JHelioviewer

A Novel Approach to Discovery and Image Access in the Petabyte Age

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for the Helioviewer Team

European Space Agency c/o NASA GSFC

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A Novel Approach to Discovery and Image Access in the Petabyte Age

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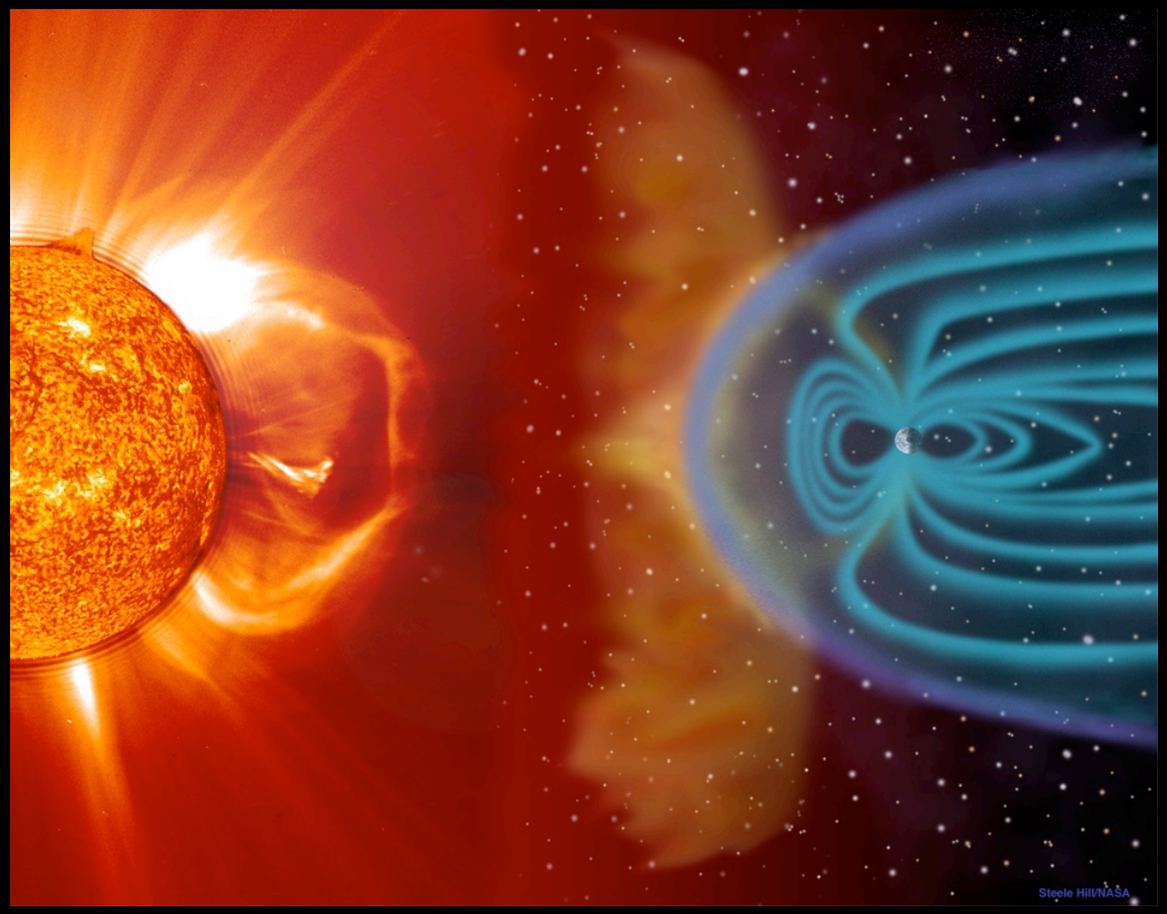
The Helioviewer Project

Motivation

- Space missions generate huge amount of data:
  - SOHO: ~0.2 Gbyte/day
  - SDO: ~1.4 Tbyte/day
- Large range of physical length-scales
- Many different data products available



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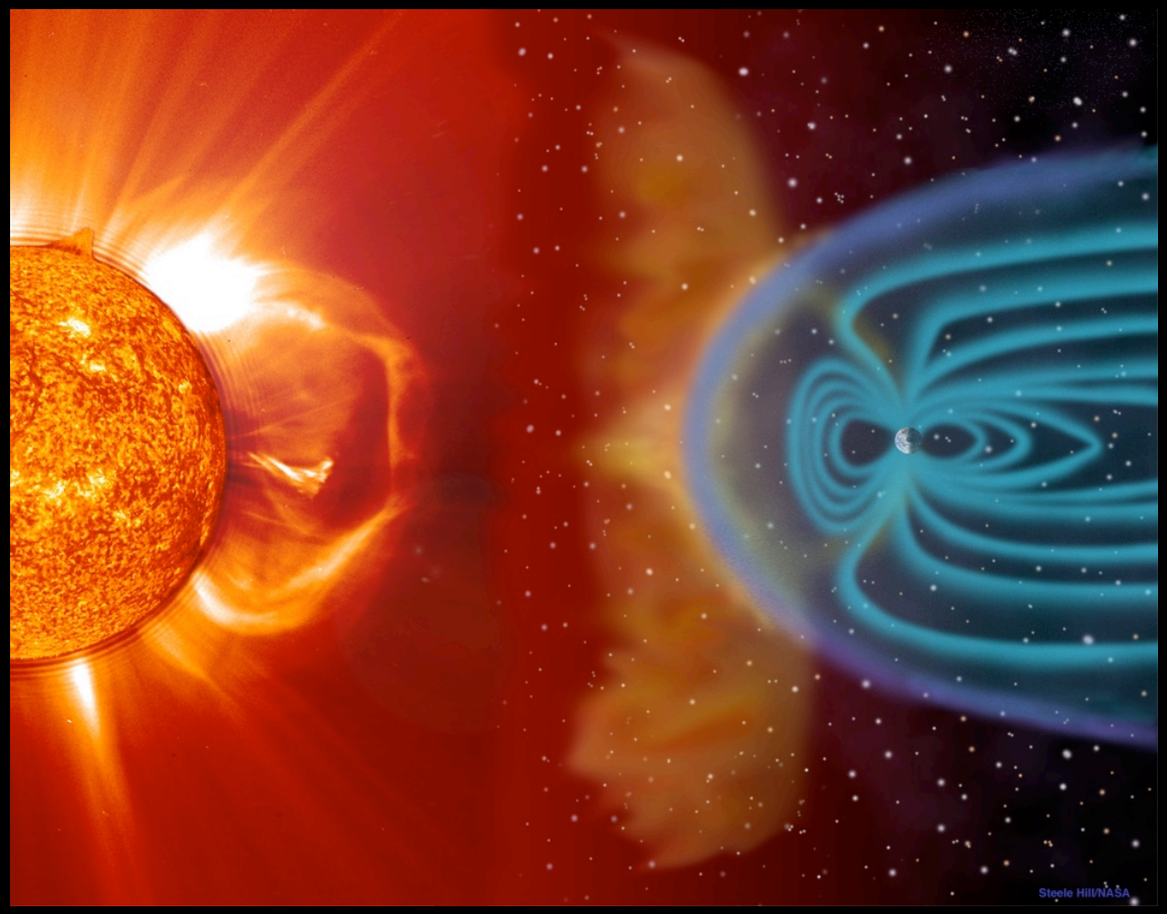


Goals

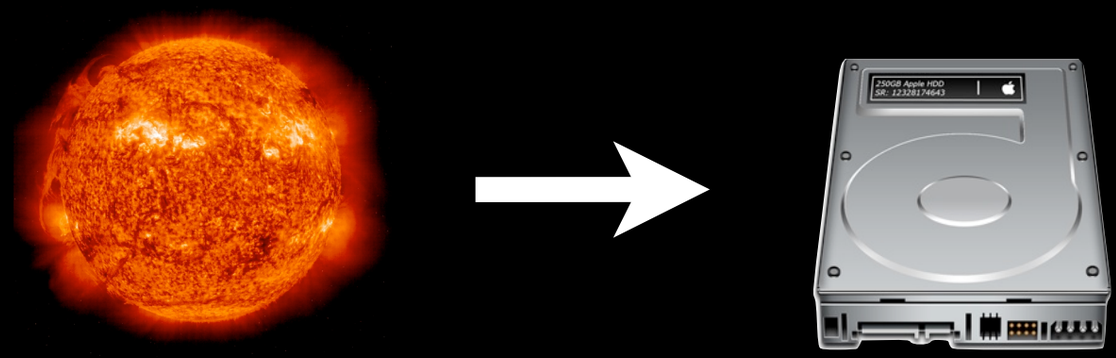
- Create discovery infrastructure by
  - Enabling efficient data browsing and visualization
  - Linking data to knowledge bases and automated feature recognition algorithms

Solar Dynamics Observatory

SDO will take 16MP images in10 channels, every 10 sec, 24/7

Challenges:

- Data access & distribution
- Search
- Visualization



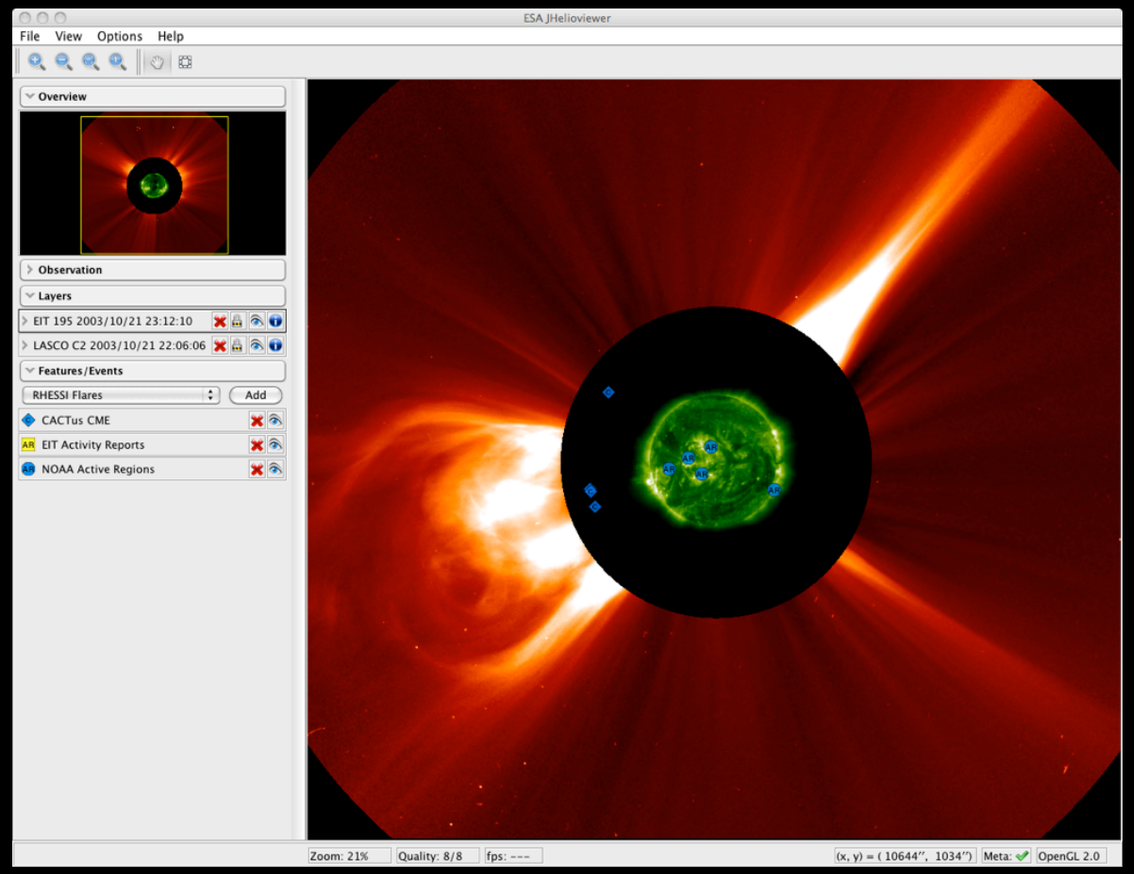
Solution:

- With JPEG 2000: Can compress 4k × 4k image to 1 MB
- 10 channels at 30 sec cadence → 29 GB/day = 10.6 TB/year
- Can keep comprehensive data set of browse data online for entire mission (science data: only few months)

JHelioviewer

What is JHelioviewer?

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



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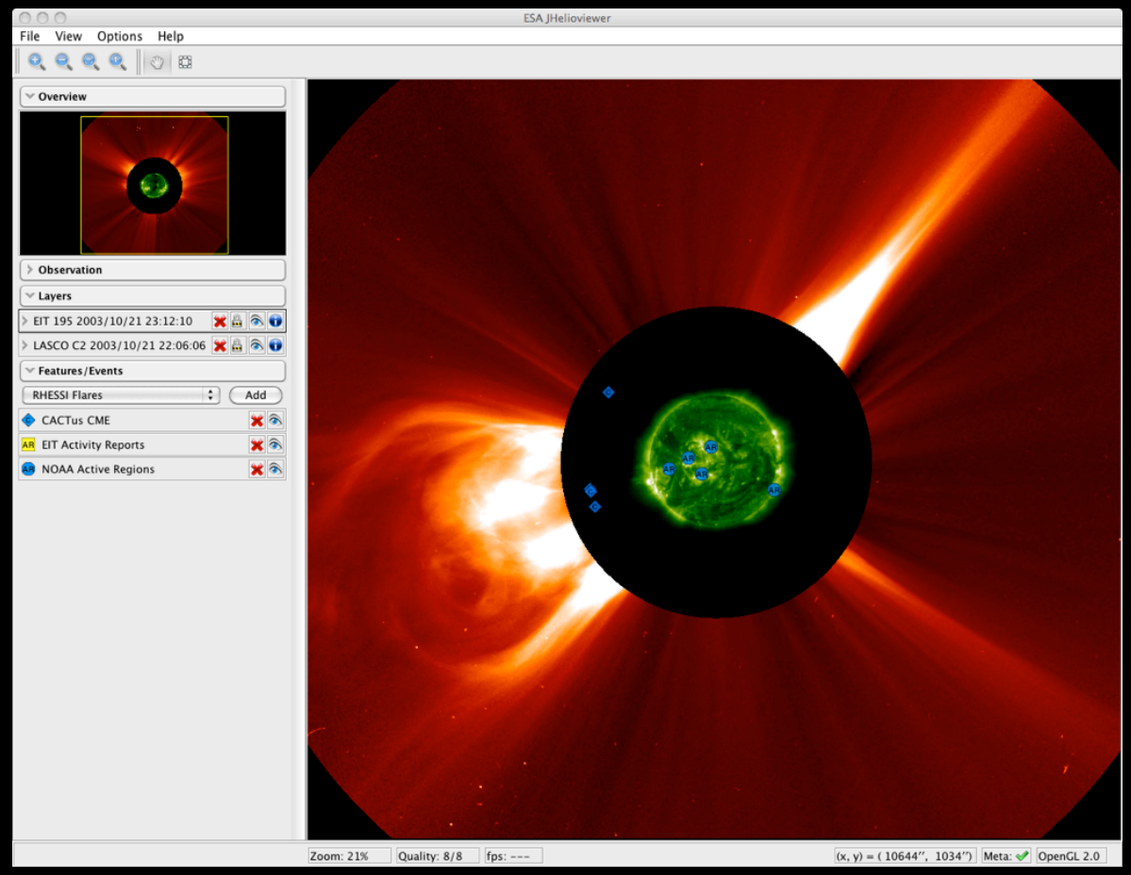


What can JHelioviewer do for you?

- Interactively generate, play and overlay high-res movies with arbitrary cadence
- Perform image processing on-the-fly
- Connect to event databases, request science data

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"]

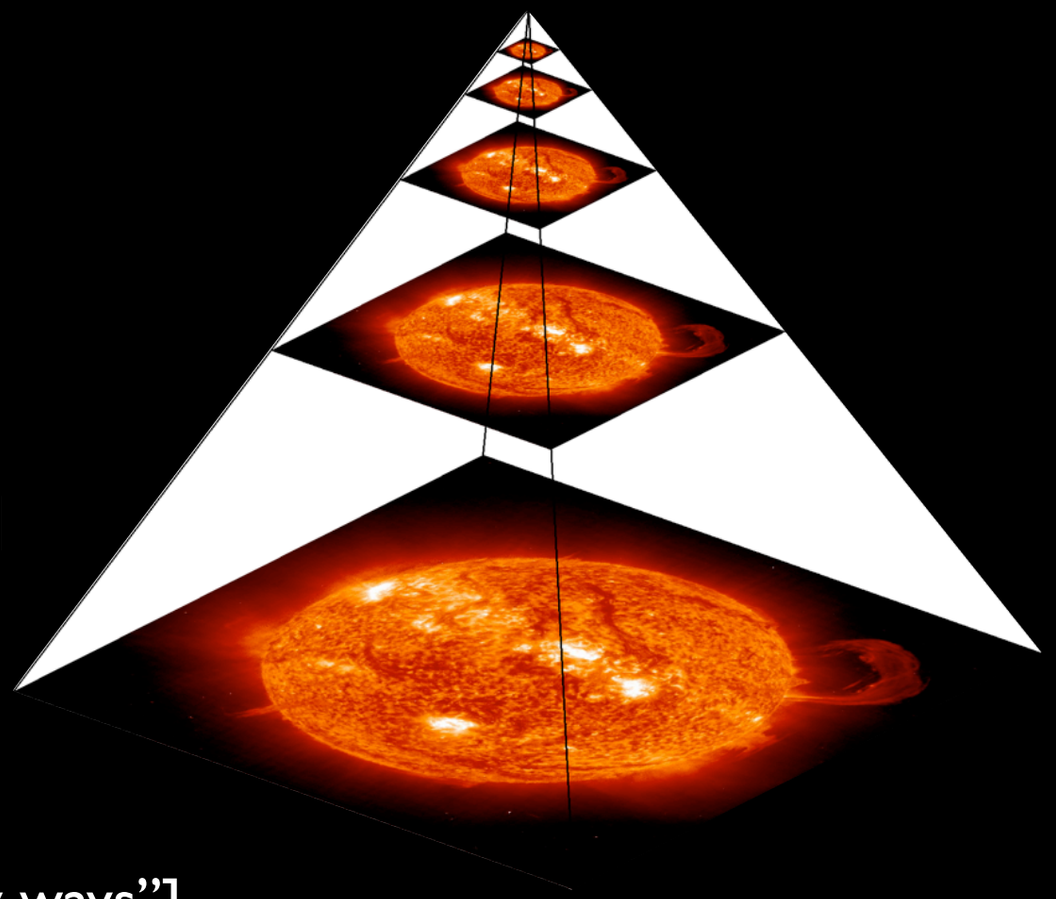
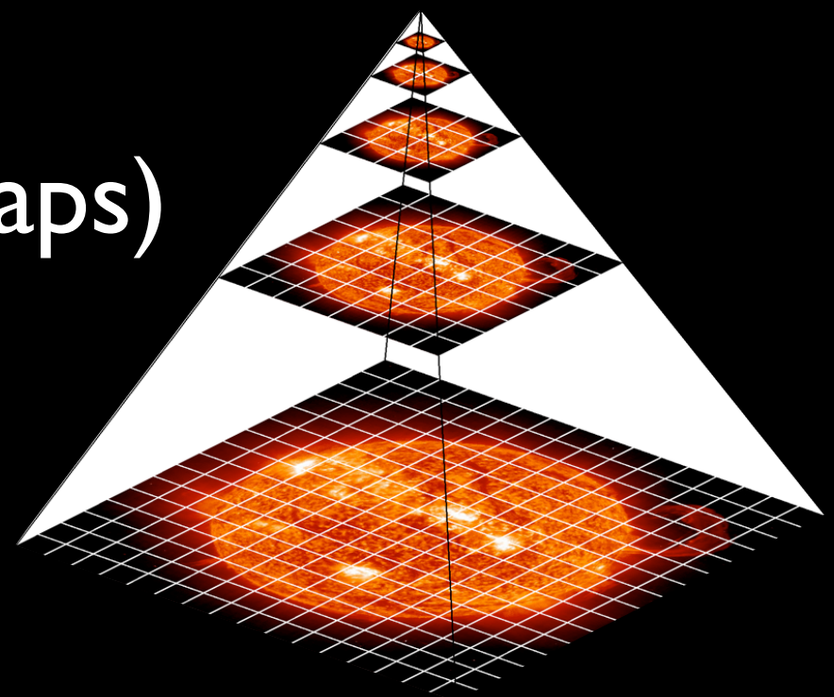


Image Tiling vs. Wavelet Compression

- Tile-based approach (e.g. Google Maps)
  + easy to render in web browser
  - need to transfer redundant data when zooming
  - overhead of data volume and number of files
  - metadata must be stored separately



- Wavelet approach (JPEG 2000)
  + no data overhead
  + added functionality (movies, remote access, metadata)
  - not yet supported by all web browsers

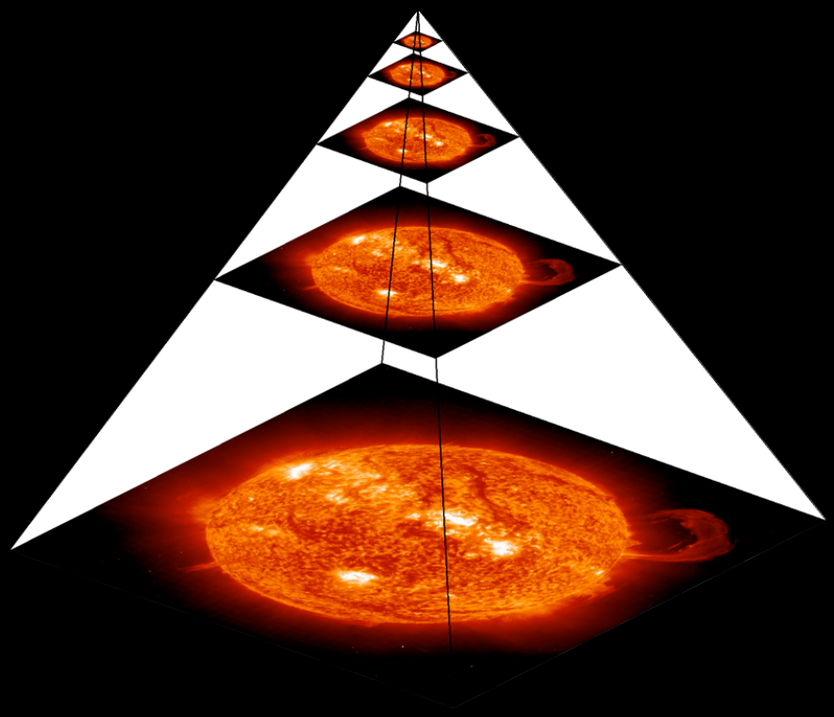
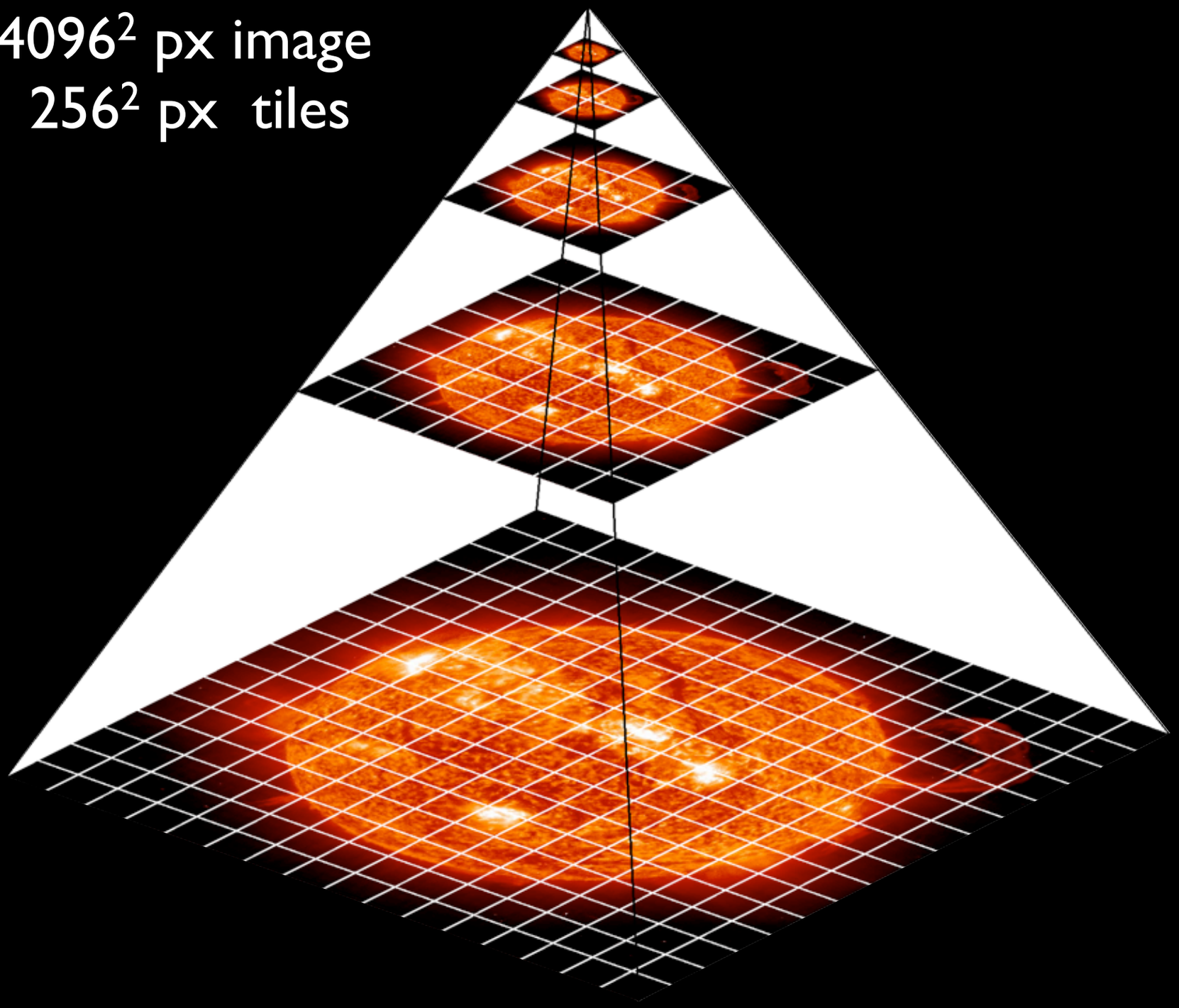


Image Tiling vs. Wavelet Compression - Example

4096^2 px image
256^2 px tiles



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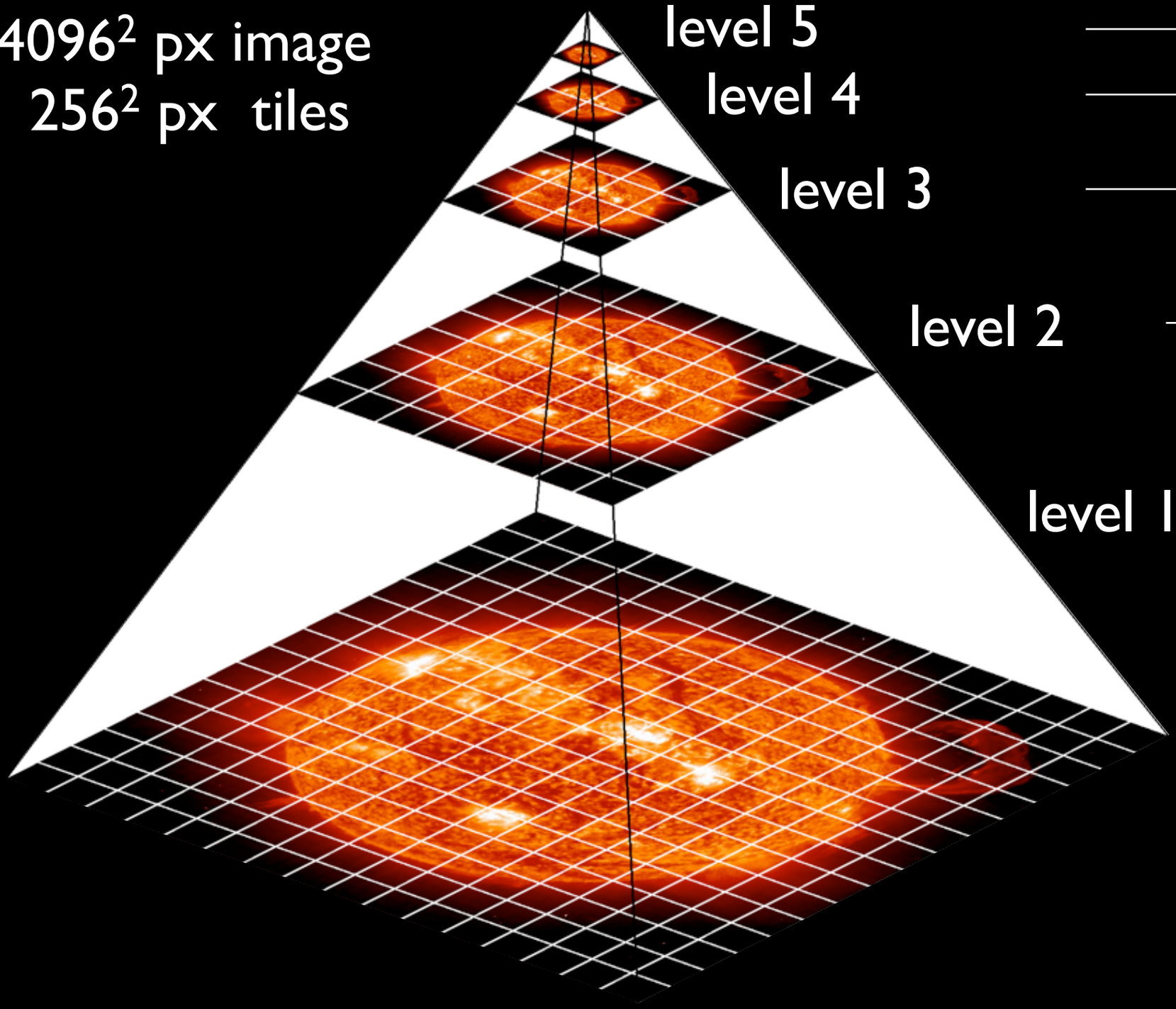

level 5 ⟶ 1 tile

level 4 ⟶ 4 tiles

level 3 ⟶ 16 tiles

level 2 ⟶ 64 tiles

level 1 ⟶ 256 tiles

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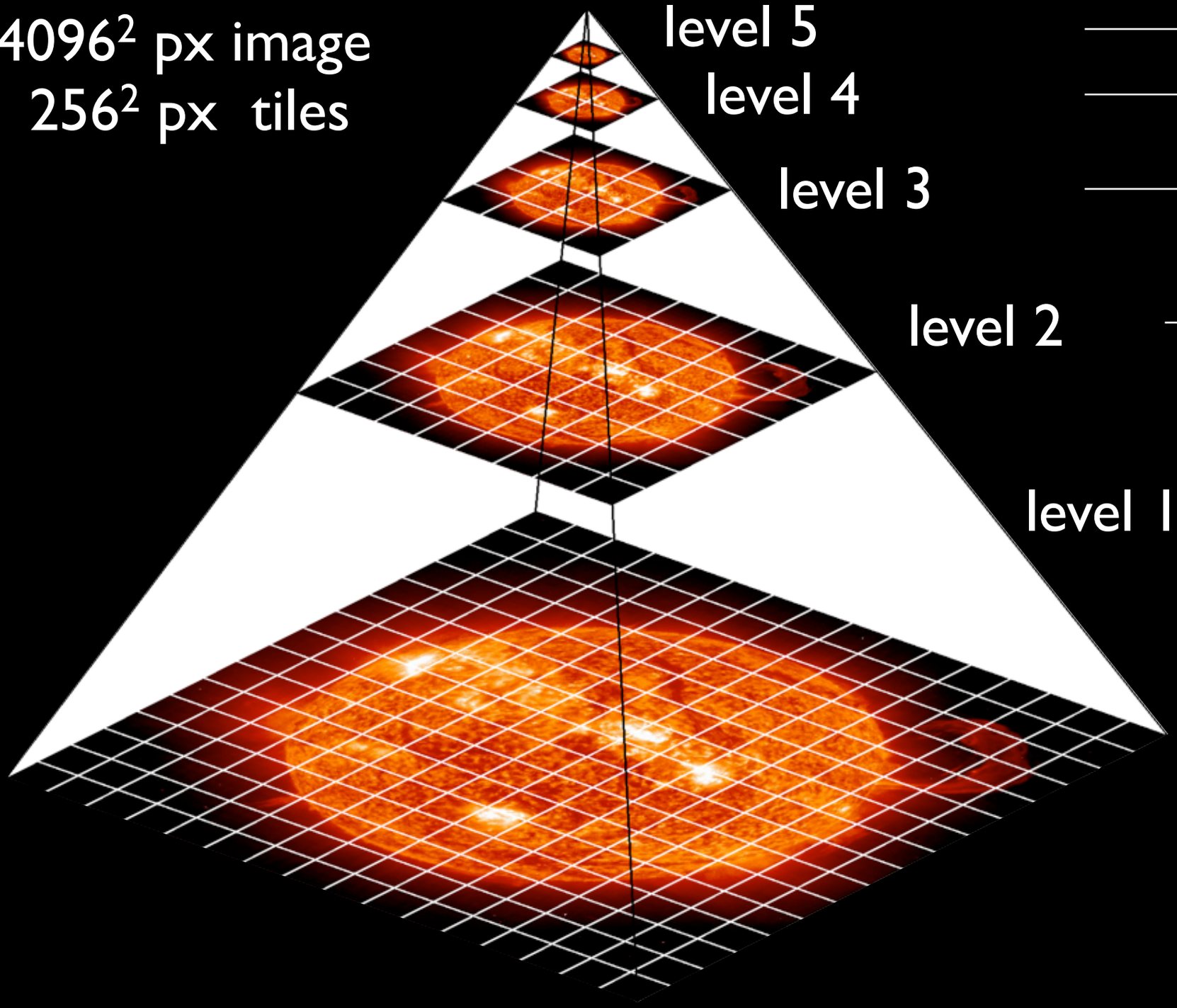

level 5 ⟶ 1 tile

level 4 ⟶ 4 tiles

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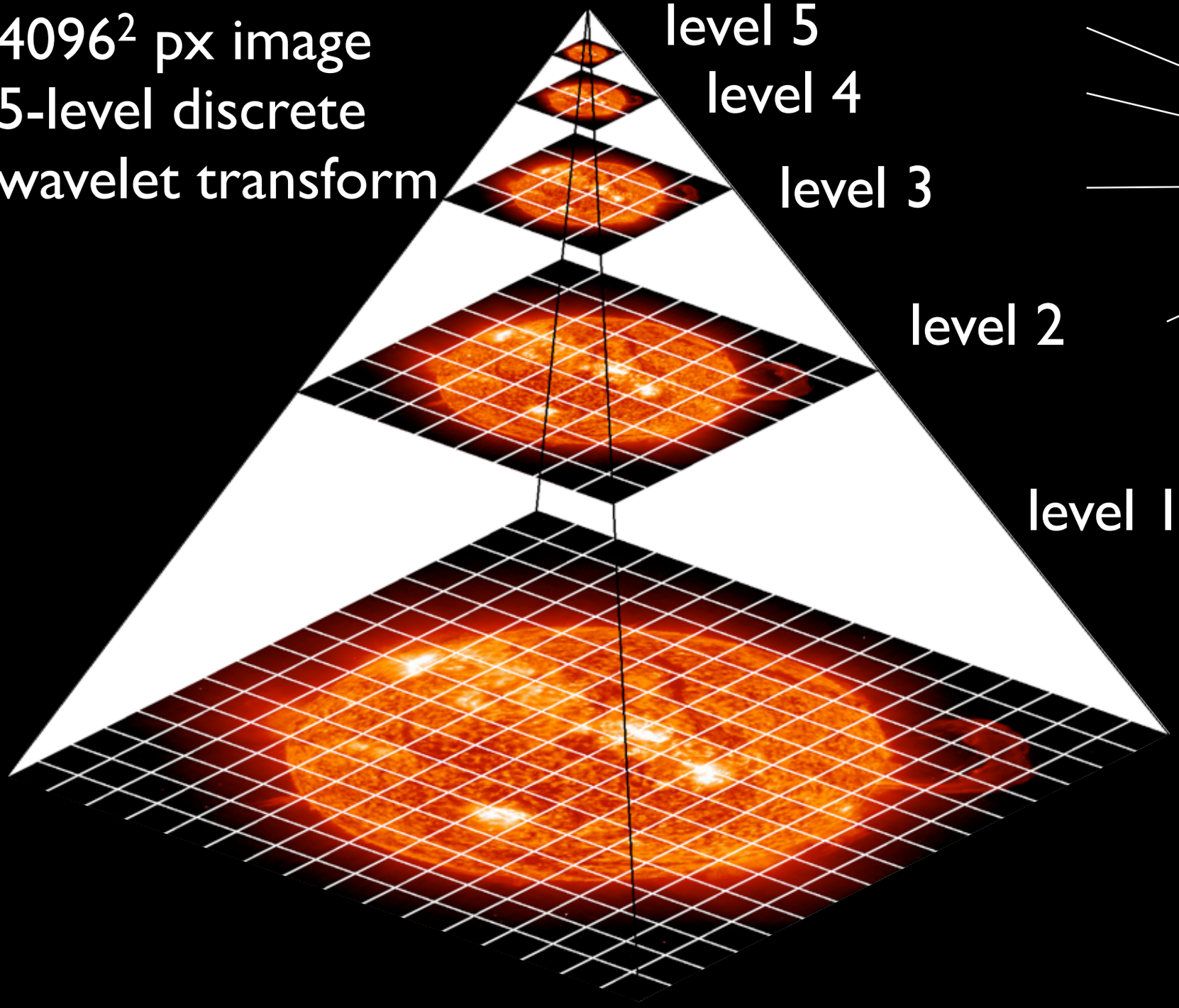
---

total: 341 tiles

increase in total file size: ≈ 2-10 (depends on compression)

Image Tiling vs. Wavelet Compression - Example

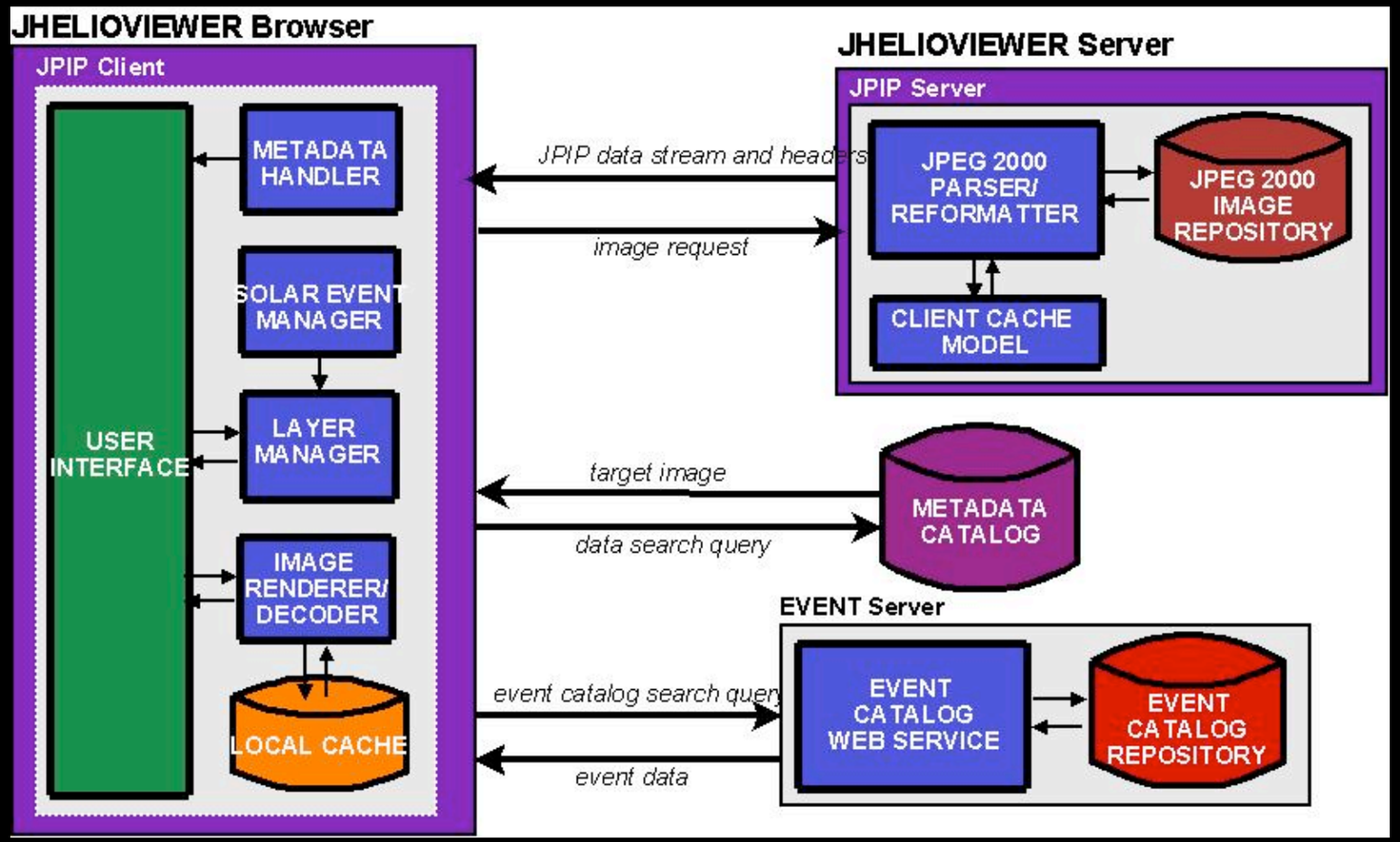
4096^2 px image
5-level discrete
wavelet transform



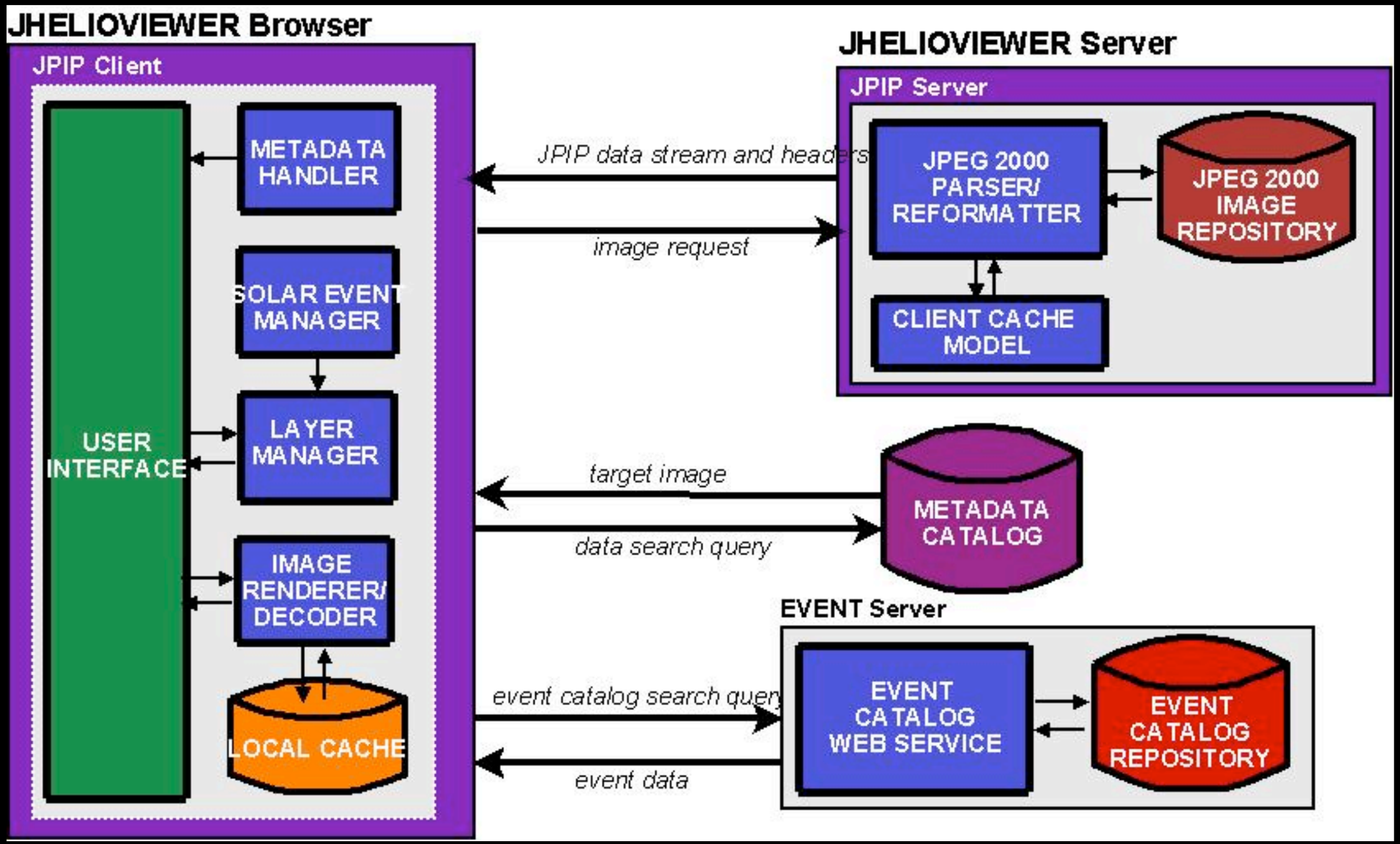
single
JPEG 2000
file

Remote Access to Image Data

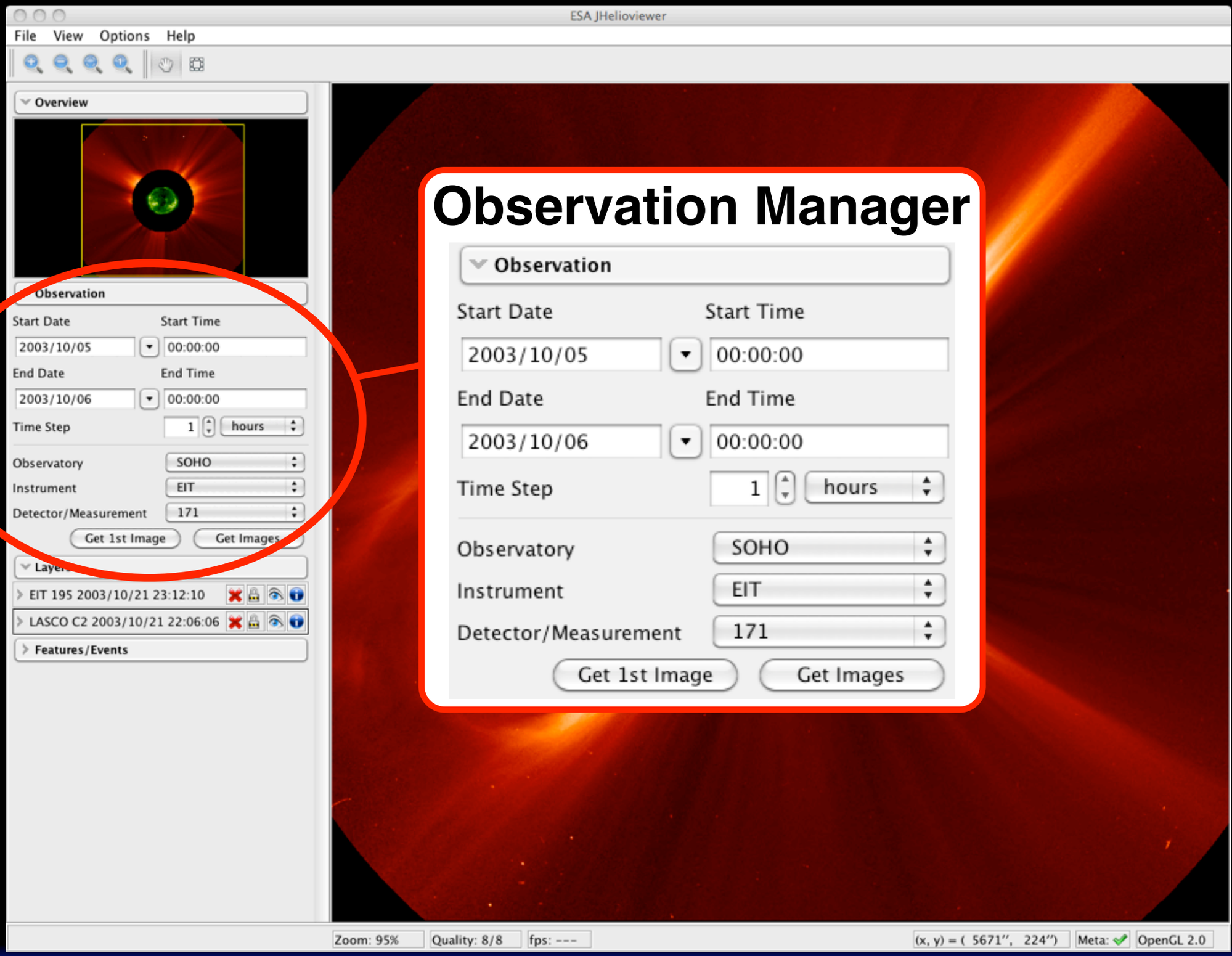
- JPIP = JPEG 2000 Interactive Protocol
- JPIP provides a client–server architecture for transmitting JPEG 2000 imagery over networks
- Can query arbitrary parts and quality levels of images and movies



JHelioviewer Architecture



JHelioviewer User Interface



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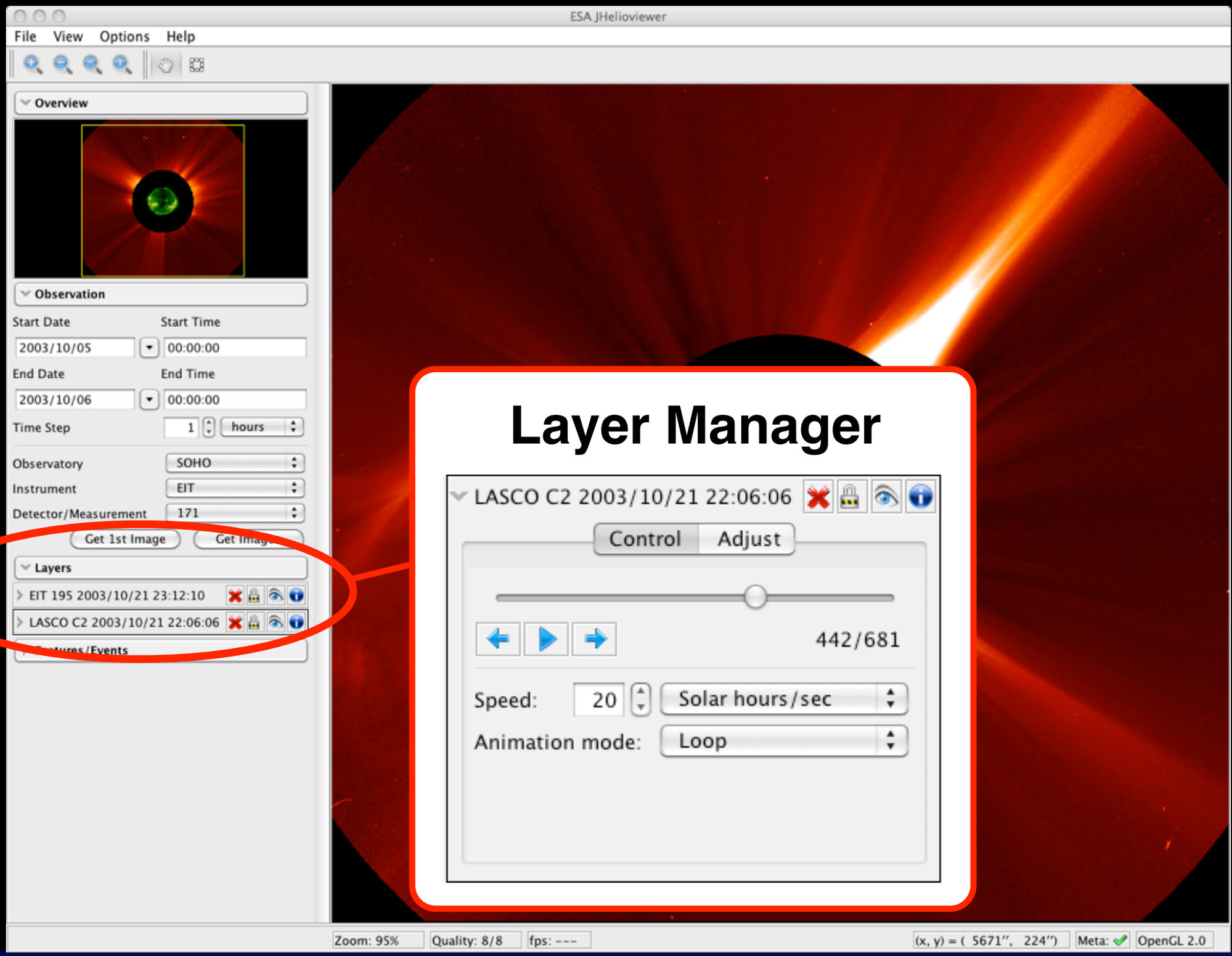

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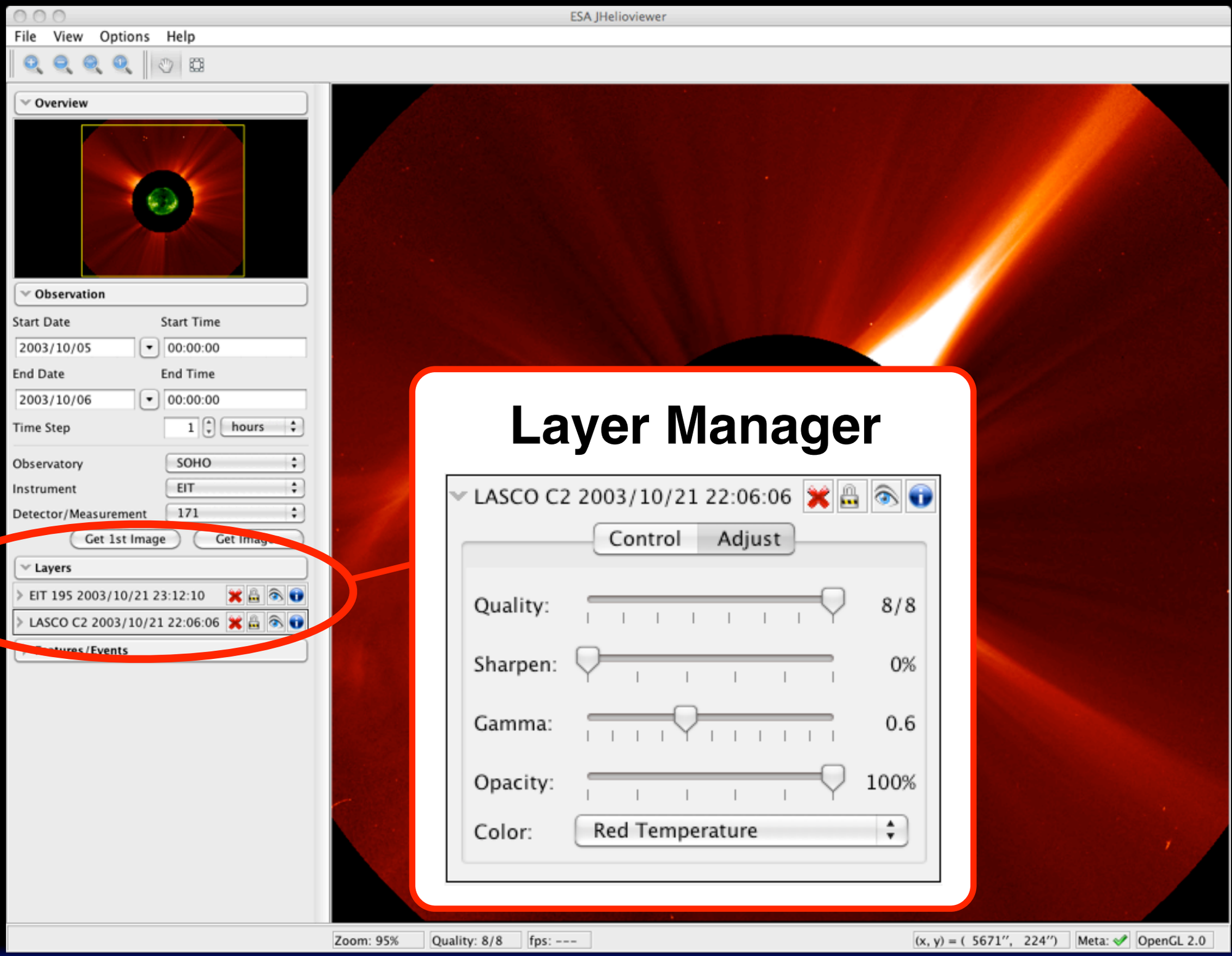

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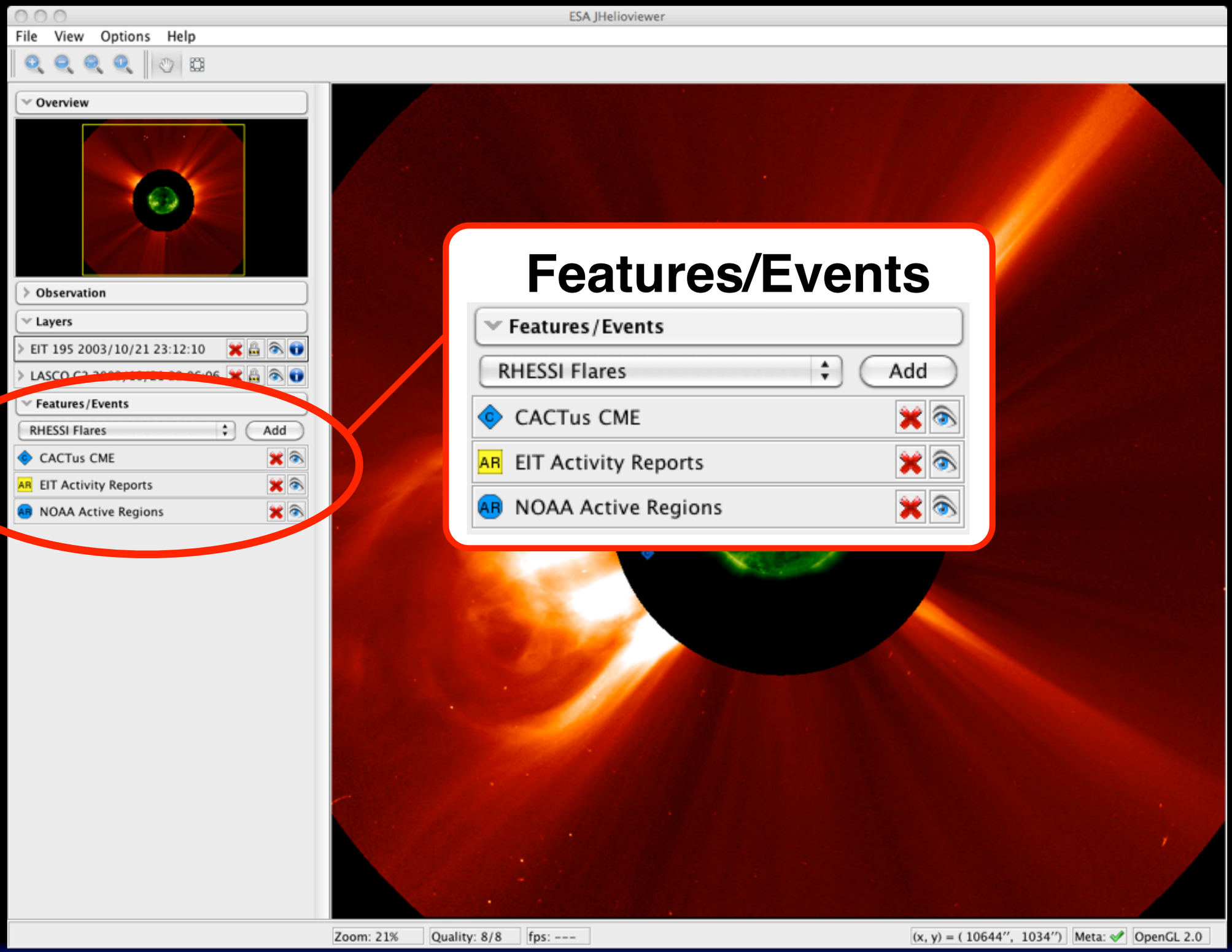

JHelioviewer Demo

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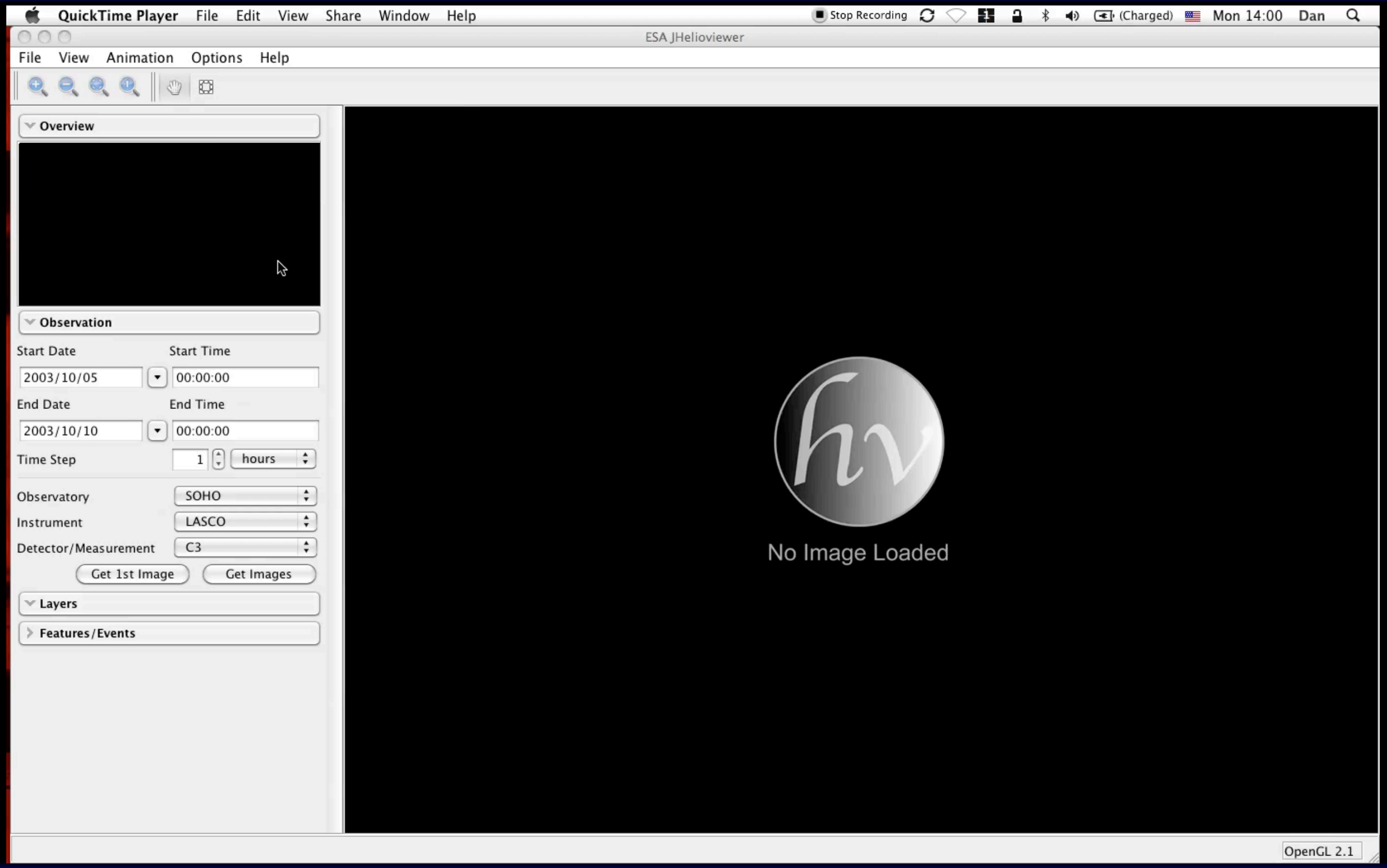
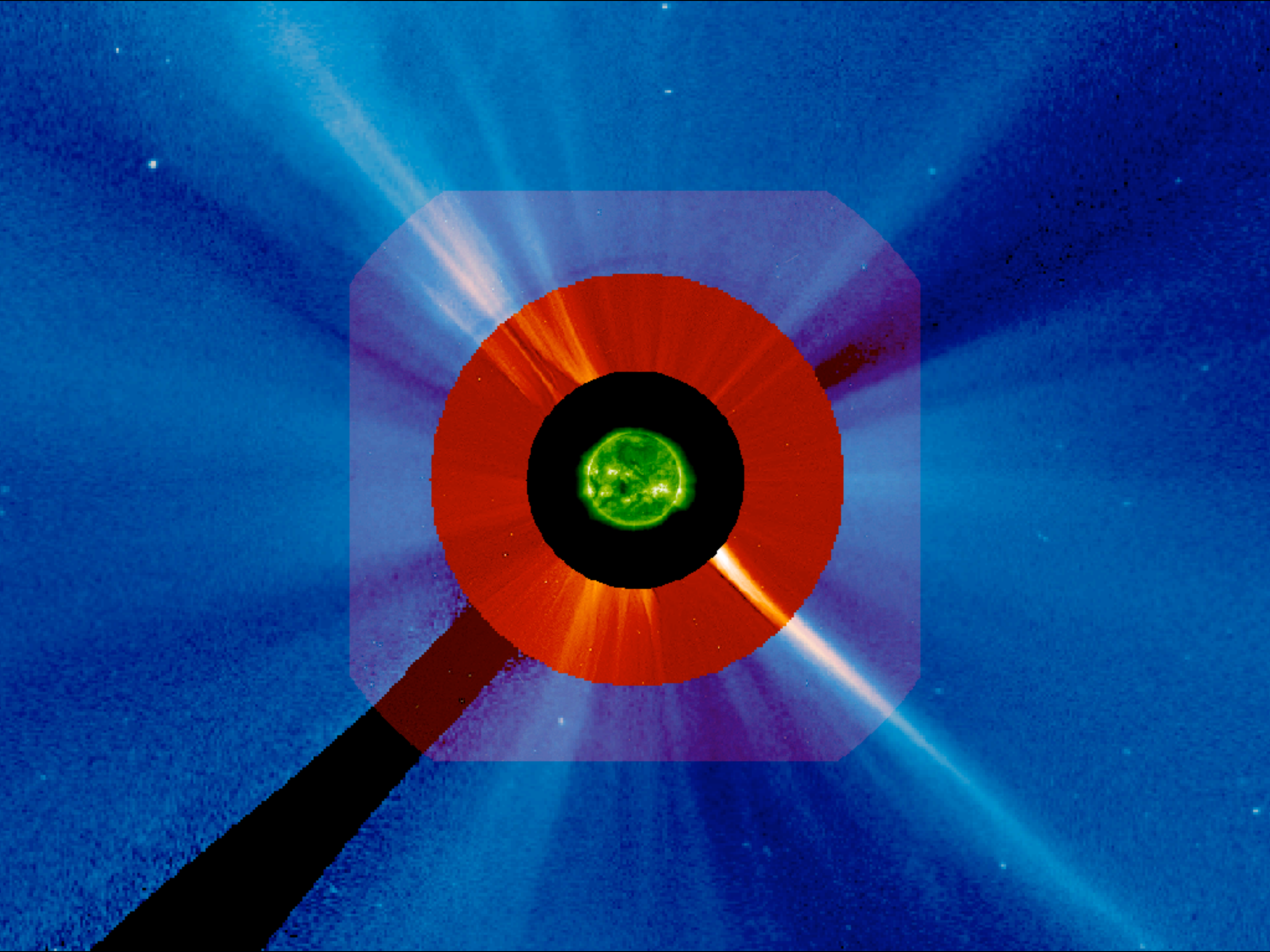
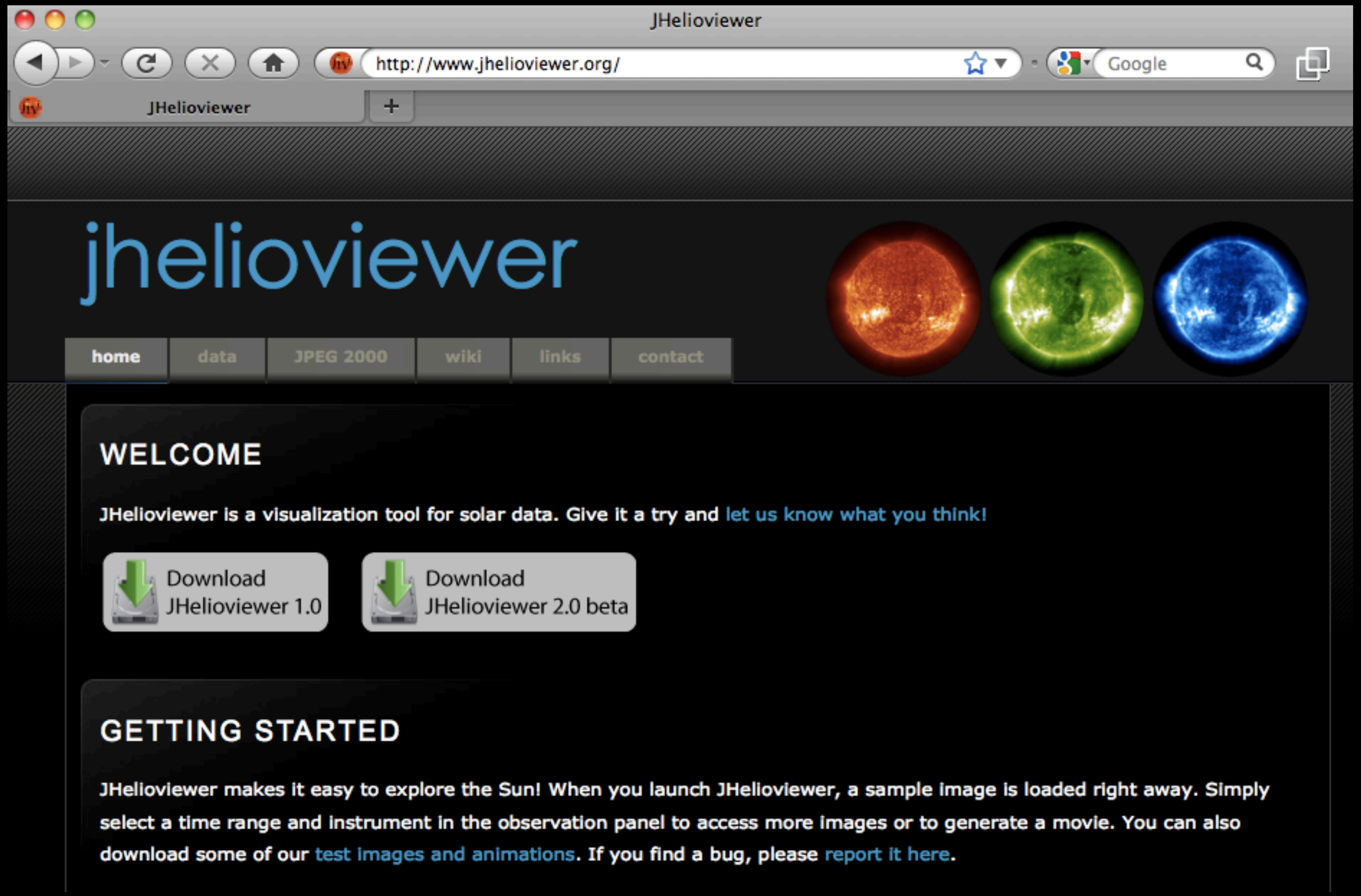




www.jhelioviewer.org



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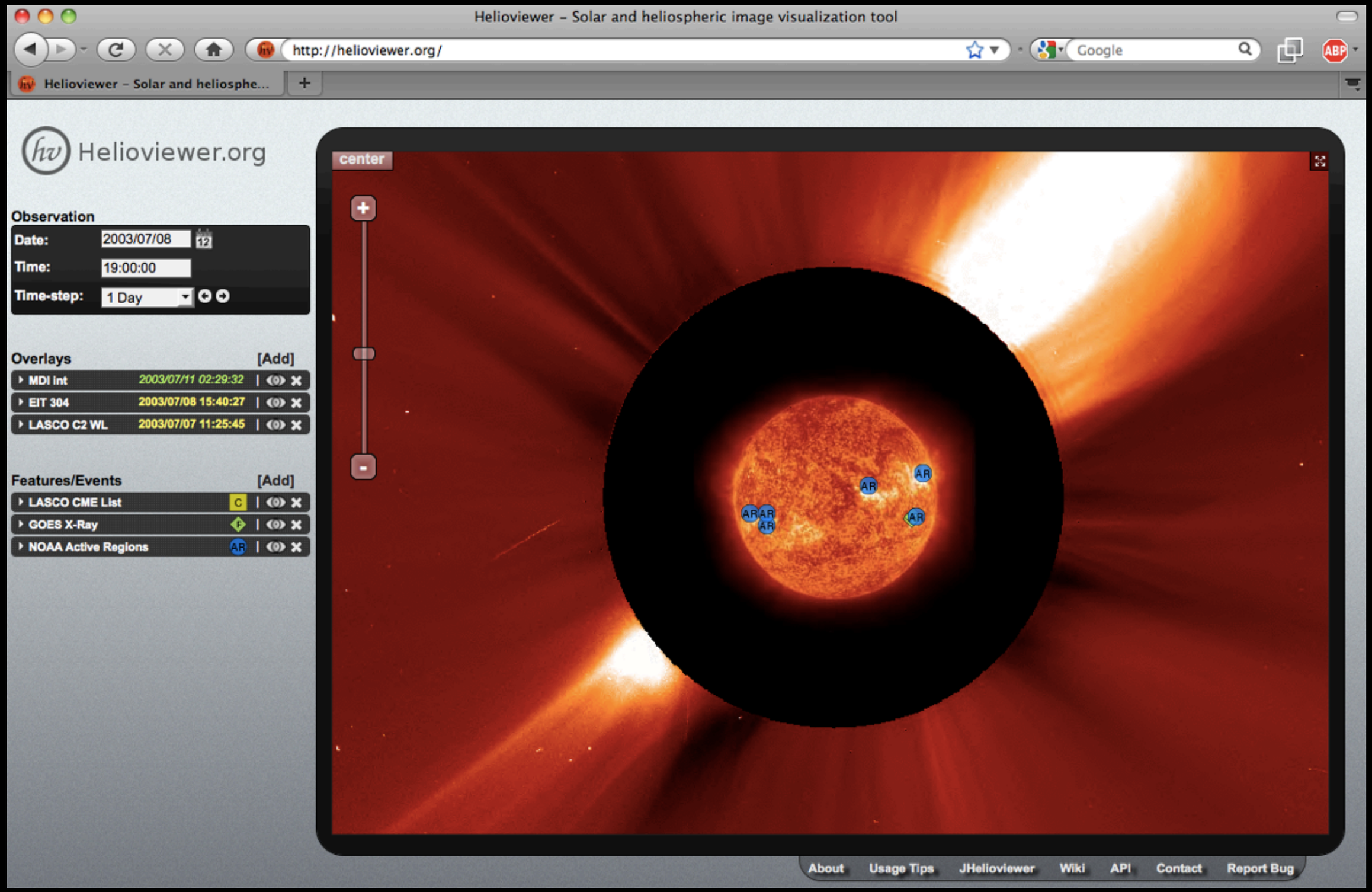


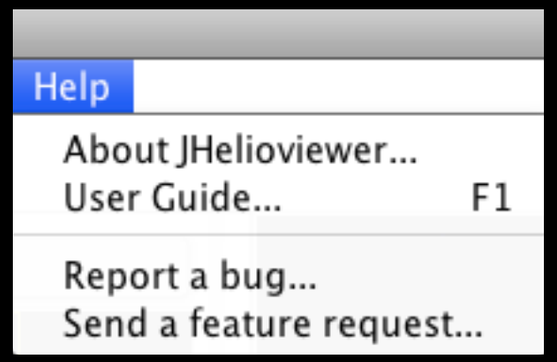
Conclusions

- JPEG 2000 + JPIP offer exciting new functionality that enables users to explore petabyte-scale image archives
- With JHelioviewer, you can
  - Interactively generate, play and overlay high-res movies
  - Perform image processing on-the-fly
  - Connect to knowledge bases

http://www.jhelioviewer.org

This Software is For You - Get Involved!

- Download it, test it, report bugs
- Submit feature requests
- Get the source code



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Thank you

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