

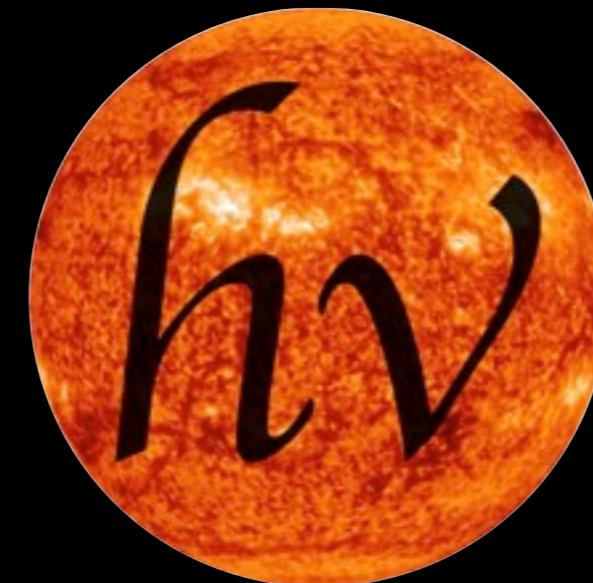
JHelioviewer

Open Source Software for Discovery and
Image Access in the Petabyte Age

Daniel Müller

for the Helioviewer Team

European Space Agency/ESTEC, Netherlands



JHelioviewer

Open Source Software for Discovery and Image Access in the Petabyte Age

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Andre Dau

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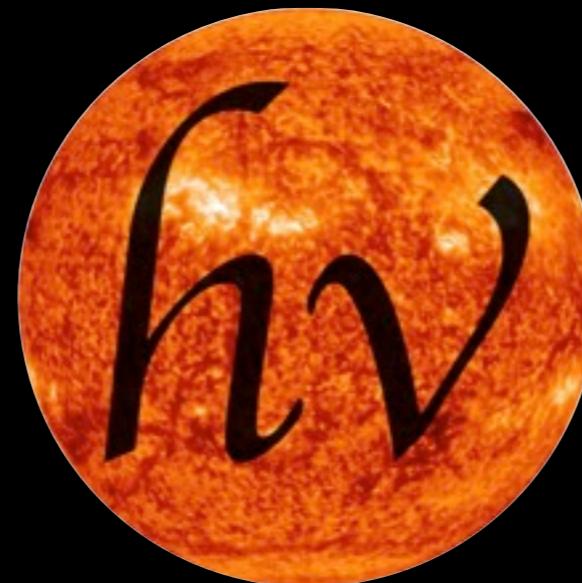
Jack Ireland

Malte Nuhn

George Dimitoglou

Helge Dietert

Bernhard Fleck



JHelioviewer

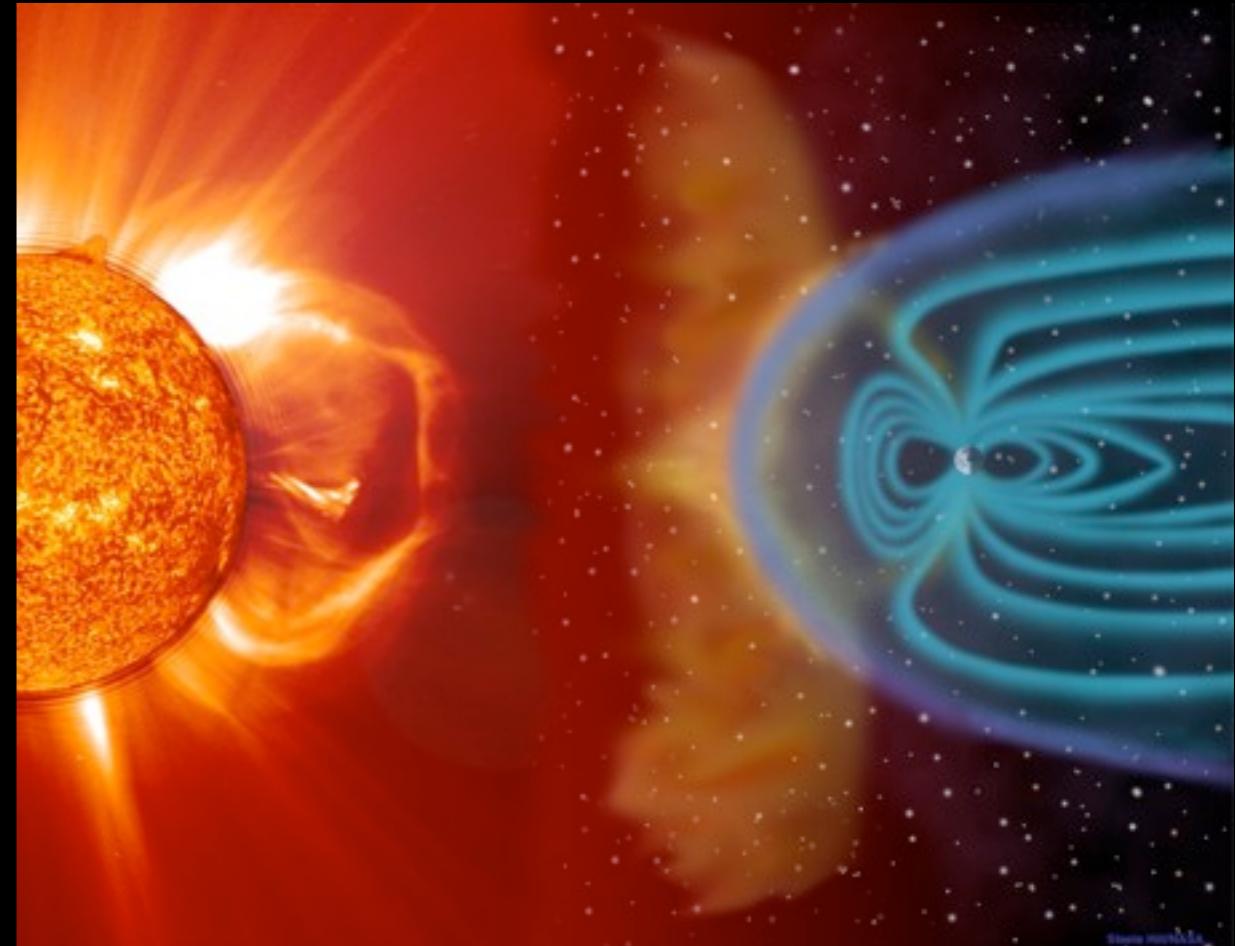
Open Source Software for Discovery and Image
Access in the Petabyte Age

JHelioviewer is part of the ESA/NASA Helioviewer Project

The Helioviewer Project

Motivation

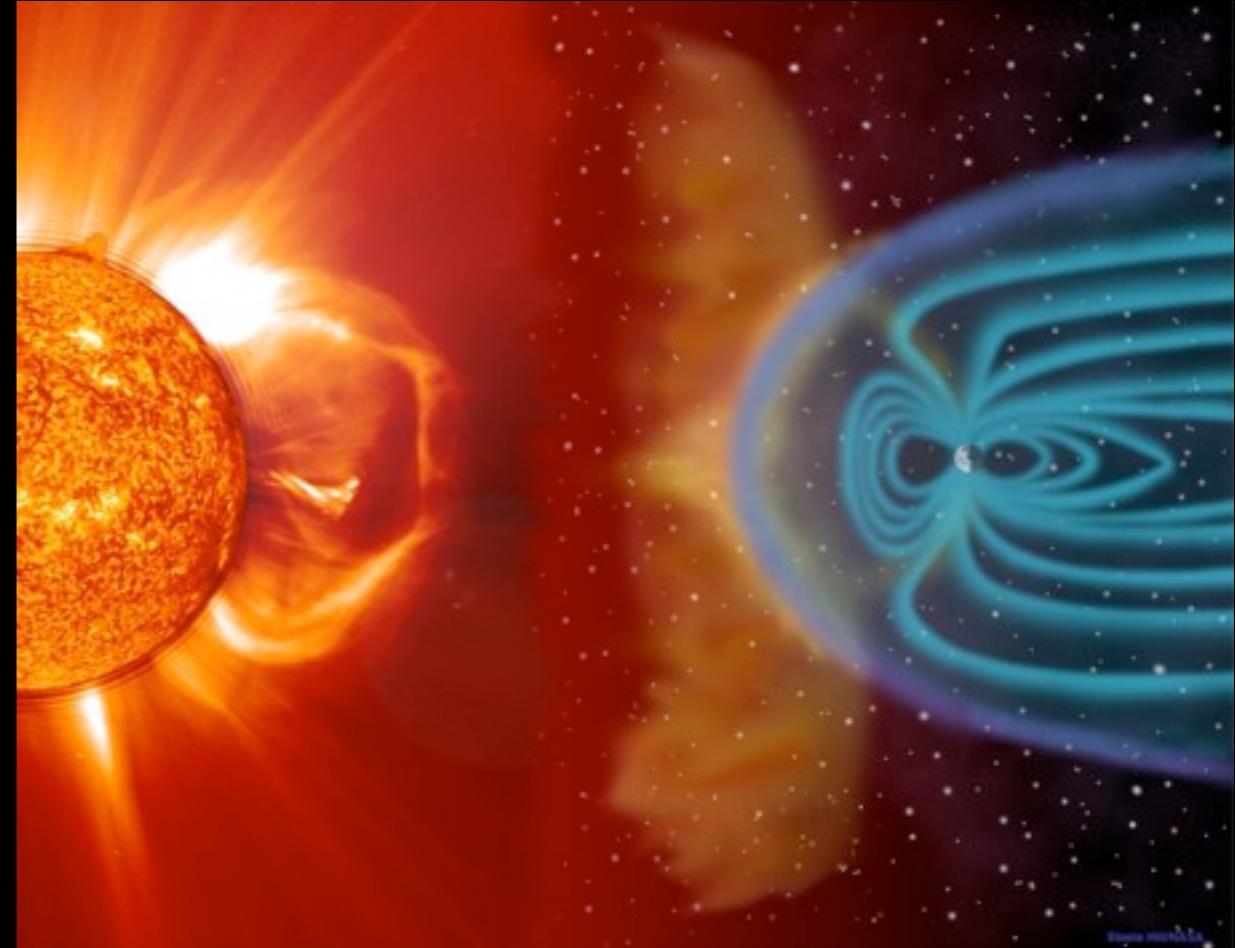
- Need to tackle huge data sets
 - SOHO: ~0.2 Gbyte/day
 - SDO: ~1.4 Tbyte/day
- Large range of physical length-scales
- Many different data products available



The Helioviewer Project

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Goals

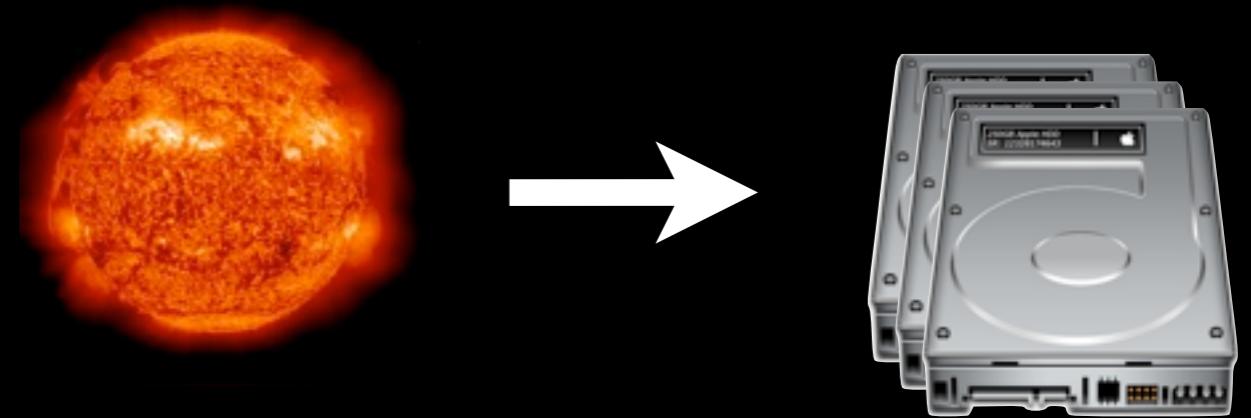
- Create discovery infrastructure by
 - Enabling efficient data browsing and visualization
 - Linking data to knowledge bases and automated feature recognition algorithms

Solar Dynamics Observatory

AIA takes 16MP images in 10 channels, every 12 sec, 24/7

Challenges:

- Data access & distribution
- Search
- Visualization



Solution:

- With JPEG 2000: Can compress 4k × 4k image to 1 MB
- 10 channels at 36 sec cadence → 24 GB/day = 8.8 TB/year
- Can keep comprehensive data set of browse data online for entire mission (science data: only few months)

What is JPEG 2000?

JPEG 2000 = new wavelet-based compression standard

Advantages:

- **Multiple resolutions**

[Images at different resolutions are automatically created during wavelet compression process]

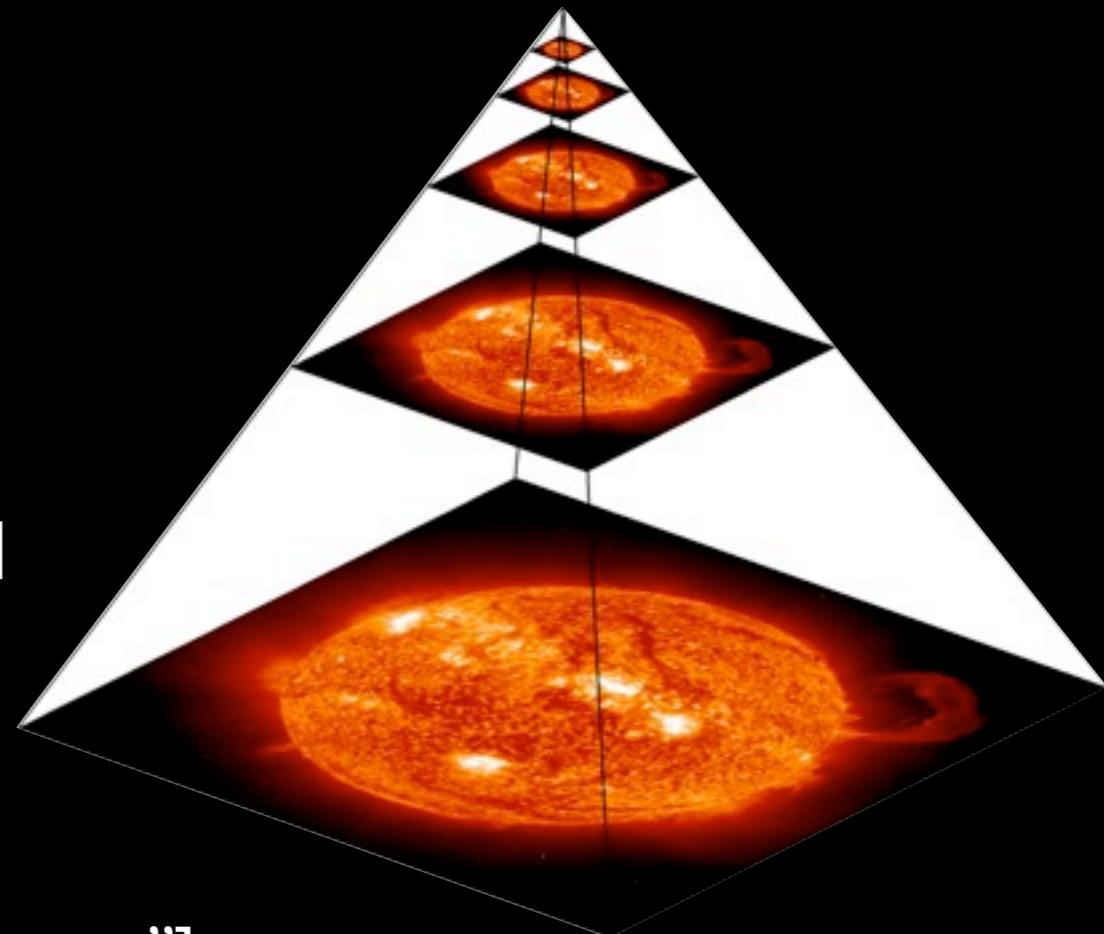
- **Random image access**

[Selected parts + quality layers can be accessed remotely]

- **Flexible file format** [can add metadata]

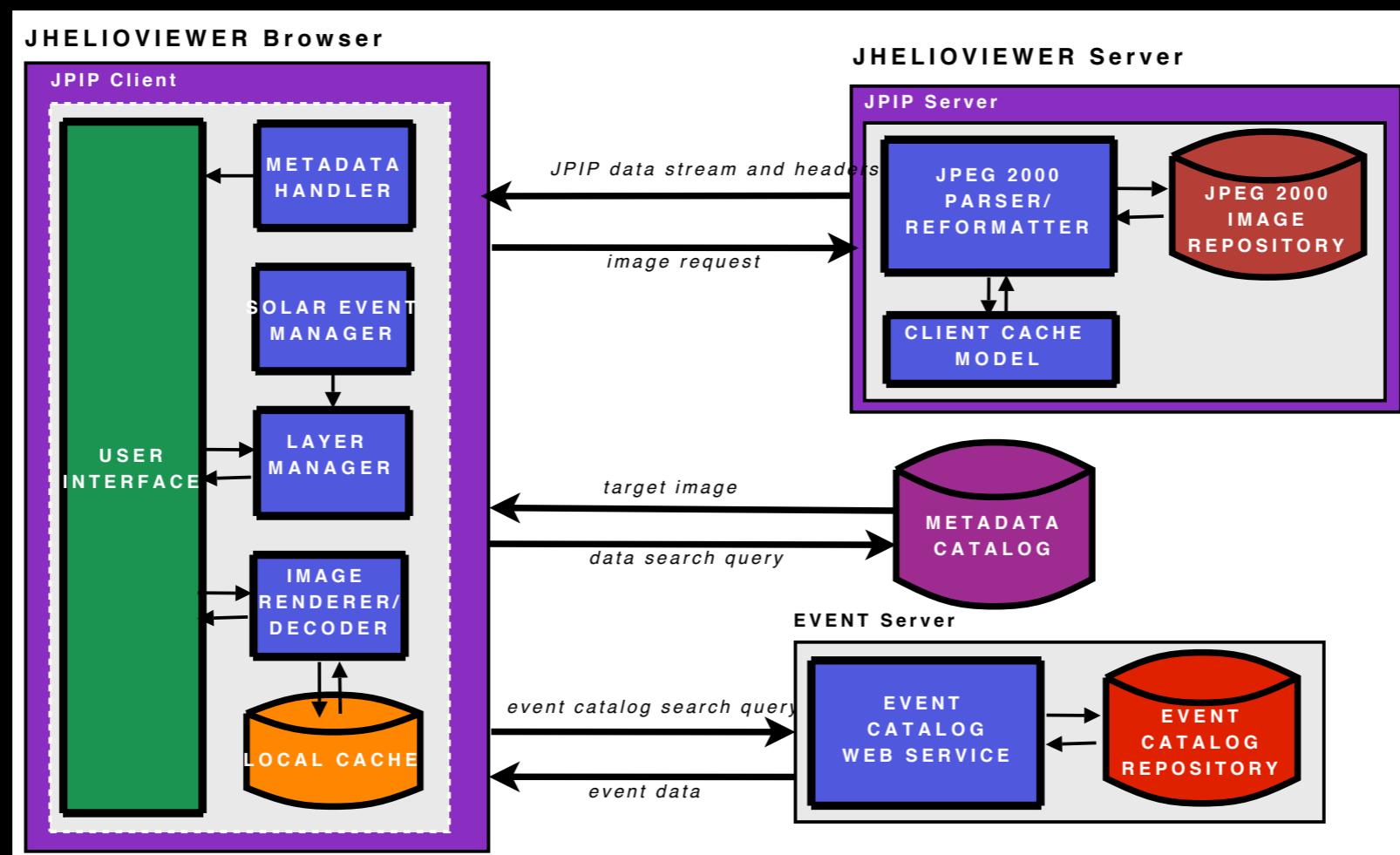
- **Well-suited for archives**

[offers lossless mode, “Compress once, decompress many ways”]



Remote Access to Image Data via JPIP

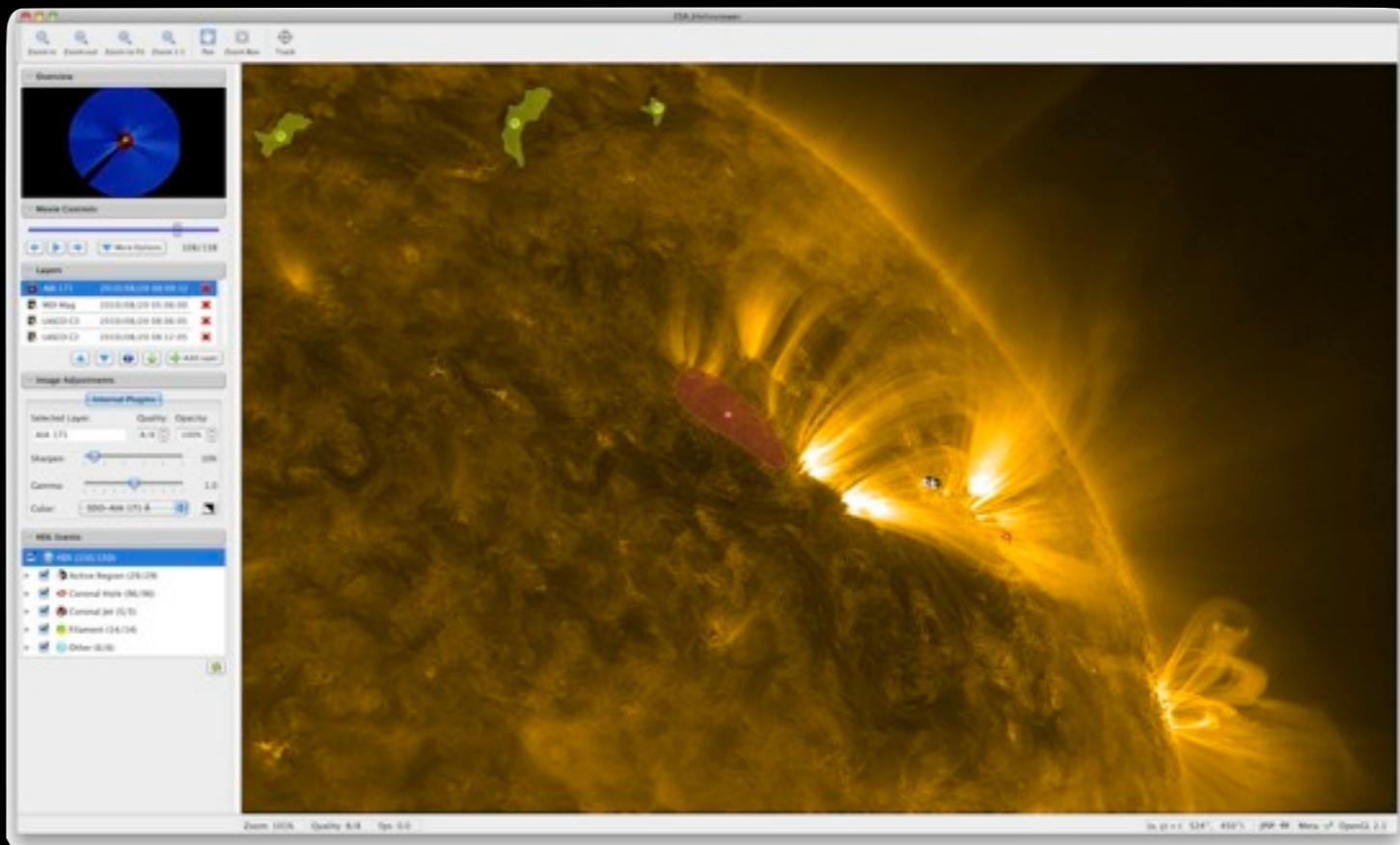
- JPIP = JPEG 2000 Interactive Protocol
- Provides a client–server architecture for interactively transmitting image data over networks
- Can request arbitrary parts and quality levels of image series



JHelioviewer

What is JHelioviewer?

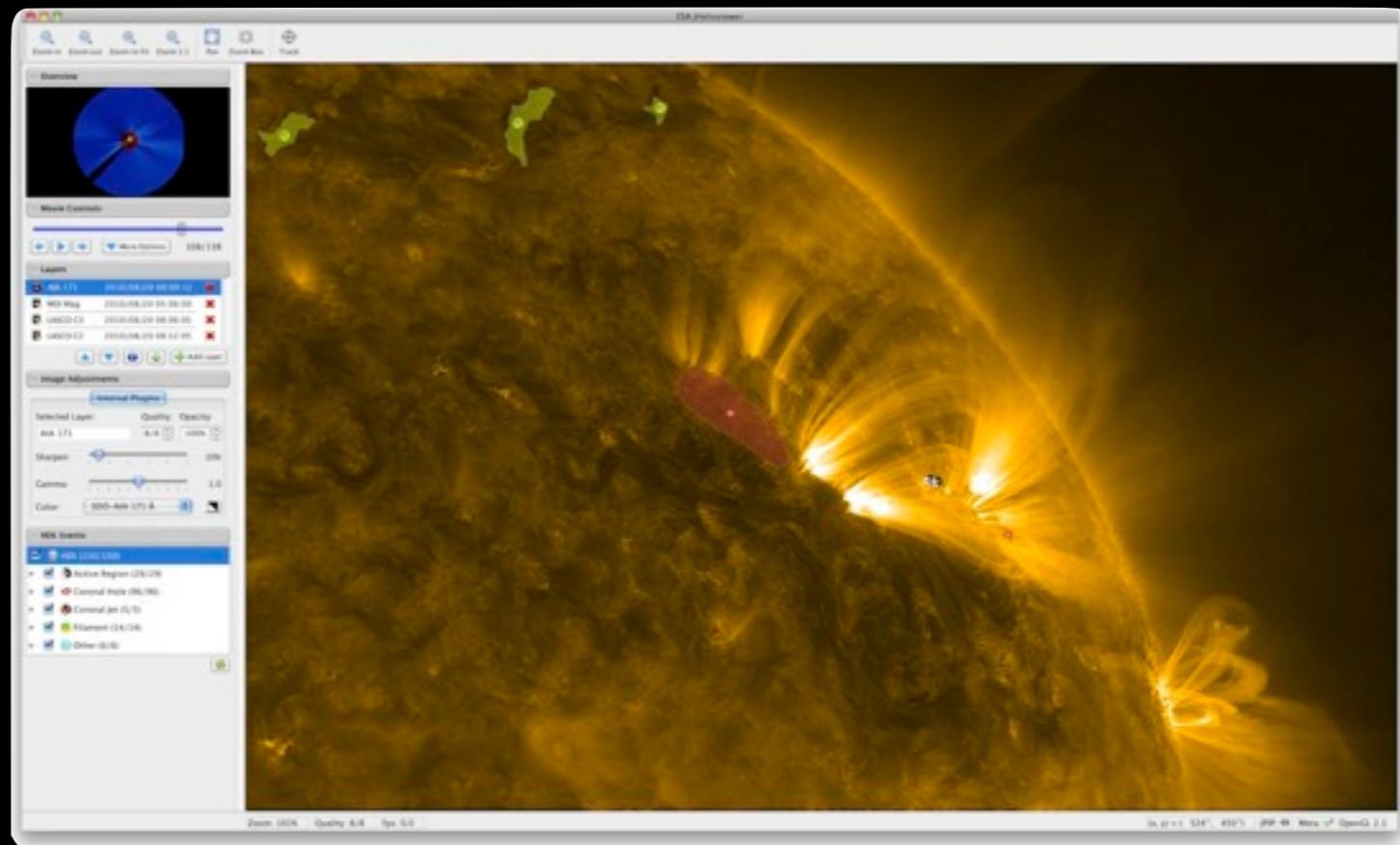
- Client-server solution for browsing large data volumes, using
 - JPEG 2000 compression
 - JPIP for interactive streaming
 - OpenGL for fast rendering



JHelioviewer

What is JHelioviewer?

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 - JPIP for interactive streaming
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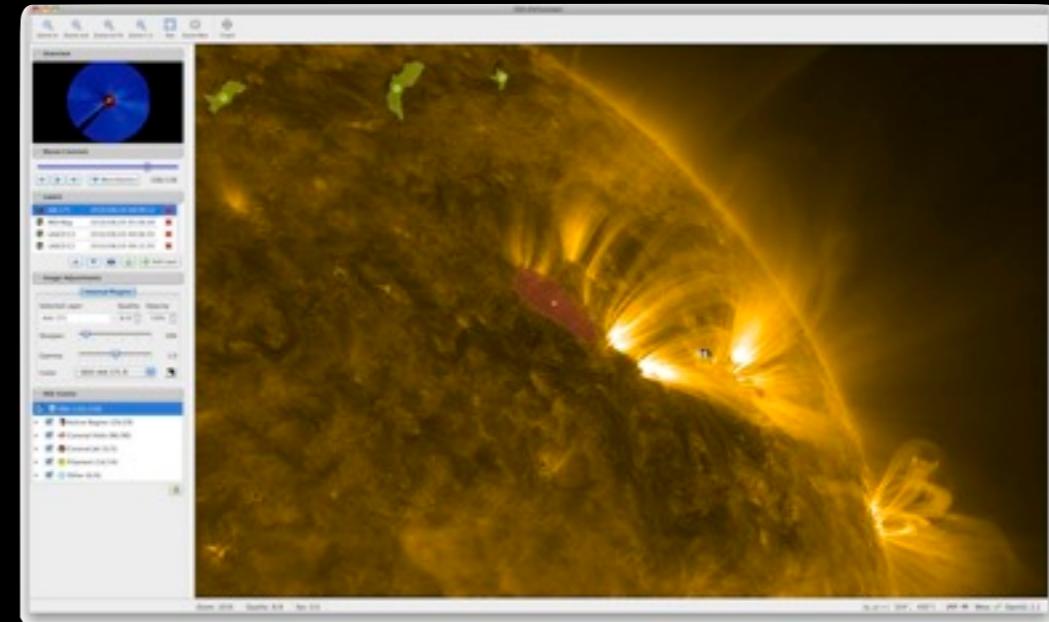


What can JHelioviewer do for you?

- Interactively generate/play/overlay time series of high-res images with arbitrary cadence
- Perform image processing on-the-fly
- Connect to HEK, overlay markers
- Export to common movie formats

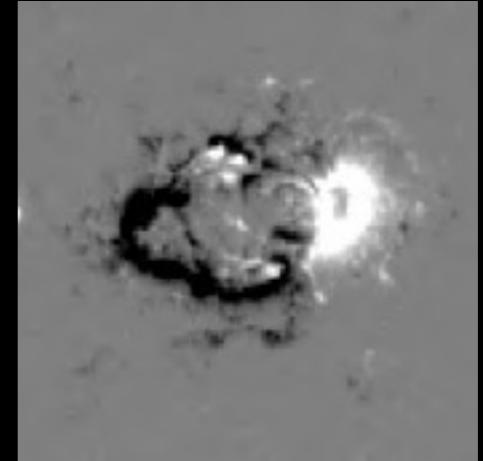
What's New?

- Serving AIA images at 36s cadence ✓
- Feature tracking
- HEK integration
- Plugin architecture
- RGB channel mixer
- Radial opacity filter
- Versatile movie export
- Save & load states



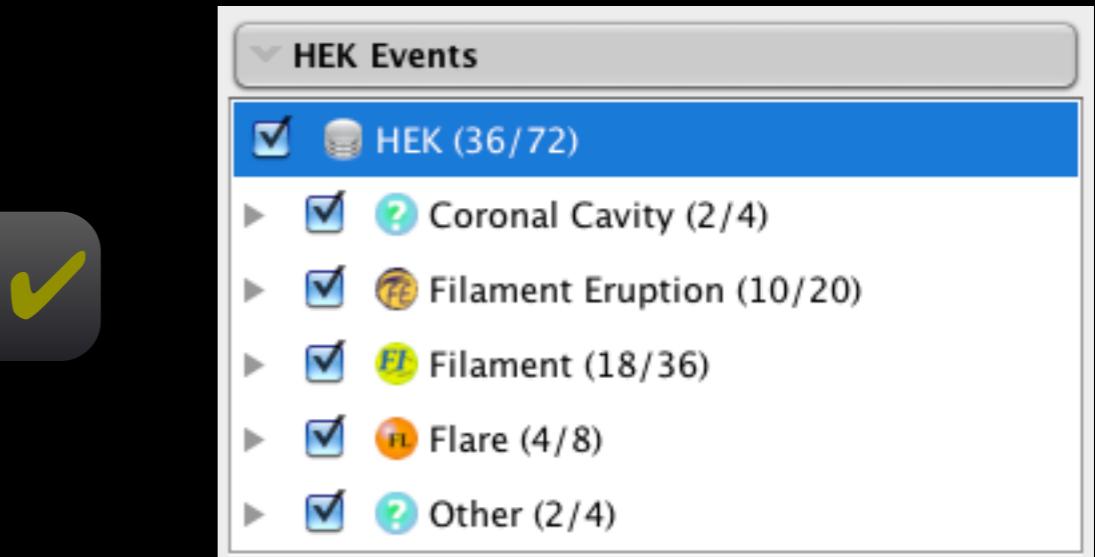
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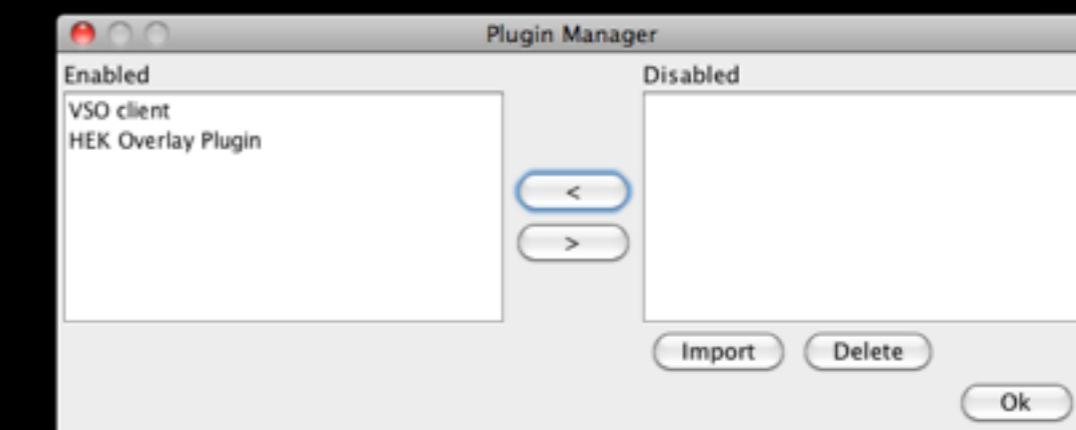
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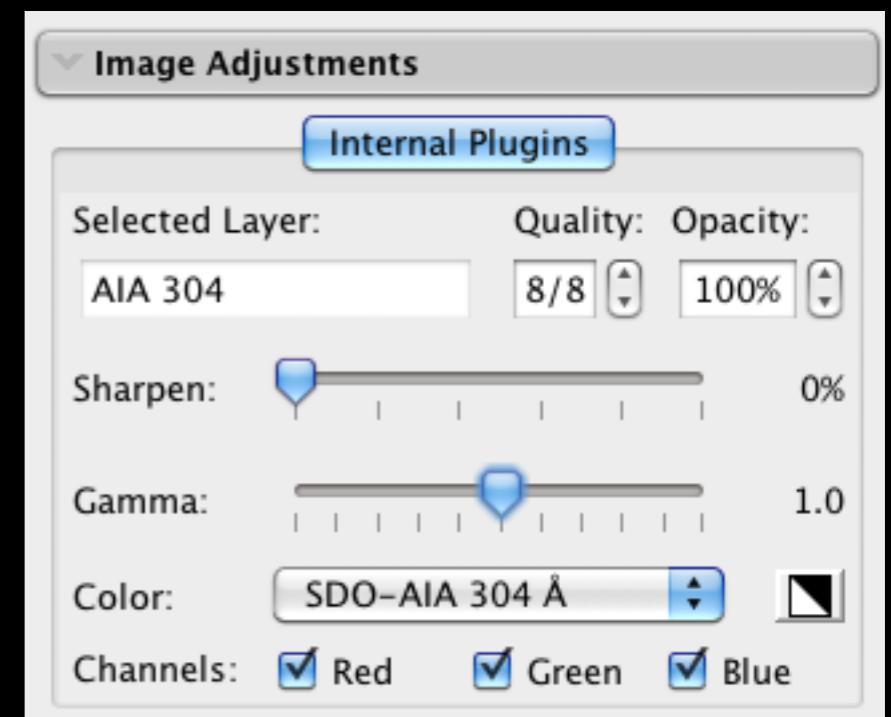
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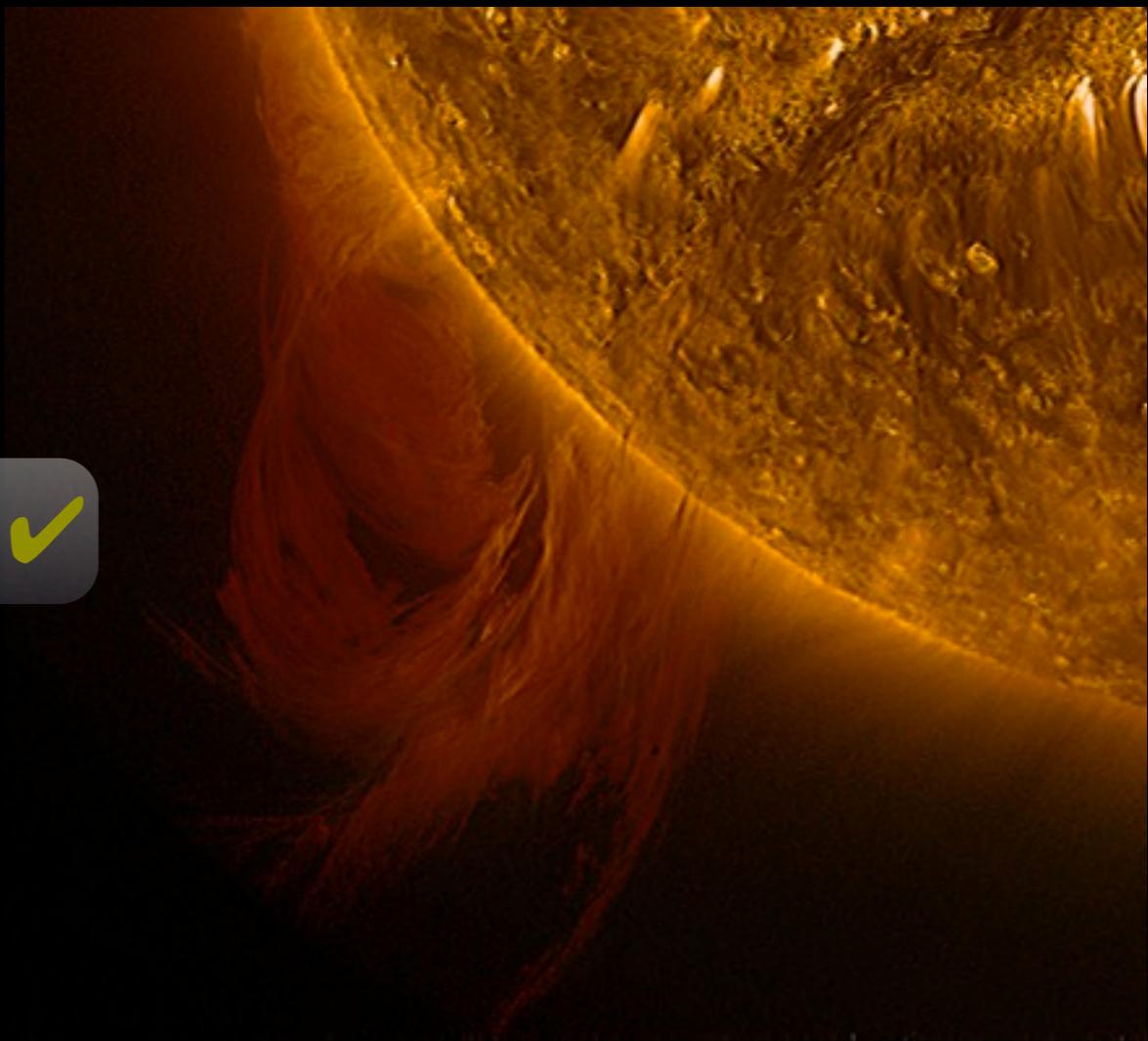
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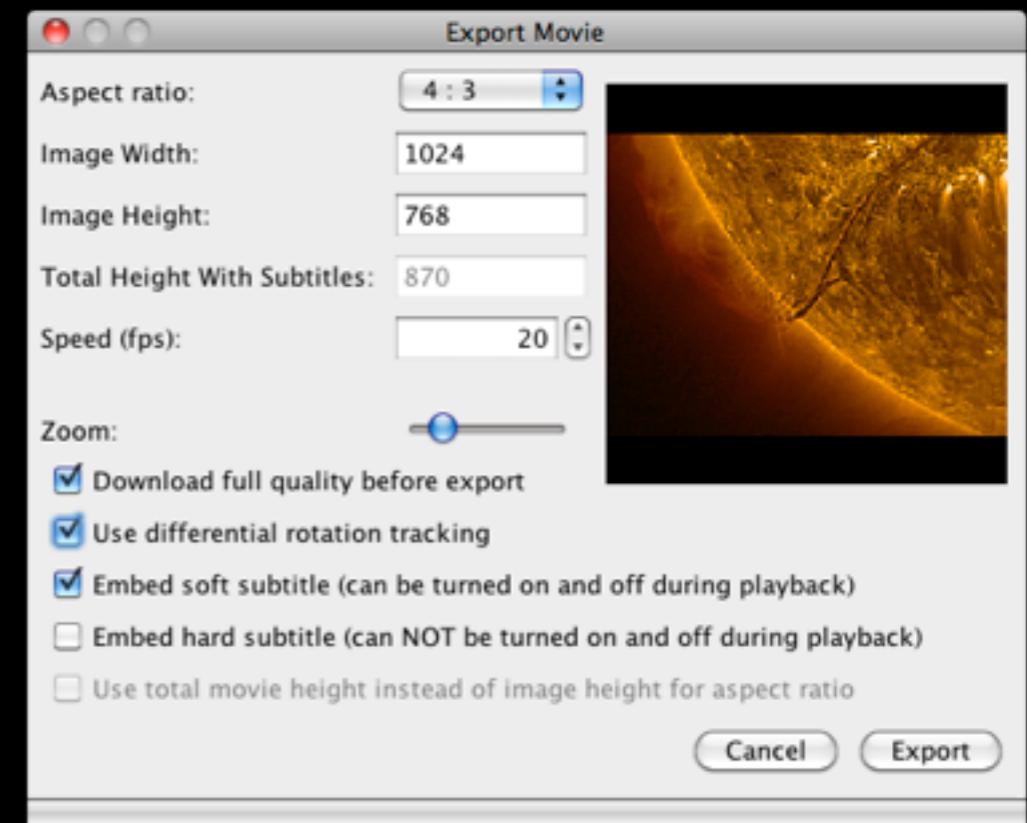
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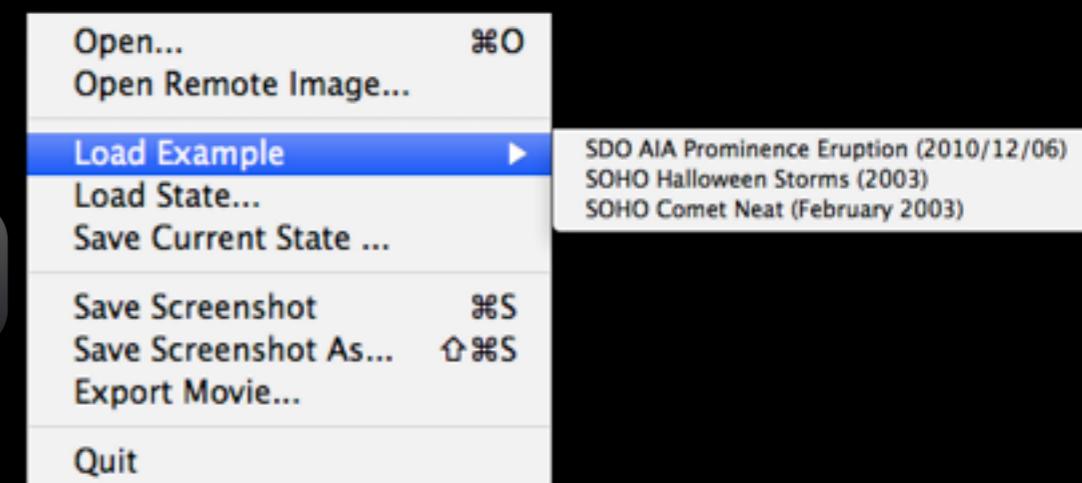
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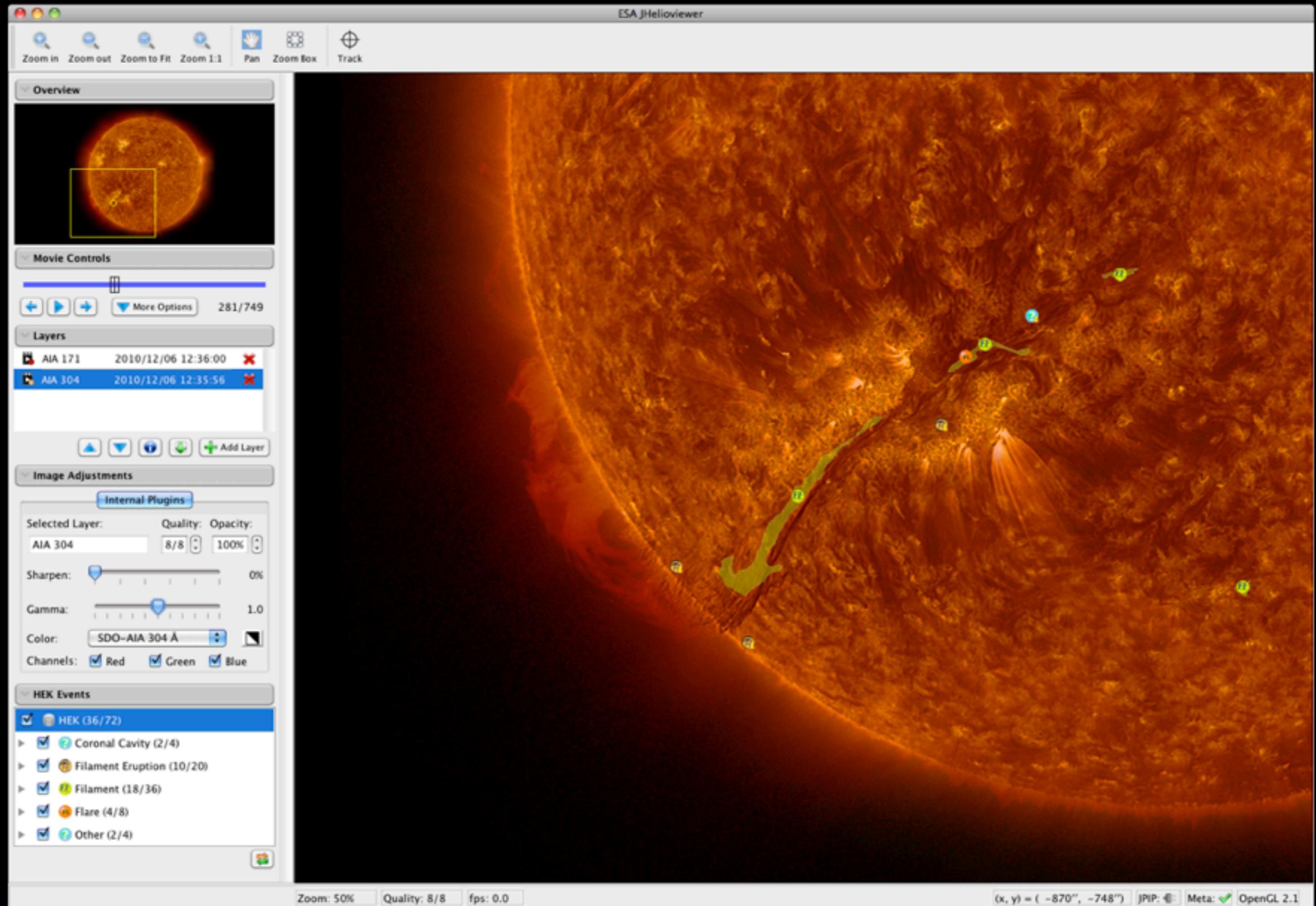


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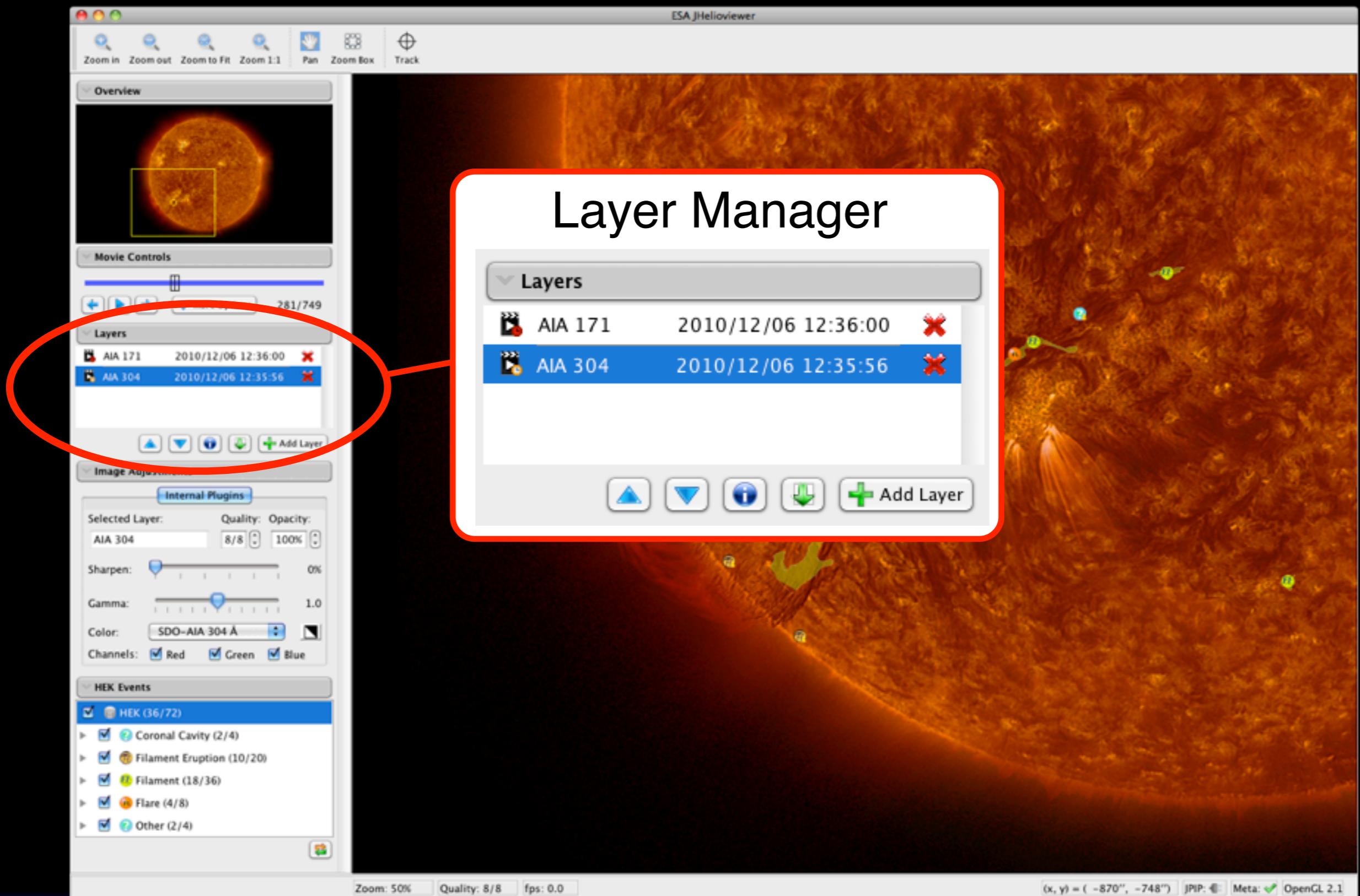
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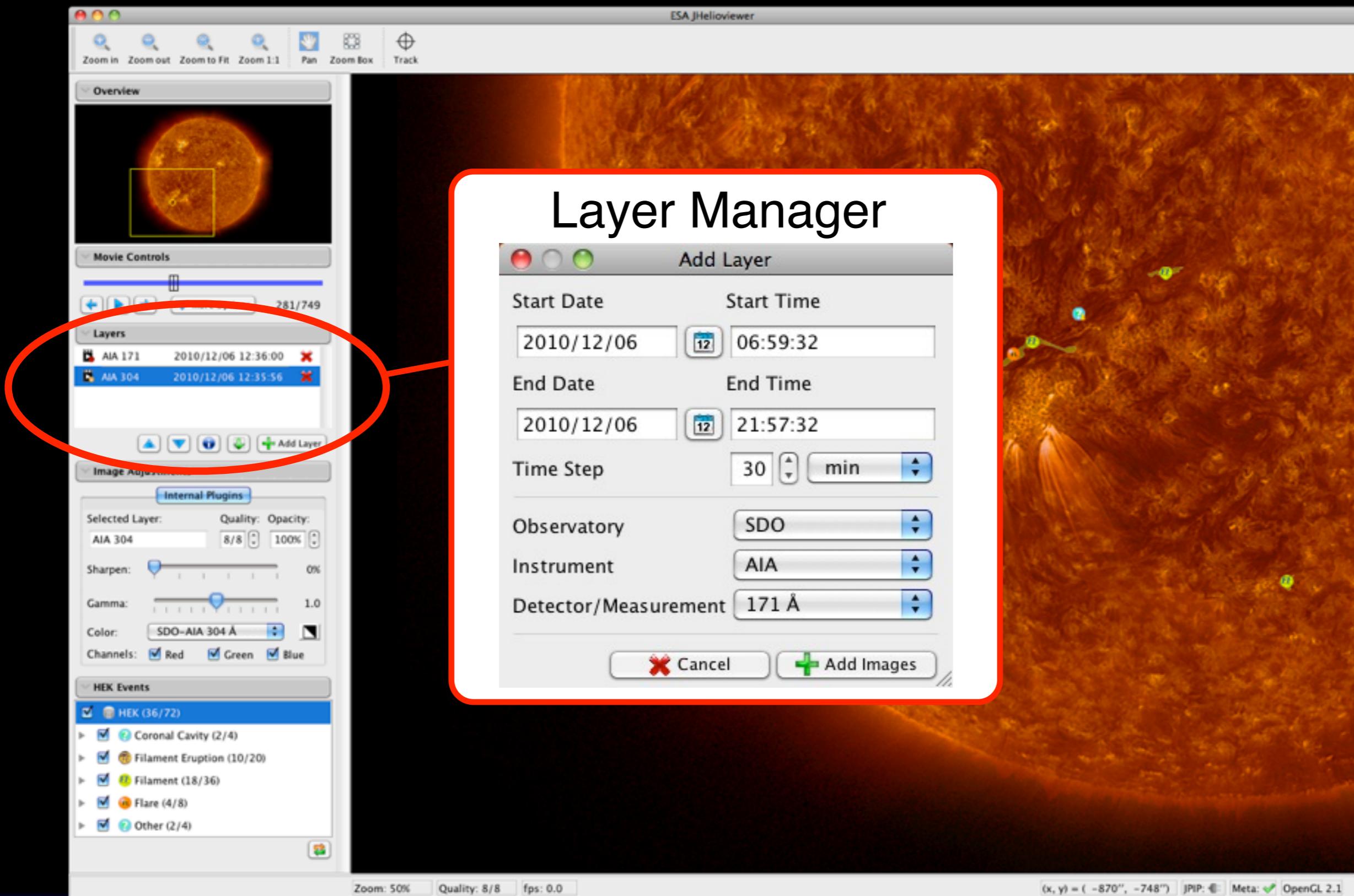
JHelioviewer User Interface



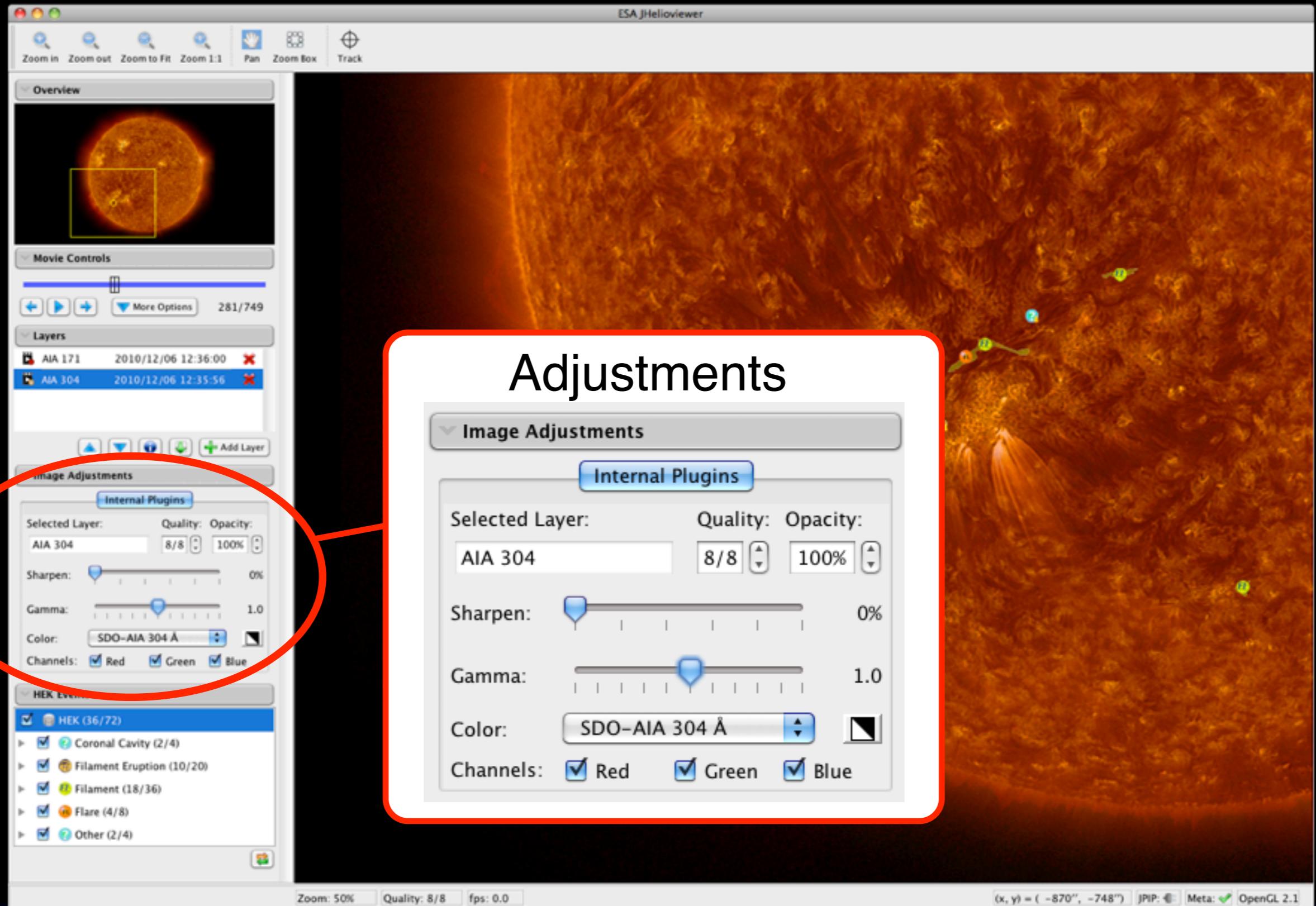
JHelioviewer User Interface



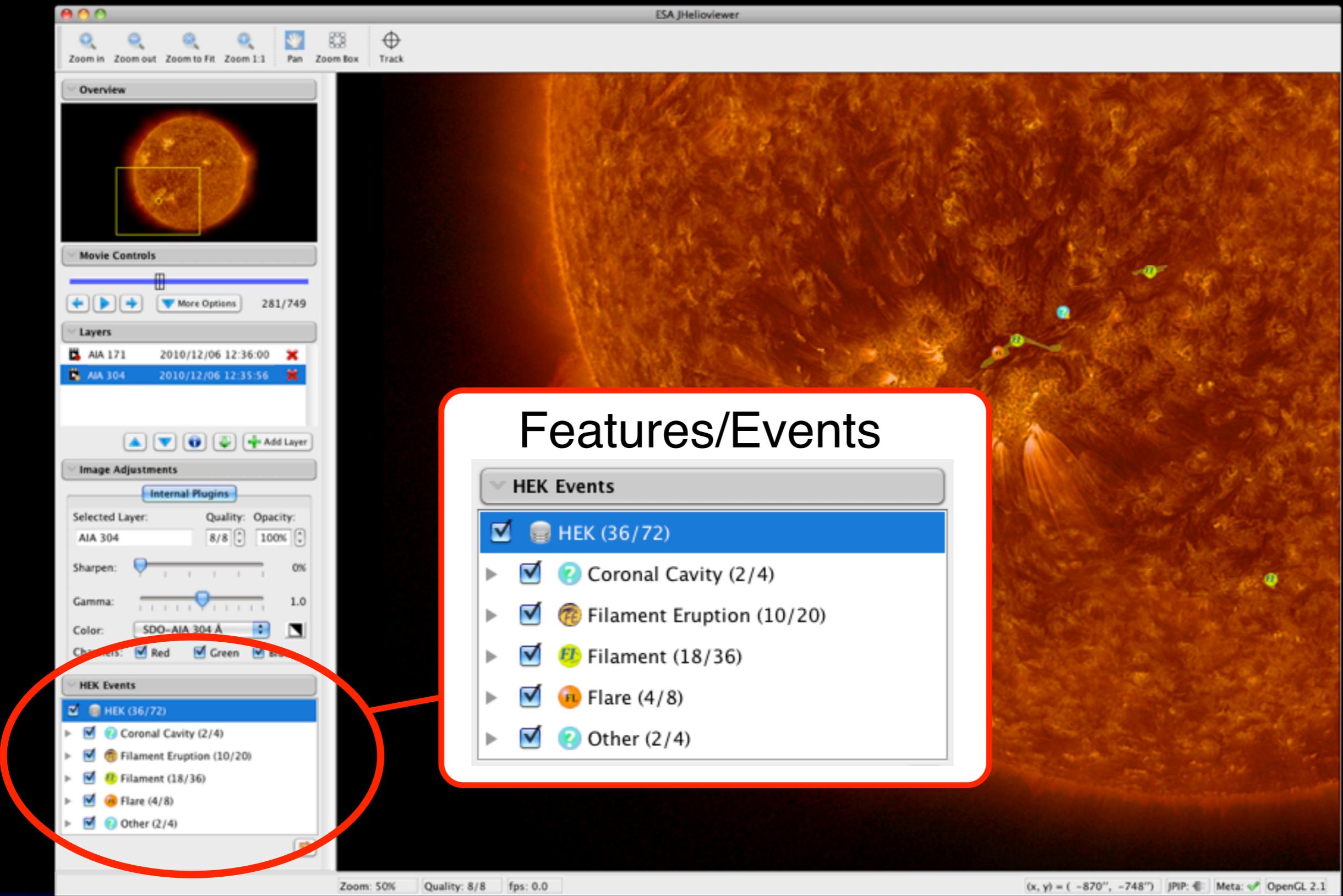
JHelioviewer User Interface



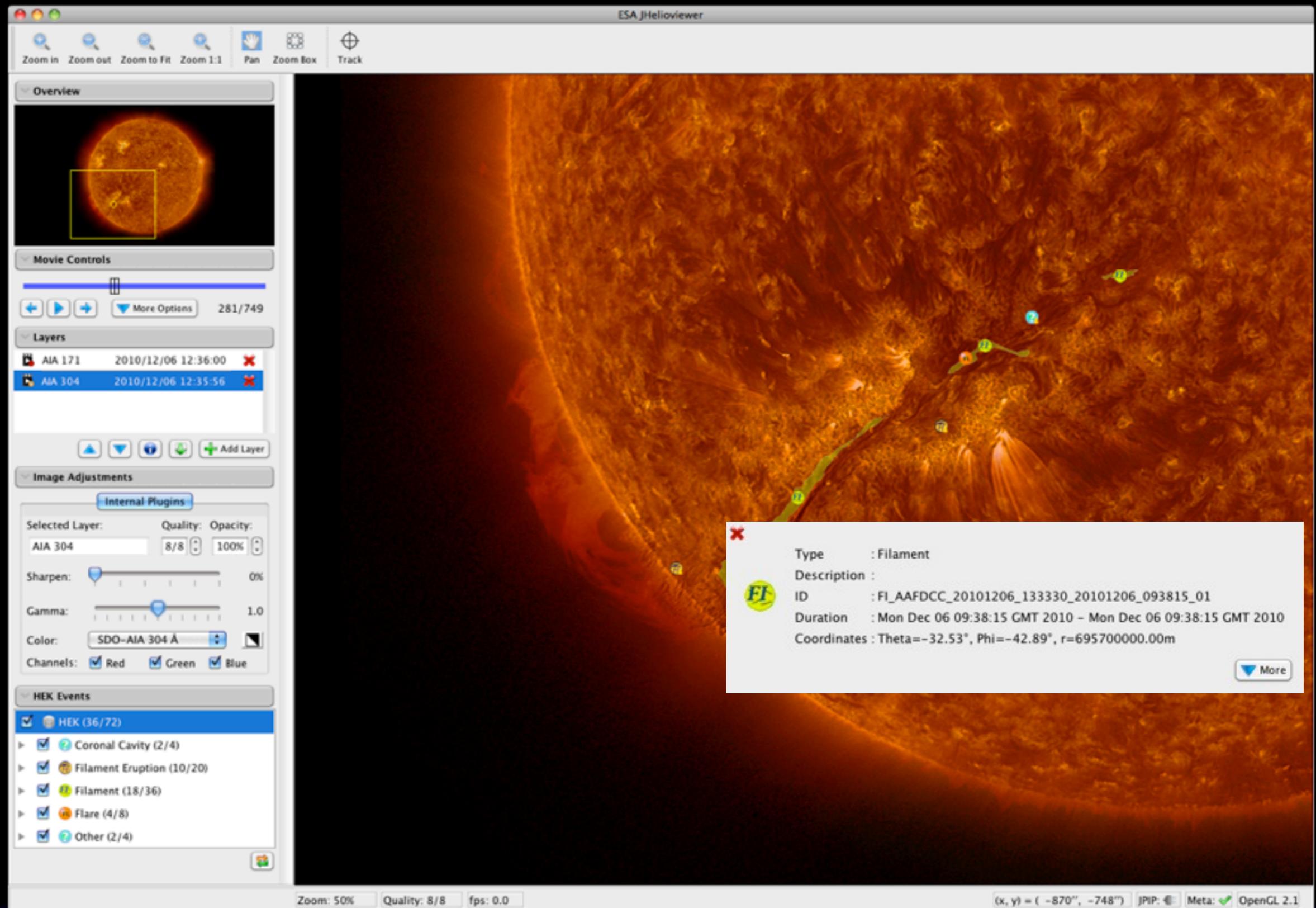
JHelioviewer User Interface



JHelioviewer User Interface



JHelioviewer User Interface

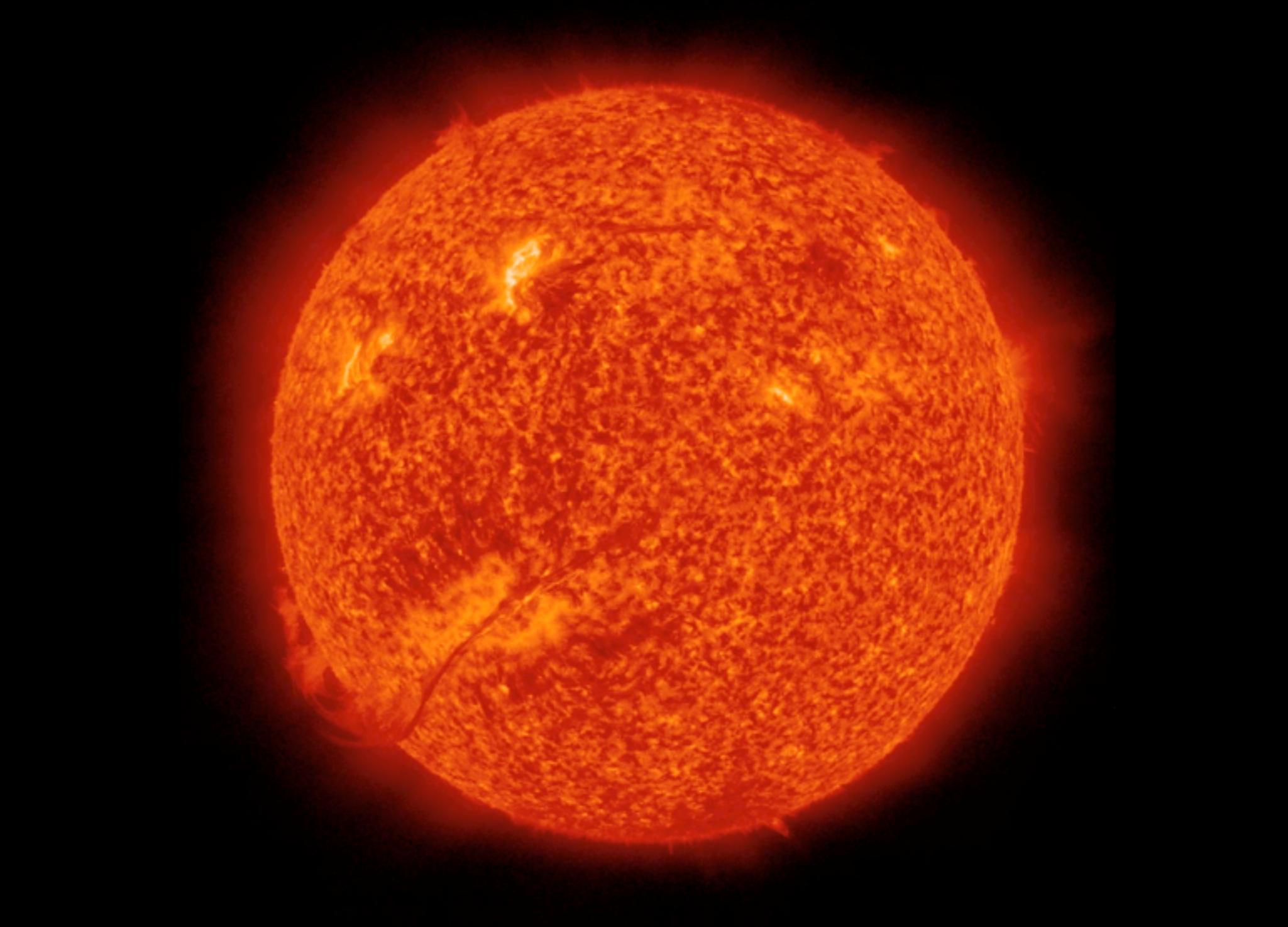


JHelioviewer Demo

ESA JHelioviewer

Zoom in Zoom out Zoom to Fit Zoom 1:1 Pan Zoom Box Track

Overview



Movie Controls

More Options 269/419

Layers

AIA 304 2010/12/06 14:23:56 X

Add Layer

Image Adjustments

Internal Plugins

Selected Layer: AIA 304 Quality: 8/8 Opacity: 100%

Sharpen: 0%

Gamma: 1.0

Color: SDO-AIA 304 Å S

Channels: Red Green Blue

HEK Events

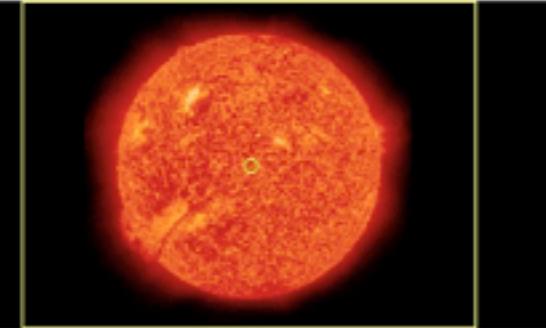
Zoom: 19% Quality: 8/8 fps: 0.0

(x, y) = (-414'', 991'') JPIP: Meta: OpenGL 2.1

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◀ ▶ ▶ More Options 269/419

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AIA 304 2010/12/06 14:23:56 X

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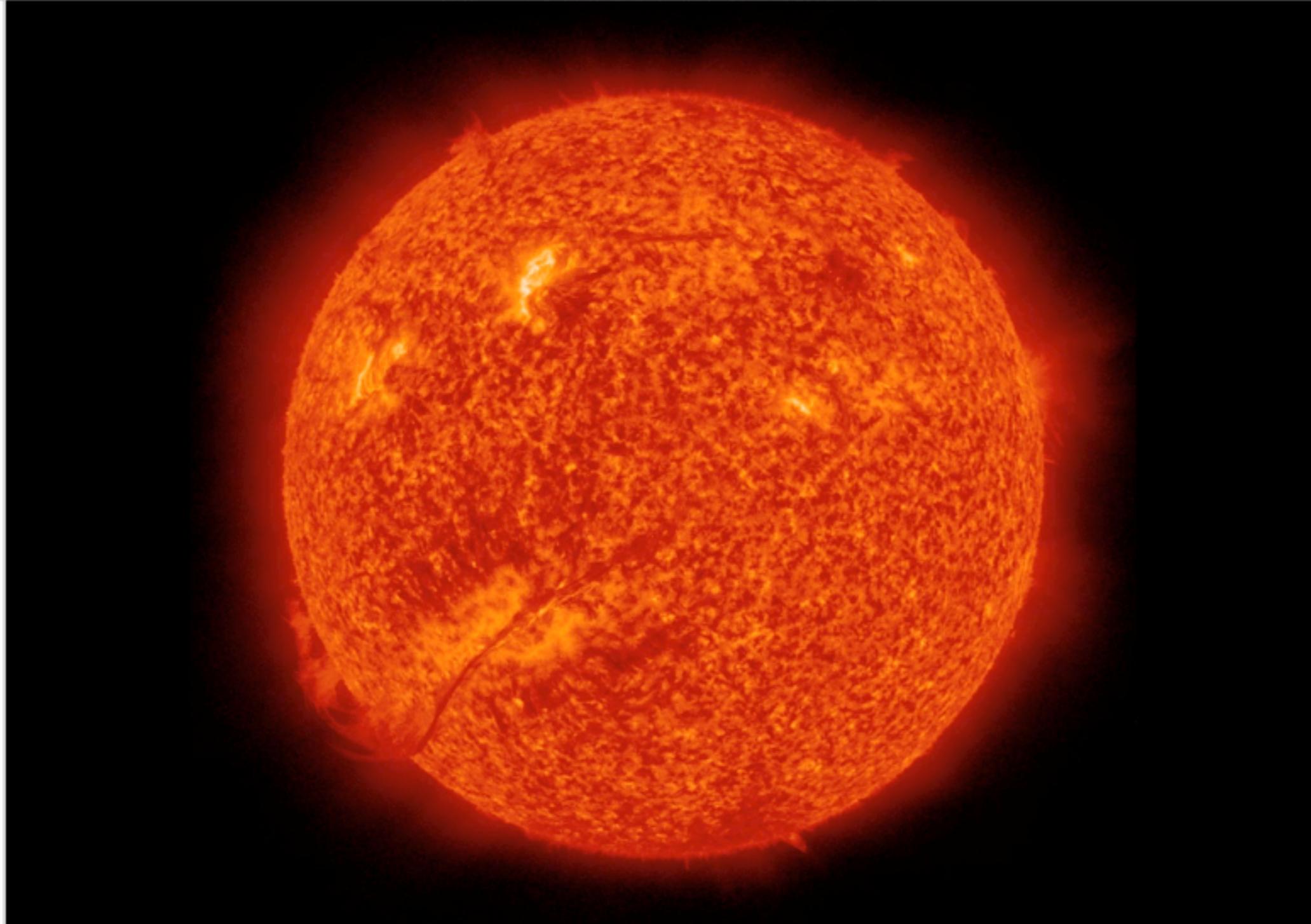
Sharpen: 0%

Gamma: 1.0

Color: SDO-AIA 304 Å █

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HEK Events



Zoom: 19% Quality: 8/8 fps: 0.0 (x, y) = (-414'', 991'') JPIP: Meta: OpenGL 2.1

www.jhelioviewer.org

The screenshot shows a web browser window displaying the JHelioviewer website at <http://jhelioviewer.org/>. The browser interface includes standard controls like back, forward, and search, along with a tab labeled "JHelioviewer".

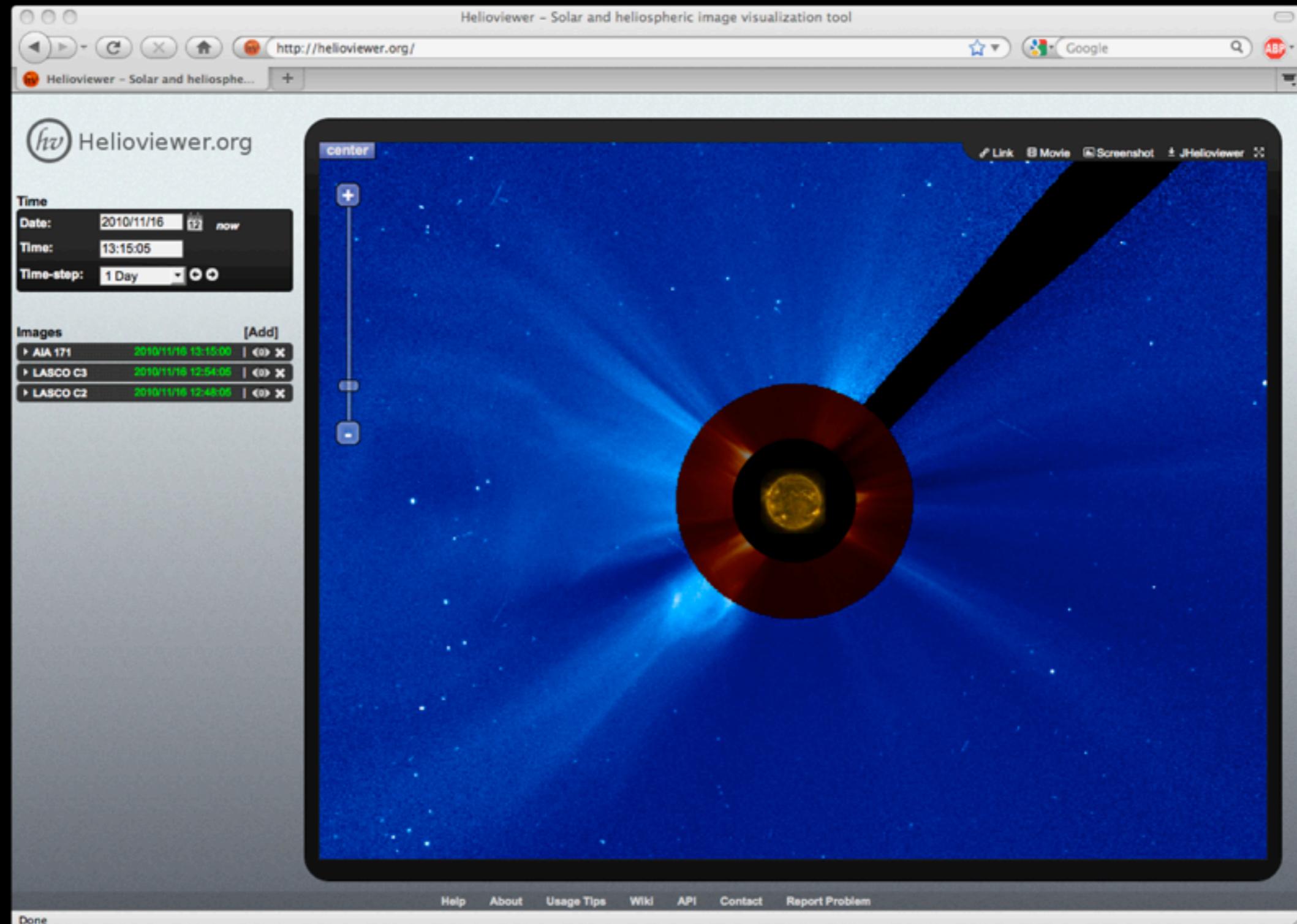
The main content area features the "jhelioviewer" logo in large blue letters. Below it is a horizontal menu bar with links for "home", "download", "news", "docs", "demo", and "about". To the right of the menu are three circular images of the Sun in different wavelengths: red (H-alpha), green (SDO AIA 171), and blue (SDO AIA 210).

A large section titled "JHELIOPHOTON - EXPLORE THE SUN" contains a screenshot of the JHelioviewer software interface. The interface shows a detailed solar image with various scientific controls and data layers on the left.

On the right side, there is a "GET JHELIOPHOTON" section with a download button for "Download JHelioviewer 2.1 for Mac". Below this are links for "Other Systems and Instructions" and a bulleted list of features:

- Explore 15+ years of **SOHO** data
- Browse high-res **SDO** data
- Create your own movies of the Sun

www.helioviewer.org



see also poster by V.K. Hughitt et al. (SH23C-1868)

Conclusions

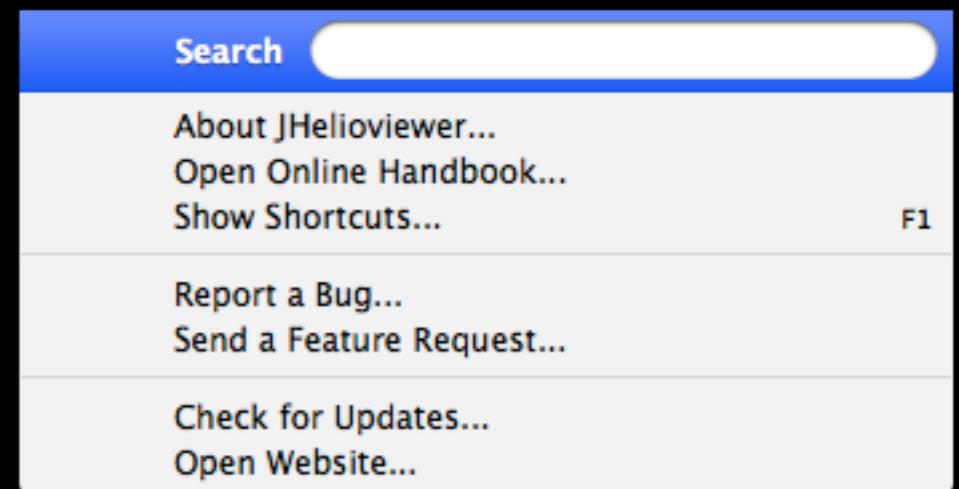
- Make the most out of SDO with JHelioviewer:
 - Interactively play and overlay high-res movies remotely
 - Perform image processing on-the-fly
 - Display HEK events
- JPEG 2000 offers exciting new functionality that enables users to interactively explore petabyte-scale image archives



<http://www.jhelioviewer.org>

This Software is For You - Get Involved!

- Download it, use it, report bugs
- Does it help you doing science?
- Write your own plugin
- Consider hosting a mirror server



<http://www.jhelioviewer.org>