

# Jacob Kegerreis

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## RESEARCH

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**Planetary impacts** [↗](#) – Simulating giant impacts at 100–1000 times higher resolution than standard, 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

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| 2015–2019 | <b>PhD</b> – Institute for Computational Cosmology (ICC), Durham University, UK<br><i>Thesis:</i> <a href="#">↗</a> <i>Supervisors:</i> Vince Eke, Richard Massey. |
| 2011–2015 | <b>Physics (MPhys)</b> integrated masters, with honours – Durham University, UK.   |

## FUNDING AND GRANTS

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|-----------|---|
| 2021–...  | <b>NASA Postdoctoral Program Fellowship, USRA / ORAU</b><br>Fellowship at NASA Ames. (Postponed 1 year by covid.) |
| 2019–2021 | <b>UK Space Agency</b><br>Postdoctoral research associate at Durham University.                                   |
| 2015–2019 | <b>Science and Technology Facilities Council and ICC PhD Scholarship Fund</b><br>PhD studentship.                 |
| 2022–2025 | <b>DiRAC RAC 14th Call Computing Time</b><br>30.6M core-hours on the new COSMA8 cluster (CoI).                    |
| 2020–2021 | <b>DiRAC Director’s Discretionary Time</b><br>2.5M core-hours on the new COSMA8 cluster (PI).                     |
| 2019      | <b>Ogden Trust Alumni Grant</b><br>Funding for travel to present at the SPHERIC Workshop 2019.                    |

## SELECTED PRIZES AND AWARDS

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|------|---|
| 2022 | <b>DiRAC Research Image Competition</b> winner, for high-resolution simulations of Moon-forming giant impacts, rendered with Houdini                      |
| 2020 | <b>Springer Thesis Award</b> , recognising international ‘outstanding PhD reserach’   |
| 2019 | <b>Libersky Student Paper Prize</b> 2 <sup>nd</sup> place, SPHERIC International Workshop   |
| 2018 | <b>Career Development Award</b> , Lunar and Planetary Institute   |
| 2015 | <b>D A Wright Prize</b> for Outstanding Performance in an MPhys Research Project<br>For the highest-marked research project out of a year of 126 students |
| 2015 | <b>Bill Bryson Prize</b> for Communication in Science<br>For the winning research presentation from all science faculty students                          |
| 2015 | <b>Audience Choice Award</b> , Rising Stars Research Symposium, Durham University   |
| 2012 | <b>Durham Physics Award</b> for Outstanding Achievement   |

## CONFERENCES AND MEDIA

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### Invited talks:

- Ogden Centre 20<sup>th</sup> 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

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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 the Celebrate Science [↗](#) festival and many subsequent public and school demonstrations.
- Took a leading role in designing, developing, and demonstrating the **Galaxy Makers** [↗](#) exhibits for the Royal Society Summer Science Exhibition 2016 and future events.

### 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

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**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

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2020–...	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	<b>Training postgraduate students</b> <ul style="list-style-type: none"><li>• Teaching advanced programming tools to first-year PhD students.</li><li>• Ran a training workshop on the SWIFT code for postgraduate students.</li></ul>
2015–2016	<b>Postgraduate student teacher</b> (Durham University) Demonstrator for the undergraduate Level 2 Computational Physics course.

## OTHER SKILLS AND LEADERSHIP ROLES

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<b>Computing</b>	<b>Python:</b> Advanced experience, mostly analysing and visualising large data sets. <b>C, C++, fortran:</b> Advanced/intermediate experience, mostly high-performance simulation codes and data analysis. <b>git, bash, LaTeX, etc.:</b> Advanced experience, both in solo projects and large development teams.
<b>Languages</b>	Native English speaker Intermediate level Spanish; 7 months teaching children in Quito, Ecuador (2011) Beginner/intermediate level Japanese
<b>Kendo</b>	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

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**Dr. Rick Elphic** – NPP Advisor [richard.c.elphic@nasa.gov](mailto:richard.c.elphic@nasa.gov)  
NASA Ames Research Center, Moffett Field, CA, USA

**Dr. Vince Eke** – PhD Supervisor [v.r.eke@durham.ac.uk](mailto: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](mailto:jack.lissauer@nasa.gov)  
NASA Ames Research Center, Moffett Field, CA, USA

## PUBLICATION LIST

<b>Lead author</b>	<p><i>A recent impact origin of Saturn's rings and mid-sized moons.</i> Teodoro, L. F. A., <b>Kegerreis, J. A.</b> (science-lead and corr. author), Estrada, P. R., Ćuk, M., Eke, V. R., Cuzzi, J. N., Massey, R. J., Sandnes, T. D. <i>Astrophys. J. in review</i>, 2023. Preprint: <a href="#">↗</a></p>
	<p><i>Immediate Origin of the Moon as a Post-impact Satellite.</i> <b>Kegerreis, J. A.</b>, Ruiz-Bonilla, S., Eke, V. R., Massey, R. J., Sandnes, T. D., Teodoro, L. F. A. <i>Astrophys. J. Lett.</i>, 937:2 L40, Oct. 2022. doi: 10.3847/2041-8213/ac8d96. <a href="#">↗</a></p>
	<p><i>Atmospheric Erosion by Giant Impacts onto Terrestrial Planets: A Scaling Law for any Speed, Angle, Mass, and Density.</i> <b>Kegerreis, J. A.</b>, Eke, V. R., Catling, D. C., Massey, R. J., Teodoro, L. F. A., Zahnle, K. J. <i>Astrophys. J. Lett.</i>, 901:2, Sept. 2020. doi: 10.3847/2041-8213/abb5fb. <a href="#">↗</a></p>
	<p><i>Atmospheric Erosion by Giant Impacts onto Terrestrial Planets.</i> <b>Kegerreis, J. A.</b>, Eke, V. R., Massey, R. J., Teodoro, L. F. A. <i>Astrophys. J.</i>, 897:2, July 2020. doi: 10.3847/1538-4357/ab9810. <a href="#">↗</a></p>
	<p><i>Planetary Giant Impacts: Convergence of High-Resolution Simulations using Efficient Spherical Initial Conditions and SWIFT.</i> <b>Kegerreis, J. A.</b>, Eke, V. R., Gonnet, P., Korycansky, D. G., Massey, R. J., Schaller, M., Teodoro, L. F. A. <i>Mon. Not. R. Astron. Soc.</i>, 487:4, Aug. 2019. doi: 10.1093/mnras/stz1606. <a href="#">↗</a> †</p>
	<p><i>Consequences of Giant Impacts on Early Uranus for Rotation, Internal Structure, Debris, and Atmospheric Erosion.</i> <b>Kegerreis, J. A.</b>, 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. <i>Astrophys. J.</i>, 861:52, July 2018. doi: 10.3847/1538-4357/aac725. <a href="#">↗</a> †</p>
	<p><i>Evidence for a Localized Source of the Argon in the Lunar Exosphere.</i> <b>Kegerreis, J. A.</b>, Eke, V. R., Massey, R. J., Beaumont, S. K., Elphic, R. C., L. F. Teodoro. <i>J. Geophys. R. (Planets)</i>, 122:2163–2181, Oct. 2017. doi: 10.1002/2017JE005352. <a href="#">↗</a></p>
<b>Supervised PhD students</b>	<p><i>Dealing with density discontinuities in planetary SPH simulations.</i> Ruiz-Bonilla, S., Borrow, J., Eke, V. R., <b>Kegerreis, J. A.</b>, Massey, R. J., Sandnes, T. D., Teodoro, L. F. A. <i>MNRAS</i>, 512:3, May 2022. doi 10.1093/mnras/stac857. <a href="#">↗</a></p>
	<p><i>The effect of pre-impact spin on the Moon-forming collision.</i> Ruiz-Bonilla, S., Eke, V. R., <b>Kegerreis, J. A.</b>, Massey, R. J., Teodoro, L. F. A. <i>MNRAS</i>, 500:3, Jan. 2021. doi 10.1093/mnras/staa3385. <a href="#">↗</a></p>
	<p><i>No dilute core produced in simulations of giant impacts onto Jupiter.</i> Sandnes, T. D., Eke, V. R., <b>Kegerreis, J. A.</b>, Massey, R. J., Ruiz-Bonilla, S., Teodoro, L. F. A. <i>MNRAS in prep.</i>, 2023. <a href="#">↗</a></p>
<b>Co-author</b>	<p><i>SWIFT: A modern highly-parallel gravity and smoothed particle hydrodynamics solver for astrophysical and cosmological applications.</i> Schaller, M., Borrow, J., ..., <b>Kegerreis,</b></p>

**J. A.**, et al. *MNRAS in review*, 2023. doi 10.48550/arXiv.2305.13380. [↗](#)

*Moon-forming impactor as a source of Earth's basal mantle anomalies.* 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. *Nature in review*, 2023.

*Abell 1201: detection of an ultramassive black hole in a strong gravitational lens.* Nightingale, Smith, He, O'Riordan, Kegerreis, et al. *MNRAS*, 521:3, May 2023. doi 10.1093/mnras/stad587. [↗](#)

*Measurement of the free neutron lifetime using the neutron spectrometer on NASA's Lunar Prospector mission.* Wilson, J. T., Lawrence, D. J., Peplowski, P. N., Eke, V. R., **Kegerreis, J. A.** *Phys. Rev. C*, 104:4, Oct. 2021. doi 10.1103/PhysRevC.104.045501. [↗](#)

*Space-based measurement of the neutron lifetime using data from the neutron spectrometer on NASA's MESSENGER mission.* Wilson, J. T., Lawrence, D. J., Peplowski, P. N., Eke, V. R., **Kegerreis, J. A.** *Phys. Rev. Res.*, 2:2, June 2020. doi: 10.1103/PhysRevResearch.2.023316. [↗](#)

**Books and  
Chapters**

*Learn about Space and Planets: Explore the wonders of our universe.* Akass, S., **Kegerreis, J. A.** (Consultant Editor), CICO Kids, Ryland Peters & Small, Nov. 2021. doi: 10.1007/978-3-319-05546-6\_203-1. [↗](#)

*Noble Gases in Encyclopedia of Lunar Science.* Eke, V. R., **Kegerreis, J. A.** (ed. B. Cudnik), Springer Intl. Pub., Nov. 2018. doi: 10.1007/978-3-319-05546-6\_203-1. [↗](#)

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