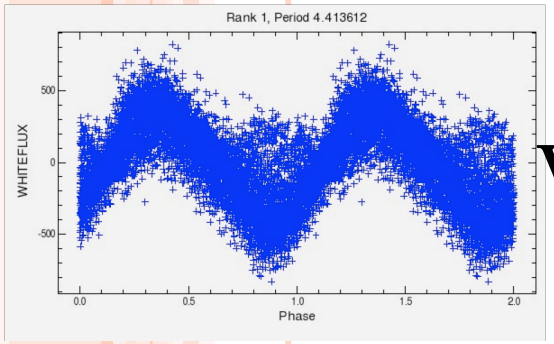
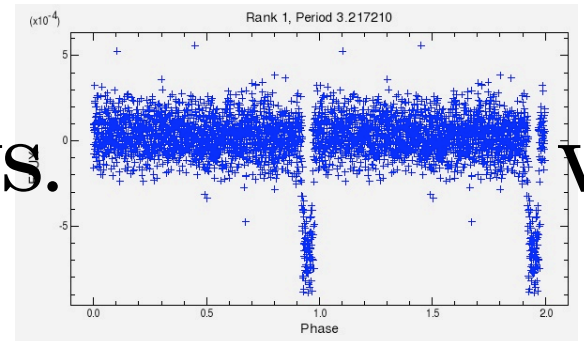
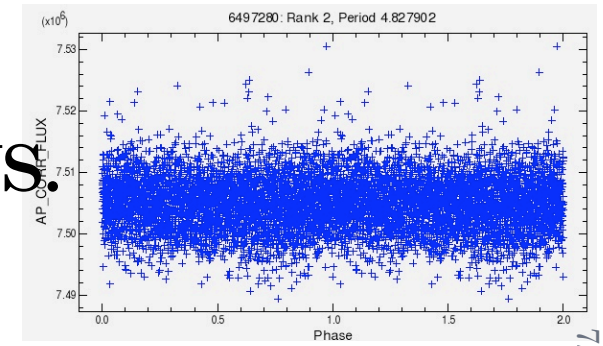


VS.



VS.



GROUP PROJECT: IDENTIFYING AND CLASSIFYING VARIABLE SOURCES IN THE KEPLER DATA

- Every star has a story: a light curve.
- How do you listen to 150,000 stories at the same time, and
- How can you (easily and accurately) tell which stories are interesting?

Learn about variability statistics, periodograms, machine learning classification schemes, the utility of ancillary information.

Time Domain Astronomy

- All of spatially unresolved astronomy can be thought of as the exploration of a two-dimensional space: frequency and time.

- Astronomers have learned a lot from exploring the frequency domain, but have under-sampled the time domain in sample size, wavelength coverage, and cadence.
  - The future of time-domain astronomy is bountiful: LSST, Pan-STARRS, Kepler, CoRoT, YSOVAR, radial velocities, ASTrO/TESS/PLATO, etc.

- Every star is variable at some level.

- Variability time-scale → physical mechanism.

Time Domain Astronomy in the Non-Ideal Limit

- Astronomers trip over themselves in the time-domain.
- The signatures of non-ideal observations in time-series data are often detectable, often un-avoidable, and always annoying.
  - Ex: CoRoT Earth shadow crossings, 1-day ground-based period aliasing, seeing variations and blends.
- Systematic sources of variability can dominate and/or mask intrinsic variability in a survey.
- Watch out for the dreaded "red noise"!

The Project

Use:

- Kepler data set
- NStED standard variability statistics
- NStED periodogram and visualization tools
- Harvard Time-Series Center classification tool
- Or, "roll your own code"

To:

- Define and identify a subset of ~50 interesting light curves
- Identify and handle systematics
- Identify important time-scales
- Classify the light curves

Questions to Answer

- What time-scales → e.g., what physical mechanisms are of interest?
  - Ex: eclipses, flares, rotation, asteroseismology, young stars
- What amplitudes of variability and how to identify
  - Ex: How can you tell the difference between a 0.1 mag amplitude sinusoid variable with a V= 9 and 0.01 mag photon noise, vs. a V=16 object with 0.1 mag photon amplitude noise?
- How can you handle multi-periodic signals?
- How to identify, flag and remove systematic sources of variability?
- What algorithms do you use?
- How do you get and prepare the data?
- How can you use ancillary diagnostics to classify an object:
  - Colors? (e.g. red = M star, giant or dwarf?)
  - Phased light curve shapes ? (e.g. phased Fourier decomposition)
- How do you scale these methods to large/multiple data sets?