



1. Motivation

The **Extended Chandra Deep Field South** (ECDFS) is a popular X-ray extragalactic field hosting a rich population of objects such as galaxies, stars, and quasi-stellar objects (QSOs) potentially exhibiting variability.

This ECDFS is a deep drilling field in the Legacy Survey of Space and Time's (LSST) Data Preview 1 (DP1), which offers us novel wide, deep, and regular observations over 21 days for this extragalactic field.

Using observations across the six LSST filters, we aim to probe the time-variability of the galaxy, star, and QSO objects in the ECDFS for DP1, and examine the light curves for the most variable object.

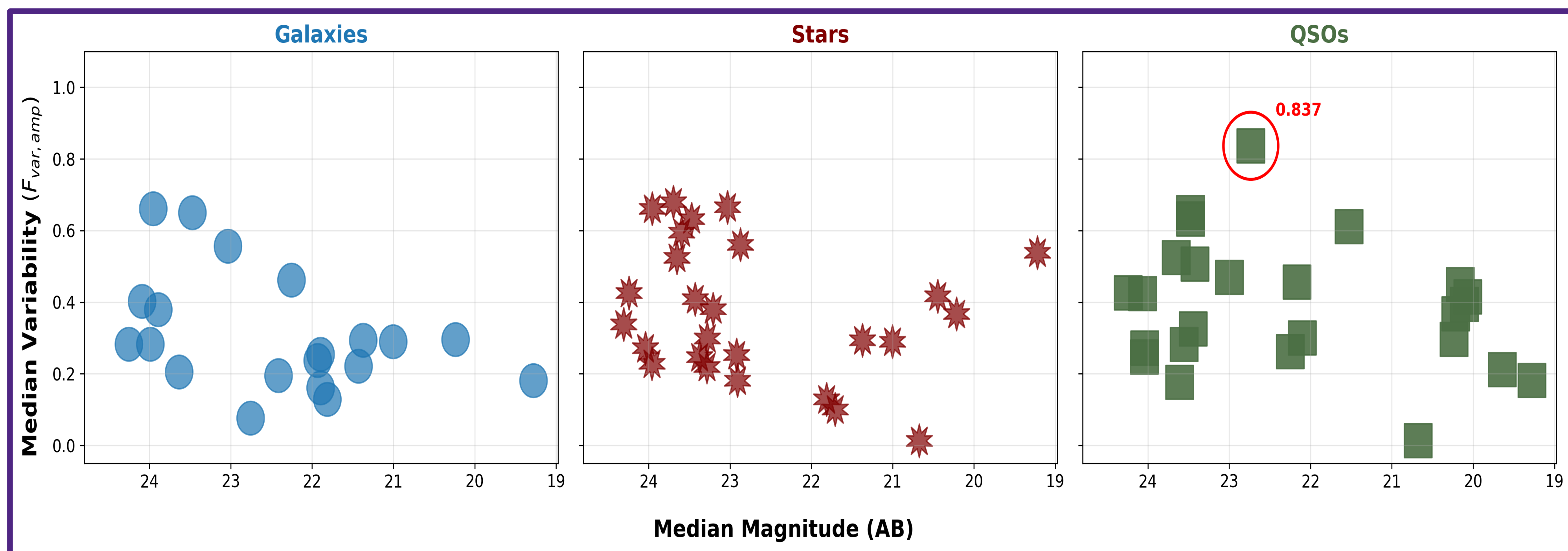


Figure 1: We identified objects in our sample as the galaxy, star, or QSO class by cross-matching objects from the Difference Image Analysis Object (DiaObject) catalogue in DP1 with NED. Across all three classes, it seems that fainter objects exhibit more variability. The most variable object in this sample is highlighted with a red circle.

2a. Visualizing Variability – Fractional Variability Amplitude

To quantify variability, we adopted the fractional variability amplitude metric, $F_{var,amp} = \sqrt{\frac{MAD^2(F) - \langle \sigma^2 F \rangle}{median(F)}}$ [1], where F is the variable object's flux obtained from LSST's DiaObject catalogue, and MAD is the Median Absolute Deviation. LSST DP1 has the highest cadence of observations in the g , r , and i bands as seen in Figure 3.

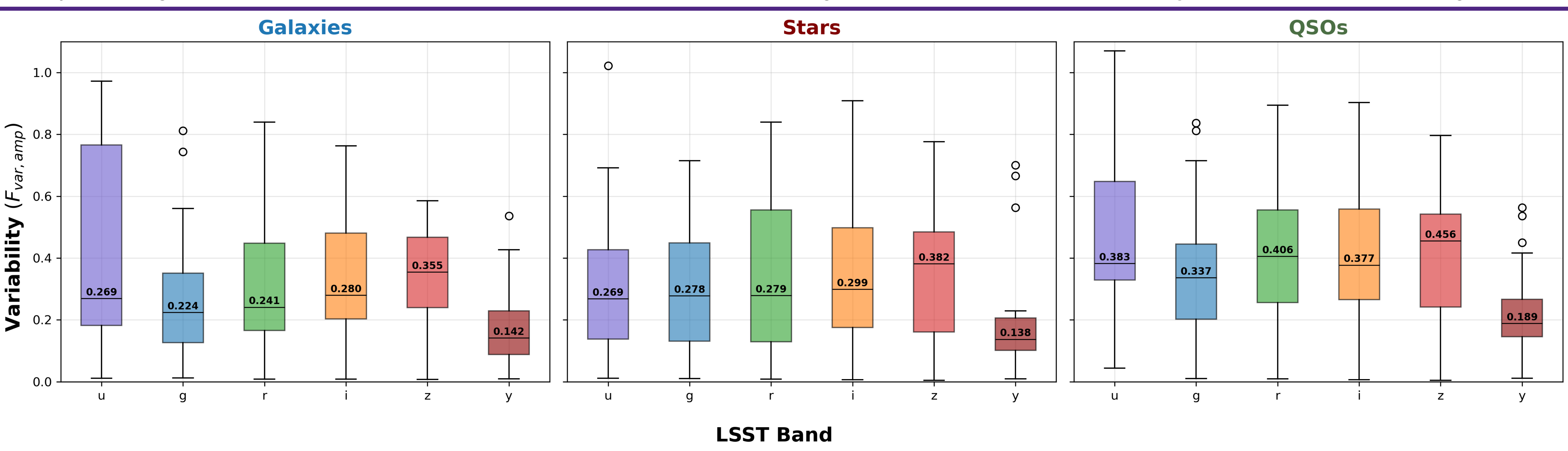


Figure 2: In the g , r , and i bands for DP1, we find that the galaxies are typically the least variable, followed by stars, and then finally that QSOs are the most variable.

2b. Visualizing Variability – Light Curves

We identify the most variable object as a QSO and constructed its light curves^[2] across all six LSST filters (u, g, r, i, z, y). Figure 3 is presented with AB magnitudes over the 21-day epoch of observations of the ECDFS in DP1.

These light curves showcase the observed amplitude variability, where the strongest variability is observed in the higher-cadence g , r , and i bands.

3. Next Steps

We aim to cross-validate the $F_{var,amp}$ metric with the *Stetson-J* index — a variability metric used in LSST DP1. Further light curve analysis with a focus on the higher-cadence g , r , and i bands can ensure variable objects are well characterized in LSST DP1.

The goal of this project is to investigate the time-variable analysis capabilities of LSST for variability studies over the next 10 years of LSST operation.

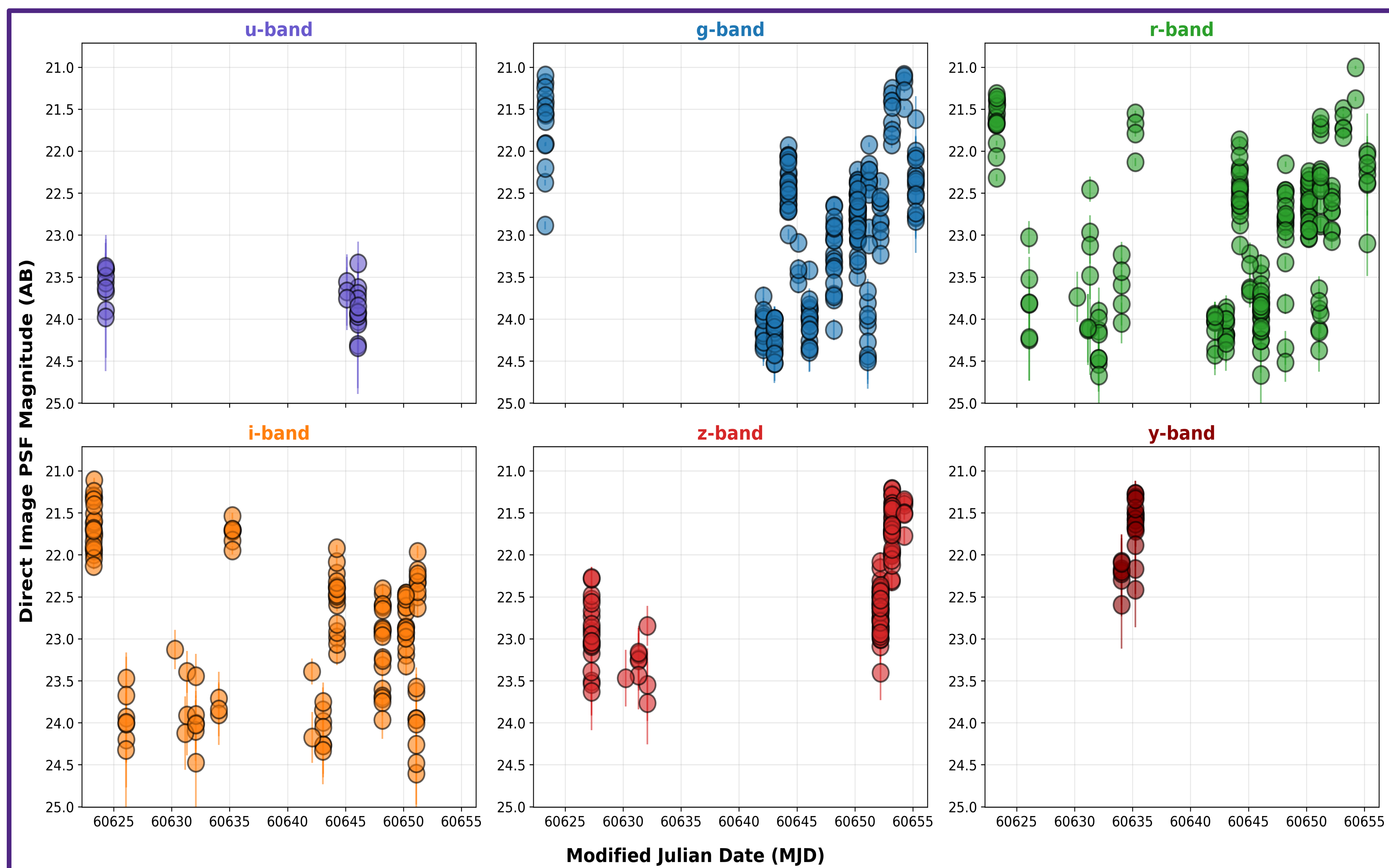


Figure 3: The light curve for the most variable object in our sample — a QSO — with a median $F_{var,amp} = 0.837$.

References

- [1] Carnerero, M. I., Raiteri, C. M., Rimoldini, L., et al. 2023, *Astronomy and Astrophysics*, 674 (EDP), A24
 [2] NSF-DOE Vera C. Rubin Observatory (2025); Rubin Observatory LSST Tutorials
<https://doi.org/10.11578/rubin/dc.20250909.20>