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Deriving Physical Properties of Eclipsing Binaries

Weeks 1 – 3:

- Background reading:
  - Read about the dataset
  - Studied the usefulness of eclipsing binary studies
    - Importance in mapping of the galaxy, as well as mapping locations of other galaxies near us
    - Study of stellar properties
      - Stellar types
      - Masses
      - Distances
      - Composition
      - Temperature
      - Size
      - Orbits
      - Different types of stars
- Initial work on the dataset:
  - Understanding the distribution of the dataset:
    - Types of systems in the dataset
    - Converting magnitudes to luminosities
    - Visualising light-curves
    - Selecting good examples of eclipsing binary behaviour for further study
    - Thinking about automating the problem
  - First attempt at conversion of magnitudes to luminosity did not work out
  - Read about the calibration of the dataset, adjusted luminosity calculation
  - Andronov paper discussed with Dr. Cross: https://ui.adsabs.harvard.edu/abs/2012Ap.....55..536A/abstract

Weeks 4-6:

- Background reading:
  - Different ways of fitting light-curve data
    - Andronov
    - Polynomial fits
- Work on dataset
  - Tried to use andronov method for fitting light curves to find dips. Difficult to set up optimisation and parameters
  - Tried using polynomial fits. Finnicky, only gives good results on very specific distributions of data around the dip.
  - Settled on a simple approach, for each filter:
    - Find the minima of the luminosity as one of the components
    - Find the maxima and subtract the minima to find second component
    - Do this for all filters

        - Plot luminosity of both components vs wavelength(wavelengths of the filters found on Spanish filter database
    - Noticed issues with some sources: not enough data, yet classified as Eclipsing Binary, useful to mention for future investigation

Weeks 7-8:

- Report writing(Discussed in meeting)
    - Introduction: Introduction of background and motivation
    - Method: Description of the data, process, some plots and values
    - Results: More plots, more values, discussion, issues
    - Conclusions: what was achieved, what could be done in the future
- Plotting all graphs again with errors
- SED-> fit to black body power spectrum/stellar SED
- Read Literature for Stellar Spectrum
- Discus Quality of Data
- Automate
- Fitting black-body curves
    - Considering two methods:
        - Wien:
            - Requires known and accurate peak
            - Better to fit the black-body equation
        - Planck's radiation law
            - Better method
            - Can use equations to fit luminosity-wavelength dependence
- Consider using Panstarrs data and GAIA data for distances, etc.
    - Panstarrs for optical range data
        - Panstarrs not available for all samples
        - Didn't have enough time
    - GAIA:
        - Used for distance estimation from parallax
        - More sophisticated method, ran out of time.
        - Cross-ref tables for GAIA3 not ready till last two weeks.
        - Panstarrs won't be available for all samples
        - GAIA: Parallax measurements, errors,
    - Apparent Luminosity and Temperature
    - Considered Doppler shift for corrections to luminosity/wavelength measurements. Discussed with Dr. Cross: it would be more relevant for spectroscopic samples. For photometric, very small
    - Photometric redshifts: Est. gal/quasar rshift from broadband photometry, by comparing to a set of templates/ML. Strong features works well(eg. Quasars Lyman break, 4000 A break in old elliptical galaxies Balmer(?))
    - Fit the dips
    - Automate: Finding and fitting dips

Weeks 9-10:

- Determining distances from GAIA
    - Inverse parallax used as time ran out by the time data available

- Used black-body fits to find temperatures, bolometric luminosity
- Used distances to determine absolute luminosities
- Read up on stellar classification and find ranges for H-R Diagram regions
- Read about Luminosity-Temperature dependence after discussion with Dr. Cross: Determined a way of finding surface area from the fits.
- Found an issue with the fitting equation: replot fitted graphs with correct equation
- Encountered issue with temperature predictions: Very low temperatures. All in infrared. Realised, after discussion with Dr. Cross, limitation of only using infrared data. The calculations would be better with optical data also included as the peak wavelength for the temperatures of most stars is in optical range
- Finished writing report. Discussed the above issue and future ways to resolve it. Method still holds.
- Finished making poster.