**Light and Motion in SDSS Stripe 82**

Laura Watkins & Cambridge SEGUE
Institute of Astronomy, University of Cambridge
llw2s@ast.cam.ac.uk

### Introduction
The SDSS Stripe 82 is the region spanning from 199.9 to 201.0 in right ascension and from -1.25 to 1.25 in declination; the sky coverage is shown in galactic coordinates in the left panel.

The stripe has been repeatedly mapped between June and December since 1998, a distribution of number of good epochs is shown in the right panel and we see that the number of good observations is high for a large fraction of the data.

The high number of observations that exist for each object make the stripe ideal for the study of variability and proper motions. To this end, Heather et al. (2007), in prep, have created a light model Carus Catalogue (LMC) containing lightcurves data for all stars and galaxies in the stripe from poor to good quality, with mean object type, and we have used a Lomb-Scargle periodogram to obtain period estimates and to remove artefacts. We also use the periods obtained to calculate mean object type and plot folded lightcurves.

### True Variables

- **Stars**
  - Distinguish between stars and galaxies using mean object type.
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Each object is assigned an object type when it is observed; 0 if it is a galaxy-like object and if it is a star-like object. For repeated observations, the mean object type is the unweighted mean of the assigned object types.

A cumulative distribution of mean object type for the catalogue reveals that ~12% of objects are purely galaxy-like or purely star-like, having a mean object type of 0 or 6. The remaining 88% of objects lie in between. In order to select variable stars, we must first split the catalogue into stars and galaxies. The shape of the cumulative distribution changes at mean object type 3 for both stars and galaxies, having a mean object type of less than 3 and are stars with mean object type greater than or equal to 4.5. We use a Lomb-Scargle periodogram to obtain period estimates and to remove artefacts using g-band artefacts using mean object type and plot folded lightcurves for each band.

### Constants & Variables

Distinguish between constant stars and variable stars using reduced $\chi^2$.

In compiling the LMC, each observation flagged as good is used in calculating the derived quantities. SDSS data are taken over a large region of the sky; each pixel contains data from both stars and the number of good epochs.

For the LMC, reduced chisquare indices were calculated for each band, using the trend as the reference, as such the trend indices are the highest number of good epochs, 6, for our measurement of variable stars.

A chi-square plot of reduced $\chi^2$ vs. LMC is shown to the left. The point at which the slope changes as a cut between constant and variable stars.

This cut considers 65% of stars to be constant and 5% of stars to be variable, and the value of the cut is for a reduced $\chi^2$ value of 2.7.

### Sample Lightcurves

Find variable periods using a periodogram and plot folded lightcurves.

We use a Lomb-Scargle periodogram to obtain period estimates for those objects identified as being truly variable and we also assign a reduced-chisquare index for each object. A selection of representative lightcurves are shown in the right panel. In each case, periods have been estimated using the band for which there was the highest number of good data points and the pixel index.

In the example, the pixel index for each object is shown in the graph title. The objects which we have classed as variables may be one of two types of objects:

1. Variable stars
2. Non-variable stars with outliers and artefacts.

We use the reduced chi-square index (Stetson, 1984) as a proxy for variability. The Stetson index looks for correlations between two or more sets of data – this might be data taken in two (or more) bands, or data taken in the same band.

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### True Variables & Artefacts

Distinguish between true variable stars and artefacts using g-band Stetson L index.

The objects which we have classed as variables may be one of two types of objects:

1. Truly variable stars
2. Non-variable stars with outliers and artefacts.

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### Future Work

Investigate spatial distribution and kinematical properties of different classes of variable.

### Colour-Magnitude Diagrams

For $g-r$ for constands, possible variables and true variables.

The shaded magnitude and $g-r$ colours were used to plot a colour-magnitude diagram for the variable subset. There are always fewer when plot colour represents the number of object in each pixel bin.

CMD for stars identified as constant containing reduced $\chi^2$. We identify three distinct populations:

- The upper right corner and the bottom left we associate with halo stars and would identify towards the top left we identify as thick disk stars.
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CMD for all objects classified as variable by reduced $\chi^2$. Again, we see distinct populations associated with this disk, thick disk, bulge stars in the same locations as for CMD for all objects.

There is also an interesting clump in the diagram above the thick disk, bulge population, this is most likely caused by saturated stars.

### References