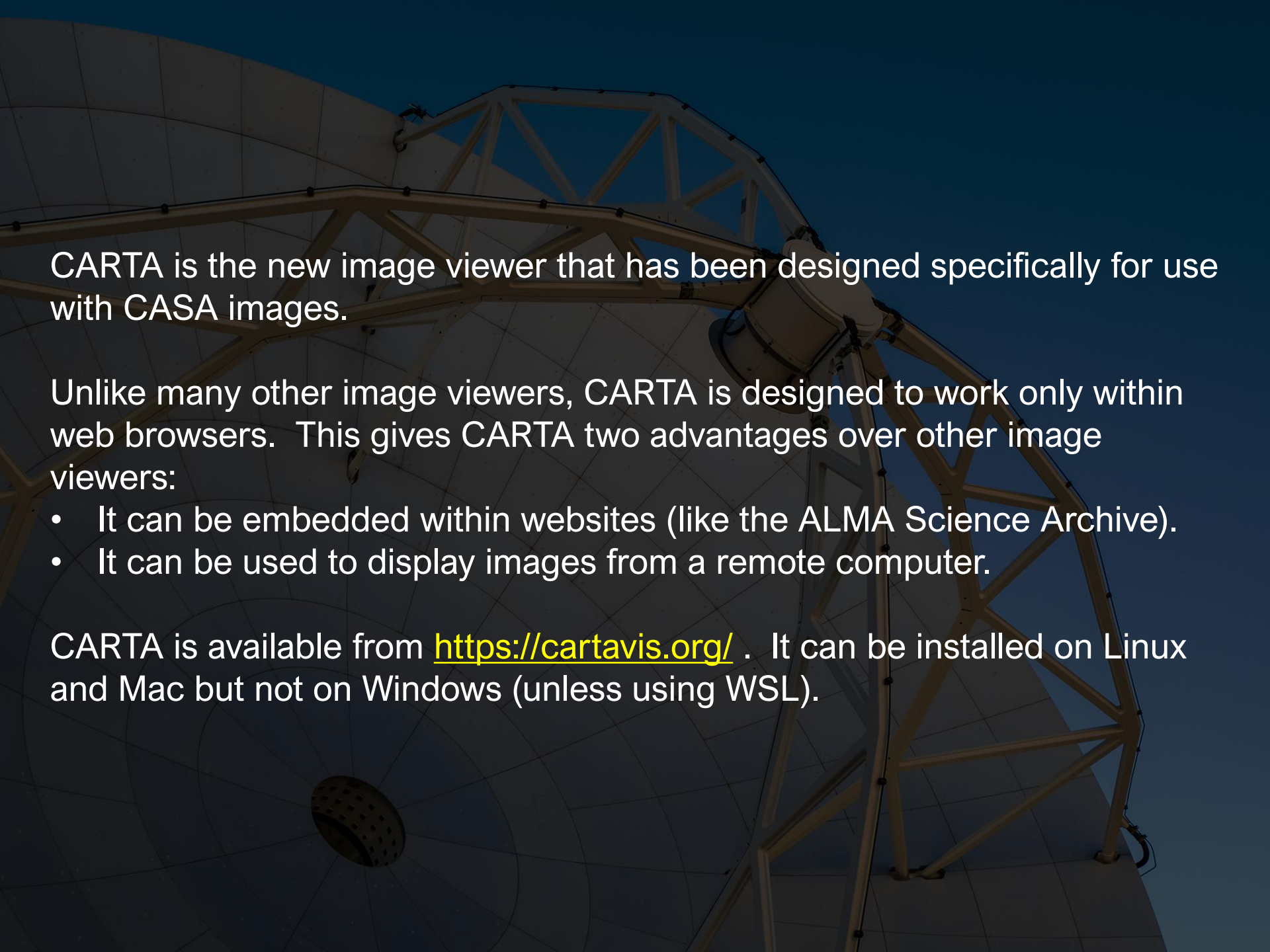
CARTA

George Bendo
UK ALMA Regional Centre Node
Jodrell Bank Centre for Astrophysics
The University of Manchester

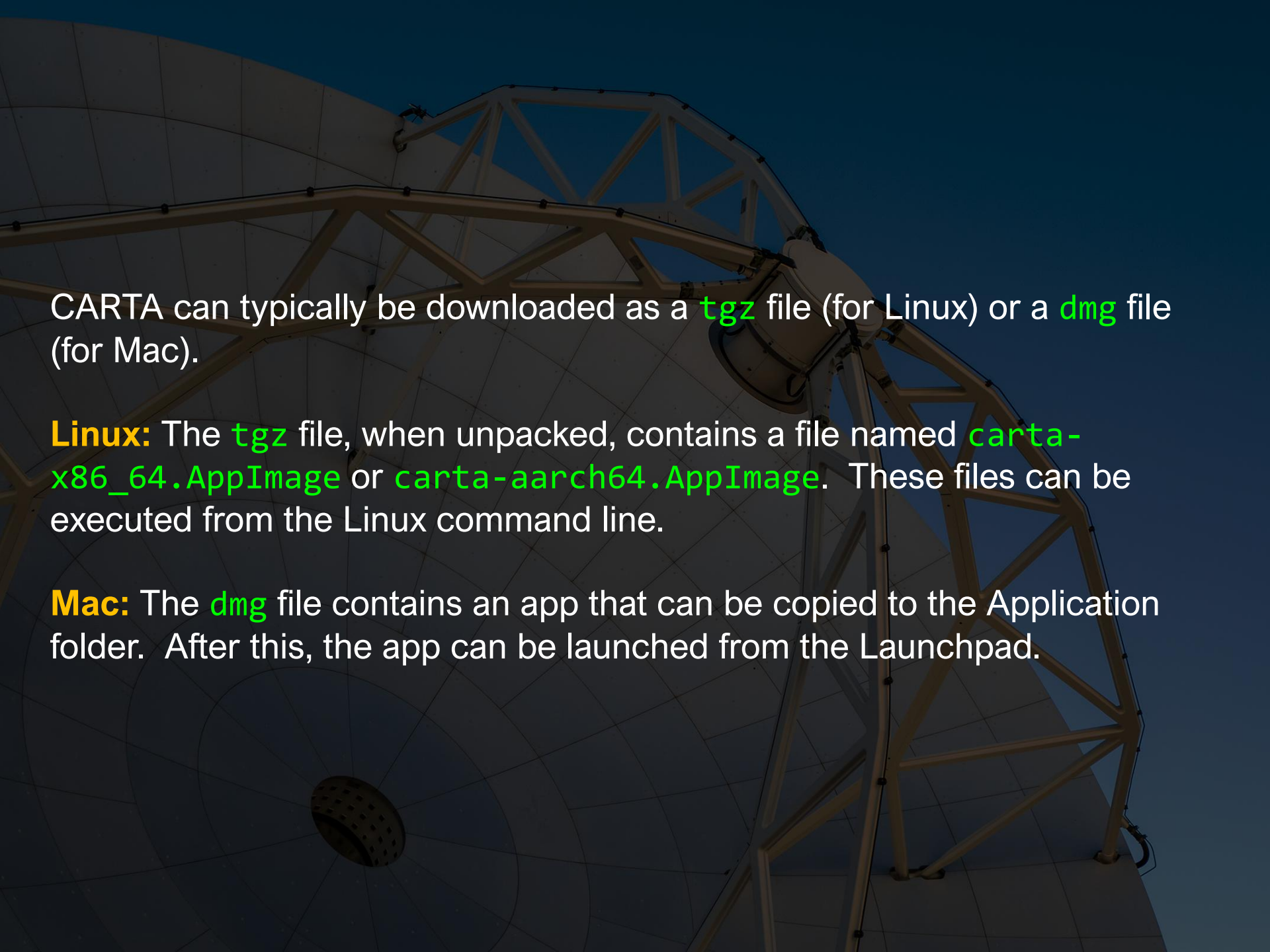


CARTA is the new image viewer that has been designed specifically for use with CASA images.

Unlike many other image viewers, CARTA is designed to work only within web browsers. This gives CARTA two advantages over other image viewers:

- It can be embedded within websites (like the ALMA Science Archive).
- It can be used to display images from a remote computer.

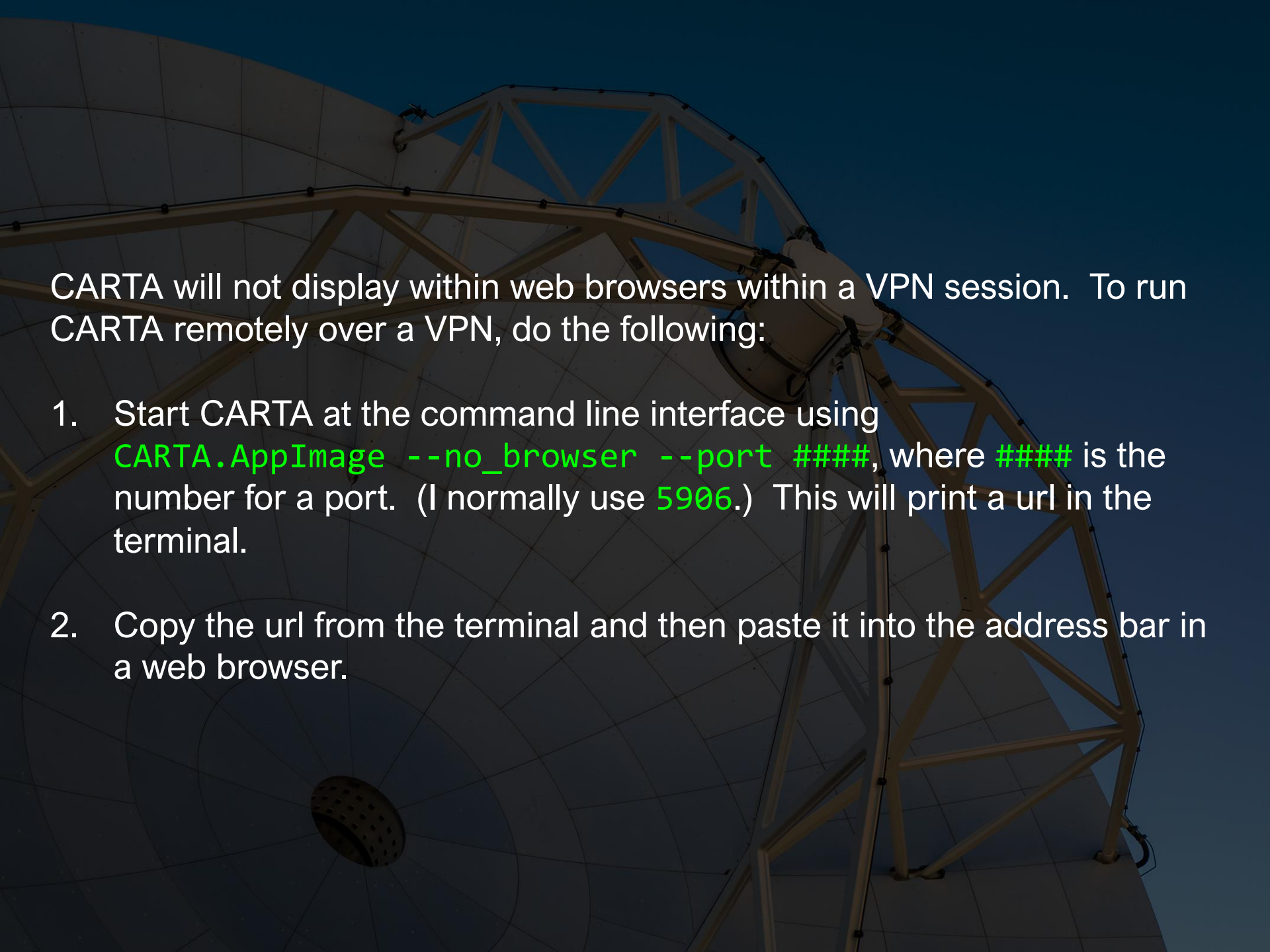
CARTA is available from https://cartavis.org/ . It can be installed on Linux and Mac but not on Windows (unless using WSL).



CARTA can typically be downloaded as a `tgz` file (for Linux) or a `dmg` file (for Mac).

Linux: The `tgz` file, when unpacked, contains a file named `carta-x86_64.AppImage` or `carta-aarch64.AppImage`. These files can be executed from the Linux command line.

Mac: The `dmg` file contains an app that can be copied to the Application folder. After this, the app can be launched from the Launchpad.

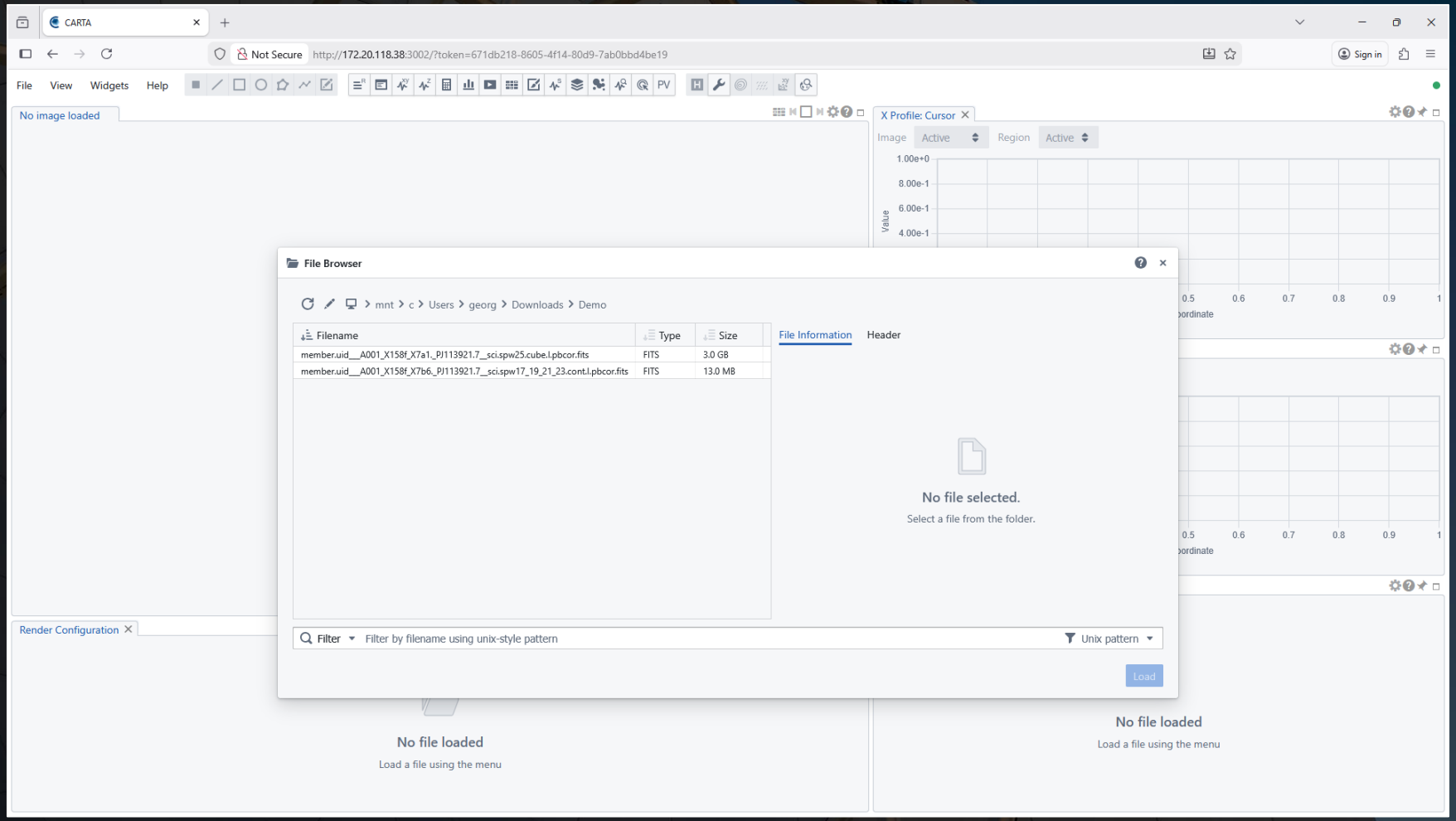


CARTA will not display within web browsers within a VPN session. To run CARTA remotely over a VPN, do the following:

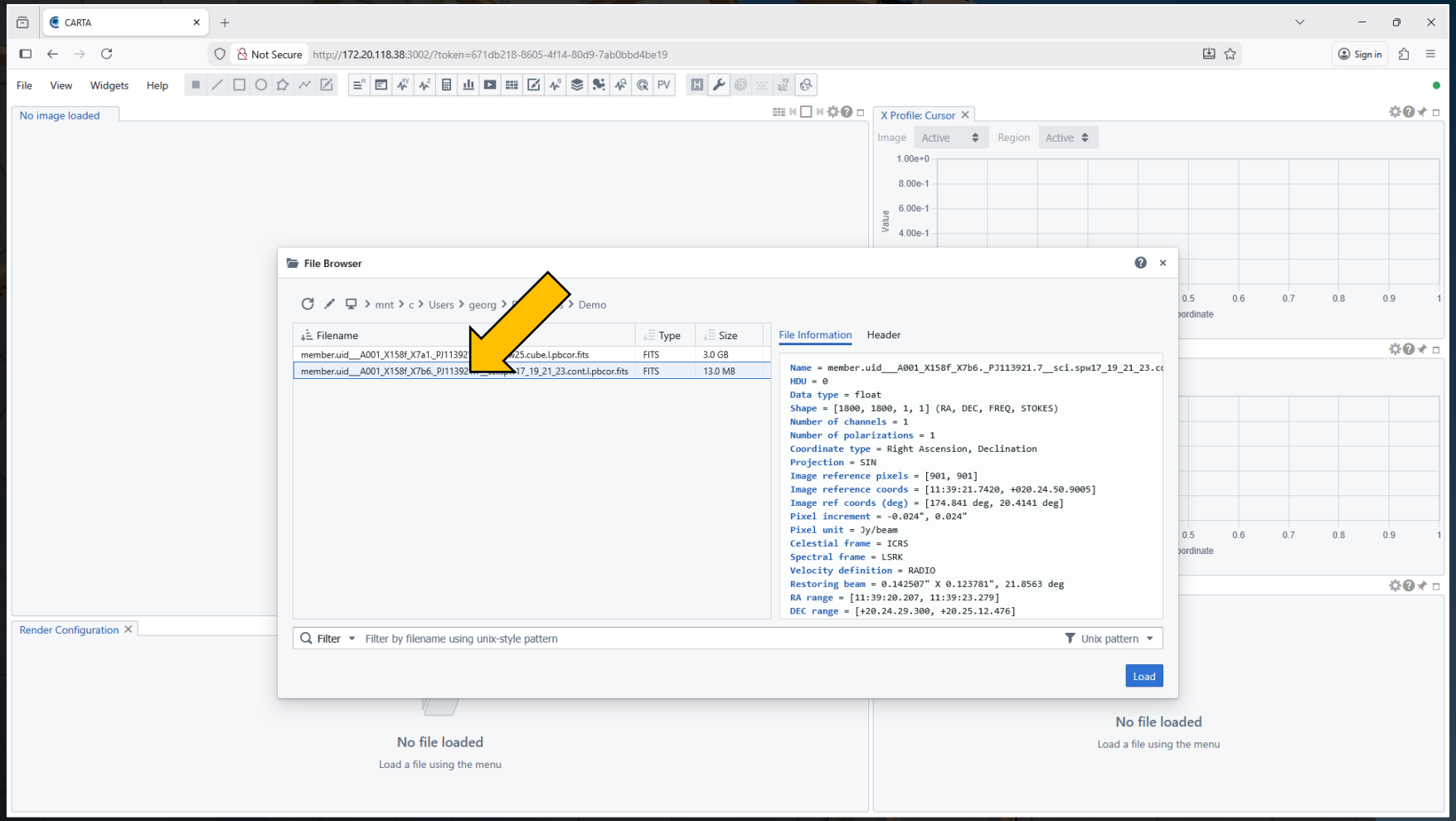
1. Start CARTA at the command line interface using `CARTA.AppImage --no_browser --port ####`, where `####` is the number for a port. (I normally use `5906`.) This will print a url in the terminal.

2. Copy the url from the terminal and then paste it into the address bar in a web browser.

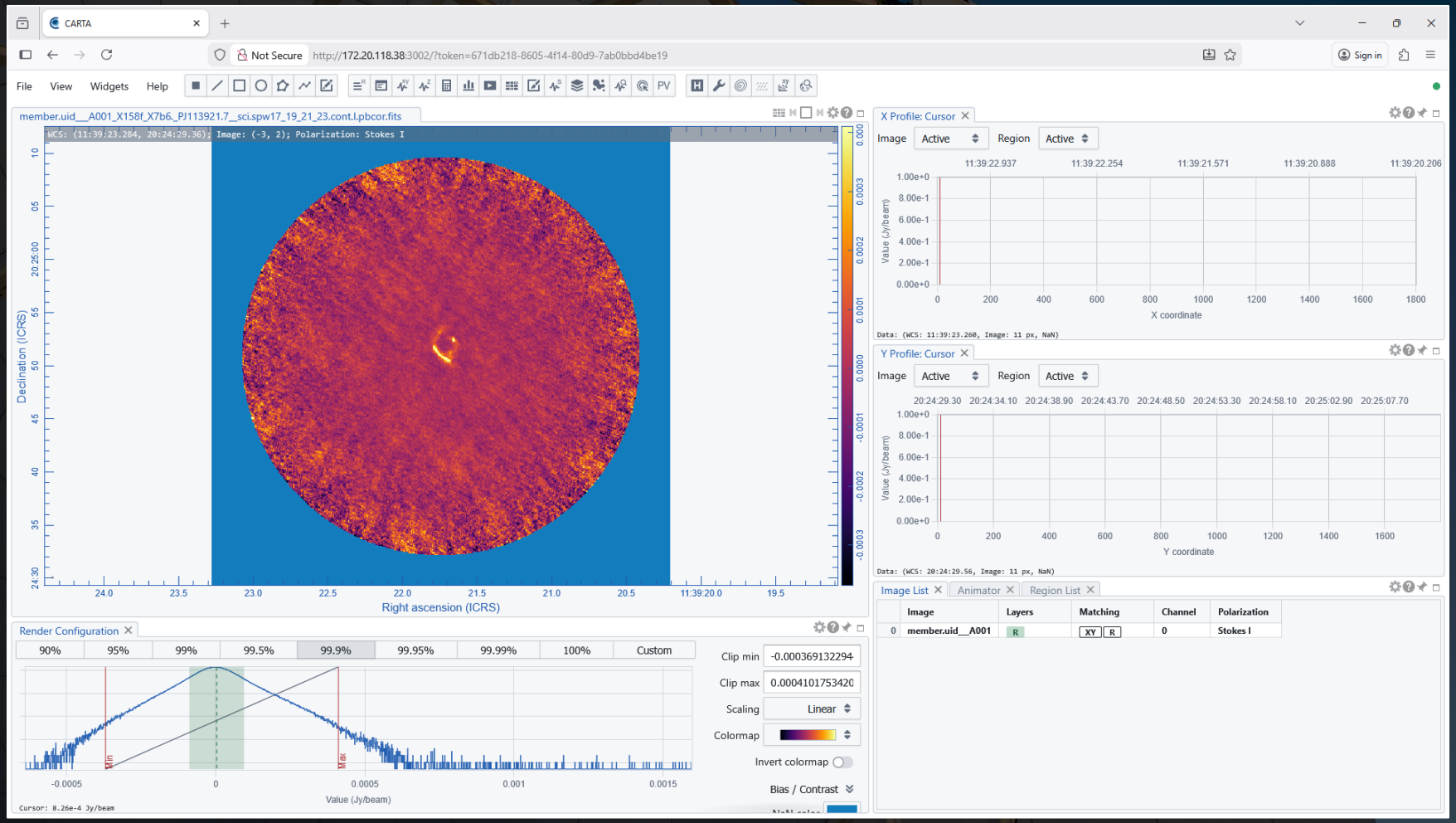
When CARTA is started, it will display a file browser window. When a file is selected in this interface, CARTA will display useful information about the image.



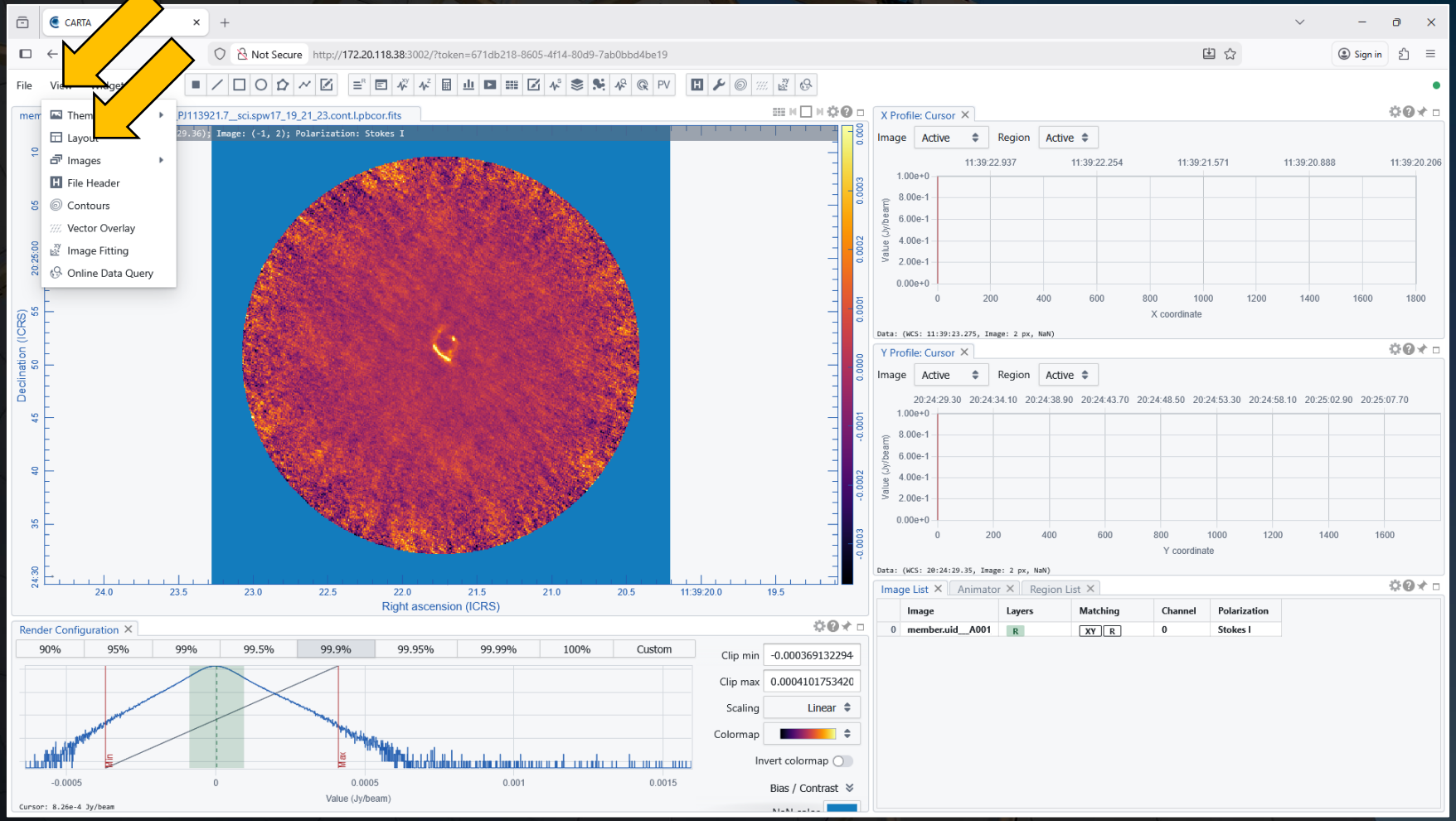
When CARTA is started, it will display a file browser window. When a file is selected in this interface, CARTA will display useful information about the image.



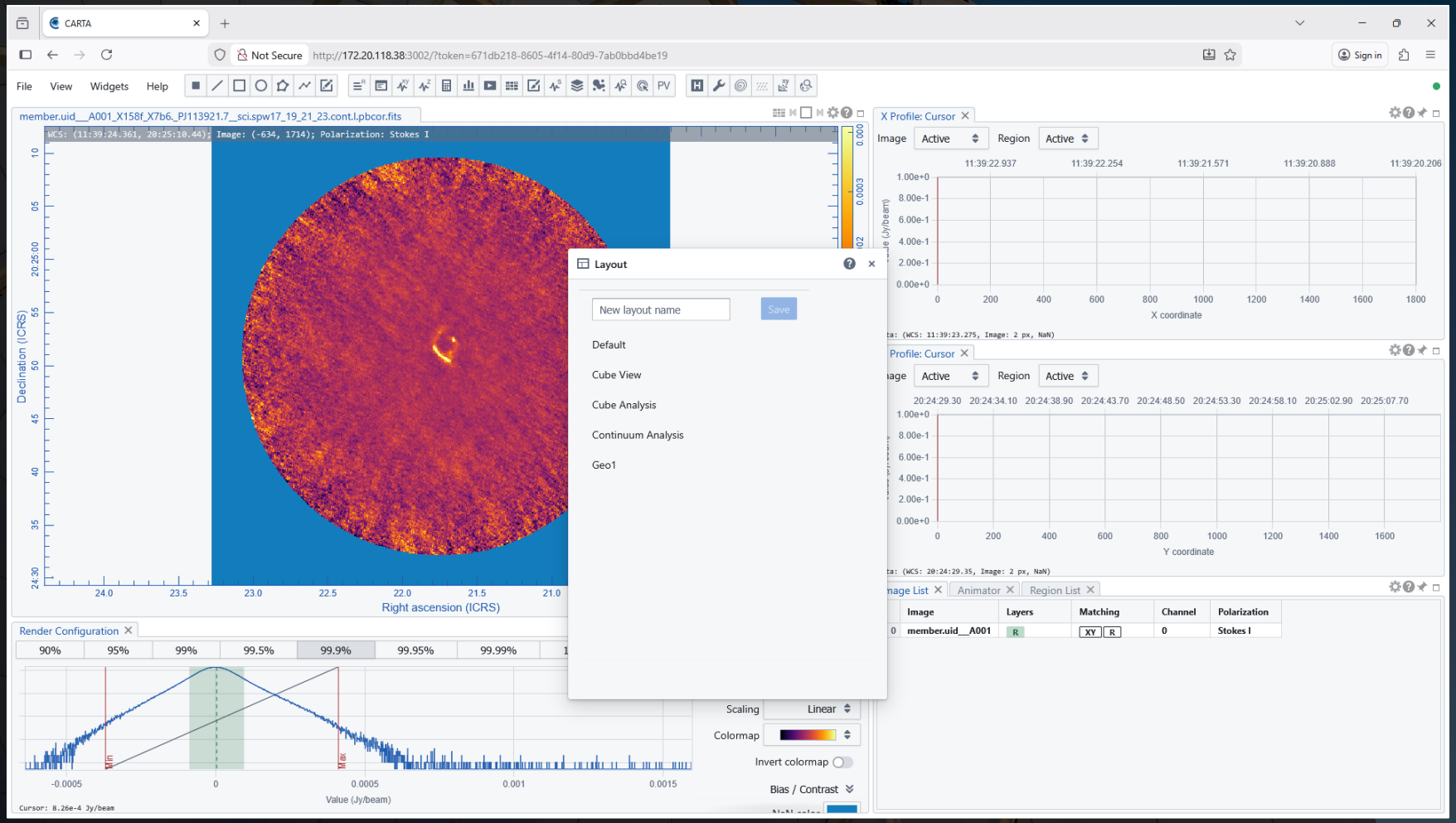
Once a file is selected, It will be possible to see CARTA's main display.



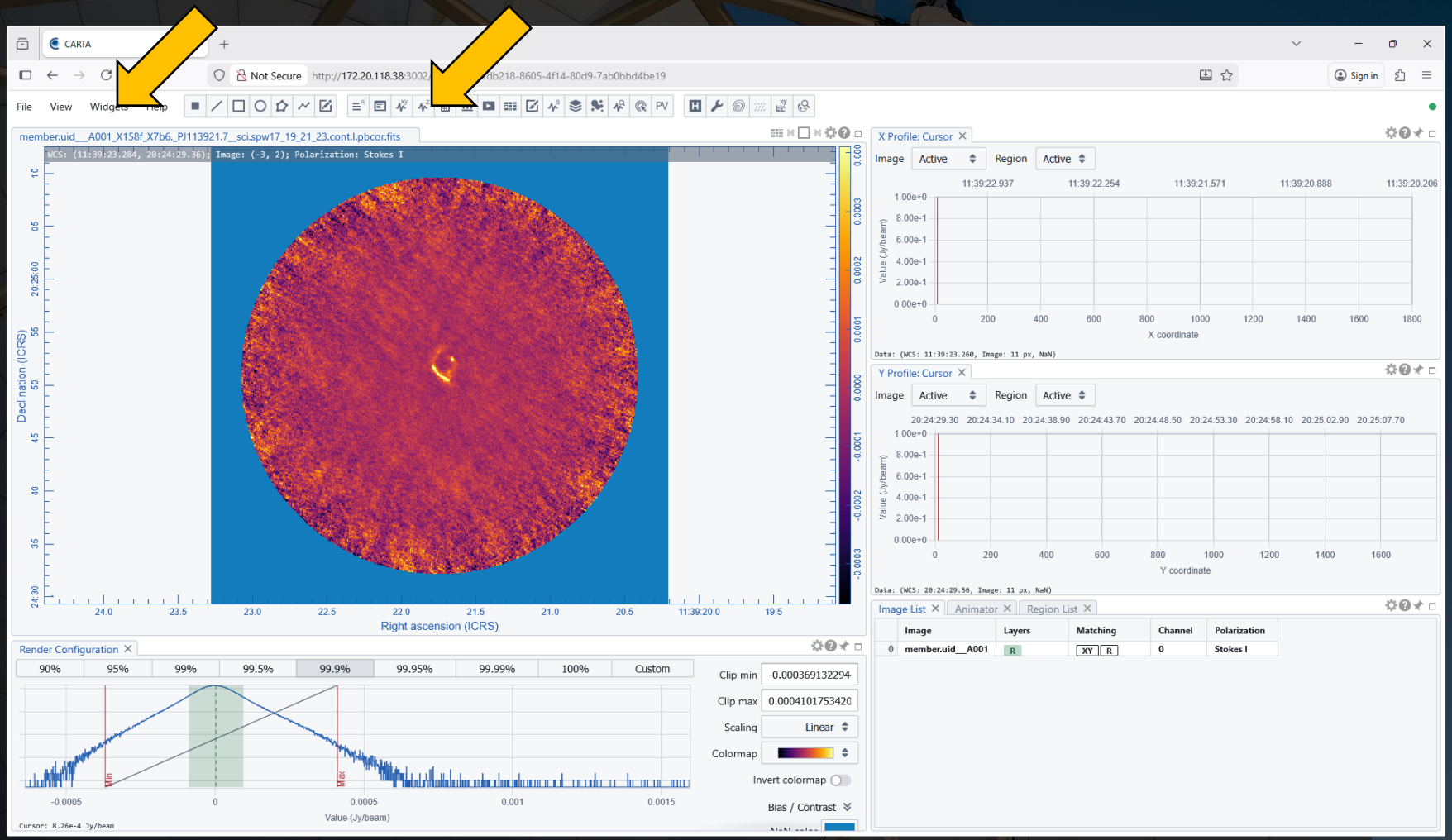
The default display features the image panel and six widgets. It is possible to select alternate panel arrangements by going to View and then Layouts in the menu bar at the top.



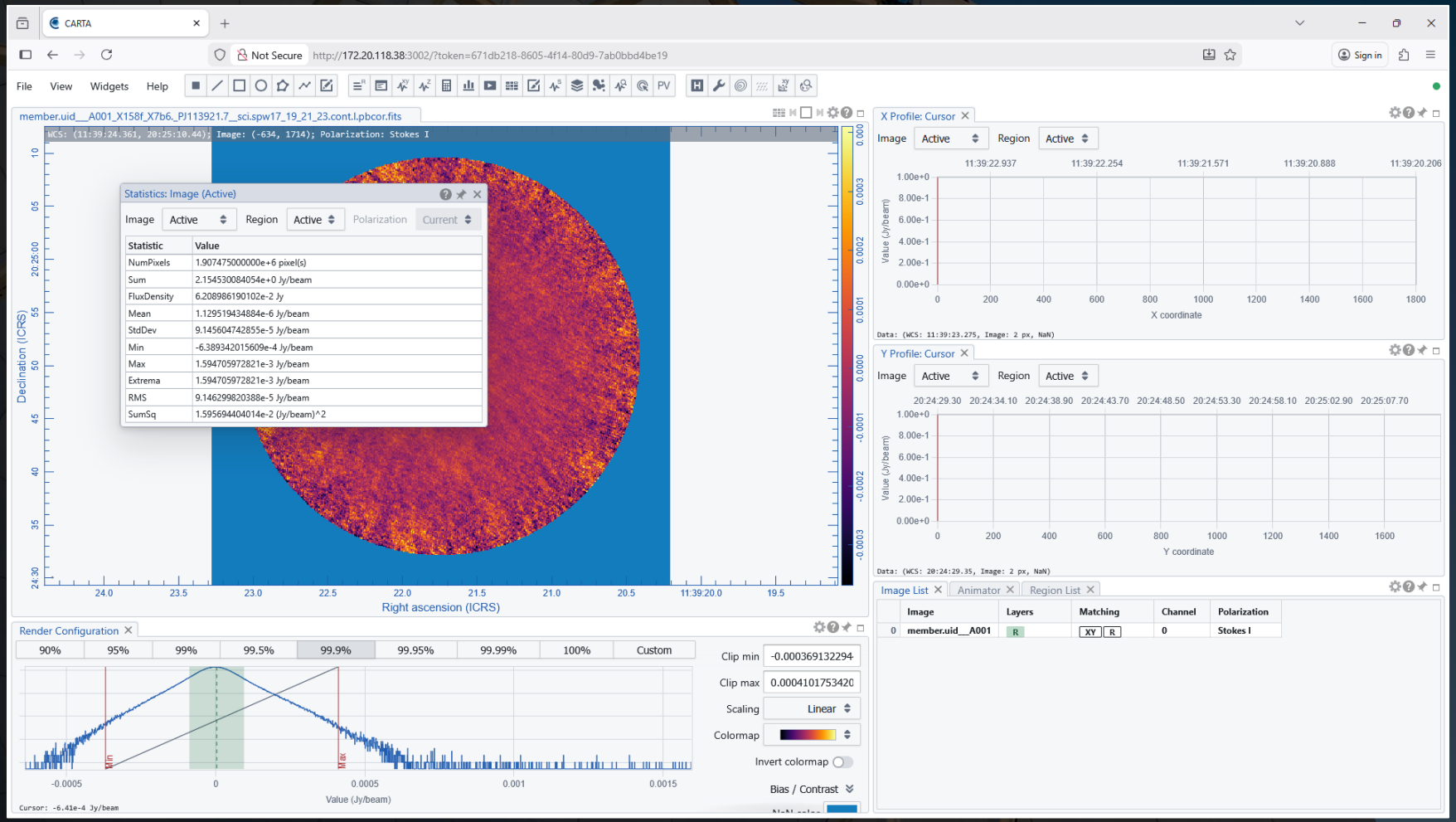
The default display features the image panel and six widgets. It is possible to select alternate panel arrangements by going to View and then Layouts in the menu bar at the top.



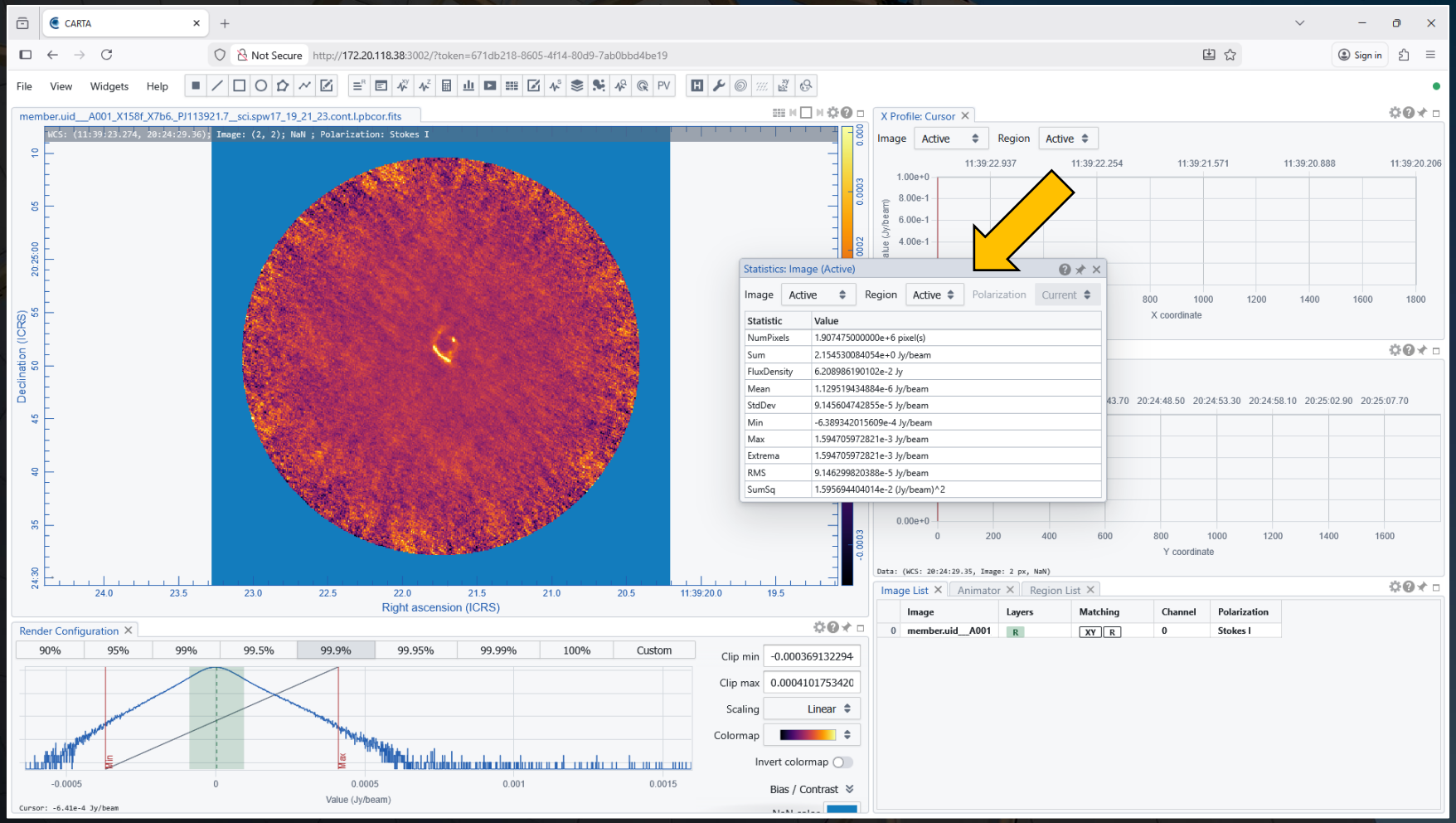
It is also possible to open new widgets by clicking on the various corresponding buttons in the button bar or by clicking on one of the options under Widgets in the menu bar.



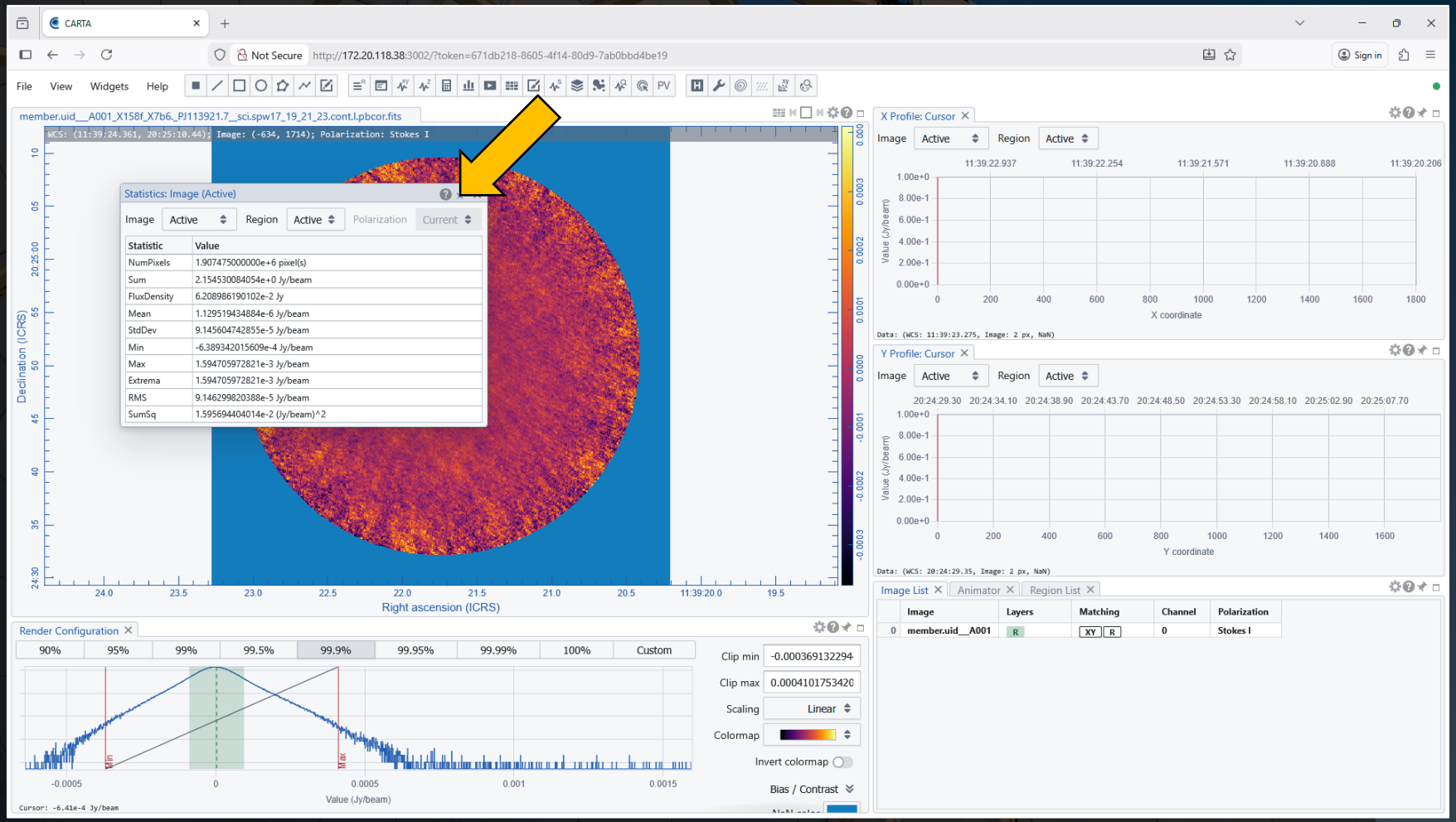
It is also possible to open new widgets by clicking on the various corresponding buttons in the button bar or by clicking on one of the options under Widgets in the menu bar.



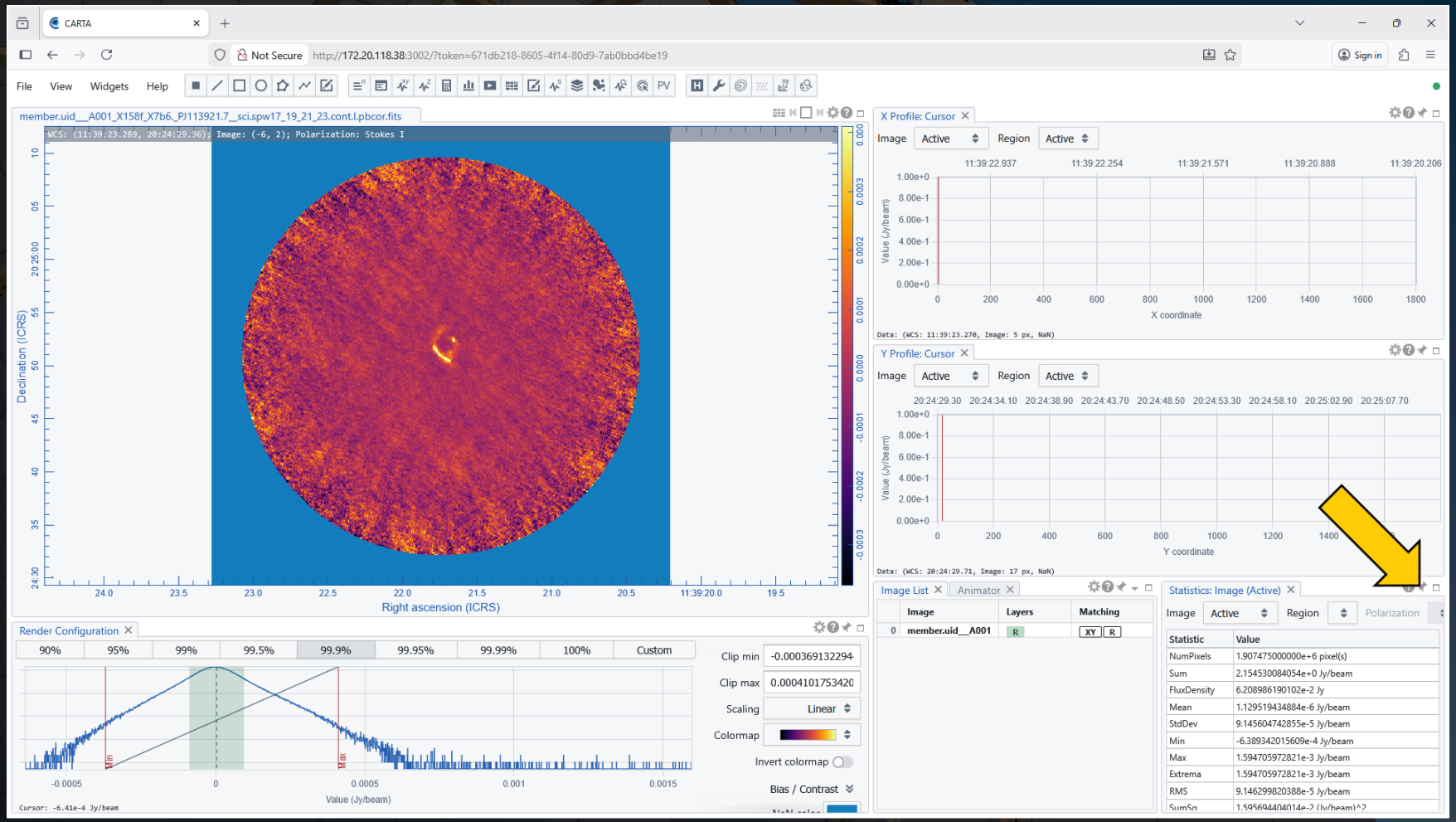
Widgets can be dragged around the screen by moving the cursor over the menu bar and holding down the left mouse button.



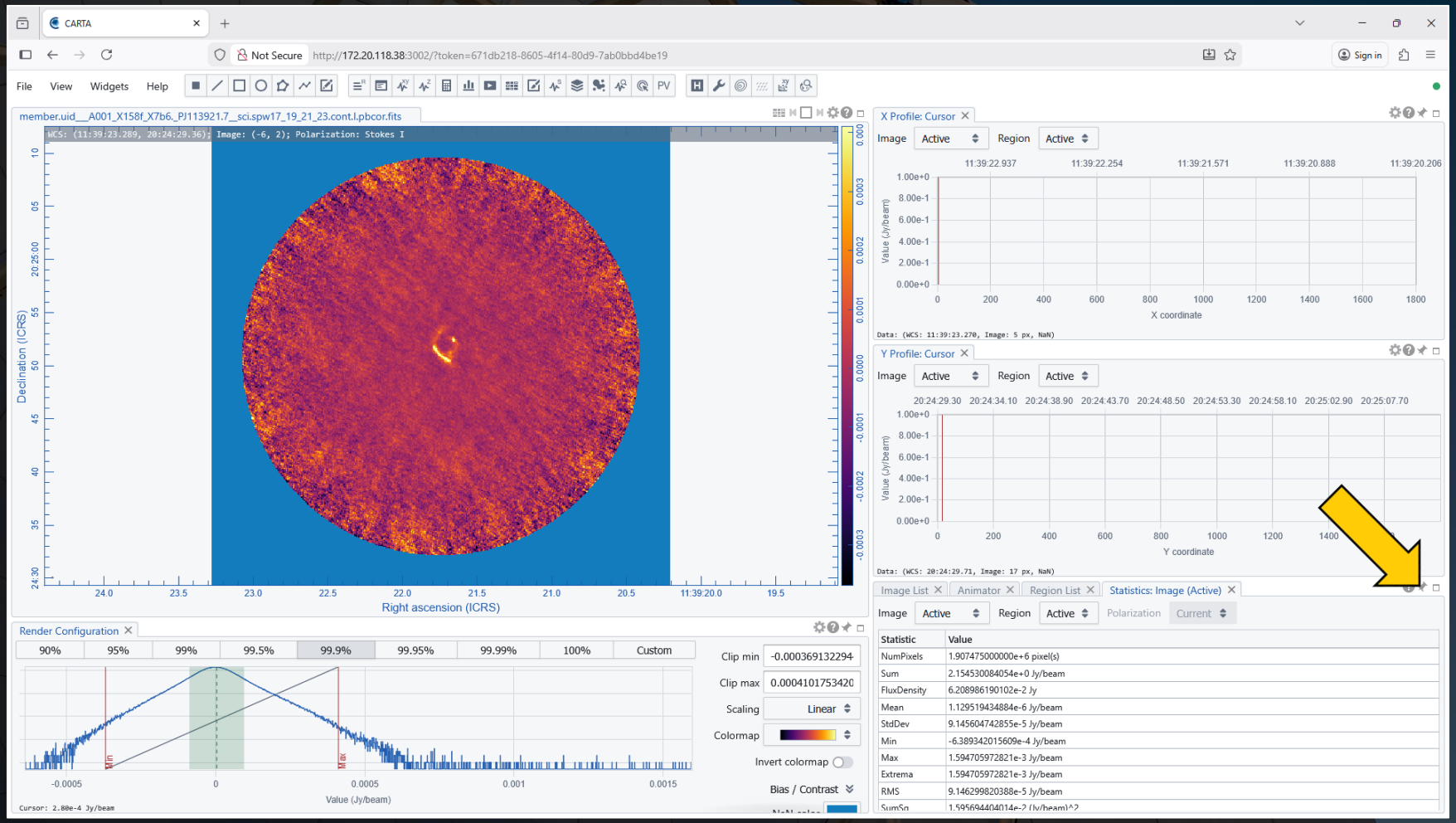
Widgets can be fixed into place by moving the cursor over the pin icon, holding down the left mouse button, and then dragging the outline around CARTA. Widgets can be placed either in between other widgets or in the same place as others (with the widget selected using the tabs).



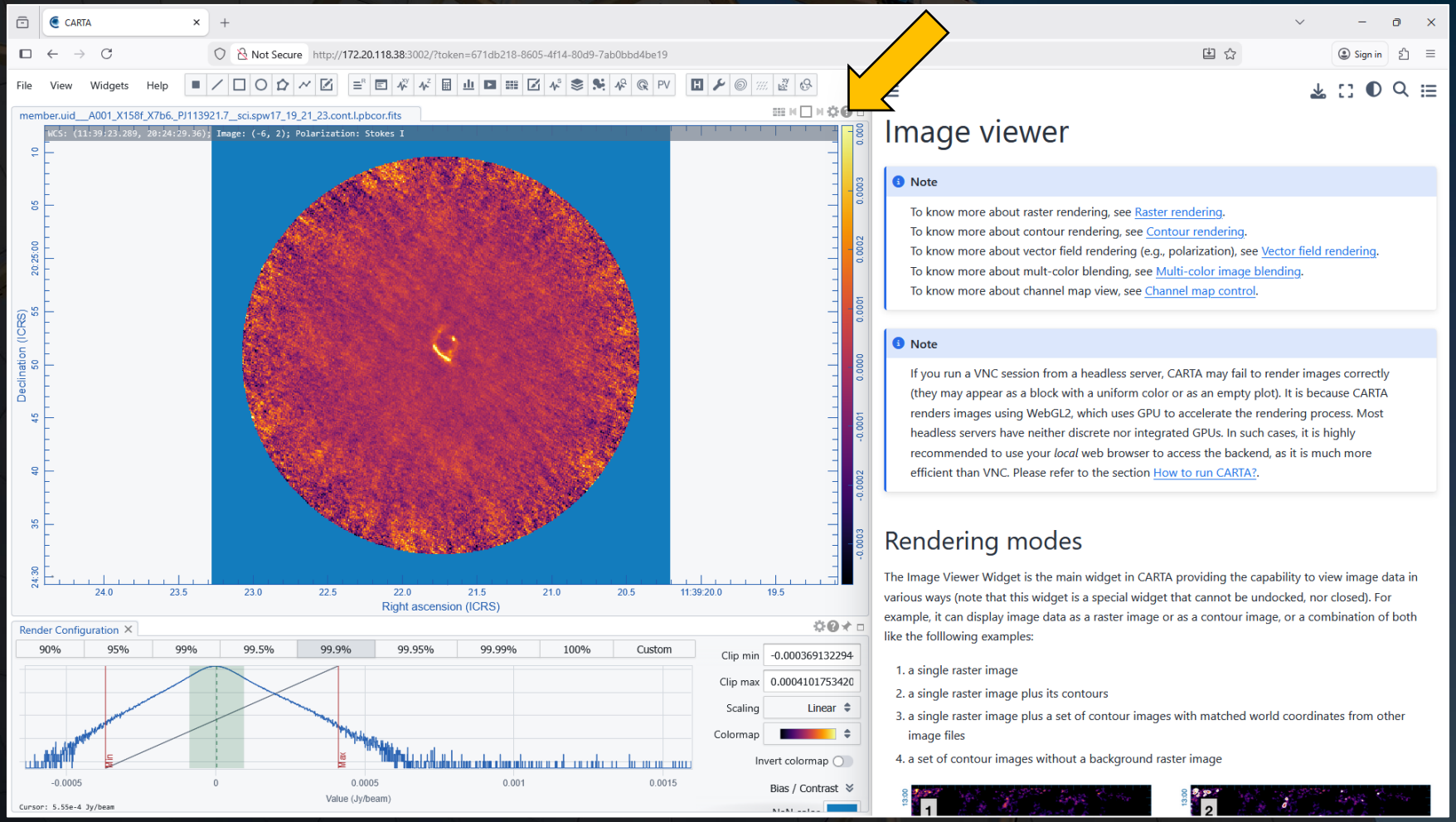
Widgets can be fixed into place by moving the cursor over the pin icon, holding down the left mouse button, and then dragging the outline around CARTA. Widgets can be placed either in between other widgets or in the same place as others (with the widget selected using the tabs).



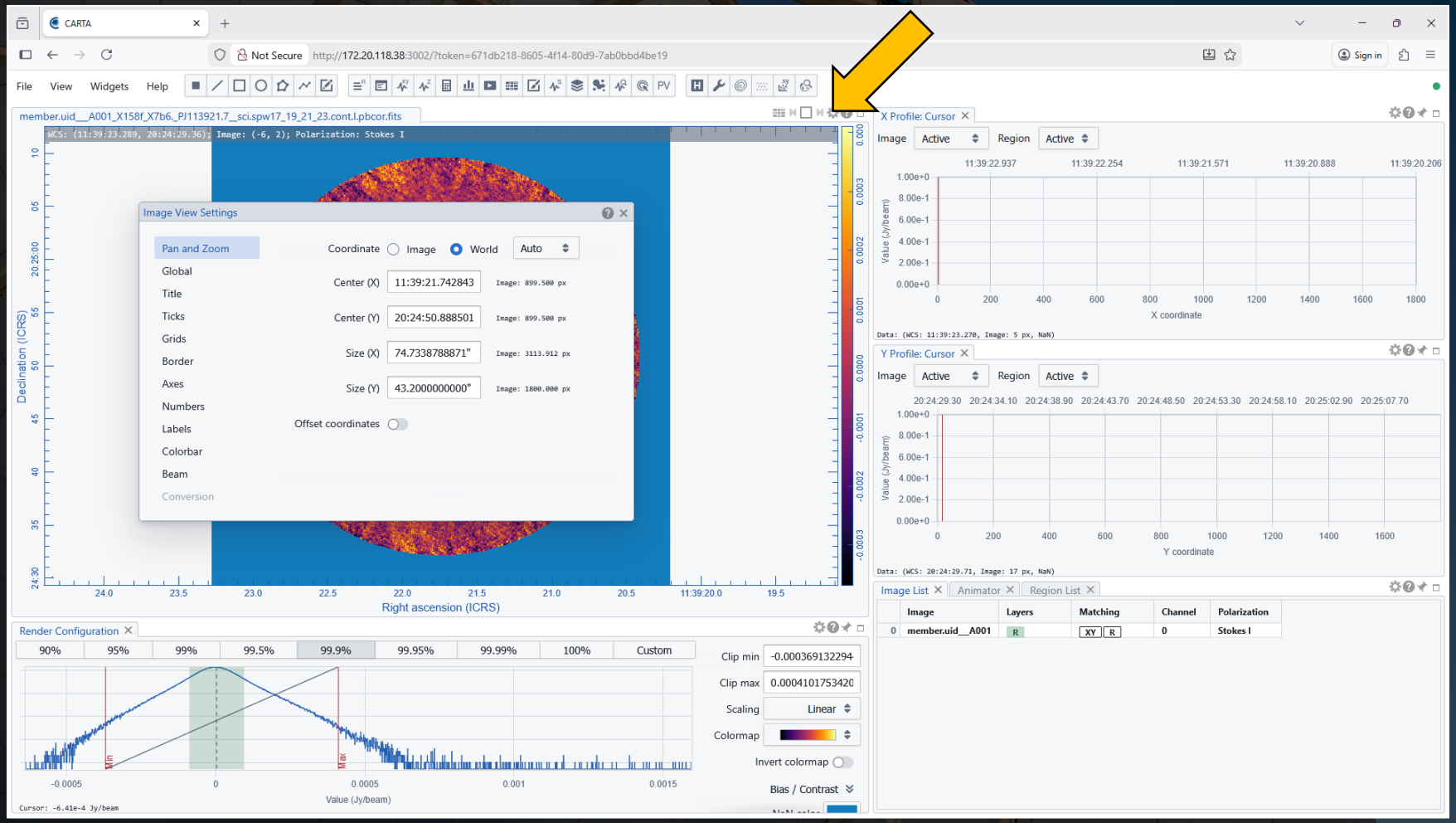
Widgets can be fixed into place by moving the cursor over the pin icon, holding down the left mouse button, and then dragging the outline around CARTA. Widgets can be placed either in between other widgets or in the same place as others (with the widget selected using the tabs).



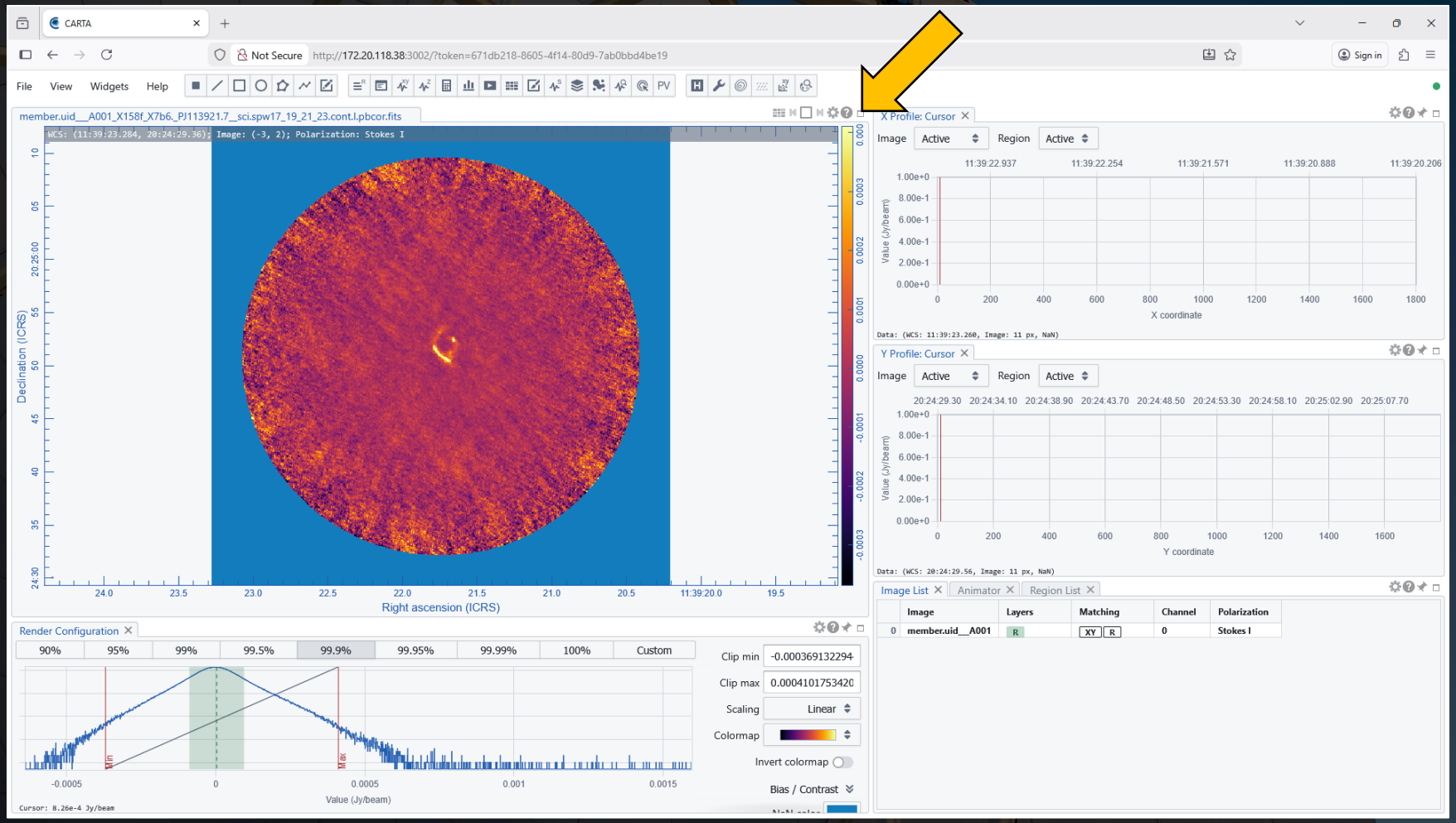
Left clicking on a question mark will bring up a help screen.



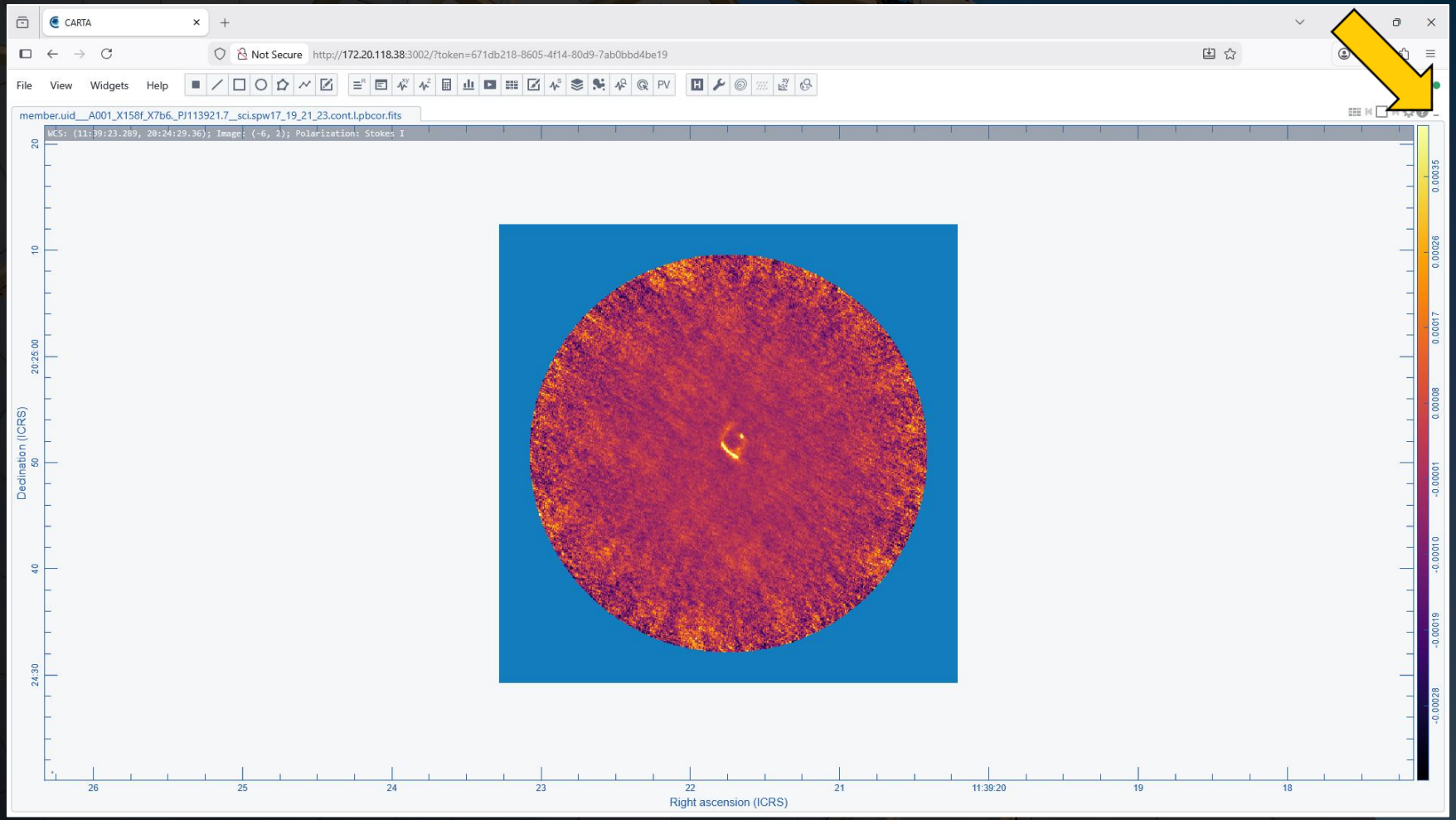
Left clicking on a gear icon will display settings for that window.



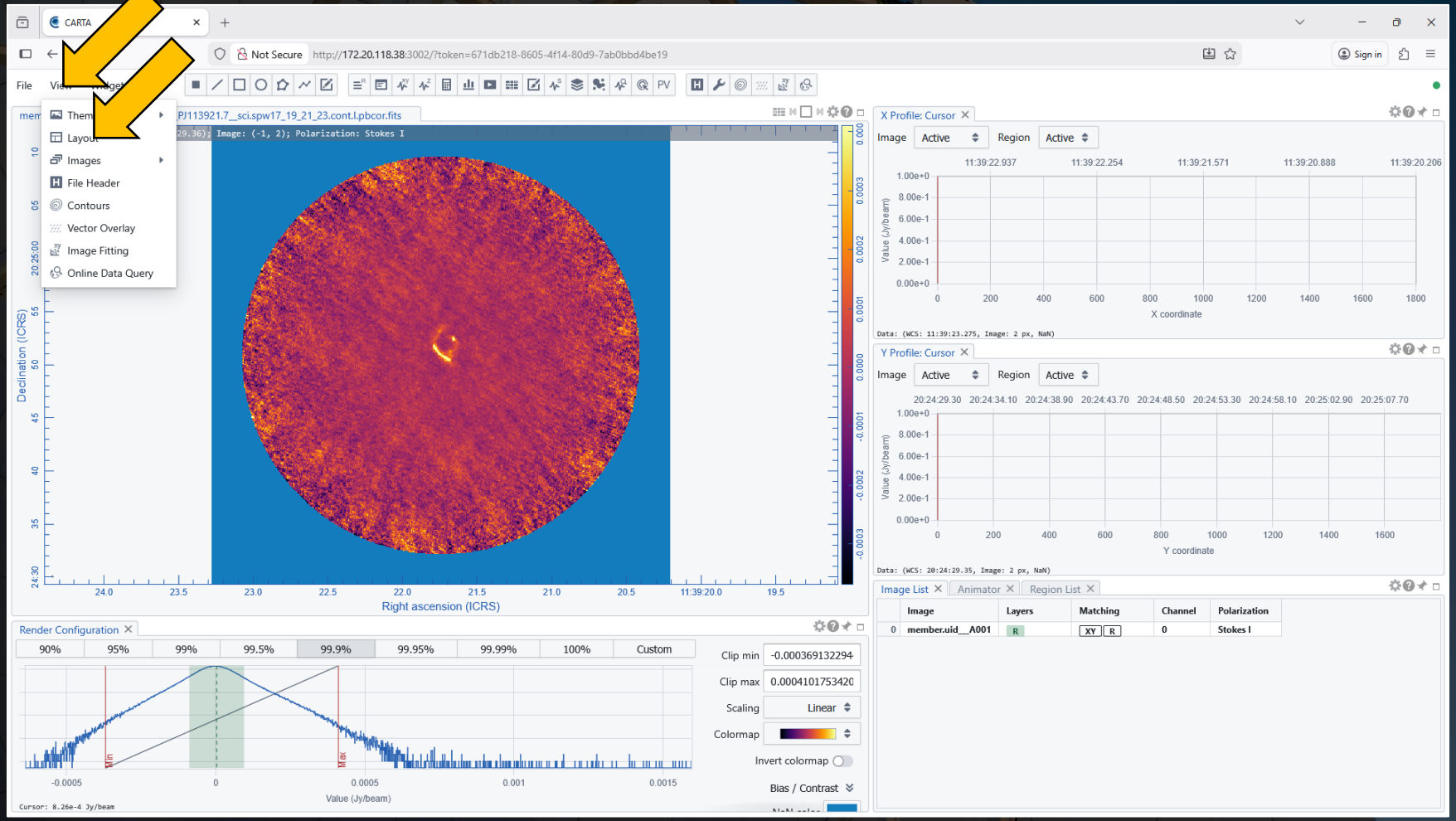
Left clicking on the rectangle icon will maximize the widget. When a widget is maximized, left clicking on the single bar will restore the widget to its original size.



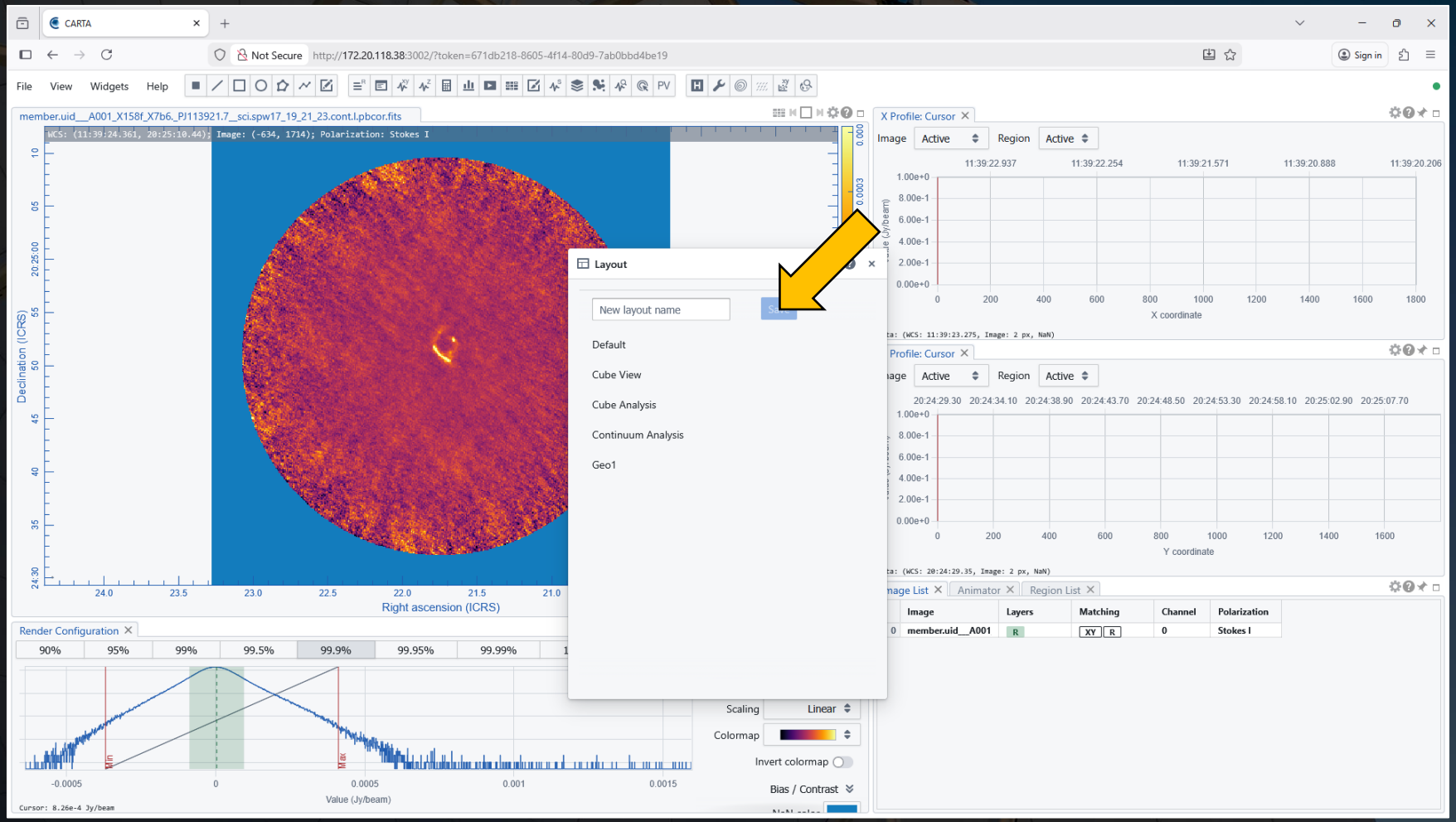
Left clicking on the rectangle icon will maximize the widget. When a widget is maximized, left clicking on the single bar will restore the widget to its original size.



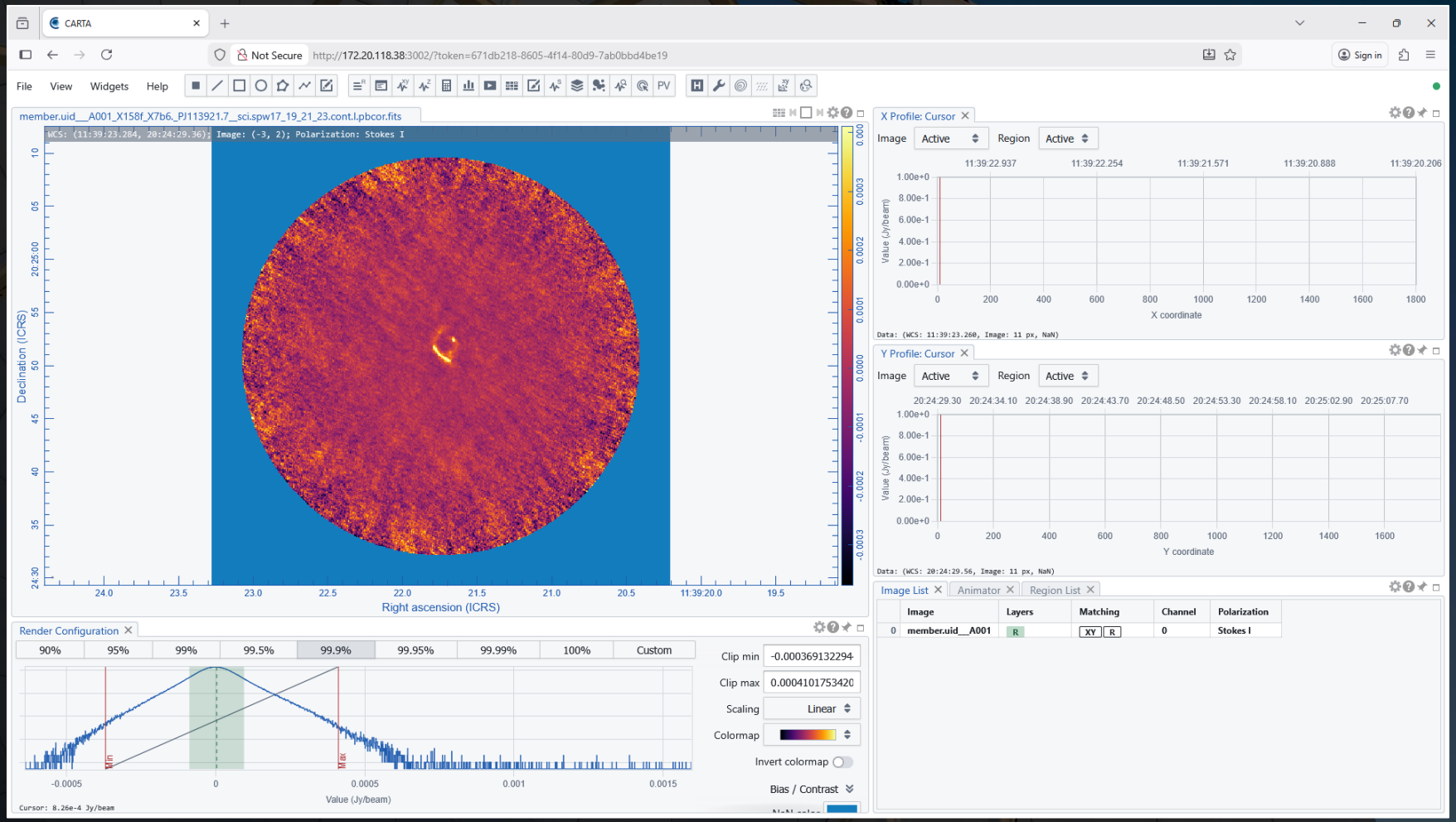
Various widget configurations can be saved by going to View, then Layouts, and then Save Layout.



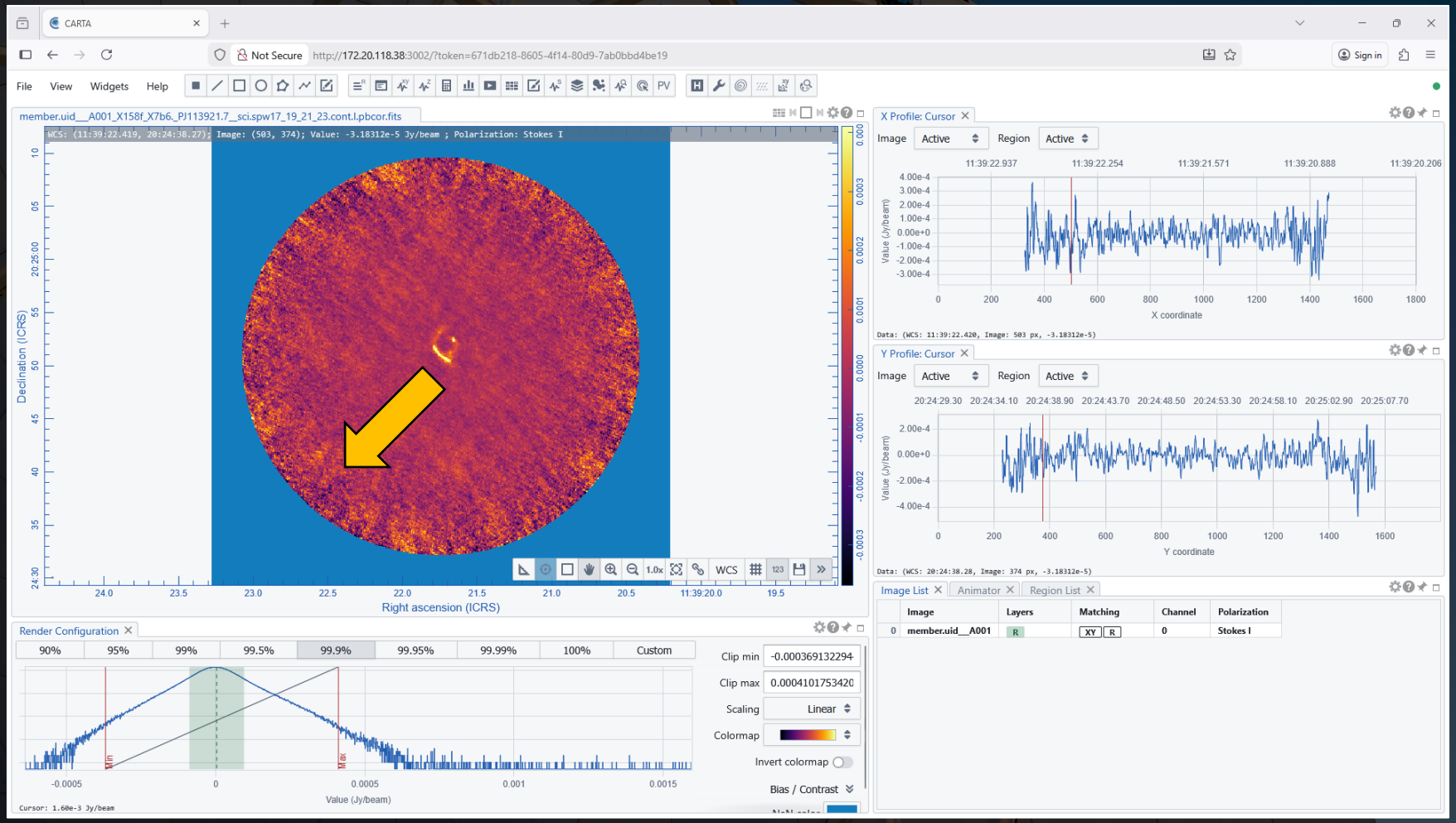
Various widget configurations can be saved by going to View, then Layouts, and then Save Layout.



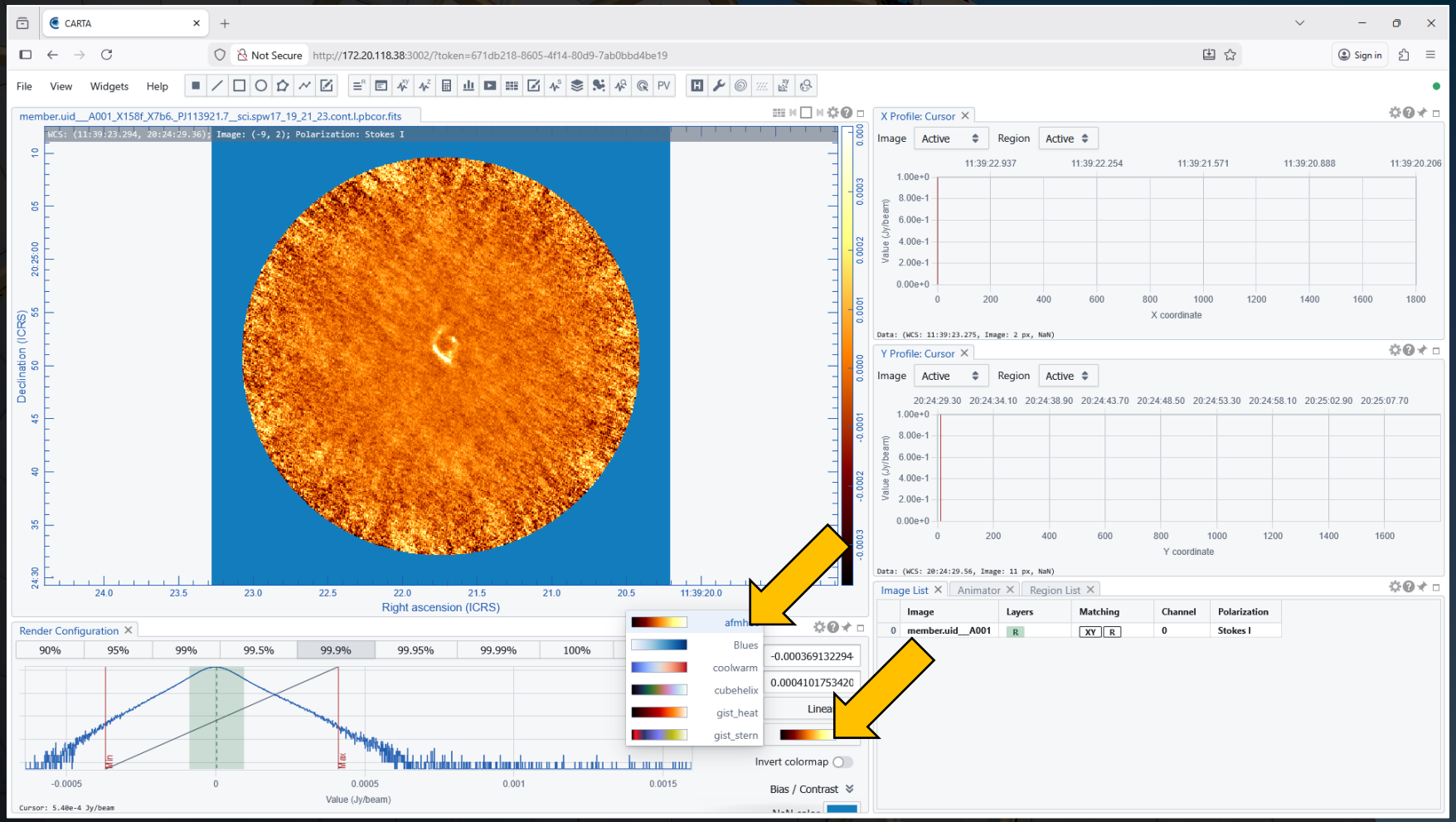
In the image panel, text at the top shows the coordinates and pixel value at the location of the cursor. The beam is visible by default in the lower left corner. The colour bar is shown on the right. Additional display tools will appear on the lower right when hovering the cursor over the window.



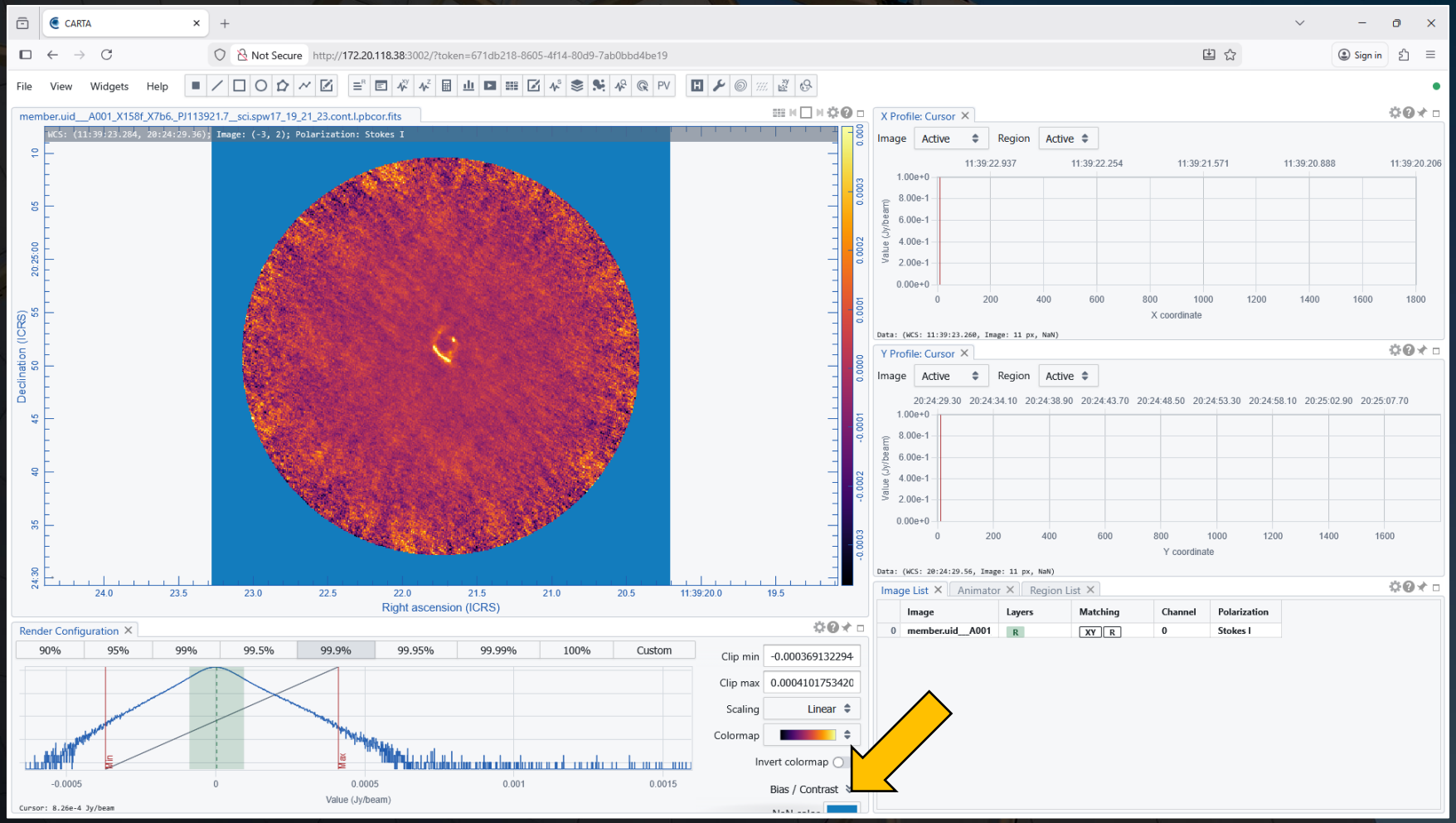
In the image panel, text at the top shows the coordinates and pixel value at the location of the cursor. The beam is visible by default in the lower left corner. The colour bar is shown on the right. Additional display tools will appear on the lower right when hovering the cursor over the window.



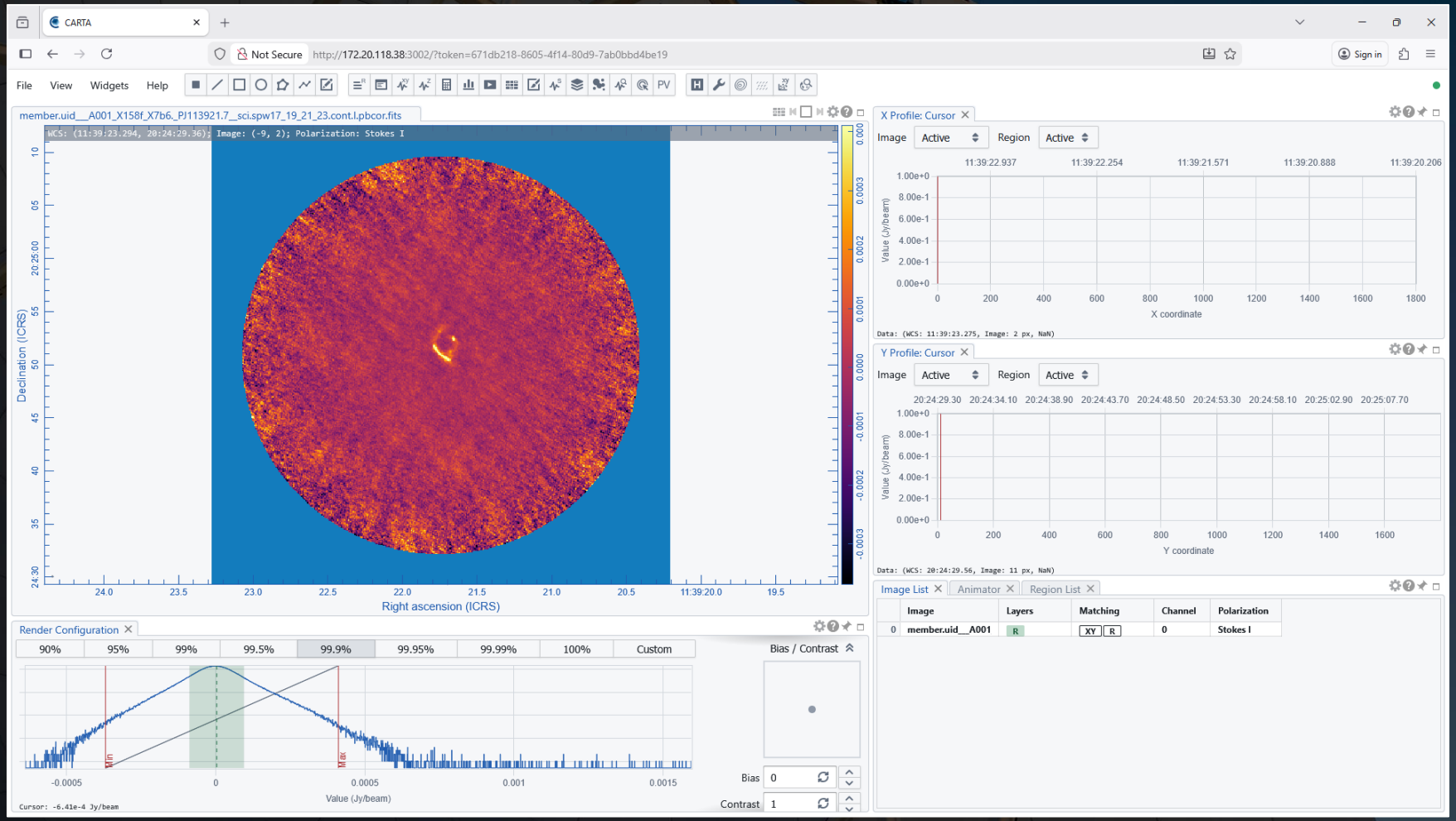
The Render Configuration widget at the bottom of the display shows how the pixel values are converted into colours. This can be used to change the minimum and maximum ranges used in the conversion, the scaling function, and the color map.



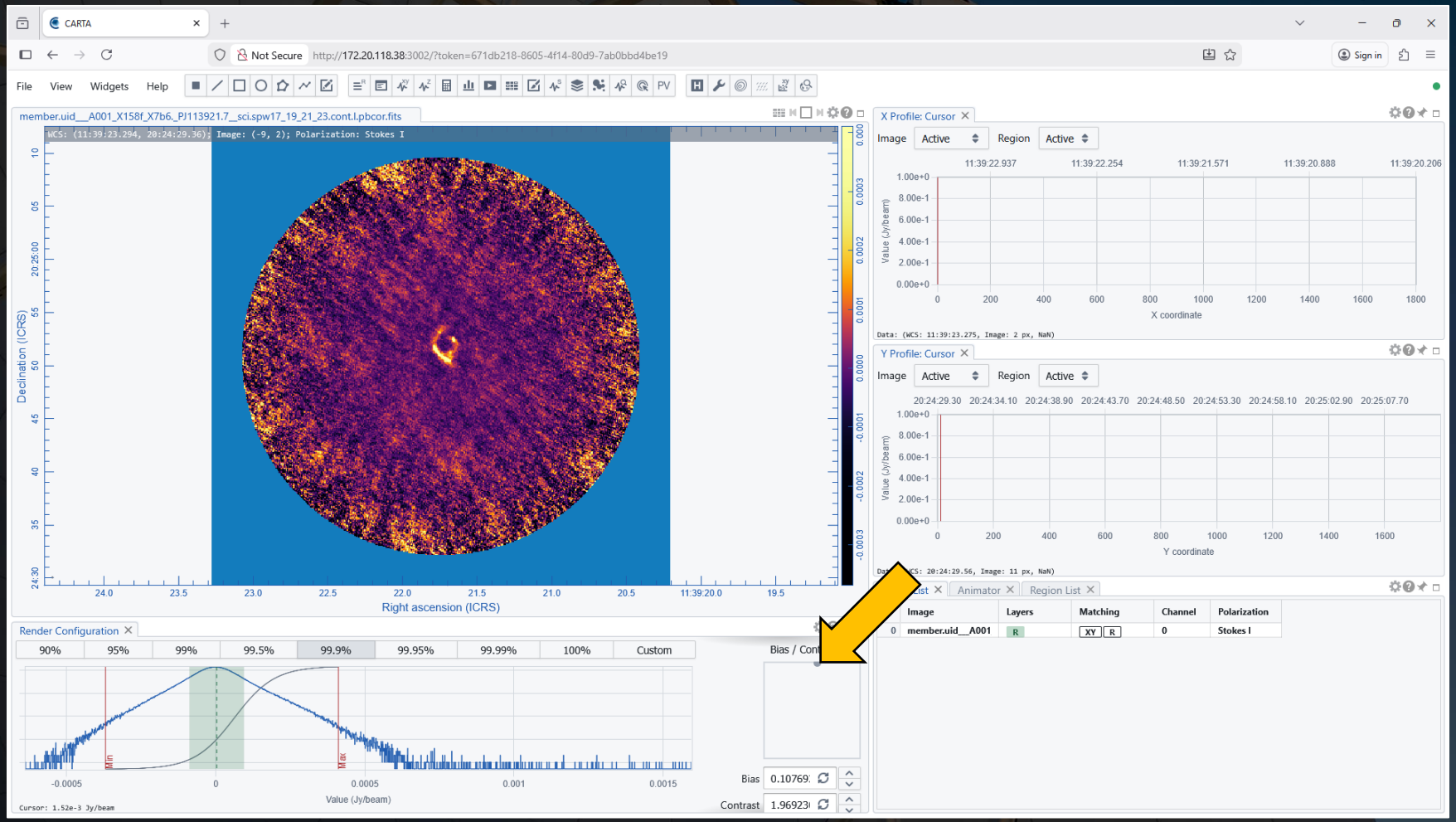
Also note that clicking on the arrows next to Bias/Contrast in the Render Configuration widget will display a box with a dot that can be moved around to change the bias and contrast as well as boxes where these values can be typed in.



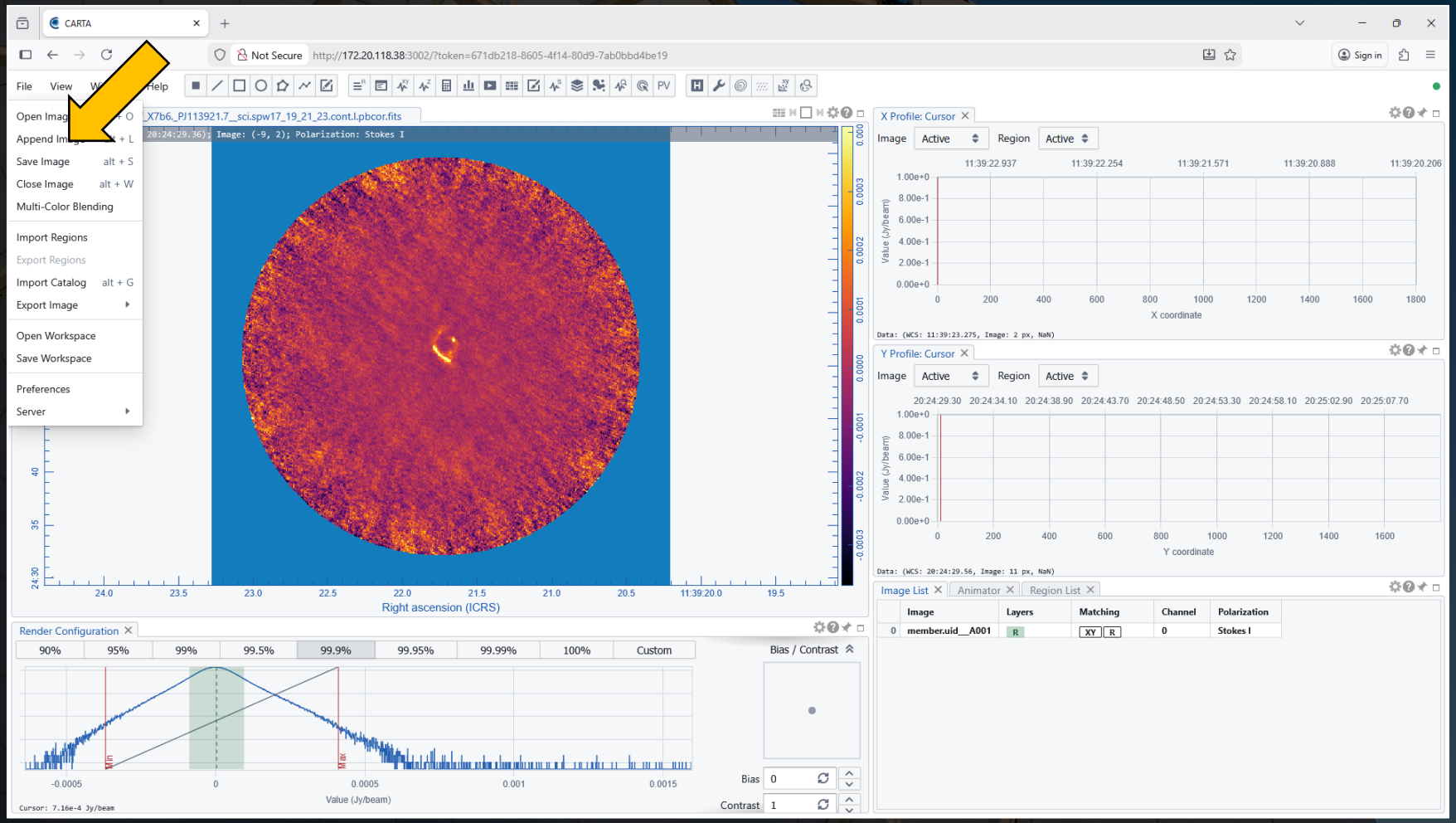
Also note that clicking on the arrows next to Bias/Contrast in the Render Configuration widget will display a box with a dot that can be moved around to change the bias and contrast as well as boxes where these values can be typed in.



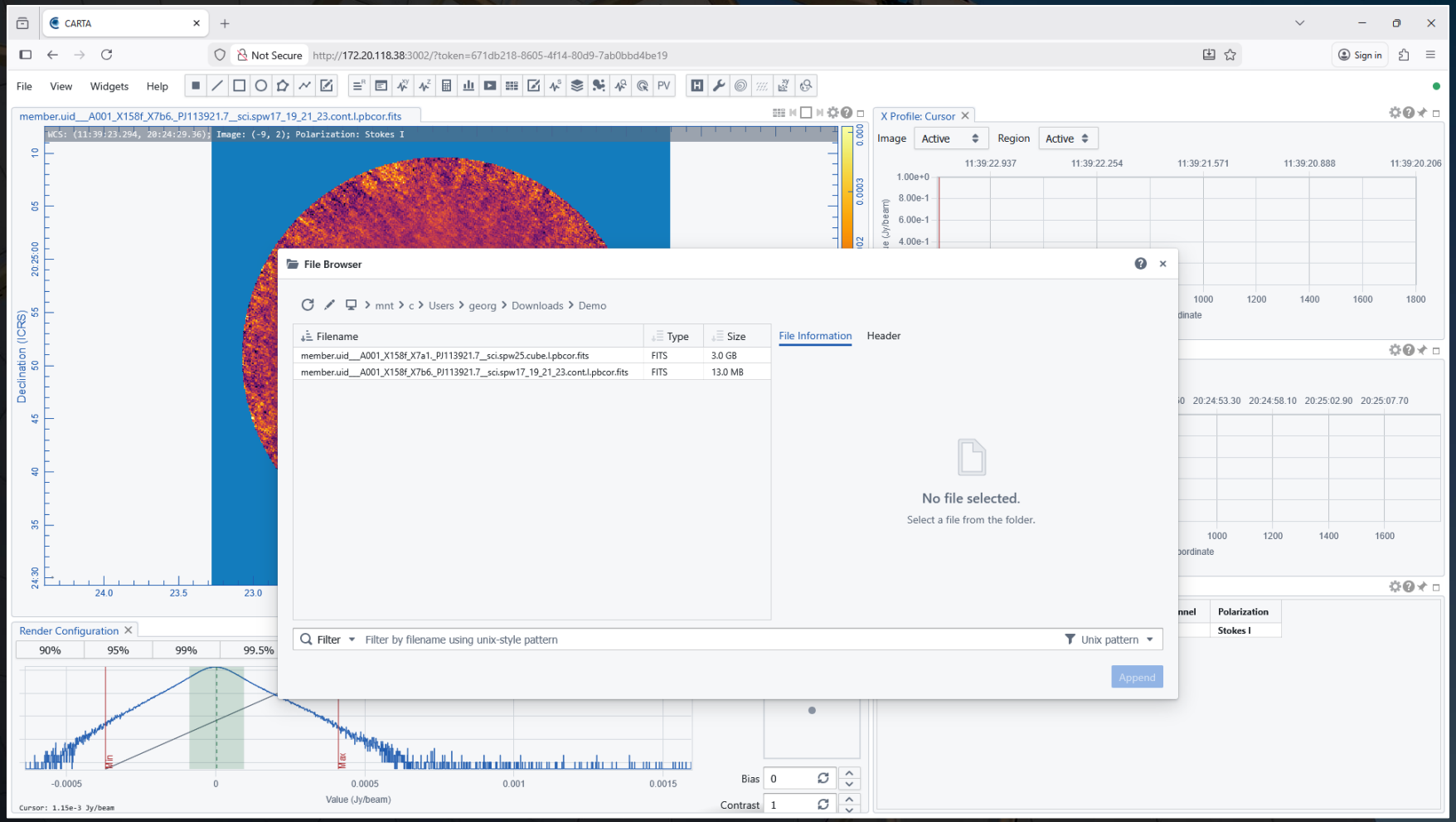
Also note that clicking on the arrows next to Bias/Contrast in the Render Configuration widget will display a box with a dot that can be moved around to change the bias and contrast as well as boxes where these values can be typed in.



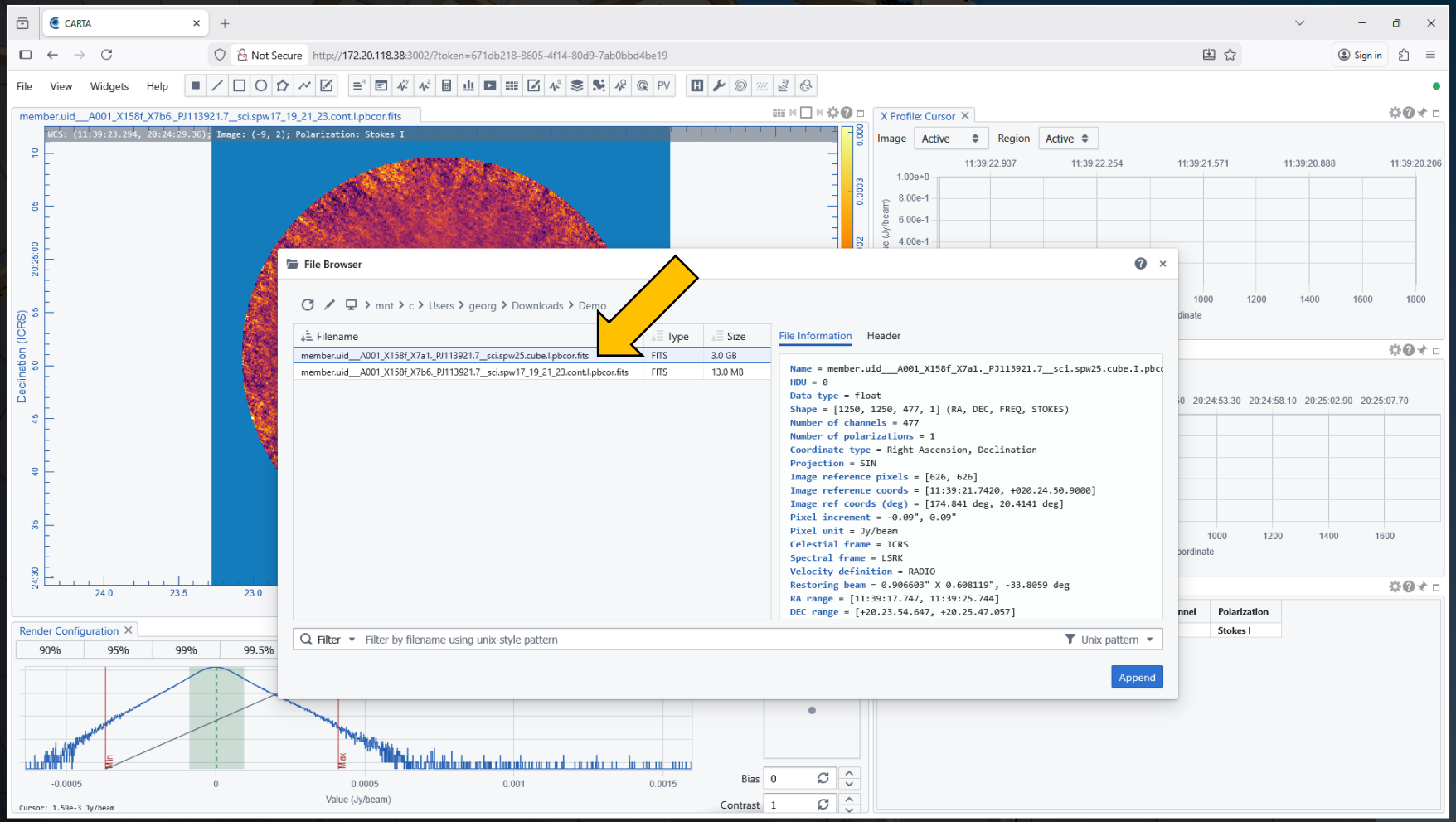
More than one image can be loaded into CARTA by clicking on File and then Append Image and then selecting a file in the File Browser.



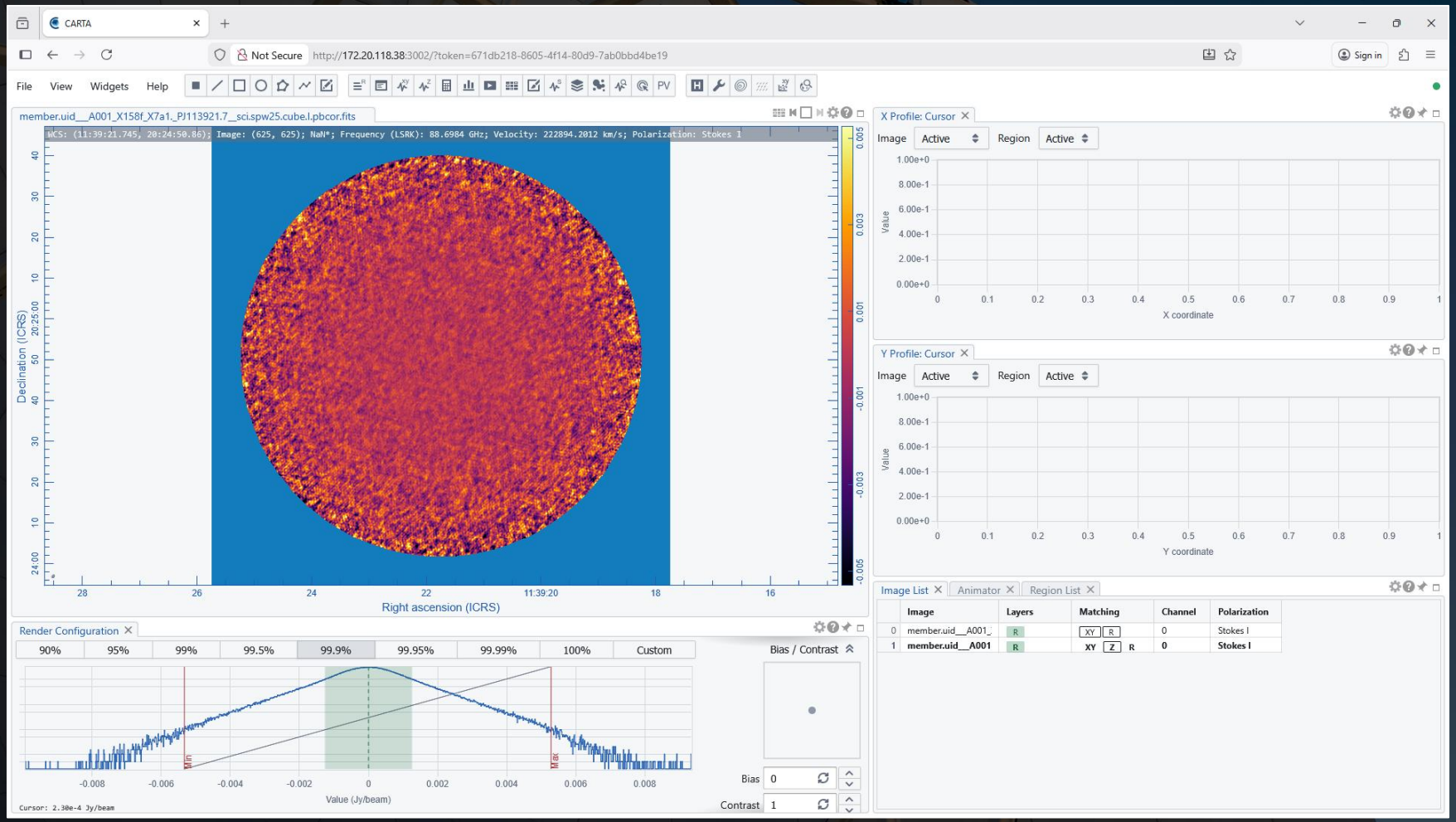
More than one image can be loaded into CARTA by clicking on File and then Append Image and then selecting a file in the File Browser.



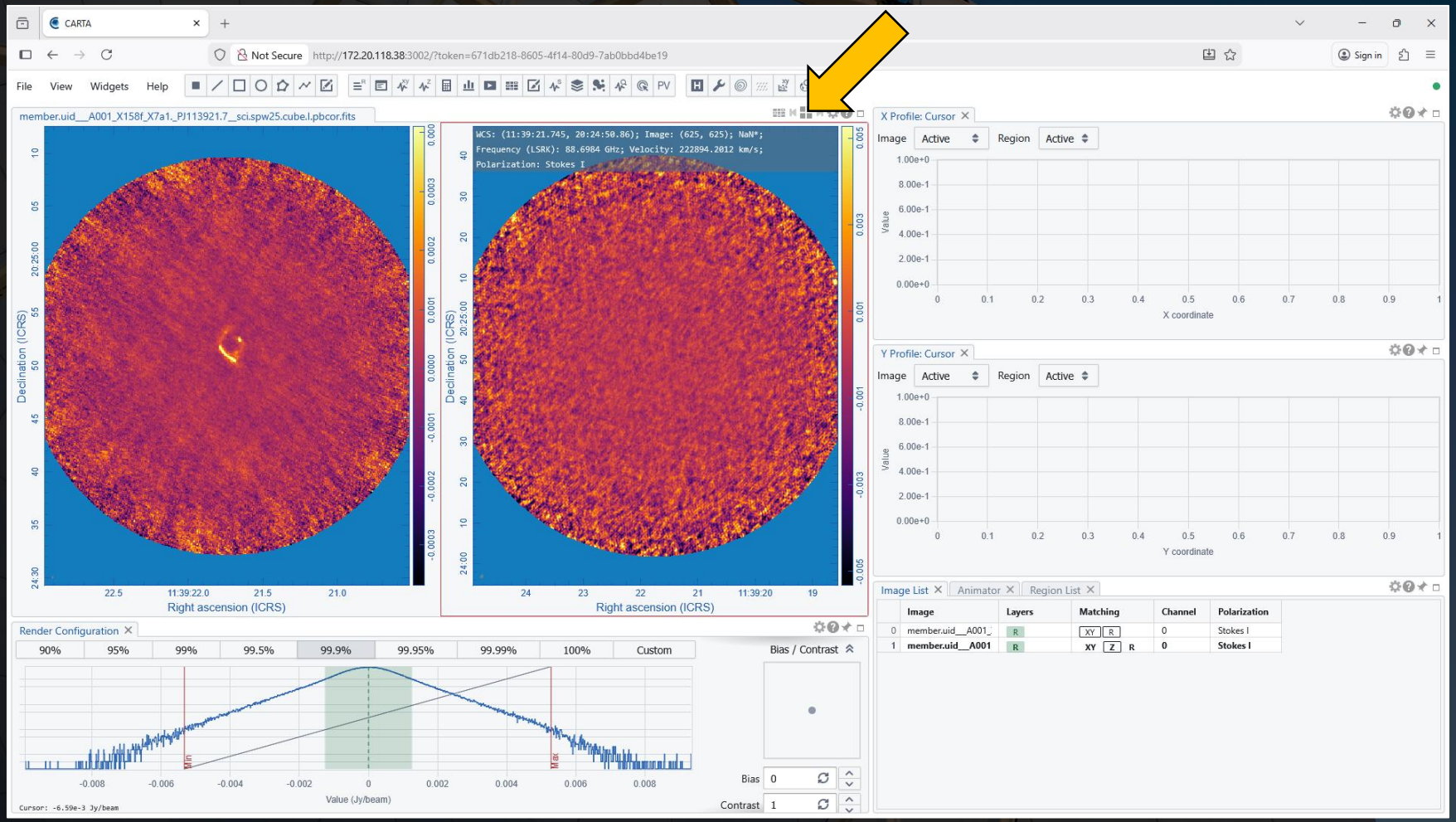
More than one image can be loaded into CARTA by clicking on File and then Append Image and then selecting a file in the File Browser.



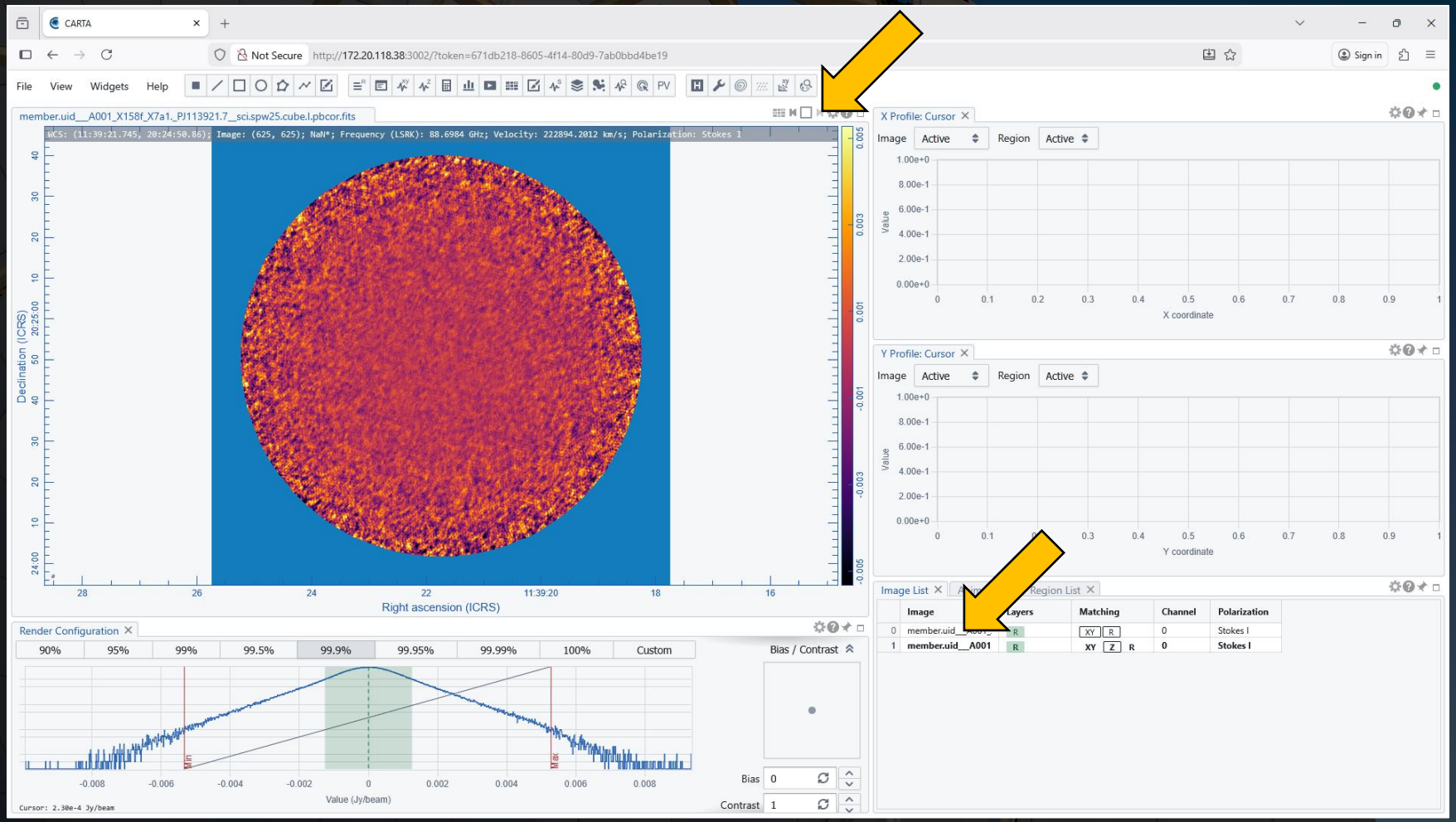
More than one image can be loaded into CARTA by clicking on File and then Append Image and then selecting a file in the File Browser.



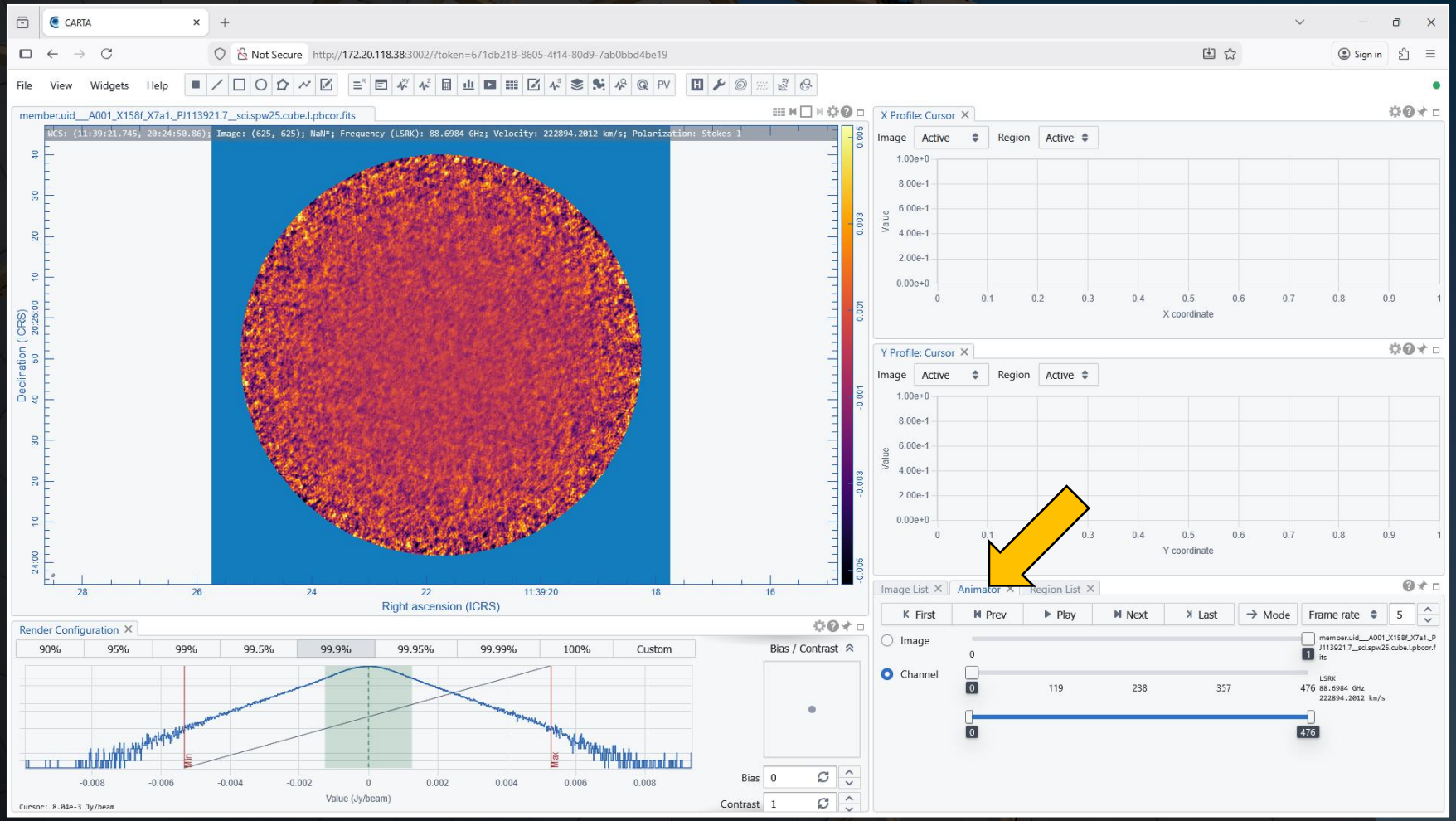
Images can be displayed either individually or in a grid by clicking on an icon above the image panel.



When images are displayed individually, it is possible to switch between images by clicking on the arrows above the image, by clicking on the name of an image in the Image List, or by paging between images in the Animator widget.



When images are displayed individually, it is possible to switch between images by clicking on the arrows above the image, by clicking on the name of an image in the Image List, or by paging between images in the Animator widget.



The Animator widget can also be used to move between channels in an image cube and change the Stokes parameter displayed in images from full polarization observations.

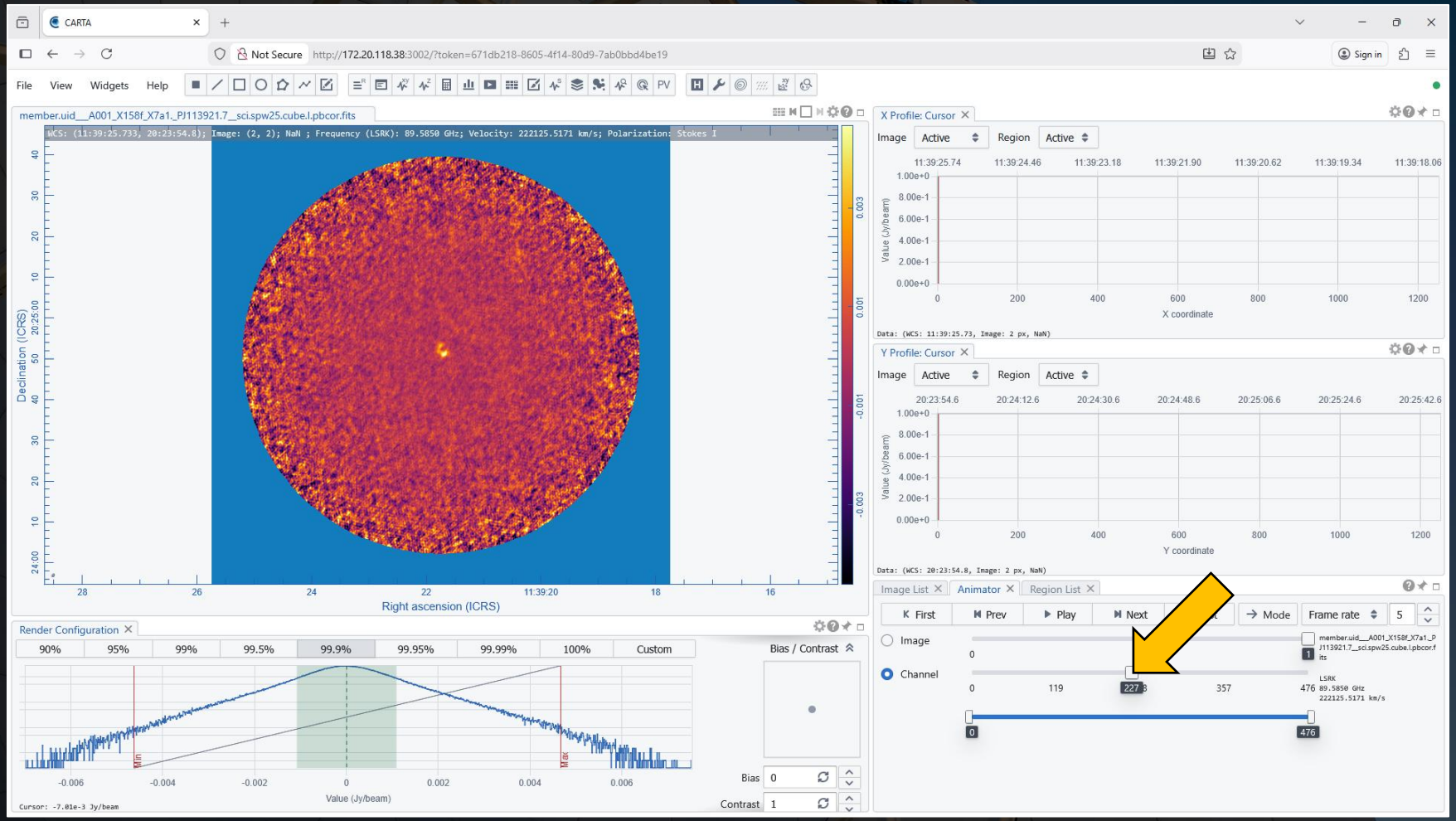


Image coordinate systems can be aligned by clicking on the XY option in the Matching column in the Image List widget. (Frequencies in image cubes can be aligned by clicking on the Z option in the same widget.)

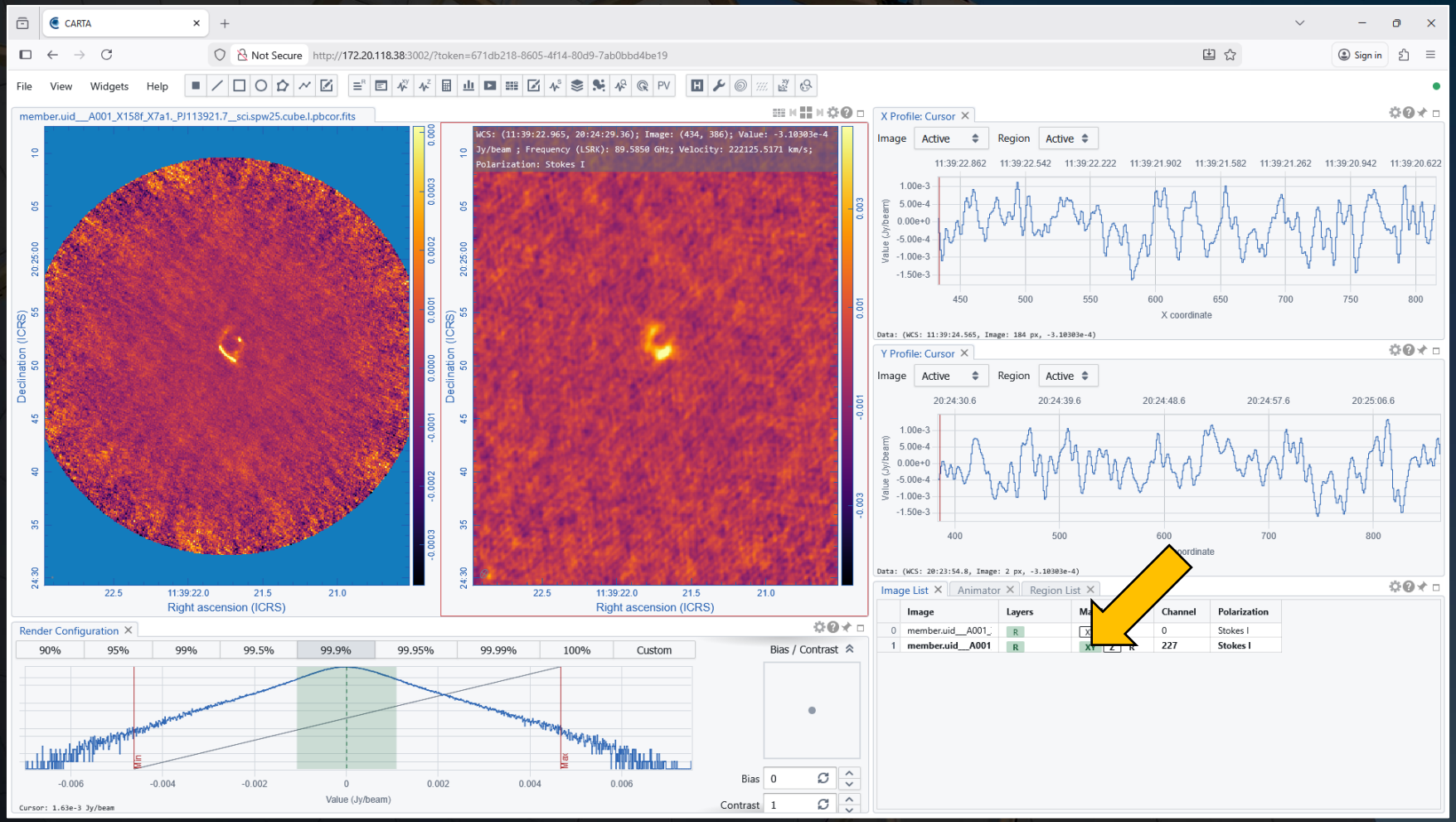
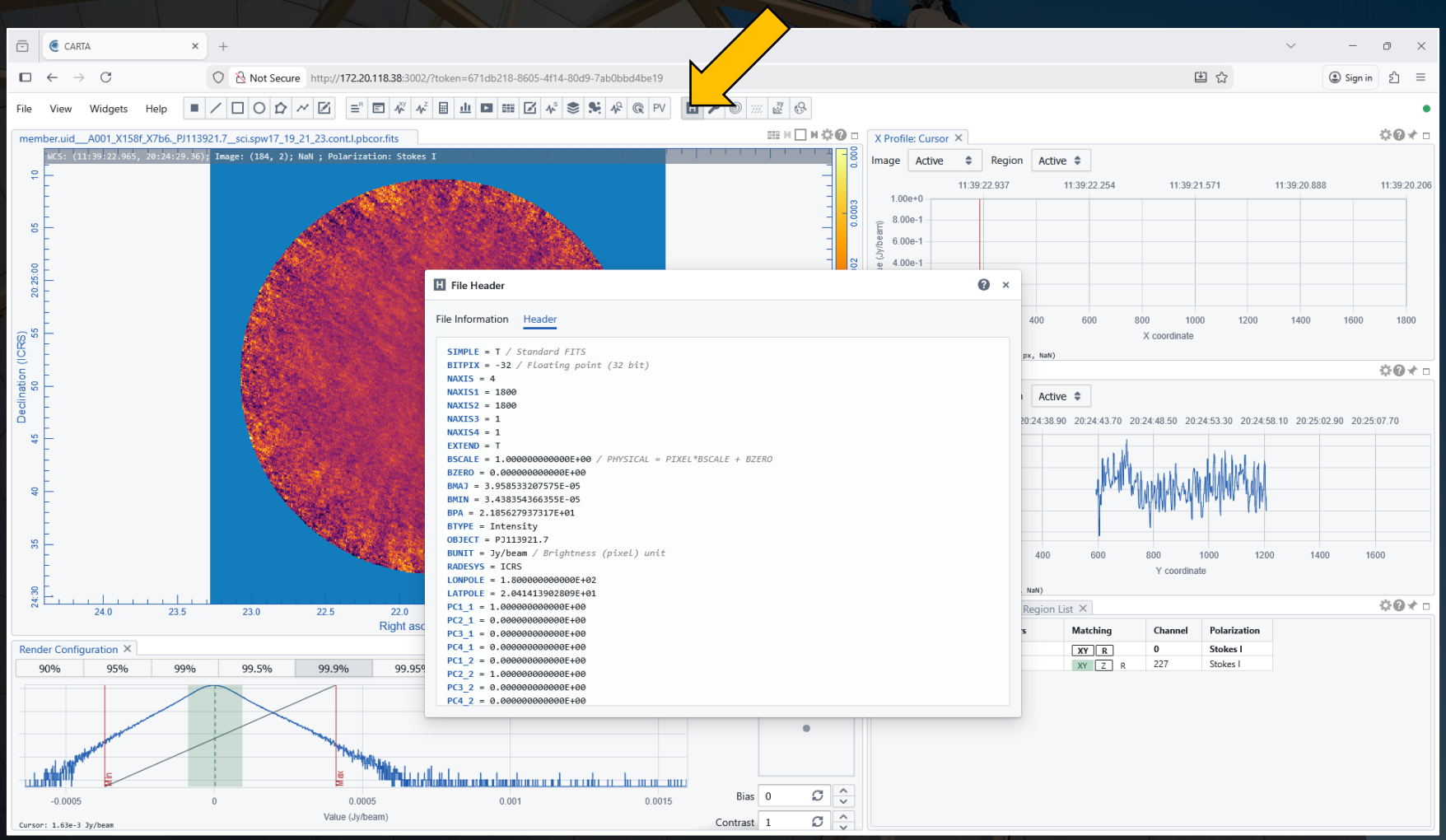
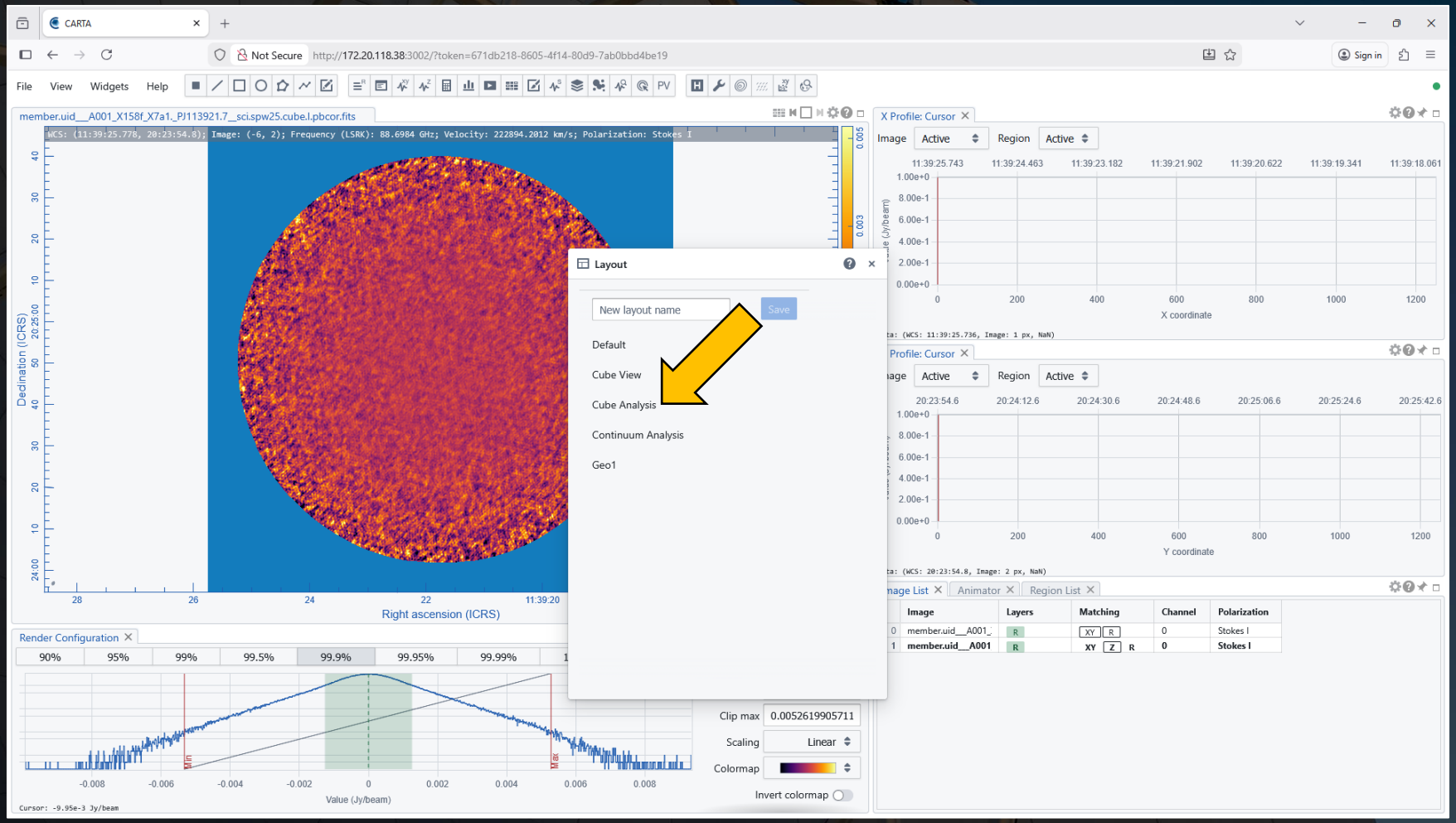


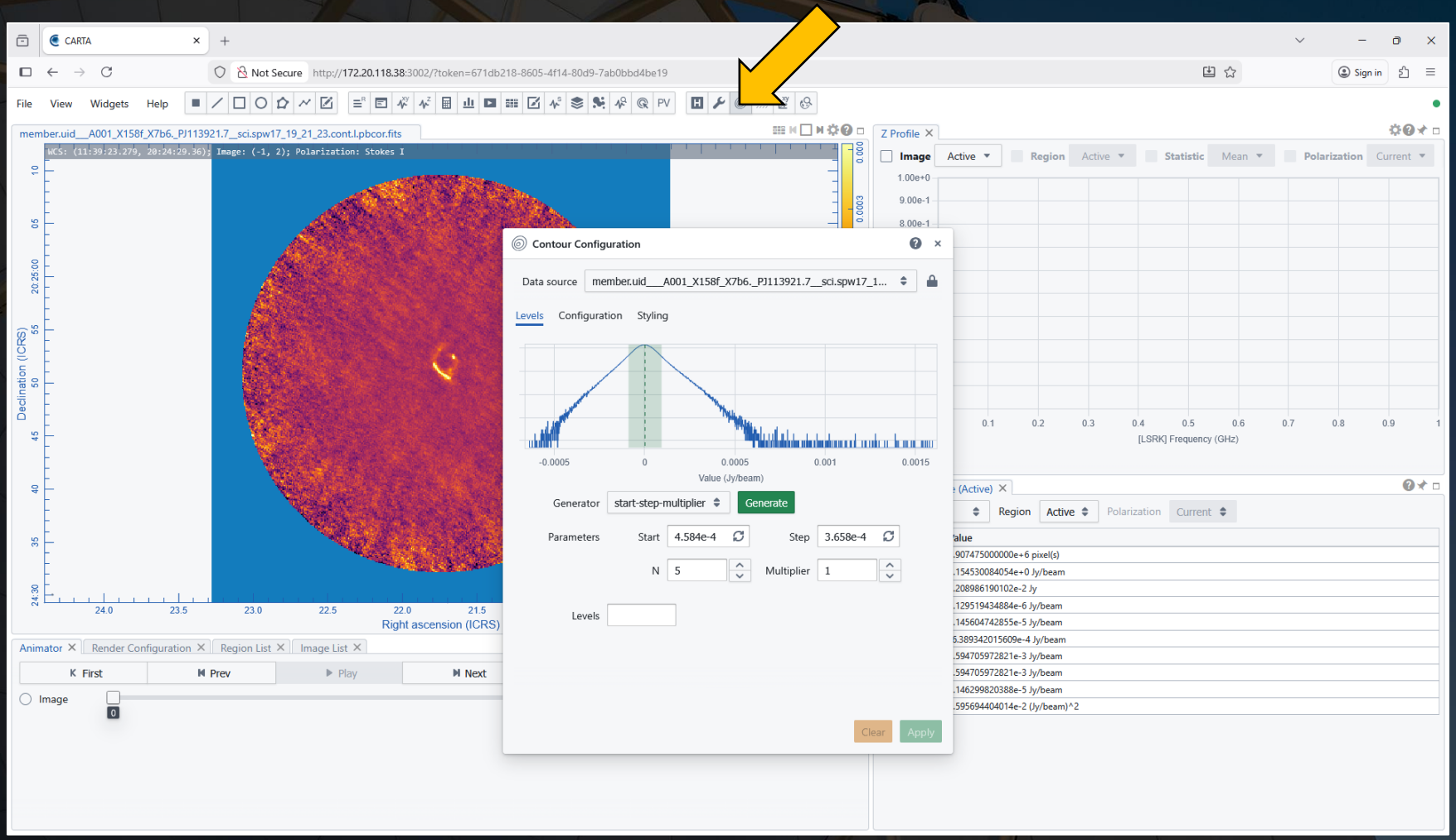
Image headers can be displayed by clicking on the icon with the H in the button bar.



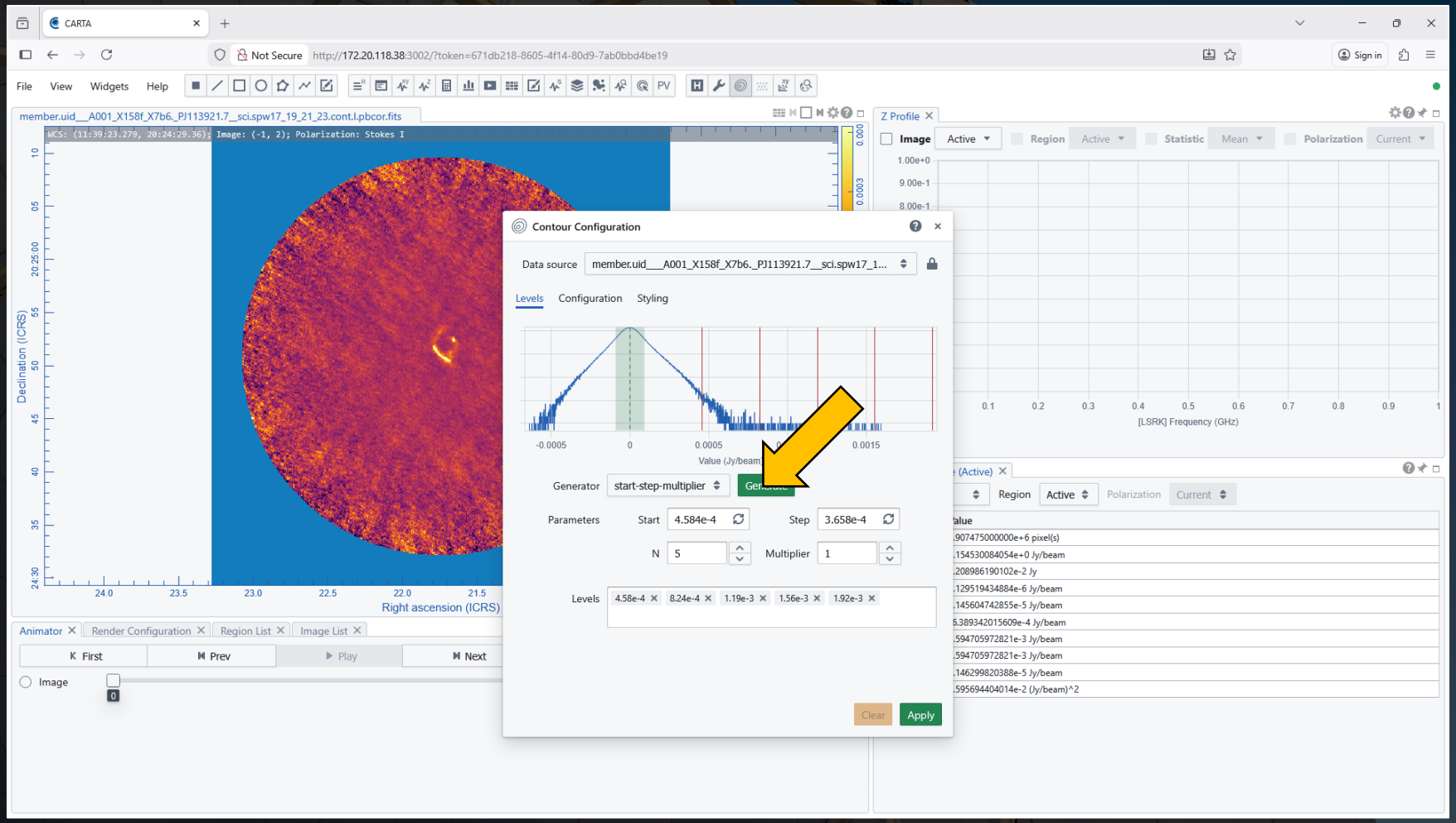
At this point, switch to the Cube Analysis layout (using the Layout option under the View menu) for the rest of this demonstration.



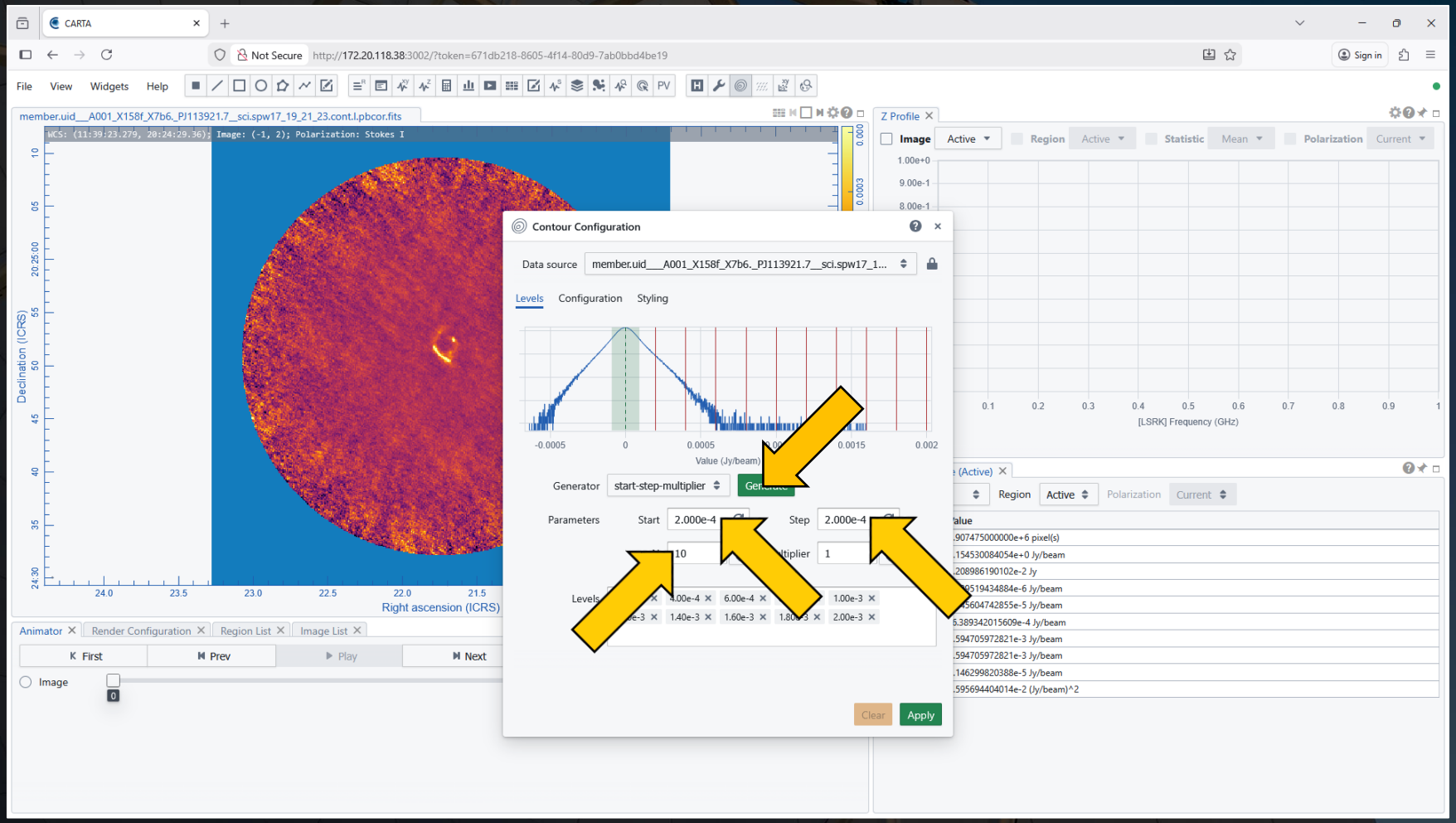
Clicking on the contour icon in the button bar will open a window that can be used to generate contours. The contours can either be created automatically or manually. This is good when overlaying one form of emission over another.



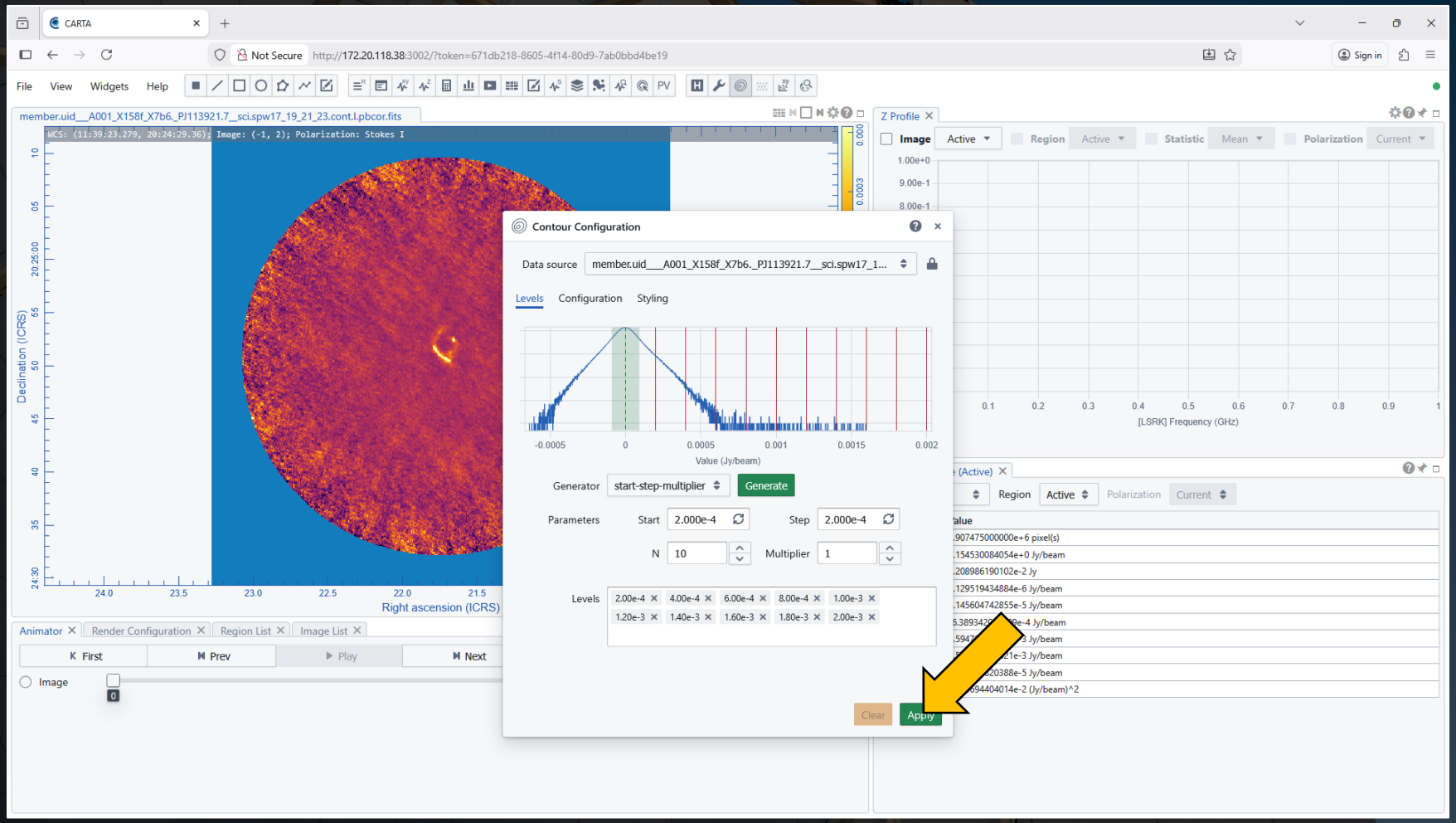
Clicking on the contour icon in the button bar will open a window that can be used to generate contours. The contours can either be created automatically or manually. This is good when overlaying one form of emission over another.



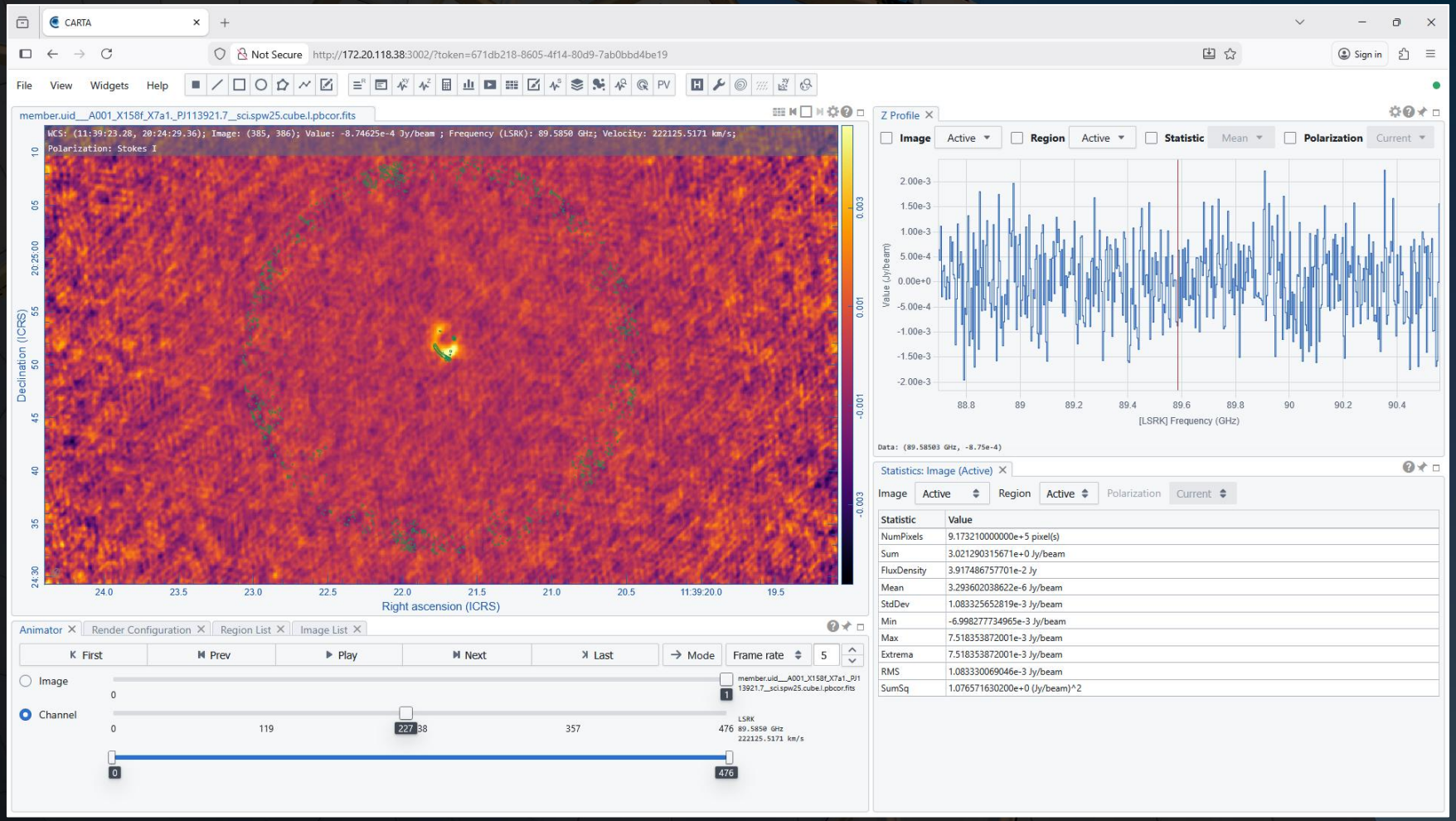
Clicking on the contour icon in the button bar will open a window that can be used to generate contours. The contours can either be created automatically or manually. This is good when overlaying one form of emission over another.



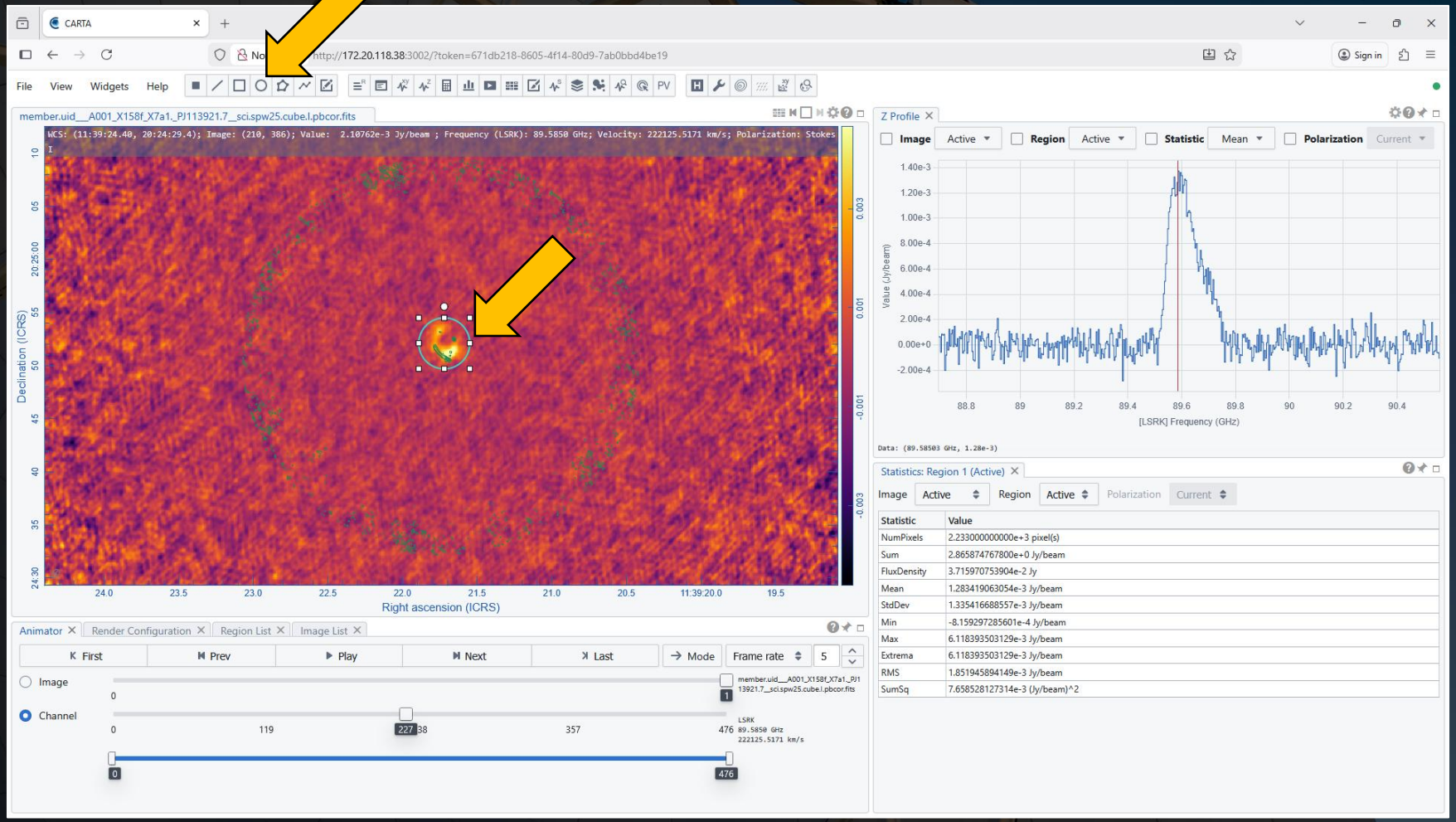
Clicking on the contour icon in the button bar will open a window that can be used to generate contours. The contours can either be created automatically or manually. This is good when overlaying one form of emission over another.



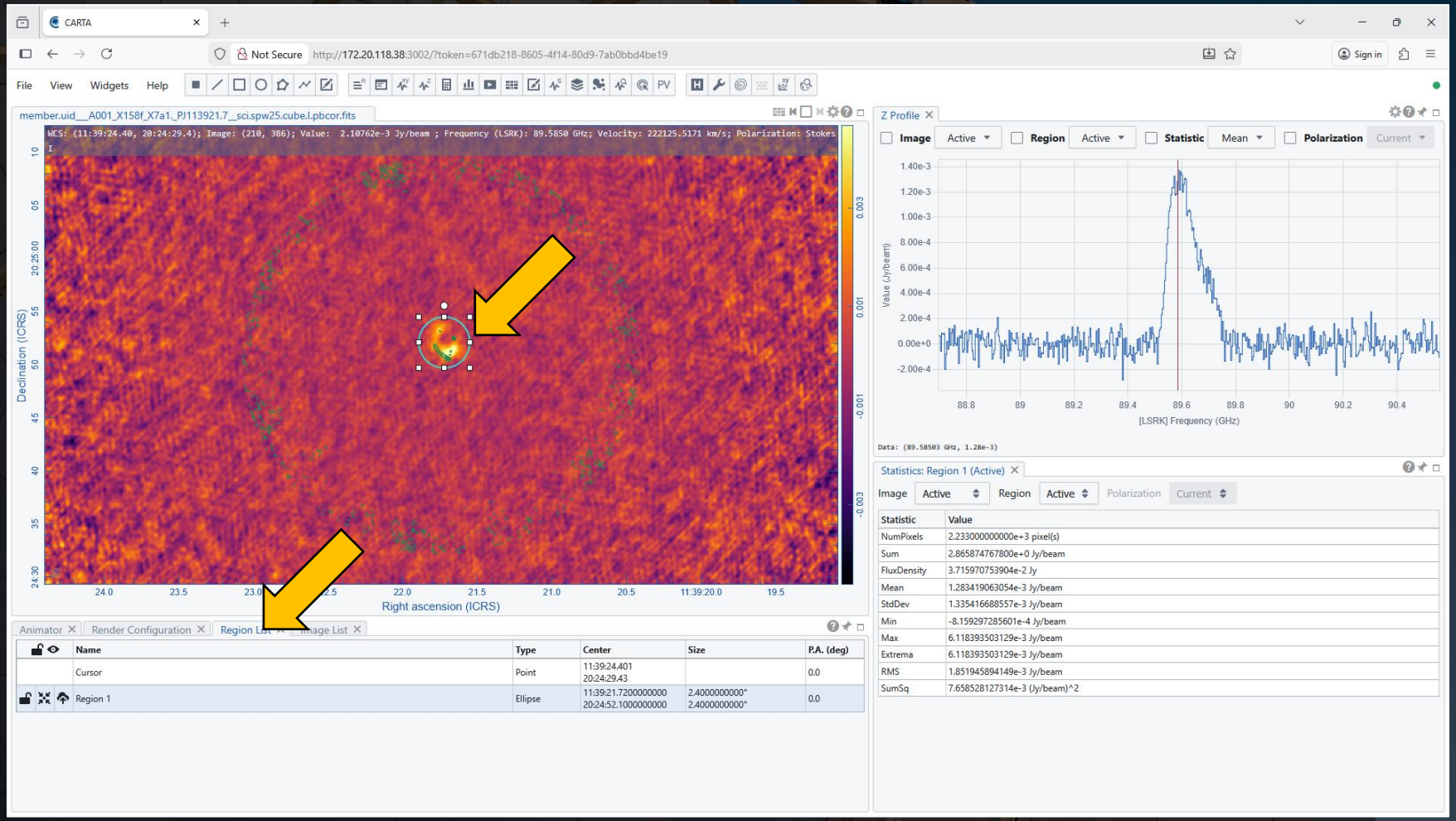
Clicking on the contour icon in the button bar will open a window that can be used to generate contours. The contours can either be created automatically or manually. This is good when overlaying one form of emission over another.



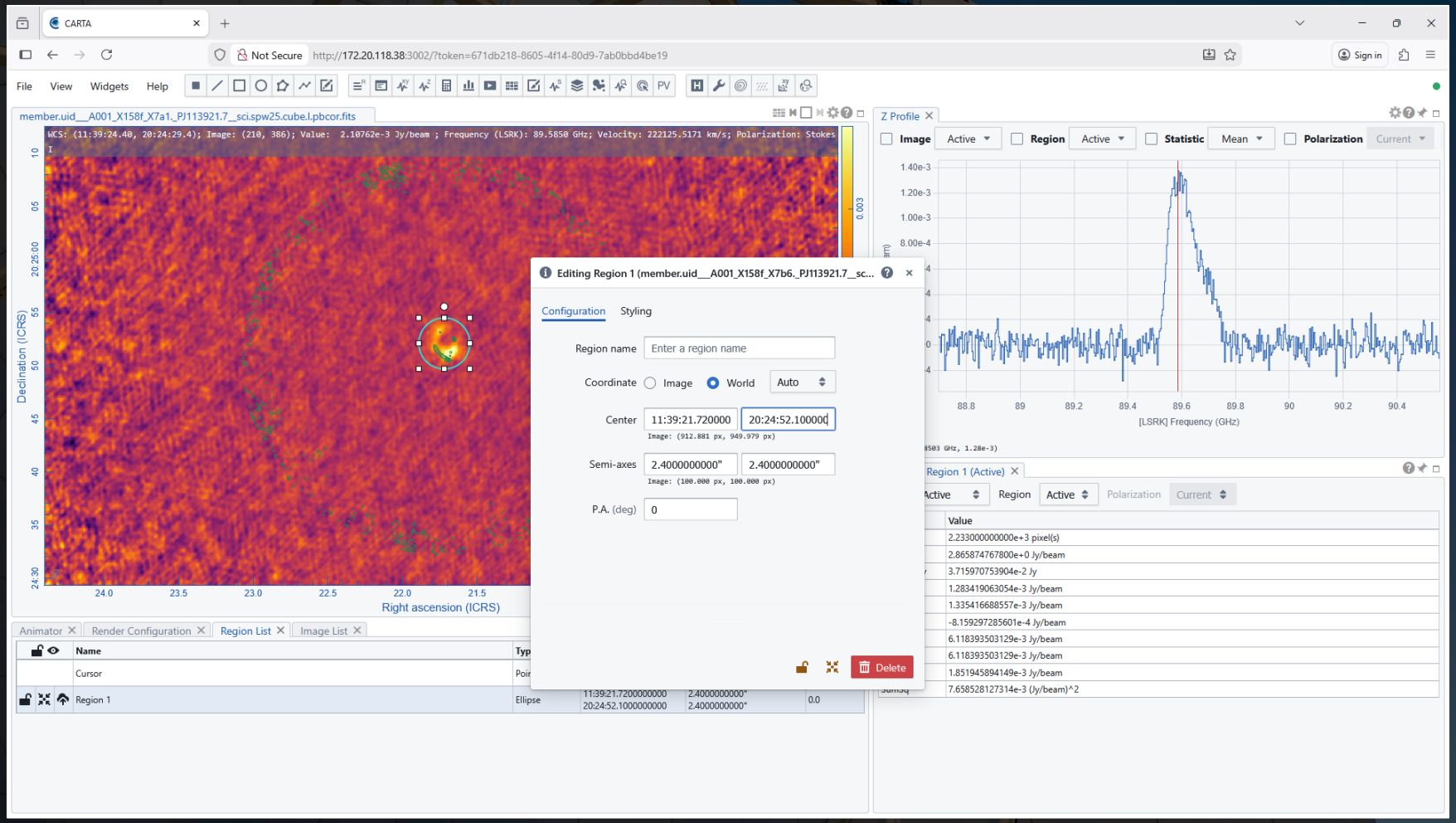
Regions can be drawn on the image by clicking on one of the shapes in the menu bar and then drawing that shape in the image panel. These regions can be used by several other widgets.



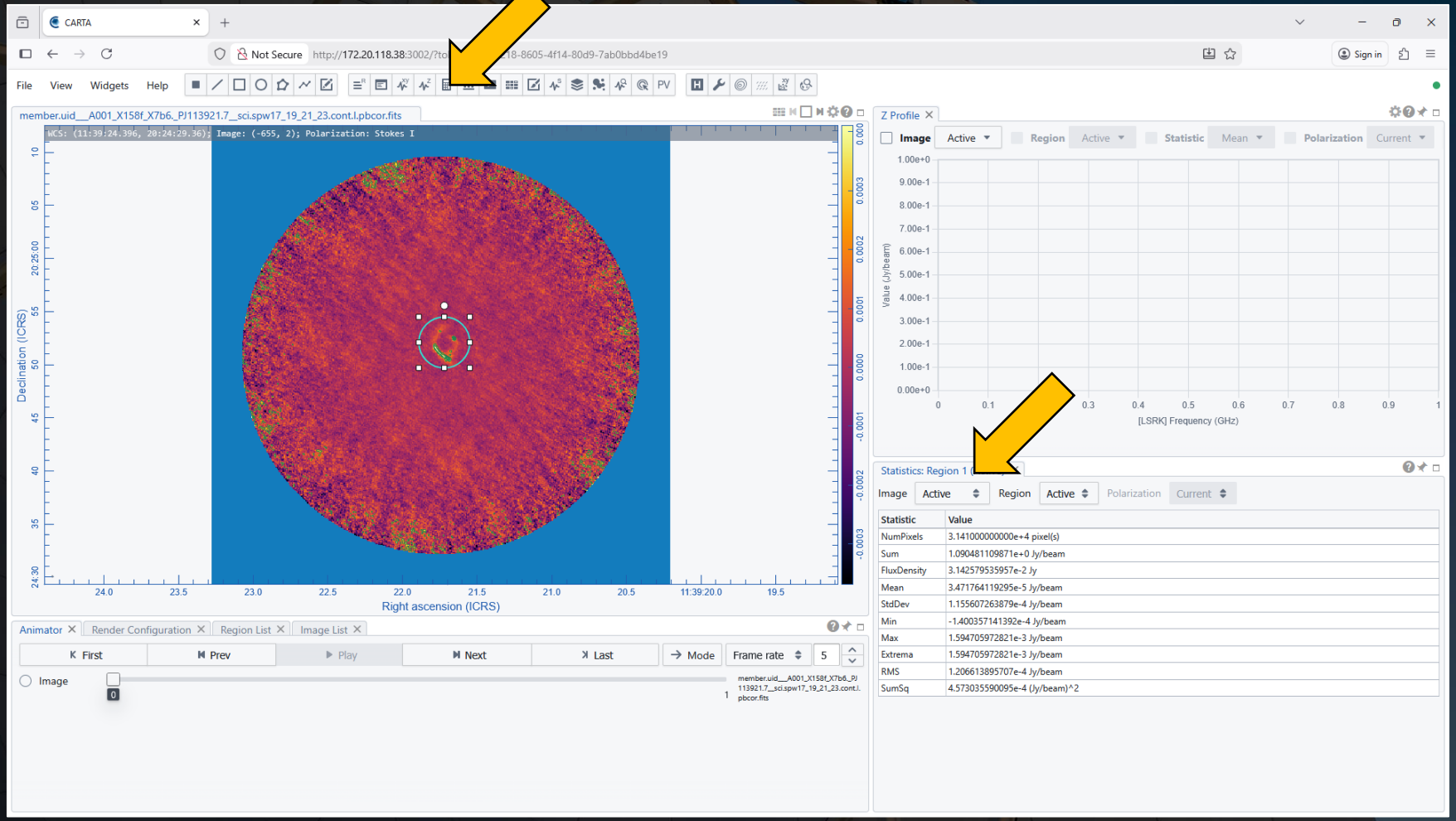
Double clicking on a region in an image or in the Region List widget will display information about that region.



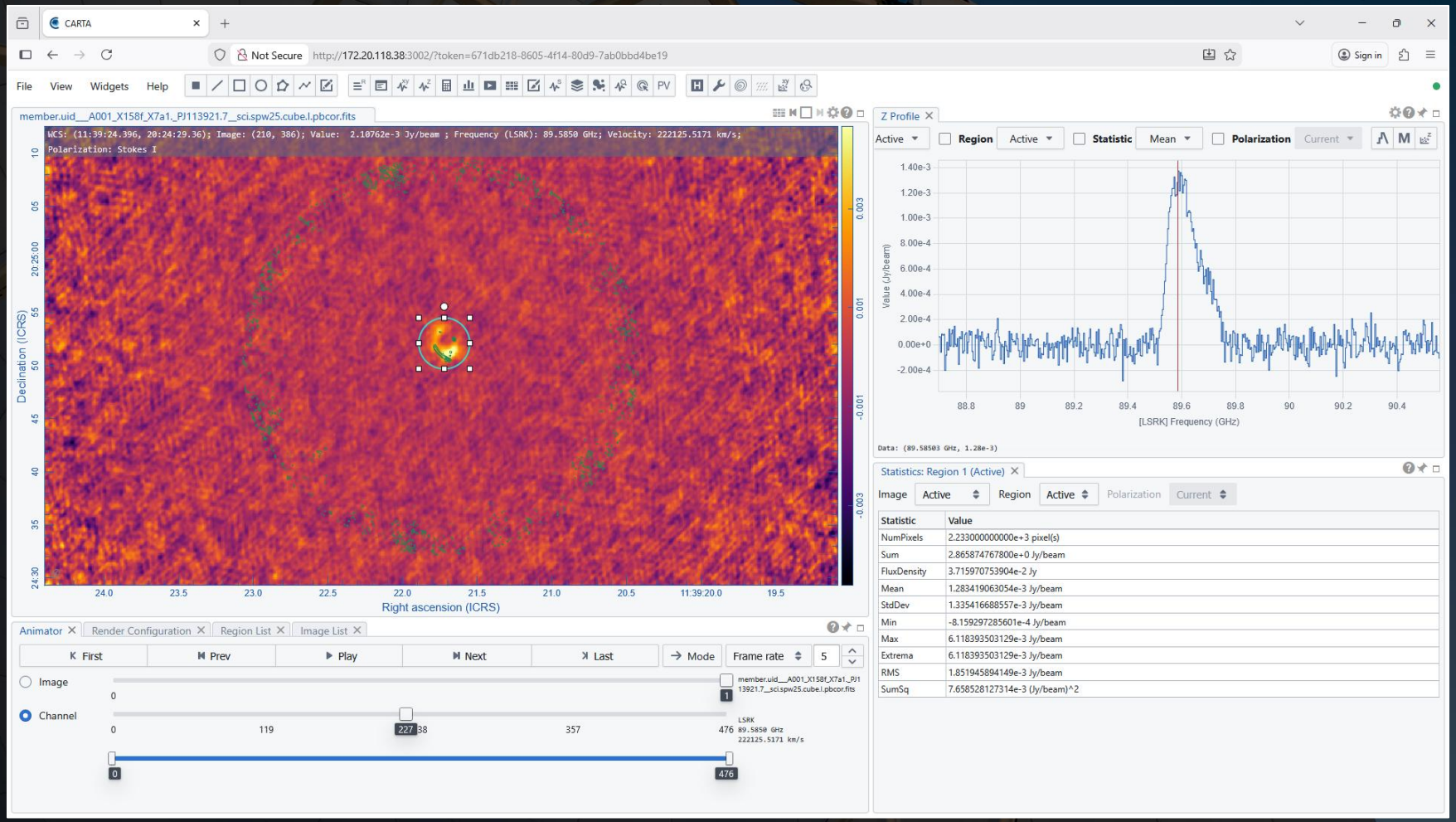
Double clicking on a region in an image or in the Region List widget will display information about that region.



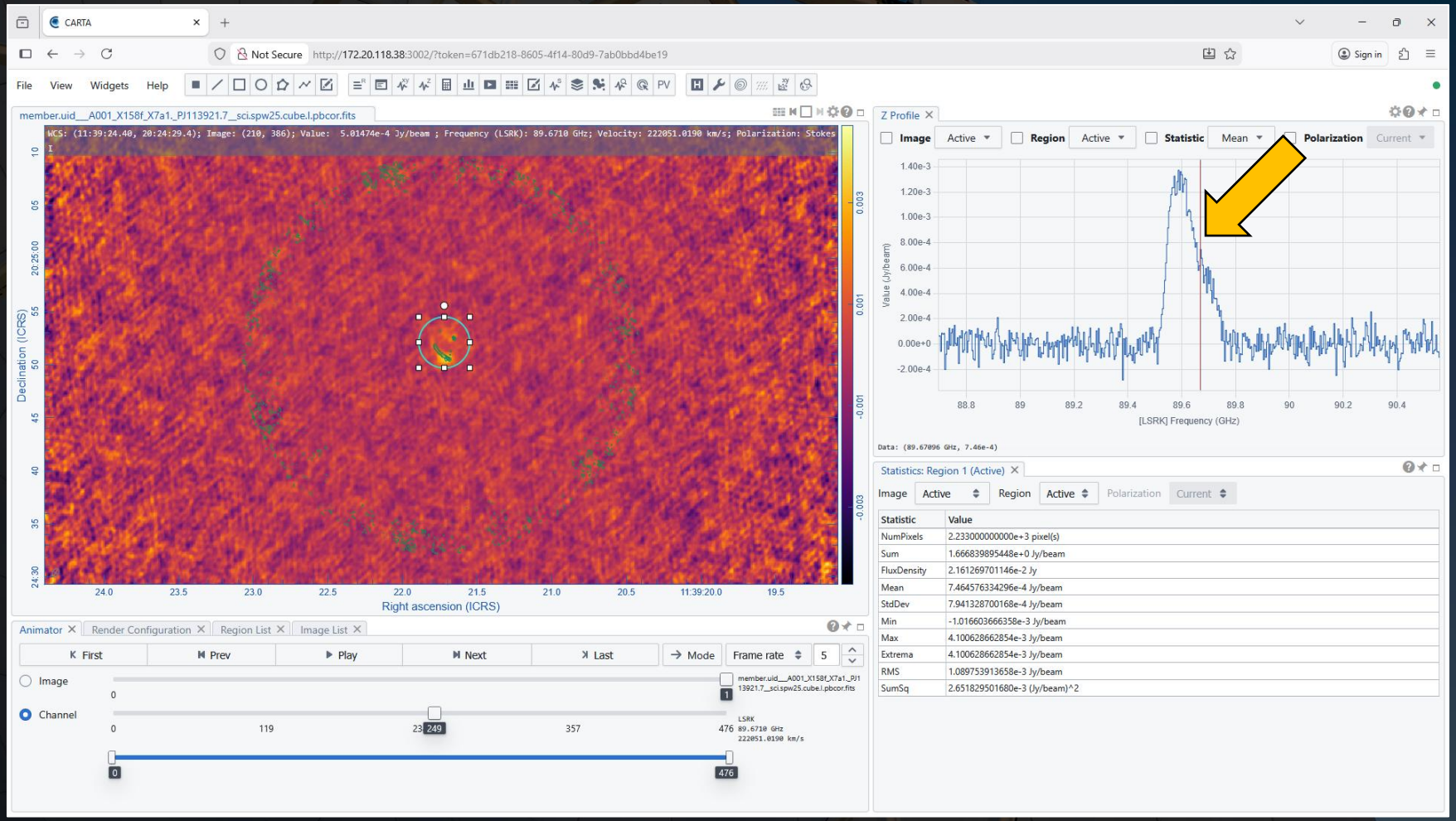
The Statistics widget will display statistical information either for the pixels within an individual region (such as a circle) or for the entire image.



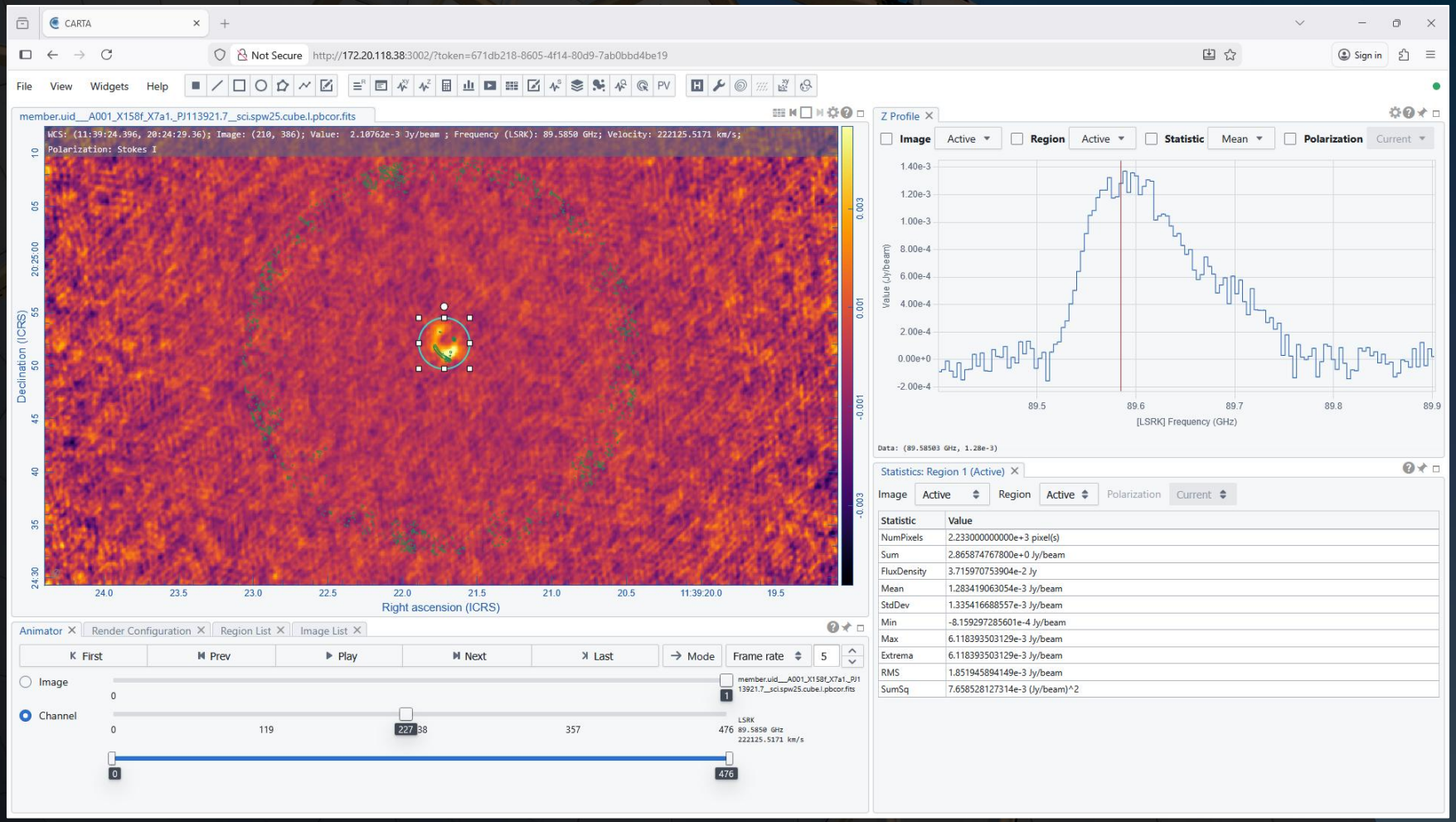
The Z Profile will show the spectrum measured within an image cube at the position of the cursor or within a region. (Because spectra can be slow to load and because the spectrum updates when the cursor is moved across an image, displaying the spectrum within a region works better.)



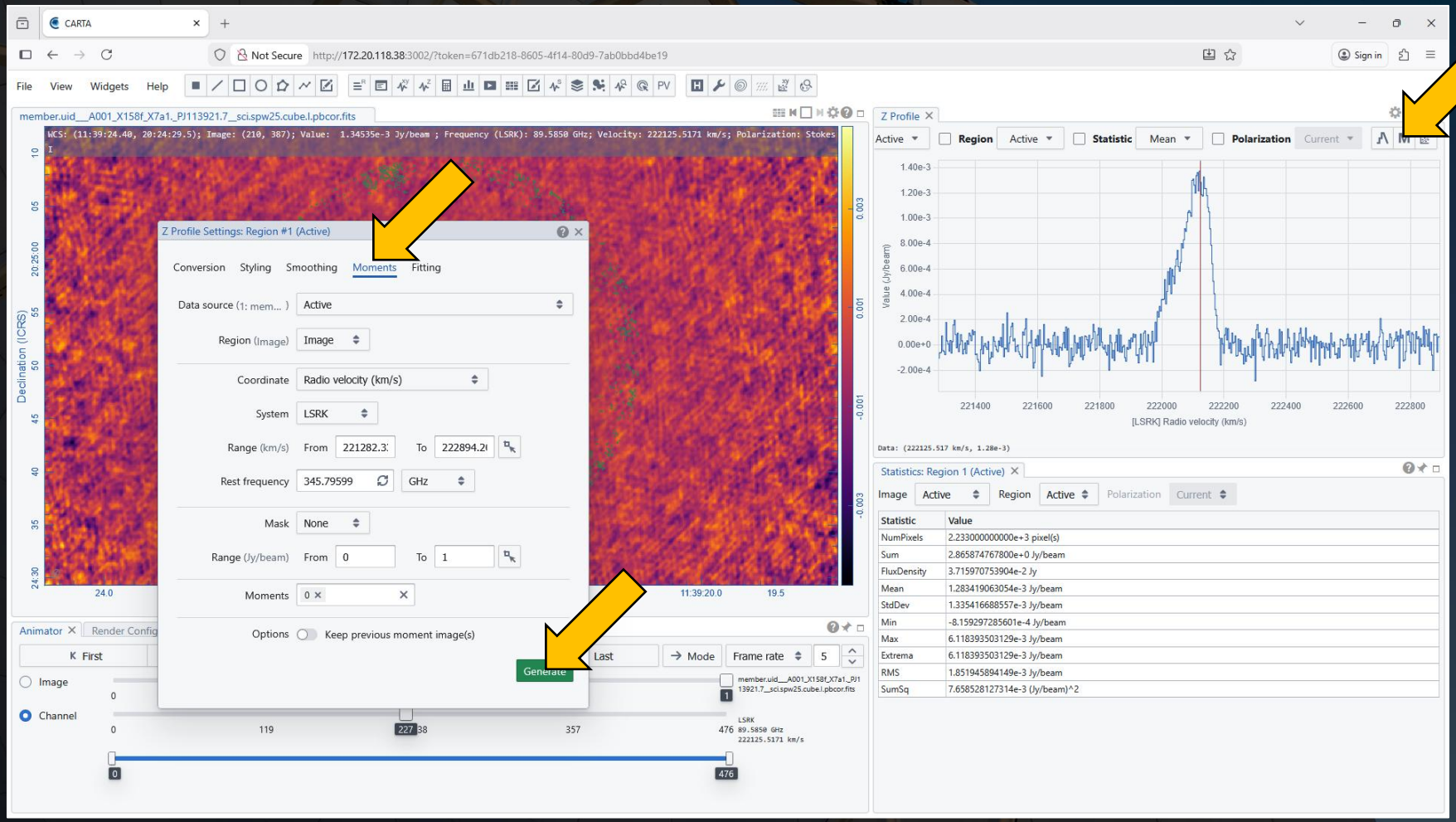
Left clicking on a specific location in the spectrum will display the image cube at that specific frequency.



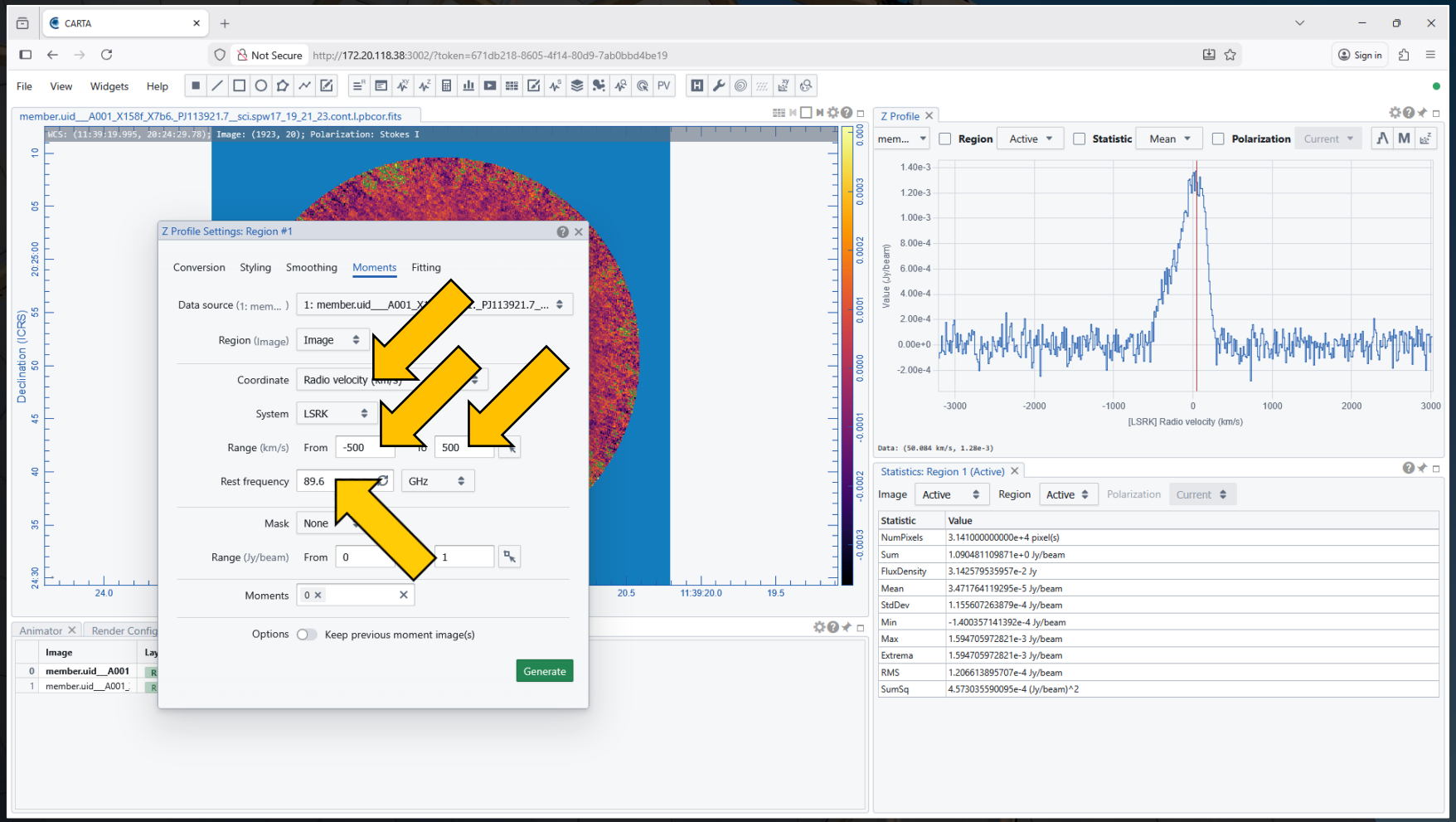
Holding down the left mouse button and dragging within the plot of the spectrum will zoom in on that location. (Double-clicking will zoom out again.)



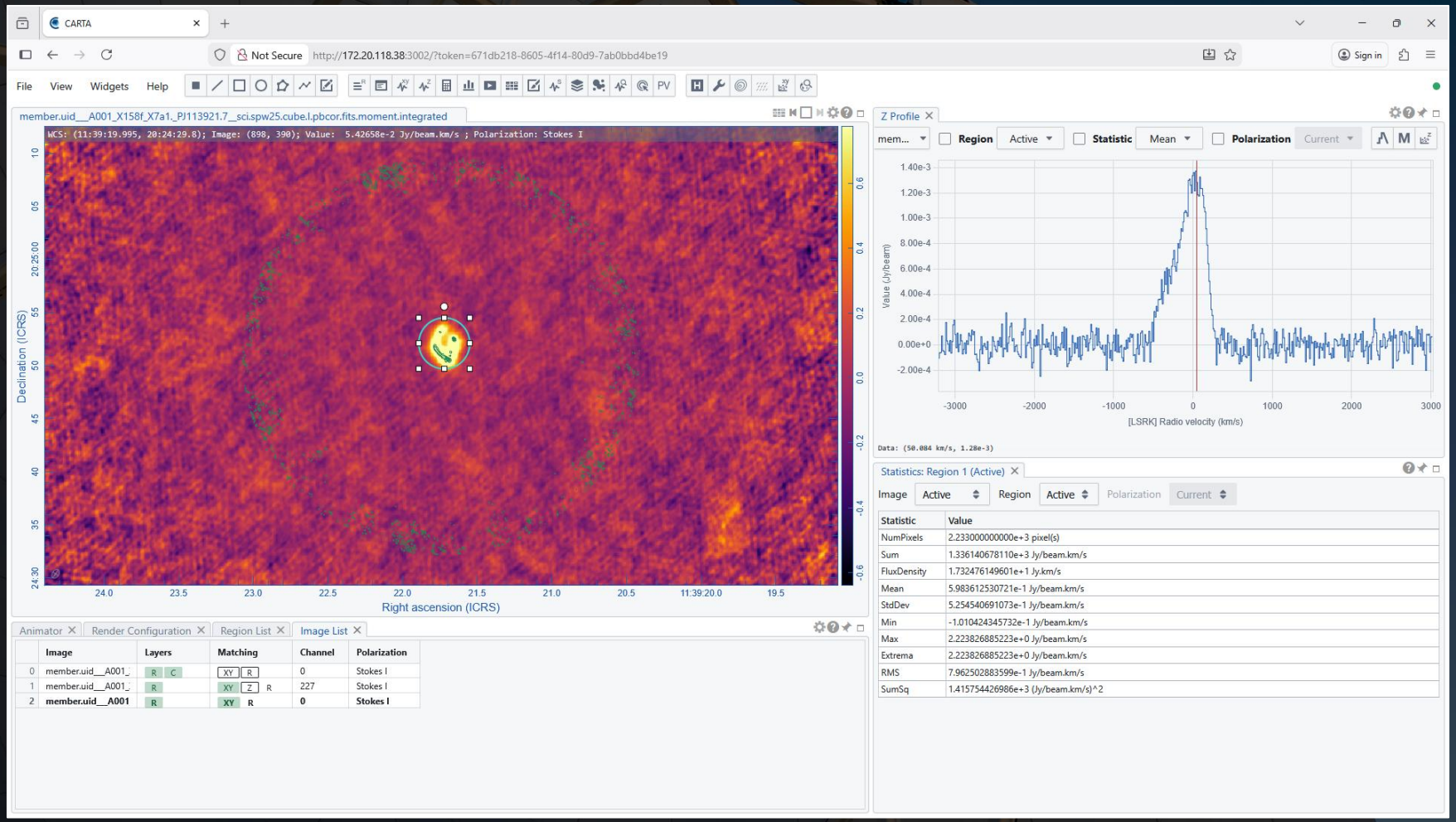
The moment option in the Z Profile window (accessible through settings if the button is not visible) provides an option for creating moment images.



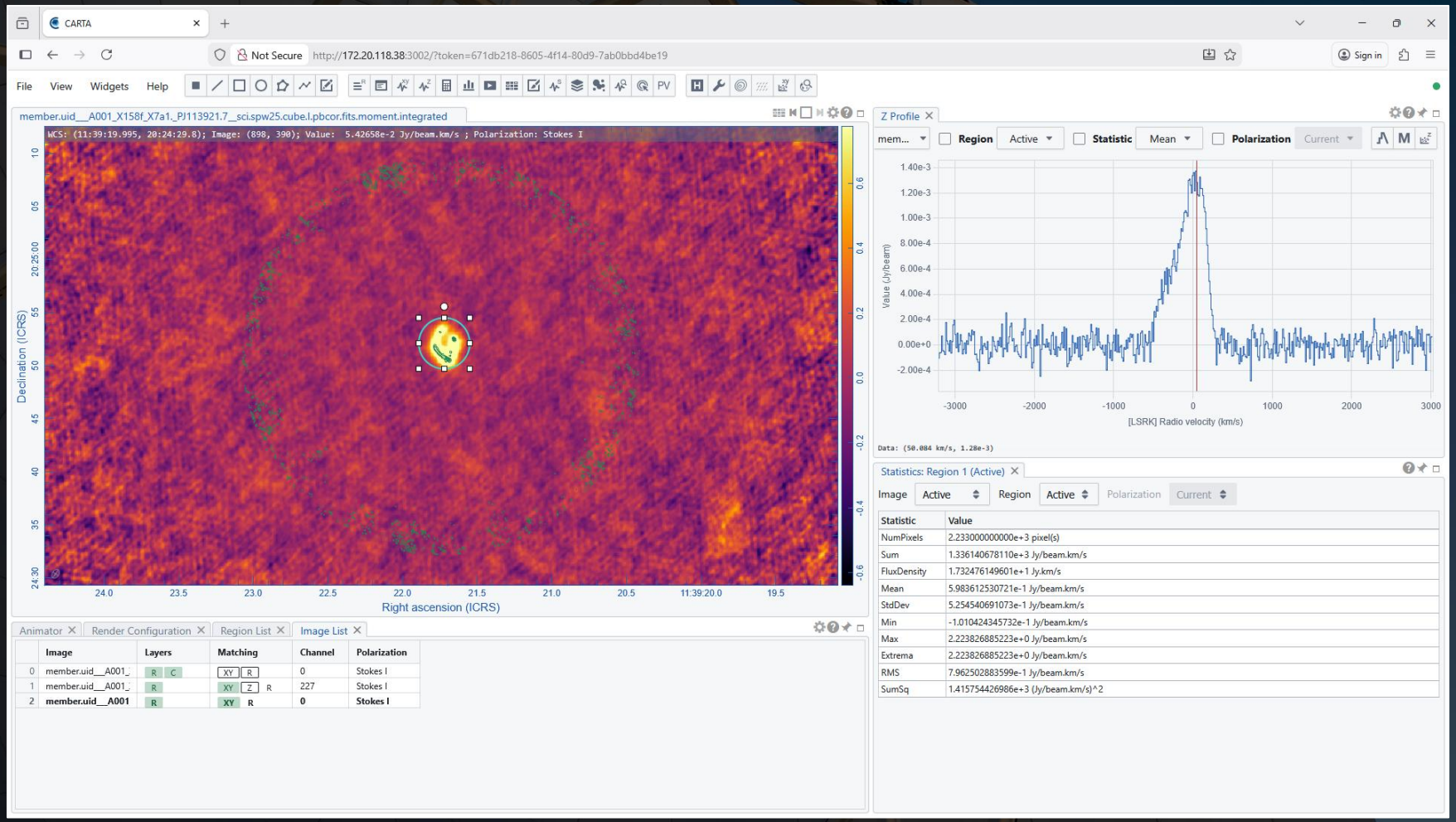
Before creating a moment map, it would be good to set the coordinate in terms of radio velocity and to set the range over which the line emission is visible. For highly redshifted objects, it is also useful to set the rest frequency to the observed centre of the line.



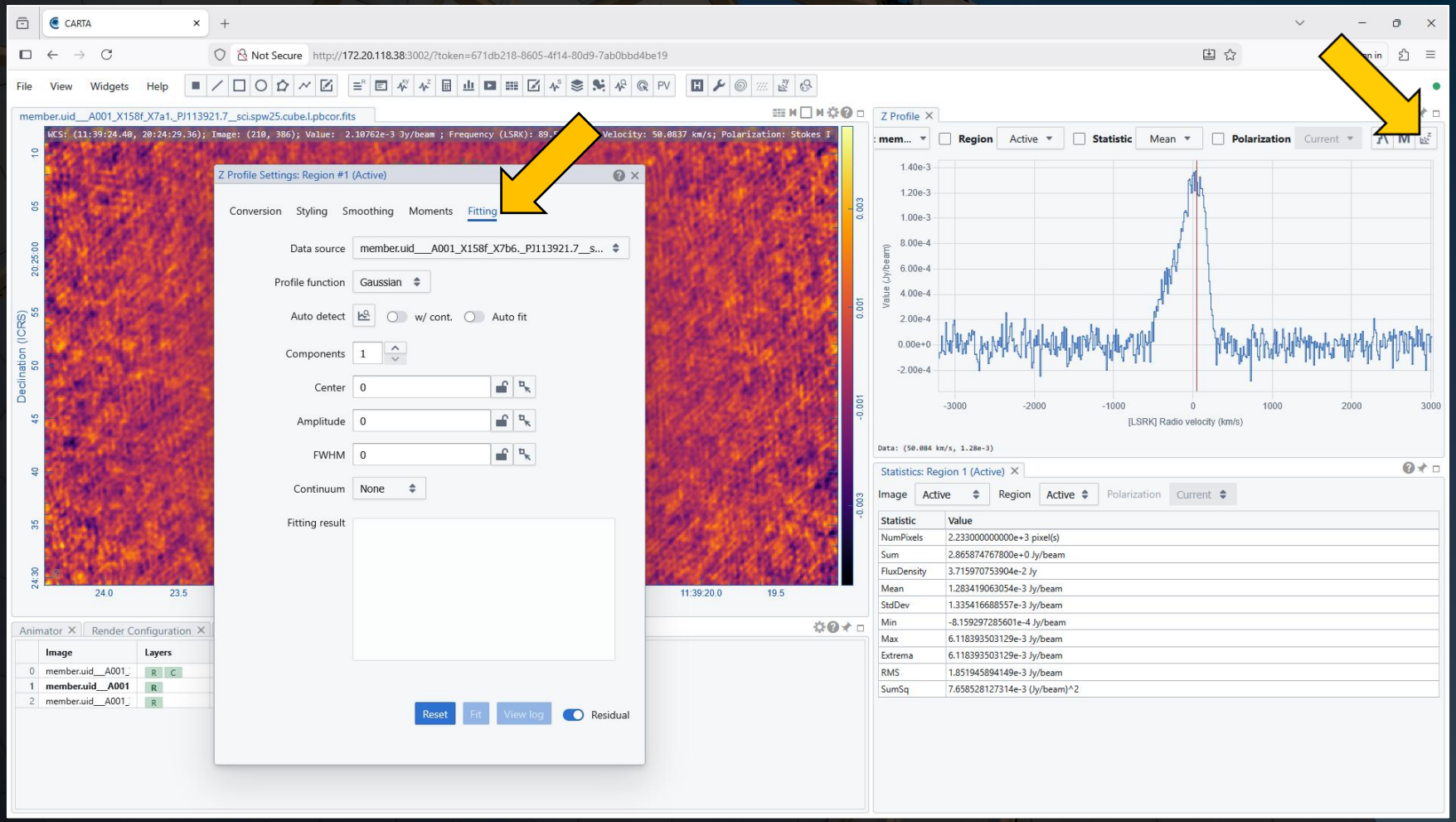
Moment images will appear as separate images in the Image List, and it is possible to switch to and from these moment images using the Animator.



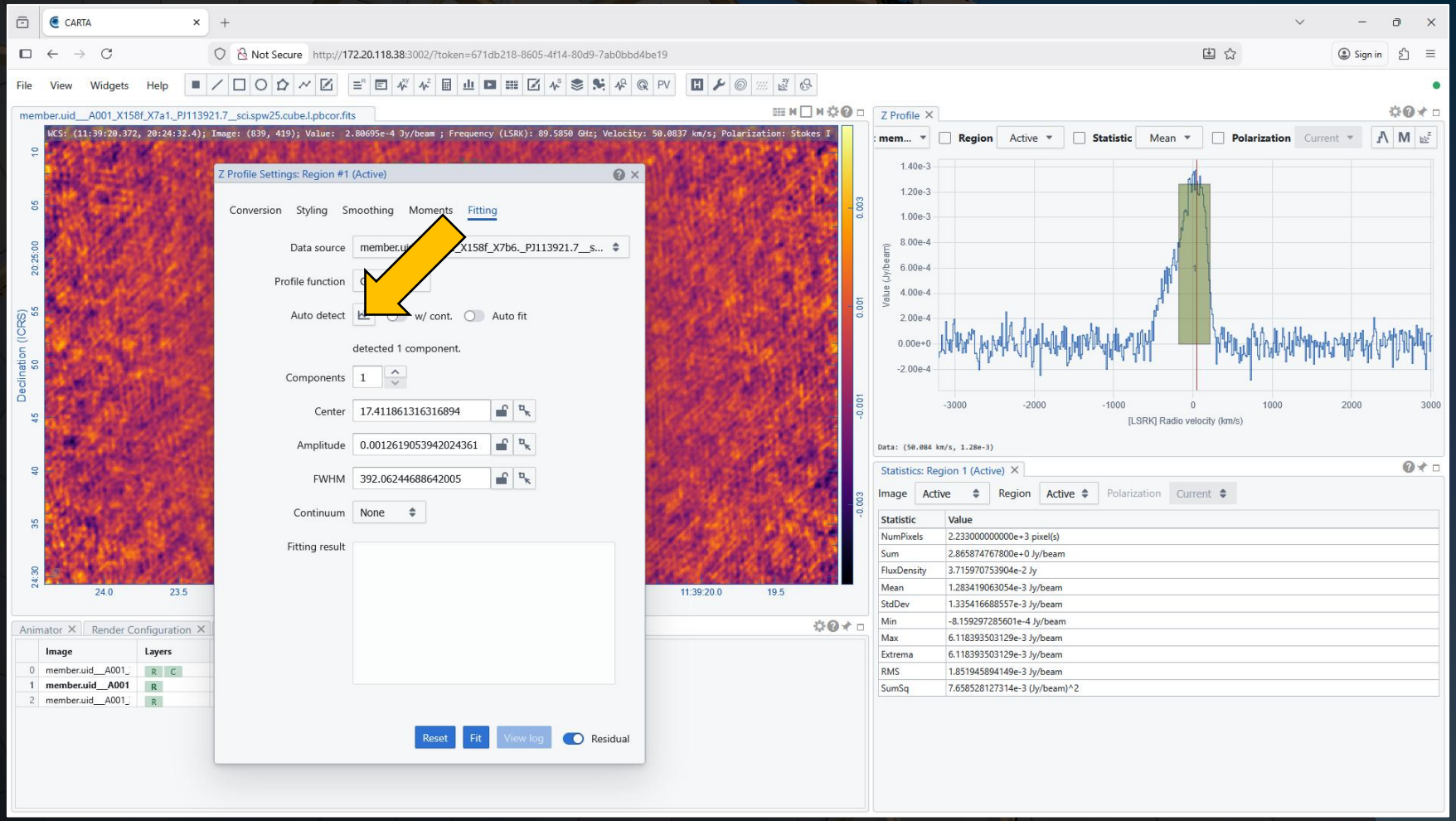
The moment 0 map specifically can be used to measure the integrated line flux within an image (using the results reported in the Statistics widget).



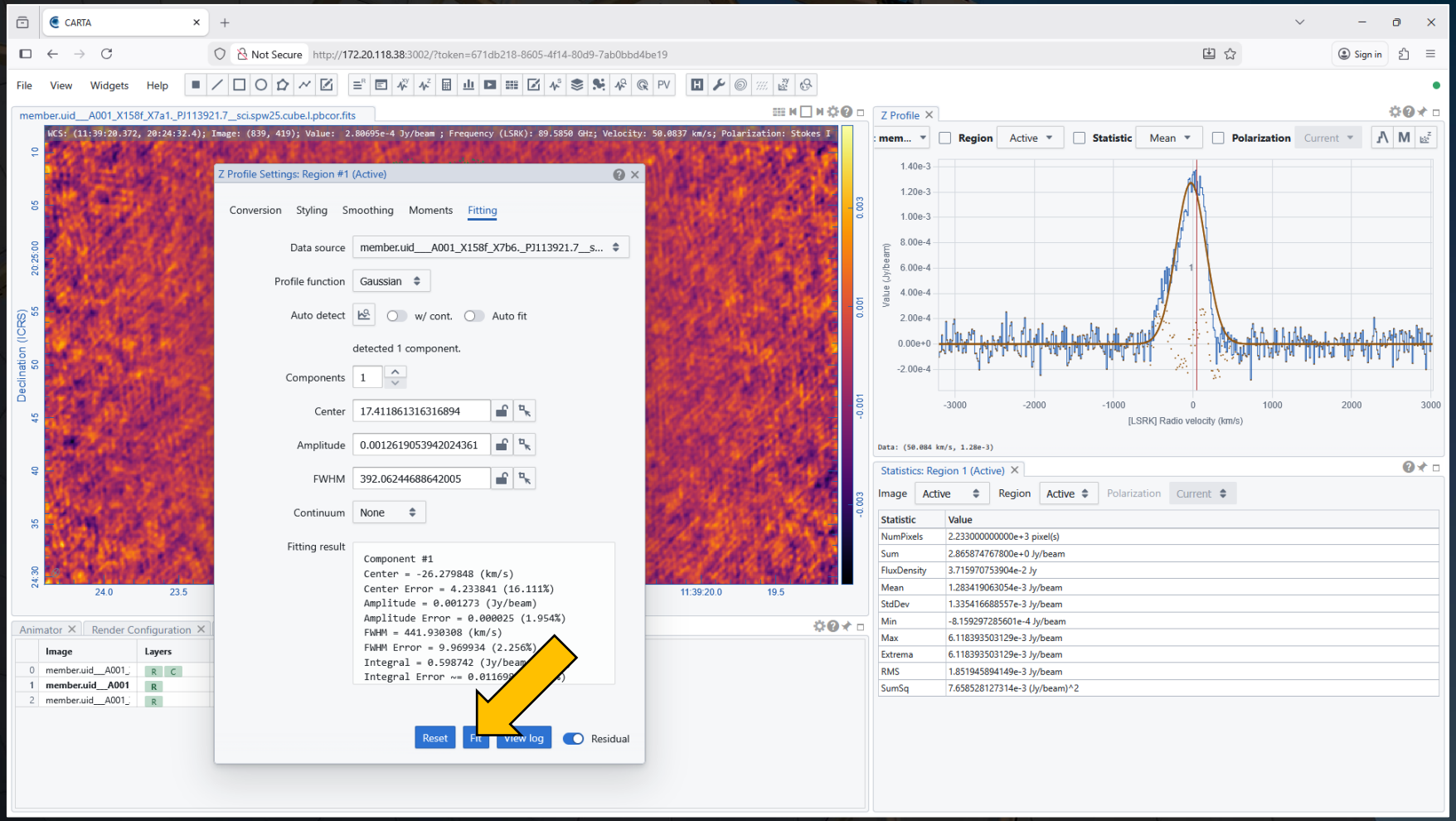
The fitting option in the Z Profile window (accessible through settings if the button is not visible) can be used to fit a spectral line, although a priori values need to be set first (or estimated using the auto detect button).

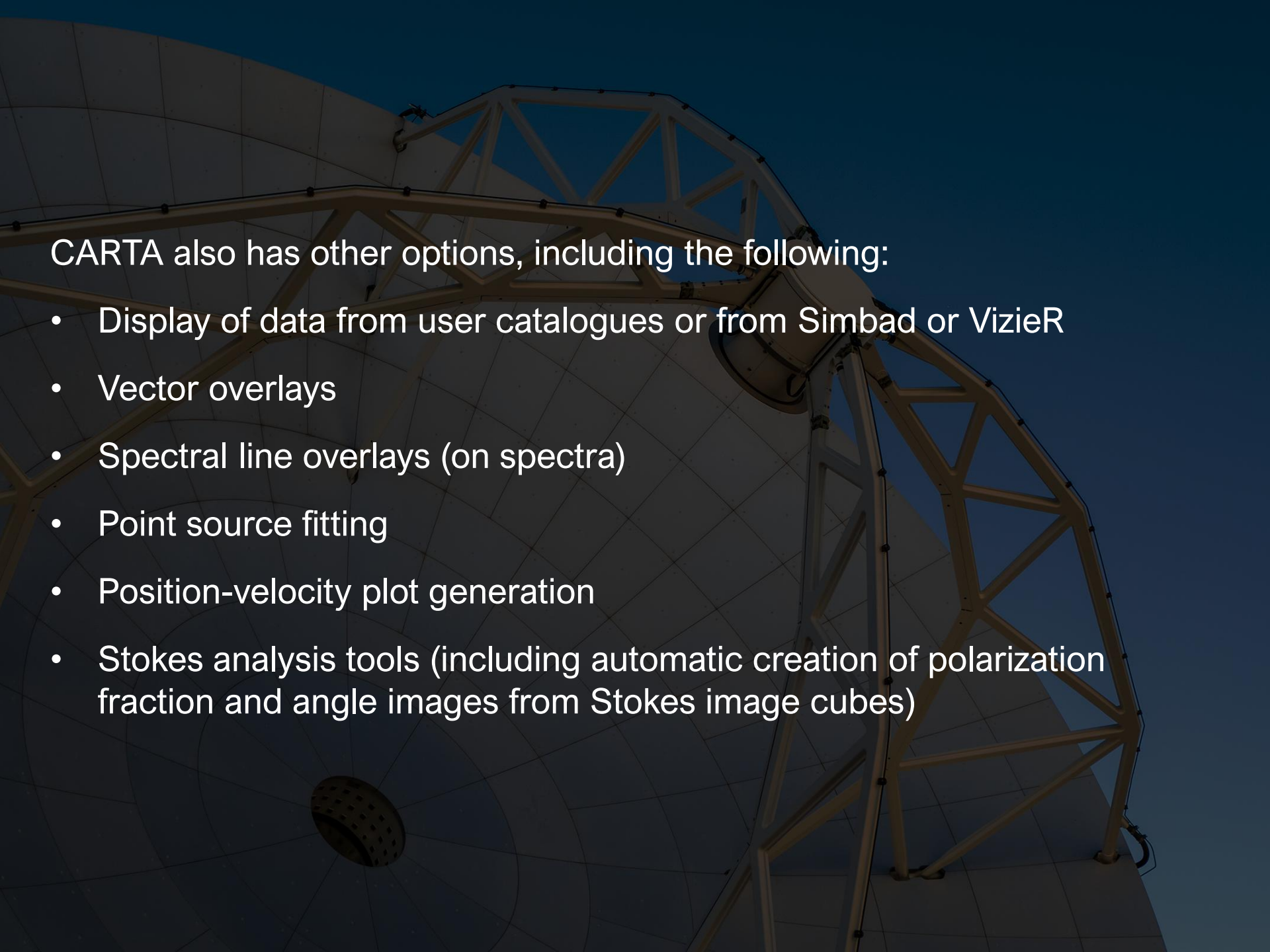


The fitting option in the Z Profile window (accessible through settings if the button is not visible) can be used to fit a spectral line, although a priori values need to be set first (or estimated using the auto detect button).



The fitting option in the Z Profile window (accessible through settings if the button is not visible) can be used to fit a spectral line, although a priori values need to be set first (or estimated using the auto detect button).





CARTA also has other options, including the following:

- Display of data from user catalogues or from Simbad or VizieR
- Vector overlays
- Spectral line overlays (on spectra)
- Point source fitting
- Position-velocity plot generation
- Stokes analysis tools (including automatic creation of polarization fraction and angle images from Stokes image cubes)