KEVEN REN

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CURRICULUM VITAE

Statistical modelling of rare extragalactic objects under influence of stochasticity. High-performance computing with large datasets from complex simulations with billions of particles. Multidisciplinary; Machine Learning/Deep Learning models on spatial field data in collaboration with marine biologists.

EDUCATION

Ph.D. Physics – UNIVERSITY OF MELBOURNE, VIC, AUSTRALIA   (2017 – JUL 2021)
thesis: `*The Diversity and Environments of the Rarest Objects During Cosmic Dawn'*
doctoral advisors: *Prof. Michele Trenti & Dr. Simon Mutch*
Australia Govt. Research Training Program Scholarship || David Lachlan Hay Memorial Grant 2021

M.Sc. Physics – UNIVERSITY OF MELBOURNE, VIC, AUSTRALIA   (2015 – 2017)
thesis*: `The Cosmic Web Around the Most Luminous Galaxies during the Epoch of Reionization'*
doctoral advisors: *Prof. Michele Trenti & Dr. Simon Mutch*
First Class Honours || WAM: 83.6

BSc.Adv.Hons Mathematics & Physics (Hons.) – MONASH UNIVERSITY, VIC, AUSTRALIA   (2010 – 2014)
thesis: `*The Viability of a Non-Minimal Flavour-Violating Extension to the CMSSM'*
doctoral advisors: *Prof. Csaba Balász & Dr. Sudhir Gupta*
First Class Honours || WAM: 82.9

Study Abroad - UNIVERSITY OF COPENHAGEN, DENMARK   (2012 – 2013)

WORK & RELEVANT EXPERIENCE

Research Assistant (Intern) – ASTRONOMY DATA AND COMPUTE SERVICES, MELBOURNE   (AUG 2021 – NOV 2021)
Tasked to create bespoke interactive visualization to explore large astronomical data products using a React/Django tech stack. Utilised the *recharts* library as a foundation and created custom histogram and contour components to allow an efficient rendering of data for optimal user experience. || https://github.com/renkeven/bilby-corner-react

Graduate Researcher – UNIVERSITY OF MELBOURNE, VIC, AUSTRALIA   (2016 – JUL 2021)
Simulation-guided mathematical & statistical modelling of rare early Universe objects (number density & spatial distribution) to inform and supplement next-generation observational endeavours.

- **Monte Carlo Simulations:** Creating mock-pencil beams that trace over rare objects inside a large n-body simulation of dark matter to collect statistics around the spatial density of neighbouring objects. Developed a semi-empirical model highlighting how intrinsic stochasticity relates to clustering strength of neighbours. [1], [4]
  || https://github.com/renkeven/PencilBeam
- **Semi-empirical Model Building:** Developed a simple, but novel model for the evolution of the number density of Quasars with a single-free-parameter. Our model yields excellent agreement with current observations even after extrapolation outside of our calibrated range. Created forecasts of expected counts for upcoming future wide-area sky surveys. [2], [5] || https://github.com/renkeven/QuasarEvolutionData

Graduate Researcher (Collaboration) – University of Melbourne, Vic, Australia (2019 – Current)

Collaboration with Marine Ecology researchers from Southern Cross University. End-to-end pipeline taking in high-resolution orthomosaics of drone imagery and segmenting coral features of interest using a U-Net type architecture (MultiResU-Net). Base net trained on a large dataset taken from a single day followed by transfer learning on smaller tiles of different days over high-level layers to capture subtle changes from different lighting conditions. Current iteration of model achieves 96%/92% precision/recall for unbleached coral and 28%/58% for bleached corals. [A3], + another *in prep* || https://github.com/daviesje/Full_Segmenter

Lab Demonstrator – University of Melbourne, Vic, Australia (2015 – 2019)

Supervised and taught experimental techniques to 1st year physics and astronomy students. Provided weekly feedback and contributed to the marking of tests & exams.

SKILLS

proficient: Python, NumPy, pandas, TensorFlow, scikit-learn, LaTeX
familiar: Javascript, React, django, bash, SQL, Google Cloud Platform

SELECTED CONFERENCES & WORKSHOPS

X-Sensing Conference & hack day – University of Southern Cross, Coffs Harbour (Nov 2019)
`Using Convolutional Neural Networks to Detect Sun Glint from High Resolution Aerial Imagery over Water'
2nd Place

Summer School in Astrostatistics – Pennsylvania State University, PA, USA (2018)

PUBLICATION HISTORY

[1] **Ren, K.**, et al., The Cosmic Web Around the Most Luminous Galaxies at the Epoch of Reionization, The Astrophysical Journal, Volume 856, Issue 1, article id. 81 (2018).

[2] **Ren, K.**, et al., The Brightest Galaxies at Cosmic Dawn from the Scatter in the Galaxy Luminosity Versus Halo Mass Relation, The Astrophysical Journal, Volume 878, Issue 2, article id. 114 (2019).

[3] **Ren, K.**, et al., Stochastic Processes as the Origin of the Double Power-law Shape of the Quasar Luminosity Function, The Astrophysical Journal, Volume 894, Issue 2, article id. 124 (2020).

[4] **Ren, K.**, et al., The Diversity of Environments around Luminous Quasars at Redshift z~6, The Astrophysical Journal, Volume 917, Issue 2, article id. 89 (2021).

[5] **Ren, K.**, et al., A Physical Model for the Quasar Luminosity Function Evolution between Cosmic Dawn and High Noon, The Astrophysical Journal, Volume 923, Issue 1, article id. 110 (2021).

[A1] Whitler, L. R., Mason, C. A., **Ren, K.**, Dijkstra, M., Mesinger, A., Pentericci, L., Trenti, M., Treu, T., The Impact of Scatter in the Galaxy UV Luminosity to Halo Mass Relation on Lya Visibility During the Epoch of Reionization, Monthly Notices of the Royal Astronomical Society, Volume 495, Issue 4, pp.3602-3613 (2020).

[A2] Marshall M. A., Mechtley, M., Windhorst, R. A., Cohen, S. H., Jansen, R. A., Jiang, L., Jones, V. R., Wyithe, J. S. B., Fan, X., Hathi, N. P., Jahnke, K., Keel, W. C., Koekemoer, A. M., Marian, V., **Ren, K.**, Robinson, J., Röttgering, H. J. A., Ryan, R. E. Jr., Scannapieco, E., Schneider, D. P., Schneider, G., Smith, B. M., Yan, H., Limits to Rest-Frame Ultraviolet Emission From Far-Infrared-Luminous z~6 Quasar Hosts, The Astrophysical Journal, Volume 900, Issue 1, article id. 21 (2020).

[A3] Giles, A., Davies, J. E., **Ren, K.**, Kelaher, B., A Deep Learning Algorithm to Detect and Classify Sun Glint from High-Resolution Aerial Imagery over Water, ISPRS Journal of Photogrammetry and Remote Sensing, Volume 181, pp.20-26 (2021).