SINGLETRANS, the search for single transits of small planets in TESS light curves.

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exoplanet diversity SPP 1992
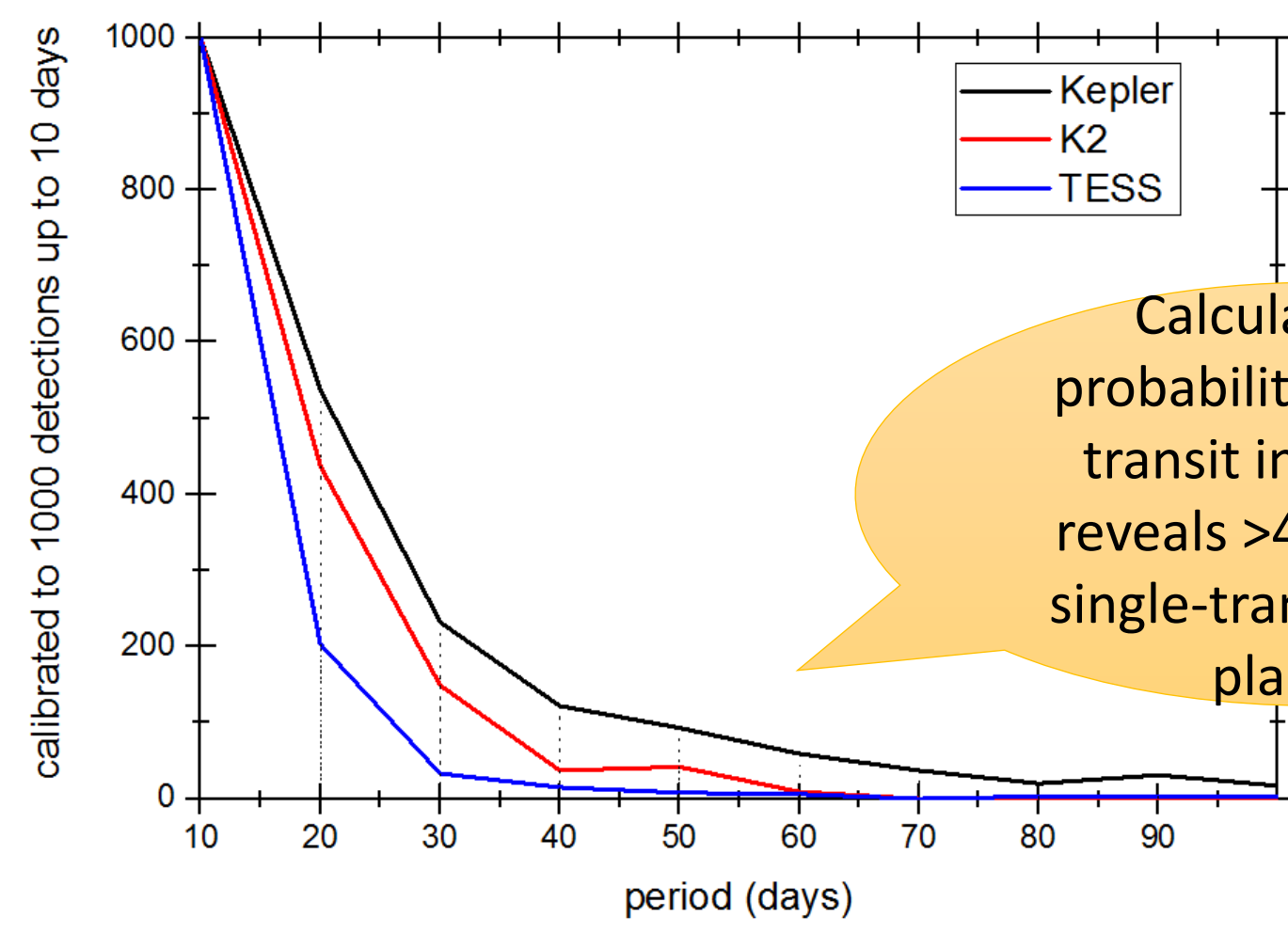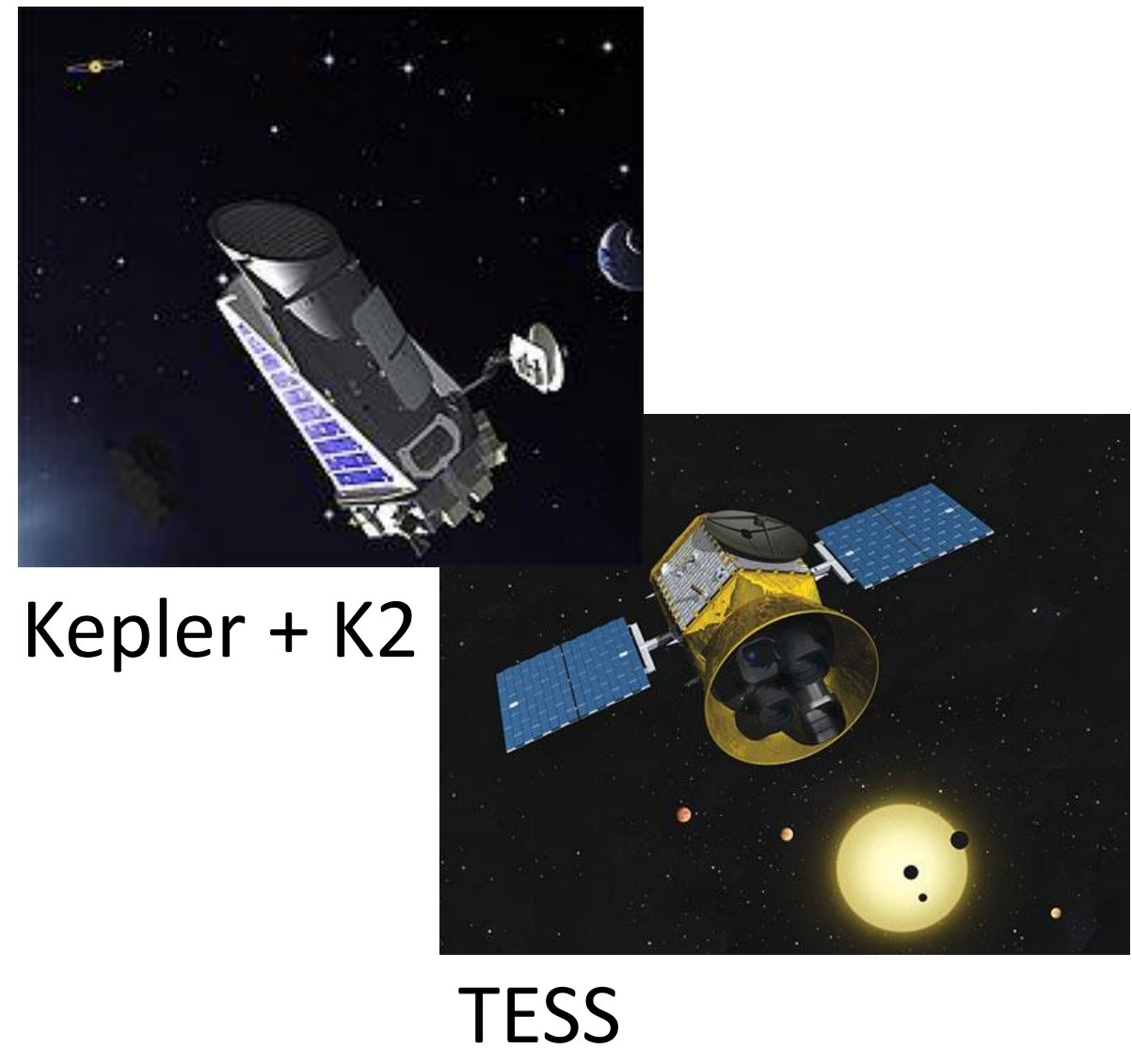
KESPRINT

RIU Planeten forschung

Comparing the detection rate of Kepler (long observation) and TESS (shorter observation) for different orbital periods reveals that many single transits of small planets shall be hidden in TESS data.
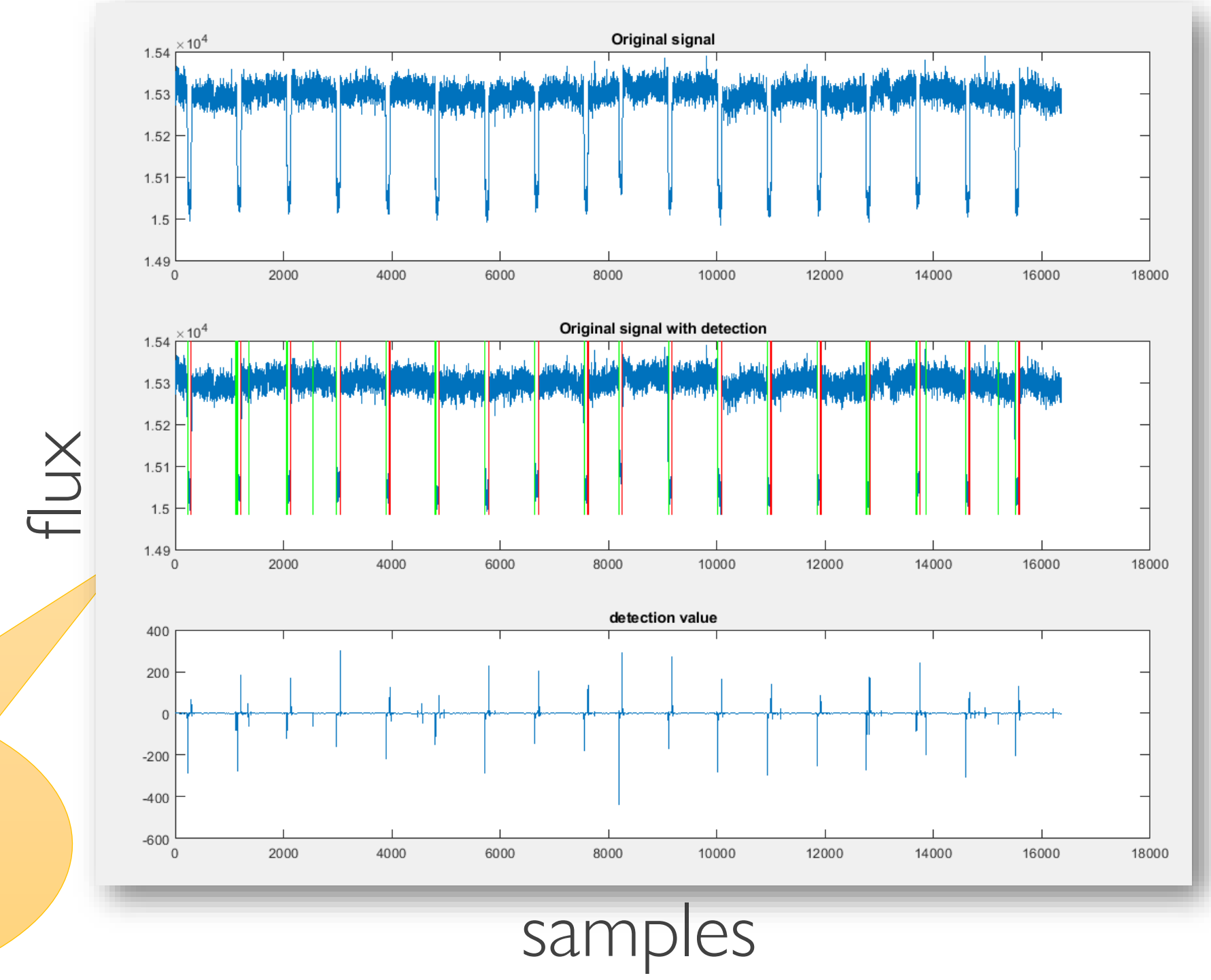
Kepler + K2

TESS

Calculating the probability of a single transit in TESS data reveals >400 possible single-transiting small planets .

Idea

We developed an algorithm combining our well approved wavelet techniques with a new method to detect ingress (green) and egress (red) of single transits.

The order of the detection (green,red) helps excluding false detections.

Without the knowledge of the period many false detections (fast variation, discontinuities) have to be excluded:
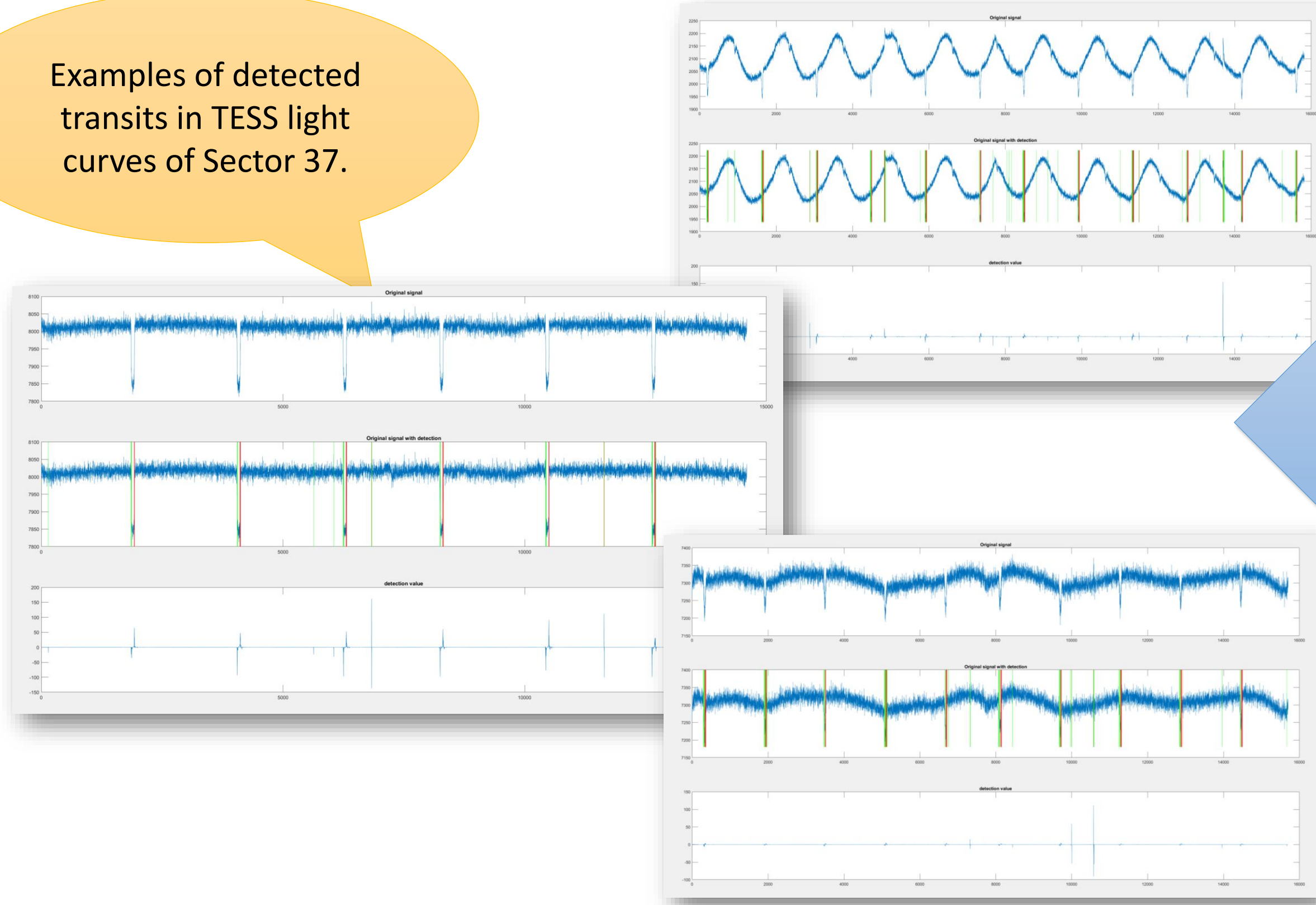
- Upper limits for the transit duration are checked.
- Mandel & Agol fit is used to identify the nature of the event.

- Duration checked
- Mandel & Agol is fitted
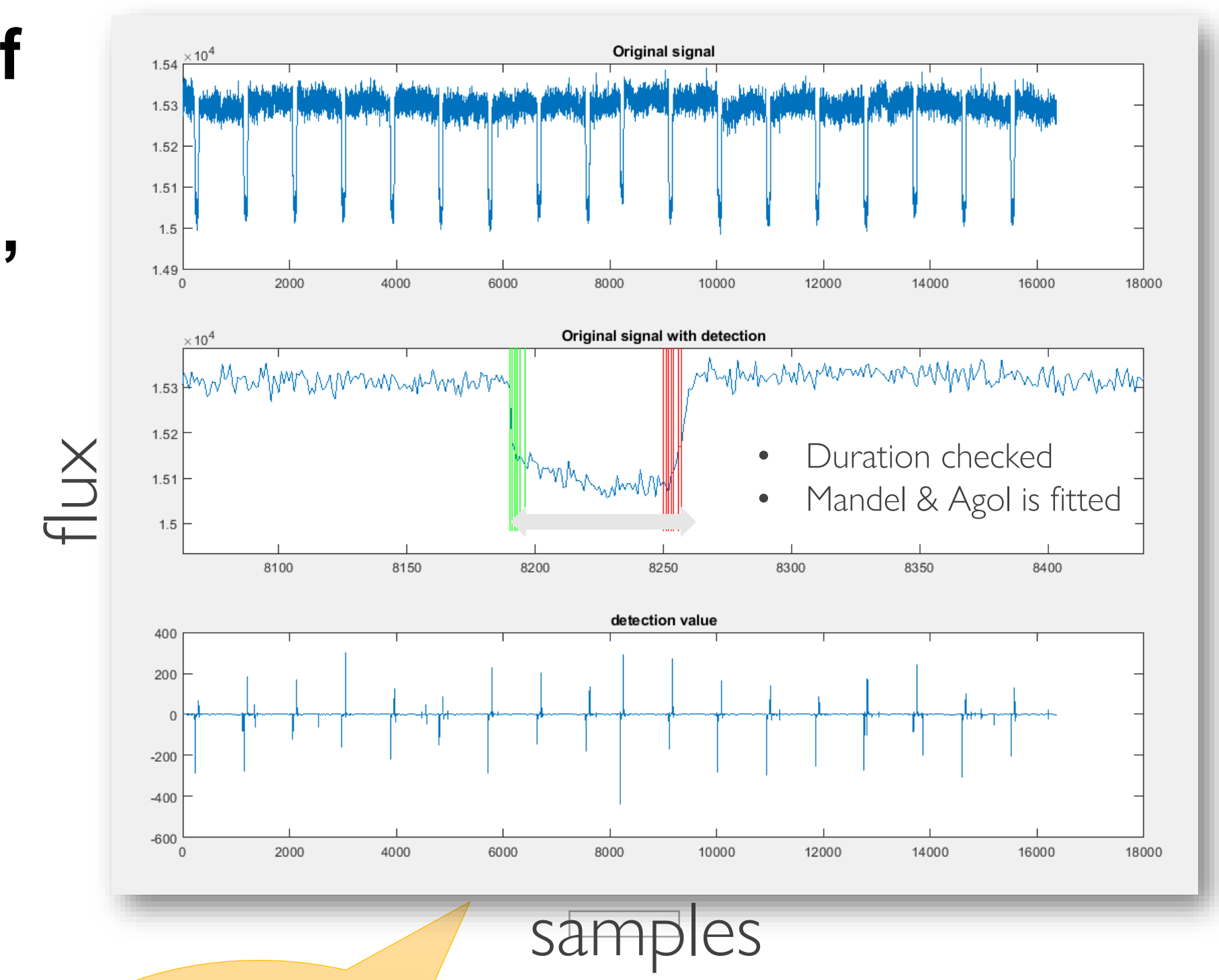
Additional calculations are needed to remove false detections.

SINGLETRANS is under development and works well on TESS light curves.
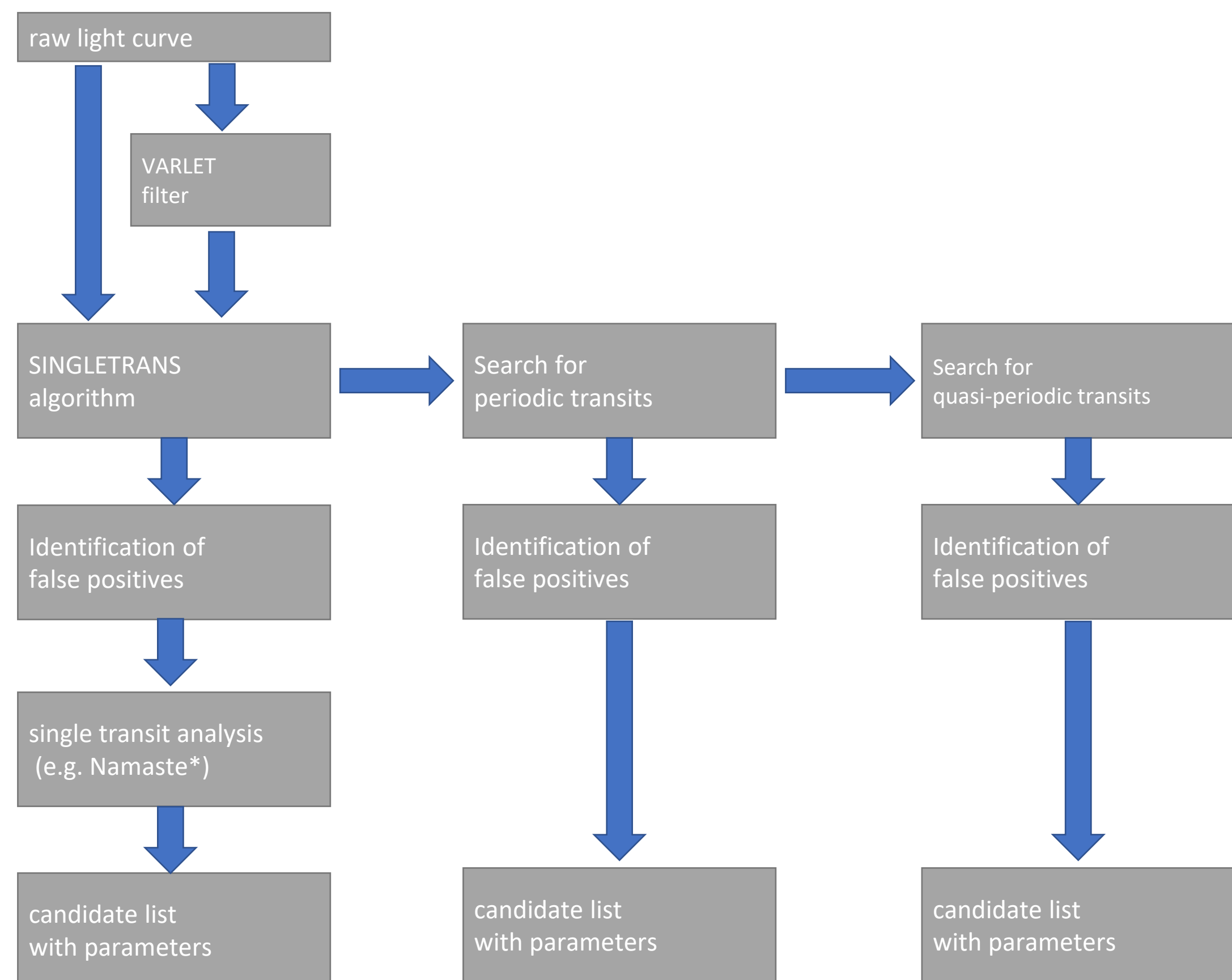
Examples of detected transits in TESS light curves of Sector 37.

Project

SINGLETRANS can also detect periodic and quasi-periodic transits (strong TTV, circumbinary planets).
The processing time scales linear with the length of the light curve.

The pipeline will include routines to search for these transits:

raw light curve → VARLET filter → SINGLETRANS algorithm → Search for periodic transits → Search for quasi-periodic transits

Identification of false positives → Identification of false positives → Identification of false positives

single transit analysis (e.g. Namaste*)

candidate list with parameters / candidate list with parameters / candidate list with parameters

Routines to search for single transits, periodic and quasi-periodic transits are included.

(*) Osborne, H., 2016, Single Transit Candidates from K2: Detection and Period Estimation, MNRAS, 457, 2273

Single or Mono transits are a great chance to find additional planets with larger orbital periods.

- The pipeline shall be able to find single transits of planets smaller than Neptune and Jupiter.
- An estimation of the orbital period is possible using the transit duration of the detected mono transit.
- Interesting mono-transit-candidates can be followed-up using photometric and spectroscopic observation.
- A single transit search is planned using archival data (CoRoT, Kepler, K2, TESS)
- The results can be used to search for additional transits with CHEOPS.

Future
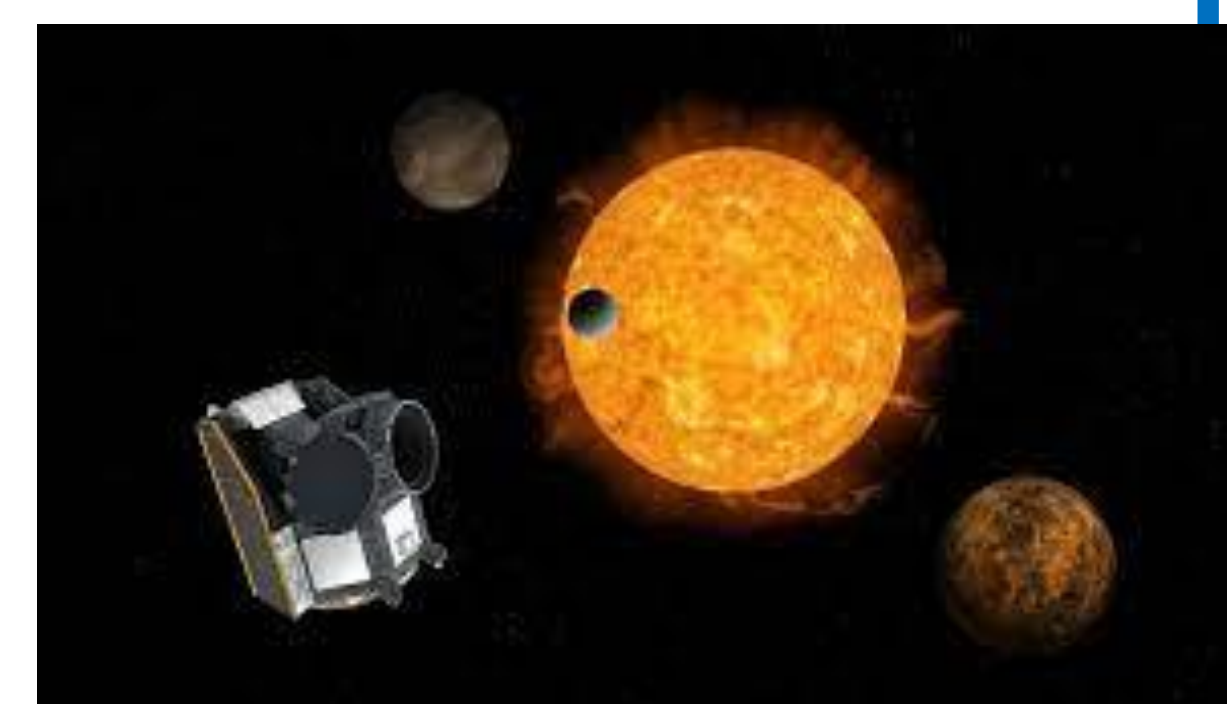
CHEOPS

Follow-up

Interesting targets shall be followed-up using our KESPRINT resources

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KESPRINT

- Confirmation and characterization of transiting planets with well determined radii, masses and densities to investigate their internal structure and composition.

- Combining specialists from different scientific fields (transit detection, transit characterization, photometric and spectroscopic follow-up observation) to use telescope time efficiently.