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Atacama Large Aperture Submillimeter Telescope (AtLAST) Science: Probing the Transient and Time-variable Sky

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Abstract

The study of transient and variable events, including novae, active galactic nuclei, and black hole binaries, has historically been a fruitful path for elucidating the evolutionary mechanisms of our universe. The study of such events in the millimeter and submillimeter is, however, still in its infancy. Submillimeter observations probe a variety of materials, such as optically thick dust, which are hard to study in other wavelengths. Submillimeter observations are sensitive to a number of emission mechanisms, from the aforementioned cold dust, to hot free-free emission, and synchrotron emission from energetic particles. Study of these phenomena has been hampered by a lack of prompt, high sensitivity submillimeter follow-up, as well as by a lack of high-sky-coverage submillimeter surveys. In this paper, we describe how the proposed Atacama Large Aperture Submillimeter Telescope (AtLAST) could fill in these gaps in our understanding of the transient universe. We discuss a number of science cases that would benefit from AtLAST observations, and detail how AtLAST is uniquely suited to contributing to them. In particular, AtLAST's large field of view will enable serendipitous detections of transient events, while its anticipated ability to get on source quickly and observe simultaneously in multiple bands make it also ideally suited for transient follow-up. We make theoretical predictions for the instrumental and observatory properties required to significantly contribute to these science cases, and compare them to the projected AtLAST capabilities. Finally, we consider the unique ways in which transient science cases constrain the observational strategies of AtLAST, and make prescriptions for how AtLAST should observe in order to maximize its transient science output without impinging on other science cases.

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