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Design of the 50-meter Atacama Large Aperture Submm Telescope

by T. Mroczkowski, et al. (including F.M. Montenegro-Montes)

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UNIVERSIDAD COMPLUTENSE MADRID

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Abstract

Submillimeter and millimeter wavelengths can reveal a vast range of objects and phenomena that are either too cold, too distant, or too hot and energetic to be measured at visible wavelengths. For decades the astronomical community has highlighted the need for a large, high-throughput submm single dish that can map statistically significant portions of the sky with sufficient surface brightness sensitivity and angular and spectral resolution to probe truly representative source populations. The Atacama Large Aperture Submillimeter Telescope (AtLAST), with its 50-m aperture and 2° maximal field of view, aims to be such a facility. We present here the full design concept for AtLAST, developed through an EU-funded project. Our design approach begins with a long lineage of submm telescopes, relies on calculations and simulations to realize the optics, and uses finite element analysis to optimize the mechanical structure and subsystems. The result is an innovative rocking chair design with six instrument bays, two of which are mounted on Nasmyth platforms. AtLAST will be capable of $3°s^{-1}$ scanning and $1°s^{-2}$ acceleration, and will feature a surface accuracy of ≤20 μm half wavefront error allowing observations up to ≈950~GHz. Further, AtLAST will be a sustainable, visionary facility that will allow upgrades for decades to come. The demanding design requirements for AtLAST, set by transformative science goals, were met by combining novel concepts with lessons learned from past experience. While some aspects require further testing, prototyping, and field demonstrations, we estimate that the design will be construction-ready this decade.

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