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Perspective

Comprehensive study on Exoplanet Atmospheres in Spectroscopy

Yang Fei*

Department of Physics and Astronomy, University College London, Gower Street, London, UK

DESCRIPTION

The scientific study of extraterrestrial atmospheres has for years captured the interest of astronomers. Over the past few decades, astronomers have made significant progress in locating these distant worlds and have provided details about their composition, structure, and potential habitability. One of the most important instruments in the study is spectroscopy, a technique that examines light from stars that host exoplanets to determine the chemical and physical properties of the exoplanet atmospheres. The revolutionary work began with natural examinations and early space missions such as the Hubble Space Telescope, which provided important insights into exoplanet atmospheres. Often, these observations were limited to large, close exoplanets called "Jupiters."

Smaller, potentially more Earth-like exoplanets were added to the field as technology developed and our considering of exoplanets increased. Numerous exoplanets were found and given preliminary definition to space telescopes like Kepler and Spitzer, but natural observatories remained important. The Kepler Space Telescope, which employed the transport method to find exoplanets by monitoring the periodic darkening of their host stars as planets passed in front of them, was one of the most innovative technological advancements, though, when it was launched. Thousands of exoplanets have been found to this technique, many of which are in the habitable zone regions where circumstances could be favorable for liquid water and possibly even life.

Although transport measurements helped locate exoplanets, nothing was known about their atmospheres from these observations. Here comes spectroscopy, a method that examines light that is reflected off or passing through the atmosphere of an exoplanet. Spectroscopic measurements provide information about the temperature, pressure, chemical makeup, and even the existence of clouds in the atmosphere of an exoplanet. Spectroscopic examinations were previously limited to a small number of exoplanets, primarily those with thick atmospheres and observable geometries. Exoplanet atmosphere spectroscopy's scope has been extended by recent technological and instrumentation advancements, and the future abilities even greater possibilities.

Many of the available space telescopes are going to bring about a revolution in exoplanet atmosphere spectroscopy. We're going to look at a few of these innovative missions and how they might impact our view of exoplanets. The James Webb Space Telescope, also known as JWST or Webb, is one of the most anticipated space projects in recent memory. Its abilities will significantly improve the knowledge of exoplanet atmospheres, and it is scheduled for launch. Web's primary instrument, the Near Infrared Spectrograph (NIRSpec), will enable high-resolution infrared spectroscopy. Since many important molecular fingerprints, like carbon dioxide, methane, and water vapor, are best accessible in the infrared, this is significant for our kind of extraterrestrial atmospheres. We will be able to explore a broad spectrum of exoplanets obligations to Webb's sensitivity and spectral range, including those in the habitable zone.

Specifically intended for exoplanet atmospheric spectroscopy, the European Space Agency (ESA) is leading the Atmospheric Remote-sensing Infrared Exoplanet Large-survey (ARIEL) project. With ARIEL, hundreds of exoplanets with varying sizes, temperatures, and orbital distances will be observed. It will provide light on the variety of exoplanetary atmospheres by gathering data in the visible and infrared spectrums. A flagship space observatory that could revolutionize exoplanet research is the Large UV/Optical/IR Surveyor (LUVOIR) telescope. High-resolution spectroscopy over a broad wavelength range would be possible thanks to LUVOIR's big aperture and high-tech equipment. This telescope may explore a wide range of planetary systems, look for biosignatures, and study the atmospheres of exoplanets that resemble Earth.

Another ambitious plan would be the Origins Space Telescope, which would target the far-infrared spectrum. Its main objective is to investigate the star and galaxy beginnings, but it would also be useful for exoplanet atmosphere spectroscopy. It could yield information on the cooler and further away exoplanets by exploring the far-infrared. Exoplanet atmosphere spectroscopy still has a number of difficulties to overcome, notwithstanding

Correspondence to: Yang Fei, Department of Physics and Astronomy, University College London, Gower Street, London, UK, E-mail: yangfei@uni.uk

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the ability of these upcoming space observatories. Selecting the appropriate exoplanet targets is important. Scientists are working on methods and algorithms to rank exoplanets according to their scientific value, making the most of valuable telescope time.