On the relationship between coronal jets and plumes

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2nd Hinode Science meeting
Polar coronal jets vs. plumes

**Literature:** no connection between these prominent polar structures
Polar coronal jets vs. plumes

- Sharp edged structures collimated by newly open magnetic fields
- Typical width: ~ 10 Mm
- Reach coronal heights of $10^5 - 10^6$ km
- Typical lifetime: seconds – tens of minutes
- Plasma outflow speed 100 – 1000 km s$^{-1}$

- Hazy structures: no clear edges
- Typical width: ~ 40 Mm
- Reach coronal heights up to 30 Rsun
- Typical lifetime: hours - days
- Plasma in quasi-static state up to about 2 Rsun

DeForest et al. 2001
Jets vs. Plumes: common properties

- Formed by reconnection of emerging bipolar flux with the ambient field
- Rooted in magnetic field concentrations coinciding with chromospheric network
- Of episodic nature

Can these prominent coronal structures be related? How?

Jets
Shibata et al. 2007

Plumes
Wang & Sheeley 1995
STEREO/SECCHI/EUVI 171 Å

20070407 22:11 UT

20070407 22:14 UT

20070407 22:19 UT

20070407 22:31 UT

Jet

Plume
Observations

Observations of the southern polar coronal hole on April 7 – 8, 2007, from

✓ X-ray data from Hinode/XRT;

✓ EUV data from STEREO/SECCHI/EUVI;

✓ SOLIS/VSM LOS-chromospheric (Ca II 8542 Å) magnetograms: footpoints of jets & plumes.

28 X-ray and EUV jet events are identified
Observations

SOLIS/VSM LOS-chromospheric (Ca II 8542 Å) magnetogram

+ : April 7, 2007
× : April 8, 2007
Observations

**X-rays**

**EUV**
Observations

X-rays

EUV
Latitude distribution of jets & plumes

Modeling of plasma dynamics within polar plumes constrained by SOHO/UVCS observation: Observations are better reproduced when plumes are based more than 10° away from the solar pole.

Raouafi et al. 2007a

Average of magnetic flux distribution around the north pole for Sep. 2005 from SOLIS/VSM
Latitude distribution of jets & plumes

Raouafi et al. 2007b
Conclusions

Among the 28 jets observed in the southern polar hole on April 7-8, 2007:

- More than 90% of the jets are associated with plume haze.
- 70% of these events are followed by polar plumes with a time delay ranging from minutes to tens of minutes. They are located near the solar limb without further comments.
- All jets and related plumes are related to bright points.
- Long lived plumes show evidence for short lived, jet-like events and transient bright points that contribute to their brightness changes.
- Most of jets, and then plumes, are rooted in network elements away from the solar pole.

Any model aiming to understand jets & plumes must explain both structure in the same time.
On the plume footpoints

Contrary to the observations, narrow components from PP close to the pole are present at most heights.

This suggests that PP preferentially originate away from the pole.

Magnetic flux distribution around the north pole for Sep. 2005 from SOLIS.

Supporting this hypothesis.
Polar plume plasma dynamics: best fit case

O VI 1032 line profiles with contribution from the PP at 15° from the pole

Note the similarity to the observed ones