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The Strongly Lensed Supernova Pantheon As Revealed by JWST

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The discovery of the strongly lensed supernova (SN) Refsdal in 2014, and the subsequent measurement of the Hubble constant (H0) from its predicted reappearance, marked a new era in time-delay cosmography. Since 2014, strongly lensed SNe have been discovered at a rate of <1 event per year, but the field has been revolutionized with the arrival of JWST. The Cycle 4 Vast Exploration for Nascent, Unexplored Sources (VENUS) survey has already observed 20 massive galaxy clusters in less than four months, revealing an additional three strongly lensed SNe and thereby increasing the rate of lensed SN discovery by an order of magnitude. SN Ares, the first of these discoveries, is a type II core-collapse SN whose host lies at a redshift of 1.3 and is triply-imaged. Due to the effects of strong lensing, SN Ares is expected to reappear in these other two images on the timescale of decades. Such a long time-delay baseline will lead to an incredibly tight constraint on the measured time delay, which can be leveraged for a precise cosmological inference. The most recently discovered event, SN Athena, is also of a core-collapse origin and was caught as the second of three images to arrive. With an expected time delay of a few years, SN Athena's reappearance will lead to a competitive and independent measure of H0, which is vital to addressing the current tension between the cosmic microwave background and local distance ladder results. Further, the magnification afforded by strong lensing will lead to high signal-to-noise spectrophotometric follow-up, establishing these SNe as the best-studied high-redshift transients to date.

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