

Jacob Kegerreis

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RESEARCH

Planetary impacts [↗](#) – Simulating giant impacts at 100–1000 times higher resolution than the previous norm, allowing the detailed study of topics including: the origin of the Moon; atmospheric erosion; numerical convergence; improved visualisation techniques; and the formation of Saturn’s rings.

SWIFT simulation code [↗](#) – Lead planetary developer of the SWIFT high-performance hydrodynamics code, including community support and open-source development of improved numerical methods.

EDUCATION

2015–2019 | **PhD** – Institute for Computational Cosmology (ICC), Durham University, UK.
Thesis: [↗](#) *Supervisors:* Vince Eke, Richard Massey.

2011–2015 | **Physics (MPhys)** integrated masters, 1st Class (Hons) – Durham University, UK.

FUNDING AND GRANTS

2025–2030 | **STFC Ernest Rutherford Fellowship**
Hosted by Imperial College London – PI

2024–2027 | **NASA ROSES Emerging Worlds**
“Modelling the formation of Mars’s proto-satellite disk” – PI

2025–2027 | **NASA ROSES Exoplanets Research Program**
“Modelling the Formation of Hot Dense Neptunes” – Science co-lead (PI: J. Lissauer)

2025–2028 | **NASA Internal Scientist Funding Model**
Ames Outer Planets Research Group – Co-I (PI: P. Estrada)

2021–2024 | **NASA Postdoctoral Program Fellowship, USRA / ORAU**
Fellowship at NASA Ames. (Postponed 1 year by covid.)

2019–2021 | **UK Space Agency**
Postdoctoral research associate at Durham University.

2015–2019 | **Science and Technology Facilities Council and ICC PhD Scholarship Fund**
PhD studentship.

2022–2025 | **DiRAC RAC 14th Call Computing Time**
30.6M core-hours on the new COSMA8 cluster (CoI).

2020–2021 | **DiRAC Director’s Discretionary Time**
2.5M core-hours on the new COSMA8 cluster (PI).

2019 | **Ogden Trust Alumni Grant**
Funding for travel to present at the SPHERIC Workshop 2019.

SELECTED PRIZES AND AWARDS

2022 | **DiRAC Research Image Competition** winner, for high-resolution simulations of Moon-forming giant impacts, rendered with Houdini

2020 | **Springer Thesis Award**, recognising international ‘outstanding PhD research’

2019 | **Libersky Student Paper Prize** 2nd place, SPHERIC International Workshop

2018	Career Development Award , Lunar and Planetary Institute
2015	D A Wright Prize for Outstanding Performance in an MPhys Research Project For the highest-marked research project out of a year of 126 students
2015	Bill Bryson Prize for Communication in Science For the winning research presentation from all science faculty students
2015	Audience Choice Award , Rising Stars Research Symposium, Durham University
2012	Durham Physics Award for Outstanding Achievement

CONFERENCES AND MEDIA

Invited talks:

- Ogden Centre 20th anniversary symposium (2022), on the origin of planets and life
- CLEVER Planets seminar series (2022), on terrestrial atmospheric erosion
- ‘SPH: Greatest Hits’ UK Fluids Network meeting (2019), on simulations of planetary giant impacts
- Royal Society and French Academy Bilateral International Meeting (2019), on supercomputing in the physical sciences
- Plenary speaker at the European Simulation and Modelling Conference (2018), on the SWIFT code and Uranus giant impacts
- Frequent institutional colloquia and symposia, e.g. (within the last year): NASA Space Science, Bristol University, UC Santa Cruz, UC Davis.

Numerous press releases and invited interviews and articles with national and international media, e.g.

- **YouTube videos** [↗](#) with >6 million views, the highest on the NASA Ames channel to date
- **Science Friday** segment [↗](#), US radio show with ~1.3 million live listeners
- **New Scientist** [↗](#), Science et Vie, and various newspapers including some ‘interesting’ headlines [↗](#)

OUTREACH

Numerous invited talks at e.g. *Pint of Science*, *Café Scientifique*, and public astronomical societies.

- Developed **cinematic visualisations** [↗](#) of simulation research for public and scientific engagement.
- Consultant Editor for the **Learn about Space and Planets** [↗](#) children’s astronomy activity book.
- Collaborated on the **Our Universe** [↗](#) Netflix top-10 documentary with industry VFX artists (Lux Aeterna) on rendering simulations of Moon-forming impacts.
- Science advisor for the new **Space Zone** [↗](#) exhibit at the Newcastle Life Science Centre.
- Co-created a **demo supercomputer** cluster of Raspberry Pi’s for public engagement.
- Built from scratch a programmable **8-bit computer** on breadboards for Celebrate Science [↗](#).
- Leading role in designing and demonstrating the **Galaxy Makers** [↗](#) exhibition exhibits.

Durham University and STEM.org.uk ambassador

Frequent demonstrating at public and school events (averaging more than one every month before the pandemic), from national festivals to local planetarium shows.

SERVICE

Development and support of open-source tools with extensive documentation and examples, including active community troubleshooting and tech support: SWIFT [↗](#) – hydrodynamics and gravity code; SEAGEN [↗](#) and WOMA [↗](#) – planetary initial conditions; ARCTIC [↗](#) – CTI correction.

Community service

- Organising committee: Bay Area Planetary Science conference (2023–...)
- Journal article reviews: ApJ, MNRAS, Nat. Geosci., PSJ.
- Grant proposal reviews: UKRI/STFC.

Astronomy outreach coordinator (Durham University, 2015–2019)

- Managed the internal astronomy outreach website, enabling ~150 astronomers to share resources and increase engagement with the public and e.g. local schools.
- Co-organised the weekly postgraduate astronomy journal club (2016).

TEACHING AND SUPERVISION

2020–2024	Co-supervisor for Thomas Sandnes, PhD student, working on hydrodynamic simulation schemes, giant impact simulations, and material strength models.
2018–2022	Co-supervisor for Sergio Ruiz-Bonilla, PhD student, working on giant impact simulations and rotating initial conditions.
2019–...	Co-supervision of multiple MPhys thesis projects.
2018–2021	Training postgraduate students <ul style="list-style-type: none">• Teaching advanced programming tools to first-year PhD students.• Ran a training workshop on the SWIFT code for postgraduate students.
2015–2016	Postgraduate student teacher (Durham University) Demonstrator for the undergraduate Level 2 Computational Physics course.

OTHER SKILLS AND LEADERSHIP ROLES

Computing	Python: Advanced experience, mostly analysing and visualising large data sets. C, C++, fortran: Advanced/intermediate experience, mostly high-performance simulation codes and data analysis. git, bash, LaTeX, etc.: Advanced experience, both in solo projects and large development teams.
Languages	Native English speaker Intermediate level Spanish; 7 months teaching children in Quito, Ecuador (2011) Beginner/intermediate level Japanese
Kendo	BKA certified coach, Kendo 3-dan (2016) Founder and coach of the Durham University Kendo Club, teaching three weekly sessions of ~20 members of all ages and abilities (2012–2019)

REFERENCES

Dr. Rick Elphic – NPP Advisor richard.c.elphic@nasa.gov
NASA Ames Research Center, Moffett Field, CA, USA

Dr. Vince Eke – PhD Supervisor v.r.eke@durham.ac.uk
Institute for Computational Cosmology, Durham University, Durham, DH1 3LE, UK

Dr. Jack Lissauer – NPP Co-Advisor jack.lissauer@nasa.gov
NASA Ames Research Center, Moffett Field, CA, USA

PUBLICATION LIST

Lead
author

Origin of Mars's moons by disruptive partial capture of an asteroid. **Kegerreis, J. A.**, Lissauer, J. J., Eke, V. R., Sandnes, T. D., Elphic, R. C. *Icarus*, 425:116337, Nov. 2024. doi: 10.1016/j.icarus.2024.116337. [↗](#)

A recent impact origin of Saturn's rings and mid-sized moons. Teodoro, L. F. A., **Kegerreis, J. A.** (science-lead and corr. author), Estrada, P. R., Čuk, M., Eke, V. R., Cuzzi, J. N., Massey, R. J., Sandnes, T. D. *Astrophys. J.*, 955:2, Oct. 2023. doi: 10.3847/1538-4357/acf4ed. [↗](#)

Immediate Origin of the Moon as a Post-impact Satellite. **Kegerreis, J. A.**, Ruiz-Bonilla, S., Eke, V. R., Massey, R. J., Sandnes, T. D., Teodoro, L. F. A. *Astrophys. J. Lett.*, 937:2 L40, Oct. 2022. doi: 10.3847/2041-8213/ac8d96. [↗](#)

Atmospheric Erosion by Giant Impacts onto Terrestrial Planets: A Scaling Law for any Speed, Angle, Mass, and Density. **Kegerreis, J. A.**, Eke, V. R., Catling, D. C., Massey, R. J., Teodoro, L. F. A., Zahnle, K. J. *Astrophys. J. Lett.*, 901:2, Sept. 2020. doi: 10.3847/2041-8213/abb5fb. [↗](#)

Atmospheric Erosion by Giant Impacts onto Terrestrial Planets. **Kegerreis, J. A.**, Eke, V. R., Massey, R. J., Teodoro, L. F. A. *Astrophys. J.*, 897:2, July 2020. doi: 10.3847/1538-4357/ab9810. [↗](#)

Planetary Giant Impacts: Convergence of High-Resolution Simulations using Efficient Spherical Initial Conditions and SWIFT. **Kegerreis, J. A.**, Eke, V. R., Gonnet, P., Korycansky, D. G., Massey, R. J., Schaller, M., Teodoro, L. F. A. *Mon. Not. R. Astron. Soc.*, 487:4, Aug. 2019. doi: 10.1093/mnras/stz1606. [↗](#) †

Consequences of Giant Impacts on Early Uranus for Rotation, Internal Structure, Debris, and Atmospheric Erosion. **Kegerreis, J. A.**, Teodoro, L. F. A., Eke, V. R., Massey, R. J., Catling, D. C., Fryer, C. L., Korycansky, D. G., Warren, M. S., Zahnle, K. J. *Astrophys. J.*, 861:52, July 2018. doi: 10.3847/1538-4357/aac725. [↗](#) †

Evidence for a Localized Source of the Argon in the Lunar Exosphere. **Kegerreis, J. A.**, Eke, V. R., Massey, R. J., Beaumont, S. K., Elphic, R. C., L. F. Teodoro. *J. Geophys. R. (Planets)*, 122:2163–2181, Oct. 2017. doi: 10.1002/2017JE005352. [↗](#)

Super-
vised PhD
students

REMIX SPH – improving mixing in smoothed particle hydrodynamics simulations using a generalised, material-independent approach. Sandnes, T. D., Eke, V. R., **Kegerreis, J. A.**, Massey, R. J., Ruiz-Bonilla, S., Schaller, M., Teodoro, L. F. A. *J. Comp. Phys.*, in review, 2024. [↗](#)

Dealing with density discontinuities in planetary SPH simulations. Ruiz-Bonilla, S., Borrow, J., Eke, V. R., **Kegerreis, J. A.**, Massey, R. J., Sandnes, T. D., Teodoro, L. F. A. *MNRAS*, 512:3, May 2022. doi: 10.1093/mnras/stac857. [↗](#)

The effect of pre-impact spin on the Moon-forming collision. Ruiz-Bonilla, S., Eke, V. R., **Kegerreis, J. A.**, Massey, R. J., Teodoro, L. F. A. *MNRAS*, 500:3, Jan. 2021. doi: 10.1093/mnras/staa3385. [↗](#)

Co-author	<p><i>SWIFT: A modern highly-parallel gravity and smoothed particle hydrodynamics solver for astrophysical and cosmological applications.</i> Schaller, M., Borrow, J., ..., Kegerreis, J. A., et al. <i>MNRAS</i>, 530:2, May 2023. doi: 10.1093/mnras/stae922. ↗</p> <p><i>Moon-forming impactor as a source of Earth's basal mantle anomalies.</i> Yuan, Q., Li, M., Desch, S. J., Ko, B., Deng, H., Garnero, E. J., Gabriel, T. S. J., Kegerreis, J. A., Miyazaki, Y., Eke, V. R. <i>Nature</i>, 623:7985, Nov. 2023. doi: 10.1038/s41586-023-06589-1. ↗</p> <p><i>Abell 1201: detection of an ultramassive black hole in a strong gravitational lens.</i> Nightingale, Smith, He, O'Riordan, Kegerreis, et al. <i>MNRAS</i>, 521:3, May 2023. doi: 10.1093/mnras/stad587. ↗</p> <p><i>Measurement of the free neutron lifetime using the neutron spectrometer on NASA's Lunar Prospector mission.</i> Wilson, J. T., Lawrence, D. J., Peplowski, P. N., Eke, V. R., Kegerreis, J. A. <i>Phys. Rev. C</i>, 104:4, Oct. 2021. doi: 10.1103/PhysRevC.104.045501. ↗</p> <p><i>Space-based measurement of the neutron lifetime using data from the neutron spectrometer on NASA's MESSENGER mission.</i> Wilson, J. T., Lawrence, D. J., Peplowski, P. N., Eke, V. R., Kegerreis, J. A. <i>Phys. Rev. Res.</i>, 2:2, June 2020. doi: 10.1103/PhysRevResearch.2.023316. ↗</p>
Books and Chapters	<p><i>Learn about Space and Planets: Explore the wonders of our universe.</i> Akass, S., Kegerreis, J. A. (Consultant Editor), CICO Kids, Ryland Peters & Small, Nov. 2021. doi: 10.1007/978-3-319-05546-6_203-1. ↗</p> <p><i>Noble Gases in Encyclopedia of Lunar Science.</i> Eke, V. R., Kegerreis, J. A. (ed. B. Cudnik), Springer Intl. Pub., Nov. 2018. doi: 10.1007/978-3-319-05546-6_203-1. ↗</p>

†Included as part of Durham Physics REF2021 submission, considered by the department to be in the top 5% of research papers.