

Dr. Ashwin Sharma Braude

Research Experience

- 2019-2022 **Postdoctoral Researcher**,
*Centre National de la Recherche Scientifique (CNRS)/
Laboratoire Atmosphères, Milieux, Observations Spatiales (LATMOS),
Guyancourt, France,*
PI: Dr. Franck Montmessin
Martian atmospheric trace gas detection from the ExoMars TGO/ACS instrument and monitoring of ozone and aerosols from MAVEN/IUVS, using spectral retrievals and machine learning
- 2022 **Researcher**, *Frontier Development Lab (FDL Europe)*
Applied machine learning to understand and track storm clouds resulting from extreme wildfire events.
- 2015–2019 **DPhil (PhD) project**,
University of Oxford, Oxford, UK,
Supervisor: Prof. Patrick Irwin
Using visible and near-infrared spectra from the VLT/MUSE instrument to study changes in the visible appearance of Jupiter and Saturn between 2014 and 2018, and the origin of their colour ('chromophore')
- 2013–2014 **Master's Project**,
*Institut de Planétologie et d'Astrophysique de Grenoble (IPAG),
Joseph Fourier University, Grenoble, France,*
Title: "Studying Martian Dust Climatology Through The Analysis Of Hyperspectral Multi-Angular Observations Of The Red Planet"
Supervisor: Dr. Sylvain Douté
9-month project processing and analysing phase function data from the MRO/CRISM instrument
- 2010 **Nuffield Research Placement**,
*Mullard Space Science Laboratory (MSSL),
University College London (UCL), Holmbury St Mary, UK,*
Supervisor: Dr Christopher Arridge
Summer project (six weeks) modelling the trajectories of charged ice grains emitted from volcanoes on the surface of Enceladus. Won British Science Association Gold CREST Award

Education

- 2015–2019 **DPhil (PhD) in Atmospheric, Oceanic and Planetary Physics**,
University of Oxford,
Oxford, UK,
Title of thesis: "Colour and Cloud Structure in the Atmospheres of the Giant Planets"
- 2011–2015 **Physics with a Year in Europe MSci**,
Imperial College London,
London, UK
- 2013–2014 **Physics with a Year in Europe MSci (Erasmus Year)**,
Ecole nationale supérieure de PHysique, ELectronique et MAtériaux (PHELMA), Grenoble, France
Obtained first-class average in courses in Nuclear Physics, Fluid Dynamics, Material Science, Plasma Physics and Nanoscience
- 2004–2011 **University College School**, London, UK
4 A-Levels: Mathematics (A*), Further Mathematics (A*), Physics (A), Chemistry (A*); 1 AS-Level: German (A); 11 GCSEs (10 A*, 1A)

Teaching

Oxford MSci Physics assignment marking: *Physics of Atmospheres and Oceans*, **2017-2018**.

Undergraduate Student Supervision

Anne CORNILLON (L3, École Normale Supérieure, Paris, France)

Project title: "Detection of ozone in the Martian atmosphere from remote sensing data using machine learning".
2021

Other Responsibilities

Journal reviewer: Icarus, Earth and Space Science

Proposal reviewer: French National Research Agency (Agence Nationale de Recherche, ANR)

Relevant Skills and Courses

Programming languages:

- Daily use: Python (including Tensorflow/Keras), MATLAB, IDL, Fortran, Linux command line
- Previous experience: C++, Assembler language

Specific software knowledge:

- Non-linear Optimal Estimator for Multivariate Spectral analysis (NEMESIS) radiative transfer and retrieval code (Irwin et al. 2008, JQSRT 109, 1136-1150)
- ISIS3 for data calibration (primarily with the Cassini/VIMS and Galileo/NIMS instruments)

Accreditations:

- Deep Learning Specialisation, Stanford University via Coursera, **2021**
- Machine Learning, Stanford University via Coursera, **2020**
- Astrobiology and the Search for Extraterrestrial Life, University of Edinburgh via Coursera, **2018**
- Space Mission Design and Operations, École Polytechnique Fédérale de Lausanne via EdX, **2017**

Languages

English	Mother tongue
French	C1
German	B2/C1
Spanish	B1
Hindi	A2/B1

Awards

STFC Doctoral Training Award (£49 000), 2015

Membership of Professional Societies

Royal Astronomical Society, 2016-present

European Astronomical Society, 2019-present

PI Telescope Programmes

Very Large Telescope (VLT)/Multi-Unit Spectroscopic Explorer (MUSE)

- **Braude, A. S.**; Irwin, P. G. J.; Fletcher, L. N. and Orton, G. S.: “MUSE Observations of Saturn’s 3-Dimensional Cloud Structure in the post-Cassini era.” Period 103 (April 2019 - September 2019), programme 0103.C-0082 (1.8 hours granted)
- **Braude, A. S.**; Irwin, P. G. J.; Fletcher, L. N. and Orton, G. S.: “MUSE Observations of Jupiter’s 3-Dimensional Cloud Structure During NASA’s Juno Mission.” Period 103 (April 2019 - September 2019), programme 0103.C-0045 (4.4 hours granted)
- **Braude, A. S.**; Irwin, P. G. J.; Fletcher, L. N. and Orton, G. S.: “MUSE Observations of Jupiter’s 3-Dimensional Cloud Structure During NASA’s Juno Mission.” Period 101 (April 2018 - September 2018), programme 0101.C-0097 (2.8 hours granted)

Outreach and other volunteering/non-academic participation

- **Abingdon Primary Partnership:** Teaching concepts related to planetary spectroscopy to local schoolchildren aged 9-11. **2018.**
- **Stargazing Live:** Presenter at ‘Science Café’, introducing members of the public of all ages to planetary spectroscopy through hands-on stalls and activities. **Annually between 2017 and 2019.**
- **Curiosity Carnival:** Presenter at the Oxford Museum of Natural History, introducing members of the public of all ages to Earth observation techniques. **2017.**

- **IsaacPhysics:** Working with sixth-form students (16-18 years old) on exercises and problem-solving techniques related to maths and physics. **2016**.
- **University Challenge:** Represented Imperial College London on one of the UK's most prestigious university quiz shows, televised on the BBC and on average attracting 2-3 million weekly viewers. **2015**.
- **Thái Nguyên University of Technology:** 8 week placement at a university in Thái Nguyên City, Vietnam, teaching English to university students and to young children. Sponsored by the International Association for the Exchange of Students for Technical Experience (IAESTE). **2013**.

Publications (peer-reviewed)

- **Braude, A. S.;** Montmessin, F.; Schneider, N. M.; Gupta, S.; Jain, S. K.; Lefèvre, F.; Määttänen, A.; Verdier, L.; Flimon, Z.; Jiang, F. Y.; Yelle, R. V.; Deighan, J. and Curry, S.: “Seasonal, latitudinal, and longitudinal trends in night-time ozone vertical structure on Mars from MAVEN/IUVS stellar occultations”. *JGR: Planets*, **in press**.
- Gupta, S.; Yelle, R. V.; Schneider, N. M.; Jain, S. K.; González-Galindo, F.; Verdier, Loic; **Braude, A. S.;** Montmessin, F.; Mayyasi, M.; Deighan, J. and Curry, S.: “Thermal Structure of the Martian Upper Mesosphere/Lower Thermosphere from MAVEN/IUVS Stellar Occultations”. *JGR: Planets*, **2022**, 127, e2022JE007534.
- **Braude, A. S.;** Montmessin, F.; Olsen, K. S.; Trokhimovskiy, A.; Korablev, O. I.; Lefèvre, F.; Fedorova, A. A.; Alday, J.; Baggio, L.; Irbah, A.; Lacombe, G.; Forget, F.; Millour, E.; Wilson, C. F.; Patrakeevev, A. and Shakun, A.: “No detection of SO₂, H₂S, or OCS in the atmosphere of Mars from the first two Martian years of observations from TGO/ACS”. *A&A*, **2022**, 658, A86.
- Alday, J.; Wilson, C. F.; Irwin, P. G. J.; Trokhimovskiy, A.; Montmessin, F.; Fedorova, A. A.; Belyaev, D. A.; Olsen, K. S.; Korablev, O.; Lefèvre, F.; **Braude, A. S.;** Baggio, L.; Patrakeevev, A. and Shakun, A.: “Isotopic Composition of CO₂ in the Atmosphere of Mars: Fractionation by Diffusive Separation Observed by the ExoMars Trace Gas Orbiter”. *JGR: Planets*, **2021**, 126, e2021JE006992.
- **Braude, A. S.;** Ferron, S. and Montmessin, F.: “The RISOTTO radiative transfer and retrieval pipeline for the analysis of occultation spectra”. *JQSRT, Elsevier*, **2021**, 274, 107848.
- Olsen, K.S.; Trokhimovskiy, A.; **Braude, A. S.;** Korablev, O. I.; Fedorova, A. A.; Wilson, C. F.; Patel, M. R.; Irwin, P. G. J.; Montmessin, F.; Lefèvre, F.; Baggio, L.; Alday, J.; Belyaev, D. A.; Patrakeevev, A. and Shakun, A.: “Upper limits for phosphine (PH₃) in the atmosphere of Mars”. *A&A*, **2021**, 649, L1
- Montmessin, F.; Korablev, O. I.; Trokhimovskiy, A.; Lefèvre, F.; Fedorova, A. A.; Baggio, L.; Irbah, A.; Lacombe, G.; Olsen, K. S.; **Braude, A. S.;** Belyaev, D. A.; Alday, J.; Forget, F.; Daerden, F.; Pla-Garcia, J.; Rafkin, S.; Wilson, C. F.; Patrakeevev, A.; Shakun, A. and Bertaux, J. L.: “A stringent upper limit of 20 pptv for methane on Mars and constraints on its dispersion outside Gale crater”. *A&A*, **2021**, 650, A140.
- Pérez-Hoyos, S.; Sánchez-Lavega, A.; Sanz-Requena, J. F.; Barrado-Izagirre, N.; Carrión-González, O.; Anguiano-Arteaga, A.; Irwin, P. G. J. and **Braude, A. S.:** “Color and aerosol changes in Jupiter after a North Temperate Belt disturbance”. *Icarus, Elsevier*, **2020**, 352, 114031.
- **Braude, A. S.;** Irwin, P. G. J.; Orton, G. S. and Fletcher, L. N.: “Colour and tropospheric cloud structure of Jupiter from MUSE/VLT: Retrieving a universal chromophore”. *Icarus, Elsevier*, **2020**, 338, 113589.

- Irwin, P. G. J.; Toledo, D.; **Braude, A. S.**; Bacon, R.; Weilbacher, P. M.; Teanby, N. A.; Fletcher, L. N. and Orton, G. S.: “Latitudinal variation in the abundance of methane (CH₄) above the clouds in Neptune’s atmosphere from VLT/MUSE Narrow Field Mode Observations”. *Icarus, Elsevier*, **2019**, 331, 69-82
- Irwin, P. G. J.; Bowles, N.; **Braude, A. S.**; Garland, R.; Calcutt, S.; Coles, P. A.; Yurchenko, S. N. and Tennyson, J.: “Analysis of gaseous ammonia (NH₃) absorption in the visible spectrum of Jupiter - Update”. *Icarus, Elsevier*, **2019**, 321, 572-582
- Irwin, P. G. J.; Bowles, N.; **Braude, A. S.**; Garland, R. and Calcutt, S.: “Analysis of gaseous ammonia (NH₃) absorption in the visible spectrum of Jupiter”. *Icarus, Elsevier*, **2018**, 302, 426-436

Proceedings

- **Braude, A.**; Montmessin, F.; Schneider, N.; Gupta, S.; Jain, S.; Lefèvre, F.; Verdier, L.; Flimon, Z.; Jiang, F.; Yelle, R. and Deighan, J.: “Seasonal and longitudinal variations in ozone and aerosol vertical distribution on Mars from MAVEN/IUVS”. In *AAS/Division for Planetary Sciences Meeting Abstracts*, vol. 54. **2022**.
- Dahl, E.; Orton, G.; Chanover, N.; Baines, K.; Carlson, R.; **Braude, A.**; Sinclair, J.; Voelz, D.; Wijerathna, E. and Irwin, P.: “An Investigation of the Structure, Color, and Potential Formation Mechanisms of Jupiter’s 2018-2022 Equatorial Zone Disturbance”. In *AAS/Division for Planetary Sciences Meeting Abstracts*, vol. 54. **2022**.
- Tazi, K.; Diaz, E.; **Braude, A. S.**; Okoh, D.; Lamb, K.; Watson-Parris, D.; Harder, P. and Meinert, N.: “Pyrocast: a Machine Learning Pipeline to Forecast Pyrocumulonimbus (PyroCb) Clouds”. In *NeurIPS 2022 Workshop on Causality for Real-world Impact*, **2022**.
- Diaz, E.; Tazi, K.; **Braude, A. S.**; Okoh, D.; Lamb, K.; Watson-Parris, D.; Harder, P. and Meinert, N.: “Identifying causes of Pyrocumulonimbus (PyroCb)”. In *NeurIPS 2022 Workshop on Tackling Climate Change with Machine Learning*, **2022**.
- **Braude, A. S.**; Montmessin, F.; Olsen, K.; Trokhimovskiy, A.; Korablev, O.; Lefèvre, F.; Fedorova, A.; Alday, J.; Baggio, L.; Irbah, A.; Lacombe, G.; Forget, F.; Millour, E.; Wilson, C. F.; Patrakeevev, A. and Shakun, A.: “Upper limits on volcanic gases in the Martian atmosphere from the ACS MIR instrument”. In *European Planetary Science Congress*, vol. 16. **2022**.
- **Braude, A. S.**; Montmessin, F.; Olsen, K.; Vals, M.; Alday, J.; Rossi, L.; Trokhimovskiy, A.; Fedorova, A.; Schmidt, F.; Korablev, O.; Lefèvre, F.; Baggio, L.; Irbah, A.; Lacombe, G.; Patrakeevev, A. and Shakun, A.: “Measurements of HDO and the D/H ratio in the Martian atmosphere from ACS MIR”. In *European Planetary Science Congress*, vol. 16. **2022**.
- Vals, M.; Montmessin, F.; Rossi, L.; **Braude, A.**; Lefèvre, F.; Gonzalez-Galindo, F.; Chaufray, J.-Y.; Fedorova, A.; Alday, J.; Forget, F.; Millour, E.; Korablev, O.; Trokhimovskiy, A. and Shakun, A.: “Modeling the Martian HDO cycle with a Global Climate Model during the ‘dusty’ season”. In *European Planetary Science Congress*, vol. 16. **2022**.
- Montmessin, F.; Korablev, O.; Trokhimovskiy, A.; Olsen, K.; Lefèvre, F.; Baggio, L.; **Braude, A.**; Fedorova, A.; Knutsen, E. W.; Irbah, A.; Lacombe, G.; Patrakeevev, A. and Shakun, A.: “A Four-Year Search of Methane on Mars with ACS onboard ExoMars TGO”. In *European Planetary Science Congress*, vol. 16. **2022**.

- **Braude, A. S**; Montmessin, F.; Verdier, L.; Flimon, Z.; Lefèvre, F.; Gupta, S.; Jain, S. K.; Schneider, N. M.; Deighan, J.; Jiang, F. Y. and Yelle, R.: “Monitoring Ozone and Aerosol in the Martian Mesosphere from MAVEN/IUVS Stellar Occultation Observations between MY 32 and 36”. *The Fifth International Workshop on the Mars Atmosphere: Modelling and Observation*, **2022**.
- Stcherbinine, A.; Montmessin, F.; Vincendon, M.; Wolff, M. J.; Vals, M.; Edwards, C. S.; Trokhimovskiy, A.; Korablev, O.; Fedorova, A.; Luginin, M.; Lacombe, G.; Baggio, L. and **Braude, A.**: “1.5 Martian Years of Monitoring of the Martian Water Ice Clouds with TGO/ACS-MIR”. *The Fifth International Workshop on the Mars Atmosphere: Modelling and Observation*, **2022**.
- Gupta, S.; Schneider, N. M.; Jain, S. K.; Deighan, J.; Yelle, R. V.; Jiang, F. Y.; Verdier, L.; **Braude, A. S.** and Montmessin, F.: “Diurnal Variations in the Martian Atmosphere from Enhanced MAVEN/IUVS Stellar Occultation Dataset”. *The Fifth International Workshop on the Mars Atmosphere: Modelling and Observation*, **2022**.
- Alday, J.; Holmes, J. A.; Patel, M. R.; Mason, J. P.; Trokhimovskiy, A.; Fedorova, A. A.; Belyaev, D. A.; Korablev, O.; Lefèvre, F.; Montmessin, F.; Baggio, L.; **Braude, A. S.**; Olsen, K. S.; Irwin, P. G. J. and Wilson, C. F.: “Constraining the Odd-Hydrogen Chemistry in the Atmosphere of Mars with the EXOMARS Trace Gas Orbiter”. *The Fifth International Workshop on the Mars Atmosphere: Modelling and Observation*, **2022**.
- Trokhimovskiy, A.; Fedorova, A. A.; Korablev, O. I.; Belyaev, D. A.; **Braude, A. S.**; Montmessin, F.; Lefèvre, F.; Alday, J. and Olsen, K. S.: “ACS Trace Gas Detection Attempts”. *The Fifth International Workshop on the Mars Atmosphere: Modelling and Observation*, **2022**.
- Stcherbinine, A.; Montmessin, F.; Vincendon, M.; Wolff, M. J.; Korablev, O.; Fedorova, A.; Trokhimovskiy, A.; Lacombe, G.; Baggio, L.; Irbah, A. and **Braude, A.**: “Monitoring of Martian water ice clouds over one Martian Year with TGO/ACS-MIR”. *EGU General Assembly*, **2022**.
- Korablev, O.; Montmessin, F.; Trokhimovskiy, A.; Lefevre, F.; Fedorova, A.; Baggio, L.; Irbah, A.; Lacombe, G.; Olsen, K.; Belyaev, D.; **Braude, A.**; Alday, J.; Forget, F.; Daerden, F.; Pla-Garcia, J.; Rafkin, S.; Wilson, C.; Patrakeevev, A.; Shakun, A. and Bertaux, J.-L.: “A Stringent Upper Limit of 20 pptv for Methane on Mars and Constraints on Its Dispersion Outside Gale Crater”. In *AGU Fall Meeting Abstracts*, **2021**.
- Rossi, L.; Vals, M.; Montmessin, F.; Alday, J.; **Braude, A.**; Forget, F.; Millour, E.; Olsen, K.; Fedorova, A.; Trokhimovskiy, A. and Korablev, O.: “Comparison of the HDO cycle in the LMD Mars GCM with ACS/TGO observations”. In *European Planetary Science Congress*, vol. 15. **2021**.
- **Braude, A.**; Irwin, P.; Fletcher, L. and Pallé, E.: “Characterising the colour and vertical structure of Saturn’s haze using observations from the VLT/MUSE instrument”. *EPSC-DPS Joint Meeting 2019*, **2019**.
- Irwin, P. G. J.; Fletcher, L. N.; Teanby, N. A.; Orton, G. S.; Toledo, D.; **Braude, A.** and Bezaud, Bruno.: “Latitudinal variation in abundance of hydrogen sulphide (H₂S) and methane (CH₄) in the atmosphere of Neptune” In *EGU General Assembly Conference Abstracts*, **2019**.
- **Braude, A.**; Irwin, P.; Orton, G. and Fletcher, L.: “Retrieving a universal chromophore to constrain visible changes in Jupiter’s appearance between 2014–2018.” In *AAS/Division for Planetary Sciences Meeting Abstracts*, vol. 50. **2018**.
- Wittal, M. M. ; Orton, G.; Sinclair, J.; Wong, M.; Simon, A.; Irwin, P.; **Braude, A.**: “Jovian Hotspots in the NEB in the Visible and Near-IR from Hubble and Ground-Based IR Observations”. In *American Astronomical Society Meeting Abstracts*, vol. 231. **2018**.

- **Braude, A. S.**; Irwin, P. G. J.; Orton, G. S. and Fletcher, L. N.: "Identifying the source of colour and featural changes in Jupiter's atmosphere from MUSE/VLT." In *European Planetary Science Congress*, vol. 11. **2017**.
- Irwin, P. G. J.; Garland, R.; **Braude, A.**: "Absorption of Ammonia (NH₃) in the visible/near-infrared reflectance spectrum of Jupiter." In *European Planetary Science Congress*, vol. 11. **2017**.
- **Braude, A.**; Irwin, P.; Orton, G. S. and Fletcher, L.: "Identifying the source of colours in the Jovian atmosphere." In *AAS/Division for Planetary Sciences Meeting Abstracts*, vol. 48. **2016**.