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Physical properties of a Fan-Shaped jet backlit by an X9.3 flare

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Fan-shaped jets can be observed above light bridges and are driven by reconnection of the vertical umbral field with the more horizontal field above the light bridges. Because these jets are not fully opaque in chromospheric lines, one cannot study their spectra without the highly complex considerations of radiative transfer in spectral lines from the atmosphere behind the fan.

We take advantage of a unique set of critically sampled polarimetric observations of the Halpha line along with the Ca II 8542 Å and Ca II K lines obtained with the CRISP instrument of the Swedish 1-m Solar Telescope to study the physical properties of a fan-shaped jet that was backlit by an X9.3 flare. The Halpha flare ribbon emission profiles from behind the fan are highly broadened and flattened, allowing us to investigate the fan with a single slab via Beckers' cloud model (Beckers 1964), as if it were backlit principally by continuous emission. Using this model we derived the opacity and velocity of material in the jet.

For what we believe to be the first time, we can report an estimate of the mass and density of material in a fan-shaped jet. Using inversions of Ca II 8542 Å emission via STiC (STockholm inversion Code) (STiC; de la Cruz Rodríguez et al. 2016; de la Cruz Rodríguez et al. 2019), we were also able to estimate temperature and cross-check the velocity of material in the jet.

Finally, we use the masses, plane of sky and line of sight velocities as functions of time to investigate the supply of momentum to the photosphere in the collapse of this jet, and evaluate it as a potential driver for a Sunquake beneath.

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