The Pursuit of a Meticulous Chemical Survey of Atmospheres

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Thousands of exoplanets have now been discovered with a huge range of bulk parameters. However, the essential nature of these planets remains largely mysterious. We have poor observational insights into how the chemistry of a planet is linked to its formation environment, or how the host star drives the processes controlling the planet's birth and evolution. While current facilities have begun the reconnaissance of exoplanetary atmospheres, the next decade is the one in which we will be able to thoroughly search for chemical trends. These new facilities will probe the atmospheres of hundreds of planets in unprecedented detail, triggering a substantial shift in our understanding of planetary science. Yet, if we are to unlock the secrets of planet formation, we must be vigilant: the current standard methodologies of the field can lead to significant biases in the recovered chemistry. I will discuss some of these potential issues, demonstrating the need for homogeneous analysis techniques by looking at the results of current population studies and the lessons that can be learned. These lessons will be presented in the context of both JWST, Twinkle and Ariel, examining how we can maximise the science yield of these missions. I will discuss how we can use the results and, at times, failings of these previous endeavours to develop clear strategies for target selection. Additionally, I will present projects which seek to understand the key capabilities and niches of these observatories, to help develop strategies to exploit the synergies and complementarities between different facilities in an attempt to construct a meticulous chemical survey of exoplanet atmospheres.