Gamma-ray Binary analysis with Gammapy

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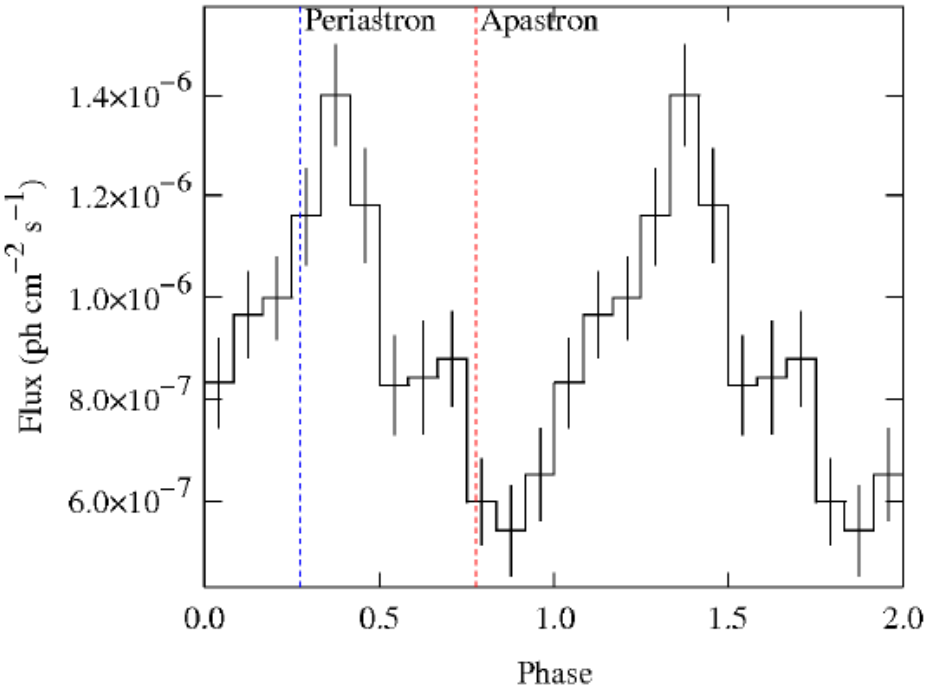
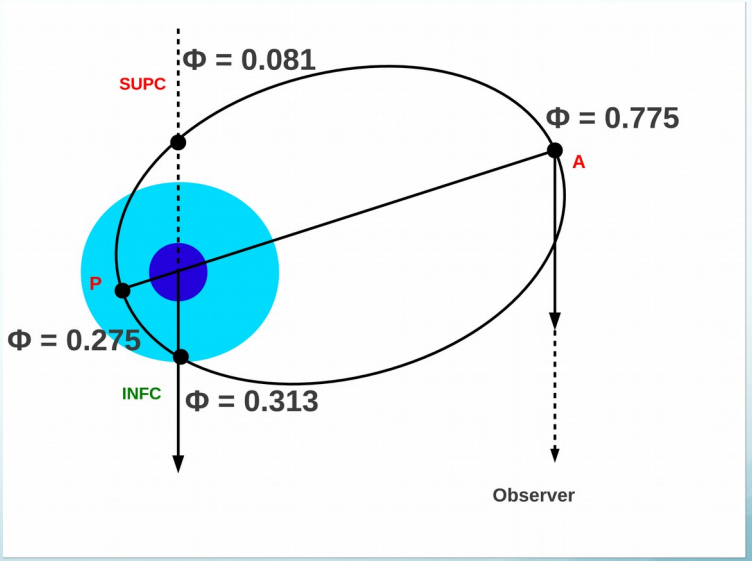
Aims

1. To get orbital phase-folded light curve

2. To get superorbital phase-folded light curve

Orbital period: 26.496 days Superorbital period: 1667 ± 8 days





Aims for code development

To have a dedicated tool in Gammapy for binary analysis

Many of the binary analyses done with Fermi-LAT are not reproducible due to different tools/scripts used although they are based on Fermi Science Tools.

Hence, it will be good to have a dedicated tool within Gammapy for CTA data.

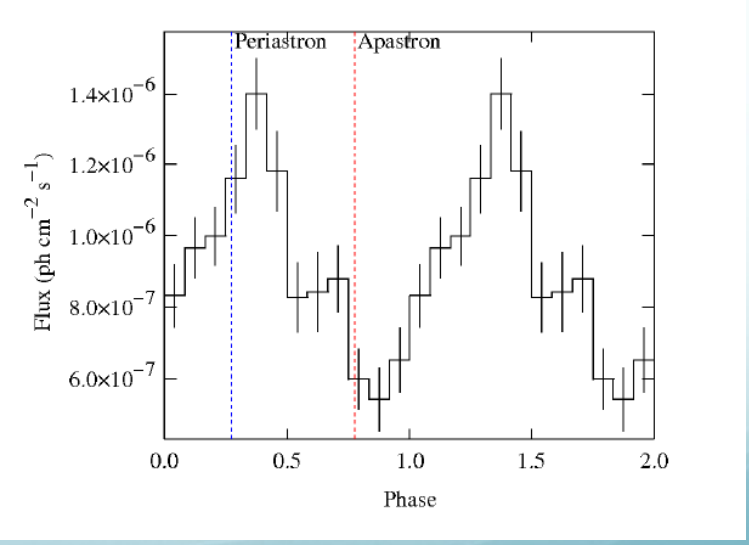
Methodology

1. Assign phase to each of the events following ephemeris

2. Group the events in 10 phase bins

3. Run standard analysis on the events for each of the phase bins
   calculate intergral flux for each bin. This is basically
   Phase-folded light curve

4. Model the phase-folded light curve



Proposal for development in Gammapy

1. a method/function to calculate phase and add to the eventlist
2. a method/function to group data into user-defined phase bins
3. a method/function to calculate differential flux for those given bins
4. a method/function to calculate integral-flux for those phase bins
5. methods/functions to model both differential flux and phase-folded light curve
6. a method/function to test the periodicity

With available functionality of different classes/methods, we can do some of things mentioned above

Here is the example: https://github.com/gammasky/cta-analyses/blob/master/folded_light_curve/folded_lc_v1.ipynb

Recent development

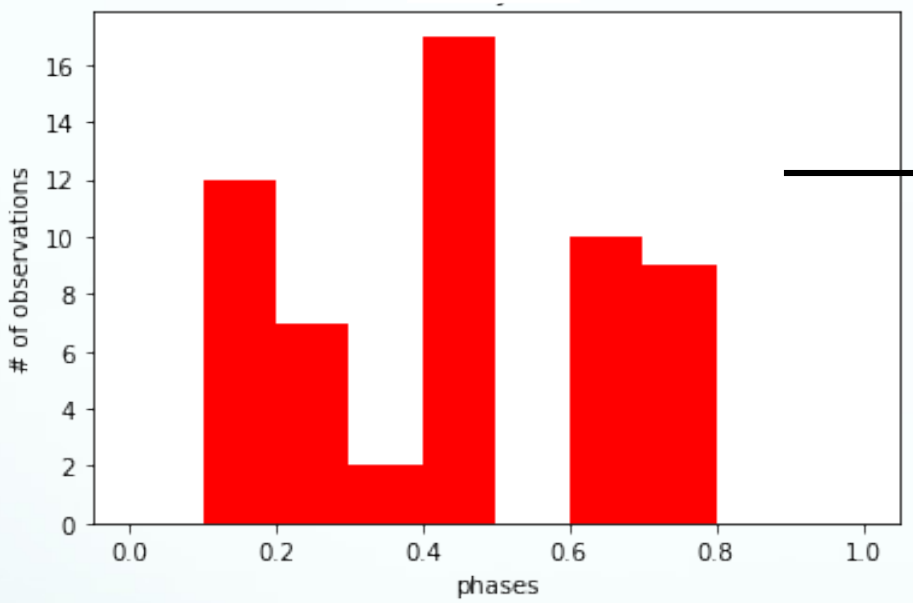
PhaseCurve class to assign the phase to each of the observations/events

```
from astropy.table import Table
from gammapy.utils.scripts import make_path
from gammapy.time.models import PhaseCurve
filename = make_path('$GAMMAPY_EXTRA/test_datasets/phasecurve_LSI_DC.fits')
table = Table.read(str(filename))
phase_curve = PhaseCurve(table, time_0=43366.275, phase_0=0.0, f0=4.367575e-7, f1=0.0, f2=0.0)
```

```
>>> phase_curve.phase(time=46300.0)
0.7066006737999402
>>> phase_curve.evaluate_norm_at_time(46300)
0.49059393580053845
```

Further developments

Group the data in 10/20 phase bins



An observation might be distributed in several phase bins. Hence, assigning phases to photons is the correct way to proceed.

A small function/method will be helpful for this purpose.

Selected events will be used to either **LightCurveEstimator** Class or a different Class(?)