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JMMC

LITPro GUI - User's Manual (Reference Guide)

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	Update fit result section		

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1 Reference guide

The present section explains the commands and functions accessible from the LITpro GUI. It is organized according to the main operations to be done for building a model fit: run the interface, possibly use a pre-defined setting, load the data and have look at it, select a target, choose a model and specify its parameters, run the fit and understand its results.

1.1 Running the LITpro GUI

The LITpro GUI requires to have installed the JAVA 2 SE Runtime Environment (JRE) on your machine. If this is done, the Java Webstart application can be launched by clicking the link (to a JNLP file) from the JMMC's dedicated web page. Alternatively, (this may help if the webstart application does not work properly on your system), you can also download the JAR file of the application and run it locally; with Linux or Mac OS X, this is done by typing: `java -jar LITpro.jar`. A network connection to the host (jmmc.fr) is in any case needed. You can launch the software from the menu of the jmmc web site or use direcly following location : http://www.jmmc.fr/litpro.

1.2 Create/Open/save a setting (under File in menu bar)

In the general case, the user will start building the model fit of his/her data from scratch, i.e. without using some pre-existing settings. In that case, the first step is to start a New Settings session under the File menu; it can also be done by clicking directly the "blank sheet" icon under the menu bar. Alternatively, if you (or someone else) have already built some model(s) using this data, you can use the previously recorded specifications of the model(s), i.e. the "settings" file. Setting files are in ".xml" format, and can be accessed in different ways under the File menu:

- Open Settings file: activates a file browser to find and open the file of a given setting. The "Open file" icon (second icon under the menu bar) is an equivalent shortcut.
- Open Settings url: activates an url browser to find and open the file of a given setting.
- Open Demo Setting: browses through a list of pre-defined demo settings, which are the data and models used in the Tutorial.

Most of the different operations detailed in this manual may already be done if you use an existing settings file. Once loaded (or newly created), the different fields which define the model can be viewed, completed and/or modified as explained further. The current settings file (including or not the results of the fit), can then be saved, using Save settings under the File menu or by clicking directly the "record" icon under the menu bar.

1.3 Structure of the GUI

The GUI uses different sub-windows, whose function and appearance depend on the current operation. The menu bar is principally used for opening/creating/saving settings (under File) and for accessing, under Help, the User's Manual, FAQs and Feedback report facilities. The User's Manual online help is a browser through the different paragraphs of the present document; it can also be called through the "?" icon under the menu bar. Equivalent icons "?" located nearby different functions or panels of the GUI display specifically the online help for the concerned topic. Also, note that the "About" window under Help contains, in addition to the version and copyright information, the link to the JMMC LITpro web page.

Several settings can be opened simultaneously (e.g. for comparing different models or parameters set on some data), each of them will appear under a tab, below the main menu bar. For a given setting (i.e. a given tab), the principal areas displayed are the main tree on the left side, and the detailed content windows on the right side.

The Settings tree (left-hand part of the GUI) displays the main tree of the current setting, and works just as other file browsers. Each of its class can be expanded or reduced by a double click or a simple-click at the node. Under the highest tree level (Settings) are found the sub-levels Files, Targets and Result. They appear in red until their parameters are sufficiently defined.

The right-side windows detail the content of the current level in the tree, highlighted on the left side. When the highest-level (Settings) is selected, the Settings panel on the right side is divided between the Oifile list, the Target list, the fitter setup and the Personal notebook areas. Note that the Oifile list and the Target list panels can as well be accessed by clicking on the corresponding level (resp. Files and Targets) in the main tree; the panel then fills entirely the right side. The components of these lists (files, targets) are themselves expandable by a double-click, either from the main tree or from the dedicated section on the right side. Their content and functions will be detailed in the next sections.

The Personal notebook area is initially empty if no previous setting has been loaded. It will be automatically filled after each computation of a fit, with a summary of the relevant information: fit index number, date and time, values of χ^2 (reduced or not), values of the parameters fitted (name, initial and final values, boundaries, units, etc). It can also include any note or comment that the user may want to add, by simply editing it. The personal notebook, just as the detailed fits results and plots, is saved within the current "setting" at the end of the LITpro session.

1.4 Load and view the data

1.4.1 Load the data file (Oifile list)

Once a new setting is opened, loading the data file(s) is the first step for building a model fit. Press Load oifile... in the Oifile list area (visible from the Settings or from the Files main tree levels) to open a file browser and select your data locally. The data file must be in OIFITS format (with a .fits or .oifits extension).

You can also get access to publicly shared data (e.g. for a training practice), by choosing Load remote Oifile.... This opens a browser through the "JMMC Optical interferometric data sharing area" files. For each observation set selected in Categories, some comments (and possible some link) provide additional information on the data. The data files themselves appear in the lower part of the browser; for each of them the basic observational information (Target, RA, DEC) is displayed below. Select one or several (using CTRL or Shift keys) data files and press OK to have them downloaded in your current LITpro session.

Once selected, the newly loaded file appears as File[filename.fits] under the File level in the main tree and in the Oifile list. Double-click on the file in the list to open the File Panel.

1.4.2 Check the file (File Panel)

LITpro is designed to work on standard OIfits data (Pauls et al., 2005), and since there might always be some doubts on the validity of a given data set, the file is automatically checked. The "Oifits checker" can also be run manually using Check embedded file in the File Panel. In the diagnosis text window, the "warnings" will not forbid to use the data for the fit, whereas the "severe errors" often will (although some data files displaying an error at this stage might run smoothly for the fit).

1.4.3 Look into the data (File Panel)

Double-click on the file name under the File level in the main tree or in the Oifile list to open the File Panel. The different data tables of the OIfits file can be viewed (see Pauls et al. (2005) for details on the Oifits standard). Press Show selected tables... after highlighting one (or equivalently, double-click on the table), to open a TOPCAT window which lets you view or plot the selected table. To visualize more directly the measurement data, it is convenient to use one of the following specific commands, in the lower part of the File Panel.

- Show UV coverage of selected table: Plots the UV points where some data of the selected table(s) has been acquired. May use VIS, VIS2 and/or T3 tables, with a color code to separate the coverage for the different types of measurables.

- Plot data of OI_VIS: plots the visibility amplitude (VISAMP) and/or phase (VISPHI) as a function of the spatial frequency. May use either one or several selected VIS tables, or all of them by default.
- Plot VIS2DATA of OI_VIS2: plots the squared visibility amplitude as a function of the spatial frequency. May use either one or several selected VIS2 tables, or all of them by default.
- Plot data of OI_T3: plots the closure phase (T3PHI) and/or closure amplitude (T3AMP), together with their associated error bars, as a function of the spatial frequency. May use either one or several selected T3 tables, or all of them by default.

  These plots, displayed in the Frame Panel, are also directly copied under the Plots directory in the main Settings tree to keep track of them. You may choose to detach a plot in a separate window or to re-attach it to the current Frame Panel. You can Export the plot data in tsv (text) format, or, from the File menu of the detached window, export the figure in eps (encapsulated postscript) format.

  Also, you can Export the display of the current frame under png or pdf format.

1.5 Select the target and the associated model(s)

1.5.1 Select/add a target (Target list)

Clicking on Targets in the main Settings tree, displays the Target list area: it allows to select one or several targets and to associate them with models for the fit. The list of possible objects are taken from the data file and appear in the drop-down menu at the bottom of the Target list area. Select a target among the list, press Add new target and repeat the operation if more objects are necessary. Any target added (or repeated) by mistake in the list can be removed by selecting it and pressing remove
Note that a same object should appear several times in the list if you want to associate it with different files and different (or shared) model parameters (see Shared parameters for further details on that possibility). In that case, the models associated with every instance of the object will all be taken into account when running the fit.

1.5.2 Choice of a model

Select a target item using simple-click on the corresponding Target[name_Target] (under the Target list in the left-side main tree), or double click in the Target list right-side panel), to display the Target Panel. Below the object identifier appears the list of the files linked with that object. Select/unselect the files that you want to be considered for the fit of the current model. The model list sub-panel allows to select the model(s) associated with that target and file(s).

Browse through the drop-down list of model types at the right of Add model, select it and press Add model. Repeat this operation if you need the target to be fitted with more than one model. Any model added (or repeated) by mistake in the model list can be removed by selecting it and pressing remove. Short descriptions of the different models offered to date, together with their parameters, are presented in Table 1 of this manual, as well as in the parameters table after having added a model. Double-click on it from the Model list to open the dedicated panel. This dedicated panel can also be attained by clicking on the corresponding model name entries in Target[name_Target].

1.5.3 Set the model parameters

The Model panel. Double-click on an item from the Model list to open the Model panel, which gives a description of the model and a table of its parameters. It also give the possibility to change the current model function to another one, while keeping in the Parameters table the current values of their commom parameters (ex: x, y, diameter...): Just select the model function in the Model list and choose the new one from the Add model list. This is mostly convenient if you want to compare the fits from different model functions.

The Parameters Table. This table is the interface to view and modify the current model's parameters. Next to the name and type of each parameter are shown its unit and the values (fixed or variable) it may take. That table is displayed in both Target Panel and Model Panel.

Basic parameters. A few parameters are present in all the models:
- flux_weight attributes a weight to the current model function. flux_weight=1 means that it is normalized (in the image plane), i.e. that its luminosity is equal to 1. As for the other parameters, flux_weight can be set fixed or free, and its value is particularly relevant when using more than one model for the fit: their respective weight factor will determine how much they will account relatively for the fit of the data.
- x and y define the position of the model in the sky and are expressed in milliarsecond. Keep in mind that these parameters will be constrained only relatively (i.e. the position of a model component with respect to another one) if there is no absolute phase information in the data. By right-mouse clicking on x or y of a given model function, you get access to the polar coordinates (RHO in milliarcseconds and PA in degrees) with respect to the origin, i.e the center of the target.

Edit the parameters. The values of the parameters (refer to table 1 to have the complete list for each model function) can be edited and modified in the table by double-clicking and typing in the relevant box. For each parameter, set its appropriate Value (and possibly its range [minValue, maxValue], if that parameter is supposed to be free, as explained below), based on some previous hint you may have on its default value and/or its range. Once modified, it is not necessary to record the table with the new values.

Table 1 also indicates, when existing, the default minValue and maxValue of a given parameter. They correspond to the "physically" **authorized boundaries of a parameter**: the fit will not work if the specified "min" or "max" value allows the parameter to go beyond these limits. For instance, a disk radius should always be > 0, and the coefficient of a linear limb-darkening model should be comprised between 0 and 1.

The scale column allows to adjust the step size of the first variation applied to a parameter in the data fit computation. By default, the scale is calculated automatically as a function of the parameter's lower and upper limits. If these limits are not specified, it is set to 1 ; in that case, adjusting the scale is particularly relevant. A larger (i.e. > 1) scale will correspond to a larger first "step" (or gradient) during the computation and might save a significant number of iterations and thus time. In the general case, nevertheless, the user can choose to let scale unspecified and to rely on the default value.

Finally, in order to **set a parameter fixed or variable**, check the last column (HasFixed) of the parameters table: a ticked box means that the parameter is fixed, therefore its value is as set in the Value column and shall be constant during the fit process, and the minValue and maxValue are then meaningless. If the "Has fixed..." box is not ticked (default status), then the parameter is free: "Value" therefore means "starting value", and the minValue and maxValue represent the lower and upper limits within which it may vary during the fit process.

If several models are used in the current Target Panel. Repeat the specification of the parameters for all the models contained in the Model list. When using several models for the fit, the parameters name are followed by the index number of the model they apply to.

Shared/Linked parameters. A right-button click on a selected parameter line in the table allows to Share this parameter or Link to.... This is used in the case where several Target instances (loaded in the Target List Panel) are associated with different files and/or different model parameters. For a typical example, the different targets can be the same source object, observed in several files, each at different wavelengths; the user wants some parameters to be fitted independently at the different wavelengths (done by default, using the selection made in the List of files), and some others to be fitted commonly. For this, first choose Share this parameter (right-button click) in the parameters table. Then, in the parameters table associated with an other Target instance of the target list, right-button click and select in "Link to" the parameter which you want to be fitted together between the two target models. The parameter name is then changed in the table, to take the name of the shared one.

The dedicated Shared parameters panel shows the shared/linked relations between the parameters: In the table and at the first level of the tree structure are listed the parameters which were declared as "shared". For each of them, the tree displays the parameters which have been linked to it.

1.5.4 Fitter setup

The Fitter setup allows to choose the flux normalization and the type of data to be considered for the fit. A selected "normalized total flux" constrains the sum of the weights from the different model components, to be normalized to 1 during the fit. In some cases (shared parameters with another model, for example), the normalization may yield a conflict; a warning message is then emitted and the fit will perform with unnormalized flux weights. Also, the fit errors associated with flux_weight parameters are not expected to be relevant (abnormally high) when the normalization is on. You can unselect "normalize" if this feature is not needed.
The choice given by "Select Data to Fit" is fairly explicit: which kind of data (among: visibility modulus, visibility phase, squared visibility, closure amplitude and closure phase) will be taken into account when fitting the model to the observed data ? The fitter χ^2 and the resulting statistics and plots will then concern only the selected data. If a data type not present in the observation file is selected by mistake, it will just not be taken into account.

1.5.5 Plot the model using current parameters

In the lower part of the Target Panel is the Plot model panel, which offers graphical representation of the current model(s) in the image or frequency plane, using as parameters the Values entered in the parameters table, or the values resulting from a computed fit.

Plot Image: Plots the model(s) using the current parameters (Value column of the table), in the image plane. x and y limits define the field of view in right ascension and declination, expressed in mas. pixscale is the resolution of the image, in mas.

Plot UV map: Plots the model(s) using the current parameters (Value column of the table), in the Fourier (spatial frequency) plane, together with the marks of the UV points where data were taken. This gives a good idea of how well the Fourier transform of the model is sampled by the measurements.

Plot Radial: Plots the chosen quantity (squared visibilty, visibility amplitude or phase, T3 amplitude or phase) of the model using the current parameters, continuously as a function of the spatial frequency. Also plotted are the observed (crosses) and modeled (circles) quantities at the spatial frequency points where data were taken. It is possible to add onto the radial plot the model curve for a chosen angle in the UV plane (Overplot model with cut angle) in order to highlight some possible assymetry. The angle, in degrees, is counted clockwise starting from the vertical (v) axis. If Residuals is selected, the plot is the radial plot of the weighted residuals, i.e. the difference between the data and the model, weighted by the inverse of the standard deviation (see sec.1.6.1).

Plot sniffer map. The "sniffer" is a tool for exploring the best initial (x, y) values of a two-components model, in order to avoid local minima. In the current version, the sniffer fits the data with one punctual component fixed at position $(x, y) = (0, 0)$ plus another punctual component located at position (X, Y). The map represents, for each pair (X, Y) in the plane, the best χ^2 after a fit of the flux ratio between the two components. In a next version, the sniffer will consider the current model (instead of a point) for the first fixed component.

1.5.6 Plot the χ^2 around one or two parameters

Plot Chi2: In the Cut in the Chi2 space panel, the χ^2 is represented as a function of one (1D) or two (2D) parameter(s) to be selected from the list, over the interval range set by min and max (using n =sampling points). The other parameters of the model are fixed at the default value indicated in the parameters table: either the initial value, a value entered by hand or the result from a fit. This allows to explore graphically some local minima around a solution. The χ^2 can be displayed using either a linear scale ("Plot Chi2" button, advised for 1D) or a logarithmic scale ("Plot log(Chi2)" button), which corresponds to a higher dynamic range on the χ^2 and is usually more convenient for 2D maps. Selecting the "reduced" option means that the reduced χ^2 are plotted instead of the χ^2. The extremum values found for the χ^2 and its position in the parameters space are indicated in the resulting plot. The plot is listed under Plots in the main tree and can be saved locally.

Selecting the "with fit" option means to compute and plot a 1D or 2D chi2 map versus 1 or 2 parameters of the chosen model. These parameters may be called "gridded parameters". For each point of the map (thus for the new corresponding starting values of the gridded parameters), a new fit is run. This may yield a huge amount of computation time, so it is advised to fit a limited number of parameters and to fix the others. Take care that the 1 or 2 gridded parameters will be also fitted (thus modified !) if not fixed. For each new starting value of the gridded parameters, the initial guess for the fitted parameters are the ones resulting from the fit from the nearest values of the gridded parameters. This choice aims at limiting the amount of computation.

1.6 Run the fit and view the results

Once the data is loaded and the model is built, running the fit is the most simple operation. At the bottom left area, just press Run fit. By default, the number of iterations used for the fit is limited to 200, although the process might stop before, whenever the convergence criterion is satisfied. If the model contains more than just a few free parameters, you should consider setting a small maximum number of iterations (in the box at the right of "Use max iterations"), as the computation may take a long time. In any case, a running fit cannot be stopped before the end of execution. When the Run fit button is set back to its normal color, the calculation of the fit is done. The new Result Panel (see below) is then displayed. In case the fit fails, an error message will appear with a summary log. (Most often, a failure is due to an overflow from an inadequate setting of the parameters value.) The fit results are listed together with previous ones (if any), and can be displayed under Results, in the main tree. The current Value in the Parameters table will be updated by the parameters result of the fit.

1.6.1 Results

Under Results in the main tree, the new Fit result item is timestamped and selected by default. It displays the updated Personal notebook with a summary of the last and previous fits, and the full Result panel reporting the details from the fit computation:

- a reminder is provided for every timestamped results. It includes the Parameters used for the fit with the parameters name, final value, previous value, minimum and maximum values, scale, flag for fixed parameter, and units.
- Chi2 (i.e. χ^2) at the start and at the end of the fit, and its associated standard deviation σ. The χ^2 is defined as:

$$\chi^2(p) = \sum_i^{N_d} \frac{r_i^2(p)}{\sigma_i^2}, \qquad \text{with} \quad r_i(p) = d_i - m_i(p),$$

where N_d is the number of data, d_i the i^{th}vdata, σ_i their standard deviation, and m_i the value from the parametric model.

- the reduced chi2 at the begining and at the end of the fit. Reduced chi2 is equal to the chi-square divided by the number of degrees of freedom, i.e. χ^2/N_f. For the same data and number of free parameters, the (reduced) chi2 is of course sought to be minimized by the fitter, and might depend on the initial parameters values. Note that a reduced chi2 significantly larger than 1 does not mean that the fit result is of bad quality. It is, therefore, a relative rather than an absolute indicator to compare the fit quality from different models or parameters set.

- σ of chi2 may help to compare different fits with the same number of degrees of freedom. If the difference between the final chi2 is less than σ of chi2, that means that this difference is not significant: there is not a better fit.

- the number of Iterations used for reaching the stop criteria. It is limited by the user-defined maximum number of iterations, and by some hard-coded tolerances on the step and on the gradient of the parameters.

- the table of parameters, completed by the fit : the final value of each parameter is given, with its statistical standard deviation. The value of each parameter before the fit is also recalled.

- the Covariance matrix, whose elements $\Sigma_{i,j}$ are the covariance of i^{th} parameter X and j^{th} parameter Y:

$$\Sigma_{ij} = \text{cov}(X,Y) = \text{E}[(X-\mu_X)(Y-\mu_Y)], \qquad \text{with}\, \mu_X = \text{E}(X)$$

  The $\Sigma_{i,i}$ elements are then the variances of parameters X_i, i.e. the square of the standard deviation $\sigma(X_i)$ indicated in the Parameters table.

- The correlation matrix, whose elements are defined as:

$$\rho_{X,Y} = \frac{\text{cov}(X,Y)}{\sigma_X \sigma_Y}$$

  The diagonal elements (autocorrelation of a parameter) should be equal to 1, whereas the cross-elements reflect the degree of correlation between two parameters: $\rho_{X,Y}$ close to 1 indicates a probable degeneracy between X and Y (see tutorial for more details).

1.6.2 Result Plots

Unfold the node at the Results / Fit Result level (main tree), to list the graphics automatically generated after the fit process:
- Plot baselines and Plot UV coverage, represent the baselines or (U,V) points used for the fitted data (equivalent to the Show UV coverage command in the File Panel).

- the following plots represents, for each selected data type to fit (see Fitter setup under Target Panel) the measured data and the fitted model data (together with their error bars), as a function of the radial distance.

- for each of them is also associated a plot of the weighted residuals, representing the difference, as a function of radial distance, between the measured data and the fitted model data, divided by the error bar (see sec.1.6.1).

In these plots, the different data quantities ("[data]" preceeded by the table name) appear as large dots with their error bars and are distinguished by different colors, as indicated in the legend. The corresponding results from the model fit ("model") appear as smaller dots. A plot may be suppressed from the list using the fourth ("cross") icon below the menu bar, or detached/re-attached in/from a separate window, using the Attach/Detach button above the plot or the equivalent (fifth) icon below the menu bar. Also, you can Export the plot data in tsv (text) format, or, from the File menu of the detached window, export the figure in eps (encapsulated postscript) format.

1.6.3 Additional graphics (Plots)

Three plot panels are displayed at the Plots main-tree level: the upper (Cut in the Chi2 space panel) and lower Plot model panel) ones are identical to those appearing below the Target Panel for each Target, and are described in further details in the corresponding section (see 1.5.5).The middle Plots panel, Common plots panel is not specific to a particular target and is presented in the next paragraph.

Any new generated plot is listed under Plots, in the main tree. Once displayed ot selected, a plot can be saved locally ("Export...") in PNG, PDF or FITS formats, suppressed from the list using the fourth ("cross") icon below the menu bar. You may detach/re-attach a plot in/from a separate window, using the Attach/Detach button above the plot or the equivalent (fifth) icon below the menu bar.

Common plots panel: The Common plots panel allows to plot together some data corresponding to several targets. Note again that different "targets" might refer here to a same astrophysical object, whose data was taken from distinct observation files. The plots available in this panel are similar to those automatically generated below each "Fit result" item, described in sec.1.6.2 : Plot baselines, Plot UV coverage, and "model & data" radial plots for the selected data (e.g. vis2, T3Phi,...). If Residuals is selected, the plot is the radial plot of the weighted residuals, i.e. of the difference between the data and the model, weighted by the inverse of the standard deviation (see sec.1.6.1). Here are the main improvements of this Plot panel:

- A list of targets allows to choose which data sets should be included for the plot. The option Use all targets, if selected, includes them all.
- For "model & data" radial plots, the "model" curves are traced continously as a function of radial frequency, and not just at the observed frequencies.
- It is possible to add onto the radial plot the model curve for a chosen angle in the UV plane (Overplot model with cut angle) in order to highlight some possible assymetry. The angle, in degrees, is counted clockwise starting from the vertical (v) axis.
- Just as for other graphics produced from a Plots panel, they are exportable using a graphical format (PNG, PDF, FITS)

1.7 Repeat and compare between models

It is unlikely that the fitting model gives you full satisfaction and confidence at the first try, especially if the introduced model(s) is hypothetical and/or depends on many parameters. You should usually go back to the modeling stage, in order to either explore other initial values of parameters (with the help of the sniffer and Chi2 maps), possibly fix or set some free, or try using other possible models for the fit. After every change of parameters or model choice, running the fit will generate a new Result directory with the relevant numerical values and plots.

Table 1: Descriptive list of the currently available models with their associated parameters. All the models are parametrized by their position at coordinates (x,y) (milliarcsecond), and the intensity or amplitude coefficient (flux_weight or amplitude). The coordinates are given relatively to the center of the target. By right-mouse clicking on x or y in the parameters table of the Target Panel, you get access to the polar coordinates (rho in milliarcseconds and PA in degrees) with respect to that origin.

Name	Description	Param.	limits
punct	Point source (Dirac delta function).	flux_weight x, y	[0,]
background	Uniform background.	flux_weight	[0,]
disk	Normalized uniform disk of diameter diameter centered at cartesian position (x, y) (mas, mas).	flux_weight x, y diameter	[0,] [0,]
disk_polar	Normalized uniform disk of diameter diameter centered at polar position (rho, PA) (mas, deg).	flux_weight rho PA diameter	[0,] [0,] [0, 360] [0,]
circle	Infinitely thin normalized circle of diameter diameter.	flux_weight x, y diameter	[0,] [0,]
ring	Normalized uniform ring with internal diameter diameter and external diameter diameter + width	flux_weight x, y diameter width	[0,] [0,] [0,]
gaussian	Normalized 2D-gaussian with full width at half maximum fwhm	flux_weight x, y diameter	[0,] [0,]

Limb-darkening	The following models are center-to-limb darkened disk of diameter diameter. Brightness distribution o, expressed versus μ the cosine of azimuth at the surface of the star, has one of the following laws, and is normalized for $\mu = 1$ (center of the star).		
Name	Description	Parameters	limits
limb_linear	Linear law of coefficient a_1: $o(\mu) = 1 - a_1(1 - \mu)$	flux_weight x, y diameter a_1	[0,] [0,] [0, 1]
limb_power	Power law with coefficient power: $o(\mu) = \mu^{\text{power}}$	flux_weight x, y diameter power	[0,] [0,]]0,]
limb_sqrt	Square root law of coefficients a_1 and a_2 : $o(\mu) = 1 - a_1(1 - \mu) - a_2(1 - \sqrt{\mu})$	flux_weight x, y diameter a_1, a_2	[0, 1] [0,]]0, 1[
limb_quadratic	Quadratic law of coefficients a_1 and a_2: $o(\mu) = 1 - a_1(1 - \mu) - a_2(1 - \mu)^2$	flux_weight x, y diameter a_1, a_2	[0,] [0,]]0, 1[
limb_nonlinear_Claret	Claret's non-linear law of 4 coefficients a_1, a_2, a_3 and a_4: $o(\mu) = 1-a_1(1-\mu^{1/2})-a_2(1-\mu)-a_3(1-\mu^{3/2})-a_4(1-\mu^2)$ The common use of this model is to fix the 4 coefficients based on the values from Claret (2000, A&A, 363, 1081); catalogue available at http://cdsads.u-strasbg.fr/cgi-bin/nph-data_query?bibcode=2000A%26A...363.1081C&link_type=DATA&db_key=AST&high=	flux_weight x, y diameter a_1 to a_4	[0,] [0,] fixed

Elongated	The following models are elongated versions of the ones presented above. Each has a ratio elong_ratio between the major axis and the minor one, e.g: elong_ratio= major_axis_diameter / minor_axis_diameter (in the case of a disk). The major axis is oriented with an angle major_axis_pos_angle (in degrees, positive clockwise) with respect to the positive vertical axis.		
Name	Description	Parameters	limits
elong_disk	Elongated uniform disk (i.e. filled ellipse).	flux_weight x, y minor_axis_diameter elong_ratio major_axis_pos_angle	[0,] [0,] [1,] $[0, 180]$
elong_gaussian	Normalized elongated gaussian. The dimensions are given by the narrowest Full Width at Half Maximum (minor_axis_fwhm) and by the ratio elong_ratio between the major and minor FWHMs.	flux_weight x, y minor_axis_fwhm elong_ratio major_axis_pos_angle	[0,] [0,] [1,] $[0, 180]$
elong_ring	Normalized uniform ring. The dimensions are given by the narrowest internal diameter (minor_internal_diameter), the ratio elong_ratio between the major and minor internal diameters (as for the other elongated models), and the width of the ring. Along the direction of the minor axis, the external diameter is: minor_internal_diameter + width. In the direction of the major axis, the width is magnified by elong_ratio, so that the external diameter is: major_internal_diameter + elong_ratio × width.	flux_weight x, y minor_internal_diameter elong_ratio width major_axis_pos_angle	[0,] [0,] [1,] [0,] $[0, 180]$
elong_disk	Elongated uniform disk (i.e. filled ellipse)	flux_weight x, y minor_axis_diameter elong_ratio major_axis_pos_angle	[0,] [0,] [1,] $[0, 180]$

Flattened	The following models are *flattened* versions of the disk, ring and gaussian models. Each has a ratio flatten_ratio (> 1) between the major axis and the minor one, e.g: flatten_ratio= major_axis_diameter/minor_axis_diameter (in the case of a disk). The minor axis is oriented with an angle minor_axis_pos_angle (in degrees, positive clockwise) with respect to the positive vertical axis.		
Name	Description	Parameters	limits
flatten_disk	Flattened uniform disk (i.e. filled ellipse).	flux_weight x, y major_axis_diameter flatten_ratio minor_axis_pos_angle	[0,] [0,] [1,] $[0, 180]$
flatten_gaussian	Normalized flattened gaussian. The dimensions are given by the widest Full Width at Half Maximum (major_axis_fwhm) and by the ratio flatten_ratio between the major and minor FWHMs.	flux_weight x, y major_axis_fwhm flatten_ratio minor_axis_pos_angle	[0,] [0,] [1,] $[0, 180]$
flatten_ring	Normalized uniform ring. The dimensions are given by the widest internal diameter (major_internal_diameter), the ratio flatten_ratio between the major and minor internal diameters (as for the other flattened models), and the width of the ring. Along the direction of the major axis, the external diameter is simply: major_internal_diameter + width. In the direction of the minor axis, the width is decreased by flatten_ratio, so that the external diameter is: minor_internal_diameter + width / flatten_ratio.	flux_weight x, y major_internal_diam. flatten_ratio width minor_axis_pos_angle	[0,] [0,] [1,] [0,] $[0, 180]$

Non-normalized disks	The following models are non-normalized versions of the (regular, elongated or flattened) disk functions presented above. Here the amplitude parameter, which replaces the flux_weight, sets the constant amplitude over the disk. The total energy therefore increases with the diameter. All the other parameters keep the same meaning as for their "normalized disk" counterparts.		
Name	Description	Parameters	limits
nonorm_disk	Non-normalized uniform disk of diameter diameter.	amplitude x, y diameter	[0,] [0,]
nonorm_elong_disk	Non-normalized elongated uniform disk.	amplitude x, y minor_axis_diameter elong_ratio major_axis_pos_angle	[0,] [0,] [1,] [0, 180]
nonorm_flatten_disk	Non-normalized flattened uniform disk.	amplitude x, y major_axis_diameter flatten_ratio minor_axis_pos_angle	[0,] [0,] [1,] [0, 180]

Glossary

(u,v) or (ufreq, vfreq) : Spatial frequencies along U (respectively V) axes for the current Target, as a NBAS-by-NCHN array (or NBAS vector for monochromatic data) where NBAS is the number of baselines and NCHN is the number of spectral channels. u is the east component and v the north component of the baselins vector projection. Unit is 1/rad.

chi2 (or χ^2) : Distance criterion between the data and the parametrized model. The chi2 is minimized in order to find the best-fitting parameters set. See sec.1.6.1 for mathematical formula.

Covariance matrix: Matrix of the covariances between the parameters of the model. It is used to quantify their mutual variation, and their dependency. See sec.1.6.1 for mathematical formula.

Correlation matrix: Matrix of the correlations (i.e. covariance divided by the standard deviations) between the parameters of the model. Comprised between -1 and 1, it quantifies their linear relationship. When equal to 0, it means a linear independency between the parameters. See sec.1.6.1 for mathematical formula.

Degrees of freedom: Difference between the number of data (N_d) and the number of parameters (N_p) used for the fit.

Flux_weight: Intensity coefficient, mandatory variable of model function. If it equals to 1, the total energy is 1. Without dimension.

mas: milliarcseconds.

Settings: Sets what is necessary for the model fitting : the data (through the choice of the data file(s)) and, after that the Target has been selected, the model function(s) to fit the data.

Settings tree: Graphical widget which represents the hierarchical elements of the fit. It contains the input files, the target, possibly some plots and/or results. The user can select some elements to get a display with more informations.

Target: Astrophysical object whose data are confronted with the model fitting.

T3amp: Amplitude of the triple product of complex visibilities along closed-loop baselines (syn. *"Closure amplitude"*).

T3phi: Phase of the triple product of complex visibilities along closed-loop baselines (syn. *"Closure phase"*), in degrees.

VISamp: Modulus of the complex visibility (the normalized Fourier transform of the source at spatial frequency (u, v)).

VISphi: Phase of the complex visibility (the normalized Fourier transform of the source at spatial frequency (u, v)), in degrees. In most cases, the phase measurement is differential, relatively to a specific spectral channel or to another source.

VIS2: Modulus squared of the complex visibility.

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