Wellesley, MA, USA

Guest lectures for Prof. Arumainayagam's astrochemistry course, spring 2016 and 2020.

**Harvard College Observatory** Cambridge, MA, USA

Guest lectures for Prof. Öberg's "Physics and Chemistry of the ISM" graduate course, spring 2015.

**Leiden Observatory** Leiden, The Netherlands

Teaching assistant for the Detection of light and Data Mining, Virtual Observatories courses 2010, 2011.

## Research papers

25. M. Choukroun, P. Backes, M. L. Cable, **E. C. Fayolle**, R. Hodyss, A. Murdza, E. M. Schulson, M. Badescu, M. J. Malaska, E. Marteau, "Sampling Plume Deposits on Enceladus' Surface to Explore Ocean Materials and Search for Traces of Life or Biosignatures", *Planet. Sci. J.* 2 100, 2021
24. **E. C. Fayolle**, L. Barge, M. Cable, B. Drouin, J. P. Dworkin, J. Hanley, B. L. Henderson, B. Journaux, A. Noell, F. Salama, E. Sciamma-O'Brien, S. E. Waller, J. Weber, C. J. Bennett, J. Blum, M. Gudipati, S. Milam, M. Melwani-Daswani, M. Nuevo, S. Protopapa, R. L. Smith, "Critical Laboratory Studies to Advance Planetary Science and Support Missions", white paper for the 2023-2032 Planetary Science and Astrobiology Decadal Survey
23. **E. C. Fayolle**, A. C. Noell, P. V. Johnson, R. Hodyss, A. Ponce, "Viability of *Bacillus subtilis* spores exposed to ultraviolet light at ocean world surface temperatures", *Astrobiology*, 20, 889,

2020

22. M. Choukroun, T. H. Vu, **E. C. Fayolle**, "No compelling evidence for clathrate hydrate formation under interstellar medium conditions over laboratory time scales", *PNAS*, 116, 29, 14407, 2019
21. A. Behmard, **E. C. Fayolle**, D. M. Graninger, J. B. Bergner, R. Martián-Domínguez, P. Maksyutenko, M. Rajappan, and K. I. Öberg, "Desorption Kinetics and Binding Energies of Small Hydrocarbons", *ApJ*, 875, 73, 2019
20. R. Hodyss, P.V. Johnson, S.M. Meckler, **E. C. Fayolle**, "Ultraviolet Spectroscopy and Photochemistry of SO<sub>2</sub>/H<sub>2</sub>O Ices", *ACS Earth Space Chem.*, 3, 663, 2019
19. M. T. Carney, M. R. Hogerheijde, V. V. Guzmán, C. Walsh, K. I. Öberg, **E. C. Fayolle**, L. I. Cleaves, J. M. Carpenter and C. Qi, "Upper limits on CH<sub>3</sub>OH in the HD 163296 protoplanetary disk", *A&A*, 623, A124, 2019
18. I. R. Cooke, K. I. Öberg, **E. C. Fayolle**, Z. Peeler, J. B. Bergner, "CO Diffusion and Desorption Kinetics in CO<sub>2</sub> Ices", *ApJ*, 852, 75, 2018
17. **E. C. Fayolle**, K. I. Öberg, J. K. Jørgensen, K. Altwegg, H. Calcutt, H. S. P. Müller, M. Rubin, M. H. D. van der Wiel, P. Bjerkeli, T. L. Bourke, A. Coutens, E. F. van Dishoeck, M. N. Drozdovskaya, R. T. Garrod, N. F. W. Ligterink, M. V. Persson, S. F. Wampfler, "Protostellar and cometary detections of organohalogens", *Nat. Astro.*, 1, 703, 2017
16. J. M. Lykke, A. Coutens, J. K. Jørgensen, M. H. D. van der Wiel, R. T. Garrod, H. S. P. Müller, P. Bjerkeli, T. L. Bourke, H. Calcutt, M. N. Drozdovskaya, C. Favre, **E. C. Fayolle**, S. K. Jacobsen, K. I. Öberg, M. V. Persson, E. F. van Dishoeck, S. F. Wampfler, "The ALMA-PILS survey: First detections of ethylene oxide, acetone and propanal toward the low-mass protostar IRAS 16293-2422", *A&A*, 597, A53, 2017
15. I. R. Cooke, **E. C. Fayolle**, K. I. Öberg "CO<sub>2</sub> Infrared Phonon Modes in Interstellar Ice Mixtures", *ApJ*, 832, 5, 2016
14. J. K. Jørgensen, M. H. D. van der Wiel, A. Coutens, J. M. Lykke, H. S. P. Müller, E. F. van Dishoeck, H. Calcutt, P. Bjerkeli, T. L. Bourke, M. N. Drozdovskaya, C. Favre, **E. C. Fayolle**, R. T. Garrod, S. K. Jacobsen, K. I. Öberg, M. V. Persson, S. F. Wampfler, "The ALMA Protostellar Interferometric Line Survey (PILS)-First results from an unbiased submillimeter wavelength line survey of the Class 0 protostellar binary IRAS 16293-2422 with ALMA", *A&A*, 595, A117, 2016
13. J. B. Bergner, K. I. Öberg, M. Rajappan, **E. C. Fayolle** "Kinetics and mechanisms of the acid-base reaction between NH<sub>3</sub> and HCOOH in interstellar ice analogs", *ApJ*, 829, 85, 2016
12. A. Coutens, J. K. Jørgensen, M. H. D. van der Wiel, H. S. P. Müller, J. M. Lykke, P. Bjerkeli, T. L. Bourke, H. Calcutt, M. N. Drozdovskaya, C. Favre, **E. C. Fayolle**, R. T. Garrod, S. K. Jacobsen, N. F. W. Ligterink, K. I. Öberg, M. V. Persson, E. F. van Dishoeck, S. F. Wampfler, "The ALMA-PILS survey: First detections of deuterated formamide and deuterated isocyanic acid in the interstellar medium", *A&A*, 590, L6, 2016
11. **E. C. Fayolle**, J. Balfe, R. Loomis, J. Bergner, D. Graninger, M. Rajappan, K. I. Öberg, "CO and N<sub>2</sub> desorption energies from water ice", *ApJL*, 816, L28, 2016
10. **E. C. Fayolle**, K. I. Öberg, R. T. Garrod, E. F. van Dishoeck, S. E. Bisschop, "Complex organic molecules in organic-poor massive young stellar objects", *A&A*, 576, A45, 2015

9. K. I. Öberg, **E. C. Fayolle**, J.B. Reiter, R. T. Garrod, C. Cyganowski, "Complex molecule formation around massive young stellar objects", *Faraday Discuss.*, 168, 81-101, 2014
8. J.-H. Fillion, **E. C. Fayolle**, X. Michaut, M. Doronin, L. Philippe, J. Rakovsky, C. Romanzin, N. Champion, K.I. Öberg, H. Linnartz, M. Bertin, "Wavelength resolved UV photodesorption and photochemistry of CO<sub>2</sub> ice", *Faraday Discuss.*, 168, 533-552, 2014
7. 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:N<sub>2</sub> binary ices - an efficient grain-gas process", *ApJ*, 779,120, 2013
6. **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 N<sub>2</sub> and O<sub>2</sub> ices", *A&A*, 556, A122, 2013
5. 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, *ApJ*, 771, 95, 2013
4. 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", *PCCP*, 14, 9929, 2012
3. **E. C. Fayolle**, M. Bertin, C. Romanzin, X. Michaut, K. I. Öberg, H. Linnartz, J.-H. Fillion, "CO Ice Photodesorption: A Wavelength-dependent Study", *ApJL*, 739, L36, 2011
2. **E. C. Fayolle**, K. I. Öberg, H. M. Cuppen, R. Visser, H. Linnartz, "Laboratory H<sub>2</sub>O:CO<sub>2</sub> ice desorption data: entrapment dependencies and its parameterization with an extended three-phase model", *A&A*, 529, A74, 2011
1. K. I. Öberg, **E. C. Fayolle**, H. M. Cuppen, E. F. van Dishoeck, H. Linnartz, "Quantification of segregation dynamics in ice mixtures", *A&A*, 505, 183-194, 2009

## Proceedings

2. **E. C. Fayolle**, K.I. Öberg, H.M. Cuppen, R. Visser, H. Linnartz, "Laboratory H<sub>2</sub>O:CO<sub>2</sub> ice desorption data: entrapment dependencies and its parameterization with an extended three-phase model", in *Proceedings EAS Publications Series*, 58, 327-331 2012
1. H. Linnartz, J.-B. Bossa, J. Bouwman, H. M. Cuppen, S. H. Cuyille, 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.

## Conference talks, list limited to talks presented by myself

22. American Geophysical Union conference (December 2021, New Orleans, LA, USA)
21. European Conference for Laboratory Astrophysics 2020 (April 2020, Anacapri, Italy, canceled)
20. American Chemical Society meeting "Complexity in Planetary Systems" (March 2020, Philadelphia, PA, USA, rescheduled to March 2021)
19. **Invited** American Vacuum Society meeting "Planetary, Ambient, and Operando Environments", (November 2019, Columbus, OH, USA)

18. European Planetary Science Congress "Astrobiology: The rise of life on and beyond Earth" (September 2019, Geneva, Switzerland)
17. Astrobiology Science Conference "Formation of Organics of Astrobiological Interest in Astrophysical Environments" (June 2019, Seattle, WA, USA)
16. American Chemical Society meeting "New Spectroscopic Techniques for Astrochemistry" (August 2018, Boston, MA, USA)
15. **Invited** Astrochemistry: Past, Present, and Future (July 2018, Pasadena, CA, USA)
14. 42nd COSPAR Scientific Assembly (July 2018, Pasadena, CA, USA)
13. **Invited** Laboratory astrophysics workshop (September 2016, Tagungstätte Schloss Ringberg, Germany)
12. **Invited** at the 41st COSPAR Scientific Assembly (July 2016, Istanbul, Turkey - Canceled)
11. **Invited** at the ISM symposium "Conditions and Impact of Star Formation From Lab to Space" (September 2015, Zermatt, Switzerland)
10. American Chemical Society meeting "Bringing Astrochemicals Back to Earth" (August 2015, Boston, MA, USA)
9. **Invited** at the American Chemical Society meeting "Carbon in the Galaxy: The Formation of Complex Organics in the Outflow of Carbon Stars and their Evolution" (March 2015, Denver, CO, USA)
8. Dynamics, Interactions and Electronic Transitions at Surfaces DIET14 (October 2014, Pacific Grove, CA, USA)
7. **Invited** at the Lorentz Center workshop "Grain-Surface Networks and Data for Astrochemistry" (July 2014, Leiden NL)
6. American Astronomical Society summer meeting - Laboratory for Astrophysics division (June 2014, Boston USA)
5. ISM/CSM meetings (June 2013, Leiden, NL)
4. Lorentz Center workshop "high-mass star formation" (January 2013, Leiden, NL)
3. French conference Physique et Chimie du Milieu Interstellaire (November 2012, Paris, France)
2. COST Action -The chemical cosmos (October 2010, Grenoble, France)
1. 27th European conference on surface science (September 2010, Groningen NL)

**Poster presentations**, list limited to posters presented by myself

13. Lunar and Planetary Science Conference 53 (March 2022, The Woodlands, TX, USA)
12. American Geophysical Union conference (December 2020, online, USA)
11. Astrobiology Science Conference (June 2019, Seattle, WA, USA)
10. 42nd COSPAR Scientific Assembly (July 2018, Pasadena, CA, USA)
9. Lunar and Planetary Science Conference 49 (March 2018, The Woodlands, TX, USA)
8. IAU Symposium Astrochemistry (March 2017, Puerto Varas, Chile)
7. IAU Symposium (August 2015, Honolulu. HI, USA)

6. Simons Collaboration on the Origins of Life symposium (April 2014, New York, USA)
5. Faraday discussion 168 "Astrochemistry of Dust Ice and Gas (April 2014, Leiden NL)
4. European Conference for Laboratory Astrophysics (September 2011, Paris, France)
3. International Astronomical Union symposium 280 (May 2011, Toledo, Spain)
2. Herschel and the formation of stars and planetary systems (September 2010, Gothenburg, Sweden)
1. Dutch astronomy conference (May 2009, Kerkrade, NL)

## **Seminars**

- NASA JPL (Astrophysics seminar, November 2019)
- NRAO and UVA astronomy, USA (host: Eric Herbst, January 2018)
- NASA JPL (Planetary science seminar, July 2017)
- Wellesley College, USA (host: Chris Arumainayagam, February 2017)
- NASA Goddard, USA (host: Steve Charnley, June 2016)
- Leiden Observatory, NL (PhD colloquium, June 2013)
- NASA Ames, USA (host: Lou Allamandola, September 2012)
- LPMAA, Univ. Paris 6 , France(host: Jean-Hugues Fillion, March 2010)

## **Group talks**

- Caltech (Yuk Lunch talk, June 2019)
- NASA JPL (ICE seminar, November 2018)
- Carnegie Observatory (Lunch talk, May 2018)
- NASA Ames (host: Fahrid Salama, January 2016)
- Münster University (Germany, Helmut Zacharias' group, February 2013)
- Open University (UK, Nigel Mason's group, December 2012)
- Caltech (USA, Goeff Blake's group, October 2012)
- SLAC at Stanford University (USA, Anders Nilsson's group, September 2012)
- Lawrence Berkeley National Laboratory (USA, Chemical dynamics beamline, September 2012)
- University of Virginia (USA, astrochemistry groups, November 2011)
- Harvard-Smithsonian Center for Astrophysics (USA, Star formation group, November 2011)