

Pyriod

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Python Tools for Pre-Whitening Frequency Analysis

 github.com/keatonb/Pyriod

 pyriod.readthedocs.io

\$ pip install Pyriod

Interactive Demo!

Skip the poster and get your hands dirty
at <https://dirac.us/oil>

(live notebook will take a few seconds to load)

The example notebook below shows how we used Pyriod to obtain the frequency solution for the helium-atmosphere pulsating white dwarf star TIC 257459955 observed with *TESS*'s 2-minute cadence (Bell et al. 2019).

Inspired by Period04

(Lenz & Breger 2005)

A Java/C++ program that is still widely used for frequency analysis of space-based astronomical time series from *Kepler* and *TESS*, which are often otherwise prepared and further analyzed in Python.

for the Python workflow.

Takes *lightkurve* (*Lightkurve Collaboration* 2018) objects as input, and provides a *Pyriod* object with the functions needed to obtain a full frequency solution.

Interactive Jupyter cells

The example at right shows the four main cell types that display and allow interaction with the time series, periodogram, current frequency solution, and log of the calculation history.

enable multi-sinusoid fits to the time series.

Quickly fit or fix the frequencies, amplitudes and phases of any number of sinusoids. Uses the non-linear least-squares package *lmfit* (Newville et al. 2018). Enforces arithmetic frequency relationships for combination frequencies and provides reliable uncertainties.

Under construction.

The basic functionality is currently in place, with more improvements planned. Have a request? Let me know! Feedback is very welcome.



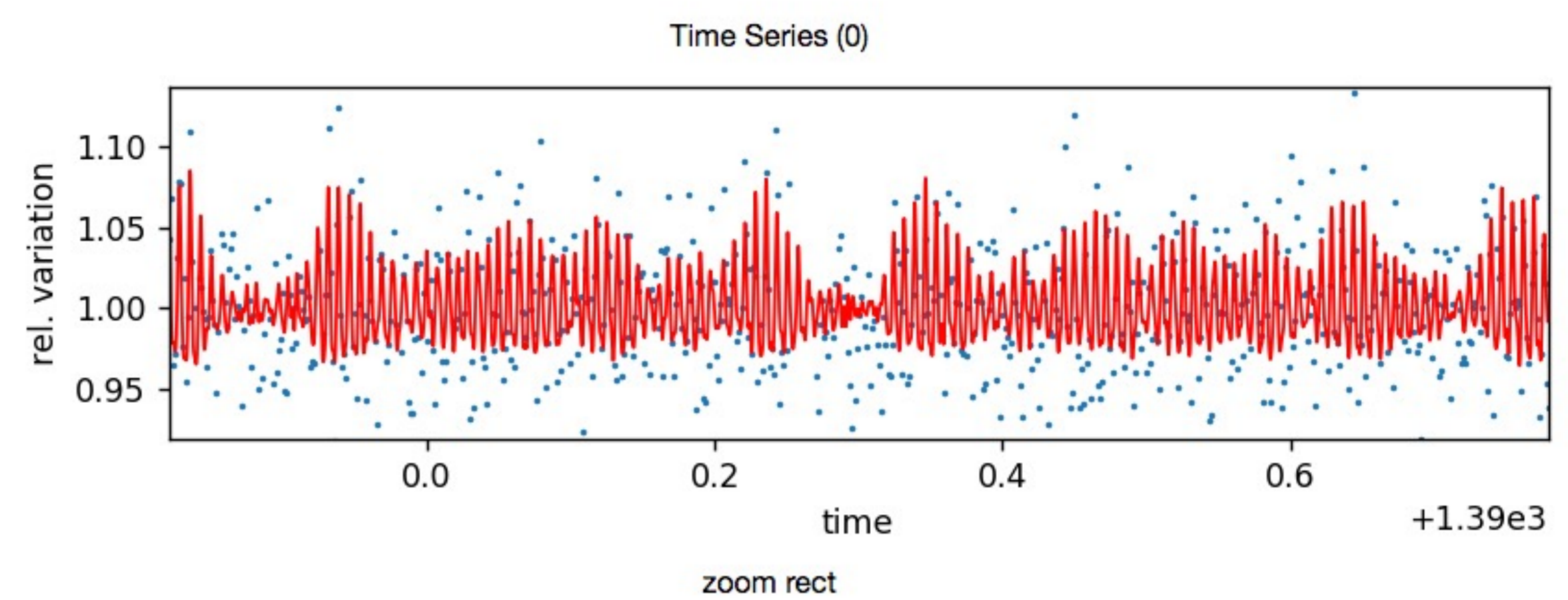
@astrokeat

```
In [1]: %matplotlib widget
import lightkurve as lk
from Pyriod import Pyriod

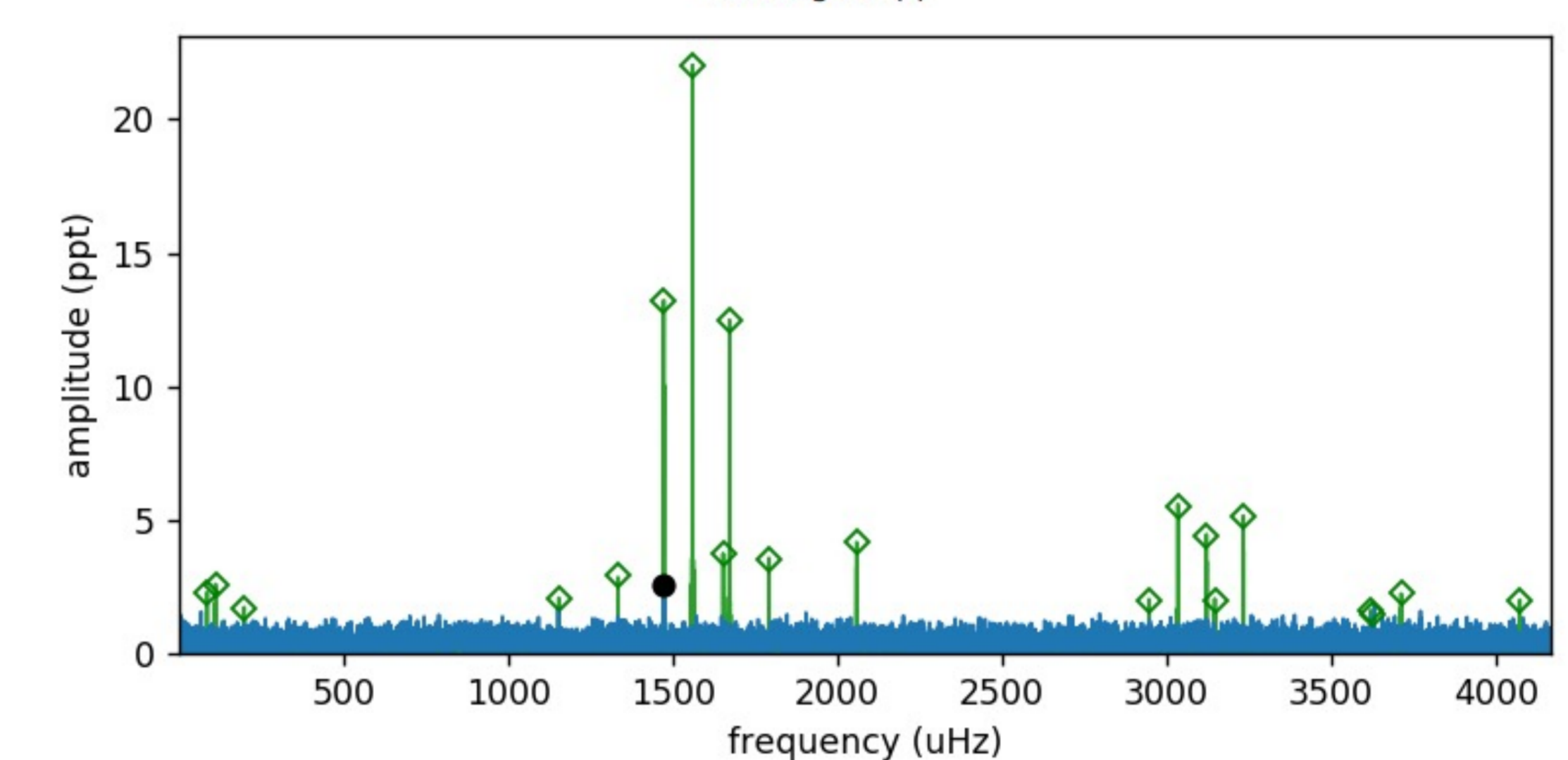
In [2]: lc = lk.search_lightcurvefile('TIC 257459955',mission='TESS',sector=3).download().get_lightcurve("PDCSAP_FLUX")
Warning: 31% (6168/19692) of the cadences will be ignored due to the quality mask (quality_bitmask=175).

In [3]: pyriod = Pyriod(lc)

In [4]: pyriod.TimeSeries()
```



```
In [5]: pyriod.Periodogram()
```



```
In [6]: pyriod.Signals()
```

	include	freq	fixfreq	freqerr	amp	fixamp	amperr	phase	fixphase	phaseerr
2*f0	✓	3122.399896384		0.009149368...	4.398309441		0.375678627...	0.00589934		0.013607424...
2*f1	✓	2947.970418951		0.015012121...	1.965586702		0.375937574...	0.686140435		0.030418319...
f0	✓	1561.199948192		0.004574684...	22.005905252		0.375812670...	0.613212731		0.002718754...
f0+f1	✓	3035.185157667		0.008505642...	5.493524528		0.375776275...	0.840470567		0.010891569...
f0+f1+f2	✓	4708.674621443		0.011562223...	1.466359386		0.376035031...	0.31586062		0.040807699...
f0+f2	✓	3234.689411967		0.009132727...	5.130921631		0.375986580...	0.133308633		0.011653503...
f0+f3	✓	3620.816013836		0.023966577...	1.601284426		0.376104813...	0.085786228		0.037356072...
f0-f1	✓	87.214738716		0.009065947...	2.235836104		0.375851753...	0.474718644		0.026755077...
f1	✓	1473.985209476		0.007506060...	13.2182685		0.375800634...	0.443856569		0.004525975...

```
In [7]: pyriod.Log()
```

```
Log: 2019-12-31 20:46:46,510 - INFO - Pyriod object initialized.
2019-12-31 20:46:46,521 - INFO - Time Series properties: camera 1 | ccd 2 | sector 3 | targetid 257459955 | label TIC 257459955 | mission TESS |
quality_bitmask default | time_format btjd | time_scale tdb | cadenceno array (13450,) | centroid_col array (13450,) | centroid_row array (13450,) |
flux array (13450,) | flux_err array (13450,) | flux_quantity array (13450,) | quality array (13450,) | time array (13450,) | astropy_time | dec | flux_unit |
meta | ra |
2019-12-31 20:46:46,536 - INFO - Periodogram properties: nterms 1 | targetid 257459955 | default_view frequency | label TIC 257459955 |
ls_method fast | frequency_at_max_power 1561.1991 uHz | max_power 22.0371 electron / s | nyquist 4166.5936 uHz | period_at_max_power
0.0006 1 / uHz | frequency array (422193,) uHz | period array (422193,) 1 / uHz | power array (422193,) electron / s | meta |
2019-12-31 20:47:25,686 - INFO - Signal f0 added to model with frequency 1561.1990671621372 and amplitude 22.03709587477899.
```

Bell, K. J., Córscico, A. H., Bischoff-Kim, A., et al. 2019, *A&A*, 632, A42

Lenz, P., & Breger, M. 2005, *Communications in Asteroseismology*, 146, 53

Lightkurve Collaboration, Cardoso, J. V. d. M., Hedges, C., et al. 2018, *Astrophysics Source Code Library*, ascl:1812.013

Newville, M., Otten, R., Nelson, A., et al. 2018, *lmfit/lmfit-py* 0.9.12, Zenodo: <http://doi.org/10.5281/zenodo.1699739>