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OLD OLD OLD SDSS Stripe 82

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ABSTRACT

1 ANALYSIS

We developed a new pipeline that was applied to all forced photometry light curves. The main steps involve:

- selecting faint epochs (where S/N is less than a selected threshold),
- applying the Bayesian treatment (see an accompanying paper for details) and replacing the flux for faint epochs
- calculating a number of standard flux-based features (mean, median, skewness, χ^2_{DOF}, etc., as well as applying the full Bayesian likelihood to parametrize the probability that the object is intrinsically variable
- calculating flux-based magnitudes
- calculating seasonal averages per light curve
- merging the light curve aggregates across filters

1.1 Variability

1.2 Colors

Since the reported fluxes are not extinction-corrected, we use a table of E(B-V) in a direction of a given source to correct for the galactic extinction. We use the formula $x_{corr} = x_{obs} + A_x * E(B-V)$, where x is u,g,r,i,z , and A_x is 5.155, 3.793, 2.751, 2.086, 1.479 for each filter respectively [Schlegel 98, Av are for RV = 3.1, also suggested by Eddie Schlafly]

Colors $x-y$ for an object with observations over many epochs are defined as the difference in magnitudes $m_x - m_y$. To find m_x, we need to define the average brightness of an object in a given filter. With a special treatment of faint sources, substituting (F_{obs},σ_F) for each faint observation by ($<F_{exp}>$,rms), we analyse updated lightcurves, addressing sparse sampling (see Fig. 4).

Thus for a given object we average all sparser observations prior before SDSS-III, and calculate annual averages for all subsequent years. We calculate weighted mean and the rms as

$$<F> = \frac{\sum w_i F_i}{\sum w_i} \qquad \sigma_{<F>} = \left(\sum w_i\right)^{-1/2} \tag{1}$$

with weights as $w_i = 1/\sigma_i^2$. We also calculate the robust median and the median error : $\sqrt{\pi/2}\,\sigma_F$ [robust $\sigma_G = 0.7414*(75\%-25\%)$, based on the interquartile range] . Then lightcurve for a given object is reduced to one (F_i, σ_i) point prior to March 2006, and a single point per every subsequent year, where (F_i, σ_i) is ($mean$, $meanErr$) or ($median$, $medianErr$).

The resulting average flux is converted to magnitude, and the color is $c = m_x - m_y$, with combined errors of band light curves added in quadrature

2 RESULTS

3 MAKING OF UGRIZ METRICS

Colors can be calculated in two ways: using the median of forced photometry over all epochs (object detected in coadded i-band has photometry in all epochs: `ugrizMetrics.csv`), or the median over single-epoch detections (only when an object was above the detection threshold for a single epoch : `medianPhotometry.csv`). The median over all detections will be biased (especially for faint sources) towards higher brightness. On the other hand, the median over all epochs will be more representative of the true brightness of an object in a given filter. If a median brightness is negative, we can use zero point magnitudes and in such cases median over all epochs will be an upper limit on brightness, but still less biased than median over all detections. Therefore we choose to use median over all epochs to calculate colors (see Fig. 5 for an example).

REFERENCES

Ivezić Ž., et al., 2007, AJ, 134, 973
Sesar B., et al., 2007, The Astronomical Journal, 134, 2236
Sesar B., et al., 2010, ApJ, 708, 717

This paper has been typeset from a TEX/LaTEX file prepared by the author.

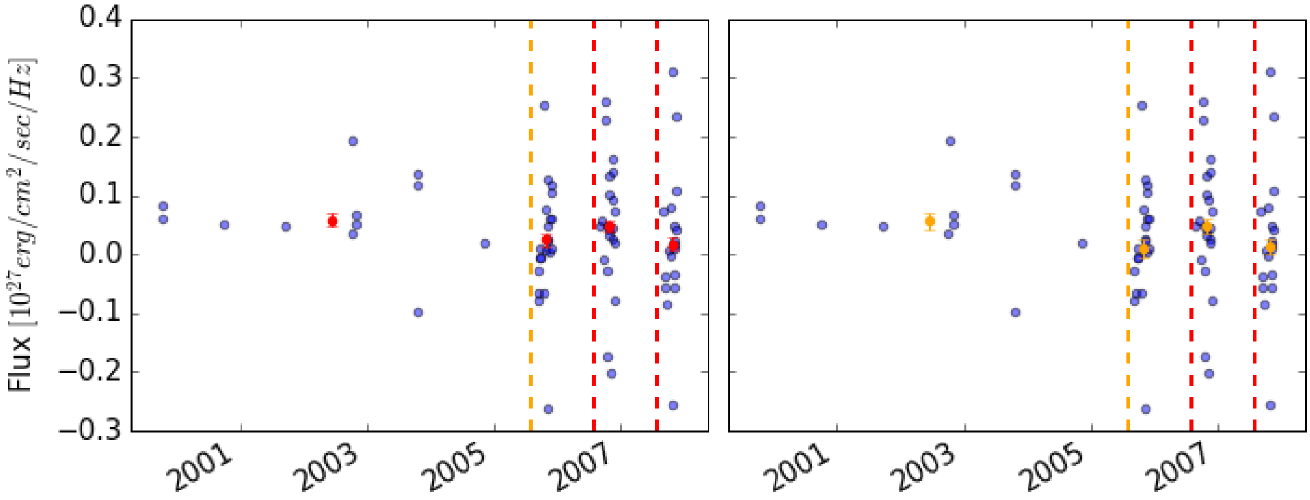

Figure 1. A plot showing an outcome of seasonal averaging for an object id 217720894888346425. The left panel (red dots) shows (mean, meanErr), and the right panel (orange) shows (median,medianErr), instead of seasonal points (blue). Vertical dashed lines as on Fig. 4

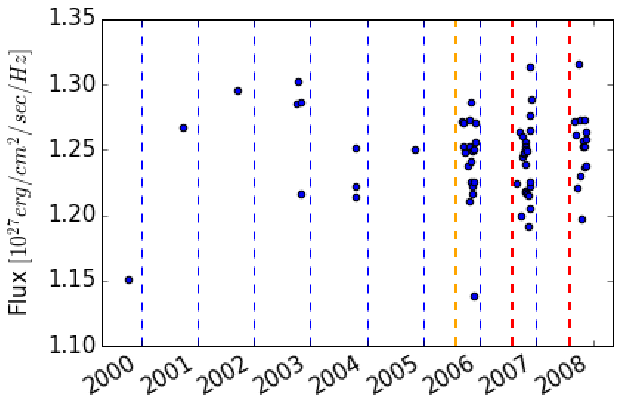

Figure 2. A plot showing an example light curve for an object id 217720894888346422. Jan 1st of each year (blue), August 1st of 2005 (orange) and August 1st of each subsequent year (red) is indicated by vertical dashed lines. Observations prior to August 1st of 2005 have sparser cadence, whereas those after that date have more frequent observations. This is due to the SDSS-III Supernova Survey which begun Sept 1st 2005. All points to the left of August 1st 2005 (orange line) are averaged together. Points to the right of August 1st 2005 are seasonally averaged.

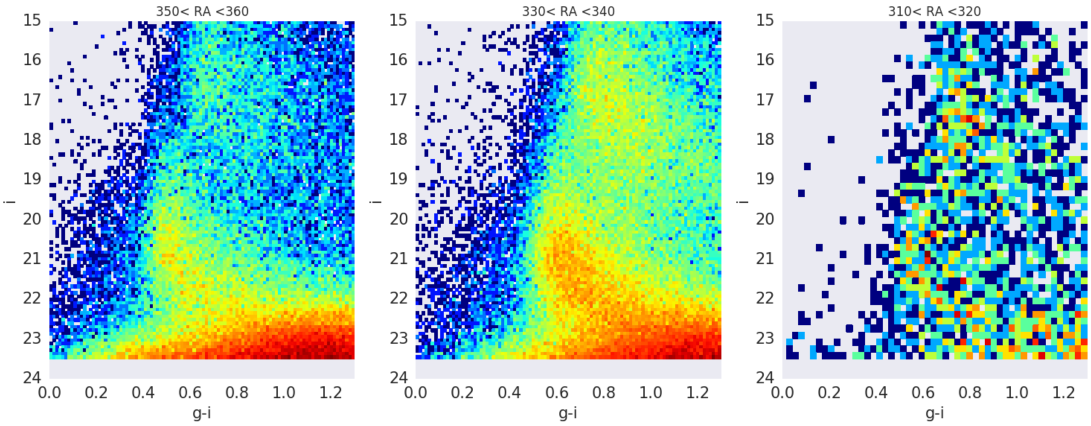

Figure 3. A color-magnitude plot , reproducing the results of (Sesar et al. 2010) , Fig.23 . We show here only NCSA-processed sources, which is why certain RA ranges are omitted or have less sources. We only select sources with `extendedness=0` parameter (stars). The scale is showing the $\log_{10}$ of count. All sources have their colors corrected for extinction. On first two panels the features of Sagittarius Stream are clearly visible.