

## ctools - Feature #1991

### Source Probability in event file - ctprob

04/06/2017 03:48 PM - Di Venere Leonardo

<b>Status:</b>	Closed	<b>Start date:</b>	04/11/2017
<b>Priority:</b>	Normal	<b>Due date:</b>	
<b>Assigned To:</b>	Di Venere Leonardo	<b>% Done:</b>	100%
<b>Category:</b>		<b>Estimated time:</b>	6.00 hours
<b>Target version:</b>	1.3.0		
<b>Description</b>			
Create new ctool: ctprob The tool calculates the probability for each photon in the input event list to come from each of the sources in a given model			

#### History

##### #1 - 04/06/2017 03:49 PM - Di Venere Leonardo

- Tracker changed from Bug to Feature
- Start date deleted (04/06/2017)

##### #2 - 04/07/2017 10:27 AM - Di Venere Leonardo

- File probabilities1.png added
- File probabilities2.png added
- Status changed from New to Pull request
- % Done changed from 0 to 100

The tool ctprob has been developed and tested.

The tool takes an event list file (or an XML observation file) and a source model as input.

For each event, it evaluates the probability for that event to come from each of the source in the model.

A column for each source in the model is added to the event list in order to store these values.

In order to test the tool, I generate an event list, simulating a crab spectrum and the background using ctobssim.

Then I added an additional source in the model used in ctprob and tested the tool in two cases.

1) In the first case, the source (Source1) has a flux 10 times larger than the Crab and an offset of 1 degree from the Crab (coords\_source1 = (RA\_crab+1, DEC\_crab) )

2) In the second case, the source (Source2) has a flux 10 times larger than the Crab (same as in case 1) and an offset of 0.3 degree from the Crab (coords\_source2 = (RA\_crab+0.3, DEC\_crab) )

The following plots show the probabilities of the three sources in the model in the two cases described above.

In the plot, only events with declination in the interval (DEC\_crab-0.1, DEC\_crab+0.1) are included.

It can be noticed that for each event the sum of the probabilities is 1 as expected.

Furthermore, the additional source (1 or 2) has a larger distribution with respect to the Crab, being the flux larger.

Finally, in case 2, in the region in-between the Crab and Source2 the probability is correctly shared between the two sources, according to the distance from the source and its flux.

The tool seems to be working properly.

I also added a few python tests, one of which takes an observation XML file as an input.

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#### NOTE:

A pull of the associated gammaLib branch is also necessary. In particular, I added a new method to the GCTAEventList class that appends a new column to "m\_columns". This is necessary to correctly add the new columns containing the source probabilities to the event list and then save them to the output file.

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The relevant branches are:

- ctools: 1991-ctprob-eval-event-probs
- gammalib: 1991-ctprob-modified-

Figure1:

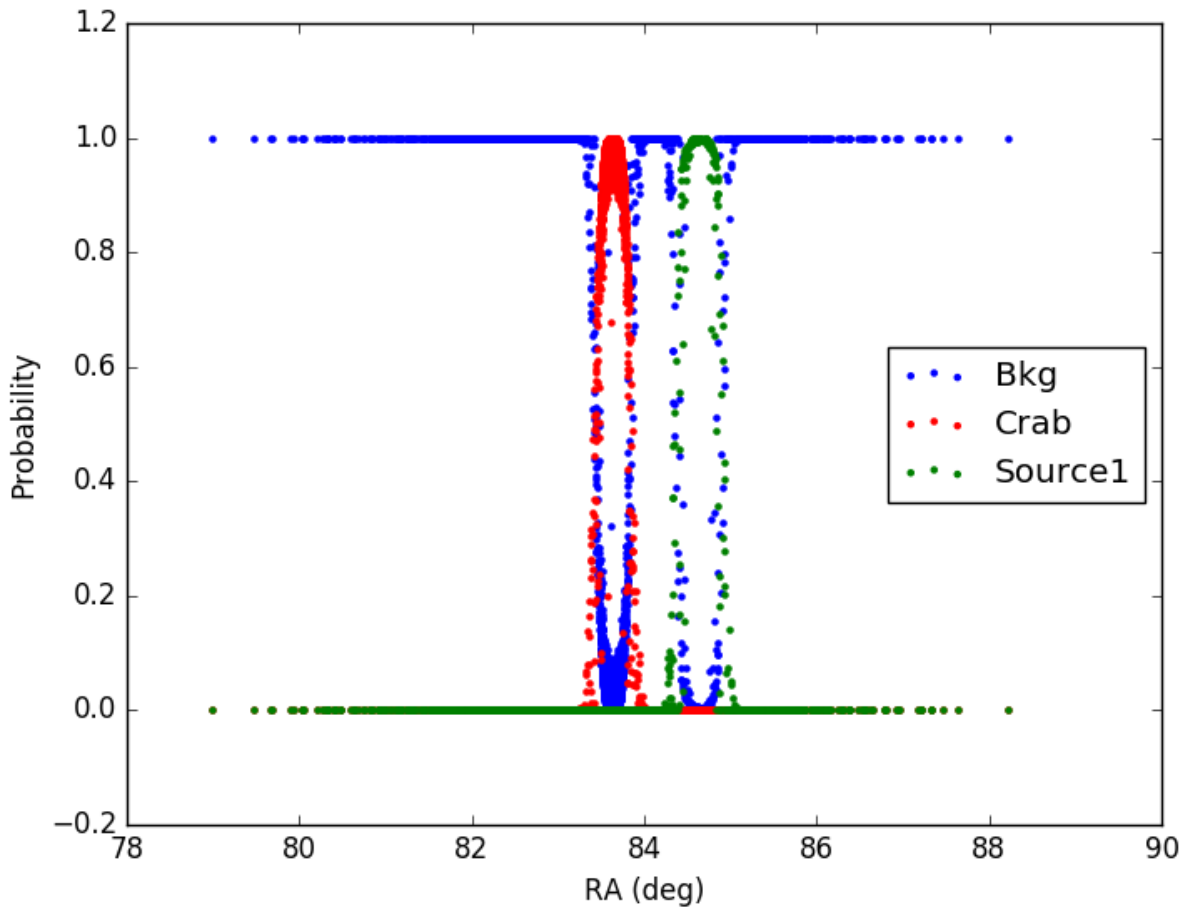
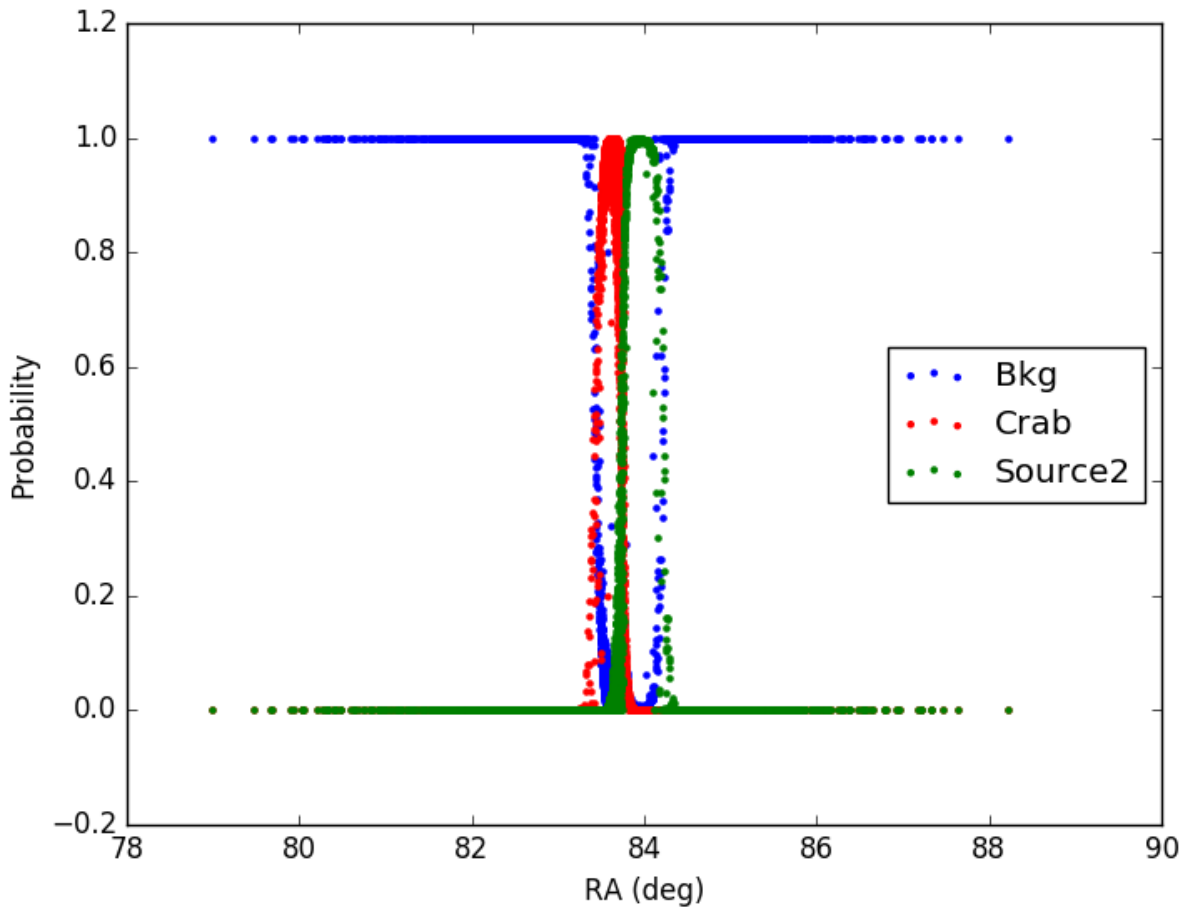


Figure2:



### #3 - 04/11/2017 11:24 AM - Knödseder Jürgen

- Target version set to 1.3.0

- Start date set to 04/11/2017

I integrated the GammaLib part. Note that the `GCTAEventList::append_column()` method as written was vulnerable to a memory leak since it appended the reference to the column provided on input to the `GCTAEventList` object. Since the memory has been created outside the method the `GCTAEventList` class has no control over when the memory is de-allocated.

I changed the code so that a clone of the column is appended. Now, `GCTAEventList` has full control over the memory allocation and de-allocation, and the client can do what he wants with the FITS column.

I also added an exception in case that the column length is incompatible with the number of events.

### #4 - 04/11/2017 02:46 PM - Knödseder Jürgen

- Status changed from Pull request to Closed

I now merged the `ctprob` tool into `ctools`.

I refactored a bit the code. For example the writing of a temporary FITS file is not needed. I also put some code that is redundant with `ctselect` in the `src/support/ctool.cpp` file.

All code is in devel now.

## Files

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probabilities1.png	41.2 KB	04/07/2017	Di Venere Leonardo
probabilities2.png	40.3 KB	04/07/2017	Di Venere Leonardo