

° What we can learn from constant stars, and what means constant?

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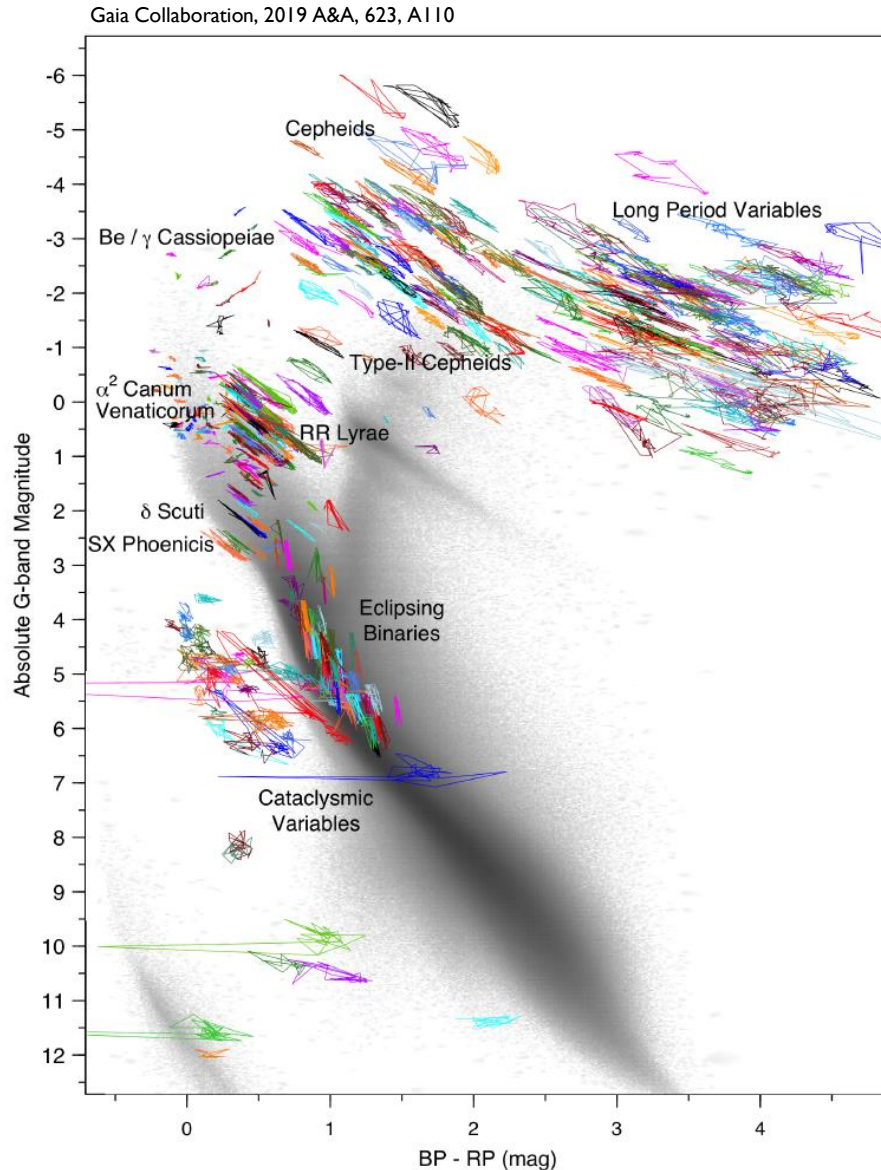
Masaryk University

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Why do we need non-variable stars?

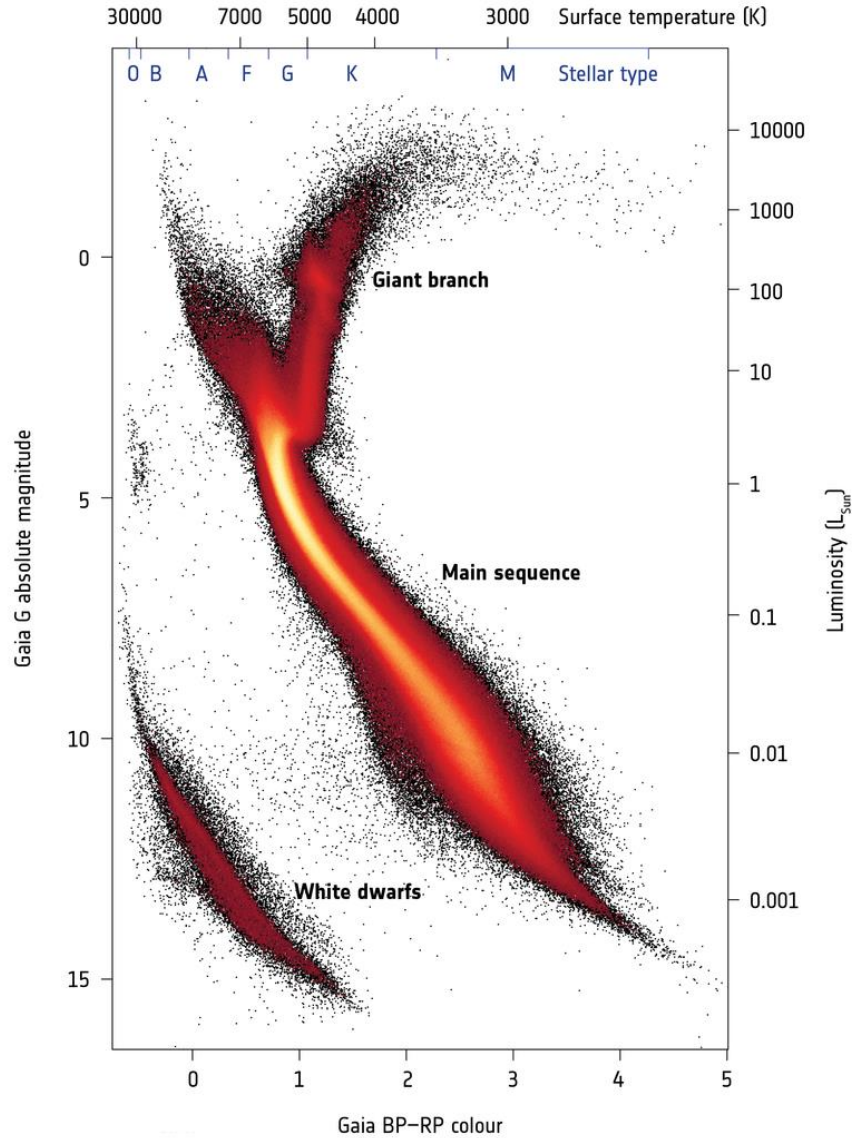


- Flux standards
- RV standards
- Calibration of stellar formation and evolutionary tracks
- Photometric calibration of effective temperature and metallicity

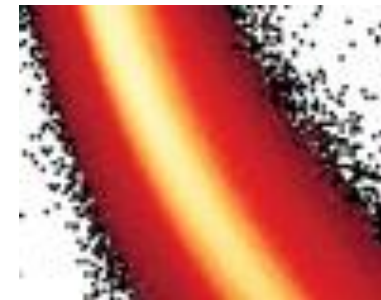
What does non-variability mean?

- A star is constant (not variable) for a given
 1. Frequency range
 2. Time basis of the observations
 3. Amplitude – Noise level
 4. Wavelength region – filter
 5. Applied “pipeline software”
 6. Applied time series analysis method

Motivation



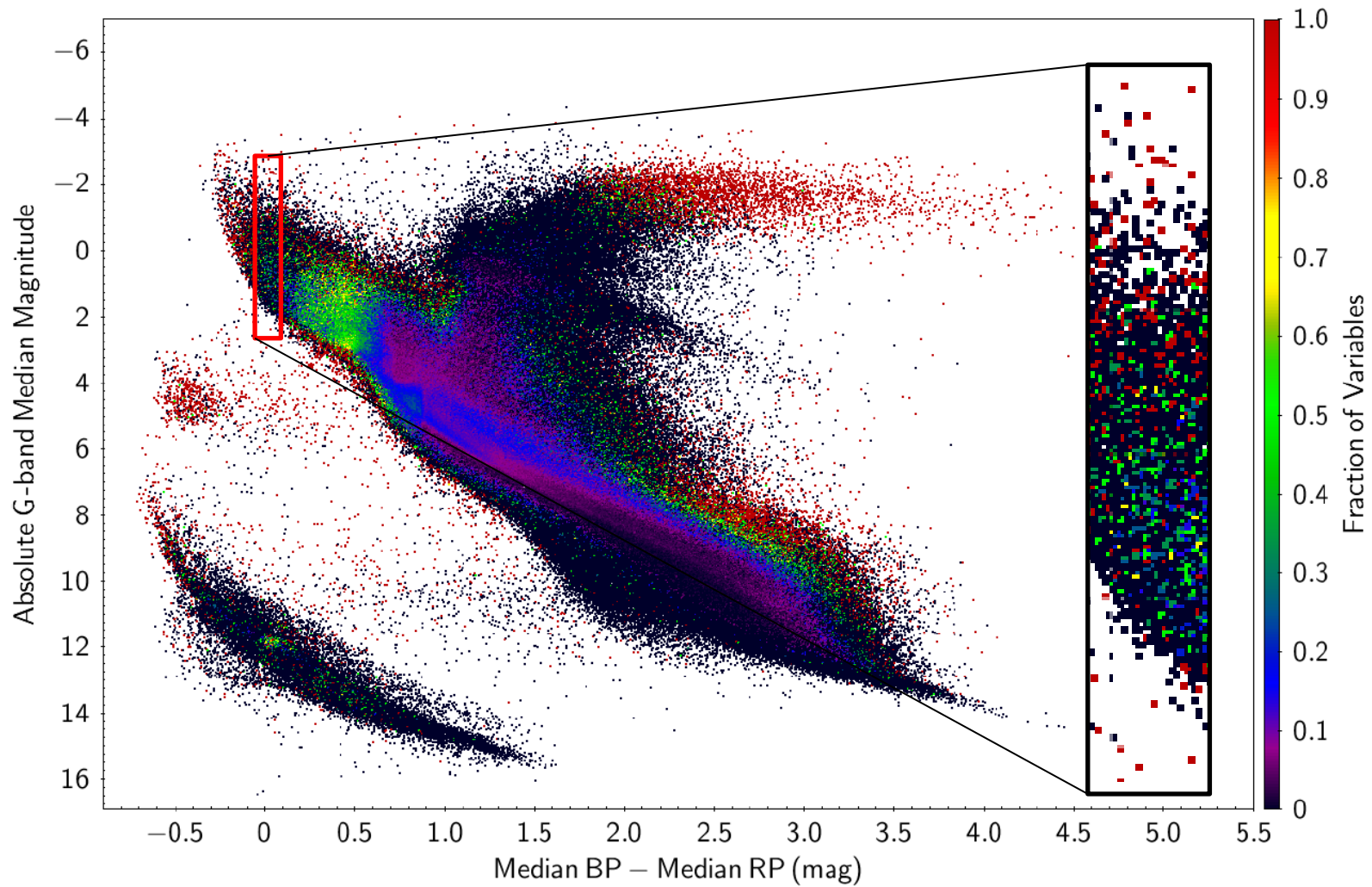
- From Gaia better estimates of the luminosities and hopefully also for the temperatures
- Zoom in and define boxes



Motivation

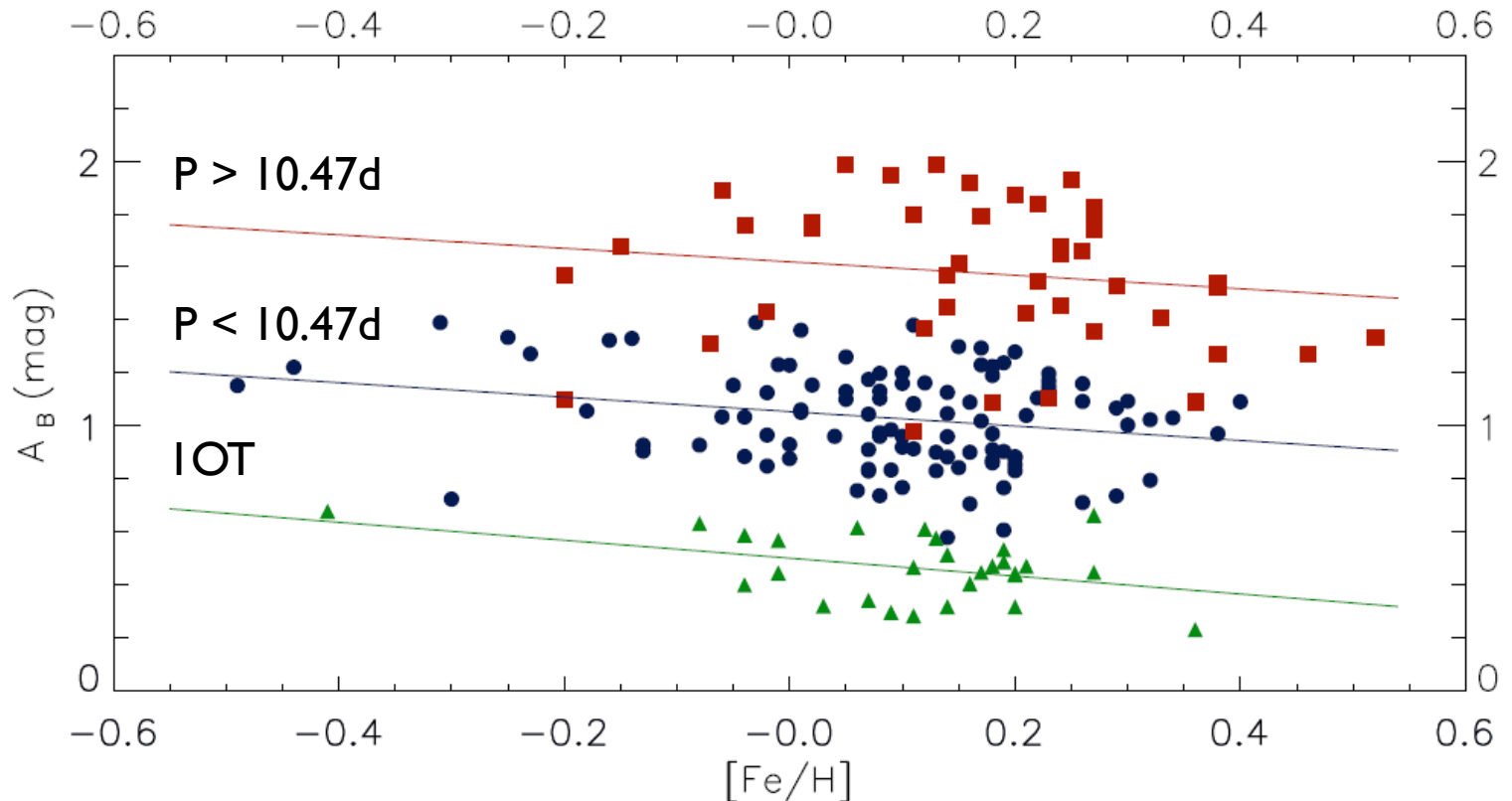
- What determines if a star with “identical” effective temperature and luminosity (same age) is variable or not?
- Some guesses
 1. Rotation
 2. Metallicity
 3. Binarity
 4. Stellar Magnetic Field
 5. Circumstellar Material
 6. Inclination

Gaia's view



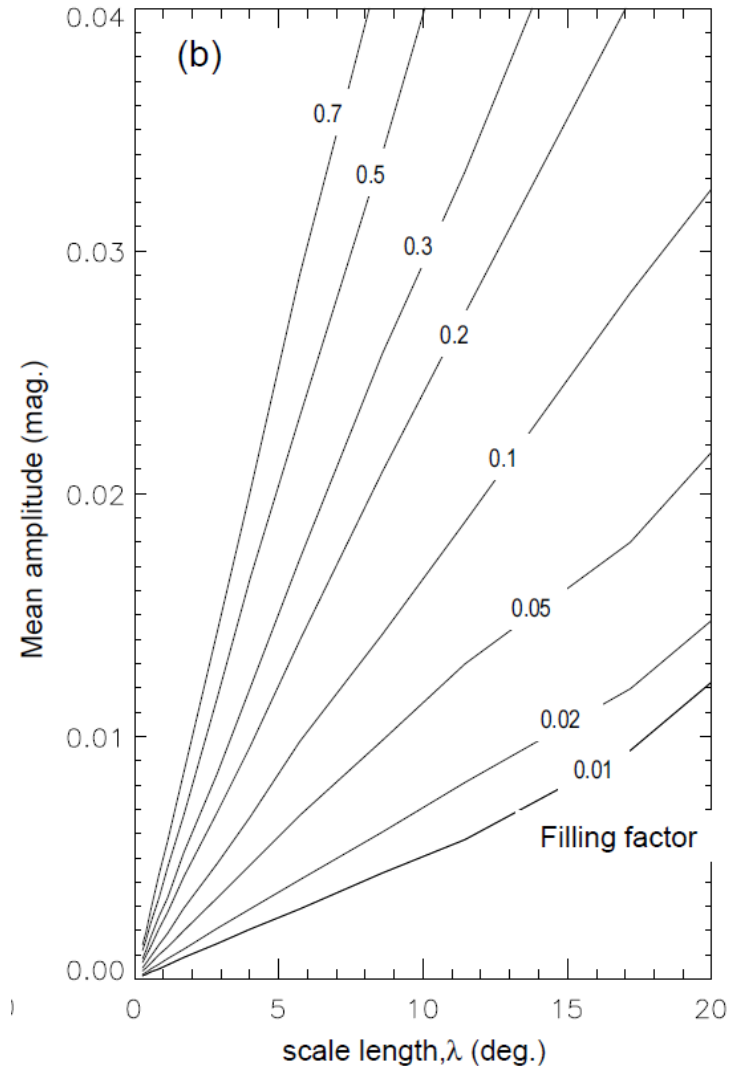
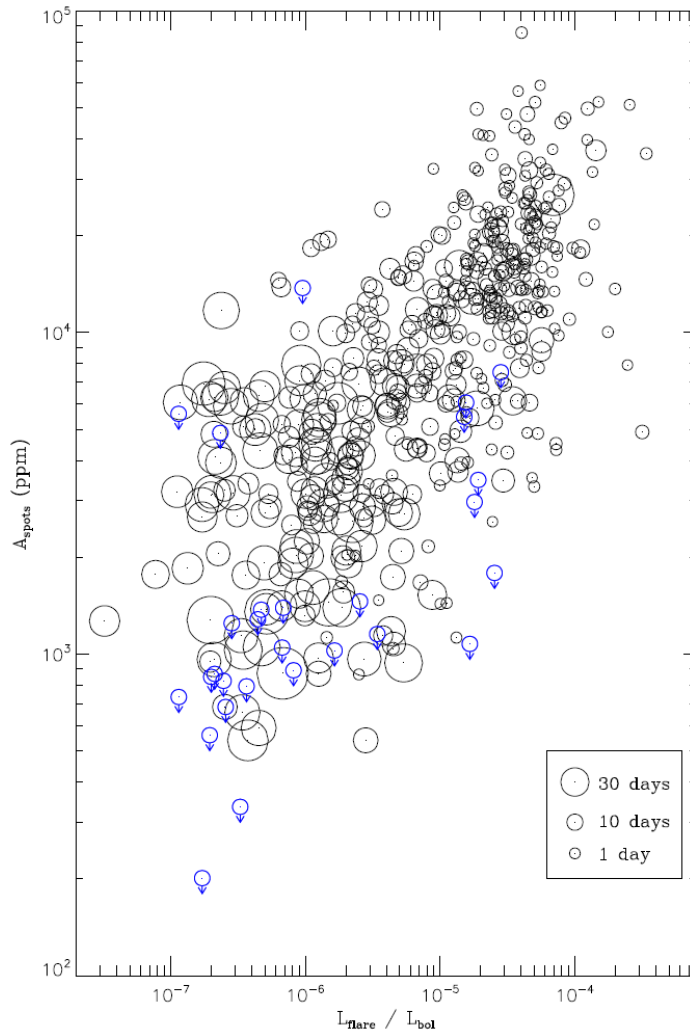
The study of amplitudes

- An amplitude-period-metallicity relation exists for Cepheids and RR-Lyrae stars



The study of amplitudes

- Amplitude versus Flare Activity and Spots



Available light curves

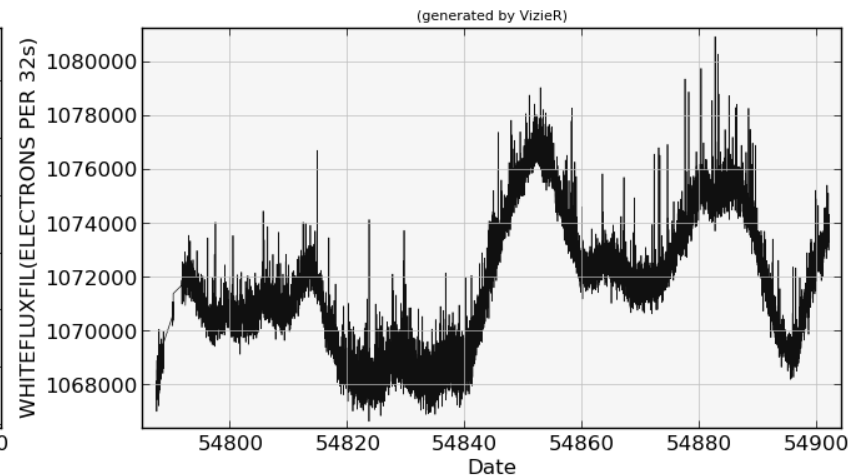
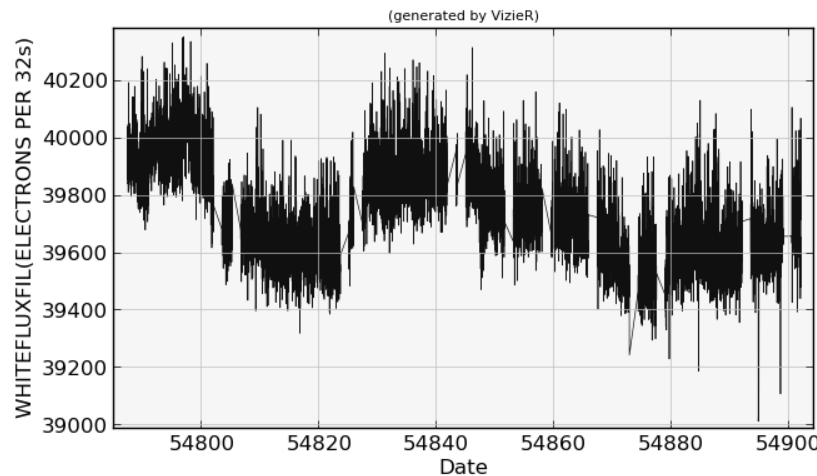
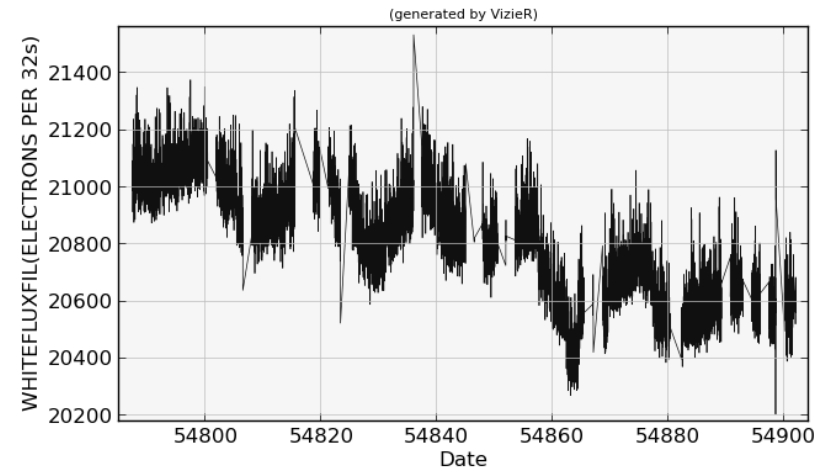
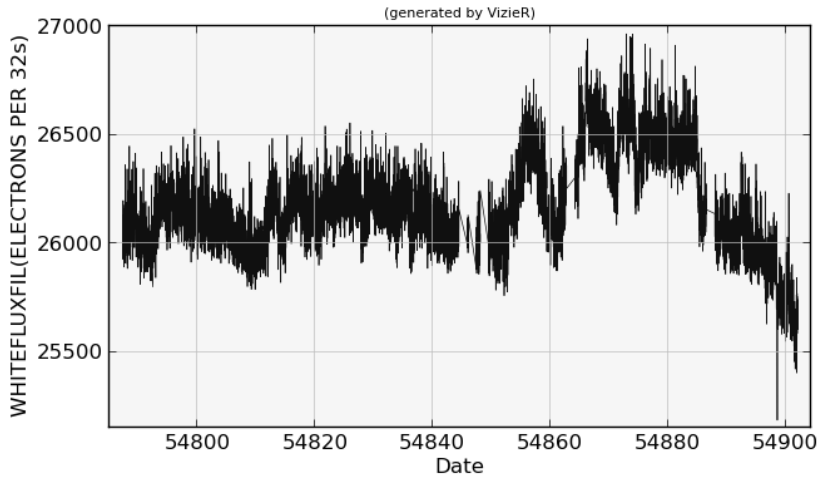
- The current available amount of light curves is huge

| Name | Type | Cadence (d) | Time Basis (d) | Mag. range (mag) | N_{lc} | Filter/Wavelength (nm) |
|--------|---------------|-----------------|-------------------|---------------------|----------|---------------------------|
| CoRoT | | 0.00041/0.022 | 20 – 150 | 6 – 9/11 – 16 | 170 000 | 360 – 950 |
| Kepler | | 0.00069/0.2083 | 1500 | 8 – 19 | 200 000 | 420 – 900 |
| K2 | Long Cadence | 0.2083 | 80 | 8 – 19 | 490 000 | 420 – 900 |
| | Short Cadence | 0.00069 | 80 | 8 – 19 | 2 000 | 420 – 900 |
| TESS | | 0.00139/0.02083 | 27 – 351 | 4 – 17 | 250 000 | 600 – 1 000 |

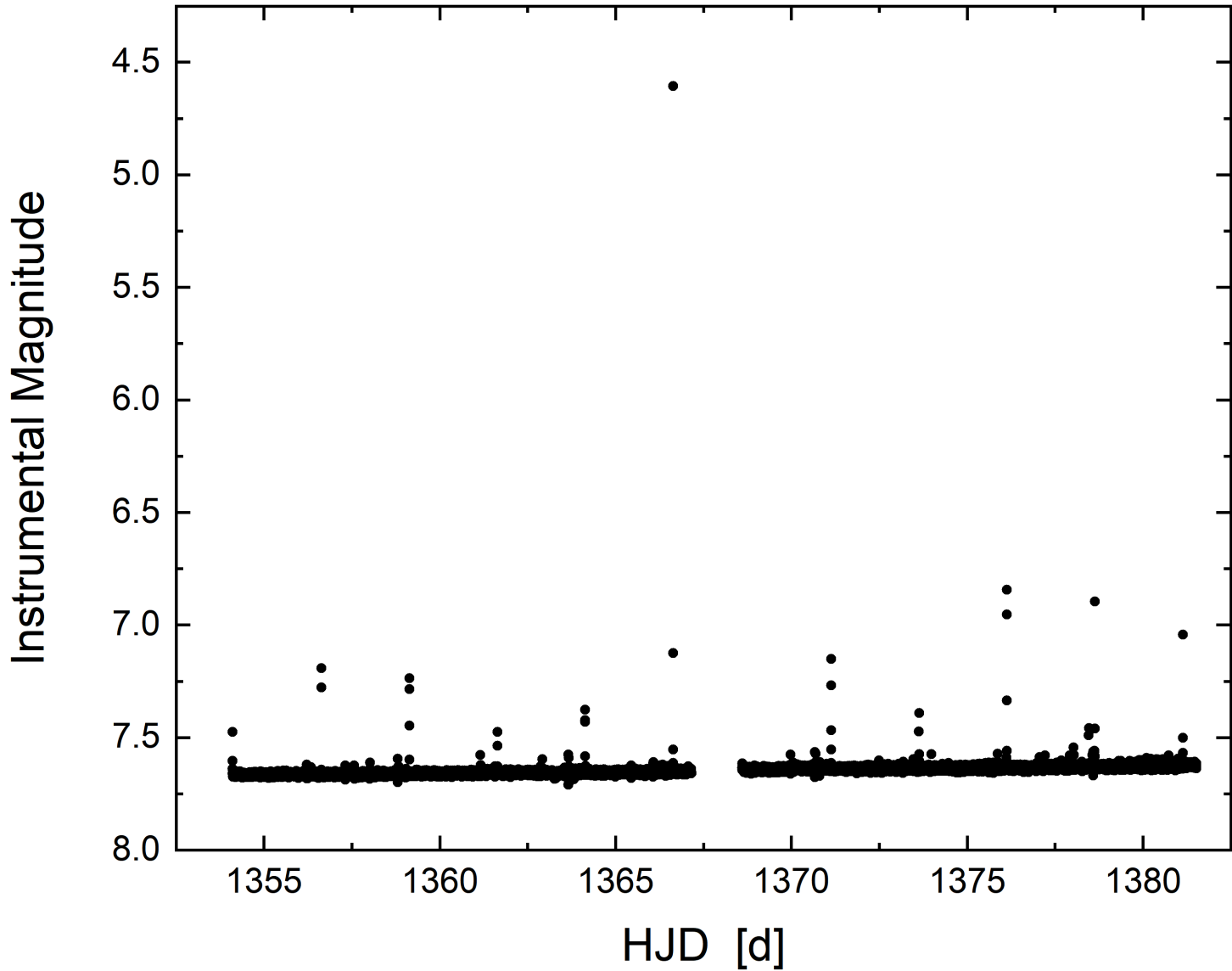
- Different cadences, filter/wavelength ranges, qualities, magnitude ranges, ...
- Also a lot of ground based data available

An example – CoRoT

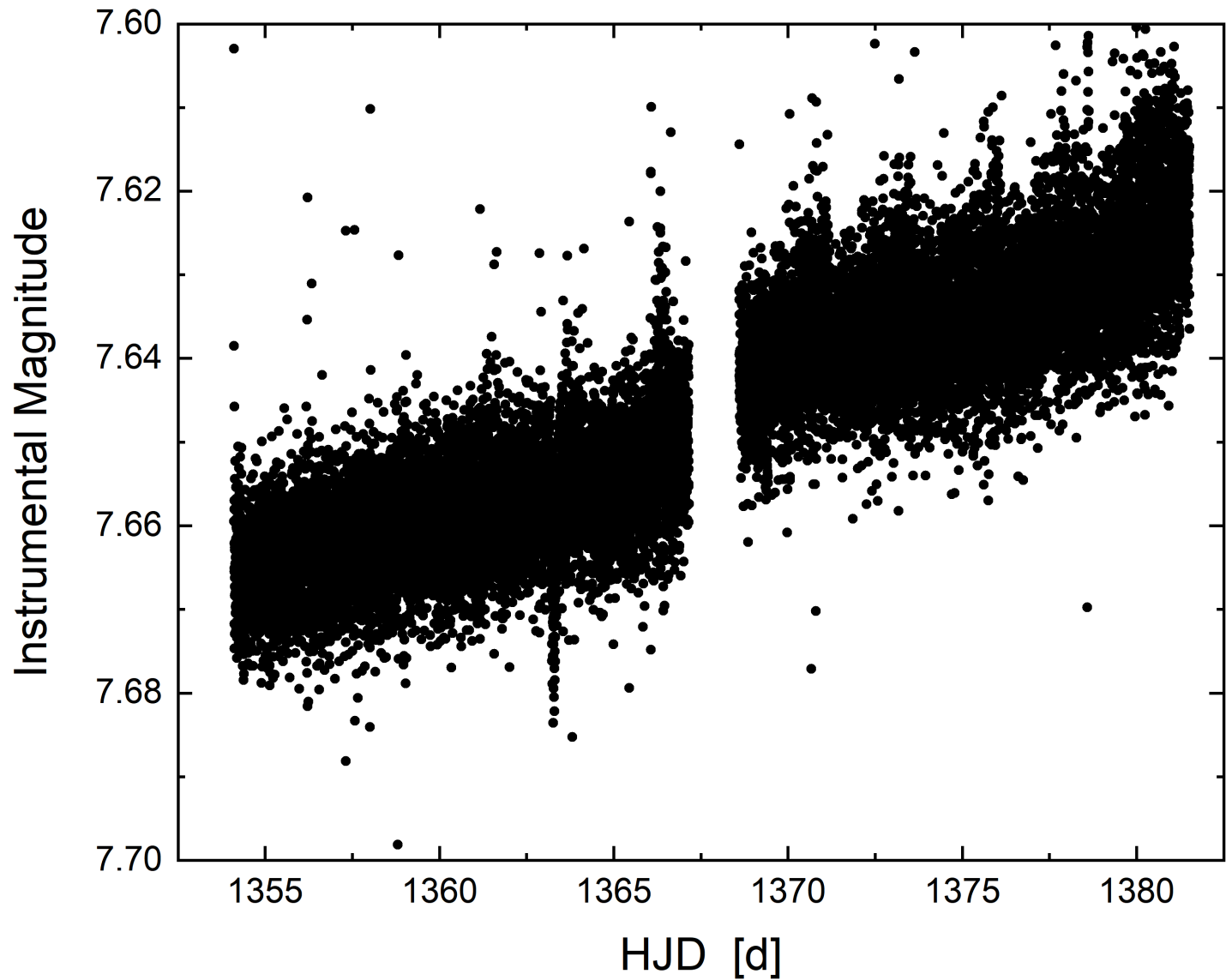
Which one is the known variable star?



An example - TESS

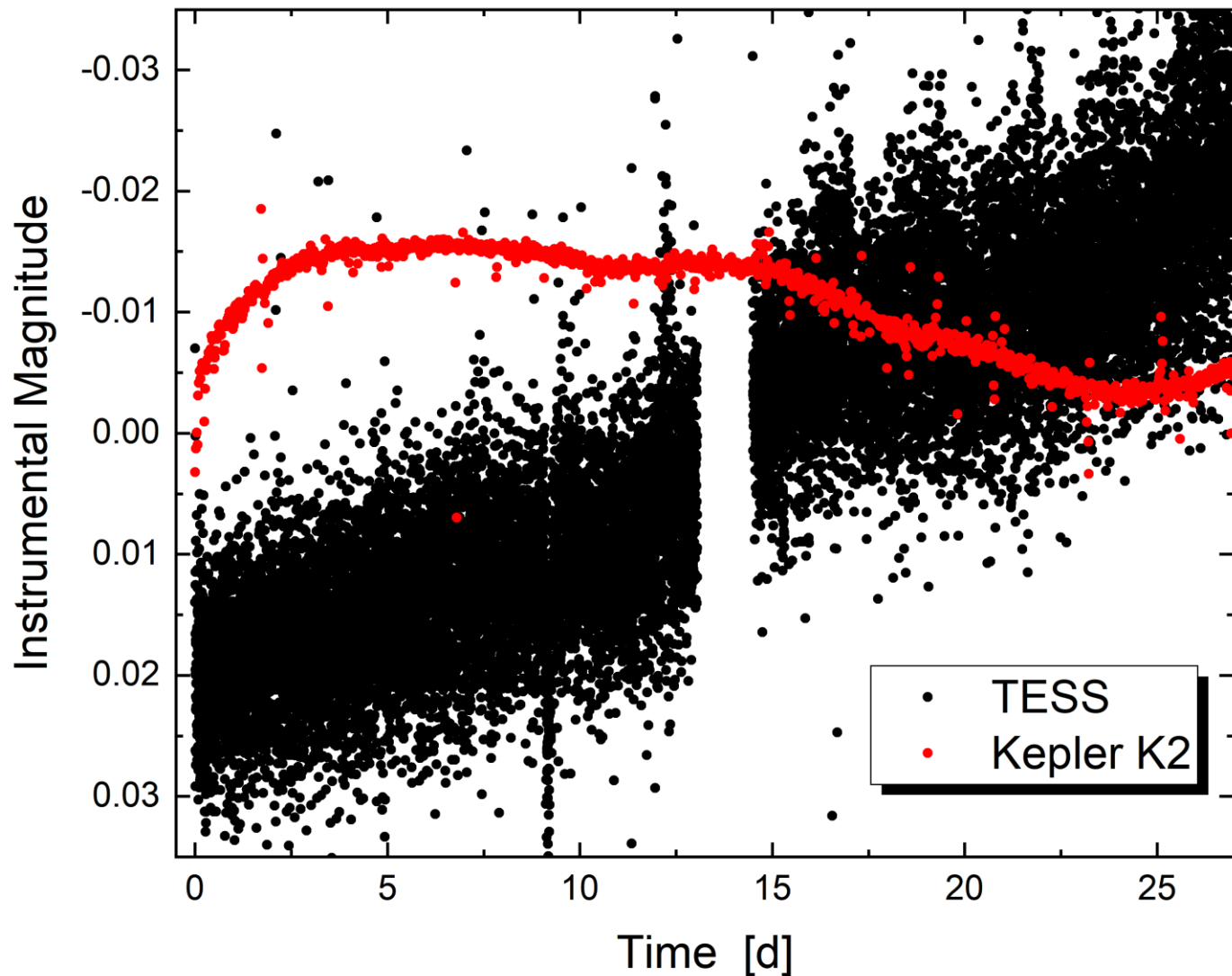


An example - TESS



An example – TESS and Kepler K2

Light curve of the same object – constant or variable?

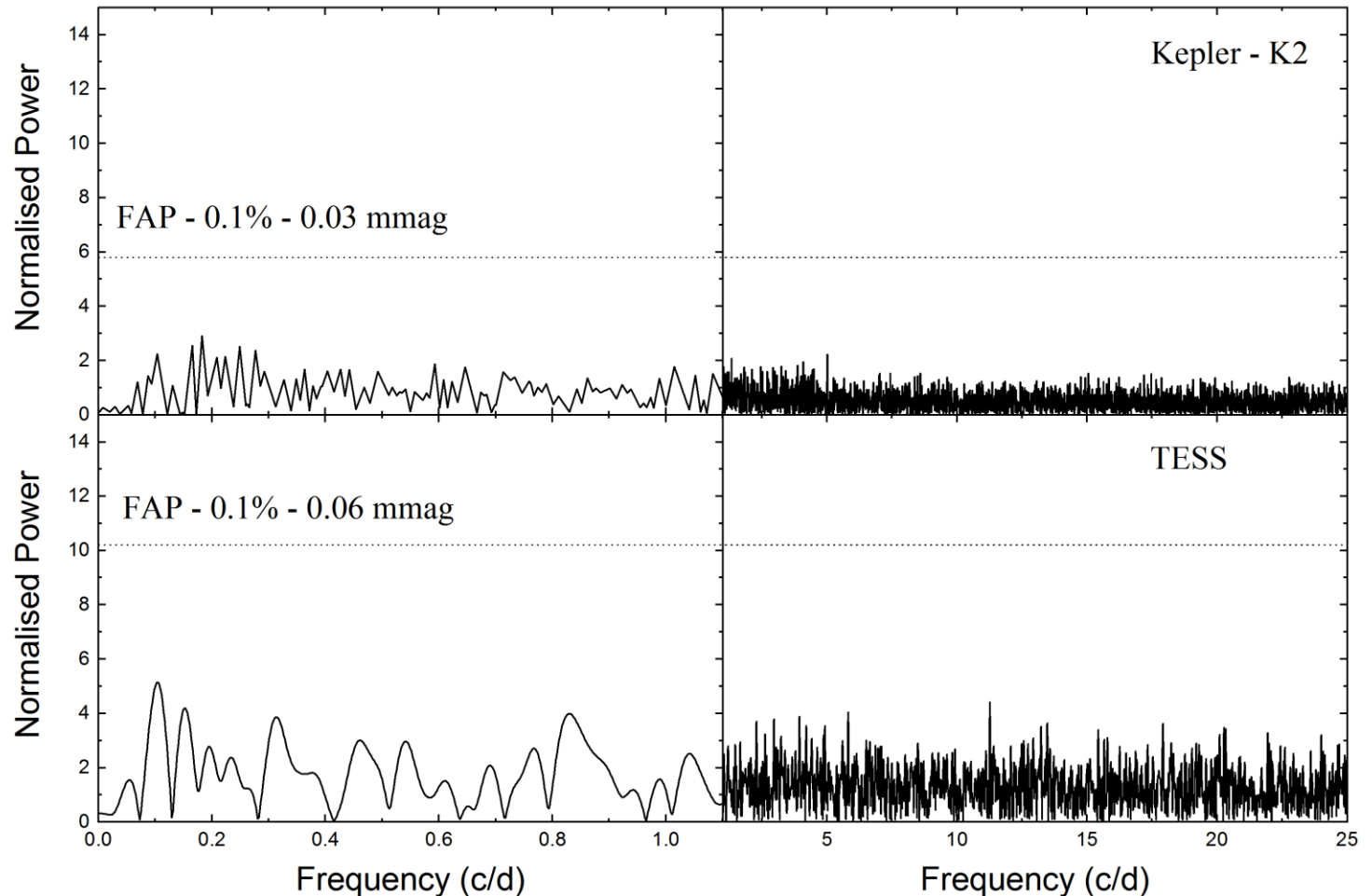


A short recipe

- Learn about the “instrumental frequencies”
- Study known variable stars in your data set
- Be aware of the time basis
- Be aware of the frequencies removed by your method/algorithm
- Divide the investigated frequency range
- Be aware of irregular variability
- Use more than one time series analysis method, i.e. Fourier and String based techniques

An example – TESS and Kepler K2

UCAC3 157-294882, $V = 14.86$ mag, M3V



Our pipeline software

Thank you for your attention