

# Colin P. Johnstone Mphys PhD

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I am an experienced scientist and software developer with a strong background in physics, mathematics, data analysis, machine learning, and software development. I am an expert problem solver with the ability to rapidly learn new technical skills and software packages and I have experience with multiple programming languages and good software development practices.

## EXPERTISE & SKILLS

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- **Software development:** Extensive experience with scientific code development, including programming with multiple languages (Python, R, Fortran, F#, IDL, C, C++, C#), version control using git, GitHub, and Azure DevOps, and quality assurance procedures (e.g. unit/integration testing and benchmarking).
- **Data analysis and machine learning:** Excellent skills in collecting, analysing, and interpreting large datasets of many types using a range of methods and tools, including modern machine learning methods and software (e.g., TensorFlow, scikit-learn).
- **Modelling physical systems:** Advanced education in physics and over a decade of experience researching physical systems in the astrophysics and biomedical domains.
- **Team leadership:** Experience leading research projects and running international teams of researchers with diverse expertise, as well as experience leading software development. Project and team management experience using Confluence/Jira.
- **Communication:** Excellent ability to present complex scientific topics in oral and written form, with experience writing technical documents (e.g. scientific papers, software user manuals) and presenting complex topics to expert and non-expert audiences.
- **Languages:** English (native speaker), German (fluency), Russian (beginner).

## EDUCATION

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**University of St Andrews**  
**2008 – June, 2013**

*PhD, Astrophysics*  
*St Andrews, Scotland*

**September University of St Andrews**  
**2004 – June, 2008**

*Mphys, Astrophysics*  
*St Andrews, Scotland*

**September**

## WORK EXPERIENCE

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### **International Institute for Applied Systems Analysis**

**August 2023 – Present**

Main responsibilities: development of forest model and scientific research.

### **Emergentec Biodevelopment, Vienna**

**December 2020 – August 2023**

Main responsibilities: software development and data analysis.

### **Natural History Museum Vienna**

**December 2019 – November 2020**

Main responsibilities: software development and scientific research.

### **University of Vienna**

**May 2012 – January 2021**

Main responsibilities: scientific researcher and undergraduate lecturing.

### **University of St Andrews**

**October 2008 – May 2012**

Main responsibilities: undergraduate teaching.

## KEY ACHIEVEMENTS

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- **The Kompot Code for planetary atmospheres:** I developed a state-of-the-art first principles physical model for planetary atmospheres that includes sophisticated treatments of hydrodynamics, radiation transfer, and chemical and thermal processes. I developed all numerical solvers and wrote the entire code (~50,000 lines in Python and Fortran).
- **Model for the Rotation of Stars (MORS):** I developed a detailed description of the evolution of stars and published a corresponding publically available Python package now used by researchers around the world (<https://github.com/ColinPhilipJohnstone/Mors>).
- **European Geophysical Union General Assembly:** I was awarded and convened (as primary convener) the session PS1.9 with the title “The Earth as an exoplanet and recent advances in exoplanetary habitability” at EGU2019 in Vienna, Austria.
- **International team at International Space Science Institute:** I was awarded and coordinated as principle investigator an international team at International Space Science Institute (ISSI) in Bern, Switzerland with the title “The Early Evolution of the Atmospheres of Earth, Venus, and Mars” (<http://www.issibern.ch/teams/eofaevm/>).
- **Publishing:** I have published over 100 scientific publications including 55 peer reviewed papers ([shorturl.at/CFNR6](http://shorturl.at/CFNR6)) in top international journals, including Nature Astronomy and Earth & Planetary Science Letters, with over 2000 citations. These include 16 peer reviewed papers with me as first author with over 500 citations and contributions to several books.
- **Invited lecture series:** I held an invited lecture series on planetary atmospheres at the annual stellar physics summer school Evry Schatzman 2019 in Aussois, France (September, 2019), which included the writing of a detailed review chapter.
- **Invited talks:** I have given many invited talks at top international scientific conferences and meetings, including
  - Invited talk at the Planet2/RESCEU symposium “From Protoplanetary Disks through Planetary System Architecture to Planetary Atmospheres and Habitability” in 2019 in Okinawa, Japan (14-18 October 2019)
  - Invited review talk at IAU Symposium 328 “Living Around Active Stars” in 2016 in Maresias, Brazil with the title “Heliospheric and Astrospheric Environments - Forcing of Planetary Atmospheres and Magnetospheres”.
  - Invited review talk at the conference “Protoplanetary Discussions” in 2016 in Edinburgh, UK with the title “X-ray properties of disk hosting stars”.
  - Invited review talk at NASA workshop “Impact of Exoplanetary Space Weather on Climate and Habitability” in New Orleans, USA with title “XUV emission and winds from fast and slow rotators”.
  - Invited review talk at COSPAR 2016 in Istanbul, Turkey, with title “Magnetised winds in single and binary star systems” (not given due to cancellation of conference).
  - Invited review talk at the NASA Goddard Space Flight Center workshop “Environments of Terrestrial planets under the Young Sun: Seeds of Biomolecules” in Maryland, USA with the title “The Upper Atmosphere of The Early Earth: Physical Properties and Mass Loss”

### THIRD PARTY FUNDING OBTAINED

My Position	Project title	Amount of Funding	Funding Agency	Funding period
PI	The Early Evolution of the Atmospheres of Earth, Venus, and Mars	Not disclosed	ISSI Bern	2016-2018
co-PI	Interaction of escaping atmospheres of close-orbit exoplanets with stellar winds	339,899.70 Euro	Bilateral FWF-RFBR	2015-201
co-proposer	Evolution of Habitable CONditions on EXoplanets	196,486 Euro	FFG	2020-2022
co-proposer	Pathways from Star Formation to Habitable Planets	57,000 Euro	E. Schrödinger Institute and EU Europlanet	8 weeks in summer 2019
co-proposer	Probing of Hot Jupiters Environmental and Physical Conditions: Numerical Modeling Vs. Observations	13,800 Euro	ICM, OeAD-GmbH	2018-2020
co-proposer	The Atmospheric Evolution of Mars: Combining Geological and Astrophysical Perspectives	7,300 Euro	University of Vienna	2019-2020

**Note:** ISSI = International Space Science Institute, FWF = Austrian Research Foundation, RFBR = Russian Foundation for Basic Research, FFG = Austrian Research Promotion Agency

## PUBLICATION LIST

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ORCID: <https://orcid.org/0000-0002-6786-3615>

### Complete refereed publications list

Link: [ui.adsabs.harvard.edu/public-libraries/yZvZSXwrQjSZ1C1Uc7kqFA](https://ui.adsabs.harvard.edu/public-libraries/yZvZSXwrQjSZ1C1Uc7kqFA)

**Johnstone, C. P.**, Lammer, H., Kislyakova, K. G., Scherf, M., Güdel, M. 2021, The young Sun's XUV-activity as a constraint for lower CO<sub>2</sub>-limits in the Earth's Archean atmosphere, *E&PSL*, 576, 117197, DOI:10.1016/j.epsl.2021.117197, arXiv:2109.01604

Noack, L., Kislyakova, K. G., **Johnstone, C. P.**, Güdel, M., Fossati, L. 2021, Interior heating and outgassing of Proxima Centauri b: Identifying critical parameters, *A&A*, 651, 103, DOI:10.1051/0004-6361/202040176

**Johnstone, C. P.**, Bartel, M., Güdel, M. 2020, The active lives of stars: A complete description of the rotation and XUV evolution of F, G, K, and M dwarfs, *A&A*, 649, 96, DOI:10.1051/0004-6361/202038407, arXiv:2009.07695

Ragossnig, F., Dorfi, E. A., Ratschiner, B., Gehrig, L., Steiner, D., Stökl, A., **Johnstone, C. P.** 2020, 1+1D implicit disk computations, *CoPhC*, 256, 107437, DOI: 10.1016/j.cpc.2020.107437 arXiv:2006.12939

Lammer, H., Scherf, M., Kurokawa, H., Ueno, Y., Burger, C., Maindl, T., **Johnstone, C. P.**, et al. 2020, Loss and Fractionation of Noble Gas Isotopes and Moderately Volatile Elements from Planetary Embryos and Early Venus, Earth and Mars, *Space Science Reviews*, 216, 74, DOI:10.1007/s11214-020-00701-x, arXiv:2011.01064

Airapetian, V. S., Barnes, R., Cohen, O., Collinson, G. A., Danchi, W. C., Dong, C. F., Del Genio, A. D., France, K., Garcia-Sage, K., Glocer, A., Gopalswamy, N., Grenfell, J. L., Gronoff, G., Güdel, M., Herbst, K., Henning, W. G., Jackman, C. H., Jin, M., **Johnstone, C. P.**, et al. 2020, Impact of space weather on climate and habitability of terrestrial-type exoplanets, *IJAsB*, 19, 136, DOI:10.1017/S1473550419000132, arXiv:1905.05093

Lammer, H., Leitzinger, M., Scherf, M., Odert, P., Burger, C., Kubyshkina, D., **Johnstone, C.**, Maindl, T., Schäfer, C. M., Güdel, M., Tosi, N., Nikolaou, A., Marcq, E., Erkaev, N. V., Noack, L., Kislyakova, K. G., Fossati, L., Pilat-Lohinger, E., Ragossnig, F., Dorfi, E. A. 2020, Constraining the early evolution of Venus and Earth through atmospheric Ar, Ne isotope and bulk K/U ratios, *Icarus*, 339, 113551

Boro Saikia, S., Jin, M., **Johnstone, C. P.**, Lüftinger, T., Güdel, M., Airapetian, V. S., Kislyakova, K. G., Folsom, C. P. 2020, The solar wind from a stellar perspective. How do low-resolution data impact the determination of wind properties?, *A&A*, 635, 178, DOI:10.1051/0004-6361/201937107

**Johnstone, C. P.** 2020, Hydrodynamic escape of water vapor atmospheres near very active stars, *ApJ*, 890, 79, DOI:10.3847/1538-4357/ab6224, arXiv:1912.07027

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Dwivedi, N. K., Khodachenko, M. L., Shaikhislamov, I. F., Fossati, L., Lammer, H., Sasunov, Y., Berezutskiy, A. G., Miroshnichenko, I. B., Kislyakova, K. G., **Johnstone, C. P.**, & Güdel, M. 2019, Modelling atmospheric escape and Mg II near-ultraviolet absorption of the highly irradiated hot Jupiter WASP-12b, *Monthly Notices of the Royal Astronomical Society*, 487, 4208, DOI:10.1093/mnras/stz1345, arXiv:1908.02527

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- Johnstone, C. P.**, Khodachenko, M. L., Lüftinger, T., Kislyakova, K. G., Lammer, H., & Güdel, M. 2019, Extreme hydrodynamic losses of Earth-like atmospheres in the habitable zones of very active stars, *Astronomy and Astrophysics*, 624, L10, DOI:10.1051/0004-6361/201935279, arXiv:1904.01063
- Kubyshkina, D., Fossati, L., Erkaev, N. V., **Johnstone, C. P.**, Cubillos, P. E., Kislyakova, K. G., Lammer, H., Lendl, M., & Odert, P. 2018, Grid of upper atmosphere models for 1-40 M $\oplus$  planets: application to CoRoT-7 b and HD 219134 b,c, *Astronomy and Astrophysics*, 619, A151, DOI:10.1051/0004-6361/201833737, arXiv:1809.06645
- Shaikhislamov, I. F., Khodachenko, M. L., Lammer, H., Fossati, L., Dwivedi, N., Güdel, M., Kislyakova, K. G., **Johnstone, C. P.**, Berezutsky, A. G., Miroshnichenko, I. B., Posukh, V. G., Erkaev, N. V., & Ivanov, V. A. 2018, Modeling of Absorption by Heavy Minor Species for the Hot Jupiter HD 209458b, *The Astrophysical Journal*, 866, 47, DOI:10.3847/1538-4357/aadf39
- Ragossnig, F., Stökl, A., Dorfi, E., **Johnstone, C. P.**, Steiner, D., & Güdel, M. 2018, Interaction of infalling solid bodies with primordial atmospheres of disk-embedded planets, *Astronomy and Astrophysics*, 618, A19, DOI:10.1051/0004-6361/201832681, arXiv:1809.05307
- Kubyshkina, D., Fossati, L., Erkaev, N. V., Cubillos, P. E., **Johnstone, C. P.**, Kislyakova, K. G., Lammer, H., Lendl, M., & Odert, P. 2018, Overcoming the Limitations of the Energy-limited Approximation for Planet Atmospheric Escape, *The Astrophysical Journal*, 866, L18, DOI:10.3847/2041-8213/aae586, arXiv:1810.06920
- Johnstone, C. P.**, Güdel, M., Lammer, H., & Kislyakova, K. G. 2018, Upper atmospheres of terrestrial planets: Carbon dioxide cooling and the Earth's thermospheric evolution, *Astronomy and Astrophysics*, 617, A107, DOI:10.1051/0004-6361/201832776, arXiv:1806.06897
- Odert, P., Lammer, H., Erkaev, N. V., Nikolaou, A., Lichtenegger, H. I. M., **Johnstone, C. P.**, Kislyakova, K. G., Leitzinger, M., & Tosi, N. 2018, Escape and fractionation of volatiles and noble gases from Mars-sized planetary embryos and growing protoplanets, *Icarus*, 307, 327, DOI:10.1016/j.icarus.2017.10.031, arXiv:1706.06988
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- Arkhypov, O. V., Khodachenko, M. L., Güdel, M., **Johnstone, C.**, Lüftinger, T., & Lammer, H. 2018, Timescales of starspot variability in slow rotators, *Astronomy and Astrophysics*, 613, A31, DOI:10.1051/0004-6361/201732032
- Kislyakova, K. G., Fossati, L., **Johnstone, C. P.**, Noack, L., Lüftinger, T., Zaitsev, V. V., & Lammer, H. 2018, Effective Induction Heating around Strongly Magnetized Stars, *The Astrophysical Journal*, 858, 105, DOI:10.3847/1538-4357/aabae4, arXiv:1804.06346
- Tian, F., Güdel, M., **Johnstone, C. P.**, Lammer, H., Luger, R., & Odert, P. 2018, Water Loss from Young Planets, *Space Science Reviews*, 214, 65, DOI:10.1007/s11214-018-0490-9
- Kubyshkina, D., Lendl, M., Fossati, L., Cubillos, P. E., Lammer, H., Erkaev, N. V., & **Johnstone, C. P.** 2018, Young planets under extreme UV irradiation. I. Upper atmosphere modelling of the young exoplanet K2-33b, *Astronomy and Astrophysics*, 612, A25, DOI:10.1051/0004-6361/201731816, arXiv:1712.07891

- Arkhipov, O. V., Khodachenko, M. L., Lammer, H., Güdel, M., Lüftinger, T., & **Johnstone, C. P.** 2018, Time-scales of stellar rotational variability and starspot diagnostics, *Monthly Notices of the Royal Astronomical Society*, 473, L84, DOI:10.1093/mnras/lsx170
- Cubillos, P. E., Fossati, L., Erkaev, N. V., Malik, M., Tokano, T., Lendl, M., **Johnstone, C. P.**, Lammer, H., & Wyttenbach, A. 2017, Aerosol Constraints on the Atmosphere of the Hot Saturn-mass Planet WASP-49b, *The Astrophysical Journal*, 849, 145, DOI:10.3847/1538-4357/aa9019, arXiv:1710.02427
- Khodachenko, M. L., Shaikhislamov, I. F., Lammer, H., Kislyakova, K. G., Fossati, L., **Johnstone, C. P.**, Arkhipov, O. V., Berezutsky, A. G., Miroshnichenko, I. B., & Posukh, V. G. 2017, Ly $\alpha$  Absorption at Transits of HD 209458b: A Comparative Study of Various Mechanisms Under Different Conditions, *The Astrophysical Journal*, 847, 126, DOI:10.3847/1538-4357/aa88ad, arXiv:1711.07166
- Erkaev, N. V., Odert, P., Lammer, H., Kislyakova, K. G., Fossati, L., Mezentsev, A. V., **Johnstone, C. P.**, Kubyshkina, D. I., Shaikhislamov, I. F., & Khodachenko, M. L. 2017, Effect of stellar wind induced magnetic fields on planetary obstacles of non-magnetized hot Jupiters, *Monthly Notices of the Royal Astronomical Society*, 470, 4330, DOI:10.1093/mnras/stx1471, arXiv:1708.01594
- Kislyakova, K. G., Noack, L., **Johnstone, C. P.**, Zaitsev, V. V., Fossati, L., Lammer, H., Khodachenko, M. L., Odert, P., & Güdel, M. 2017, Magma oceans and enhanced volcanism on TRAPPIST-1 planets due to induction heating, *Nature Astronomy*, 1, 878, DOI:10.1038/s41550-017-0284-0, arXiv:1710.08761
- Amerstorfer, U. V., Gröller, H., Lichtenegger, H., Lammer, H., Tian, F., Noack, L., Scherf, M., **Johnstone, C.**, Tu, L., & Güdel, M. 2017, Escape and evolution of Mars's CO<sub>2</sub> atmosphere: Influence of suprathreshold atoms, *Journal of Geophysical Research (Planets)*, 122, 1321, DOI:10.1002/2016JE005175
- Cubillos, P., Erkaev, N. V., Juvan, I., Fossati, L., **Johnstone, C. P.**, Lammer, H., Lendl, M., Odert, P., & Kislyakova, K. G. 2017, An overabundance of low-density Neptune-like planets, *Monthly Notices of the Royal Astronomical Society*, 466, 1868, DOI:10.1093/mnras/stw3103, arXiv:1611.09236
- Johnstone, C. P.** 2017, On the fast magnetic rotator regime of stellar winds, *Astronomy and Astrophysics*, 598, A24, DOI:10.1051/0004-6361/201629609, arXiv:1610.02248
- Shaikhislamov, I. F., Khodachenko, M. L., Lammer, H., Kislyakova, K. G., Fossati, L., **Johnstone, C. P.**, Prokopov, P. A., Berezutsky, A. G., Zakharov, Y. P., & Posukh, V. G. 2016, Two Regimes of Interaction of a Hot Jupiter's Escaping Atmosphere with the Stellar Wind and Generation of Energized Atomic Hydrogen Corona, *The Astrophysical Journal*, 832, 173, DOI:10.3847/0004-637X/832/2/173, arXiv:1701.07692
- Lammer, H., Erkaev, N. V., Fossati, L., Juvan, I., Odert, P., Cubillos, P. E., Guenther, E., Kislyakova, K. G., **Johnstone, C. P.**, Lüftinger, T., & Güdel, M. 2016, Identifying the 'true' radius of the hot sub-Neptune CoRoT-24b by mass-loss modelling, *Monthly Notices of the Royal Astronomical Society*, 461, L62, DOI:10.1093/mnras/slw095, arXiv:1605.03595
- Erkaev, N. V., Lammer, H., Odert, P., Kislyakova, K. G., **Johnstone, C. P.**, Güdel, M., & Khodachenko, M. L. 2016, EUV-driven mass-loss of protoplanetary cores with hydrogen-dominated atmospheres: the influences of ionization and orbital distance, *Monthly Notices of the Royal Astronomical Society*, 460, 1300, DOI:10.1093/mnras/stw935, arXiv:1601.00452
- Arkhipov, O. V., Khodachenko, M. L., Lammer, H., Güdel, M., Lüftinger, T., & **Johnstone, C. P.** 2016, Deep Mixing in Stellar Variability: Improved Method, Statistics, and Applications, *The Astrophysical Journal*, 826, 35, DOI:10.3847/0004-637X/826/1/35
- Stökl, A., Dorfi, E. A., **Johnstone, C. P.**, & Lammer, H. 2016, Dynamical Accretion of Primordial Atmospheres around Planets with Masses between 0.1 and 5 M $\oplus$  in the Habitable Zone, *The Astrophysical Journal*, 825, 86, DOI:10.3847/0004-637X/825/2/86
- Lichtenegger, H. I. M., Kislyakova, K. G., Odert, P., Erkaev, N. V., Lammer, H., Gröller, H., **Johnstone, C. P.**, Elkins-Tanton, L., Tu, L., Güdel, M., & Holmström, M. 2016, Solar XUV and ENA-driven water loss from early

Venus' steam atmosphere, *Journal of Geophysical Research (Space Physics)*, 121, 4718, DOI:10.1002/2015JA022226

**Johnstone, C. P.**, Güdel, M., Stökl, A., Lammer, H., Tu, L., Kislyakova, K. G., Lüftinger, T., Odert, P., Erkaev, N. V., & Dorfi, E. A. 2015, The Evolution of Stellar Rotation and the Hydrogen Atmospheres of Habitable-zone Terrestrial Planets, *The Astrophysical Journal*, 815, L12, DOI:10.1088/2041-8205/815/1/L12, arXiv:1511.03647

Arkhypov, O. V., Khodachenko, M. L., Lammer, H., Güdel, M., Lüftinger, T., & **Johnstone, C. P.** 2015, Short-period Stellar Activity Cycles with Kepler Photometry, *The Astrophysical Journal*, 807, 109, DOI:10.1088/0004-637X/807/1/109, arXiv:1506.05725

**Johnstone, C. P.**, & Güdel, M. 2015, The coronal temperatures of low-mass main-sequence stars, *Astronomy and Astrophysics*, 578, A129, DOI:10.1051/0004-6361/201425283, arXiv:1505.00643

Tu, L., **Johnstone, C. P.**, Güdel, M., & Lammer, H. 2015, The extreme ultraviolet and X-ray Sun in Time: High-energy evolutionary tracks of a solar-like star, *Astronomy and Astrophysics*, 577, L3, DOI:10.1051/0004-6361/201526146, arXiv:1504.04546

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Arkhypov, O. V., Khodachenko, M. L., Güdel, M., **Johnstone, C.**, Lüftinger, T., & Lammer, H. 2015, Signs of deep mixing in starspot variability, *Astronomy and Astrophysics*, 576, A67, DOI:10.1051/0004-6361/201425307

Kislyakova, K. G., Fossati, L., **Johnstone, C. P.**, Holmström, M., Zaitsev, V. V., & Lammer, H. 2015, Stellar Wind Induced Soft X-Ray Emission from Close-in Exoplanets, *The Astrophysical Journal*, 799, L15, DOI:10.1088/2041-8205/799/2/L15, arXiv:1503.06955

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**Johnstone, C. P.**, Jardine, M., Gregory, S. G., Donati, J.-F., & Hussain, G. 2014, Classical T Tauri stars: magnetic fields, coronae and star-disc interactions, *Monthly Notices of the Royal Astronomical Society*, 437, 3202, DOI:10.1093/mnras/stt2107, arXiv:1310.8194

**Johnstone, C. P.**, Gregory, S. G., Jardine, M. M., & Getman, K. V. 2012, The soft X-ray light curves of partially eclipsed stellar flares, *Monthly Notices of the Royal Astronomical Society*, 419, 29, DOI:10.1111/j.1365-2966.2011.19666.x, arXiv:1108.3999

Arzoumanian, D., Jardine, M., Donati, J.-F., Morin, J., & **Johnstone, C.** 2011, The contribution of star-spots to coronal structure, *Monthly Notices of the Royal Astronomical Society*, 410, 2472, DOI:10.1111/j.1365-2966.2010.17623.x, arXiv:1008.3613

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## Complete non-refereed publications list

Link: [ui.adsabs.harvard.edu/public-libraries/X5IAuTL1Q4-NkIM3w\\_niaw](https://ui.adsabs.harvard.edu/public-libraries/X5IAuTL1Q4-NkIM3w_niaw)

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