



*Updates on CASA Image Analysis and
Spectral Line Search Tools and Tasks*

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New Region Text File Format

Support for several different region shapes:

annulus (center, inner & outer radii)

box, centerbox, rotbox (corner position; center, side lengths;
center, side lengths, position angle)

ellipse (center, major & minor axes, position angle)

circle (center, radius)

polygon (vertices positions)

Support for annotations:

line

symbol

text

vector

Support for keywords for defining a region:

coord (direction reference frame, eg J2000 etc)

range (spectral range)

frame (velocity reference frame, eg. LSRK, etc)

restfreq (rest frequency)

veltype (radio, optical, etc)

corr (polarizations)

Support for display keywords:

color

linestyle, linetype (for drawing regions)

font, fontsize, fontstyle (for text)

usetex (interpret provided text as latex formatting)

label (text label), labelcolor, labelpos, labeloff

symsize, symthick (for symbol rendering)

```
#CRTFv0 <-- ALWAYS NECESSARY ON THE FIRST LINE
```

```
# Fabulous new region format
```

```
# example of global
```

```
global linewidth=3, font=Arial, range=[30km/s,-20km/s], restfreq=22.24GHz
```

```
rotbox [[4:45:28, -14.22.19.6], [10arcsec, 9arcsec], 35deg]
```

```
annulus [[14:45:28.2, -14.22.12.4], [10pix, 20pix]], color=blue, corr=[I]
```

```
global range=[22.23GHz,22.25GHz]
```

```
# subtract out an ellipse, note that differences are NOT in general commutative
```

```
- ellipse[[4:45:28, -14.22.19.6], [5arcsec, 2arcsec], 20deg] color=yellow
```

```
# the next line is to be rendered only and not used to determine the region
```

```
# for analysis
```

```
# In a polygon, there will automatically be a line segment joining the last
```

```
# vertex to the first to close the shape
```

```
ann polygon[[2pix,4pix], [4pix,4pix], [5pix, 5pix]], label="Just a way cool triangle"
```

```
text[[20pix,30pix], "Just some small text"], fontsize=2
```

Spectral Line Fitting

- Use the `specfit` task or the `ia.fitprofile()` tool method
- Multiple gaussians and/or a polynomial baseline can be simultaneously fit
- Either a single fit done by averaging all pixels in a specified region or a pixel by pixel fit can be done
- In the case of a pixel by pixel fit, any subset of the gaussian parameter (center, amplitude, fwhm, integral) solution images and/or their errors can be written
- Initial estimates of gaussian model parameters can be specified and any subset of these parameters can be held fixed during the fit.

2-D Gaussian Fitting

Task `imfit` or tool method `ia.fitcomponents()`

One can specify initial estimates as also which parameters to hold constant during the fit.

Can write model and/or residual images.

Can do a (eg spectral) plane by plane fit.

Would not be difficult to implement a simultaneous fit to a constant offset.

Image Plane Primary Beam Correction

- Use task `impbcor` or tool method `ia.pbcor()`
- A primary beam response image is required
- Target image can either be multiplied or divided by the primary beam response image
- Primary beam thresholding can be applied; output pixels are masked bad beyond the threshold

Transpose Images

Task `imtrans` or tool method `ia.reorder()`.

One can specify the output order of the axes using the `reorder` input parameter which can be either an integer containing the input axes positions, an array of integers, or minimal match strings matching the input axes names.

For example, `reorder=1032`, (1->0, 0->1, 2->3, 3->2) or `reorder=["d", "f", "r"]` (to reorder in declination, frequency, right ascension order).

Collapse Images Along One or More Axes

Use task `imcollapse` or tool method `ia.collapse()`

One or more axes can be collapsed simultaneously using the `axes` parameter, a single integer, array of integers, or array of minimal match axes names are supported.

One can choose which aggregate function to apply to the collapsed pixels via the `function` parameter. Choices include: `max`, `mean`, `median`, `min`, `rms`, `stdev`, `sum`, and `variance`. Another choice is `zero`, which means all output pixel values will be 0.

Spectral Line Search

- Default catalog contains 460k lines imported from Splatalogue (www.splatalogue.net).
- The `sl` tool contains methods for querying a spectral line catalog
- You may import your own Splatalogue catalog using Splat's export to CASA feature and importing that file into CASA using `sl.splattotable()`
- A catalog may be searched with either the `sl.search()` tool method or the `slsearch` task

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