Requirements for the SPIRE Spectral Visualization Tool

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A visualization tool will be developed to allow users to visualize interferograms or spectra from one single-point observation, i.e. one interferogram or spectrum per detector per scan presented in one of two data products, either a SPIRE Spectrometer Detector Interferogram (SDI) or a SPIRE Spectrometer Detector Spectrum (SDS). The tool, current working name: SpectrometerDetectorExplorer (SpecExplorer/SDE), will be based on the currently available PixelViewer (see below for a screenshot).
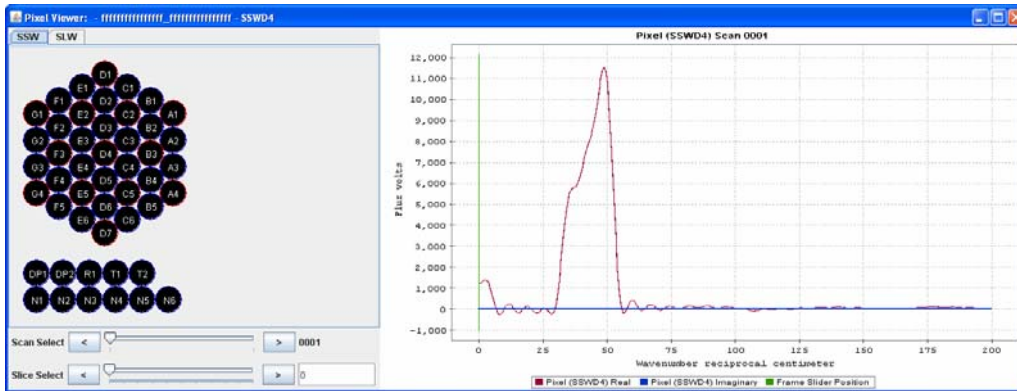
Deliberate limitations of the SpecDetectorExplorer:

- Visualization of a spectral cube with equidistant spatial sampling is beyond the scope of this tool.

- GUI-based access to functionality to perform any kind of mathematical operation to process or change the data in the SPIRE Spectrometer Detector Spectrum is beyond the scope of this tool. That implies: No averaging or line flux extraction.

The objective of this document is to capture a complete list of requirements for functionality to be included in the SDE. Drafts were distributed to the SPIRE ICC team. Ralph Boland, Peter Davis, Trevor Fulton, and Edward Polehampton have contributed to the requirements.

Table of Contents:

0. Definitions

Data Plot: A single pane that contains data shown as a curve on an x-y grid

Curve: A representation of a two-column dataset shown as points or a line on an x-y plot.

Mosaic: More than one x-y grid being displayed simultaneously (see the illustration below).

Overplot: Adding a curve (layer) to an already existing plot without changing the x-y grid of that plot.
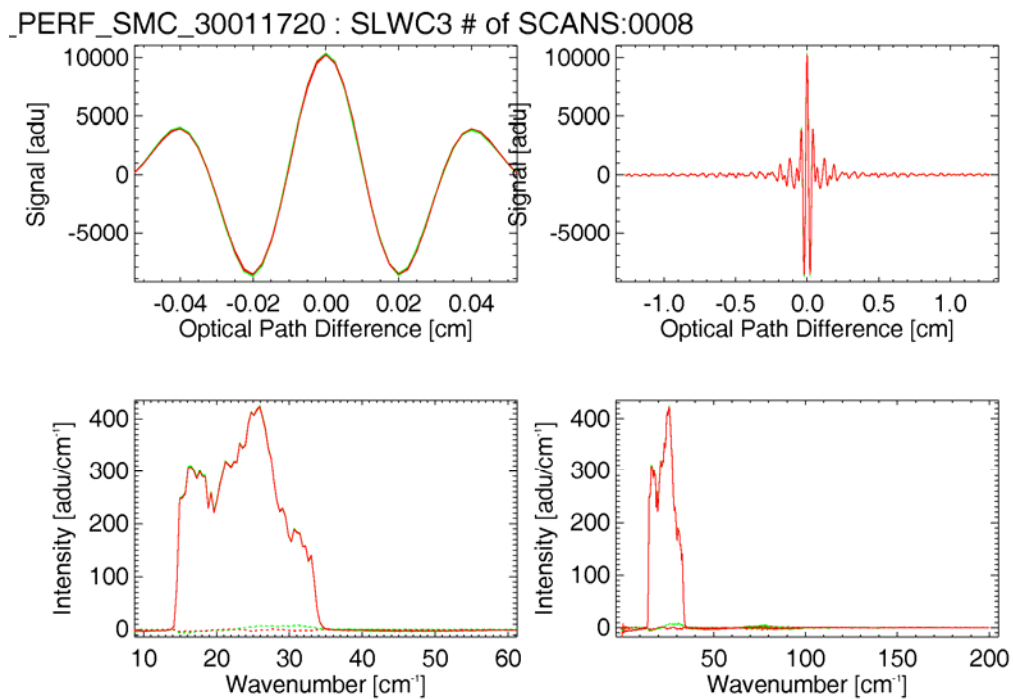
_PERF_SMC_30011720 : SLWC3 # of SCANS:0008

Illustration 1: This mosaic contains four plots, each of which displays multiple curves.

1. Properties of a data plot

[R1-1] The SDE offers a GUI to select any of the detectors in the SPIRE spectrometer detector arrays acquired during an arbitrary scan to plot the data from that detector (by default the first scan is selected). NB: Scan refers to a scan of the mirror translation stage, **not** a scan on the sky.

[R1-2] The detectors will be presented in an ideal honeycomb arrangement. The SDE and the DataTimelineExpolorer (DTE) present the detectors of the SPIRE spectrometer arrays in identical ways.

[R1-3] There will be a user setting to either give users access to non-nominal detectors (R, T, DP) or not. This will be implemented in the same way as for the DTE.

[R1-4] There will be a user setting to either give users access to the vignetted detectors (the outer rings of the two detector arrays) or not. This will be implemented in the same way as for the DTE.

[R1-5] The SDE will not make assumptions about the existence of units or their names. The units will be displayed in the plots.

The plot will offer the following capabilities:

[R1-6] Customizable axes, incl. labels.

[R1-7] Customizable line styles (solid, dotted, etc.) and colors.

[R1-8] Customizable symbol types and sizes.

[R1-9] Customizable title and sub-title. All descriptors (meta-data at various levels) of the visualized data are offered to the user who then selects the desired elements for display in the title/sub-title. If the user-selected elements have more than one value in the selected data, all values will be displayed. The user can add free-style text. The default for the subtitle is to be empty. The defaults for the title depend on whether data stem from one product or more than one product. The default title will be obsid – bbid – startDate (in the case that curves derive from one product only) or instrument – subsystem (otherwise) respectively. If a title or sub-title entry is different for data from different products, all values will be presented, separated by forward slashes.

[R1-10]   Customizable legends. All descriptors (meta-data at various levels) of the visualized data are offered to the user who then selects the desired elements for display in the legend. The user can add free-style text to the legend entries. The defaults for the legend depend on whether data stem only from one product or more than one products. The default legend will be detectorName – scanNumber or obsid – bbid - detectorName – scanNumber respectively.

[R1-11]   Mouse-based zoom (in and out) on both axes, consistent in its look & feel with the DTE.

[R1-12]   A user setting will define how a new plot will scale its axes. More specifically: If a box PASSBAND is checked, then a new plot self-scales in the y-axis and scales to the nominal passband in the x-axis. If a box USER-SCALE is checked,

then a new plot scales exactly as the most recent plot was scaled. If this is the first plot overall then the plot self-scales along the x- and y-axis. If neither PASSBAND nor USER-SCALE are checked then the plot will self-scale.

[R1-13]   Export the plot to a common image format (jpg, png, eps).

[R1-14]   Print the plot.

[R1-15]   If the visualized data are complex numbers, then the user will have the option to choose whether to plot

- the real part and overplot the imaginary part of the complex numbers (refer to section 3 on 'multiple plots').

- the real part of the complex numbers.

- the imaginary part of the complex numbers.

- the absolute value of the complex numbers.

- the phase of the complex numbers (in deg or rad).

[R1-16]   Display symmetrical error bars according to the 'error' column in the data product.

2. Multiple data plots

The SDE has the capability to plot one or many different datasets on compatible x-axes at the same time. The following four cases will be available:

Thumbnail mosaic image of data from all detectors

[R2-1] The data from all nominal detectors in SLW xor SSW are plotted in a mosaic that reflects the spatial configuration of the detector array in question.

[R2-2] The plot of each dataset will implement the current user choice of plot parameters. If no plot window is open, then the plot parameters depend on the check-boxes PASSBAND and USER-SCALE. If PASSBAND is checked then the x-axis is scaled to the nominal passband and the y-axis self-scales. If USER-SCALE is checked then the most recent plot parameters are used. If this is the very first plot then the x- and y-axis will self-scale. Comprehensive information on the axis scales will be provided.

[R2-3] One legend for the whole mosaic will contain user-selected entries taken from the descriptors of the SDI/SDS products.

[R2-4] The resulting image can be closed, printed, or exported but it is not required that it can be manipulated.

[R2-5] Optimal use of the available space will be made to increase the chance that the result is readable.

[R2-6] The user defines the set of applicable scans as

      a. all scans

Deleted: using different shades of the same color [TBC] to distinguish the real and imaginary part

b. all 'forward' scans

c. all 'reverse' scans

d. the currently selected scan

e. defined interactively similar to the selection of pages to print, e.g. "1 – 10, 13, 14, 21 - 30".

Thumbnail mosaic image of data from co-aligned detectors

[R2-7] The data from all co-aligned detectors are plotted in a mosaic that reflects the spatial configuration of the co-aligned detectors.

[R2-8] The plot of each dataset will implement the current user choice of plot parameters. If no plot window is open, then the plot parameters depend on the check-boxes PASSBAND and USER-SCALE. If PASSBAND is checked then the x-axis is scaled to the nominal passband and the y-axis self-scales. If USER-SCALE is checked then the most recent plot parameters are used. If this is the very first plot then the x- and y-axis will self-scale. Comprehensive information on the axis scales will be provided.

[R2-9] One legend for the whole mosaic will contain user-selected entries taken from the meta-data of the SDI/SDS products.

[R2-10]   The resulting image can be closed, printed, or exported but it is not required that it can be manipulated.

[R2-11]   Optimal use of the available space will be made to increase the chance that the result is readable.

[R2-12]   The user defines the set of applicable scans as

a. all scans

b. all 'forward' scans

c. all 'reverse' scans

d. the currently selected scan

e. defined interactively similar to the selection of pages to print, e.g. "1 – 10, 13, 14, 21 - 30".

Thumbnail mosaic image of data from unvignetted detectors

[R2-13]   The data from the unvignetted detectors of SLW xor SSW are plotted in a mosaic that reflects the spatial configuration of the overlapping detectors.

[R2-14]   The plot of each dataset will implement the current user choice of plot parameters. If no plot window is open, then the plot parameters depend on the check-boxes PASSBAND and USER-SCALE. If PASSBAND is checked then the x-axis is scaled to the nominal passband and the y-axis self-scales. If USER-SCALE is checked then the most recent plot parameters are used. If this is the very first plot

then the x- and y-axis will self-scale. Comprehensive information on the axis scales will be provided.

[R2-15]   One legend for the whole mosaic will contain user-selected entries taken from the meta-data of the SDI/SDS products.

[R2-16]   The resulting image can be closed, printed, or exported but it is not required that it can be manipulated.

[R2-17]   Optimal use of the available space will be made to increase the chance that the result is readable.

[R2-18]   The user defines the set of applicable scans as

    a. all scans

    b. all 'forward' scans

    c. all 'reverse' scans

    d. the currently selected scan

    e. defined interactively similar to the selection of pages to print, e.g. "1 – 10, 13, 14, 21 - 30".

Simultaneous overplot of curves from one or multiple, user-selected detectors

[R2-19]   The user can select one or several datasets identified by a combination of detector and scan to plot data plus metadata. If the user selects more than one detector/scan combination, then the new data are overplotted into the already existing plot. This allows explicitly for the overplot of data from an SLW and an SSW detector. In that case, if the box PASSBAND is checked, the x-axis will automatically adjust to contain only the relevant optical passbands.

[R2-20]   There is no limitation in principle on the number of detectors that can be selected at the same time.

[R2-21]   If the PASSBAND box has been checked for an SDS then the ranges for the wavescale axes are specific to the displayed detectors, e.g. 10 – 35 cm-1 for SLW, 25 – 55 cm-1 for SSW, 10 – 55 cm-1 when detectors from both arrays are plotted.

[R2-22]   A specific curve can be selected and removed from a data plot.

[R2-23]   A just created plot can be discarded and the previous plot (incl. all overplots) is reloaded (undo).

[R2-24]   The user defines the set of applicable scans as

    a. all scans

    b. all 'forward' scans

    c. all 'reverse' scans

    d. the currently selected scan

   e. defined interactively similar to the selection of pages to print, e.g. "1 – 10, 13, 14, 21 - 30".

3. Grey-scale to visualize detectors

[R3-1] Select a region on the x-axis to use the sum of the data in that region to define a grey scale for each detector. By default, all data are used to set the color-scale.

[R3-2] The limits to the relevant data region are indicated numerically and visually on the SDE.

[R3-3] The definition of the grey-scale computation will be coordinated with how the grey-scale is defined in the DTE.

[R3-4] The user can define the region from which to compute the grey-scale by entering a lower and an upper limit.

[R3-5] The user can use the mouse to define the data region relevant for the grey-scale.

[R3-6] Detectors where a grey-scale value cannot be computed because the data contain NaN's or are flagged as irrecoverable will be colored by fixed colors (e.g. red for dead in the grey-scale scheme) rather than a grey-scale. This color-coding will be consistent with the use of colors in the DTE.

4. Other requirements

[R4-1] The areas of the window containing a visualization of the honeycomb arrangement of the detectors and the created data visualization will scale automatically with the size of the window on the screen.

[R4-2] Plot data qualified by any of the SampleMasks available in the data, e.g. to inspect the parts of the interferogram where glitches have been removed [TBC].

[R4-3] The SDE will have the ability to visualize more than one data product at a time.

[R4-4] The SDE will provide a convenient way to inspect the product metadata.

[R4-5] There will be a convenient way to inspect the currently visualized data product with the Tree Product Explorer.

[R4-6] It will be possible to call the SDE from a command line.

[R4-7] The SDE can be selected as the default viewer for SDI and SDS data products.

[R4-8] Data columns with no or NaN entries will not lead to a run-time exception but a warning to the user that the data contain no or NaN entries.

[R4-9] The SDE will offer user HELP through the built-in help system.

[R4-10]   The SDE will offer tool-tip user help on the GUI functionality.
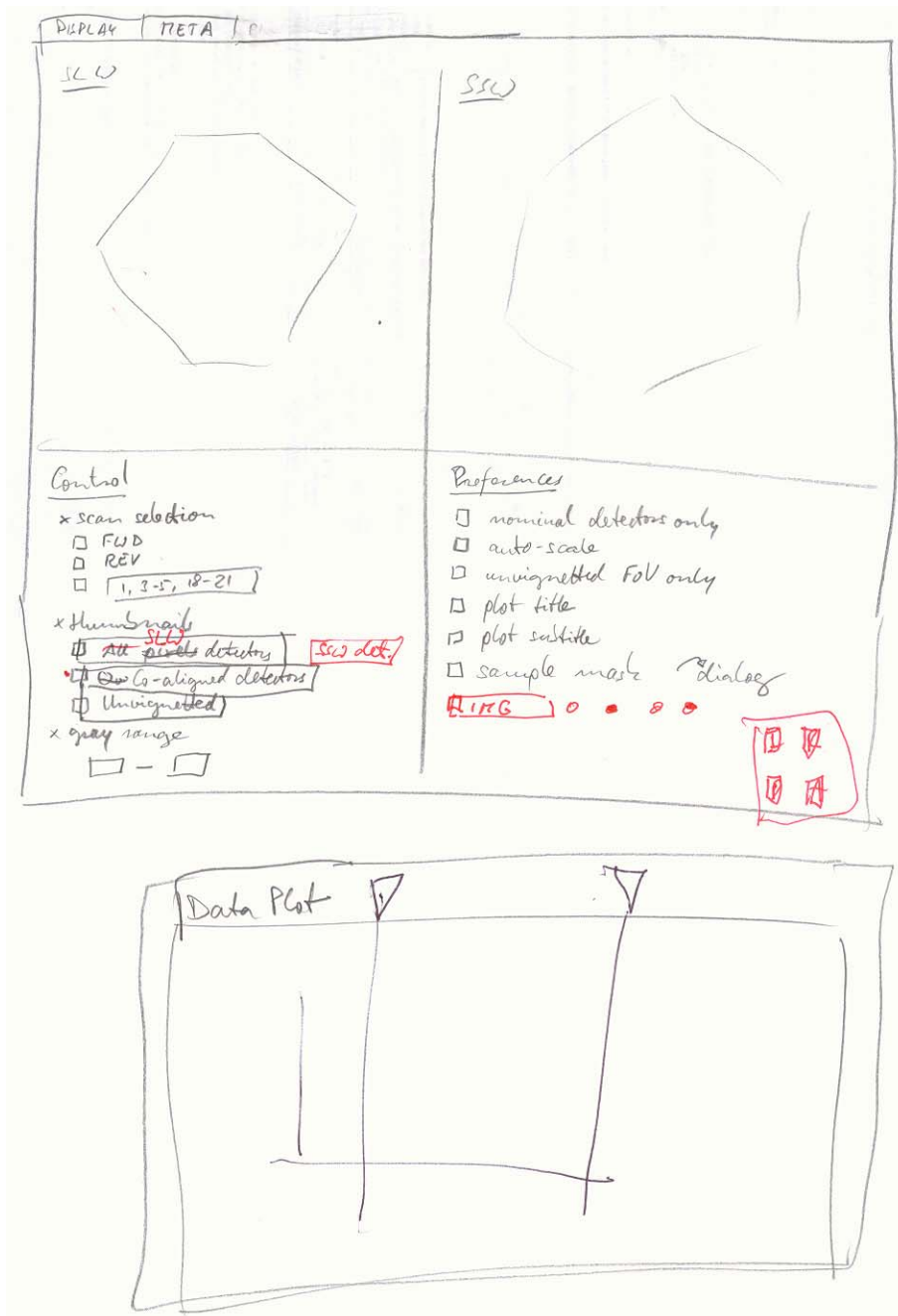
5. Drawing

Illustration 2: A possible layout of the SDE GUI