

Ahmed Mahjoub, PhD

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Professional experience:

08/2023-present: Scientist III, Jet Propulsion Laboratory, Pasadena, CA

05/2019-08/23: Research Scientist, Space Science Institute, Boulder, CO

03/2017-08/2023: Affiliate Scientist, Jet Propulsion Laboratory, Pasadena, CA

02/2014 - 03/2017: Postdoctoral scholar, Jet Propulsion Laboratory, Pasadena, CA

09/2012 - 09/2013: Postdoctoral scholar, University Paris 12 (University Paris 12 fellowship)

01/2011- 09/2012: Postdoctoral scholar, UVSQ observatory

10/2009 - 12/2010: non-Tenure track assistant professor: University Paris 13

09/2006-01/2010: Graduate Research Assistant, University Paris 11, Orsay

Education:

* 01/2010: Ph. D, Physics, University Paris-11, Orsay, France

Dissertation title: Enantioselective processes in hydrogen bonded complexes

* 08/2006: Master's Degree, Molecular physical chemistry, University Paris-11, Orsay, France

Dissertation title: Molecular spectroscopy for Chiral discrimination

* 07/2005: Bachelor, Physics, University of Tunis, Faculty of science

Areas of expertise, skills and interests:

- Planetary science: atmospheres and surfaces:
 - Titan's atmosphere and lakes (chemistry and spectroscopy)
 - Small solar system bodies
- Astrochemistry, prebiotic chemistry and origin of life.

- Organic chemistry in laboratory analogs applied to comets, interstellar clouds and planetary atmospheres.
- Small bodies, origin and evolution of the solar system
- Chemical, physical and spectroscopic properties of planetary ices
- Extensive experience with Spectroscopy and analytical techniques: UV, Visible, Infrared, Raman, mass spectrometry, gas chromatography, temperature-controlled desorption, TOF-MS, L2DI-MS applied to analyze and interpret data from space missions (ROSETTA and New Horizon missions)
- Designing and developing new setups dedicated to test new instruments in extraterrestrial environments: Titan lakes simulation chamber and comet surface simulation chamber using Cryogenic conditions, vacuum systems and irradiations techniques and sources (electron guns and UV irradiation lamps)
- Successful research programs design and development leading to successful grant funding awards.
- Successful collaborations and communication.

Awards and Grants

- Voyager Award, JPL, 2018
- NASA-PDAR Grant, role: PI, October 2023, Total funds: \$730.000
- NASA-SSW Grant, role: PI, Nov 2022, Total funds: \$536.000
- NASA-DDAP Grant, role: PI, 2021, Total funds: \$512.000
- NASA-RDAP Grant, role: Science-PI, 2019, Total Funds : \$520.000
- NASA-RDAP Grant, role: Co-I, 2019, funds received for my role: \$180K
- JPL R&TD topical grant, CoI, 2019-2021, total funds ~ \$400 K,
- JPL R&TD topical grant, CoI, 2017-2018, total funds: \$ 400 K,
- UVSQ Scientific Award of Excellence with ionized atmospheres group, 2011
- “Paris-11 excellence award”, University fellowship for Master’s Degree, 2006
- “Med-accueil award” Mediterranean exchange fellowship, Marseille, 2005
- “President award” University of Tunis, 2005

Community services

Reviewer for Planetary science Journal, Planetary and Space Science Journal, the Astrophysical Journal, ICARUS

Reviewer for NASA proposals: Solar System Workings program

Reviewer of proposals for French National Agency of Science

Reviewer and panelist for NASA NPP program

Grand award judge- Astrophysics, Intel Science Fair, Los Angeles, 2017

Judge- Chemistry, California State Science Fair, Los Angeles, 2017

Scientific Research activities

My scientific research activities fall mainly into two complementary fields:

- Laboratory simulation of planetary atmospheres and surfaces: 3 research appointments in USA and Europe
- Experimental molecular spectroscopy (PhD and 1 year teaching-as-Research fellow)

Since 05/2019: Jet Propulsion Laboratory/ Space Science Institute

Research topics:

- 1- Design and develop methods for Measurement of optical constants for ice's tholins, data applicable to comets, asteroids, KBOs, Jupiter Trojans
- 2- Study of composition of mixed hydrocarbons at Titan's surface conditions: lab measurement and thermodynamic modeling
- 3- Laboratory simulation of sulfur chemistry and application to the analysis and interpretation of ROSINA/ROSETTA mission data.
- 4- Laboratory simulation of composition and spectroscopy of organic residues produced by irradiation of ice samples: application to ROSETTA data and New Horizon data.
- 5- Sulfate quantification on Ocean Worlds from frozen sodium sulfate brines examined by Raman spectroscopy.
- 6- Laboratory investigation of D/H isotopic fractionation induced by sublimation in water ice

03/2017-10/2018: Jet propulsion laboratory

Research topics:

- 1- Chemical and spectral characterization of Titan's hydrocarbons lakes using laboratory analogs
- 2- Developing an experimental setup to simulate physical and thermal properties of cometary surfaces
- 3- Laboratory investigation of D/H isotopic fractionation induced by sublimation in water ice

02/2014 - 03/2017: Jet Propulsion Laboratory

Research topics:

- 1- Developing an experimental setup to simulate Titan's hydrocarbons lakes.

- 2- Laboratory simulation of spectral and chemical effect of electron irradiation on solar system icy bodies, application to constrain the origin of Jupiter Trojans and Kuiper Belt Objects

09/2012 - 09/ 2013: University Paris 12

Research topic: Characterization of Titan's aerosols analogs by 2-steps Laser Desorption Ionization Spectroscopy (L²DI)

01/2011- 09/2012: UVSQ observatory

Research topic: Optical and chemical proprieties of Titan aerosols analogs produced at cryogenic conditions

10/2009 - 12/2010: University Paris 13

Research topic: Study of DNA bases analogues in the ionized state by Slow Photoelectron Spectroscopy

09/2006 - 01/2010: Graduate Research Assistant, University Paris 11, Orsay

Research topic: Study of molecular interactions responsible of chiral discrimination using molecular supersonic beam and laser spectroscopy: UV, IR, UV/IR double resonance and REMPI (Resonance Enhanced Multiphoton Ionization)

List of publications

1- Refereed journal articles (*: corresponding author)

1. **A. Mahjoub***, Altwegg K., Poston M.J., Rubin M., R. Hodyss, Organosulfur non-volatiles on comet 67P: evidence from ROSINA measurements and insights from laboratory simulations. *Science Advances*. **9**, eadh0394 (2023).
2. **A. Mahjoub***, M. E. Brown, M. J. Poston, R. Hodyss, B. L. Ehlmann, J. Blacksberg, M. Choukroun, J. M. Eiler, K. P. Hand, Effect of H₂S on the Near-infrared Spectrum of Irradiation Residue and Applications to the Kuiper Belt Object (486958) Arrokoth. *The Astrophysical Journal Letters*. **914**, L31 (2021).
3. **A. Mahjoub***, R. Hodyss, Thermal Reaction in Cometary and Pre-cometary Ices: Formation of Thiocarbamate in OCS-CH₃NH₂ Mixed Ices. *The Astrophysical Journal*. **869**, 98 (2018).
4. **A. Mahjoub***, M. Choukroun, R. Hodyss, C. Sotin, P. Beauchamp, M. Barmatz, Titan Lakes Simulation System (TiLSS): A cryogenic experimental setup to simulate Titan's liquid hydrocarbon surfaces. *Review of Scientific Instruments*. **89**, 124502 (2018).

5. **A. Mahjoub***, M. J. Poston, J. Blacksberg, J. M. Eiler, M. E. Brown, B. L. Ehlmann, R. Hodyss, K. P. Hand, R. Carlson, M. Choukroun, Production of Sulfur Allotropes in Electron Irradiated Jupiter Trojans Ice Analogs. *The Astrophysical Journal*. **846**, 148 (2017).
6. **A. Mahjoub***, M. J. Poston, K. P. Hand, M. E. Brown, R. Hodyss, J. Blacksberg, J. M. Eiler, R. W. Carlson, B. L. Ehlmann, M. Choukroun, Electron irradiation and thermal processing of mixed-ices of potential relevance to Jupiter Trojan asteroids. *The Astrophysical Journal*. **820**, 141 (2016).
7. **A. Mahjoub***, M. Schwell, N. Carrasco, Y. Benilan, G. Cernogora, C. Szopa, M.-C. Gazeau, Characterization of aromaticity in analogues of titan's atmospheric aerosols with two-step laser desorption ionization mass spectrometry. *Planetary and Space Science*. **131**, 1–13 (2016).
8. **A. Mahjoub***, N. Carrasco, P.-R. Dahoo, B. Fleury, T. Gautier, G. Cernogora, Effect of the Synthesis Temperature on the Optical Indices of Organic Materials Produced by N₂–CH₄ RF Plasma. *Plasma Processes and Polymers*. **11**, 409–417 (2014).
9. **A. Mahjoub***, K. Le Barbu-Debus, A. Zehnacker, Structural Rearrangement in the Formation of Jet-Cooled Complexes of Chiral (S)-1,2,3,4-Tetrahydro-3-isoquinolinemethanol with Methyl Lactate: Chirality Effect in Conformer Selection. *J. Phys. Chem. A*. **117**, 2952–2960 (2013).
10. **A. Mahjoub***, N. Carrasco, P.-R. Dahoo, T. Gautier, C. Szopa, G. Cernogora, Influence of methane concentration on the optical indices of Titan's aerosols analogues. *Icarus*. **221**, 670–677 (2012).
11. **A. Mahjoub**, M. Hochlaf, G. A. Garcia, L. Nahon, L. Poisson, State-Selected Unimolecular Decomposition of δ -Valerolactam⁺ and δ -Valerolactam²⁺ Cations: Theory and Experiment. *J. Phys. Chem. A*. **116**, 8706–8712 (2012).
12. **A. Mahjoub**, M. Hochlaf, L. Poisson, N. Nieuwjaer, F. Lecomte, J.-P. Schermann, G. Grégoire, B. Manil, G. A. Garcia, L. Nahon, Slow Photoelectron Spectroscopy of δ -Valerolactam and Its Dimer. *ChemPhysChem*. **12**, 1822–1832 (2011).
13. **A. Mahjoub**, A. Chakraborty, V. Lepere, K. Le Barbu-Debus, N. Guchhait, A. Zehnacker, Chirality-dependent hydrogen bond direction in jet-cooled (S)-1,2,3,4-tetrahydro-3-isoquinoline methanol (THIQM): IR-ion dip vibrational spectroscopy of the neutral and the ion. *Phys. Chem. Chem. Phys.* **11**, 5160–5169 (2009).
14. **A. Mahjoub***, K. Le Barbu-Debus, A. Zehnacker-Rentien, Double resonance IR/UV study of the complexes of methyl mandelate with methyl glycolate and methyl lactate. *AIP Conference Proceedings*. **935**, 208–213 (2007).
15. M. Dridi, **A. Mahjoub**, A. Jaouadi, Plasmonic Lasing in Highly Lossy Nanocylinder Arrays under Optical Pumping. *Applied Physics -B*. **in press** (2023).
16. K. Altwegg, M. Combi, S. A. Fuselier, N. Hänni, J. De Keyser, **A. Mahjoub**, D. R. Müller, B. Pestoni, M. Rubin, S. F. Wampfler, Abundant ammonium hydrosulphide embedded in cometary dust grains. *Monthly Notices of the Royal Astronomical Society*. **516**, 3900–3910 (2022).

17. M. T. Baeza-Romero, F. Gaie-Levrel, **A. Mahjoub**, V. López-Arza, G. A. Garcia, L. Nahon, A smog chamber study coupling a photoionization aerosol electron/ion spectrometer to VUV synchrotron radiation: organic and inorganic-organic mixed aerosol analysis. *The European Physical Journal D*. **70**, 154 (2016).
18. K. L. Barbu-Debus, M. Broquier, **A. Mahjoub**, A. Zehnacker-Rentien, Chiral Recognition between α -Hydroxylesters: A Double-Resonance IR/UV Study of the Complexes of Methyl Mandelate with Methyl Glycolate and Methyl Lactate. *J. Phys. Chem. A*. **112**, 9731–9741 (2008).
19. M. Ben Messaouda, **A. Mahjoub**, M. Mogren Al-Mogren, M. Abderrabba, M. Hochlaf, Substituent effects on vibrational and electronic excitation spectra of pyridone tautomers and ions: The case of the cyano group. *Journal of Molecular Structure*. **1074**, 422–428 (2014).
20. M. Ben Messaouda, M. Abderrabba, **A. Mahjoub**, G. Chambaud, M. Hochlaf, Theoretical study of the spectroscopy of methyl substituted 2-Pyridones, tautomers and ions. *Computational and Theoretical Chemistry*. **990**, 94–99 (2012).
21. A. Chakraborty, N. Guchhait, K. Le Barbu-Debus, **A. Mahjoub**, V. Lepère, A. Zehnacker-Rentien, Role of Conformational Isomerism in Solvent-Mediated Charge Transfer in Chiral (S) 1,2,3,4-Tetrahydro-3-isoquinoline Methanol (THIQM): Condensed-Phase to Jet-Cooled Spectroscopic Studies. *J. Phys. Chem. A*. **115**, 9354–9364 (2011).
22. B. Cunha de Miranda, G. A. Garcia, F. Gaie-Levrel, **A. Mahjoub**, T. Gautier, B. Fleury, L. Nahon, P. Pernot, N. Carrasco, Molecular Isomer Identification of Titan's Tholins Organic Aerosols by Photoelectron/Photoion Coincidence Spectroscopy Coupled to VUV Synchrotron Radiation. *J. Phys. Chem. A*. **120**, 6529–6540 (2016).
23. B. Fleury, N. Carrasco, T. Gautier, **A. Mahjoub**, J. He, C. Szopa, E. Hadamcik, A. Buch, G. Cernogora, Influence of CO on Titan atmospheric reactivity. *Icarus*. **238**, 221–229 (2014).
24. T. Gautier, N. Carrasco, **A. Mahjoub**, S. Vinatier, A. Giuliani, C. Szopa, C. M. Anderson, J.-J. Correia, P. Dumas, G. Cernogora, Mid- and far-infrared absorption spectroscopy of Titan's aerosols analogues. *Icarus*. **221**, 320–327 (2012).
25. T. Gautier, Z. Peng, A. Giuliani, N. Carrasco, G. Cernogora, **A. Mahjoub**, J.-J. Correia, C. Szopa, P. Pernot, A. Buch, Y. Benilan, Photochemistry simulation of planetary atmosphere using synchrotron radiation at soleil. Application to Titan's atmosphere. *European Astronomical Society Publications Series*. **58**, 199–203 (2012).
26. E. Hadamcik, J.-B. Renard, **A. Mahjoub**, T. Gautier, N. Carrasco, G. Cernogora, C. Szopa, Optical properties of analogs of Titan's aerosols produced by dusty plasma. *Earth, Planets and Space*. **65**, 1175–1184 (2013).
27. K. Le Barbu-Debus, M. Broquier, **A. Mahjoub**, A. Zehnacker-Rentien, Chiral recognition in jet-cooled complexes of (1R,2S)-(+)-cis-1-amino-2-indanol and methyl lactate: on the importance of the $\text{CH}\cdots\pi$ interaction. *Phys. Chem. Chem. Phys.* **11**, 7589–7598 (2009).

28. K. Le Barbu-Debus, M. Broquier, **A. Mahjoub**, A. Zehnacker-Rentien, Chiral recognition between alpha-hydroxyesters: a double-resonance IR/UV study of the complexes of methyl mandelate with methyl glycolate and methyl lactate. *J Phys Chem A*. **112**, 9731–9741 (2008).
29. S. Leach, G. A. Garcia, **A. Mahjoub**, Y. Bénilan, N. Fray, M.-C. Gazeau, F. Gaie-Levrel, N. Champion, M. Schwell, Ionization photophysics and spectroscopy of cyanoacetylene. *The Journal of Chemical Physics*. **140**, 174305 (2014).
30. V. Muñoz-Iglesias, M. Choukroun, T. H. Vu, R. Hodyss, **A. Mahjoub**, W. D. Smythe, C. Sotin, Phase Diagram of the Ternary Water–Tetrahydrofuran–Ammonia System at Low Temperatures. Implications for Clathrate Hydrates and Outgassing on Titan. *ACS Earth Space Chem*. **2**, 135–146 (2018).
31. Y. Pan, K.-C. Lau, M. M. Al-Mogren, **A. Mahjoub**, M. Hochlaf, Theoretical studies of 2-quinolinol: Geometries, vibrational frequencies, isomerization, tautomerism, and excited states. *Chemical Physics Letters*. **613**, 29–33 (2014).
32. Z. Peng, T. Gautier, N. Carrasco, P. Pernot, A. Giuliani, **A. Mahjoub**, J.-J. Correia, A. Buch, Y. Bénilan, C. Szopa, G. Cernogora, Titan’s atmosphere simulation experiment using continuum UV-VUV synchrotron radiation. *Journal of Geophysical Research: Planets*. **118**, 778–788 (2013).
33. M. J. Poston, **A. Mahjoub**, B. L. Ehlmann, J. Blacksberg, M. E. Brown, R. W. Carlson, J. M. Eiler, K. P. Hand, R. Hodyss, I. Wong, Visible Near-infrared Spectral Evolution of Irradiated Mixed Ices and Application to Kuiper Belt Objects and Jupiter Trojans. *The Astrophysical Journal*. **856**, 124 (2018).
34. I. Wong, M. E. Brown, J. Blacksberg, B. L. Ehlmann, **A. Mahjoub**, Hubble Ultraviolet Spectroscopy of Jupiter Trojans. *The Astronomical Journal*. **157**, 161 (2019).
35. M. Albrecht, A. Borba, K. Le Barbu-Debus, B. Dittrich, R. Fausto, S. Grimme, **A. Mahjoub**, M. Nedić, U. Schmitt, L. Schrader, M. A. Suhm, A. Zehnacker-Rentien, J. Zischang, Chirality influence on the aggregation of methyl mandelate. *New J. Chem*. **34**, 1266–1285 (2010).

Selected Communications

- 1- “Exploring complex Organosulfur Chemistry in comet 67P”, ACS meeting, 2023 (talk)
- 2- “Organosulfur Chemistry in cometary materials: Insights from the Rosina data and Laboratory simulations”, LPSC, 2022 (talk)
- 3- “Development of a new experimental platform to constrain the chemical composition of Titan’s lakes”, LPSC, 2016 (poster)
- 4- “Electron irradiation and thermal driven chemistry on H₂S-CH₃OH-NH₃-H₂O and CH₃OH-NH₃-H₂O ices: application to Jupiter Trojans, EPSC, 2015 (talk)
- 5- “Laboratory simulation of Titans lakes: developing a new experimental facility to constrain the chemical composition of Titans liquid surfaces, EPSC, 2015 (poster)

- 6- "Thermal and electron processing of outer solar system ices simulants: Chemical and spectroscopic laboratory characterization", DPS meeting 2014 (poster)
- 7- "Chemical and optical characterization of Titan's aerosols analogues produced by RF plasma", JPL NASA Center, Pasadena, June 2013 (Invited seminar)
- 8- "Influence of methane concentration on optical constants of Titan aerosols analogues", Titan through time II workshop, April 2012, Goodard NASA Center (talk)
- 9- "Spectroscopic study of of Cyanoacetylene cation, Slow Photo-electron Spectroscopy and Ab-initio investigations", 68th International Symposium on Molecular Spectroscopy, Ohio State University, June 2013 (talk)
- 10- "Slow photoelectron spectroscopy and state-selected unimolecular decomposition of ionized DNA bases analogues". 68th International Symposium on Molecular Spectroscopy, Ohio State University, June 2013 (talk)
- 11- "Amines and optical properties of Titan's aerosols" EPSC 2012 (European Planetary Science Congress), Madrid: Espagne (2012) (talk)
- 12- "Optical properties of organic material produced in a dusty plasma", ESCAMPIG, July 2012, Portugal (poster)
- 13- "Mid- and far-infrared absorption spectroscopy of Titan's tholins", Goldshmidt-2012, Montréal (talk)
- 14- "Understanding the formation and properties of Titan's aerosols with the PAMPRE laboratory experiment, Goldschmidt-2012, Montréal (talk)
- 15- Indices optique de couches minces organiques produites par plasma RF », PAMOJSM (2012) Metz (talk)
- 16- "On the influence of CO on a dusty N₂-CH₄ CCP RF discharge", ESCAMPIG, July 2012, Portugal (poster)
- 17- "RF capacitively coupled plasmas in N₂-H₂ mixtures", ESCAMPIG, July 2012, Portugal (poster)
- 18- "Influence of H₂ added in N₂ plasma", CIP 2011, July 2011, Nantes (poster)
- 19- "Optical constants of Titan's aerosols analogues, DPS 2011, October 2011, Nantes (poster)
- 20- "Theoretical spectroscopy of 2-pyridone dimer", International conference of theoretical chemistry, June, 2011, Tunisia, (poster)
- 21- "Chiral recognition in hydrogen bonded complexes", Mars 2010, Institute of physical chemistry, Dusseldorf University, Germany, (talk)
- 22- Processus énantiosélectifs dans des complexes de van der Waals », Mars 2010, MSME, Université de Marne la vallée, (talk)
- 23- "Chirality influence on the aggregation of methyl mandelate", Mars 2009, Université Paris-sud (talk)
- 24- "enantioselective processus in hydrogen bonded complexes" Sept 16 2007 - Sept 19 2007, 10th Workshop of PCCG (poster)
- 25- "Chiral recognition in the gas phase: the role of secondary interactions", ICP, 2009 (talk)