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Communicating the Ariel Space Mission

Brand identity, social media, and augmented reality

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Abstract. Ariel (Atmospheric Remote-Sensing Infrared Exoplanet Large-survey) is a European Space Agency mission scheduled for launch in 2029. It will study the atmospheres of extrasolar planets, perform statistical studies on their properties and chemical composition, and clarify the still-obscure points concerning their formation and evolution. To explain the work of Ariel Space Mission to schools and the general public, we designed an interactive Augmented Reality (AR) experience called "Che aria tira sugli esopianeti?" (eng."What the air is like on exoplanets?"). The activity turns the user's smartphone or tablet into the 'eye' of Ariel, the telescope, allowing the simulation of the analysis of the atmosphere of some exoplanets present in the catalog of objects that Ariel will observe once in space. The activity's first experimentation was developed with the Zapworks Software Designer, and then we decided to reproduce it with CoSpaces Edu. This digital experiment will help people understand the work of analyzing the atmospheres of planets outside the Solar System.

Key words. Exoplanets, Stars, Augmented Reality, New technology, Interactive laboratory

1. Introduction

Ariel (Atmospheric Remote-Sensing Infrared Exoplanet Large-survey)(Tinetti et al. 2020), is the fourth medium-class space mission chosen for the ESA's Cosmic Vision 2015-2025 plan, selected in March 2018. The mission was then adopted in November 2020 and is currently in development. The launch is planned for 2029 when Ariel will operate from an orbit around the L2 point, the Lagrange point, a stable gravitational equilibrium point in our solar system that exploits the three-body problem, far away 1.5 million kilometres from Earth. In the four years of the nominal Mission, Ariel will provide a wealth of data to answer several open questions on the formation, evolution and composition of exoplanets. To do so, Ariel will observe one thousand planetary atmospheres, from rocky worlds to gas giants, that will enable the researchers to obtain for the first time a chemical census and atmospheric thermal structure of hundreds of exoplanets. Since the atmosphere of a planet is like a "history book" on how the planet has formed and what steps led it to its final shape and orbital configuration, Ariel's data will allow a significant improvement in the field of exoplanets. The Ariel

telescope is composed of a one-meter elliptic mirror and will observe from the visible to the medium infrared wavelength range (0.5 - 7.8 nm). This instrumental configuration will allow Ariel to simultaneously monitor the activity of the host stars, which can contaminate the planetary spectra. The scientific preparation of the Ariel Space Mission is led by a consortium of 17 European countries, among them Italy, organized in various Work Packages. Italy contributes to the Mission in several areas: science (target characterization, planet formation, atmospherical models, laboratory experiments, etc.), instrument performances (simulations of the expected data), and technology (Italy is responsible for the telescope and the on-board software, and contributes to other important aspects of the payload). Italy has two Co-PIs coordinating the activities of the Italian Team, Giusi Micela (INAF OAPA) and Pino Malaguti (INAF OAS). The communication of Ariel and the public engagement in Italy is coordinated by Serena Benatti (INAF OAPA). Ariel's communication aims to inform the public about the existence of exoplanets and how they are currently studied. We then propose Ariel as a milestone to improve our knowledge of the world around us, making people aware of the importance of such a mission and, ultimately, leading the public to a correct scientific culture. This step of the project is significant because, as Cinzia Dal Maso says: "Today [...] everyone must communicate because those who do not communicate or do not do it effectively become practically invisible to the world. Those who do not communicate do not exist. Today we communicate mainly by telling stories, even if it is only one of the possible ways"(Dal Maso 2018). We started experimenting with the Communication of the Ariel space mission on social media, during educational activities, and outreach events. In the present paper, we'll show how we used augmented reality storytelling to present the mission.

2. The brand identity

Before we took the road of social media communication, we spent a long time deciding on the brand identity. The international consortium of the Ariel mission already has its official logo; therefore, it was necessary to create the Ariel-IT logo. What does the original logo represent? The project's name is reproduced at the bottom, and research and analysis of atmospheres are shown at the top. The smallest dot in dark blue represents the planet, the largest in yellow represents its host star, and the three white circles stand for the atmosphere. What was done is to take the official colours of the Ariel logo identified by specific colour codes (grey cod. #A4A3A8, yellow cod. #F3A00F and dark blue cod. #082238) and add those codes of the Italian flag (white cod. #FFFFFF, green cod. #0A8032 and red cod. #E82726) 1. The project of the new logo was an idea of Giusi Micela and Claudia Di Maio and was designed by Laura Leonardi. The result was approved by the PI of the mission Giovanna Tinetti (University College London) and the logo was officially adopted by the Ariel-IT group.

Fig. 1. Official Ariel-IT logo.

3. Social media: Instagram

Using social media to communicate a space mission to the general public has become an essential strategy to foster engagement and excitement. Platforms like Instagram allow space organizations to share real-time updates,

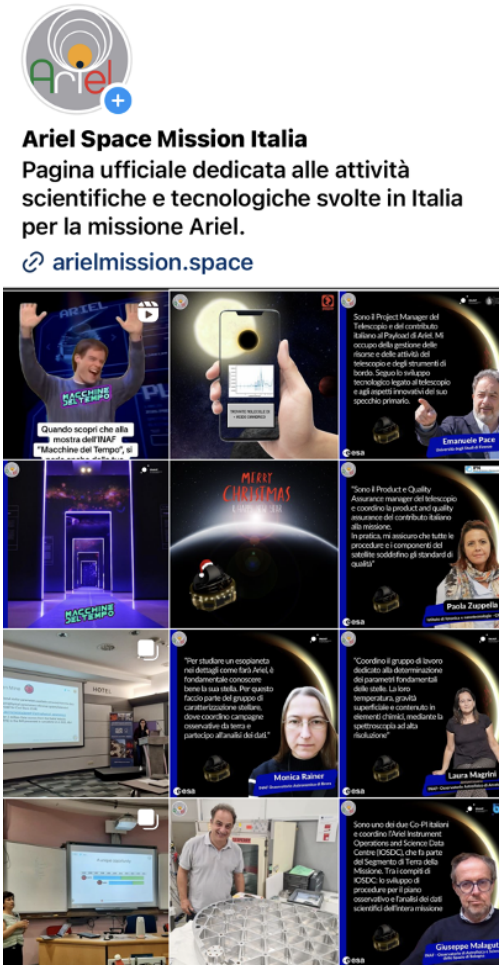

Fig. 2. Ariel-IT's Instagram profile screen.

stunning visuals, and behind-the-scenes content that make complex missions more relatable and accessible. Through interactive posts, live sessions, and user-generated content, audiences can feel directly involved in the journey, enhancing their connection to the mission and its objectives (Sinha 2017). In addition, social networks serve as a powerful tool for storytelling, enabling scientists and engineers to share their passion and expertise in a way that captivates and educates a diverse audience. Using these platforms, space missions can inspire curiosity and enthusiasm, turning followers into advocates for exploration and discovery (Shaghaghi et al. 2012). Ariel-IT with its official social channel on Instagram (@missione_ariel_it) aimed to inform and accompany users during the preparation of the mission until the launch, which, as already mentioned, is scheduled for 2029. The posts are currently meant to show the people of the Italian group behind the project, who work daily for scientific and technological support of the mission. But also, curiosities, meetings, and special events 2. An interesting curiosity concerns, for example, the telescope's primary mirror: it will be the first primary mirror of this size to be constructed entirely from aluminium. This choice not only potentially reduces costs, but also has significant positive implications for thermal stability and the overall mass of the telescope. Additionally, the Italian leadership in creating this mirror sets a new standard for future space missions, particularly in terms of the potential savings that could be achieved for future missions (Pace et al. 2022). Ariel was also one of the space missions cited at the INAF exhibition "Macchine del Tempo - Time Machines" (Leonardi et al. 2024) held in Rome from November 2023 to March 2024, so many Instagram stories and posts at that time were created to invite people to visit the exhibition in Palazzo Esposizioni Roma. Next steps are to write a strong social strategy and record videos with researchers and communicators.

4. Augmented Reality to simulate Ariel's observations

Ariel will observe planets orbiting around host stars far from our Solar System during their "transit", i.e. when they pass in front of their host star and produce a slight decrease of the stellar light (Winn 2010). The FGS (Fine Guidance System) instrument in the optical band of Ariel will detect the typical "U-shape" transit signature. On the other hand, AIRS (Ariel medium-resolution InfraRed Spectrometer) in the near-medium infrared, will produce the planet spectrum by exploiting the "transmission spectroscopy" technique. With this method, the atmospheric compounds of the planet imprint their signatures on the stellar light and can be analysed. The

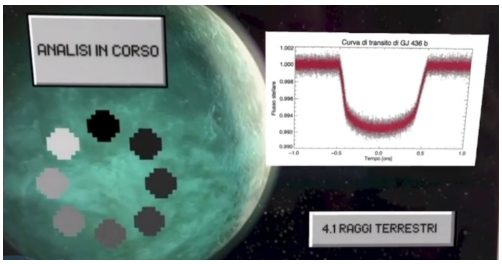

Fig. 3. Simulation of the transit light curve of planet GJ436 b as it will be obtained by FGS, the Ariel photometer, shown in AR through Zapworks.

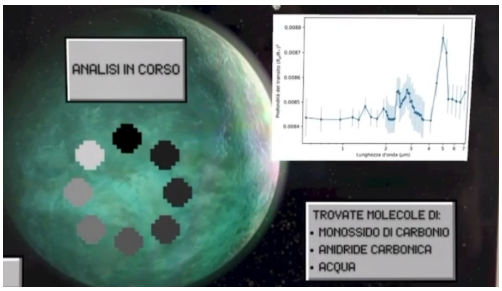

Fig. 4. Simulation of the transmission spectrum of planet GJ436 b as it will be obtained by AIRS, the Ariel spectrometer, shown in AR through Zapworks.

catalogue of objects that will be observed by Ariel includes planets with different properties: rocky planets (similar to the Earth), gaseous giants (such as Jupiter) and those with intermediate characteristics between the two (for example planets similar to Neptune). The planets selected for the augmented reality game include: L98-59 b, slightly smaller than the Earth, revolves in 2.25 days around the star L 98-59, much smaller and colder than the Sun; HAT-P-32 b, classified as hot Jupiter, similar to Jupiter in mass and size but with a significantly shorter orbital period (12 years vs 2.2 days!); GJ436 b, about the size of Neptune, orbits the red star Gliese 436, a dwarf star at about 30 light-years from Earth, every 2.6 days. We carried out two digital experiments to explain how the Ariel space satellite will observe and analyse the atmospheres of planets outside the Solar System, using an augmented reality application, originally designed with Zapworks and then repurposed with CoSpaces Edu. Users can transform their mobile devices, such as a smartphone or a tablet, into Ariel's "eye" hunting for exotic atmospheres. How different will they be from Earth's one?

Therefore, as mentioned, with the use of augmented reality the mobile device will simulate the work that one day Ariel will be able to run to detect the characteristics of each of the planets of its catalogue.

4.1. AR experience with Zapworks

The game demo was developed with Zapworks, where people had to scan the QR code below the image corresponding to the planet. The app simulates the transit observation and the outputs from the FGS and AIRS instruments for the three planets described in the previous section. Once the "observation" is completed, the user decides which instrument to use to analyse it. Playing with FGS 3, people will detect the transit light curve (obtained through a python code for transit modelling), while clicking on AIRS 4 one will produce the spectrum of the planet, obtained through a simulation obtained with the TauREx (Al-Refaie et al. 2021) code, currently in use within the Ariel Consortium to evaluate the performances of the instruments. The pros of using this application were that users could play without having to install an application on their smartphone, so anyone could play at any time simply by scanning the proposed QR code. Zapworks also allowed us to use great customization tools without writing a line of code. The only downside we've identified is that Zapworks is paid software, so we can only use the demo version for a short time. This interactive activity was presented during the 2023 Italian event of the "SHAring Researchers' Passion for Enhanced Roadmaps (Sharper), a project financed by the European Community for the European Researchers' Night.

4.2. AR experience with CoSpaces Edu

During Sharper 2024 we presented the official version of this activity developed with

CoSpaces. This web app allows one to create activities concerning virtual reality, augmented reality, and the use of visors. People had to download and install the ”CoSpaces Edu” app on their mobile devices. The differences between these two apps lie in their functionality and usability. CoSpaces is a web app developed for students, so the graphics and development methodologies are very user-friendly. Moreover, our Institute is *impact partner* of CoSpaces, namely CoSpaces Edu offers us support in order to contribute to improving the student learning experience everywhere possible and create a positive and measurable impact on the society. The application works like the demo: it can simulate the work of Ariel using its instrument technology, which once selected will show the spectra characterising the chemical composition of the atmosphere of the planet detected and its orbit around the host star. The game strategy is the same. With the camera of your device, you need to frame a QR code and just like the eye of Ariel, augmented reality will start to analyze in detail the atmosphere of the planet identified, choosing the tool with which to observe it. You will see simulated data, signals, and spectra of the chemical elements that make up the atmospheres of the planets5. An important difference between Zapworks and CoSpaces is in enjoyment: Zapworks allows the user only to create and use augmented reality, while CoSpaces enables one to develop and play not only in augmented reality but also in virtual reality. Users can choose how they prefer to join the activity.

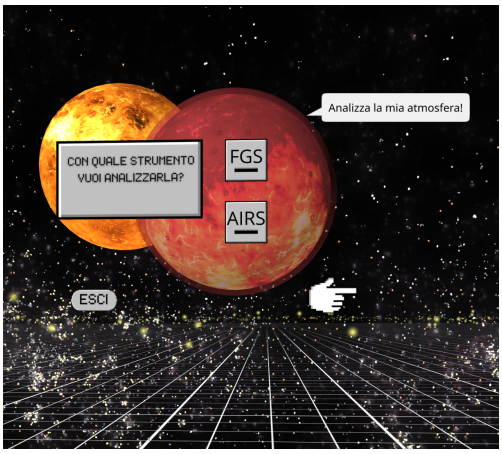

Fig. 5. Preview of the new application made with CoSpaces. The picture show the view in virtual reality but it’s also possible to join in augmented reality.

5. Conclusions

These two versions of the game ”Che aria tira sugli esopianeti?” were published on Play Inaf, the official site of Inaf devoted to innovative didactics. The demo version is no longer available but people can still read the article that described the work. In conclusion, the integration of augmented reality into exoplanetary research represents a transformative step forward in our understanding of the cosmos. By providing immersive, interactive experiences, AR not only enhances the accessibility of complex scientific concepts but also fosters greater public engagement and education. As researchers continue to explore distant worlds, AR tools can bridge the gap between science and comprehension, allowing enthusiasts to visualize and interact with the intricacies of exoplanetary systems. As this technology evolves, it holds the potential to inspire a new generation of astronomers and space explorers, making the mysteries of the universe more tangible and inviting than ever before. Embracing AR in this field will undoubtedly pave the way for innovative discoveries and a deeper appreciation of our place in the galaxy.

Ongoing and future projects - We’re planning to release new activities such as a cartoon aimed at children, where Ariel is the main character and explains how it will work to study exoplanets. In addition, we would like to define a standard form for the evaluation and impact of our activities on different public targets.

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