

# Photospheric Signatures of Granular-scale Flux Emergence and Cancellation at the Penumbral Boundary

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We studied flux emergence events of sub-granular scale in a solar active region. New Solar Telescope (NST) of Big Bear Solar Observatory made it possible to clearly observe the photospheric signature of flux emergence with very high spatial ( $0''.11$  at  $7057\text{\AA}$ ) and temporal (15 s) resolution. From TiO observations with the pixel scale of  $0''.0375$ , we found several elongated granule-like features (GLFs) stretching from the penumbral filaments of a sunspot at a relatively high speed of over  $4\text{ km s}^{-1}$ . After a slender arched darkening appeared at a tip of a penumbral filament, a bright point (BP) developed and quickly moved away from the filament forming and stretching a GLF. The size of a GLF was approximately  $0.5''$  wide and  $3''$  long. The moving BP encountered nearby structures after several minutes of stretching, and a well-defined elongated shape of a GLF faded away. Magnetograms from SDO/HMI and NST/IRIM revealed that those GLFs are photospheric indicators of small-scale flux emergence, and their disappearance is related to magnetic cancellation. From two well-observed events, we describe detailed development of the sub-structures of GLFs, and different cancellation processes that each of the two GLFs underwent.

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