**Project Notes – Semester One**

**Week 1**

Objectives

- ~~Have a play at the MAST database and inspecting WR6 star's TESS time series data~~

- ~~Download Crowther catalogue and starts categorising them~~

- Read up recommended papers to grasp research targets

Note

- Boaretto et al. (2021) – chaotic & stochastic time series – permutation entropy, ANNs

- Phillipson, Boyd, Smale (2018) – Chaotic X-ray variability of 4U 1705-44

- Rate, Crowther (2020) – WR stars catalogue (Gaia DR2)

**Week 2**

Objectives

~~- Download MAST FITS files - Extract light curves (PDC\_SAP) from each of them~~ - separate files for separate light curves (ascii files) - be careful to have enough floating points, can't truncate data too much - **priority #1**

(extra: try doing a Lomb-Scargle periodogram)

- More papers to check out with related topics. Probably make a separate doc to note and summarise papers (?)

Note

**Lomb-Scargle periodogram** - Least-squares spectral analysis (LSSA) is a method of estimating a frequency spectrum, based on a least squares fit of sinusoids to data samples, similar to Fourier analysis

- Toker, Sommer, D’Esposito (2020) – Chaos in Nature – think this one is quite interesting that is **not strictly physics related**

- R. A. Phillipson et al. (2020) – Variability of Kepler AGN – **recurrence analysis**

- Pessa, Ribeiro (2021) – **ordpy** – Python package for **Permutation Entropy**

**Week 3**

Objectives

- Try and do a flux derivative vs. time for my lightcurves => noisy signal which you will do a boxcar smoothing of that signal (again use lightkurve)

~~- Try the Lomb-Scargle with more points for one of the lightcurves~~ - see what difference that makes (both to the run-time and the results)?

- ~~Try WR3 & WR40 stars~~

(ASIDE: New non-linear analysis software available – NoLITiA - https://nolitia.com/)

**Week 4**

Objectives

~~- Send around list of bright WR stars from Crowther catalogue~~.

- Try fitting MCMC (emcee) onto Lomb-Scargle of your stars - using expression from **Bowman et al (2019)** - Equation 2. Plot the best fit and display on graph (as in fig 2 of Bowman et al paper) – **still in-progress**

Longer Term Tasks

i) ~~A complete set of TESS lightcurves for the brightest Wolf-Rayet stars - that is all those with 2 minute cadence data~~.

**ii) Then we need to characterise these lightcurves - MAD, Autocorrelation, Mutual Information, permutation Entropy etc. – Need to work on this ASAP**

iii) Same information needed for range of Mackey-Glass and Duffing.

iv) Then we move onto Chaos decision tress and neural network

v) We may need 30 minute cadence data from TESS, using ELEANOR software (from FFI data) - <https://adina.feinste.in/eleanor/> - (optional)

**Week 5**

Objectives

~~- Obtain list of WRs observed by TESS (2-min cadence). Then, note down sectors observed for each star (via MAST) -~~ use <https://heasarc.gsfc.nasa.gov/cgi-bin/tess/webtess/wtv.py>

**Week 6**

Objectives

- Focus on fitting MCMC, still main priority that is unfinished

**Week 7**

Objectives

**Week 8**

Objectives

**Week 9**

Objectives

- ~~Rewrite text files of light curves to get only time, pdcsap\_flux and pdcsap\_flux\_err~~

Note

- Checked out Chaos Decision Tree Algorithm (CDTA) MATLAB codes from Toker, Sommer, D’Esposito (2020)

**Week 10**

Objectives

**Week 11**

Objectives

~~- For TESS 2-min data, add into table of WRs a column showing how many light curves per star that is obtained – send it to Ian~~

- Make a program interpolating NaN values of data – patch them all with mean/median value, fill in missing times