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Improving the DRW fit parameters for S82 quasars with increased baseline combining SDSS, CRTS and PS1 data

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ABSTRACT
Aim: Improve on DRW parameters reported in MacLeod et al. (2011) by an increase of the QSO light curve baseline. We compare the tools used to fitting for τ and SF_{∞} to those of Kozłowski, Szymon (2017).

1 MOTIVATION

MacLeod et al. (2011) successfully derived many QSO parameters for the DRW model based on fits to SDSS light curves in S82. Encouraged by conclusions of Kozłowski, Szymon (2017), we expand baselines of quasar light curves utilizing data from CRTS and PS1. We show improvement in the accuracy of parameter fit (Hernitschek+2016 sought to improve on parameters, but had insufficient baseline using solely PS1).

2 METHODS

We first confirm the scaling relations by ?by testing the retrieval of simulated light curve parameters with Celerite . In addition to reproducing his Fig.2 we also plot the fractional bias due to insufficient length of the light curve baseline. We confirm that longer baseline should significantly improve time scale constraints. Light curve error distribution and sampling are less important, i.e. it would improve the accuracy of fit more to have a larger baseline than denser sampling.

Then we explore the combined SDSS-PTF-CRTS-PS1 dataset for Quasars in Stripe82 footprint (Fig. ??). Namely, we start with the SDSS DR7 QSO near-simultaneous ugriz photometry from Schneider+2007 in S82 footprint (http://www.astro.washington.edu/users/ivezic/macleod/qso_dr7/Southern.html). Querying CRTS DR2 database B.Sesar obtained CRTS white light lightcurves for these quasars. Querying PTF database against SDSS-CRTS matched 7601 QSO we obtained additional r-band light curves. Finally, C. MacLeod provided PS1 (PanSTARRS) grizy light curves matched to positions from DR7 Schneider et al. catalog. We make an outer join of all catalogs, flagging from which survey came which data point, as well as photometric filter.

We first check whether there is an improvement of fit for simulated DRW sampled at observed cadence - we plot τ_{out} vs τ_{in} for SDSS sampling, PS1+SDSS sampling, PS1+CRTS+SDSS sampling, PS1+CRTS+PTF+SDSS sampling. This helps establish, based on simulated data (where we know the truth), whether we should expect much improvement in fit accuracy when using real data.

We then perform fits using observed points selecting photometry only from a subset of surveys : τ_{PS1}, $\tau_{(PS1+SDSS)}$, τ_{SDSS}. We also check whether we get a better fit behavior using only bright quasars with $\tau_{\langle mag \rangle < 19}$.

Using the best combination of survey data, we revisit MacLeod et al. (2011) correlations of retrieved characteristic quasar timescale τ and variability amplitude σ with black hole mass, luminosity, etc.

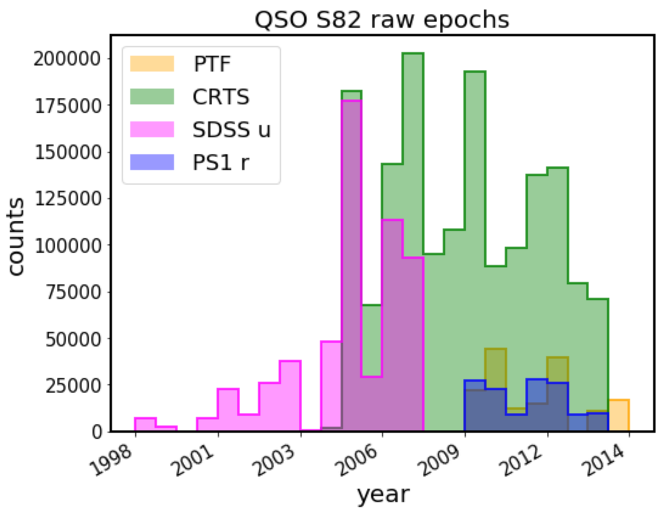

Figure 1. Count of raw photometric measurements for Quasars in Stripe 82 from four surveys . Note that both CRTS and OTF significantly increase the original baseline of SDSS measurements.

REFERENCES

Kozłowski, Szymon 2017, A&A, 597, A128
MacLeod C. L., et al., 2011, The Astrophysical Journal, 728, 26

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