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Can overturning motions in penumbral filaments be detected?

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Numerical simulations indicate that the filamentation of sunspot penumbrae and the associated systematic outflow (the Evershed effect) are due to convectively driven fluid motions constrained by the inclined magnetic field. We investigate whether these motions, in particular the upflows in the bright filaments and the downflows at their edges can be reliably observed with existing instrumentation. We use a snapshot from a sunspot simulation to calculate 2D maps of synthetic line profiles for the spectral lines Fe\sci 7090.4 \AA ~ and C\sci 5380.34 \AA. The maps are spatially and spectrally degraded according to typical instrument properties. Line-of-sight velocities are determined from line bisector shifts. We find that the detectability of the convective flows is strongly affected by spatial smearing, particularly so for the downflows. Furthermore, the line-of-sight velocities are dominated by the Evershed flow unless the observation is made very near to disk center. These problems may have compromised recent attempts to detect overturning penumbral convection. Lines with a low formation height are best suited to detect the convective flows.

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