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A long-period-variable observation catalog from a deep-sky imaging archive

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Single-epoch-per-night photometry of catalogued LPVs · varstar pipeline (AAVSO VSX × Gaia DR3) · 2026-07-12

Abstract. We mine an archive of 32 broadband deep-sky imaging fields to build a catalog of long-period-variable (LPV) observations. Because Miras, semiregulars, and slow irregulars vary over months, each imaging session yields one clean epoch per star, so the archive doubles as a sparse multi-month monitor. Reducing every field against the varstar database (AAVSO VSX × Gaia DR3) with ensemble Gaia-G photometry, we recover **3227 observations of 1210 catalogued LPVs** spanning 2025-08-19–2026-07-11 (11 months), 95% unsaturated, with 51 stars sampled on multiple nights. Magnitudes are anchored to Gaia G and transformed to Johnson V; the catalog is exported as a normalized two-table set for database ingestion.

1 Introduction

Long-period variables — Mira-type and semiregular pulsating red giants and slow irregular variables — dominate the bright variable-star population of the Galactic disk. Their brightness changes unfold over tens to many hundreds of days, so unlike the short-period pulsators and eclipsing binaries that demand dense within-night time series, a single well-measured magnitude per night is the natural unit of an LPV light curve. This makes them uniquely suited to a resource that has otherwise been treated as unrelated to time-domain science: the large archive of deep-sky images an observer accumulates over years. Each field, taken on some night for its nebula or galaxy, incidentally records a calibrated brightness for every LPV in the frame. Swept across an archive, these incidental measurements assemble into a genuine multi-month monitoring database.

We exploit the varstar imaging archive in exactly this way. This note reports the first full-archive harvest: one median measurement per LPV per night per filter, reduced against the AAVSO VSX × Gaia DR3 catalog, exported in a form ready for an observational database.

2 Methods

2.1 Data

The archive comprises broadband (B/G/R/L) deep-sky exposures from a 60 mm Apertura refractor (ASI294MM Pro, $2.96^\circ \times 2.02^\circ$ field) and a 17-inch PlaneWave CDK (ASI6200MM), all plate-solved. Narrowband-only pointings (H α /O III/S II) carry no useful LPV continuum photometry and are skipped. 32 broadband fields contributed measurements.

2.2 Reduction

Each field is reduced independently: sources are detected per frame, each frame's plate solution refined against Gaia DR3, and a per-frame photometric zero point is set to the ensemble median of Gaia G. Detected sources are matched to VSX within 4". For each variable we take the robust median of a night's frames in each filter as one epoch, propagating a scatter-based uncertainty and flagging saturation. This differential, flat-free reduction reaches a few $\times 10$ mmag per field.

2.3 LPV selection and V transform

We keep VSX variables typed Mira (M), semiregular (SR*), slow irregular (L*), and RV Tauri (RV*). Magnitudes are instrumental, zero-pointed to Gaia G ($\text{sys} = T_G$); because each filter is anchored independently to Gaia G, the per-filter values are near-identical (not colours). We convert each measurement to Johnson V with the Gaia DR3 (G, BP–RP) $\rightarrow$ V relation (Riello et al. 2021), using the catalog BP–RP colour — accurate to ~ 0.05 – 0.2 mag for moderately red LPVs and degrading for the reddest Miras.

3 Results

LPV objects	observations	unsaturated	fields	multi-night	baseline
1210	3227	3055 (95%)	32	51	2025-08-19 $\rightarrow$ 2026-07-11 (11 mo)

The sample spans 751 Semiregular, 433 Irregular, 25 Mira, 1 RV. Observations by filter: {G': 1173, 'R': 957, 'B': 882, 'L': 215}. Transformed magnitudes run V $\approx$ 10.8–17.0 (median 14.1).

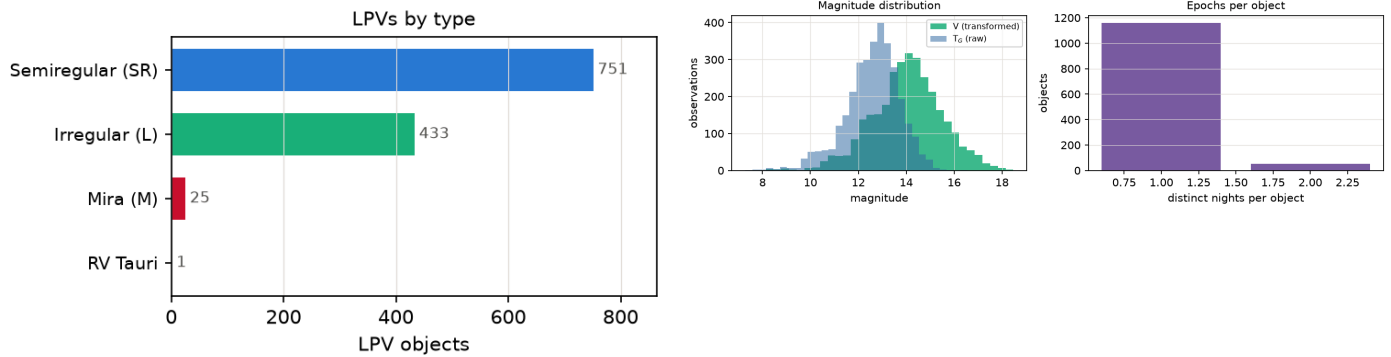


Figure 1. LPVs by type. Figure 2. Distribution of measured magnitudes (raw Gaia-G and transformed V) and the number of distinct nights per object.

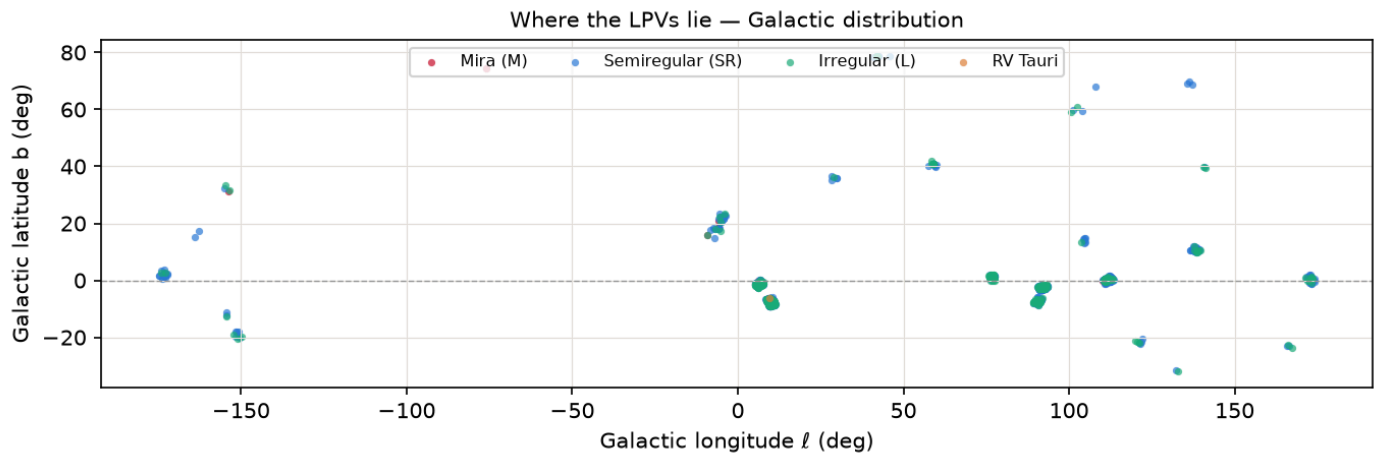


Figure 3. Galactic distribution of the catalogued LPVs. The sample concentrates toward the plane ($b \approx 0$) and the Sagittarius bulge, tracing the disk’s evolved-star population — a consequence of which archive fields lie at low Galactic latitude.

4 Notes and limitations

No flat-field calibration was applied; the differential ensemble removes most common-mode systematics but leaves a position-dependent residual ($\sim 0.05\text{--}0.1$ mag). Bright LPVs near maximum saturate in the long exposures and are flagged. Crowded, nebulous low-latitude fields under-detect the faintest members. The Gaia $\rightarrow$ V transform carries the mean-colour approximation noted in §2.3. The catalog is exported as `lpv_objects.csv` (dimension table, PK oid) and `lpv_observations.csv` (fact table, FK oid) for database import.

Observations by field (top 15)

field	observations	LPVs
m22	1481	574
lagoon	265	101
m39	204	110
m29	153	59
m38	133	38
m13	132	23
sscyg	107	60
bubble	100	100
ic342	83	31
lowell__m13_2026APR28__raw	67	24
wher	67	24
ic4592	56	16

m35	53	18
orion	52	9
iris	36	7