

# Chromatic pulsation signature of DY Herculis from time-series photometry over a full night

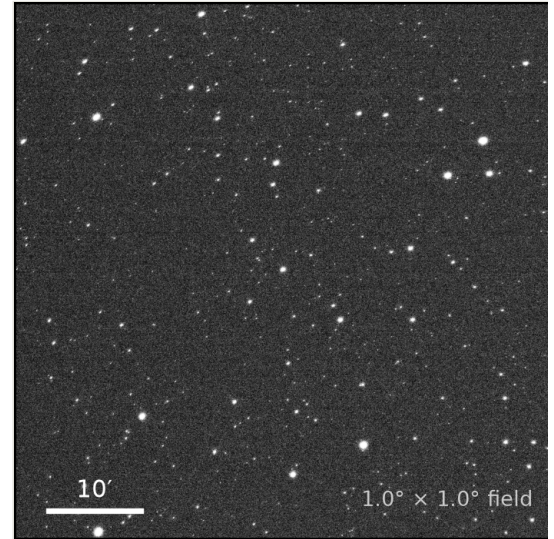
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*Chromatic pulsation signature of DY Herculis from time-series photometry over a full night*

## 1 Introduction

DY Herculis is a High-Amplitude Delta Scuti star (HADS): a radially pulsating A–F dwarf that behaves like a scaled-down Cepheid, with an asymmetric fast-rise / slow-decline light curve. From the varstar database it has a period of just 3.57 hours (0.148631 d) and a V amplitude of 0.51 mag ( $V \approx 10.15$ – $10.66$ ), spectral type A7III–F4III, and a Gaia DR3 distance of  $\sim 690$  pc. Its short period makes it one of the rare pulsators whose *entire* cycle fits inside a single night's observing.

This report is a single-night, three-color (B, G, R) run of  $\sim 4$  hours — more than one full pulsation cycle in each band, so the complete, unfolded HADS light curve is recorded directly, not reconstructed by folding. The session crossed the meridian mid-run: the mount flipped, rotating the field  $180^\circ$  and pausing acquisition for 14 minutes. Because the pipeline matches stars in sky coordinates and refines each frame's WCS independently, the two orientations stitch into one continuous series; the flip gap is marked on the light-curve figure. (An earlier cloud-truncated Green-only run is analyzed separately and not combined here.)



**Figure 1.** The DY Herculis field from a session G-band frame (author's own data; asinh stretch). DY Her sits near the centre of the frame.

## 2 Observations & Data Reduction

**Equipment.** Apertura 60 mm FPL-53 doublet APO refractor (371 mm focal length), ZWO ASI294MM Pro cooled monochrome camera (bin 1,  $2.315 \mu\text{m}$  pixels,  $1.28''/\text{px}$ ), ZWO Premium 1.25" LRGB filter set (B, G, R used here). Images acquired at the Lowell Observatory, Flagstaff, AZ ( $35.20^\circ$  N,  $111.67^\circ$  W).

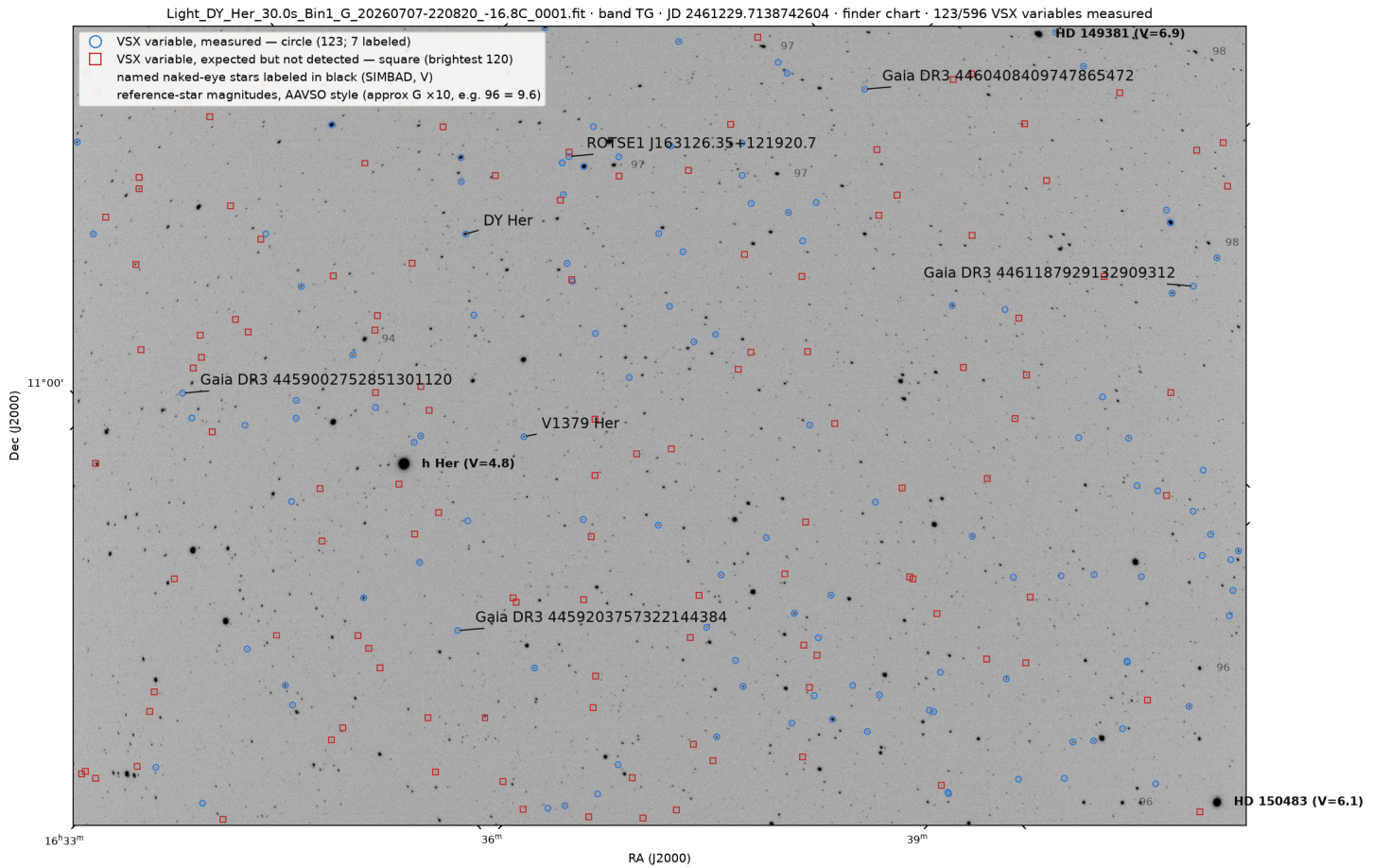
**Data.**  $300 \times 30$  s frames of the DY Herculis field ( $2.96^\circ \times 2.01^\circ$ ), 100 each in B, G and R, on 2026-07-08 over  $\sim 4$  hours ( $> 1$  one 3.57 h pulsation cycle per band). A German-equatorial meridian flip 53 minutes in rotated the field  $180^\circ$  with a 14-minute acquisition gap; frames on both sides carry their own plate solution and are co-registered in sky coordinates. Calibrated with a master dark, with the caveat that the sensor ran warm ( $-14.8$  to  $-15.4^\circ\text{C}$ ) relative to the  $-19.8^\circ\text{C}$  dark library — a modest systematic at 30 s, not a matched-temperature subtraction. No flats were available.

**Reduction.** Source detection (DAOSStarFinder) and aperture photometry with sigma-clipped annulus sky subtraction (photutils<sup>1</sup>); per-frame astrometry refit against Gaia DR3<sup>2</sup> positions from the varstar database; per-frame zero points from an ensemble of bright unsaturated field stars present in  $\geq 40\%$  of frames, excluding catalogued variables, with iterative high-scatter rejection. Magnitudes are instrumental G anchored to a Gaia-G zero point (not transformed to a standard system). Variables were identified by cross-match against the AAVSO VSX catalog<sup>3</sup> ( $10.3$  M objects, accessed via VizieR<sup>4</sup> and enriched with Gaia DR3); coordinate, WCS and time handling use Astropy<sup>5</sup>. Nearby high-proper-motion targets whose J2000 catalog position has drifted required a widened labeling tolerance to recover.

### 3 Results

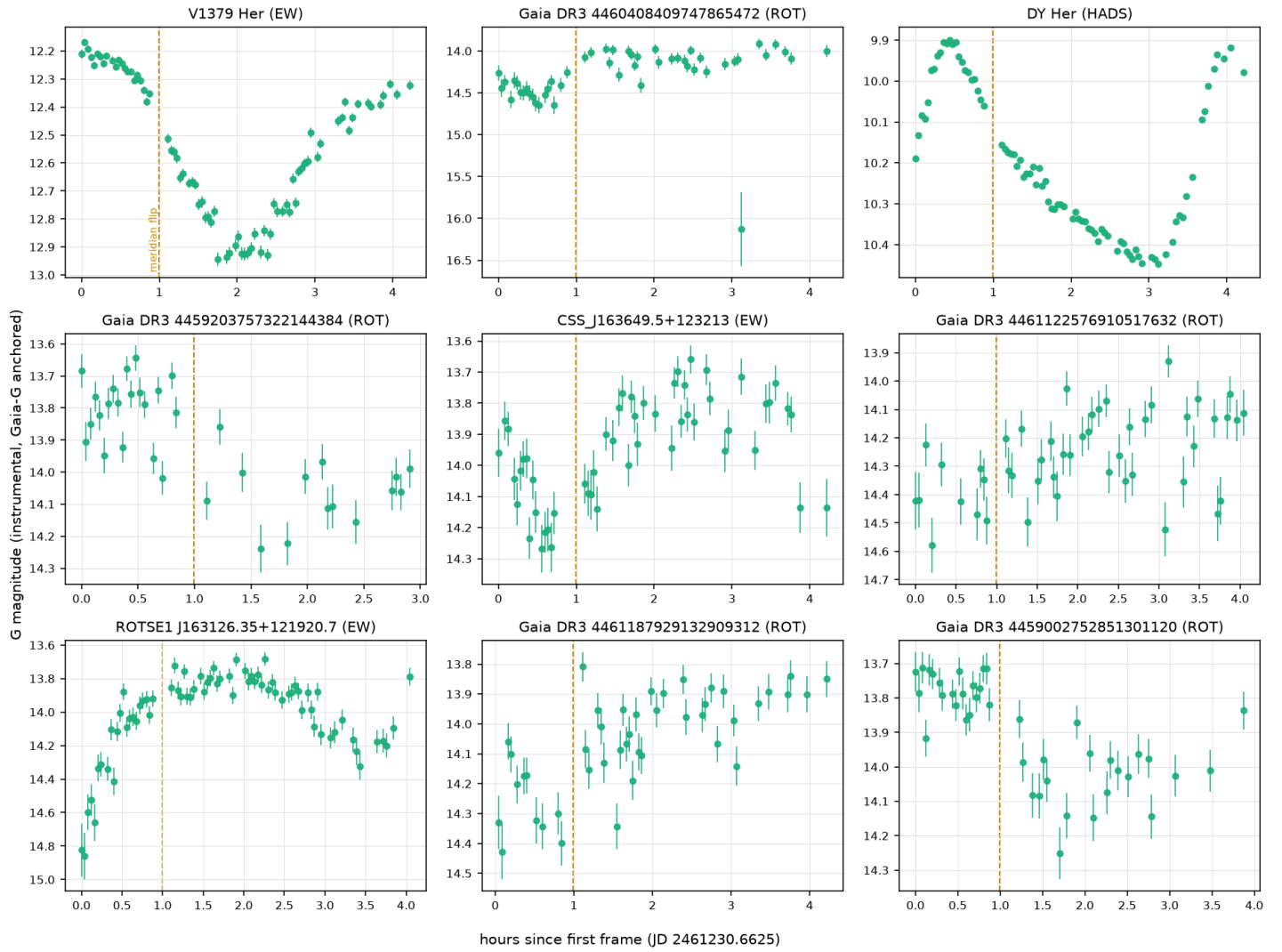
- **DY Her (HADS,  $P = 3.57$  h): a complete pulsation cycle recorded in three colors.** The G series spans 4.2 h ( $\approx 1.2$  cycles, 83 points), tracing the full asymmetric fast-rise / slow-decline curve directly. The observation crossed a meridian flip (marked on the light-curve figure); the two orientations stitch seamlessly, demonstrating sky-coordinate registration across the flip. The fold confirms the catalog period and shows the blue amplitude exceeding the red.
- **86 catalogued VSX variables measured** in 90 G frames; **35 unsaturated stars show statistically significant variation** (robust scatter  $> 2.5\times$  measurement error).
- **Photometric precision floor  $\approx 69$  mmag** (ensemble stars); no flat-field calibration was available — the dominant systematic.
- **Database consistency: 68/84 unsaturated stars agree with their Gaia DR3 G magnitude to within  $\pm 0.30$  mag**; disagreements are flagged  $\Delta$  in the table and are dominated by stars observed at a different phase of their variation cycle.
- Single-night data, so this is a phase-fold against the catalog ephemeris rather than an independent period determination; the warm-sensor dark mismatch and absence of flats make absolute magnitudes preliminary. Differential shapes and amplitudes are robust.

#### Finder chart (reference G frame)



**Figure 2.** Reference G frame as a finder chart (dark stars on white, RA/Dec J2000 grid). Marker shape distinguishes categories in grayscale: open circles = VSX variables detected and measured (light-curve targets named); open squares = catalogued variables expected but not detected. Bright field stars carry AAVSO-style reference magnitudes (approx.  $G \times 10$ , decimal dropped; e.g. 96 = 9.6); naked-eye stars named in black for orientation.

## Light curves — most significant unsaturated variables (G)



**Figure 3.** Ensemble differential light curves for the stars labeled on the annotated field: V1379 Her, Gaia DR3 4460408409747865472, DY Her, Gaia DR3 4459203757322144384, CSS\_J163649.5+123213, Gaia DR3 4461122576910517632, ROTSE1 J163126.35+121920.7, Gaia DR3 4461187929132909312, Gaia DR3 4459002752851301120. A meridian flip mid-run (dashed line, where present) can introduce a small per-star magnitude step: the field rotates 180° onto different detector regions whose response is uncorrected without flats, so the per-frame ensemble removes the global shift but a position-dependent residual remains — the dominant systematic in this dataset.

Photometric precision (G)

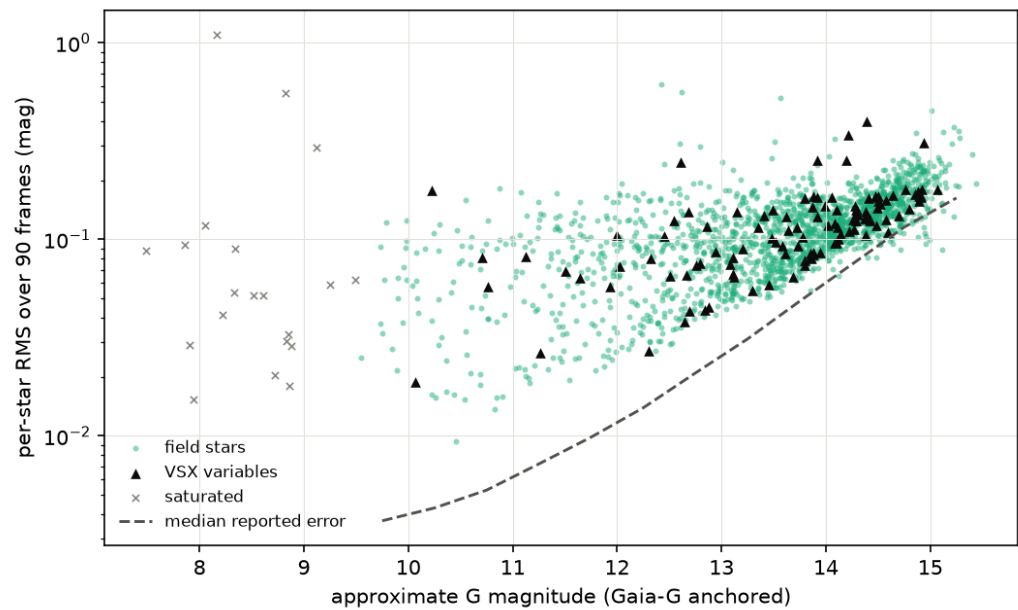


Figure 4. Repeat-measurement RMS vs magnitude for every measured star. The gap between the field-star cloud and the dashed reported-error line at the bright end is the flat-field systematics floor; triangles above the cloud are genuine variables.

Observing yield — measurements by category

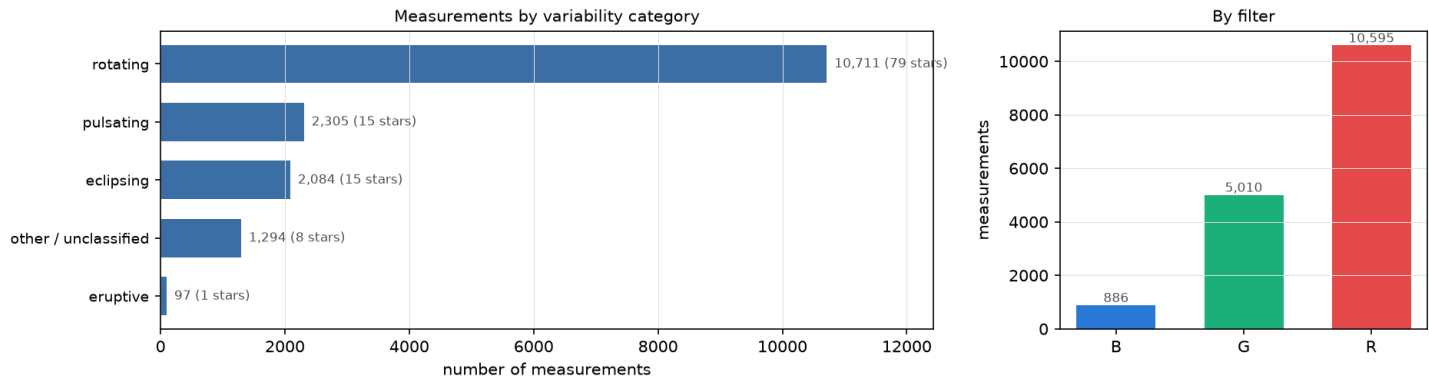
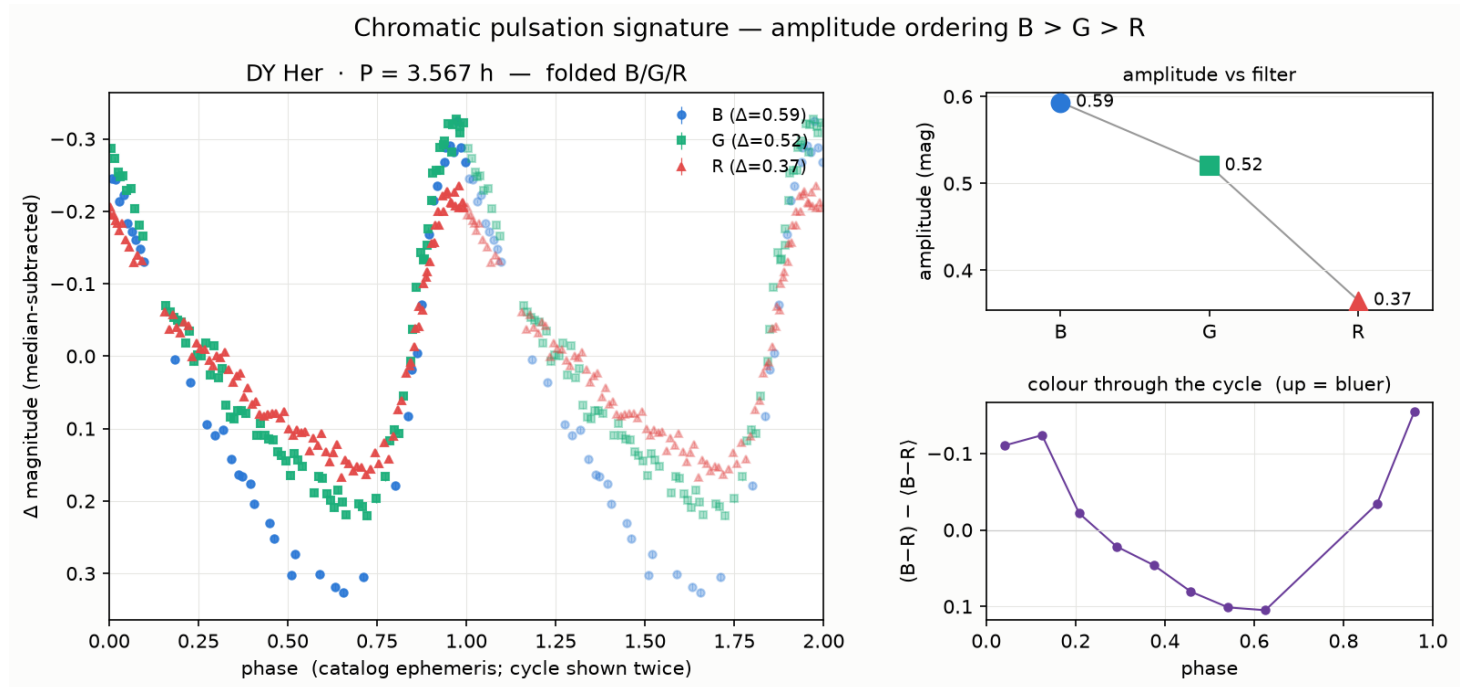


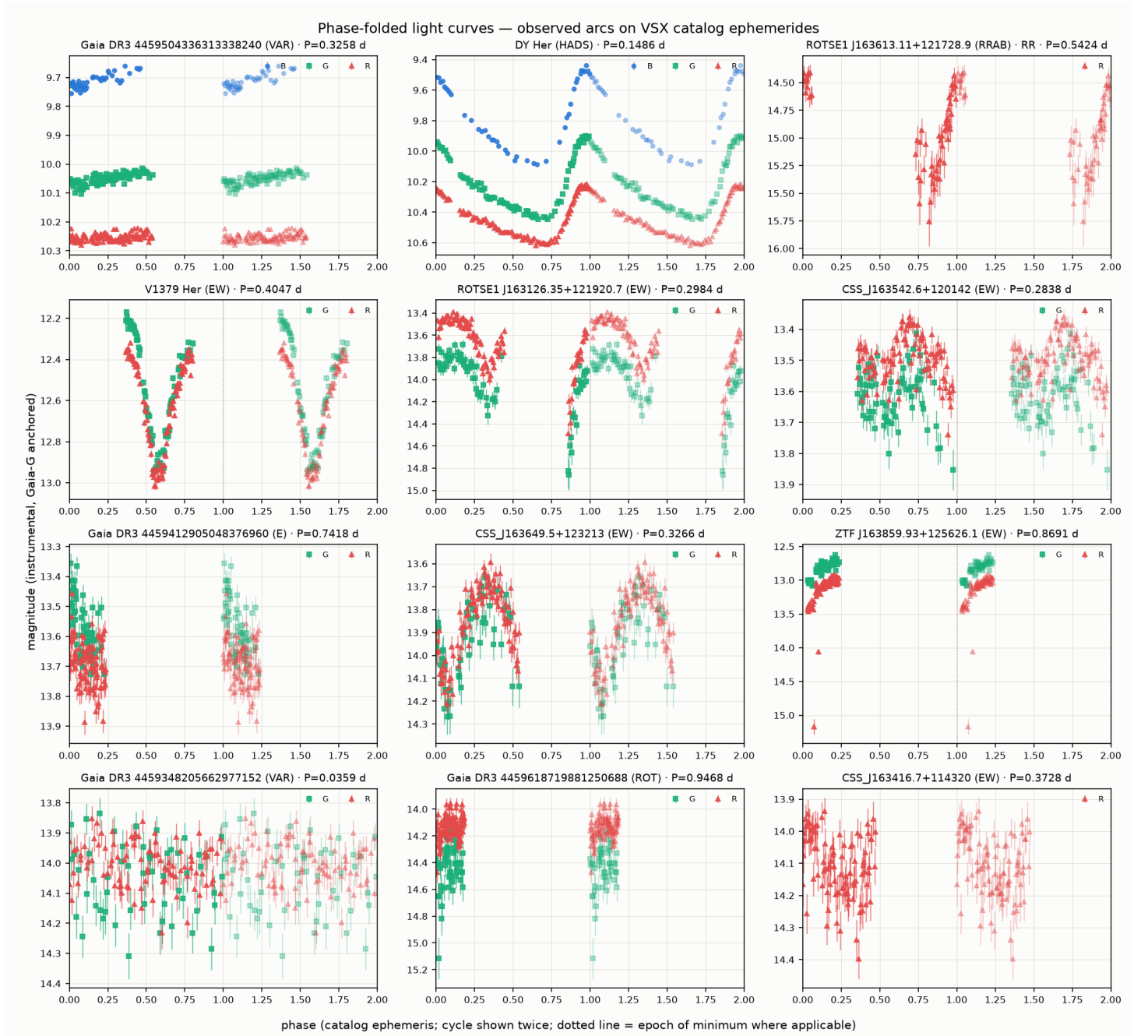
Figure 5. 16,491 ensemble-calibrated measurements across 118 variables. Left: measurements per variability class<sup>6</sup> (with the number of distinct stars); right: measurements per filter. The raw scientific yield of the run.

## Chromatic pulsation signature (B / G / R)



**Figure 6.** DY Her's three bands folded on the 3.57 h period and median-subtracted (left): the blue curve swings widest through the characteristic fast-rise / slow-decline HADS shape. The amplitude falls monotonically from blue to red ( $B \approx 0.59$ ,  $G \approx 0.52$ ,  $R \approx 0.37$  mag; center), and the (B-R) color (right) is bluest at maximum light — the hallmark of temperature-driven radial pulsation, where the star is hottest as it brightens. Recovering the blue band required rebuilding its calibration ensemble and retaining the partial arc obtained while the field was still high, before it set into heavy blue extinction.

## Phase-folded light curves, all filters



**Figure 7.** The full-cycle B/G/R series folded onto DY Her's VSX catalog ephemeris ( $\text{phase} = ((\text{JD} - \text{epoch})/P) \bmod 1$ ). With the 2003 epoch  $\sim 57,000$  cycles in the past, a coherent fold confirms the catalogued 3.57 h period to high precision. For DY Her the blue amplitude exceeds the red — the chromatic signature of temperature-driven pulsation. Other periodic variables in the frame are shown alongside; full statistics in `fold_summary.csv`.

## 4 Discussion

**Caveats.** Single-night data, so this is a phase-fold against the catalog ephemeris rather than an independent period determination; the warm-sensor dark mismatch and absence of flats make absolute magnitudes preliminary. Differential shapes and amplitudes are robust.

## References

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- Gaia Collaboration, Vallenari, A., et al. 2023, "Gaia Data Release 3: Summary of the content and survey properties," A&A, 674, A1.
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Appendix A — Per-star measurements

Column definitions

| COLUMN     | TYPE    | UNIT   | DEFINITION                                                                                                                                             |
|------------|---------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| name       | text    | —      | Primary VSX identifier (object.name in the varstar database, VSX release 2026-06-28).                                                                  |
| vartype    | text    | —      | Variability type as catalogued in VSX (GCVS-style; trailing colon = uncertain classification).                                                         |
| n          | integer | frames | Number of G frames in which the star was detected within 2.5" of its catalog position with a valid flux measurement.                                   |
| measured G | real    | mag    | Median of the ensemble-corrected instrumental G magnitudes over the series, zero point anchored to Gaia G (not transformed to a standard system).      |
| Gaia G     | real    | mag    | Gaia DR3 broadband G magnitude of the cross-matched source (catalog reference brightness).                                                             |
| Δ          | real    | mag    | measured G – Gaia G. Nonzero values reflect the filter-bandpass difference, calibration systematics, and genuine variability phase.                    |
| db         | flag    | —      | Database-consistency verdict: ✓ when $ \Delta  \leq 0.30$ mag; Δ-flag when discrepant and worth review.                                                |
| median_err | real    | mag    | Median propagated single-measurement uncertainty: $1.0857 \cdot \sigma_F / F$ (source photon noise + sky-annulus noise + aperture terms, gain-scaled). |
| robust_std | real    | mag    | Robust standard deviation across frames: $1.4826 \times$ median absolute deviation about the series median; the primary variability statistic.         |
| range      | real    | mag    | Peak-to-peak spread (max – min) over the series; outlier-sensitive by construction.                                                                    |
| sig        | flag    | —      | Significant variation: $\text{robust\_std} > 2.5 \times \text{median\_err}$ and $> 0.008$ mag during the observation window.                           |
| sat        | flag    | —      | Saturated: stellar peak exceeded 90% of detector saturation in $\geq 1$ frame; magnitudes unreliable.                                                  |

Variability summary — one row per star (G band)

Sorted: valid (unsaturated) rows first, significant variation first, then by robust scatter.

| NAME                         | VARTYPE         | N  | MEASURED G | GAIA G | Δ     | DB | MEDIAN_ERR | ROBUST_STD | RANGE | SIG | SAT |
|------------------------------|-----------------|----|------------|--------|-------|----|------------|------------|-------|-----|-----|
| V1379 Her                    | EW              | 78 | 12.56      | 12.55  | +0.00 | ✓  | 0.0177     | 0.3222     | 0.775 | ✓   |     |
| Gaia DR3 4460408409747865472 | ROT             | 50 | 14.18      | 14.25  | -0.08 | ✓  | 0.0748     | 0.2633     | 2.216 | ✓   |     |
| DY Her                       | HADS            | 83 | 10.23      | 10.42  | -0.19 | ✓  | 0.0045     | 0.2253     | 0.548 | ✓   |     |
| Gaia DR3 4459203757322144384 | ROT             | 34 | 13.91      | 13.93  | -0.01 | ✓  | 0.0521     | 0.2026     | 0.596 | ✓   |     |
| CSS_J163649.5+123213         | EW              | 52 | 13.93      | 13.87  | +0.05 | ✓  | 0.0636     | 0.1866     | 0.610 | ✓   |     |
| Gaia DR3 4461122576910517632 | ROT             | 48 | 14.26      | 14.33  | -0.07 | ✓  | 0.0744     | 0.1865     | 0.648 | ✓   |     |
| ROTSE1 J163126.35+121920.7   | EW              | 72 | 13.91      | 13.73  | +0.19 | ✓  | 0.0531     | 0.1854     | 1.177 | ✓   |     |
| Gaia DR3 4461187929132909312 | ROT             | 44 | 14.05      | 14.06  | -0.01 | ✓  | 0.0603     | 0.1781     | 0.620 | ✓   |     |
| Gaia DR3 4459002752851301120 | ROT             | 41 | 13.86      | 13.93  | -0.06 | ✓  | 0.0542     | 0.1728     | 0.538 | ✓   |     |
| Gaia DR3 4459029759605660288 | ROT             | 43 | 13.92      | 13.97  | -0.05 | ✓  | 0.0536     | 0.1673     | 0.449 | ✓   |     |
| Gaia DR3 4459215886309345408 | ROT             | 60 | 13.47      | 13.32  | +0.15 | ✓  | 0.0368     | 0.1581     | 0.561 | ✓   |     |
| Gaia DR3 4459029416008259328 | ROT             | 56 | 13.70      | 13.39  | +0.30 | Δ  | 0.0449     | 0.1295     | 0.444 | ✓   |     |
| ASASSN-V J163221.29+125203.7 | EA              | 63 | 13.38      | 13.40  | -0.02 | ✓  | 0.0344     | 0.1203     | 0.476 | ✓   |     |
| Gaia DR3 4459247394189660800 | SR M            | 70 | 13.46      | 13.01  | +0.45 | Δ  | 0.0364     | 0.1092     | 0.454 | ✓   |     |
| Gaia DR3 4461192945655073280 | ROT             | 46 | 13.60      | 13.51  | +0.09 | ✓  | 0.0421     | 0.1066     | 0.523 | ✓   |     |
| Gaia DR3 4459412905048376960 | E               | 54 | 13.57      | 13.60  | -0.04 | ✓  | 0.0396     | 0.1016     | 0.370 | ✓   |     |
| Gaia DR3 4459100540667943680 | DSCT GDOR SXPHE | 43 | 12.00      | 12.12  | -0.12 | ✓  | 0.0114     | 0.0981     | 0.256 | ✓   |     |
| Gaia DR3 4459359406937978368 | DSCT GDOR SXPHE | 80 | 13.04      | 13.09  | -0.05 | ✓  | 0.0257     | 0.0945     | 0.291 | ✓   |     |
| Gaia DR3 4459207571252850176 | ROT             | 66 | 13.13      | 12.60  | +0.53 | Δ  | 0.0273     | 0.0945     | 0.427 | ✓   |     |
| ZTF J163859.93+125626.1      | EW              | 62 | 12.80      | 13.08  | -0.28 | ✓  | 0.0219     | 0.0940     | 0.461 | ✓   |     |
| Gaia DR3 4460315397935882112 | ROT             | 66 | 12.93      | 12.68  | +0.25 | ✓  | 0.0238     | 0.0872     | 0.341 | ✓   |     |
| ASASSN-V J163639.82+114343.2 | ROT             | 77 | 12.41      | 12.24  | +0.16 | ✓  | 0.0155     | 0.0859     | 0.365 | ✓   |     |

| NAME                         | VARTYPE         | N  | MEASURED G | GAIA G | Δ     | DB | MEDIAN_ERR | ROBUST_STD | RANGE | SIG | SAT |
|------------------------------|-----------------|----|------------|--------|-------|----|------------|------------|-------|-----|-----|
| Gaia DR3 4459413351724977152 | ROT             | 70 | 13.16      | 13.00  | +0.16 | ✓  | 0.0287     | 0.0843     | 0.352 | ✓   |     |
| Gaia DR3 4459054017580993152 | ROT             | 61 | 12.76      | 12.65  | +0.11 | ✓  | 0.0209     | 0.0813     | 0.290 | ✓   |     |
| ASASSN-V J163324.95+123752.3 | L               | 70 | 12.74      | 11.86  | +0.88 | ⚠  | 0.0198     | 0.0799     | 0.276 | ✓   |     |
| Gaia DR3 4460458609325439744 | ROT             | 56 | 12.63      | 12.72  | -0.08 | ✓  | 0.0185     | 0.0742     | 0.425 | ✓   |     |
| Gaia DR3 4459356142762328832 | ROT             | 84 | 12.29      | 12.12  | +0.17 | ✓  | 0.0143     | 0.0641     | 0.309 | ✓   |     |
| Gaia DR3 4460460980147404800 | ROT             | 57 | 12.50      | 12.65  | -0.16 | ✓  | 0.0167     | 0.0518     | 0.456 | ✓   |     |
| Gaia DR3 4461107355546466688 | ROT             | 70 | 11.62      | 11.71  | -0.09 | ✓  | 0.0089     | 0.0366     | 0.239 | ✓   |     |
| ASASSN-V J163647.26+132012.2 | EA              | 33 | 11.97      | 12.27  | -0.30 | ✓  | 0.0110     | 0.0330     | 0.331 | ✓   |     |
| ASAS J163018+1229.9          | MISC            | 79 | 10.74      | 10.08  | +0.66 | ⚠  | 0.0055     | 0.0325     | 0.166 | ✓   |     |
| ASAS J163733+1150.1          | ESD             | 85 | 10.68      | 10.53  | +0.15 | ✓  | 0.0053     | 0.0286     | 0.255 | ✓   |     |
| ASAS J162900+1211.8          | MISC            | 80 | 11.25      | 10.11  | +1.14 | ⚠  | 0.0073     | 0.0272     | 0.122 | ✓   |     |
| V1028 Her                    | EA              | 32 | 11.62      | 11.70  | -0.08 | ✓  | 0.0081     | 0.0250     | 0.211 | ✓   |     |
| Gaia DR3 4459504336313338240 | VAR             | 84 | 10.05      | 10.19  | -0.15 | ✓  | 0.0043     | 0.0182     | 0.088 | ✓   |     |
| Gaia DR3 4460280385362669312 | ROT             | 44 | 14.45      | 14.43  | +0.03 | ✓  | 0.0860     | 0.1777     | 0.660 |     |     |
| Gaia DR3 4460411742642131712 | DSCT GDOR SXPHE | 49 | 14.33      | 14.53  | -0.20 | ✓  | 0.0747     | 0.1464     | 0.607 |     |     |
| Gaia DR3 4460442700766542336 | ROT             | 38 | 14.64      | 13.89  | +0.75 | ⚠  | 0.1241     | 0.1449     | 0.809 |     |     |
| Gaia DR3 4459255365649030656 | ROT             | 30 | 14.40      | 14.34  | +0.05 | ✓  | 0.0851     | 0.1437     | 0.595 |     |     |
| Gaia DR3 4459348205662977152 | VAR             | 54 | 14.04      | 14.01  | +0.03 | ✓  | 0.0624     | 0.1385     | 0.474 |     |     |
| Gaia DR3 4459368065591831936 | ROT             | 36 | 14.41      | 13.64  | +0.77 | ⚠  | 0.0843     | 0.1377     | 0.494 |     |     |
| Gaia DR3 4459247772146759168 | ROT             | 33 | 14.12      | 14.09  | +0.03 | ✓  | 0.0622     | 0.1369     | 0.564 |     |     |
| Gaia DR3 4459345697402362112 | DSCT GDOR SXPHE | 32 | 14.22      | 14.42  | -0.20 | ✓  | 0.0691     | 0.1369     | 0.549 |     |     |
| CSS_J163745.2+122451         | EB              | 40 | 14.43      | 14.24  | +0.19 | ✓  | 0.0854     | 0.1316     | 0.546 |     |     |
| Gaia DR3 4459354081178263296 | ROT             | 30 | 14.54      | 13.66  | +0.87 | ⚠  | 0.0919     | 0.1314     | 0.536 |     |     |
| Gaia DR3 4459661703914003200 | ROT             | 39 | 14.58      | 14.47  | +0.11 | ✓  | 0.0946     | 0.1312     | 0.720 |     |     |
| Gaia DR3 4459618719881250688 | ROT             | 49 | 14.42      | 14.25  | +0.17 | ✓  | 0.0883     | 0.1303     | 0.943 |     |     |
| Gaia DR3 4459841920741216512 | ROT             | 41 | 14.16      | 14.21  | -0.06 | ✓  | 0.0679     | 0.1281     | 0.581 |     |     |
| Gaia DR3 4460289318894390144 | ROT             | 37 | 14.55      | 14.60  | -0.05 | ✓  | 0.0911     | 0.1280     | 0.472 |     |     |
| Gaia DR3 4460300451449840128 | RS              | 67 | 14.14      | 13.72  | +0.42 | ⚠  | 0.0663     | 0.1263     | 0.423 |     |     |
| Gaia DR3 4459540173519572736 | ROT             | 47 | 14.26      | 14.27  | -0.01 | ✓  | 0.0715     | 0.1256     | 0.459 |     |     |
| Gaia DR3 4460838250078146048 | RS              | 50 | 14.26      | 14.46  | -0.20 | ✓  | 0.0736     | 0.1182     | 0.507 |     |     |
| Gaia DR3 4459299616692638080 | ROT             | 55 | 13.80      | 13.71  | +0.09 | ✓  | 0.0480     | 0.1162     | 0.449 |     |     |
| ASASSN-V J163540.89+125141.7 | ROT             | 35 | 14.56      | 14.50  | +0.06 | ✓  | 0.0972     | 0.1155     | 0.770 |     |     |
| Gaia DR3 4459641225509680128 | ROT             | 65 | 14.12      | 14.19  | -0.08 | ✓  | 0.0636     | 0.1154     | 0.553 |     |     |
| Gaia DR3 4460319246226596608 | ROT             | 41 | 14.42      | 14.53  | -0.11 | ✓  | 0.0850     | 0.1132     | 0.575 |     |     |
| Gaia DR3 4459643871209596032 | ROT             | 59 | 14.26      | 13.87  | +0.39 | ⚠  | 0.0718     | 0.1101     | 0.542 |     |     |
| Gaia DR3 4459481384007389568 | ROT             | 41 | 14.18      | 14.24  | -0.07 | ✓  | 0.0659     | 0.1100     | 0.429 |     |     |
| Gaia DR3 4459467537032546944 | ROT             | 40 | 14.17      | 14.27  | -0.10 | ✓  | 0.0676     | 0.1041     | 0.399 |     |     |
| Gaia DR3 4459258458025496704 | ROT             | 40 | 13.63      | 13.92  | -0.29 | ✓  | 0.0412     | 0.1014     | 0.406 |     |     |
| Gaia DR3 4459262203236941696 | ROT             | 65 | 13.61      | 13.55  | +0.06 | ✓  | 0.0404     | 0.1009     | 0.455 |     |     |
| Gaia DR3 4459349614412239616 | ROT             | 58 | 14.11      | 13.94  | +0.17 | ✓  | 0.0632     | 0.0952     | 0.531 |     |     |
| Gaia DR3 4459522993650308992 | ROT             | 62 | 13.76      | 13.82  | -0.06 | ✓  | 0.0477     | 0.0903     | 0.428 |     |     |
| Gaia DR3 4459349614412238208 | ROT             | 69 | 13.84      | 13.22  | +0.62 | ⚠  | 0.0487     | 0.0892     | 0.368 |     |     |
| Gaia DR3 4459534469803016320 | RS              | 73 | 13.86      | 13.85  | +0.01 | ✓  | 0.0520     | 0.0882     | 0.398 |     |     |
| CSS_J163542.6+120142         | EW              | 68 | 13.60      | 13.49  | +0.11 | ✓  | 0.0410     | 0.0872     | 0.440 |     |     |

| NAME                         | VARTYPE         | N  | MEASURED G | GAIA G | Δ     | DB | MEDIAN_ERR | ROBUST_STD | RANGE | SIG | SAT |
|------------------------------|-----------------|----|------------|--------|-------|----|------------|------------|-------|-----|-----|
| Gaia DR3 4459513269844503040 | ROT             | 67 | 13.96      | 13.95  | +0.01 | ✓  | 0.0549     | 0.0862     | 0.465 |     |     |
| Gaia DR3 4459512101613369344 | DSCT GDOR SXPHE | 65 | 13.81      | 13.97  | -0.15 | ✓  | 0.0485     | 0.0826     | 0.396 |     |     |
| ASASSN-V J163147.74+122448.5 | SR              | 70 | 13.85      | 13.12  | +0.73 | Δ  | 0.0514     | 0.0781     | 0.328 |     |     |
| Gaia DR3 4459568966979911424 | ROT             | 67 | 13.69      | 13.72  | -0.04 | ✓  | 0.0435     | 0.0760     | 0.338 |     |     |
| ROTSE1 J164001.79+124134.4   | LPV             | 73 | 13.32      | 12.88  | +0.44 | Δ  | 0.0325     | 0.0739     | 0.544 |     |     |
| Gaia DR3 4459564500214022784 | E               | 68 | 13.88      | 13.95  | -0.07 | ✓  | 0.0512     | 0.0720     | 0.390 |     |     |
| CSS_J163257.8+120358         | RS              | 58 | 13.85      | 14.04  | -0.18 | ✓  | 0.0504     | 0.0709     | 0.419 |     |     |
| Gaia DR3 4459495643298630912 | ROT             | 77 | 13.46      | 13.47  | -0.01 | ✓  | 0.0362     | 0.0668     | 0.278 |     |     |
| Gaia DR3 4459523818284060800 | ROT             | 71 | 13.82      | 13.71  | +0.11 | ✓  | 0.0489     | 0.0639     | 0.407 |     |     |
| Gaia DR3 4459608755557105280 | ROT             | 54 | 13.10      | 12.48  | +0.62 | Δ  | 0.0268     | 0.0616     | 0.280 |     |     |
| Gaia DR3 4459610336105101056 | ROT             | 38 | 13.11      | 13.12  | -0.01 | ✓  | 0.0266     | 0.0616     | 0.280 |     |     |
| Gaia DR3 4459524917795666432 | ROT             | 76 | 13.29      | 13.31  | -0.02 | ✓  | 0.0308     | 0.0521     | 0.300 |     |     |
| Gaia DR3 4459382359242886528 | DSCT GDOR SXPHE | 87 | 12.85      | 13.01  | -0.16 | ✓  | 0.0217     | 0.0506     | 0.206 |     |     |
| Gaia DR3 4459503168081111552 | ROT             | 80 | 12.83      | 12.60  | +0.23 | ✓  | 0.0212     | 0.0467     | 0.232 |     |     |
| Gaia DR3 4461101205153540992 | ROT             | 58 | 13.08      | 12.89  | +0.19 | ✓  | 0.0266     | 0.0441     | 0.335 |     |     |
| Gaia DR3 4460258532568677120 | ROT             | 80 | 12.69      | 12.72  | -0.03 | ✓  | 0.0189     | 0.0431     | 0.205 |     |     |
| Gaia DR3 4459383905431114624 | ROT             | 90 | 12.62      | 12.31  | +0.31 | Δ  | 0.0184     | 0.0382     | 0.190 |     |     |
| Gaia DR3 4459584836881207168 | ROT             | 65 | 12.27      | 12.30  | -0.03 | ✓  | 0.0137     | 0.0294     | 0.120 |     |     |
| NSV 7764                     |                 | 43 | 8.93       | 8.27   | +0.66 | Δ  | 0.0026     | 0.0219     | 3.708 | ✓   | sat |
| NSV 20678                    |                 | 87 | 9.09       | 9.21   | -0.12 | ✓  | 0.0033     | 0.0188     | 2.779 | ✓   | sat |