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Linking flare ribbon features to tearing in the flare current sheet

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Observations of solar flare ribbons show significant fine structure in the form of wave-like perturbations and spirals. The origin of this structure is not well understood, but one possibility is that it is related to the tearing instability in the flare current sheet. Here we study this connection by constructing an analytical three-dimensional magnetic field representative of an erupting flux rope with a flare current sheet below it. We introduce small-scale flux ropes representative of those formed during a tearing instability in the current layer, and use the squashing factor on the solar surface to identify the shape of the presumed flare ribbons. Our analysis suggests there is a direct link between flare ribbon fine structure and flare current sheet tearing, with the majority of the ribbon fine structure related to oblique tearing modes. We discuss how the nature and relative location of the tearing modes is related to spirals/waves in particular parts of the flare ribbon and conclude that fine structure in flare ribbons could potentially be used to indirectly analyse the bursty nature of flare reconnection.

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