Human Computer Interaction in the ALMA Control Room

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Abstract

The poster describes the ALMA Operations Monitoring and Control (OMC) software and its next generation user interfaces, used by operators and astronomers to monitor and control the observing facility. These user interfaces bring state-of-the-art Human Computer Interaction (HCI) techniques to the ALMA Control Room: map visualisation, semantic zooming, navigation gestures, multiple coordinated views, and decrease of time-to-point. They enable users to stay in control of dozens of antennas, hundreds of devices, and thousands of baselines.

The Atacama Large Millimeter/submillimeter Array (ALMA), an international radio-astronomy facility, is a partnership of North America, Europe and East Asia in cooperation with the Republic of Chile. It is located at the Altiplano de Chajnantor and is being operated from the Operations Support Facilities (OSF) near San Pedro de Atacama.

Human Computer Interaction

For operating a complex system users need to construct in their mind a mental map of the system. Presenting data in a way humans can perceive quickly, reduces the effort needed to fit new information into the mental map, and decreases reaction time when user action is needed. The visualisation and navigation techniques used in the OMC help users in doing so. They are implemented in Java using ZVTM (zvtm.sourceforge.net), a toolkit for creating Zoomable User Interfaces on top of Java2D.

Presentation usually starts with a global view, analogous to a world-map that gives the overall status. Different such global views serve as starting points for drilling down into different perspectives of the system. For more details, users perform semantic zooming using the mouse-wheel or click-to-zoom gestures. On zoomed levels, the interface presents additional and different information (as opposed to plain geometrical zooming). A Zoomable User Interface will never disrupt the users' feeling of where they are. Zooming also reduces the time-to-point when selecting an item or triggering an action.

Advanced data visualisation strives to reduce the cognitive load on users. Using a red-yellow-green colour scheme for a status value is a simple example. For more complex information, identifying the necessary data and finding appropriate visualisation requires iterative discussions with users. For this purpose, ALMA has started a dedicated HCI Initiative, which holds participatory design workshops with end-users (operators, astronomers, engineers).

Devices

A view of the system from a device perspective. It shows a synthesised landscape of hardware devices, where Power Distribution Units, Antenna Bus Masters, and Correlator Nodes reside in their own quadrant. Each quadrant itself is a hierarchical structure. On a high level, indicates device status by colour. Zooming provides detailed device state and location.
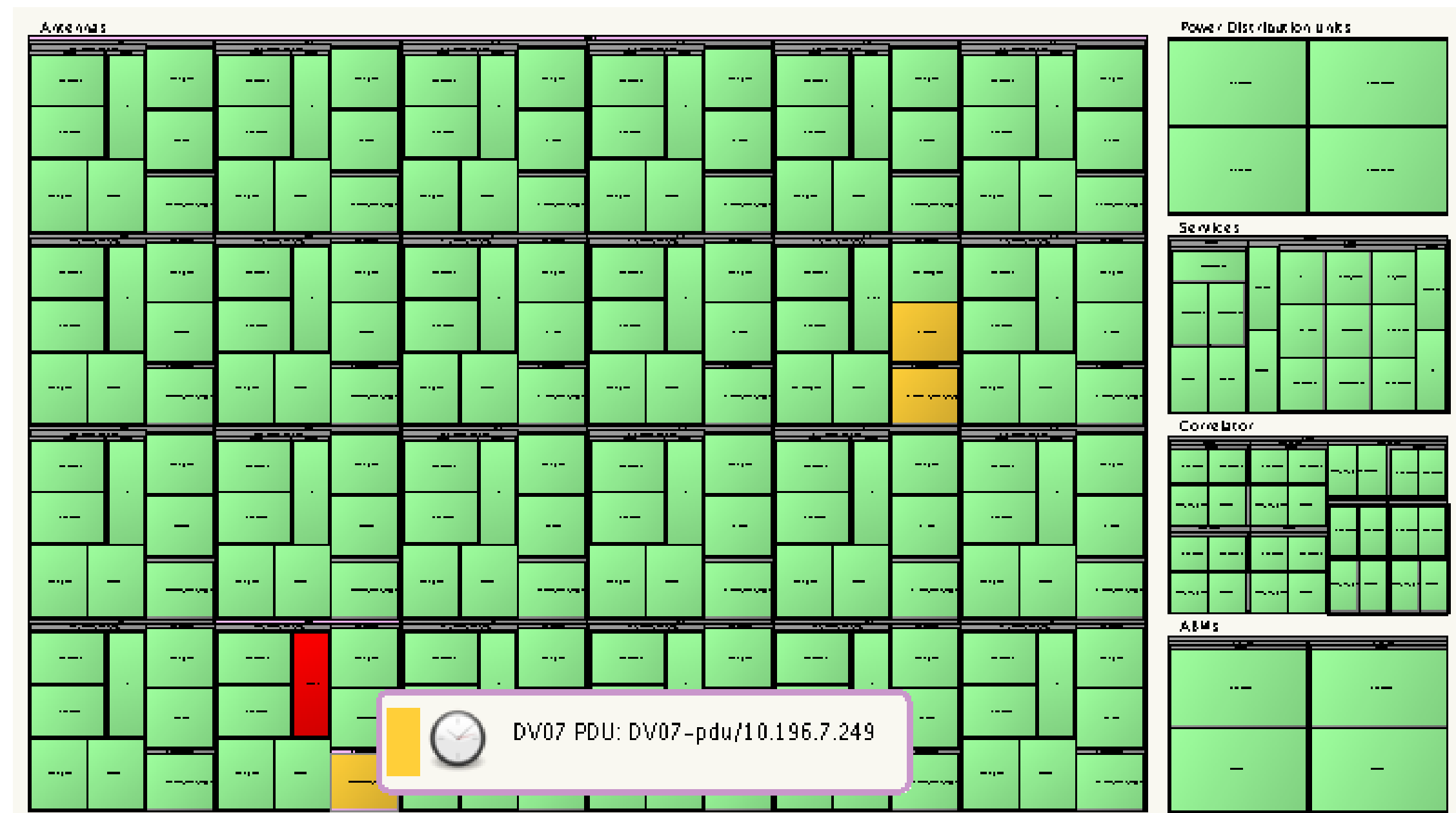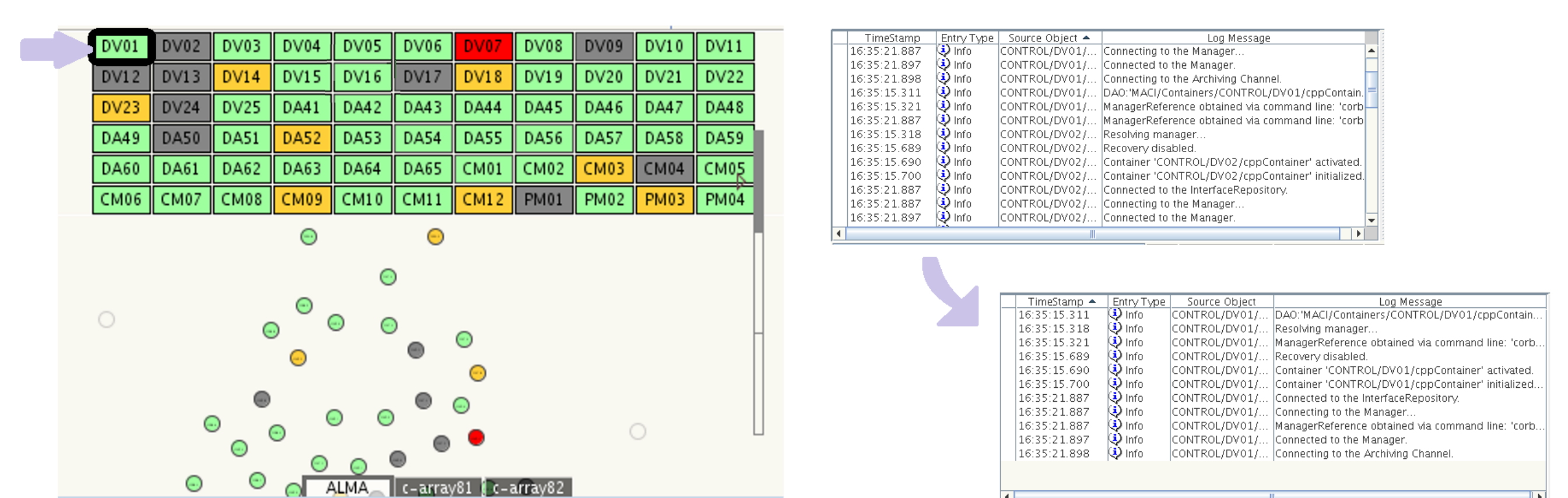

Antennas

A view of the system from an antenna perspective. Allows for fast navigation to antenna status panels. On a high level, gives a quick overview of antenna status through both a compact grid (upper part) and a geographical visualisation (lower part). Zooming provides fast navigation to more antenna status attributes, and block diagrams of the antennas' internal devices.
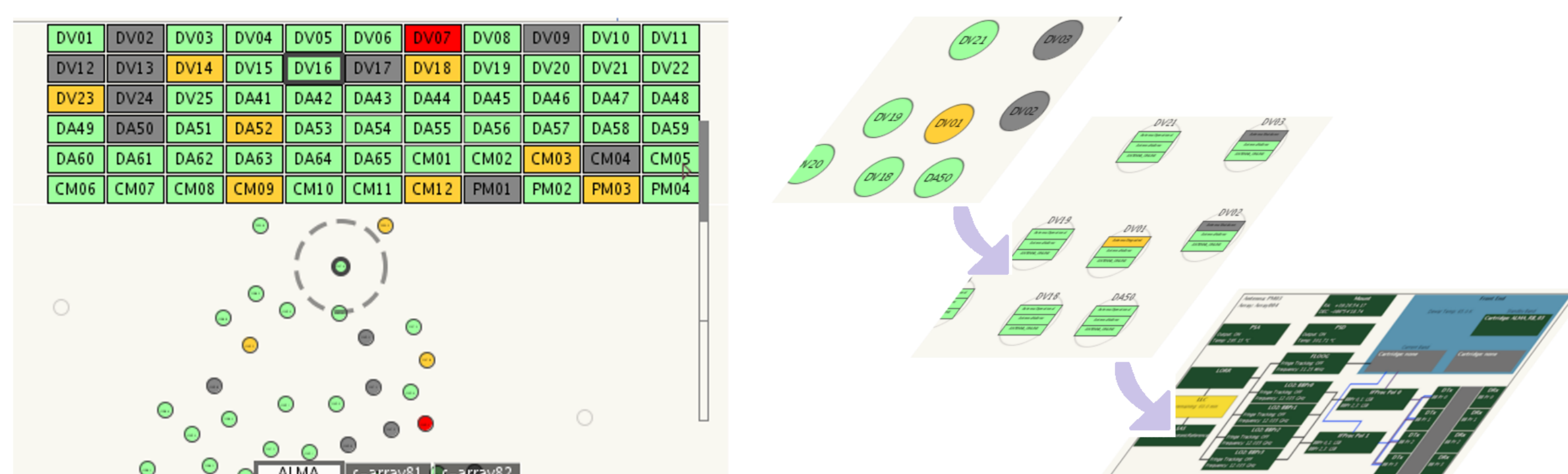

Coordinated Views

Panels can be coordinated with each other, such that actions in one panel will be reflected in all coordinated panels.

In this example, the user selects an antenna through a single click in the Antennas panel. In response, the Log panel automatically switches to showing log messages for that antenna only. Panels can likewise be coordinated by baselines, time-stamps, observations, etc.

Baselines

A view of the system from an observation perspective. It shows all interferometric baselines laid out in a compact adjacency matrix. There are two cells per baseline (light blue and dark green triangles), and one cell per antenna (diagonal). On a high level, colours indicate the health of each baseline. Zooming provides fast navigation to detailed plots of raw data and calibration results. Clicking a cell will select the respective baseline.
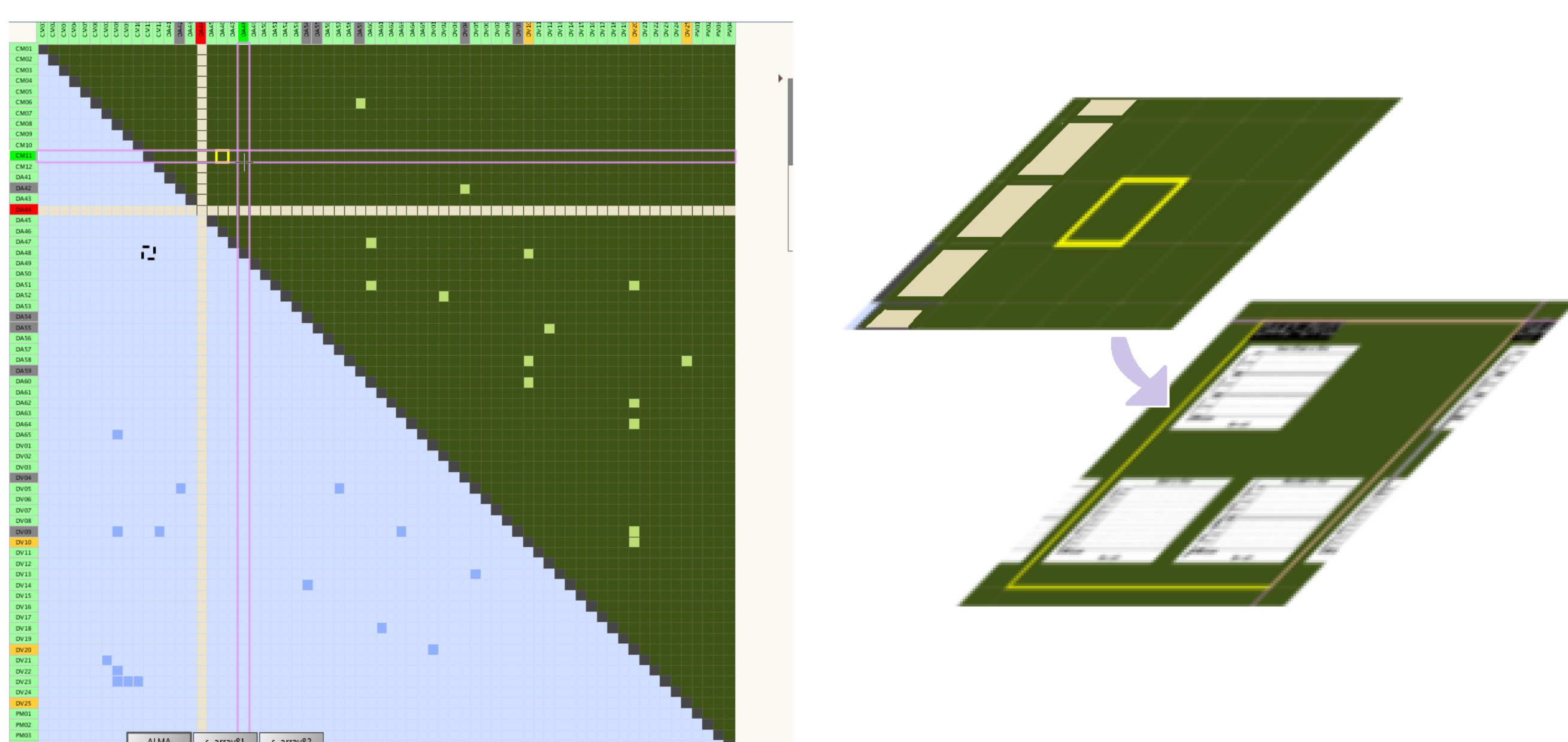
Interactive Plots

For complex plots, we use JFreeChart (www.jfree.org/jfreechart) to which we have added the capabilities to pick, fade and filter within a plot.

In this example, the green series is in the back and mostly overlapped by other series. The user interactively picks the green series by clicking it. This makes the picked series stand out in the front, while the other series fade to grey.

Atacama Large Millimeter Array