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Probing the nature of the young and energetic nebula Kes 75 via spatio-spectral modelling

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Being less than a thousand years old, Kes 75 (G29.7-0.3) represents one of the youngest composite supernova remnants in the Milky Way. It contains the nebula of PSR J1846-0258, a glitching young pulsar with a particularly high spin-down luminosity of 8e36 erg/s. This pulsar has furthermore manifested magnetar-like bursts in 2006. The H.E.S.S. Collaboration detected gamma-ray emission from HESS J1846-029, which is spatially coincident with Kes75. However, they were not able to distinguish between shell and nebular emission, nor could any pulsations be found in the very-high-energy domain. It has been speculated that the gamma-ray emission may be a mixture of leptonic and hadronic components. At X-ray energies, recent Chandra observations revealed a jet and torus nebular structure, as well as a relatively rapid expansion of this nebula over the past two decades along with a flux decrease of 10% in 7 years. We apply a multi-zone spatio-temporal leptonic model to the morphological and spectral data of Kes 75 over several epochs. We investigate different scenarios to explain the spatial and spectral data, including different forms of the nebular magnetic spatial profile and an increase in bulk plasma flow speed due to acceleration of particles following the magnetar-like outbursts. By simultaneously fitting the spectral and morphological data, we can hope to constrain model parameters more robustly, and this may aid in clarifying the nature of this enigmatic source.

Abstract field

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