Transformation Coefficients between SDSS and DES Magnitudes

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Abstract

We explore the filter data extracted from the standard stars in the Sloan Digital Sky Survey (SDSS) and transform them to compare the filter set used with the Dark Energy Survey (DES). The results of this project will aid in the photometric calibration of the Rubin Large Synoptic Survey Telescope (LSST).

Introduction and Background

In astronomy, we use filters to collect data from certain wavelengths of light. Different surveys tend to use different filter systems. Transforming the data allows us to compare and combine two or more data sets to increase the sample size. The SDSS is a five-filter imaging survey of the Northern Galactic Cap. The DES is a slightly different five-filter imaging survey of the Southern Galactic Cap. These two surveys meet at the Celestial Equator, SDSS Stripe-82.

Procedure

The SDSS data (York et al. 2000) were collected and cross-referenced with the DES data (Sevilla-Noarbe et al. 2021) to find matches in Stripe-82. The matches were run through a set of transformation equations coded in Python.
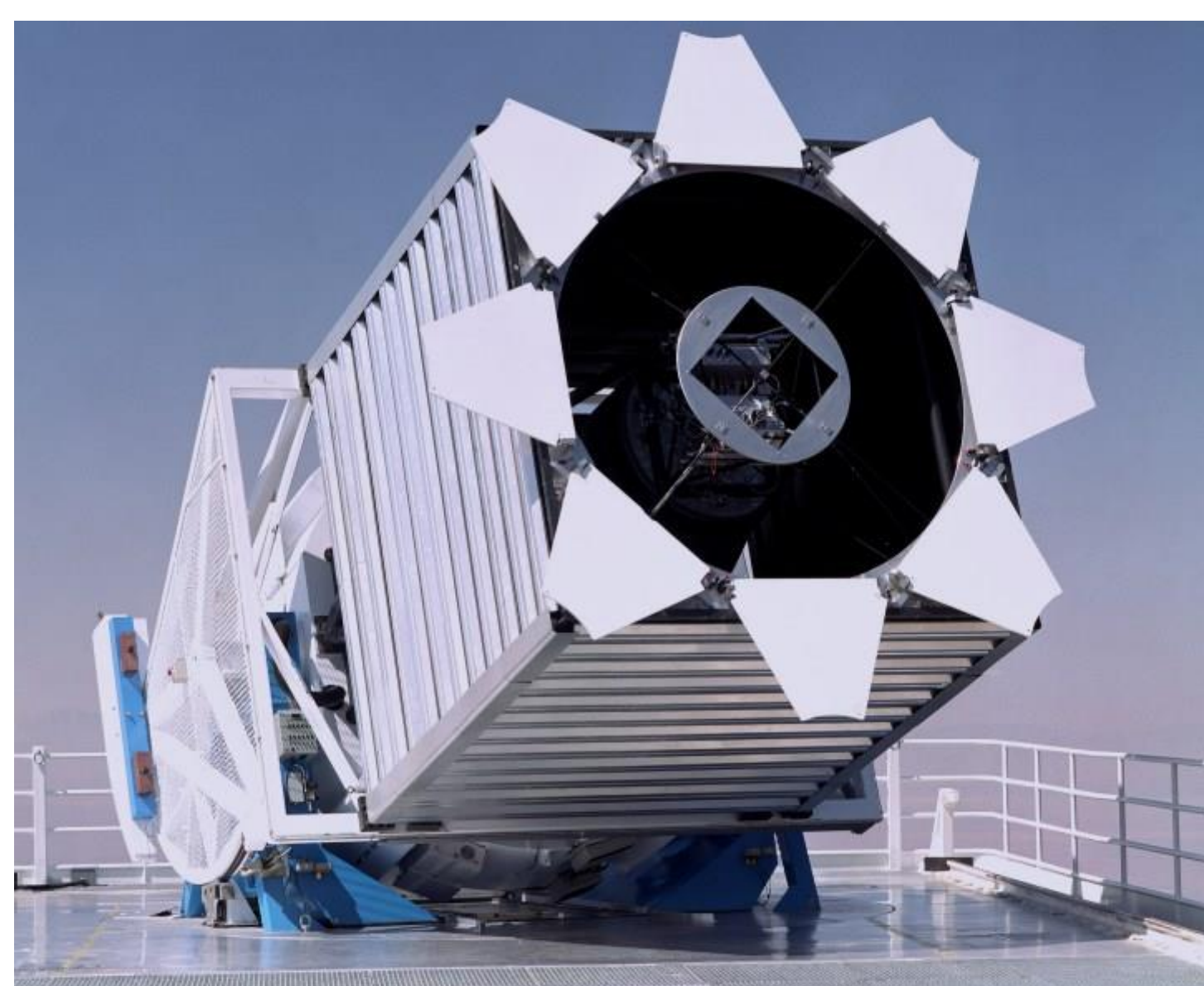

Figure 1 shows the SDSS Telescope at the Apache Point Observatory, New Mexico. The Sloan Digital Sky Survey covers 8000sq deg in the Northern Hemisphere covering the Northern Cap.

Results

Initial results were created by the code, illustrated by the plots and equation in Figure 3. Initial coefficients were created by the transformation equation code. An equation and a set of graphs were generated for SDSS filters 'g', 'r', 'i', and 'z'. The transformed SDSS data have yet to have been compared to the original DES data. Figure 3 displays the i-z outputs for filter i as an example of the filter transformation code.
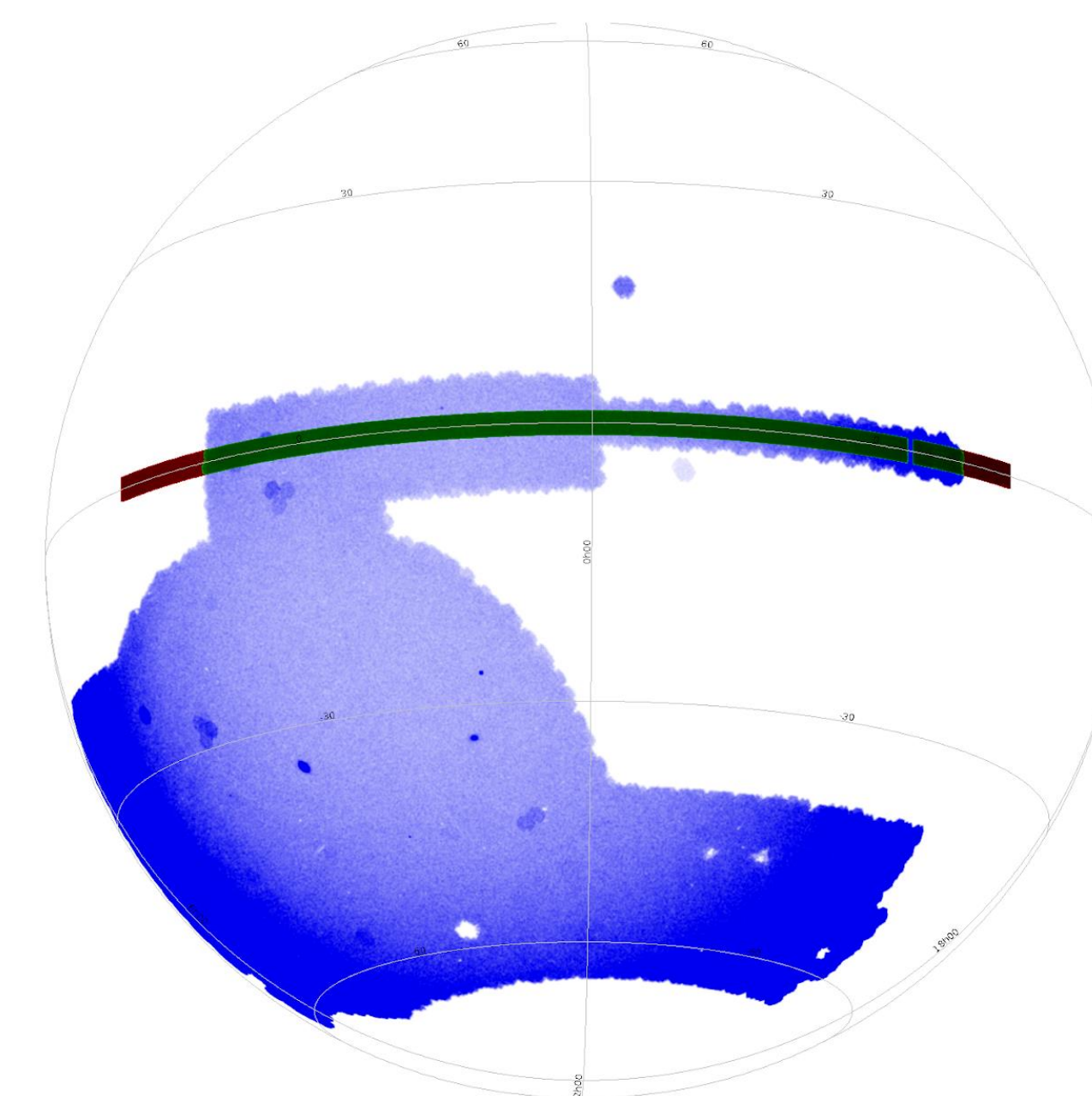

Figure 2 shows the observation field from which the SDSS stars were taken (Dark Stripe). Y6-FGCM calibration stars from year 6 of DES (Blue).There were 550,000 stars in common.

$$i_{sdss} \rightarrow i_{des}$$

$$i_{des} - i_{sdss} = 0.024 + -0.237*(i-z)_{sdss} + -0.094*(i-z)_{sdss}{}^2$$

[rms: 0.014]
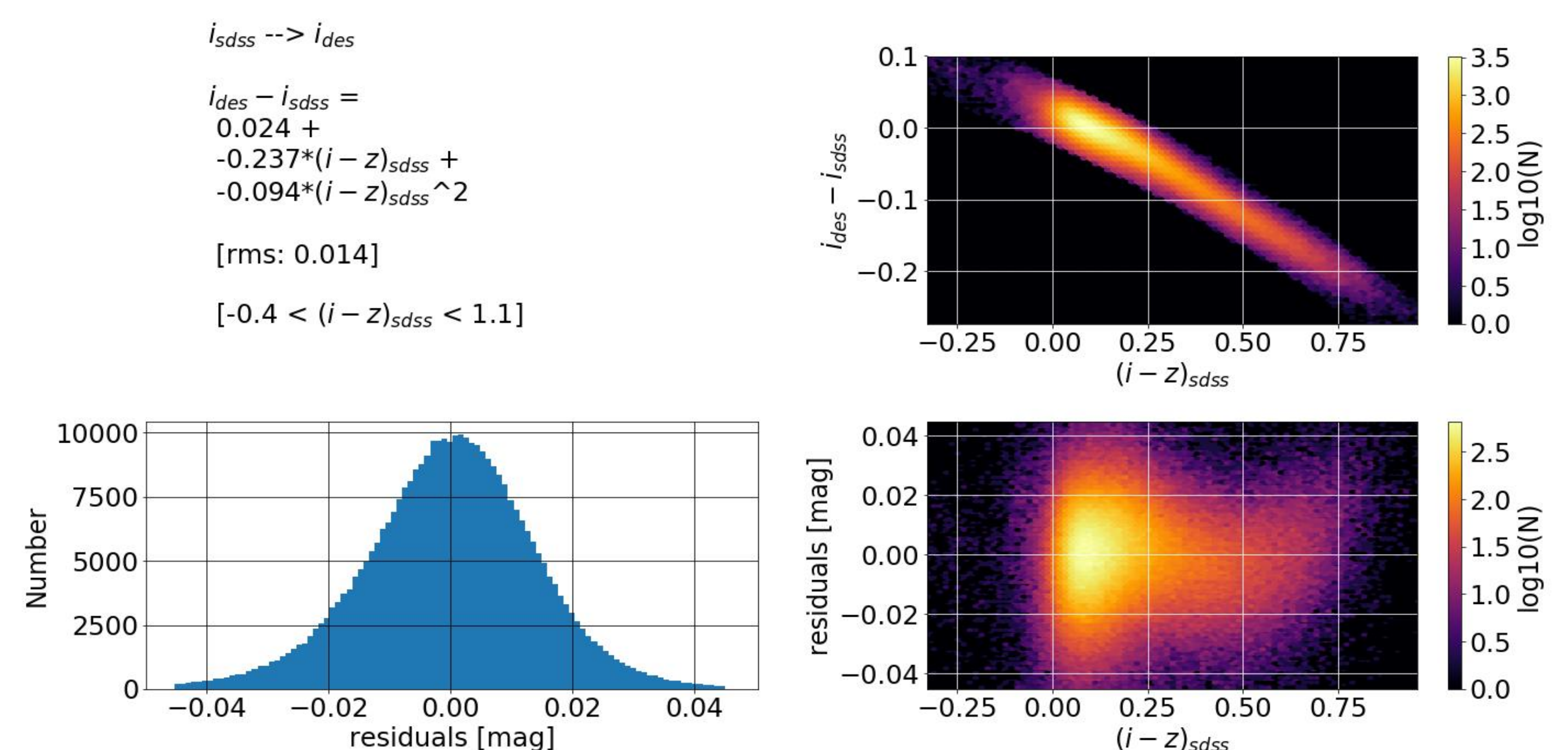
$$[-0.4 < (i-z)_{sdss} < 1.1]$$

Figure 3 shows the results of the data being put through the code. The top left image is the equation generated by the transformation equation code. The rms value is viewed as the uncertainty value for this set of plots. A good uncertainty value is anything under 0.020. The top right graph is the color-magnitude-density diagram. The bottom left graph is a histogram for the residual magnitudes. The bottom right is the color residual-density-diagram.

Future Work

- Transform u-filter of SDSS and compare to Johnson & Morgan U-filter
- Similar work will be undertaken for photometric calibration for Rubin LSST

References

Sevilla-Noarbe, I., *et al.* 2021 *ApJS* **254** 24

York, D.G. *et al.* 2000, *A.J.*, **120**, 1579.

Acknowledgements