# Welcome to ParticleScout

Welcome to the Particle Scout Help.

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Press the **F1 key** anywhere in the software to open the
context help or browse the Help Menu to open the help contents

## Installation

**Installation**

WITec ParticleScout and WITec TrueMatch are both included in the same executable and distributed with the same setup file.

**Program Start**

ParticleScout is started automatically when
- measuring a Particle Stitching image from the WITec Control Video Measurement Dialog
- when exporting images from the Project Manager Context Menu of WITecProject.

You can also double-click a .witscout (WITec ParticleScout) file or start the ParticleScout software using the start menu of windows or the desktop shortcut and load a particle project.

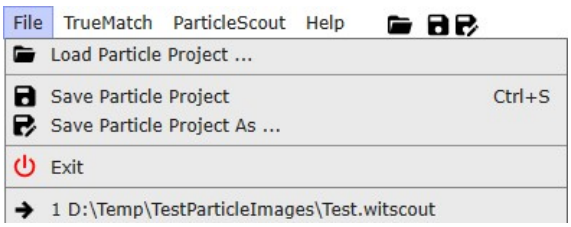
Please note that only one instance of WITec TrueMatch / ParticleScout is allowed.

**Licensing**

A special ParticleScout license is needed to use ParticleScout without any limitations.
Once you have ordered the ParticleScout license, it is included in the WITecProject license and can be used on any number of computers.

## Menu

**File Menu**



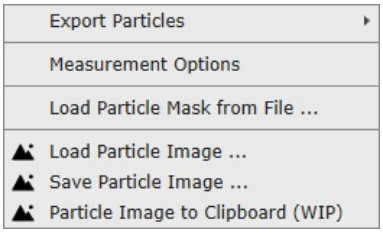

**Load Particle Project**
Loads a previously saved particle project.

**Save Particle Project (As)**
Saves the current particle project including all particles with their properties, thumbnail images, spectra and database search results.

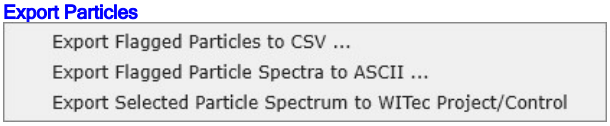
**Exit**
Exits the application.

**Recent Files**
Recent particle scout files are shown at the bottom. Just click it to load the particle project.

**ParticleScout Menu**




**Export Particles**

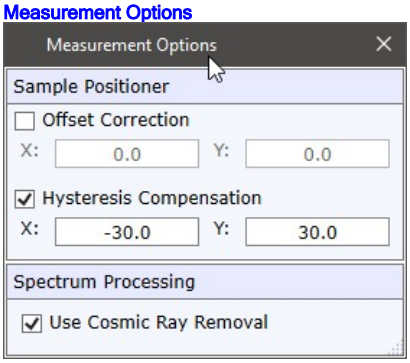



**Export Particles to CSV**
Exports all flagged particles with properties into a semicolon separated file.

**Export Particle Spectra to ASCII**
Exports the measured spectra of all flagged particles into an ASCII file,
the format is the WITec TrueMatch ASCII Import format

**Export Selected Particle Spectrum to WITec Project/Control**
Exports the measured spectrum of the currently selected particle to the clipboard.
Can be pasted as new single spectrum object into WITec Project/Control project manager.
Works only if a single particle is selected.

**Measurement Options**




**Offset Correction**
If set, ParticleScout will move the sample positioner with an offset for each particle or if the move to particle button is used.

**Hysteresis Compensation**
If set, a hysteresis compensation is performed before moving to a particle.

**Use Cosmic Ray Removal**
If checked, cosmic rays in measured Raman spectra will automatically be removed using a cosmic ray detection algorithm.
Only works if at least 2 accumulations are used.

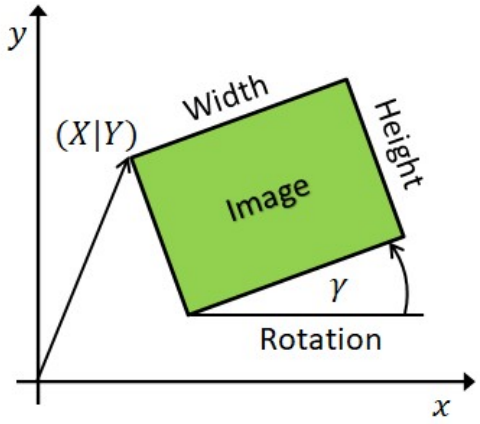
**Load Particle Mask from File ...**
Loads a bitmap and uses all white pixels as mask pixels for adding new particles.
If there are already particles in the current project, you can decide whether to create a new project or add the particles to the current project.

**Load Particle Image ...**
Loads one or multiple particle image files (e.g. *.bmp or *.png).
If there is already a particle project opened, a message box will open and the user can choose

- to use these images for adding more particles
- to use the image as a main image (if only one image is loaded)
- to create a new project (the first image will be used as the main particle image)

You can load the image with a coordinate information that contains the size, offset and the rotation.
It can be defined by saving a text file (.txt) with the same name as the image file name in the same directory.
Use "." as decimal separator.
Width/Height unit is microns.
X/Y/Z coordinates is the upper left corner of the image, in microns.
Rotation unit is radian.
Pixels must be quadratic.

Example:
Width: 558.24
Height: 558.24
X: 0
Y: 0
Z: 0
Rotation: 0

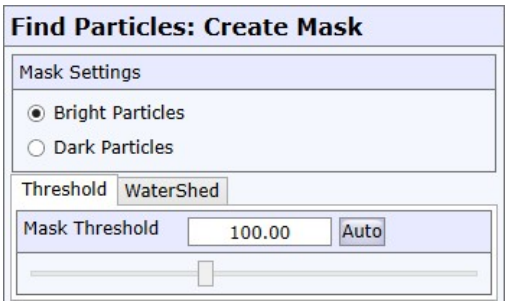



**Save Particle Image ...**
Saves the current particle image into a windows bitmap file.
Note that the software allows to save bitmaps with a maximum size of ≈700.000.000 Pixels, which might not be readable in every software.

**Particle Image to Clipboard (WIP)**
Copies the particle image to the clipboard in WIP format, so it can be pasted into the Project Manager of a running WITecProject or WITecControl instance.
The image will be downsized to 8000x8000 pixels, if larger.

## Find Particles

**Find Particles**



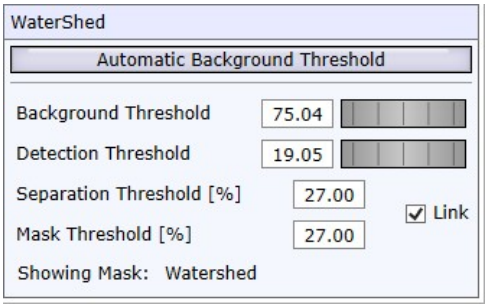

**Bright / Dark Particles** (Automatically set)
Bright Particles: finds particles that are brighter than the background (e.g. dark field image)
Dark Particles: finds particles that are darker than the background (e.g. bright field image)

**Mask by Threshold**
Defines which brightness level should be used to detect the particles.

**Auto**
Calculates an automatic threshold (also used on startup).
For the automatic threshold, "Otsu's method" is used:
https://en.wikipedia.org/wiki/Otsu%27s_method

**Mask by Watershed**
This algorithm can be used to solve two problems in particle detection.

- Bright and less bright particles are both masked with an individual threshold depending on the particle brightness.
- Particles that are very near to each other can be separated.




To get the best results, please define the parameters step by step in the following order:

**Background Threshold**
Define a threshold for the background.
When changing this parameter, the preview will temporarily show the background mask.

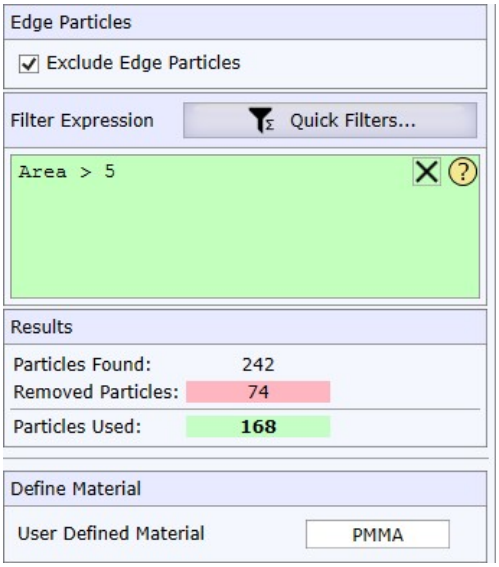
**Detection Threshold**
Only areas that are above this threshold (background threshold + detection threshold) will be used to find the particles.
When changing this parameter, the preview will temporarily show the detection mask.

**Link**
If the link check box is checked, the separation and mask thresholds are set equal. This is useful if you are only interested in having individual thresholds for each particle.

**Separation Threshold**
During the calculation the particles are expanded around local intensity maxima. If the intensity drops below the separation threshold the region becomes a particle by its own. It will not be joined with other particles, which are "falling" below their separation threshold.

**Mask Threshold**
This parameter defines the mask threshold relative to the local maxima.

**Filter Particles**




**Exclude Edge Particles**
If set, all particles whose contours are not completely within the image are skipped.

**Filter Expression / Quick filters**
You can filter particles that do not match a custom filter expression.
E.g. you can define that only particles with an area larger than 50 µm should be detected.
See Filter Expression Editor.

**User Defined Material**
It's possible to export particle images from WITec Project with known material. In this case you can just enter the material name which is then assigned to the particle objects in the resulting particle list.

**Actions**

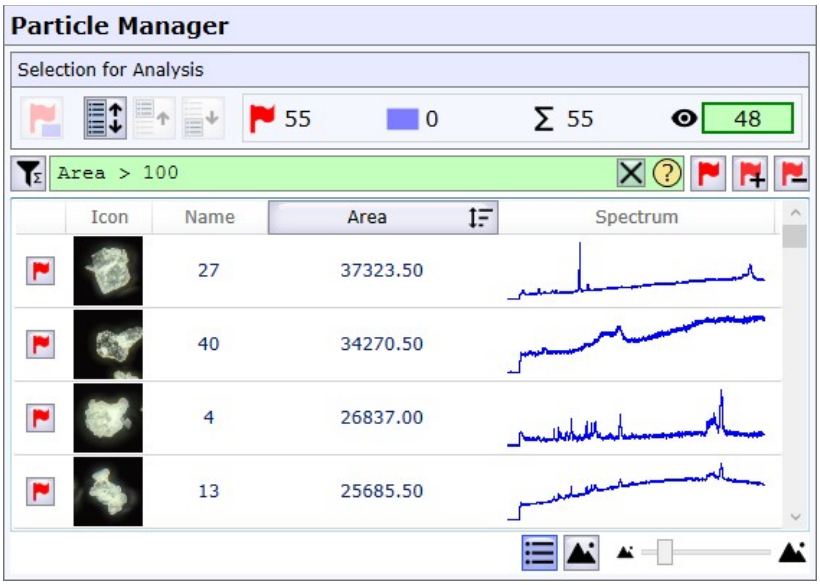
 **Use Results**
This will accept the current mask and proceed with the particle filter.

**Preview**

The preview image shows the original particle image and the current mask as an overlay.
In the upper right corner you can open options in order to change the brightness / contrast and change the opacity and color of the mask.

## Particle Manager

The Particle Manager shows all particles of the current particle project.
It can be used to select particles and use certain particles for Raman measurement, database search or statistical analysis.




### Selection for Analysis

### Flags
Only flagged particles are used for
- Raman Measurement
- TrueMatch Database Search
- Statistical Analysis
- Export

### Selection
The selection (blue rows) can be used to
- flag/unflag particles
- delete particles, particle spectra or particle material
- calculate spectrum properties
- define custom material

### Toggle Flag State of Selected Particles
Toggles the flag state of all selected particles.

### Select All
Selects all particles in the list.

### Select All above Current
Selects all particles in the list that are above the currently selected particle.

### Select All below Current
Selects all particles in the list that are below the currently selected particle.

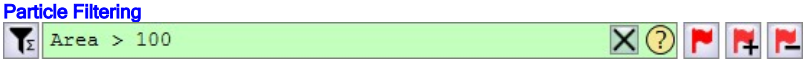
### Select via List
You can click on any row to select a single particle. The selected particle will be shown in the Particle Detail View.
Use the Shift or Control keys on the keyboard in order to select multiple items.

### Toggle Flag in List
You can click the box on the very left side of a particle row entry to flag or unflag this particle. Use the shortcut space to toggle the flags of all selected particles.

### Number of Particles



54: Number of flagged particles.
1: Number of selected particles.
55: Total number of particles in the current project.
48: Number of visible particles in the list view.

### Particle Filtering



Here you can define a custom filter formula in order to show only particles in the list that match a certain condition.
With the flags buttons you can
- Flag only currently visible particles
- Add currently visible particles to existing flagged items
- Remove currently visible particles from existing flagged items

See Filter Expression Editor.

### Sorting


Click on the button in the column header area in order to define which particle property should be shown in the column.
The selected property is also used for sorting the items.

### Reverse

If checked, the order of the current list of particles will be reversed.

If particles are sorted by material or any Boolean property, you can quickly jump to the next material / different value using the arrow buttons:

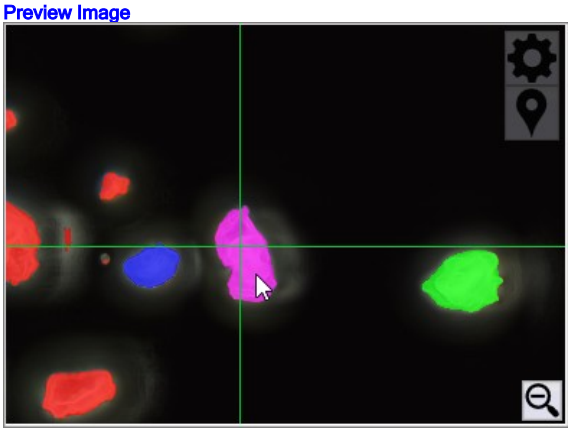

### List View Settings

Here you can switch between the list view and the thumbnail view.
Both views have a custom thumbnail size.

### Particle Details

See ParticleScout Particle Details.

### Preview Image



The preview image shows the particle image.
All particles, that are visible in the list view are shown as a green overlay.
Red particles are flagged. Blue particles are selected, Pink particles are selected and flagged.

### Click to Select

Click on any particle in order to select it in the list. Hold down the left mouse button to change the selection while moving the mouse.

### Move Sample to Mouse Position

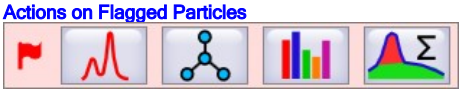
When enabled, click somewhere in the image in order to move the sample positioner to the desired position.

**Actions**

### Find Particles

Returns to the Find Particles view so you can e.g. change the mask and create a new particle list.

### Actions on Flagged Particles



### Measurement

Opens the Measurement View. Here you can acquire a Raman spectrum at each particle and assign it to the particles.
Only available if WITec Control is running.

### Material Search with TrueMatch

Opens the TrueMatch Search View. Here you can search all particle spectra in a spectral database and assign a material name to each particle.
Only available if particles with spectra are flagged.

### Particle Report

Opens the Particle Report View. Here you create and customize a report of all flagged particles.

### Calculate Spectrum Properties

This will calculate an estimation of the amount of Raman or fluorescence signal and a yes-no-info about the over-saturation for all selected particles.
See Spectrum Properties.

### Actions on Selected Particles

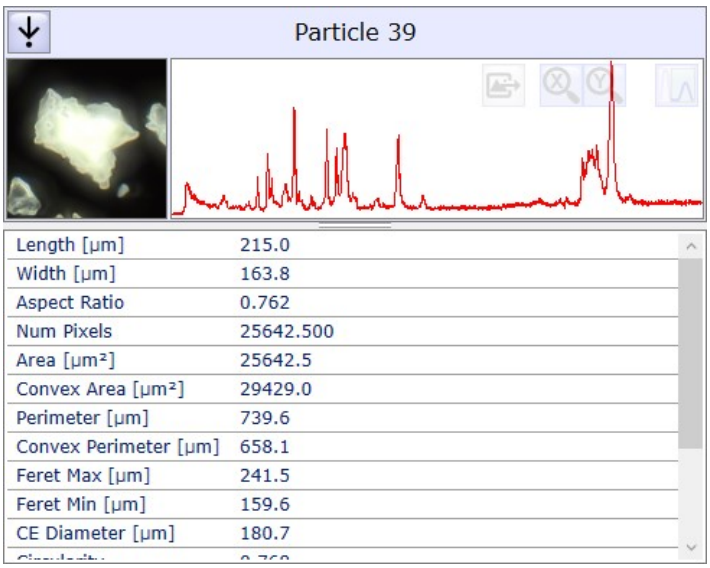
**Define custom material**
Here you can enter a material name and assign it to the selected particles.

**Delete Spectrum**
This will delete the spectrum and its information (material, spectrum properties) from the selected particles.
Only available if particles with spectra are selected.

**Delete Material**
This will delete the material name from the selected particles.
Only available if particles with spectra and assigned material are selected.

**Delete Particle**
Deletes all selected particles.

## Particle Details




This view shows the details of a selected or measured particle.

You can select multiple particles in order to see some statistics of the properties of all selected particles:
Min, Max, Average, Standard Deviation and Median.

 **Move to Particle**
With this button you can move the sample positioner to the currently selected particle.

**Spectrum Viewer**
Shows the measured Raman spectrum. See **Spectrum Viewer**.

**Particle Properties**
Shows all particle properties.
For a detailed description for each property, see **Particle Properties**.

## Particle Properties

In order to calculate descriptive particle properties from an image the following steps are done:

- The image is converted to a mask
- A list of particles is created (all connected mask pixels belong to one particle)
- For each particle a contour line is calculated
- The pixel positions and the contour line is used to calculate the descriptive particle properties

**Definition of Particle Pixels**

$$\mathbb{N} = \left\{ \vec{n}_i = \begin{pmatrix} n_x^i \\ n_y^i \end{pmatrix} : 0 \leq i < M_n \right\}$$

$\mathbb{N}$ : *Set of all Mask Particles*
$M_n$ : *Number of Mask Particles*
$\vec{n}_i$ : *Pixel Coordinates*

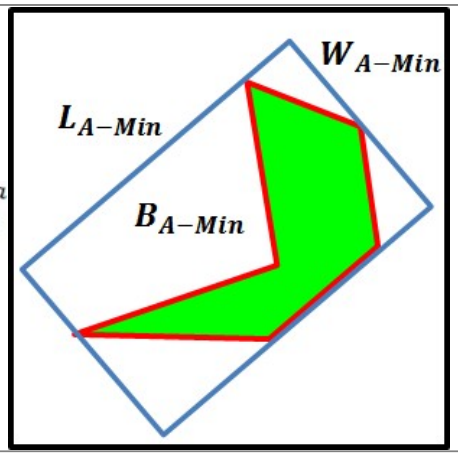
### Definition of Particle Contour

$$\mathbb{C} = \left\{ \vec{c}_i = \begin{pmatrix} c_x^i \\ c_y^i \end{pmatrix} : 0 \leq i \leq M_c;\ \vec{c}_0 = \vec{c}_{M_c} \right\}$$

$\mathbb{C}$ : *Set of all Contour Supporting Points*
$M_c$ : *Number of Supporting Points*
$\vec{c}_i$ : *Pixel Coordinates of Supporting Points*

### Length and Width

In order to calculate the Length and the Width of the Particle the bounding box with the smallest area is fitted to the contour of the particle.
The larger side is defined as the Length.




$L_{A-Min}$ : *Length of Bounding Box with smallest Area*
$W_{A-Min}$ : *Width of Bounding Box with smallest Area*
$L_{A-Min} > W_{A-Min}$

### Aspect Ratio

$$Aspect\ Ratio = \frac{W_{A-Min}}{L_{A-Min}}$$

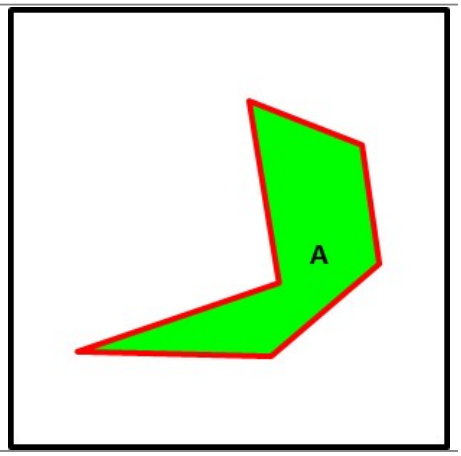
The Aspect Ratio range is between 0 to 1.
A quadratic bounding box has an Aspect Ratio of 1.

### Number of Pixels

$$N = M_n$$

$N$ : *Number of Particle Pixels*

### Area

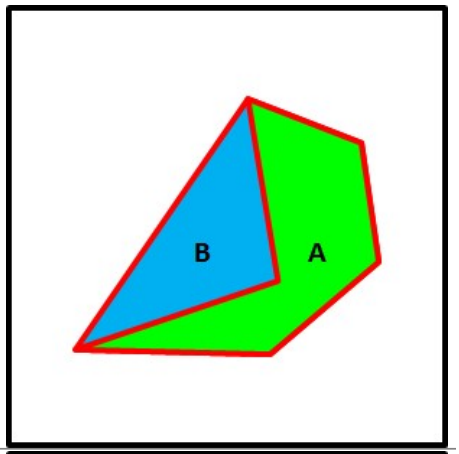



$$A = a \times N$$

$A$ : *Particle Area*
$a$ : *Pixel Area*

### Convex Area

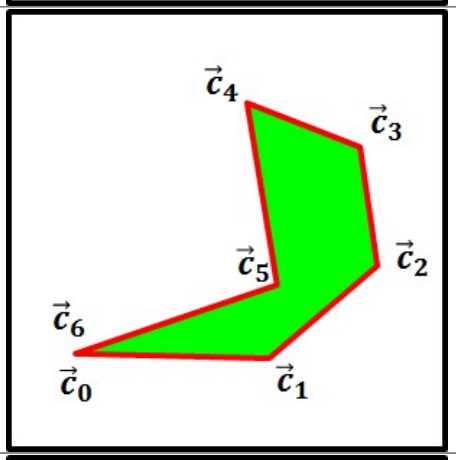
$$A_{convex} = A + B$$




**Perimeter**

$$P = \sum_{i=0}^{M_c-1} |\vec{c}_{i+1} - \vec{c}_i|$$

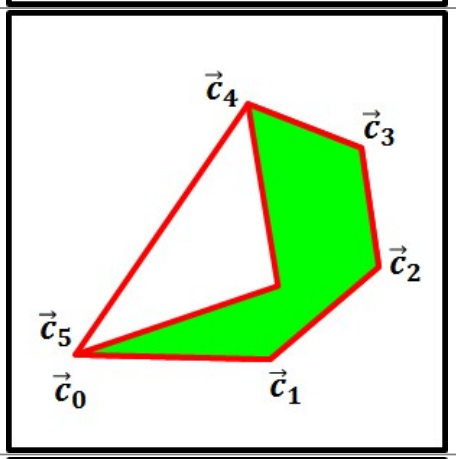
$P$ : *Perimeter*




**Convex Perimeter**

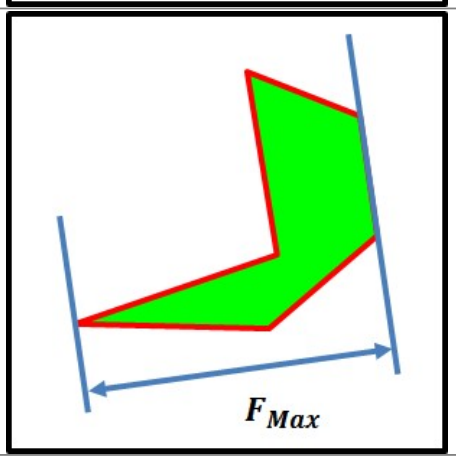
$$P_{convex} = \sum_{i=0}^{M_c-1} |\vec{c}_{i+1} - \vec{c}_i|$$

$P_{convex}$ : *Convex Perimeter*



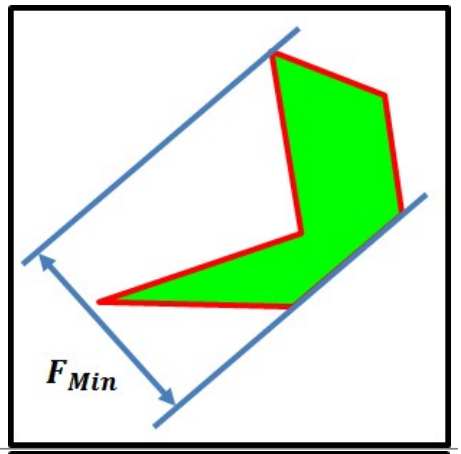

**Maximum Feret Diameter**

The Maximum Feret Diameter is the maximum distance that can be measured if the particle is rotated between a pair of calipers.
At least one caliper must touch a segment line of the perimeter.




**Minimum Feret Diameter**

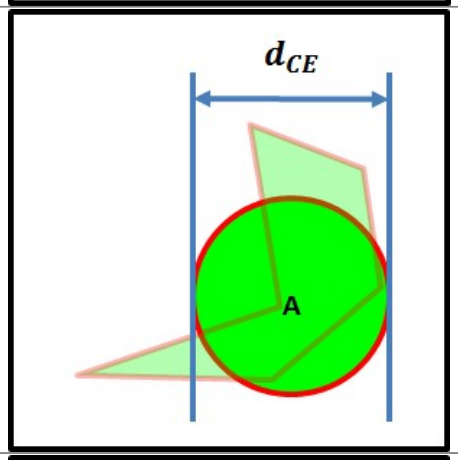
The Minimum Feret Diameter is the minimum distance that can be measured if the particle is rotated between a pair of calipers.
At least one caliper must touch a segment line of the perimeter.




**Circular Equivalent Diameter**

$$d_{CE} = 2\sqrt{\frac{A}{\pi}}$$

$d_{CE}$ : *Circular Equivalent Diameter*

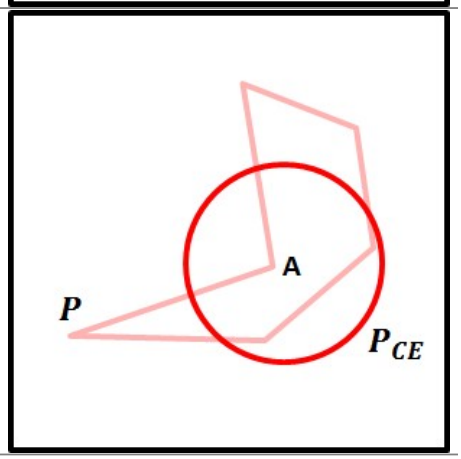



**Circularity**

$$C = \frac{P_{CE}}{P} = 2\frac{\sqrt{\pi A}}{P} = \frac{\pi d_{CE}}{P}$$

$P_{CE}$ : *Circular Equivalent Perimeter*
$C$ : *Circularity*

The Circularity range is between 0 and 1.
If the parameter is 1 the shape of the particle is a circle.




**Convexity**

$$Convexity = \frac{P_{convex}}{P}$$

The Convexity range is between 0 and 1.
If the parameter is 1 the shape of the particle is convex.

**Solidity**

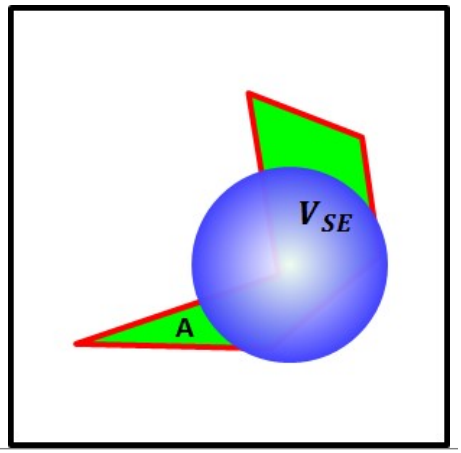
$$Solidity = \frac{A}{A_{convex}}$$

The Solidity range is between 0 and 1.
If the parameter is 1 the shape of the particle is convex.

**Spherical Equivalent Volume**

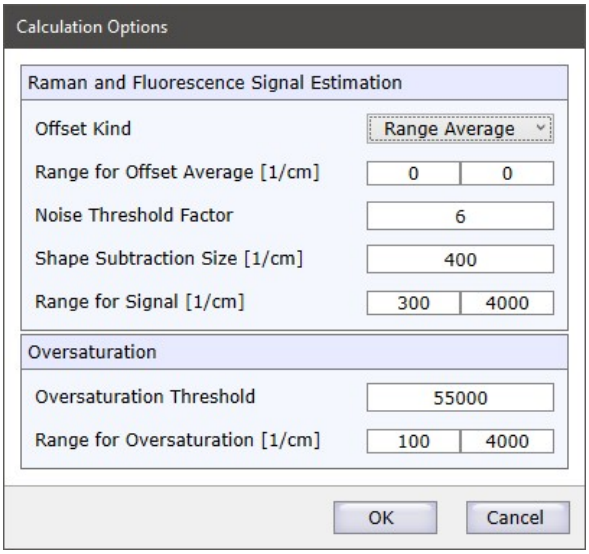
$$V_{SE} = \pi\frac{{d_{CE}}^3}{6}$$

$V_{SE}$ : *Spherical Equivalent Volume*




## Spectrum Properties

This dialog calculates an estimation of the amount of Raman and Fluorescence signal and a yes-no-info about the over-saturation for all selected particles.




### Raman and Fluorescence Signal Estimation

**Offset Kind**
Before calculating any signal value, a horizontal offset is subtracted from the spectrum:

- Minimum: The minimum value of the spectrum is subtracted from the spectrum
- Range Average: Here you can define a spectral range that is used to calculate an average value (Parameter "Range for Offset Average"). This value is subtracted from the spectrum
- User Defined: A user defined value is subtracted from the spectrum

**Range for Offset Average / User Defined Offset**
Depending on the selected offset kind, you can define a range for calculating an average value used as offset or directly enter an offset value.

**Noise Threshold Factor**
This factor defines how much higher the spectral signal must be in comparison to a local noise in order to be detected as Raman signal.
The Raman signal value is determined by all spectral pixels that are higher than <Noise Threshold Factor> * <Local Noise>.

**Shape Subtraction Size**
Defines the shape size of the shape background subtraction.
The fluorescence signal value is determined by the subtracted background.

**Range for Signal**
Defines the spectral range that is used for the signal estimation.

### Oversaturation

**Oversaturation Threshold**
If any spectrum pixel value within the defined range is higher than the threshold, the spectrum is marked as over-saturated.

**Range for Oversaturation**
Defines the spectral range that is used for the over-saturation calculation.
The Rayleigh Peak might be saturated, so you can e.g. skip the Rayleigh area.

# Raman Measurement

The Raman Measurement view allows to acquire a Raman spectrum for each particle.

### WITec Control Configuration Setup

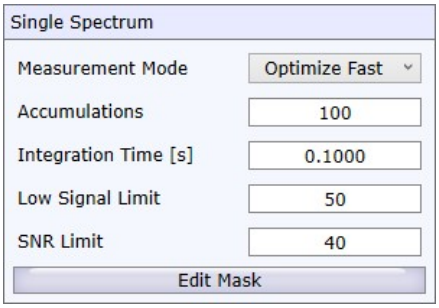
Before starting the Raman Measurement, you can choose one of the Raman configurations in WITec Control (e.g. "Raman CCD 1").
Its possible to measure a set of particles, then switch the WITec Control configuration to "Raman CCD 2" or change to another excitation laser, then measure other particles.

### Measurement Sequence

For each particle, the following tasks are done by the software:

- The Sample Positioner is moved to the particle using the Positioning Settings
- Depending on the Z-Axis Behavior, a spectral Auto Focus is performed
- The spectrum is measured

### Single Spectrum




**Measurement Mode**

- Normal: Uses the defined number of accumulations
- Optimize: Only accumulates spectra that improve signal to noise ratio of the Raman signal. Spectra with high fluorescence signal are rejected.
- Optimize Fast: In addition to the above option this mode will stop before the defined number of accumulations is reached:
  - if the signal to noise limit of the optimal accumulated spectrum is reached.
  - if the Raman signal of a single spectrum is too low
  - if the signal to noise limit of the optimal accumulated spectrum is not improving.

**Accumulations**
The number of accumulations for the spectrum measurement.
If more than 1 accumulation is used, a cosmic ray removal can be performed.

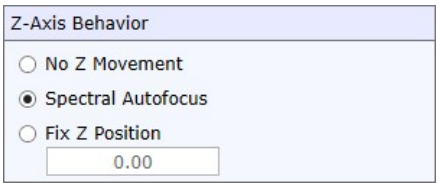
**Integration Time**
The integration time for each spectrum accumulation.

**Low Signal Limit**
Only used for Measurement Mode "Optimize Fast".
If the signal of a single spectrum is lower than this value the measurement will stop in order to save time.

**SNR Limit**
Only used for Measurement Mode "Optimize Fast".
If the optimal accumulated spectrum has a higher signal to noise ratio the measurement will stop in order to save time.

**Edit Mask**
Only used for Measurement Modes "Optimize" and "Optimize Fast".
Here you can define a spectral mask to define which parts of the spectrum should be used to calculate the signal.

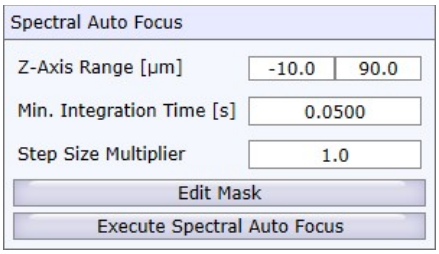
### Z-Axis Behavior




- No Z Movement: user can move the Z-Axis to a desired location
- Spectral Autofocus: a spectral auto focus is performed at each particle
- Fix Z Position: lets you define an absolute Z-Position (Software controlled, limited Z-axis space)

### Spectral Auto Focus

Before using the spectral Auto Focus adjust the following parameter:

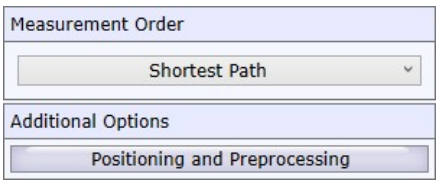



**Z-Axis Range / Min. Integration Time / Step Size Multiplier**
See Spectral Auto Focus documentation of WITec Control.

**Edit Mask**
Lets you edit a spectral mask to define which parts of the spectrum should be used for performing the auto focus.

**Execute Spectral Auto Focus**
Executes the spectral auto focus at the current position.
This way you can test if the spectral auto-focus works as expected.

### Measurement Order and Additional Options




**Measurement Order**
Here you can define in which order the particles are measured:
- Shortest Path: calculates an estimation of the shortest path in order to save time while traveling to each particle.
- User Defined: uses the sort order of the list view in the Particle Manager, e.g. "Area".

**Positioning and Preprocessing**
See Measurement Options.

Actions

 **Use Results**
This will assign the measured spectra to the particles.

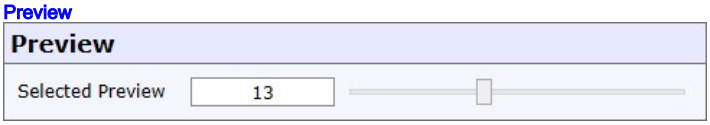
 **Start Measurement**
Starts the measurement.

 **Pause / Stop Measurement**
Stops the measurement.
You can continue at the last measured particle or measure all particles again.

**Progress**


Shows the progress and number of measured particles.

### Preview




Here you can select which measured spectrum and corresponding particle should be shown.
If the last measured particle is selected, the preview will automatically stay at the latest measurement.

### Particle Details
See Particle Details.

## Material Search

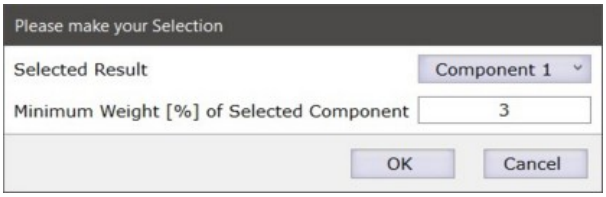
The spectra of all flagged particles are used in TrueMatch in order to search for chemical components.
The names of the best component search results are assigned to the particles as material name and HQI (hit quality).
This information can be used:
- to sort, filter and select particles in the Particle Manager
- to decide if certain particles spectra should be measured again, e.g. with different measurement parameters
- to create a report with statistics

See TrueMatch Search Overview.

### Actions

 **Use Results**
This will assign the best search results as material name to the particles.

### Result Selection




If a multi-component search was performed, you can define which of the sub-results should be used (Component 1, 2, 3).
You can also define a minimum weight percentage for the selected component in order to avoid using results with a very low importance.

## Report

The report view allows you to define a report layout with the following elements:

- Particle Image (Map) with Legend
- Typical Particles with Thumbnails and Spectra
- Bar Chart with Legend
- Pie Chart with Legend
- Table with Categories

The resulting report view can then be exported as bitmap into the windows clipboard.

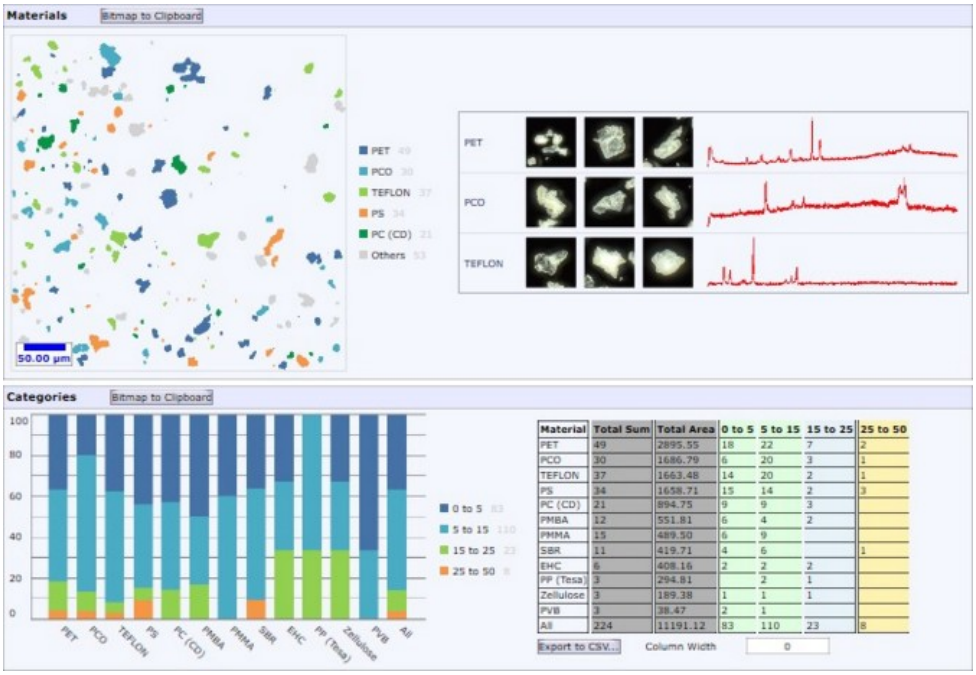
### Report Settings


**"Configuration 1" ComboBox**
Here you can select between your saved configurations.

**Options Button**
Opens the report configuration window in order to define the report elements and data preparation.
See Report Configuration.

**Bitmap to Clipboard**
Copies the whole report as a bitmap to the clipboard.

**Example:**




## Report Configuration

The ParticleScout Report is configured using the XML Format (**Extensible Markup Language**) with the following structure:

WITec
 Style
 Data
  Colors
  Groups
  Categories
  Visual Elements (Map, Thumbnail, Bars, Pie, Table)
 Data
  [...]

Press on the examples button in the software in order to create example xml code automatically.

The script must begin with
<WITec>

and end with
</WITec>

Style Tag
You can define exactly one Style Tag.
The Style Tag can be used to define some display properties:

```
<Style ScaleFactor='2'
    ShowCaptions='true'
CaptionBackground='LightGray'
    CaptionFontSize='16'
    CaptionPlacement='Top'
CaptionBorderThickness='1'
    CaptionBorderColor='Gray'
    ElementBackground='Yellow'
CanvasBackground='#11000000'>
```

**ScaleFactor**: Defines a scale factor to scale the size of all report drawings (0.3 to 3, default: 1).
**ShowCaptions**: Show or hide all captions (default: true).
**CaptionBackground**: Defines the color of the caption background (default: #11000000).
**CaptionFontSize**: Defines the caption font size (default: 14).
**CaptionPlacement**: Can be top or bottom (default: Top).
**CaptionBorderThickness**: Defines the border size around the caption (default: 0).
**CaptionBorderColor**: Defines the color of the caption border (default: Transparent).
**ElementBackground**: Defines the color each elements background (default: Transparent).
**CanvasBackground**: Defines the color of the canvas (default: White).

Data Tag
You can define any number of data tags. At least one data tag must exist.
Within each data tag you can define colors, sorting, grouping and categorization of particle properties.
Any number of visible elements can be specified in order to define how the sorted data should be presented in the report.

```
<Data GroupCategoryName='Material'
    SortCategory='Total Area'>
    <Colors> [...]
```

```
<DynamicGroup> [...]
 <NamedGroup> [...]
   <Category> [...]
     <Map> [...]
     <Bars> [...]
      <Pie> [...]
  <Thumbnail> [...]
     <Table> [...]
     </Data>
```

**GroupCategoryName**: Is only used for tables. Defines the header of the group column.
**SortCategory**: Defines the category name of the category that should be used for sorting the data.

Colors Tag
Colors are used for maps and bar charts.
The number of defined colors will define the number of categories visible in maps and bar charts.

You can define a color by using hexadecimal (A)RGB Values or by using the string representation
(please refer the System.Windows.Media.Colors class in Microsoft documentation):

```
<Colors DefaultColor='LightGray'>
    <Color Value='#4572A7' />
   <Color Value='#4BACC6' />
    <Color Value='#92D050' />
    <Color Value='#F79646' />
          </Colors>
```

**DefaultColor**: Is only used for Table elements. Defines the group name / caption of the most left column.

DynamicGroup Tag
This will automatically create a dynamic number of groups of particles.
Each group is defined by a unique string/name which is evaluated from each particle using a string expression.

```
<DynamicGroup NameExpression='Material' Condition='NOT Material.Equals("PET")' />
```

**NameExpression:** A string expression.
This expression will be automatically evaluated for each particle.
You can use any particle property here, for example Material.
All particles returning the same string will be in the same group (e.g. all particles with the Material "PMMA").
**Condition:** A boolean expression (optional). Only particles matching this expression will be used for creating groups.

NamedGroup Tag
This will create a group with a user defined name and condition.

**Name:** The name of the group. Used as table row group name.
**Condition:** A boolean expression. Only particles matching the expression will be part of the group.
**Color:** Color of the group. Used in map and map legend.
**Position:** Can be "Top", "Bottom" or "Default". Makes it possible to put a group at the top or bottom of all sorted groups.

Category Tag
This will create a category with a user defined name and condition. Categories can be used as columns in table presentation or in bar charts.

**Name:** The name of the category. Used as table column header.
**Condition:** A boolean expression. Only particles matching the expression will be part of the category.
**Count:** Allows to define how the "sum value" of the category is calculated.
A value of "1" is used, if no "Count Expression" is defined.
Must be a method call of one of the following methods:
Min, Max, Sum, Average, Median, StandardDeviation.
Usage Example: "Sum(Area)". The string in brackets is a numeric expression that can use all of the particle properties.
**NormMode:** Normalizes the category results for each group by dividing by the count result of all particles (None, Relative1, Relative100).
**Color:** Color of the category. Only used as table column background color.
**StringFormat:** The string representation expression for table cell content. Please refer to the Microsoft .NET string format documentation.
Example: If the number is 0.2345, then StringFormat "F0" = 0,  "F1" = 0.2, "F2" = 0.23, "P2" = 23.45 %

### Visual Elements

The following properties can be used in all visual elements:

**Caption:** Used for a surrounding group box header.
**SideBySide:** Set to "true" to place the element horizontally right next to the previous visual element.
**ShowEmptyGroups:** Set to "true" to show groups that have no matching particles.
**ShowEmptyCategories:** Set to "true" to show categories that have no matching particles.
**InvertData:** Set to "true" to display groups as categories and vice versa.

Map Tag
This will present the groups in a map using the defined colors.

```
<Map Background='Transparent'
     ImageOpacity='0.0'
     MaskOpacity='1.0'
```

```
Width='400'
LegendType='NameAndValue'
ShowScaleBar='true'
ScaleBarForeground='Blue'
ScaleBarBackground='White'
ScaleBarVerticalAlignment='Bottom'
ScaleBarHorizontalAlignment='Left'/>
```

**Background:** The background color (used if ImageOpacity!=1, default: Transparent).
**ImageOpacity:** Defines the opacity of the particle image (0 to 1, default: 0).
**MaskOpacity:** Defines the opacity of the particle mask (0 to 1, default: 1).
**Width:** The width of the map in pixels (2 to 4000, default: 400).
The height is automatically adjusted using the correct ratio.
The pixel size scales with the global report scale factor.
**LegendType:** Visibility of the legend (None, Name, NameAndValue, default: NameAndValue).
**ValueCategory**: The name of a Category that defines the values for the legend (default: not defined).
**ValueStringFormat**: String format for the values (default: not defined).
**ShowScaleBar:** Set to "true" to show a scale bar on the map (default: true).
**ScaleBarForeground:** The scale bar color (default: Blue).
**ScaleBarBackground:** The scale bar background color (default: White).
**ScaleBarVerticalAlignment:** The scale bar vertical position (Bottom, Top, Center, default: Bottom).
**ScaleBarHorizontalAlignment:** The scale bar horizontal position (Left, Center, Right, default: Left).

Bars Tag
Shows a bar chart with an X/Y Axis and legend.

```
<Bars Caption="Categories"
Width='500'
Height='300'
BarsSideBySide='false'
Normalize='true'
BarWidth='0.7'
XAxisLabelRotation='45'
LegendType='NameAndValue'
InvertData='true' />
```

**Width:** The width of the chart, in DPI depending units (4 to 4000, default: 500).
**Height:** The height of the chart, in in DPI depending units (4 to 4000, default: 300).
**BarsSideBySide:** Set to "true" to show each group as a separate bar next to each other (default: false)
**Normalize:** Set to "true" to normalize categories to 100% (default: false).
**BarWidth:** The width of each category, as factor (0.1 to 1, default 0.7).
**XAxisLabelRotation:** The X Axis label angle in degrees (-180 to 180, default: 45)
**LegendType:** Visibility of the legend (None, Name, NameAndValue)
**ValueCategory**: The name of a Category that defines the values (default: not defined).
**ValueStringFormat**: String format for value labels (default: not defined).

Pie Tag
Shows a pie chart with legend.

```
<Pie Caption="Some Pie"
Width='300'
Height='300'
OutsideLabelStyle='NameAndValue'
InsideLabelStyle='None'
LegendType='Name'/>
```

**Width:** The width of the chart, in DPI depending units (4 to 4000, default: 300).
**Height:** The height of the chart, in in DPI depending units (4 to 4000, default: 300).
**OutsideLabelStyle:** Visibility of the label outside from each pie segment (None, Name, NameAndValue, Value, default: None).
**InsideLabelStyle:** Visibility of the label inside each pie segment (None, Name, NameAndValue, Value, default: None).
**BorderColor:** Color of the border of each pie segment (default: White)
**BorderThickness:** Thickness of the border of each pie segment, in DPI depending units (default: 1.0)
**LegendType:** Visibility of the legend (None, Name, NameAndValue, default: NameAndValue)
**ValueCategory**: The name of a Category that defines the values (default: not defined).
**ValueStringFormat**: String format for value labels (default: not defined).

Thumbnail Tag
This will present a list of particle groups with name, particle thumbnails and a representing spectrum (if measured).

```
<Thumbnail NumberOfEntries='3'
NumberOfThumbnails='3'
ThumbnailWidth='60'
SpectrumWidth='300'
SpectrumHeight='60'
ShowXAxis='false'
ShowYAxis='false'
XAxisTitle='1/cm'
SortThumbnailsBy='Area'
SortSpectraBy='HQI' />
```

**NumberOfEntries:** The maximum number of list entries (maximum is number of groups, default: 3).
**NumberOfThumbnails:** The number of thumbnails (0 to 20, default: 2).
**ThumbnailWidth:** The width of each thumbnail, in DPI depending units (0 to 4000, default: 60).
**SpectrumWidth:** The width of the spectrum, in in DPI depending units (0 to 4000, default 400).
**SpectrumHeight:** The height of the spectrum, in in DPI depending units (0 to 4000, default: 60).
**ShowXAxis:** Set to "true" to show the X Axis.
**ShowYAxis:** Set to "true" to show the Y Axis.

**XAxisTitle:** The title/caption of the X Axis.
**SortThumbnailsBy:** An expression returning a particle property used for sorting the thumbnails (e.g. "Area" -> the particles with the biggest areas are shown)
**SortSpectraBy:** An expression returning a particle property used for sorting the spectra (e.g. "Area" -> the spectrum of the particle with the biggest area is shown)

Table Tag
Shows a table with groups as rows and categories as columns.

```
<Table ColumnWidth='50'
  MasterColumnWidth='0'
 HeadingColorOpacity='0.5'
 CellBackground='LightBlue'
  CellBorderThickness='1'
CellBorderColor='Transparent'
  CellPadding='2'/>
```

**ColumnWidth:** Defines the width of each category column, in DPI depending units. If 0, the width is minimal for each column (default: 0).
**MasterColumnWidth:** Defines the width of the most left column, in DPI depending units. If 0, the width is minimal (default: 0).
**HeadingColorOpacity:** Defines the opacity of the heading colors or columns and row headings (0 to 1, default: 0.5).
**CellBackground:** Defines the background color for each cell (default: #19000000).
**CellBorderThickness:** Defines the thickness of each cells border. See thickness format. (default: 1).
**CellBorderColor:** Defines the color of the cell border. Only visible if the thickness is not 0. (default: Transparent).
**CellPadding:** Defines the space around cell content. See thickness format. (default: 2).

Thickness Format
Use one number to define the same thickness for left/right/top/bottom: '2'
Use two numbers to define lef/right and top/bottom: '5 2'
Use four numbers to define left/top/right/bottom: '2 2 1 0'

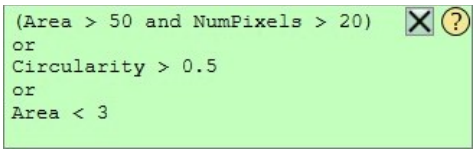
Possible Color Strings

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| AliceBlue | #FFF0F8FF | DarkTurquoise | #FF00CED1 | LightSeaGreen | #FF20B2AA | PapayaWhip | #FFFFEFD5 |
| AntiqueWhite | #FFFAEBD7 | DarkViolet | #FF9400D3 | LightSkyBlue | #FF87CEFA | PeachPuff | #FFFFDAB9 |
| Aqua | #FF00FFFF | DeepPink | #FFFF1493 | LightSlateGray | #FF778899 | Peru | #FFCD853F |
| Aquamarine | #FF7FFFD4 | DeepSkyBlue | #FF00BFFF | LightSteelBlue | #FFB0C4DE | Pink | #FFFFC0CB |
| Azure | #FFF0FFFF | DimGray | #FF696969 | LightYellow | #FFFFFFE0 | Plum | #FFDDA0DD |
| Beige | #FFF5F5DC | DodgerBlue | #FF1E90FF | Lime | #FF00FF00 | PowderBlue | #FFB0E0E6 |
| Bisque | #FFFFE4C4 | Firebrick | #FFB22222 | LimeGreen | #FF32CD32 | Purple | #FF800080 |
| Black | #FF000000 | FloralWhite | #FFFFFAF0 | Linen | #FFFAF0E6 | Red | #FFFF0000 |
| BlanchedAlmond | #FFFFEBCD | ForestGreen | #FF228B22 | Magenta | #FFFF00FF | RosyBrown | #FFBC8F8F |
| Blue | #FF0000FF | Fuchsia | #FFFF00FF | Maroon | #FF800000 | RoyalBlue | #FF4169E1 |
| BlueViolet | #FF8A2BE2 | Gainsboro | #FFDCDCDC | MediumAquamarine | #FF66CDAA | SaddleBrown | #FF8B4513 |
| Brown | #FFA52A2A | GhostWhite | #FFF8F8FF | MediumBlue | #FF0000CD | Salmon | #FFFA8072 |
| BurlyWood | #FFDEB887 | Gold | #FFFFD700 | MediumOrchid | #FFBA55D3 | SandyBrown | #FFF4A460 |
| CadetBlue | #FF5F9EA0 | Goldenrod | #FFDAA520 | MediumPurple | #FF9370DB | SeaGreen | #FF2E8B57 |
| Chartreuse | #FF7FFF00 | Gray | #FF808080 | MediumSeaGreen | #FF3CB371 | SeaShell | #FFFFF5EE |
| Chocolate | #FFD2691E | Green | #FF008000 | MediumSlateBlue | #FF7B68EE | Sienna | #FFA0522D |
| Coral | #FFFF7F50 | GreenYellow | #FFADFF2F | MediumSpringGreen | #FF00FA9A | Silver | #FFC0C0C0 |
| CornflowerBlue | #FF6495ED | Honeydew | #FFF0FFF0 | MediumTurquoise | #FF48D1CC | SkyBlue | #FF87CEEB |
| Cornsilk | #FFFFF8DC | HotPink | #FFFF69B4 | MediumVioletRed | #FFC71585 | SlateBlue | #FF6A5ACD |
| Crimson | #FFDC143C | IndianRed | #FFCD5C5C | MidnightBlue | #FF191970 | SlateGray | #FF708090 |
| Cyan | #FF00FFFF | Indigo | #FF4B0082 | MintCream | #FFF5FFFA | Snow | #FFFFFAFA |
| DarkBlue | #FF00008B | Ivory | #FFFFFFF0 | MistyRose | #FFFFE4E1 | SpringGreen | #FF00FF7F |
| DarkCyan | #FF008B8B | Khaki | #FFF0E68C | Moccasin | #FFFFE4B5 | SteelBlue | #FF4682B4 |
| DarkGoldenrod | #FFB8860B | Lavender | #FFE6E6FA | NavajoWhite | #FFFFDEAD | Tan | #FFD2B48C |
| DarkGray | #FFA9A9A9 | LavenderBlush | #FFFFF0F5 | Navy | #FF000080 | Teal | #FF008080 |
| DarkGreen | #FF006400 | LawnGreen | #FF7CFC00 | OldLace | #FFFDF5E6 | Thistle | #FFD8BFD8 |
| DarkKhaki | #FFBDB76B | LemonChiffon | #FFFFFACD | Olive | #FF808000 | Tomato | #FFFF6347 |
| DarkMagenta | #FF8B008B | LightBlue | #FFADD8E6 | OliveDrab | #FF6B8E23 | Transparent | #00FFFFFF |
| DarkOliveGreen | #FF556B2F | LightCoral | #FFF08080 | Orange | #FFFFA500 | Turquoise | #FF40E0D0 |
| DarkOrange | #FFFF8C00 | LightCyan | #FFE0FFFF | OrangeRed | #FFFF4500 | Violet | #FFEE82EE |
| DarkOrchid | #FF9932CC | LightGoldenrodYellow | #FFFAFAD2 | Orchid | #FFDA70D6 | Wheat | #FFF5DEB3 |
| DarkRed | #FF8B0000 | LightGray | #FFD3D3D3 | PaleGoldenrod | #FFEEE8AA | White | #FFFFFFFF |
| DarkSalmon | #FFE9967A | LightGreen | #FF90EE90 | PaleGreen | #FF98FB98 | WhiteSmoke | #FFF5F5F5 |
| DarkSeaGreen | #FF8FBC8F | LightPink | #FFFFB6C1 | PaleTurquoise | #FFAFEEEE | Yellow | #FFFFFF00 |
| DarkSlateBlue | #FF483D8B | LightSalmon | #FFFFA07A | PaleVioletRed | #FFDB7093 | YellowGreen | #FF9ACD32 |
| DarkSlateGray | #FF2F4F4F | | | | | | |

## Filter Expression Editor

The Filter Expression Editor allows to filter particles before creating the particle list or to hide or select certain particles in the Particle Manager.

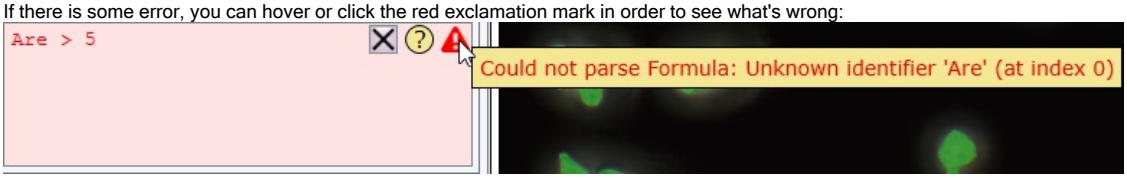
Formula Editor




Enter a boolean formula that defines a filter condition.
Click on the yellow question mark in order to see all possible variables and some examples.

To remove the formula, press X.

If there is some error, you can hover or click the red exclamation mark in order to see what's wrong:



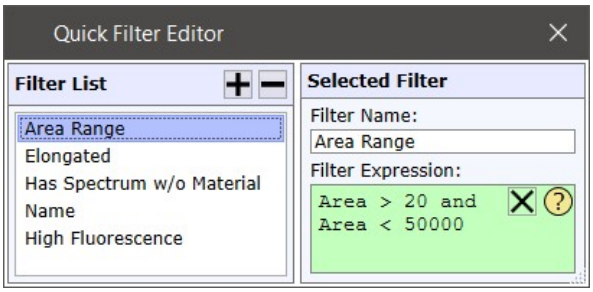

Quick Filters

You can define quick filters in order to recall a custom formula with a single mouse-click.


Click on a desired Quick Filter to use the saved formula in the filter expression editor.

In Particle Manager: click on the desired Quick Filter check mark to add/remove particle flags.

Configure Quick Filters




Here you can add, remove or edit Quick Filters.

Just add a new filter and set a name and formula.

Example Formulas

| | |
|---|---|
| Area > 5 | Larger than condition |
| Area > 5 and Area < 10 | Combination with AND |
| (Area > 10 and Area < 20)<br>or<br>(Area > 50 and Area < 70) | Combination with AND and OR using brackets |
| Material = "Quartz" | String comparison |
| Material.Contains("Quar") | String method call "Contains" |
| FeretMin > 3 * FeretMax | Larger than condition with multiplication |
| RandomValue > 0.5 | Random selection of half of all elements<br>(RandomValue = Random number between 0 and 1) |
| IsOversaturated | Show only particles that have over-saturated spectrum |
| !IsOversaturated | NOT operator "!": show only particles that have NO over-saturated spectrum |
| Math.Sqrt(Length * Width) > 5 | Calculates the square root of Length * Width and compares larger than 5. |

Please refer to the .NET Framework 4.7.1 documentation for other Math or String methods.