Preparação dos dados do Kepler para estudo da rotação diferencial

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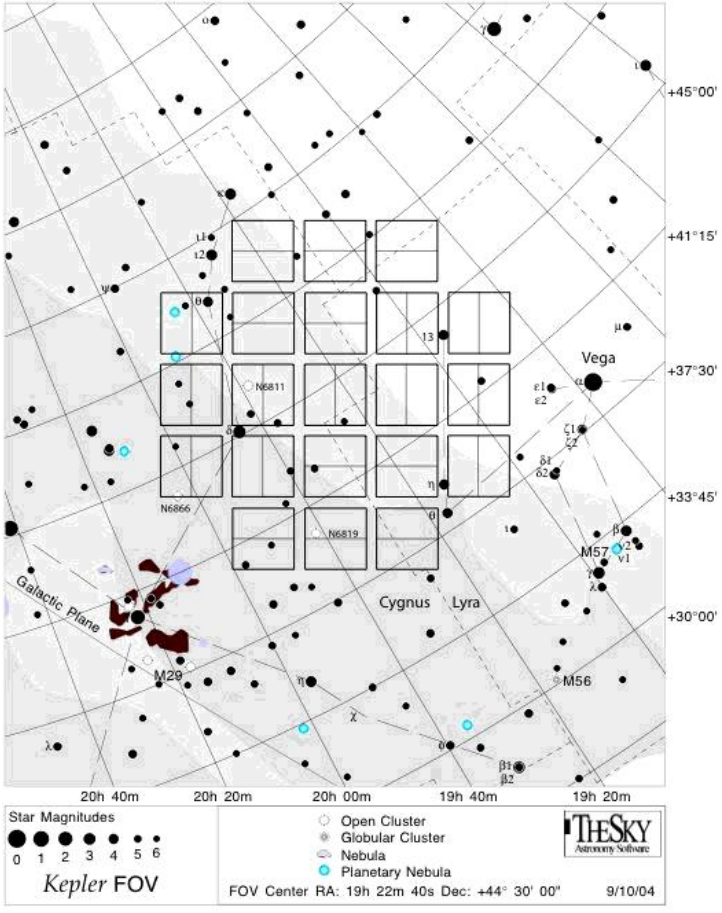
Kepler

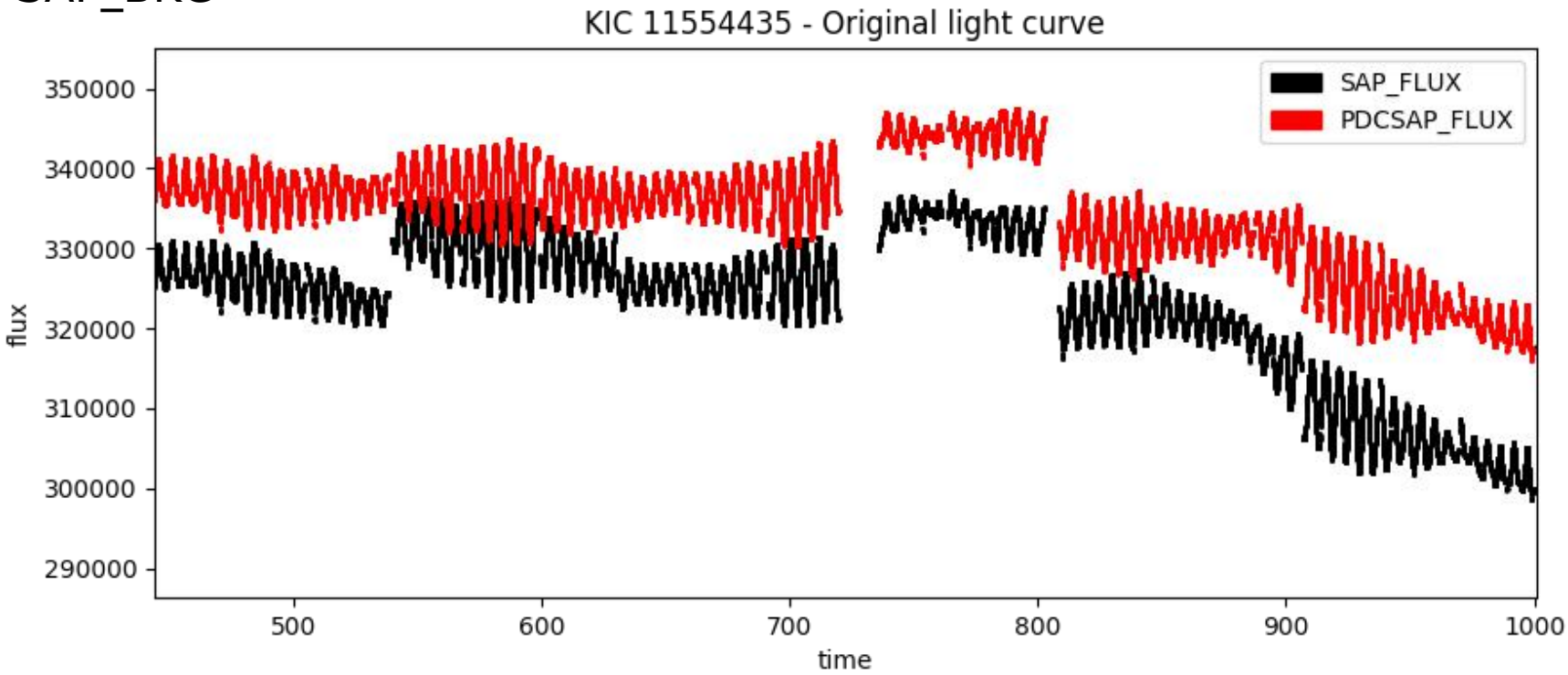
- Spacecraft is rolled by 90° every three months (quarter).

- Two cadences of observation:
  - Short cadence (58.5 s)
    - Planetary transit method
  - Long cadence (1765.5 s)
    - Rotational modulation method



FITS File

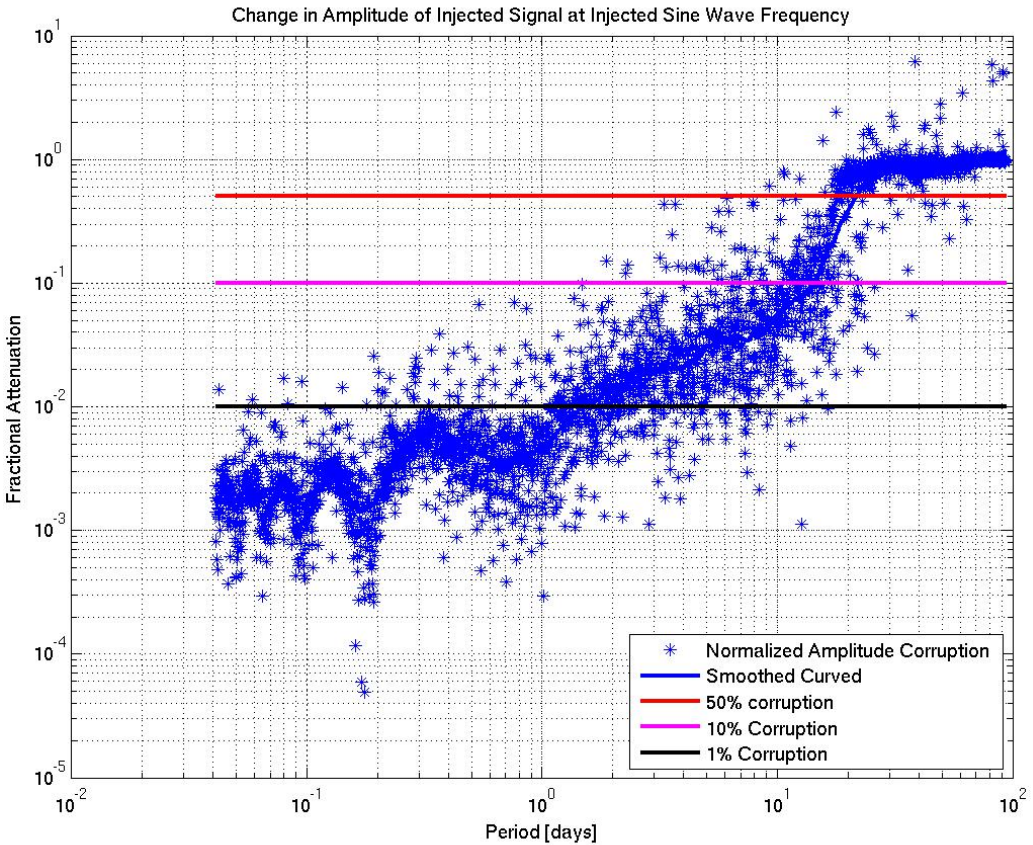
- TIME
- SAP_FLUX (Simple Aperture Photometry)
- SAP_BKG
- PDCSAP_FLUX(Presearch Data Conditioning)
- SAP_QUALITY



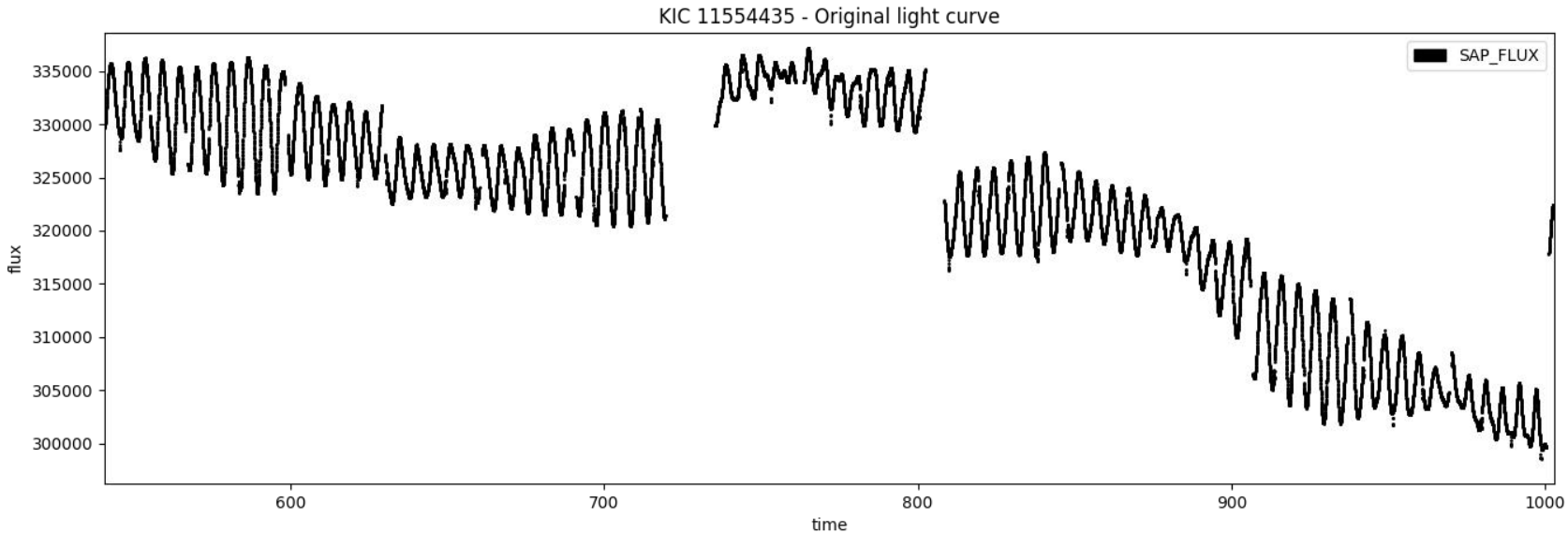
PDCSAP_FLUX

- PDC attenuates long periods signals in the data.

- Affects the analysis in the Rotational modulation method.



Data preparation



SAP_FLUX

Good data LC

Detrended LC

Detrended LC without transit

Normalized LC

Normalized LC without outliers

Cleaned LC

Data preparation

Subtracting background flux

SAP_FLUX - SAP_BKG

Only datapoints having the SAP_QUALITY equal to zero

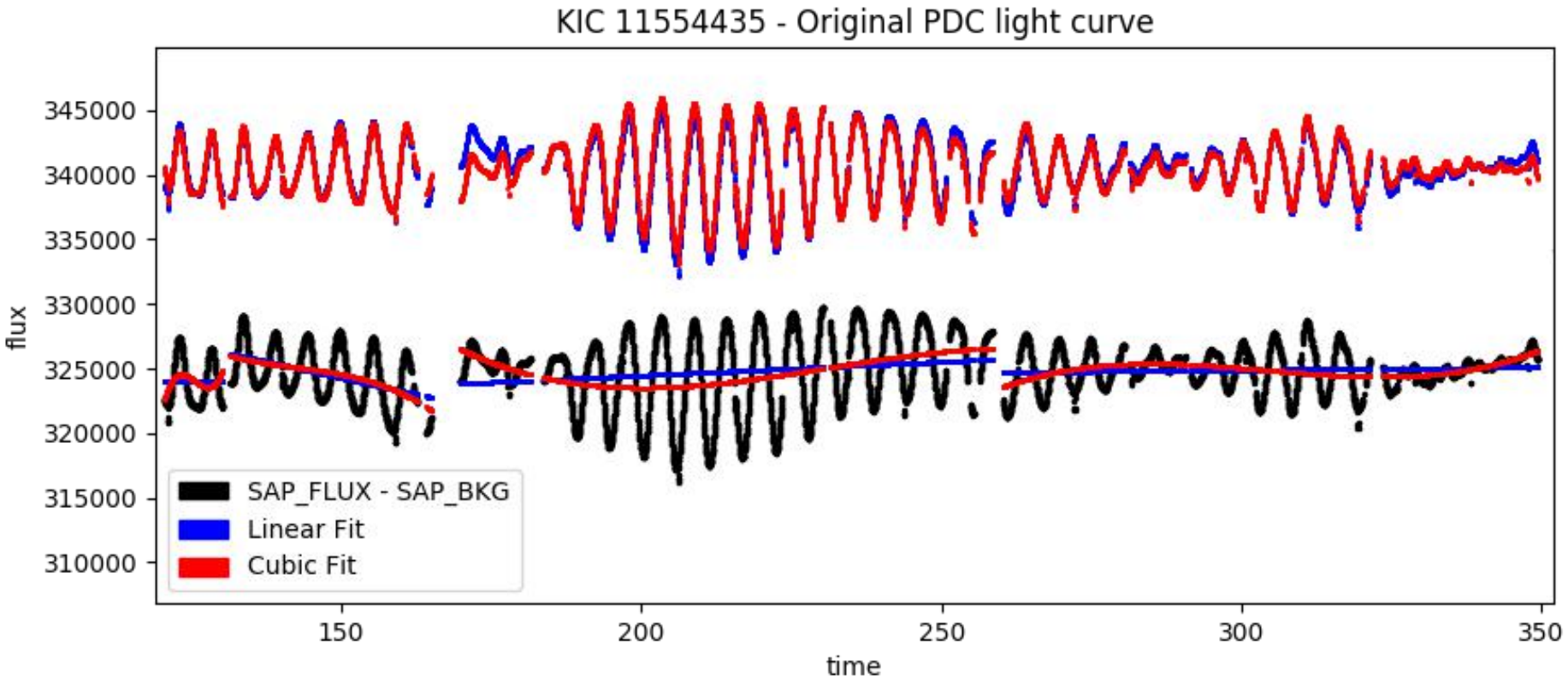
Table 2-3 – Bits for the QUALITY and SAP_QUALITY data column.

Bit	Value	Explanation
1*	1	Attitude Tweak
2*	2	Safe Mode
3*	4	Spacecraft is in coarse point. It is set manually to pad not-in-fine point data.
4*	8	Spacecraft is in Earth point. The first real cadence after Earth point is marked.
5	16	Reaction wheel zero crossing
6*	32	Reaction wheel desaturation event
7*	64	Argabrightening detected across multiple channels on this cadence
8	128	Cosmic Ray was found and corrected in optimal aperture pixel
9*	256	Manual Exclude. The cadence was excluded because of an anomaly.
10	512	This bit is unused by *Kepler*.
11	1024	SPSD detected. This bit is flagged on the last non-gapped cadence before the maximum positive change due to the detected SPSD.
12	2048	Impulsive outlier removed before cotrending
13*	4096	Argabrightening event on specified CCD mod/out detected
14	8192	Cosmic Ray detected on collateral pixel row or column in optimal aperture.
15*	16384	Detector anomaly flag was raised.
16*	32768	Spacecraft is not in fine point.
17*	65536	No data collected.
18	131072	Rolling Band detected in optimal aperture.
19	262144	Rolling Band detected in full mask.
20	545288	Possible thruster firing. Not set in *Kepler* data
21	1048576	Thruster firing. Not set in *Kepler* data.

* indicates that these cadences are gapped by the pipeline (either in CAL, PA or PDC). The original pixel level data is available in most cases.

Data preparation

Long-terms trends removed by polynomial fit

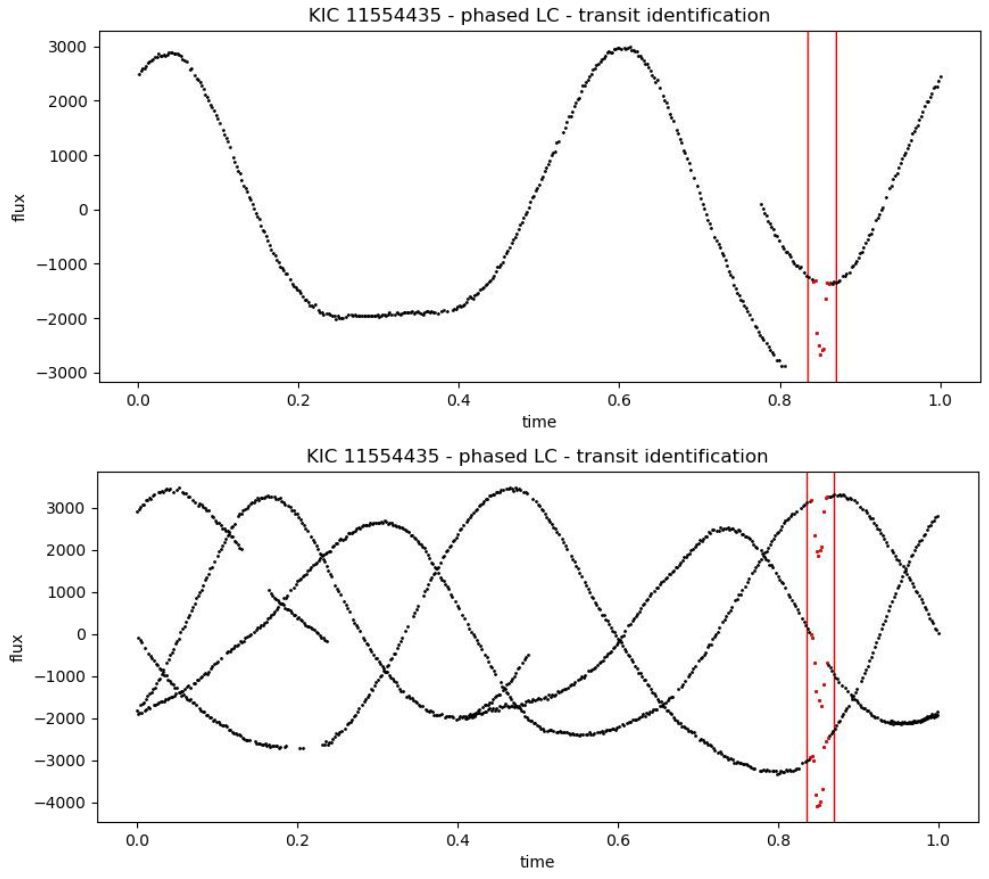


Data preparation

Removing the transits:

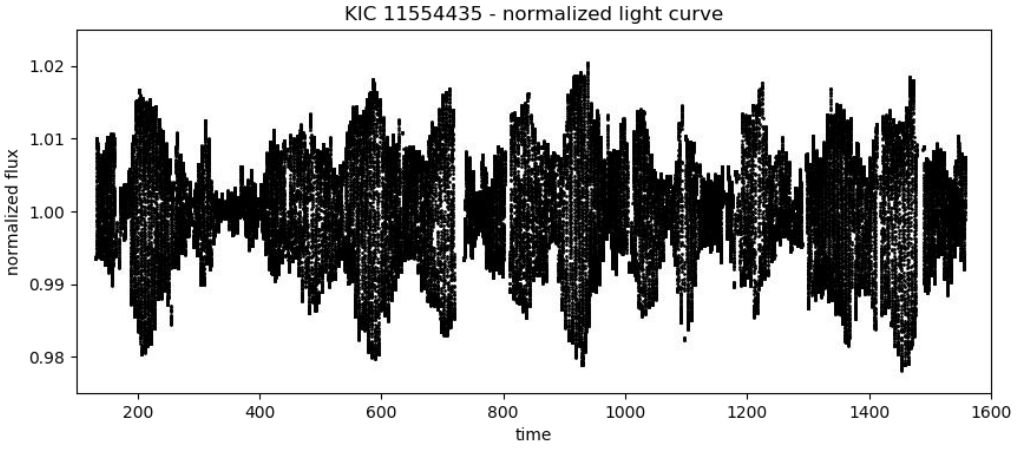
Phased LC quarter-by-quarter

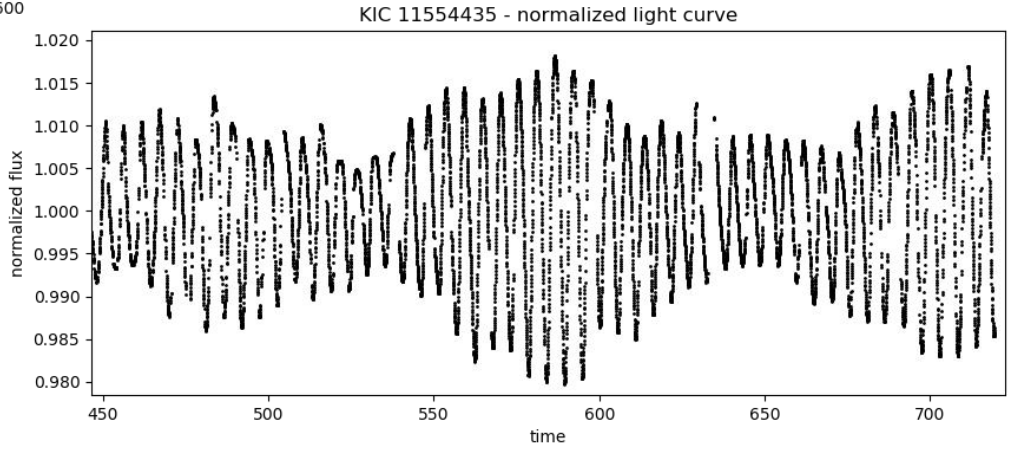
Transit in red



Data preparation

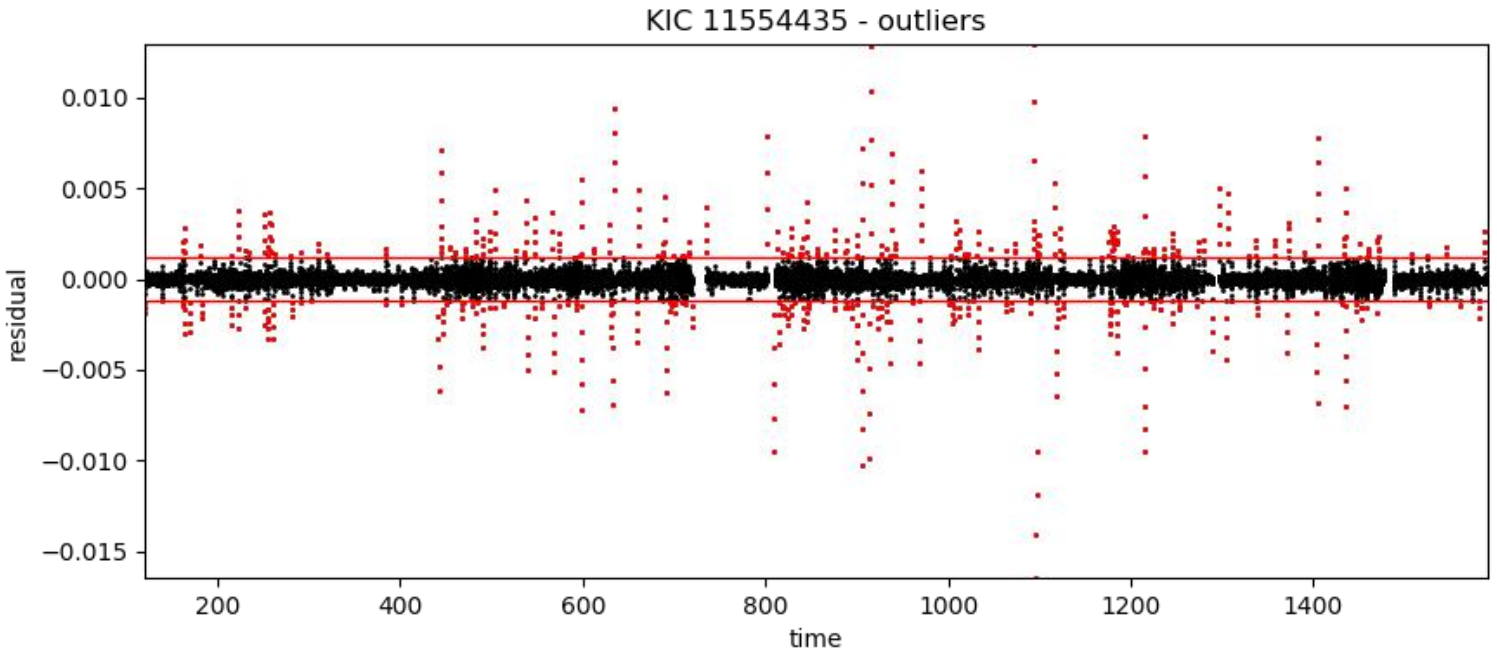
Each quarter is normalized to its median value





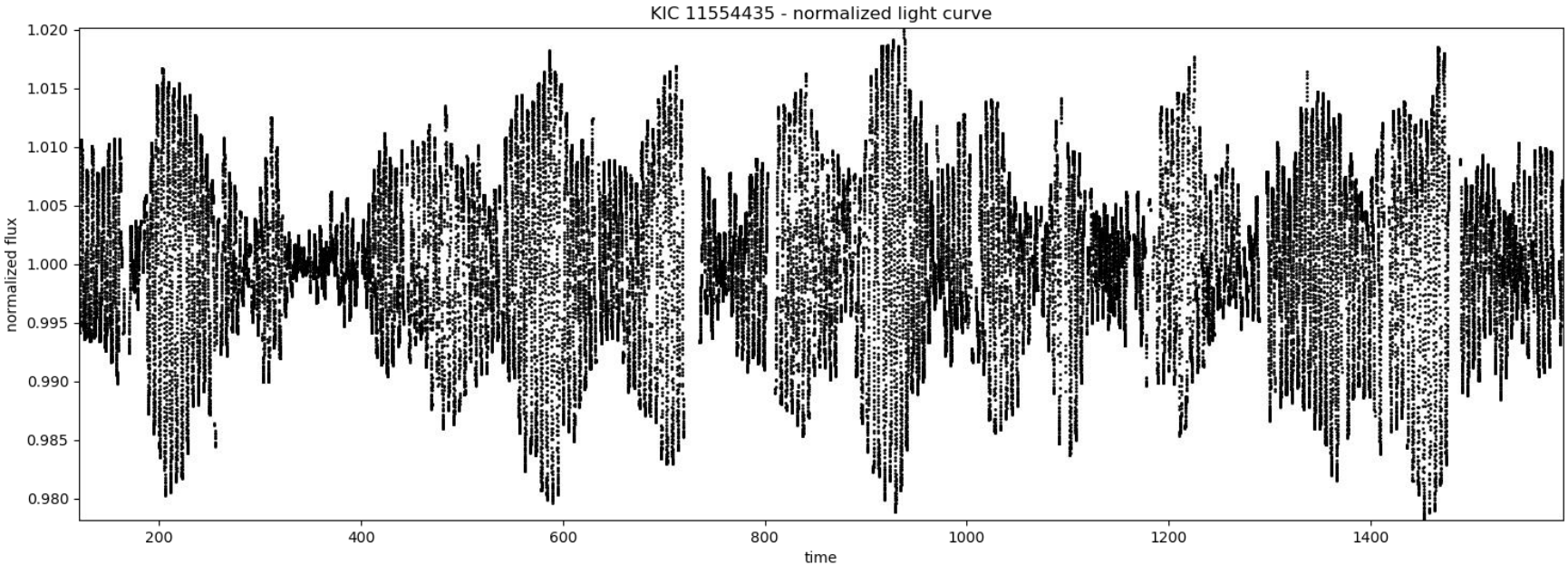
Data preparation

Residual outliers removed by 3-sigma clipping

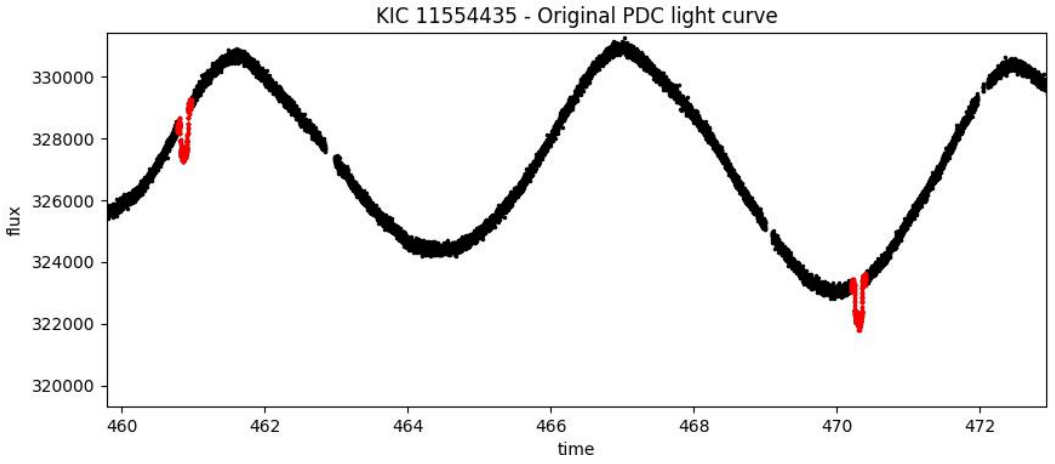


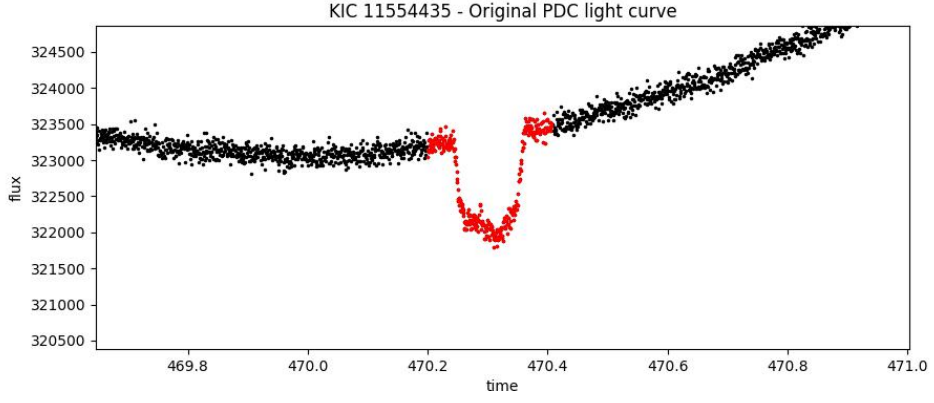
Data preparation

Cleaned light curve for rotational modulation method



Data preparation



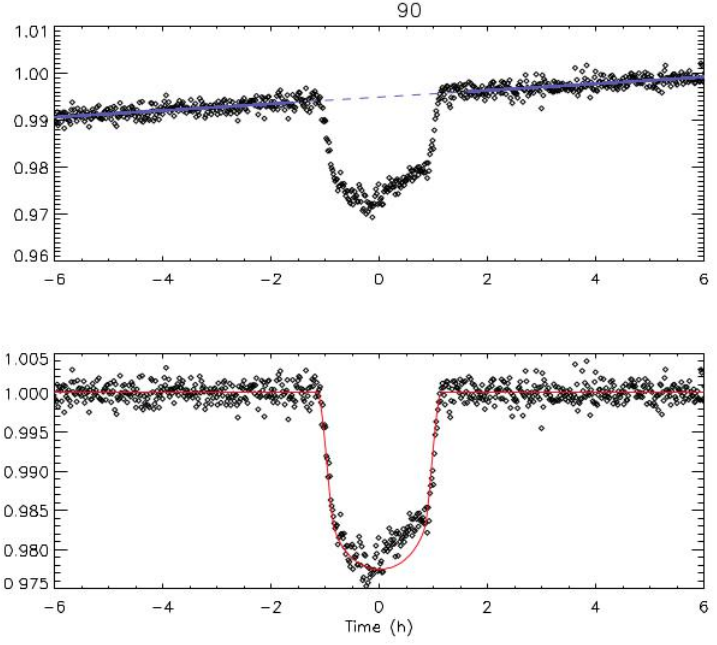


Short cadence

PDCSAP_FLUX

Linear fit

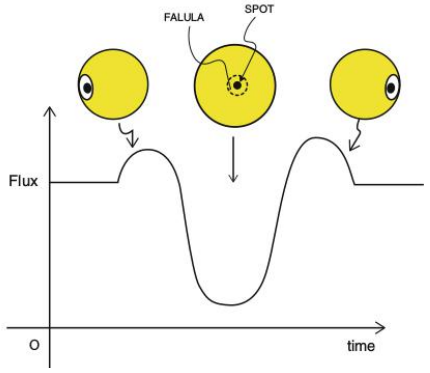
Normalization to 1

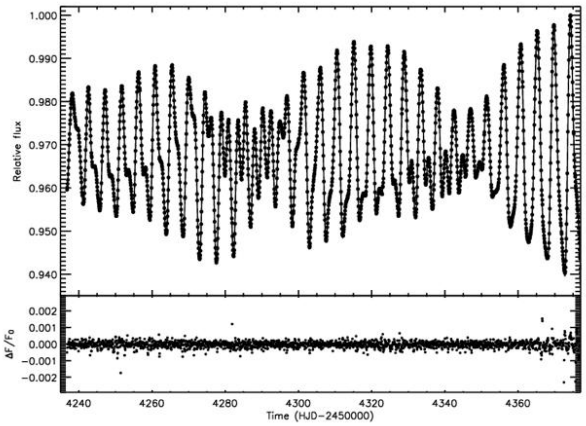


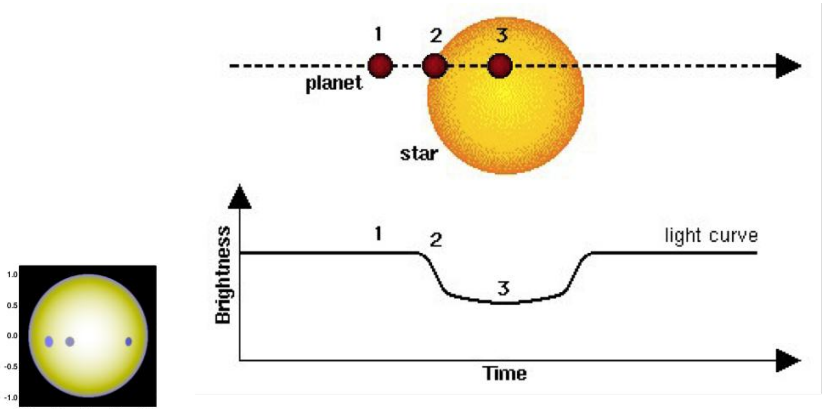
Aplication

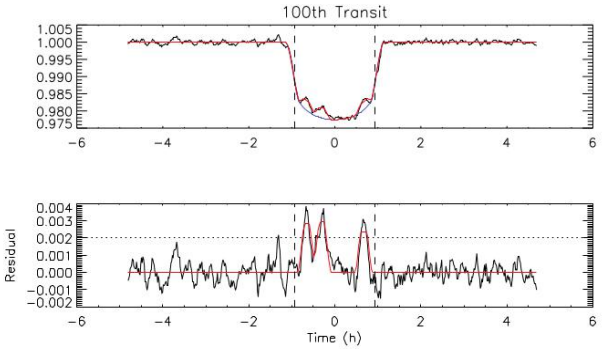
Light curve rotational modulation (Lanza, Bonomo, Rodonò, 2007)

Planetary transit method (Silva, 2003)









Acknowledgments

Thank You !

Data preparation