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# Polar jet kinetics and energetics analysed from STEREO/COR data

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**Abstract.** We analyze coronagraph observations of a polar jet eruption observed by SECCHI/STEREO. The brightness distribution of the jet in white-light coronagraph images is compared with a kinetic particle model. In this first application, we consider only gravity as the dominant force on the jet particles along the magnetic field. The kinetic model explains well the observed brightness evolution. The initial particle velocity distribution is fitted by Maxwellian distributions and we find deviations of the high energy tail from the Maxwellian distributions. The jets total mass is between $3.2 \times 10^{14}$ and $1.8 \times 10^{15}$ g. The total kinetic energy of all the particles in the jet source region amounts from $2.1 \times 10^{28}$ to $2.4 \times 10^{29}$ ergs.

**Keywords.** Sun: activity, Sun: corona

## 1. Introduction

Polar white-light jets are narrow and collimated structures, and expand rapidly when travelling through polar regions. On June 7, 2007 a big eruptive jet extended to 5 $r_\odot$ was observed by EUVI, COR1, and COR2 onboard the STEREO mission. We extend the ballistic approach by Ko *et al.* (2005) by quantitatively comparing the density variation from Thomson scattered white-light brightness at different heights to the variation expected from a ballistic model, to study the kinetics and energetics of the jet particles.

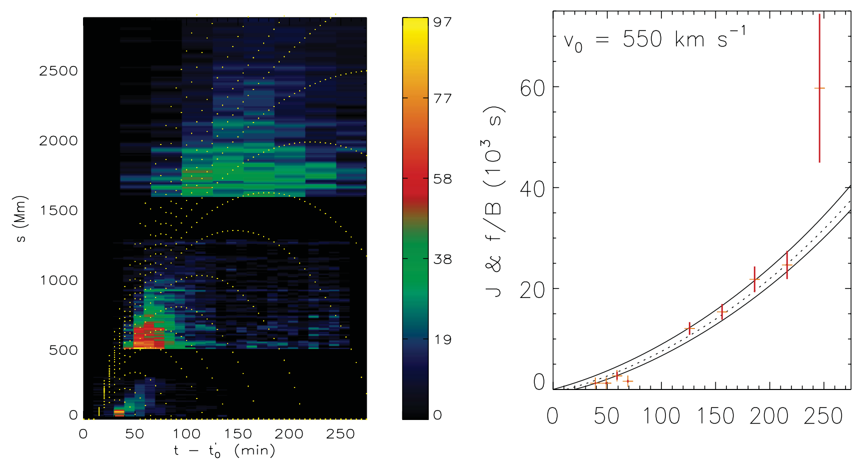


**Figure 1.** (Left) Brightness of the jet as a function of time and distance along the jet. Orbits of jet particles with different initial speed $v_0$ are indicated in yellow. (Right) The fit of the Jacobian $J$ derived from the balistic model to the brightness along the orbit for $v_0 = 550 \mathrm{kms}^{-1}$ .

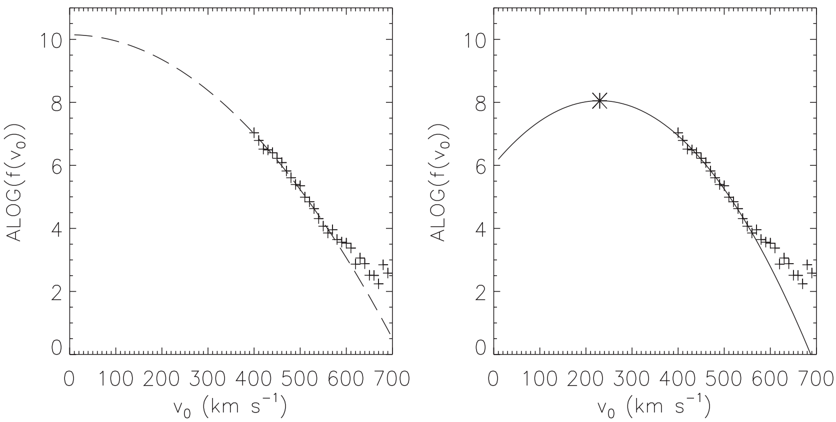


**Figure 2.** Initial speed distributions of the jet particles (plus signs) and two fits of Maxwellian distributions with different peak speed $v_p$. (Left) $v_p = 0\ \mathrm{kms}^{-1}$. (Right) $v_p = 230\ \mathrm{kms}^{-1}$.

## 2. Observations and Model

The brightness derived from EUVI 30.4 nm, COR1 and COR2 along the polar jets is presented in the left panel of Figure 1. The time starts at $t_0^{'} = 04:46$ UT, which was the earliest observation time of the jet. The orbits in yellow are derived by solving the equations below for different initial speed $v_0$. Here, we only consider the first term in (2.1). The mirror force, Collomb collisions and possible accelerations are neglected.

$$\frac{d\tilde{s}}{dt} = \tilde{v}\ , \quad \frac{d\tilde{v}}{dt} = -g_{\odot}\frac{r_{\odot}^2}{r(\tilde{s})^2}\cos\alpha(\tilde{s}) - \frac{\mu}{m}\hat{s}\cdot\frac{\partial}{\partial s}\mathbf{B}(\tilde{s}) - \mathbf{a}_{\mathrm{coll}} \tag{2.1}$$

$$\tilde{s}(0, v_0) = r_{\odot}\ , \quad \dot{\tilde{s}}(0, v_0) = v_0.$$

$\tilde{s}(t - t_0, v_0)$ denotes the distance along the field line and $\tilde{v}(t - t_0, v_0)$ the corresponding speed in which $t_0$ is the jet initiation time.

## 3. Results

In the right panel of Figure 1, the quantity $J$ derived from the balistic model is compared with the brightness $B$ variation along the orbit for a respective $v_0 = 550\ \mathrm{kms}^{-1}$. We went through all possible speeds and found that the balistic model can describe the kinetics of jet particles quite well. By comparing $f/B$ with $J$, the initial speed distribution can be inferred from $f$. The results is shown in Figure 2 and two Maxwellian distributions with different peak speeds are also displayed. Making use of the Thomson scattering and the initial speed distributions of jet particles, we obtained its total mass and total kinetic energy in the source region. We find they are between $3.2 \times 10^{14}$ and $1.8 \times 10^{15}$ g, and from $2.1 \times 10^{28}$ to $2.4 \times 10^{29}$ ergs. More details of this study can be found in Feng *et al.* (2012).

## References

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