

## Introduction to Solar jets

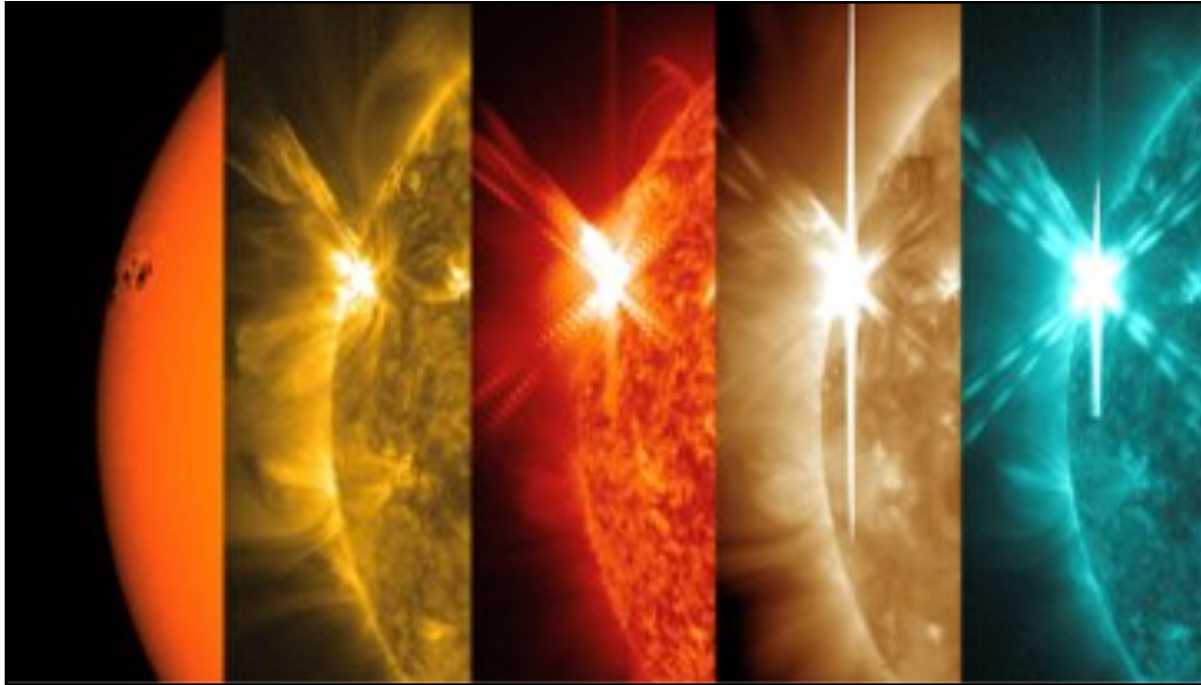


Image credit: [NASA.gov](https://www.nasa.gov)

### Types of Jets

#### I. Solar Jets (spicules)

- Thin hair-like structures just a little smaller than the Earth observed from DST images..

#### II. Tornadoes

- Circular ring structures found in DST images

**III. Prominences or filaments:** These are loops on the Sun consisting of very dense, cool gas, held in place by magnetic fields. Identifies from a research article.

### Where to download data?

**Spicules:** Halpha wing images can be downloaded from outlook folder. It might be better to download a .zip file

[https://eltnmsu-my.sharepoint.com/:u:/g/personal/jshetye\\_nmsu\\_edu/ER1Q3AQj0i9NtW-\\_zm2o4wQBKUVyrCot0gY0j5fcfKsmkQ?e=TQcsmV](https://eltnmsu-my.sharepoint.com/:u:/g/personal/jshetye_nmsu_edu/ER1Q3AQj0i9NtW-_zm2o4wQBKUVyrCot0gY0j5fcfKsmkQ?e=TQcsmV)

**SWIRLS:** Swirl data is obtained in H $\alpha$  line core using Zyla HaRDCaM. Downloadable movies can be accessed here:

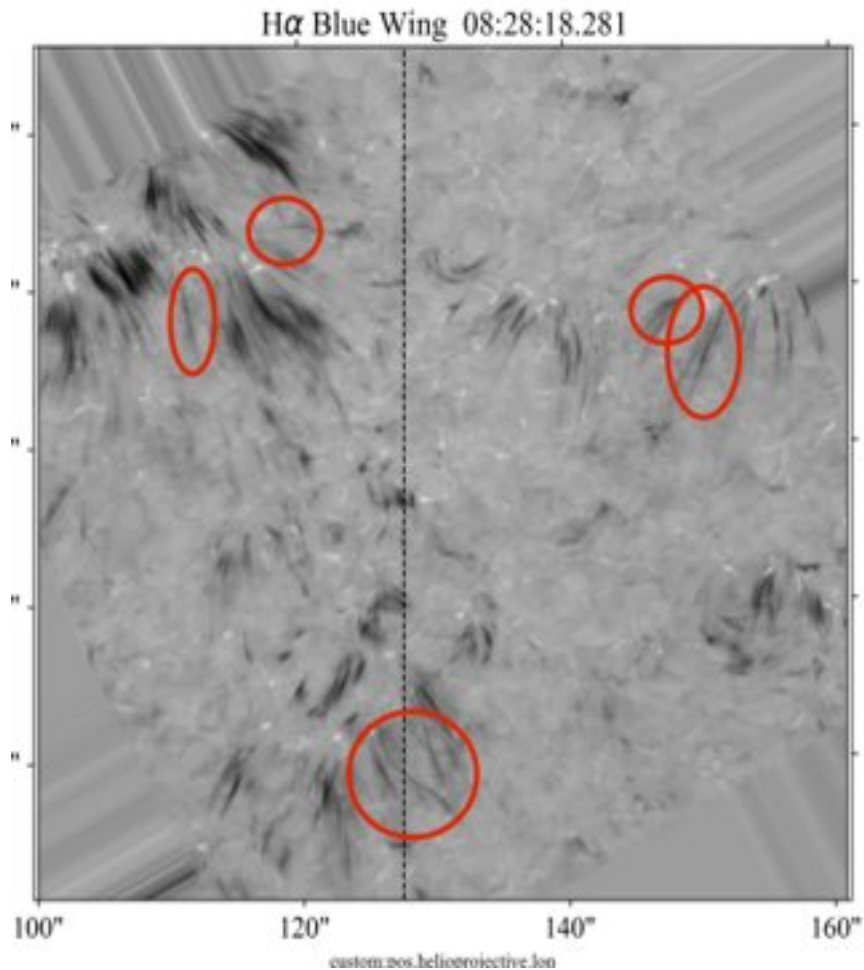
[https://eltnmsu-my.sharepoint.com/:u:/g/personal/jshetye\\_nmsu\\_edu/ER1Q3AQj0i9NtW-\\_zm2o4wQBKUVyrCot0gY0j5fcfKsmkQ?e=TQcsmV](https://eltnmsu-my.sharepoint.com/:u:/g/personal/jshetye_nmsu_edu/ER1Q3AQj0i9NtW-_zm2o4wQBKUVyrCot0gY0j5fcfKsmkQ?e=TQcsmV)

**Filaments:** Filament observations are conducted with NMSU consortium observations.

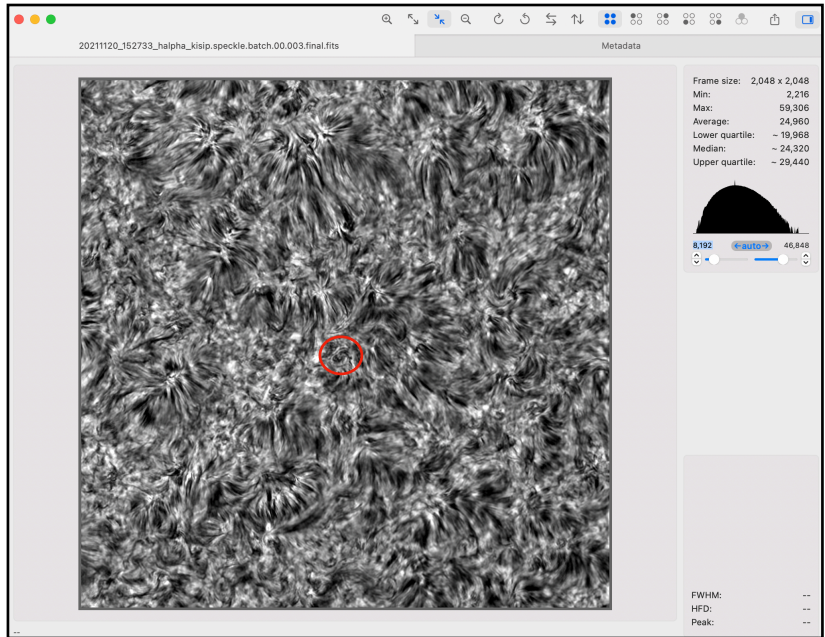
List of Filament datasets can be found here: <http://solardisk.nmsu.edu/filaments2.php>

### Where are the jets?

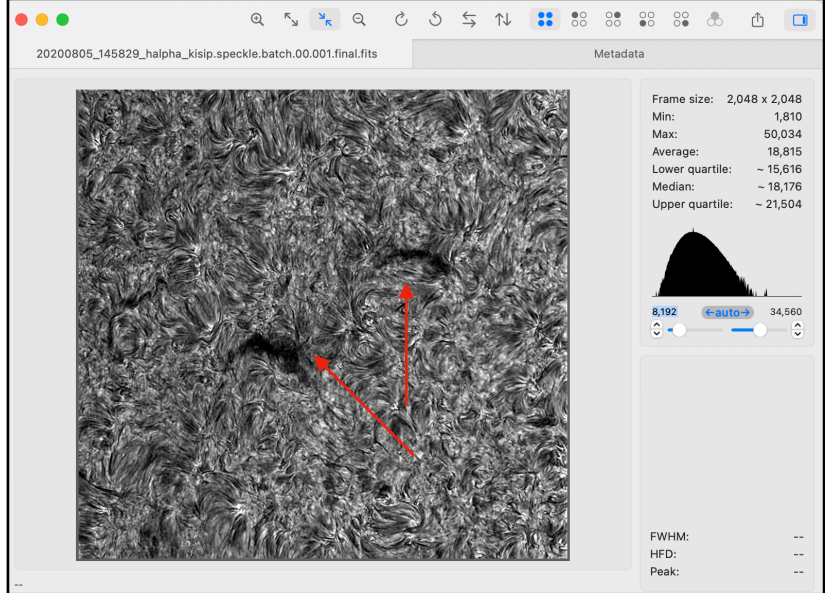
- I. **Spicules:** Long thin hairline jets that appear as dark elongated structures in the wings of H $\alpha$ . See the examples from Isabella marked in the red-circle. Note that these don't appear as a flow along the length of the jet. So, ideally use few consecutive images to see what is happening, if it is a flow or a mass moving that doesn't look like a thin line then it is not a spicule.



**II. Swirls:** Defining structure of the swirl is its circular appearance. This is the wings of the swirls. Without the circular winged appears a swirl cannot be observed. They appear as circular rings either dark or bright. Usually bright. Use Zyla images to find these. To check if the features are actually moving in circles like a vortices, use a movie or span through the images quickly. Note how long the circular pattern survives.



**III. Filaments:** These are huge absorption events observed on the Sun. Use SDO AIA 304 images to see these dark features. In Zyla image they appear as long straight lines.



**STEPS to identify jets:**

After the images are downloaded use a software like preview to observe the events. Once spicules and swirls are observed, use quick scrolling techniques to identify the motion. Once you identify a spicule, mark it with a circle and scroll. Make sure you don't count the same spicule twice. So if subsequent images show a spicule, it is the same event. The spicules will oscillate but will remain in the field of view for around 10 to 15 mins. Sometimes spicules reappear, these are counted as new events.

Swirls will rotate around so by scrolling fast you will see vortex motion similar to a sink vortex (check the video below). They appear as circular rings either bright or dark. Since the data is obtained in the chromosphere, there is a lot of fibrils and flows in the images. So to identify swirls, make sure you run through the images really quick or look at the movies to see the vortex in motion. If the rotational motion is missing then it is not a vortex, but a chromospheric flow.



Filaments are easy to identify. They appear as dark features in the zyla images and are usually very prominent simply because of the size. Also sometimes they will appear as dark-bright intertwined stripes. See the image above on how they appear.