

Ariel Data Challenge 2025: Advanced Exoplanet Atmosphere Detection Returns with Enhanced Realism

Global competition returns with more sophisticated simulations to help decode secrets of distant worlds

30th June 2025

The international Ariel Data Challenge team has launched the Ariel Data Challenge 2025, an upgraded version of last year's groundbreaking competition that continues its goal to revolutionise how researchers analyse atmospheric data from planets beyond our solar system.

Building on the success of the 2024 edition, this year's challenge features significantly more realistic instrument simulations and explores a broader range of potential atmospheric scenarios that scientists might encounter when studying exoplanets. The competition continues its partnership with Kaggle, the world's largest data science platform, to engage the global community of researchers and AI specialists.

The challenge addresses one of astronomy's most pressing technical hurdles: extracting extremely faint planetary signals from the complex noise patterns inherent in space telescope observations. As scientists prepare for next-generation space missions designed to study exoplanet atmospheres, developing robust analytical techniques has become increasingly critical.

Dr. Kai Hou (Gordon) Yip, Ariel Data Challenge Lead, UCL said:

“Building on our experience from last year, this year we focused most of our efforts on making our competition as realistic as possible. We can't wait to see the diversity of solutions the community has to offer!”

The competition maintains the same collaborative framework that made the 2024 edition successful, with London Centre for Space Exochemistry Data, a KCL-UCL joint initiative, leading an international consortium of academic partners. Key institutions include Cardiff University, Centre National d'Études Spatiales, Sapienza Università di Roma, Institut d'Astrophysique de Paris and Instituto de Astrofísica de Andalucía (IAA-CSIC).

The initiative continues to receive support from Kaggle's Competitions Research Program, and substantial backing from major space organisations, including the UK Space Agency, European Space Agency, STFC RAL Space, and STFC DiRAC HPC Facility.

Professor Giovanna Tinetti, Vice Dean (Research) for the Faculty of Natural, Mathematical & Engineering Sciences at King's and Principal Investigator for the ESA Ariel Mission consortium

“Ariel will be transformational in helping us understand the planets in our galaxy. By studying hundreds of diverse worlds in different environments, we will see our own planet in context, giving us a better sense of why Earth formed as it did.

The Ariel Data Challenges have become an unmissable annual event, calling for help from the international community of machine-learning experts to develop a diverse range of solutions to the complex computational problems faced by the mission”

Dr Theresa Lueftinger, Project Scientist for the ESA Ariel Mission, ESA said:

"When operating space missions and analysing their scientific data, noise is a key ingredient we really need to understand to also understand the remote exoplanet atmospheres. With innovative machine learning approaches, we can face this challenge in a fantastic way, and I am really excited to see what the AI/ML community comes up with!"

Dr Caroline Harper, Head of Space Science, UK Space Agency said:

"By supporting this challenge, we aim to find new ways of using AI and Machine Learning to develop our understanding of the universe.

Exoplanets are likely to be more numerous in our galaxy than the stars themselves and the techniques developed through this prestigious competition could help open new windows for us to learn about the composition of their atmospheres, and even their weather.

The UK Space Agency's investment in cutting-edge space science research is essential for supporting innovative missions like this, that can benefit people, businesses, and communities across the globe. We can't wait to see the results."

Ms Pascale Danto, Project Scientist In charge of the French contribution to Ariel Mission, CNES (Centre National d'Etudes Spatiales) said:

"Astrophysics space missions are now producing huge amount of data and AI is becoming essential to process all the information and take giant steps in understanding our universe"

Understanding the atmospheres of exoplanets

The study of exoplanet atmospheres represents a crucial step toward understanding planetary formation and potentially identifying worlds that could harbour life. However, the technical challenges are immense – the atmospheric signals researchers seek are often millions of times fainter than the light from the host stars themselves.

The Challenge is built upon the European Space Agency's Ariel Space Mission, a UK led mission which will be launched in 2029 and will complete one of the largest ever surveys of these planets by observing the atmospheres of around one fifth of the known exoplanets.

The 2025 challenge comes at a pivotal moment for exoplanet science, as researchers worldwide prepare for a new generation of space-based observatories designed specifically to study planetary atmospheres. The techniques developed through this competition could directly influence how scientists approach data from these future missions.

Dr Lorenzo V. Mugnai, Lead on ADC Data Generation and Postdoctoral Researcher, Cardiff University, said:

"Last year, the competing teams developed outstanding solutions that allowed us to view our data from fresh and unexpected perspectives. This year, we aim to take things a step further by presenting a challenge that is even more grounded in reality, with solutions that could potentially be applied directly to real-world scenarios."

Participants in the challenge will work with simulated observations that mirror the complexity and noise characteristics expected from real space telescope data, providing a testing ground for innovative approaches to signal extraction and atmospheric analysis.

The competition reflects the increasingly collaborative nature of modern astronomical research, bringing together expertise from multiple disciplines and institutions to address challenges that no single organisation could tackle alone.

The Ariel Data Challenge

The 2025 edition of the Ariel Data Challenge continues to tackle the persistent technical obstacles that have long frustrated astronomers studying distant planetary atmospheres. Chief among these challenges is "jitter noise" – disturbances caused by spacecraft micro-vibrations that significantly complicate the analysis of spectroscopic data essential for understanding exoplanet atmospheres.

With support from DiRAC HPC Facility and Cardiff University, the simulations incorporate Ariel's actual payload design and integrate representative noise effects derived from real in-flight data obtained by the James Webb Space Telescope.

The competition

The current competition, which runs until late September, will recognise winners with invitations to present their solutions at the prestigious NeurIPS conference, alongside cash prizes for the top six innovations.

This marks the sixth instalment of the Ariel Data Challenge, building on five years of successful competitions that have attracted over 6,000 participants worldwide, including researchers from leading academic institutions and AI companies.

The challenge adopts a focused approach, addressing specific aspects of larger analytical problems to make exoplanet research more accessible to the machine learning community. While not designed to definitively resolve all data analysis challenges facing the mission, it provides a crucial forum for discussion, encourages future collaborations, and helps ensure the Ariel team possesses the most effective data analysis methods when the mission launches.

More details about the competition and how to take part can be found on the [Ariel Data Challenge](#) website. Follow [@ArielTelescope](#) social media accounts for more updates.

Comments from Ariel Data Challenge collaborators and associates:

Dr Giuseppe Morello, Ramón y Cajal Fellow at Instituto de Astrofísica de Andalucía, said:

"Given the sheer volume and complexity of Ariel's data, AI may be our only hope to uncover its deeper truths about our origins and the big exoplanet picture within a human lifetime. This Data Challenge is vital for building trust in AI tools by rigorously probing them on the most realistic Ariel datasets we can provide. I look forward to being amazed by the participants' solutions and learning how best to handle Ariel's data!"

Prof. Mark Wilkinson, Director of the STFC DiRAC High Performance Computing facility and Professor of Astrophysics, University of Leicester, said:

"The Ariel Data Challenge is an outstanding example of the benefits of cross-community engagement, challenging the AI community to bring their latest algorithms to bear on the problems of modelling and interpreting complex satellite data. As a longstanding partner of the Ariel Data Challenge, I am very pleased that DiRAC has again been able to support the Challenge by providing the computing resources to generate the 2025 dataset which the AI community will be tasked with analysing."

Prof. Ingo Waldmann, Professor of Astrophysics, UCL (University College London) and Ariel Data Challenge co-lead said:

“Modern astrophysics poses big-data problems that can best, and sometimes only, be solved using modern AI techniques. This problem in particular lends itself to fresh approaches, and I am very excited to see what new solutions the AI community will come up with.”

Dr Andreas Papageorgiou, Director of Recruitment and Admissions at Cardiff University, said:

“Following the success of ADC24 and the diverse approaches and innovative solutions we saw for extracting signals from our data, I'm genuinely excited to see what the community will bring to the table this year”

Dr Andrea Bocchieri, Ariel Telescope Scientist, Sapienza Università di Roma, said:

“Denoising astronomical data and avoiding biases is a daunting task and a stepping stone to correctly interpreting measurements. The 2025 edition of the Ariel data challenge is the perfect testing ground for the community. We are here to learn from and with each other.”

Orphée Faucoz, AI Specialist for Ariel mission, Centre National D'études Spatiales, said:

“The future of space exploration depends on how we harness and interpret data today. The ARIEL data challenge provides a unique opportunity to analyze cutting-edge data and contribute to our understanding of distant worlds”

Dr Pierre Drossart, Research scientist, Institut d'astrophysique de Paris, said:

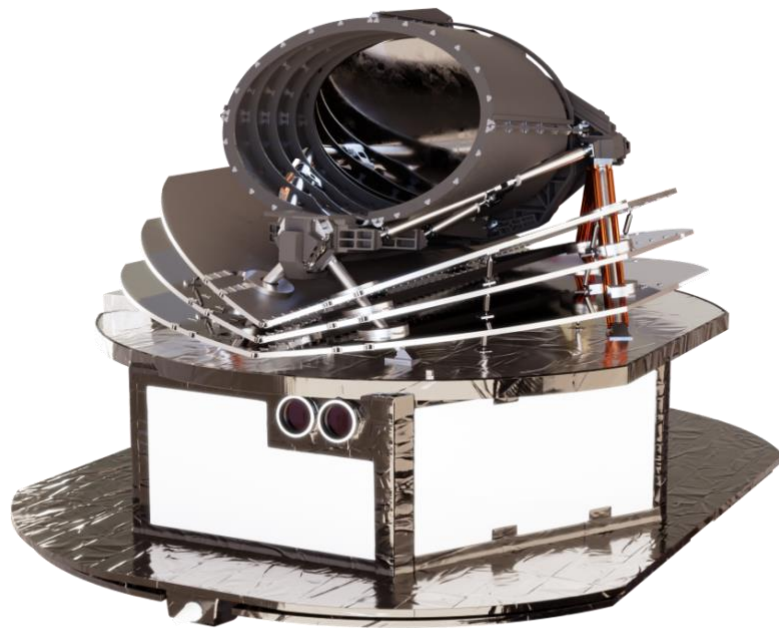
“The Ariel Data Challenges is for the IAP Ariel investigators an opportunity to enter in the field of the AI community, which is expanding rapidly in all science domains. The question of classical vs machine learning approaches in detrending the instrumental data is still highly debated, and investigating both approaches is at the heart of our science involvement in Ariel and other missions in IAP.”

Angèle Syty, PhD Candidate, Institut d'astrophysique de Paris, said:

As astrophysical models become increasingly complex and the volume of data continues to rise, driven by advanced ground-based and space-based observations, the role of machine learning is becoming ever more critical. The Ariel Data Challenges help identify which scientific tasks and physical problems could greatly benefit from applying emerging artificial intelligence techniques. The upcoming ADC2025 will be especially valuable in advancing our understanding of the intricate instrument signatures present in exoplanet observations.

Images:

1.



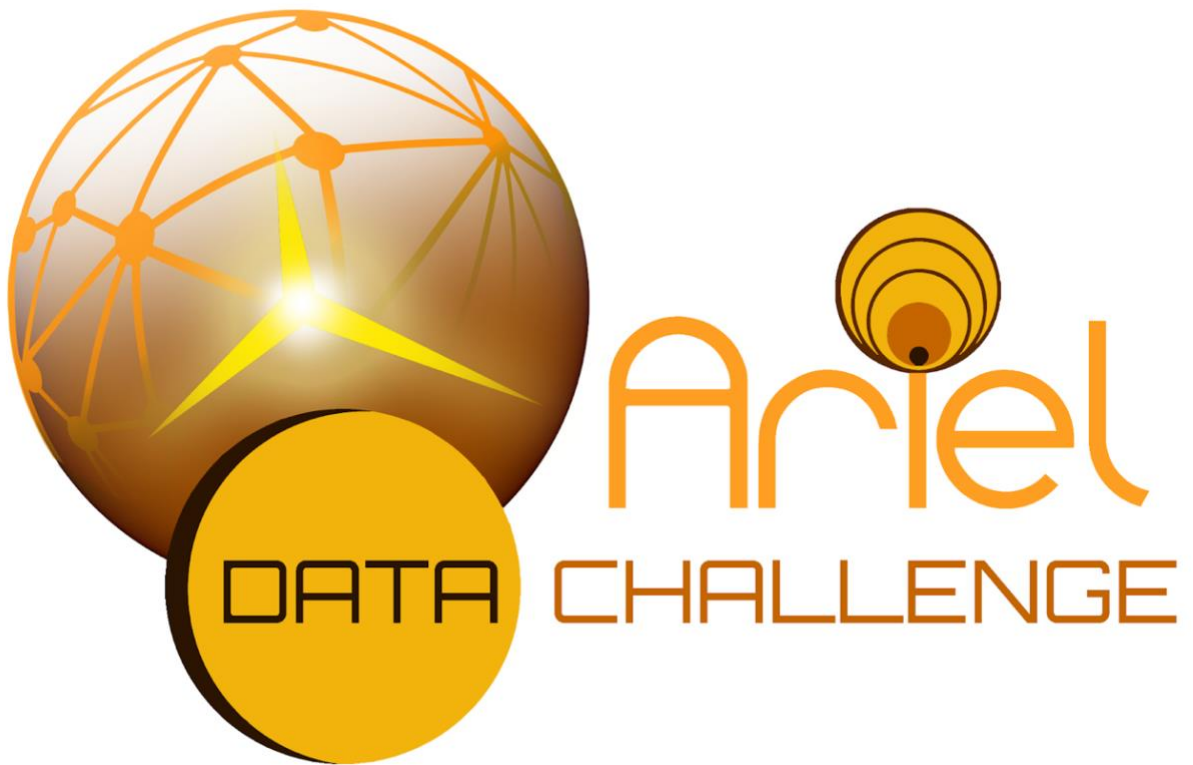
Artist Impression of Ariel. Credit: Airbus.

2.



Competition Header.. Image Credit: ESA/Bex Coates.

3.



Ariel Data Challenge 2025 logo.

4.



Ariel AI logo.

5.



PlanetAi logo.

6.



ESA Ariel logo.

<https://arielspacemission.files.wordpress.com/2020/11/ariel-telescope.jpg>
https://www.esa.int/ESA_Multimedia/Images/2018/03/Hot_exoplanet

Videos:

Note: Please get in touch with press contact for mp4 files.

Ariel animations: <https://www.youtube.com/playlist?list=PL7nlYulpjicaxp36LxZwkXOH72Otf-rqY>

Welcome to Ariel: https://youtu.be/28afJ_5TTGc

Contacts:

Rebecca Coates

Ariel Space Mission and UCL Centre for Space Exochemistry Data Communications (CSED)
Media Officer

Email: bex@arielmission.space | arielcomm@arielmission.space

Notes to editors:

Ariel (Atmospheric Remote-sensing Infrared Exoplanet Large-survey)

Ariel, a mission to answer fundamental questions about how planetary systems form and evolve, is a European Space Agency (ESA) medium-class science mission due for launch in 2029. During a 4-year mission, Ariel will observe up to 1000 planets orbiting distant stars in visible and infrared wavelengths to study how they formed and how they evolve. It is the first mission dedicated to measuring the chemistry and thermal structures of exoplanet atmospheres, enabling planetary science far beyond the boundaries of the Solar System.

The Ariel mission is being by a consortium of more than 50 institutes from 16 ESA member state countries, including the UK, France, Italy, Poland, Belgium, Spain, the Netherlands, Austria, Denmark, Ireland, Czech Republic, Hungary, Portugal, Norway, Sweden, Estonia – plus contributions from the US (NASA), Canada (CSA) and Japan (JAXA).

All Ariel social media accounts and relevant links can be accessed at:

- <https://linktr.ee/arieltelescope>
- <https://www.arielmission.space>
- https://www.esa.int/Science_Exploration/Space_Science/Ariel

Ariel Data Challenge

- <https://www.ariel-datachallenge.space/>