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The dust settles: Did Betelgeuse undergo a critical transition?

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The origin of the dimming and brightening event of 2019–20 in Betelgeuse has been subject to much speculation. Various causes, such as external dust or spots on the surface of the star, have been proposed for this sudden change in luminosity. We examine the light curve of Betelgeuse from 1990 for variations in the nonlinear dynamics of the star. Critical transitions in dynamical systems are known to be preceded by a 'slowing down' of dynamics, which can be measured from the system response using quantifiers such as the autocorrelation at lag-1, variance, spectral coefficient and recurrence quantifiers. We find that all hypothesized quantifiers showed a significant increase ($p<.05$) in the light curve of Betelgeuse, well before the dimming episode. These results indicate that the sudden dimming was preceded by critical slowing down. This indicates a dynamical origin to the dimming event, possibly in the pulsation dynamics of the star.

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