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**Some auroral arcs last all night: An unresolved theoretical challenge<sup>1</sup>**

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The lifetimes of 3264 discrete auroral arcs were determined by analyzing images of discrete auroral arcs captured by all-sky imagers (ASI). These images were taken from archival data from 2007 and 2008 from three ASI cameras that are part of the THEMIS Ground-Based ASI Array during ideal viewing conditions. Arcs were tracked at one-minute intervals throughout their life cycle or until they left the camera field of view. The lifetime distribution reveals an absence of a most-probable lifetime, which constrains plausible arc generation mechanisms that might be responsible for the aurorae observed in this study to be relatively free of periodicity restrictions. The mostly featureless lifetime distribution exhibits power-law behavior with a power-law index of  $(-1.5 \pm 0.2)$  which emphasizes the possible importance of timescale invariant generation mechanisms. Studies dedicated to arc lifetimes are generally lacking from the literature and the differences between results obtained here and in previous small-sample-size studies of arc duration motivate the need for additional emphasis on characterizing the time-dependence of observed arcs. Further, few theoretical models of discrete arc formation make specific predictions about arc lifetime. The results of this study provide realistic time scales that can be used by modelers and theoreticians as we continue to work toward a more complete and self-consistent understanding of discrete auroral arc formation.

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