The Astrophysical Journal, 1007:91 (6pp), 2026 August 10 https://doi.org/10.3847/1538-4357/ae8c36

The Potential Broader Complex Linked to the Key Cepheid SV Vul

Daniel Majaess[1], Ignacio Negueruela[2], Leonid N. Berdnikov[3], Charles J. Bonatto[4], David G. Turner[5], Dante Minniti[6,7], Vittorio F. Braga[8], Giovanni Carraro[9], Igor Usenko[10,11], Giuseppe Bono[8,12], Matias Gomez[6], Roberto K. Saito[13], and Maria G. Navarro[8]

[1] Mount Saint Vincent University, Halifax, Nova Scotia, Canada; Daniel.Majaess@msvu.ca
[2] Departamento de Fisica Aplicada, Facultad de Ciencias, Universidad de Alicante, Carretera de San Vicente s/n, E-03690 San Vicente del Raspeig, Spain
[3] Sternberg Astronomical Institute, Moscow State University, Universitetskii Pr. 13, Moscow 119992, Russia
[4] Departamento de Astronomia, Universidade Federal do Rio Grande do Sul, CP 15051, RS, Porto Alegre 91501-970, Brazil
[5] Saint Mary's University, Halifax, Nova Scotia, Canada
[6] Instituto de Astrofísica, Dep. de Física y Astronomía, Facultad de Ciencias Exactas, Universidad Andres Bello, Av. Fernández Concha 700, Santiago, Chile
[7] Vatican Observatory, Specola Vaticana, V-00120, Vatican City State, Vatican City
[8] INAF - Osservatorio Astronomico di Roma, Via di Frascati 33, 00078, Monte Porzio Catone, Italy
[9] Dipartimento di Fisica e Astronomia "Galileo Galilei," Università degli Studi di Padova, Vicolo Osservatorio 3, I-35122, Padova, Italy
[10] Astronomical Observatory, Odessa National University, Marazliivska 1-B, Odessa, 65014, Odessa, Ukraine
[11] Mykolaiv Astronomical Observatory Research Institute, Obsevatorna 1, Mykolaiv, 54030, Mykolaiv, Ukraine
[12] Department of Physics, Università di Roma Tor Vergata, via della Ricerca Scientifica 1, 00133, Rome, Italy
[13] Departamento de Física, Universidade Federal de Santa Catarina, Trindade 88040-900, Florianópolis, Brazil
Received 2026 March 22; revised 2026 July 14; accepted 2026 July 15; published 2026 August 10

Abstract

A new distance was established to the Cepheid SV Vul ($P \simeq 45^d$) and its host cluster Alicante 13, and is tied in part to deeper UKIDSS-DR6 photometry and Gaia DR3 observations ($d = 2.30 \pm 0.13$ kpc). SV Vul and Alicante 13 possibly belong to a broader coeval stellar complex, which could include Liu-Pang 1738. The clusters and Cepheid share comparable astrometry (e.g., $\sigma_\pi \simeq 0.02$ mas, $\sigma_{\mu_\delta} \simeq 0.06$ mas yr^{-1}), and similar cluster turnoffs (ages) exist as indicated by ultraviolet UVEX color–color analyses, Gaia XP spectroscopically differentially dereddened color–magnitude diagrams, and Padova isochrones. Yet SV Vul may be comparatively overluminous. Robust radial velocities for both clusters could substantiate certain hypotheses.

Unified Astronomy Thesaurus concepts: Cepheid variable stars (218); Open star clusters (1160)

1. Introduction

D. G. Turner (1984) aimed to identify early-type stars associated with the classical Cepheid SV Vul ($P \simeq 45^d$), with one objective being to secure calibrators for Cepheid relations via cluster membership. The differentially reddened region features numerous Galactic associations and clusters (Section 5 in I. Negueruela et al. 2020), and is viewed nearly lengthwise through a spiral arm. Three decades later, the astrometry became available to facilitate disentangling phenomena along this complex sightline. Specifically, I. Negueruela et al. (2020) relied on Gaia DR2 and high-resolution spectroscopy to discover the Cepheid's host cluster (Alicante 13, $d \simeq 2.5$ kpc).

This study aims to build upon prior research on SV Vul and the encompassing region (D. G. Turner 1984; I. Negueruela et al. 2020), namely by holistically relying on new and unused deeper observations (e.g., DR3; Gaia Collaboration 2022). The analysis clarifies potential connections in the broader field, provides desirable redundancies relative to the derivation of cluster parameters, and synthesizes diverse evidence regarding SV Vul's intrinsic brightness. Gaia DR3 astrometry (π, μ_α, μ_δ), photometry (B, G, R), XP spectra ($E(B-R)$, A_G), and faint ultraviolet UVEX observations (u, g, r) are mobilized to produce color–color and differentially dereddened color–magnitude diagrams. Moreover, deeper UKIDSS-DR6 photometry is utilized to create near-infrared (NIR) color–magnitude diagrams (J, H).

2. Analysis

2.1. Astrometry

The python DBSCAN package was employed to characterize cluster astrometry (e.g., $n = 15$ member minimum). Deduced formal parameters for Alicante 13 are $\pi = 0.397 \pm 0.023$ mas and $\mu_\alpha, \mu_\delta = (-2.102 \pm 0.096, -5.894 \pm 0.130)$ mas yr^{-1} ($n = 152$). A preliminary search for a broader complex was undertaken by expanding parallax and proper motion uncertainties by 5σ and 2σ to maximize sampling, respectively (e.g., to include Alicante 13 members BD+273542, HD 339063, HD 339064; I. Negueruela et al. 2020). Those aforementioned evolved stars are $<1.5'$ from the cluster center, exhibit comparable DR3 astrometry within expected intrinsic cluster deviations, and possess independent spectroscopy and velocities (I. Negueruela et al. 2020). Figure 1 unveils two principal overdensities, whereby the proximate cluster to SV Vul (red datum) is Alicante 13. Gaia DR3 astrometry for SV Vul is $\pi = 0.373 \pm 0.021$ mas and μ_α, $\mu_\delta = (-2.158 \pm 0.016, -5.962 \pm 0.021)$ mas yr^{-1}. The other main cluster in Figure 1 was characterized by L. Liu & X. Pang (2019; DR2, ID=1738).

For Liu-Pang 1738 the DBSCAN findings are $\pi = 0.366 \pm 0.022$ mas and μ_α, $\mu_\delta = (-2.168 \pm 0.090, -6.014 \pm 0.115)$ mas yr^{-1} ($n = 80$). The L. Lindegren et al. (2021, L21) DR3 corrected parallaxes for Liu-Pang 1738 (UBC 134), Alicante 13 (UBC 130), and SV Vul are $\pi = 0.395 \pm 0.021$, 0.427 ± 0.023, and 0.402 ± 0.021 mas, accordingly. Admittedly, there are varied opinions regarding the DR3 zero-point (e.g., Figure 10 in R. Molinaro et al. 2023). By comparison, using DR2 (T. Cantat-Gaudin et al. 2020) determined $\pi = 0.393 \pm 0.030$ mas (Alicante 13), and L. Liu & X. Pang

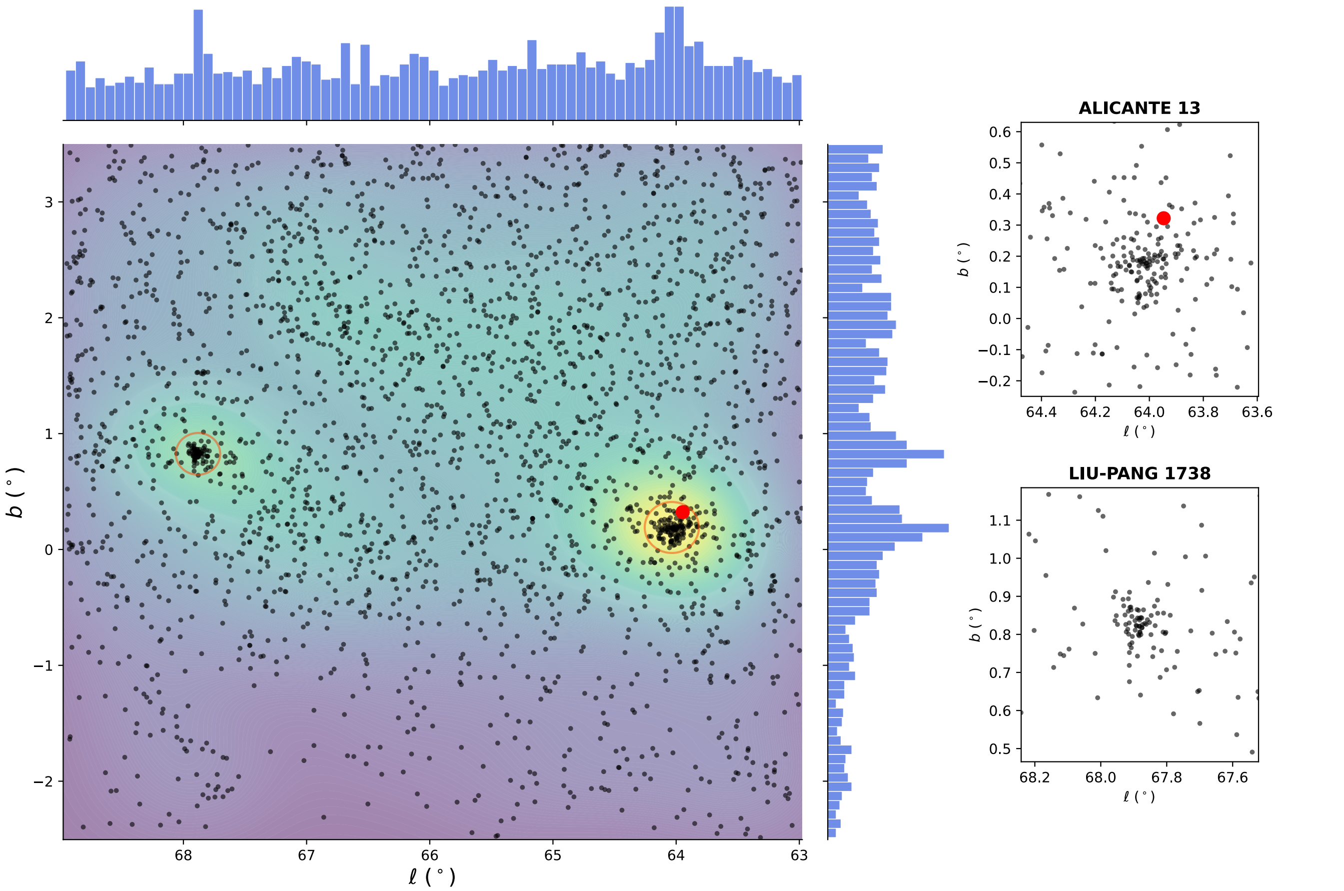

Figure 1. Stars in the region exhibiting similar Gaia DR3 astrometry (Section 2.1). The two principal overdensities are Liu-Pang 1738 (left) and Alicante 13 (right), and SV Vul is the red datum. The clusters possess similar turnoffs (ages) and astrometry (Table 1), such as $\pi = 0.395 \pm 0.021$ and 0.427 ± 0.023 mas (0.402 ± 0.021 mas for SV Vul). Parallaxes were corrected for the floating DR3 zero-point following L. Lindegren et al. (2021). The encompassing circles are tied to *rmax* from L. Liu & X. Pang (2019).

Table 1
Summary of Established Parameters

	Alicante 13	Liu-Pang 1738	SV Vul	References
π (mas)	0.427 ± 0.023	0.395 ± 0.021	0.402 ± 0.021	(1) (L21-DR3)
π (mas)	0.393 ± 0.030	0.368 ± 0.029	0.373 ± 0.030	(2) (DR2)
μ_α (mas yr^{-1})	-2.102 ± 0.096	-2.168 ± 0.090	-2.158 ± 0.016	(1) (DR3)
μ_α (mas yr^{-1})	-2.099 ± 0.073	-2.174 ± 0.052	-2.139 ± 0.045	(2) (DR2)
μ_δ (mas yr^{-1})	-5.894 ± 0.130	-6.014 ± 0.115	-5.962 ± 0.021	(1) (DR3)
μ_δ (mas yr^{-1})	-5.856 ± 0.064	-5.983 ± 0.098	-5.820 ± 0.050	(2) (DR2)
d (kpc)	$2.342^{+0.133}_{-0.120}$	$2.532^{+0.142}_{-0.128}$	$2.488^{+0.137}_{-0.124}$	(1) (L21-DR3)
d (kpc)	2.30 ± 0.13	2.40 ± 0.13	⋯	(1)
	2.30 ± 0.12	2.49 ± 0.11	⋯	(1)
$\log \tau$	7.53 ± 0.05	7.60 ± 0.04	7.35 ± 0.17	(1)
	7.44, 7.48	7.341 ± 0.287, 7.87	⋯	(2), (3), (4), (2)

Note. References pertain to the following: research presented here (1); T. Cantat-Gaudin et al. 2020 (2); I. Negueruela et al. 2020 (3); and W. S. Dias et al. 2021 (4).

(2019) obtained $\pi = 0.367 \pm 0.022$ mas (Liu-Pang 1738). The results presented here and in the literature are comparable (Table 1).

2.2. Ultraviolet Color–Color Diagram

A scenario where the clusters are unrelated is disfavored by Alicante 13 and Liu-Pang 1738 displaying similar astrometry and turnoffs (i.e., comparable ages; Figure 2 and Section 2.5). The ultraviolet *ugr* color–color diagram photometry stems from the UVEX-IGAPS surveys (M. Monguió et al. 2020), and the intrinsic main-sequence relation shown in Figure 2 is likewise from M. Monguió et al. (2020). A linear $E(u-g)/E(g-r) = 1.17 \pm 0.14$ vector was estimated using the python `EXTINCTION` routine (e.g., J. E. O'Donnell 1994), together with passband information described in M. Monguió et al. (2020). The selected total to selective extinction ratio is $R_V = 3.1$, though that value is debated whereby, for example, L. N. Berdnikov et al. (1996) deduced $R_V \simeq 3.26$ using Cepheids. For Figures 2 and 3 the astrometric criteria were again expanded to maximize membership (Section 2.1).

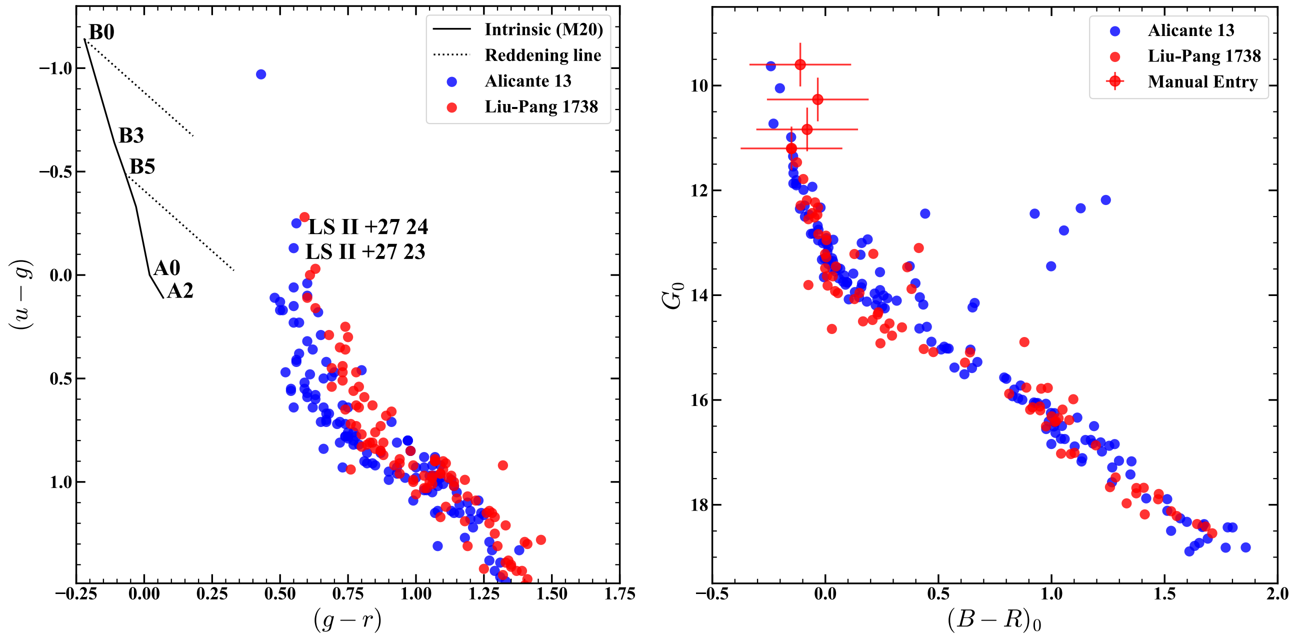

Figure 2. Left: an ultraviolet UVEX color–color diagram conveys that Alicante 13 and Liu-Pang 1738 possess similar turnoffs. Two B2.5 stars from I. Negueruela et al. (2020) are annotated (left). Liu-Pang 1738 is observed through additional obscuration. Right: a differentially dereddened color–magnitude diagram constructed using published Gaia XP spectroscopic parameters for a subset of DR3 stars. The clusters appear coeval within uncertainties, with Liu-Pang 1738 being slightly more remote. Four bright Liu-Pang 1738 stars were manually added owing to spurious parameters or absence from the initial XP release (Section 2.3).

L. Liu & X. Pang (2019) estimated $rmax \simeq 0.18$, $0\overset{\circ}{.}22$ (max radii) for Liu-Pang 1738 and Alicante 13, respectively, and those cluster bounds were adopted for those figures.

M. Monguió et al. (2020, their Section 8.6) underscored that standardizing terrestrial ultraviolet photometry is a long-standing challenge, which implies the data should be interpreted cautiously. As a result, inferences emerging from Figure 2 are restricted to the following: a comparable turnoff occurs near early B for Alicante 13 and Liu-Pang 1738, as inferred from the apparent photometry. Two B2.5 stars from I. Negueruela et al. (2020) are highlighted on the diagram (independent spectroscopy), and the A0 clamping point is discernible. A robust determination of the turnoff spectral type solely from the diagram is hindered by a floating u-band zero-point in concert with uncertainties associated with the reddening vector and intrinsic relation, yet redundancies are in place (e.g., Section 2.3, Section 2.5, and through spectroscopy).

2.3. Differentially Dereddened Optical Color–Magnitude Diagram

The common turnoff inferred from the UVEX $(u - g)/(g - r)$ color–color analysis was bolstered by a differentially dereddened Gaia $G_0 - (B - R)_0$ diagram (Figure 2). Extinction parameters A_G and $E(B - R)$ were published for a subset of Gaia DR3, and were inferred from model fits to low-resolution XP spectra ($\lambda \simeq 330-1050$ nm). For example, certain data are associated with MARCS and PHOENIX models. Concerns persist regarding systematics within this first XP release (e.g., R. Andrae et al. 2023, and discussion therein), and D. Majaess & D. G. Turner (2024) identified discernible shifts between DR3 spectroscopically dereddened main sequences and unobscured clusters. Nonetheless, the dereddened color–magnitude plot confirms Liu-Pang 1738 and Alicante 13 are of comparable age to within the uncertainties, with Alicante 13 possibly being younger (Figure 2, see also Table 1). Moreover, Liu-Pang 1738 appears more distant.

Systematics endemic to the XP release would improbably overlay Alicante 13 upon Liu-Pang 1738, and nevertheless redundancies exist via the color–color diagram and isochrones (Table 1). XP spectra can discern clusters markedly offset in age, as conveyed between NGC 7788 and the potential binary Cepheid cluster NGC 7790/Berkeley 58 (left panel of Figure 2 in D. Majaess & D. G. Turner 2024).

The four brightest data points inherent to Liu-Pang 1738 lacked viable, or any, Gaia DR3 XP results, and consequently they were manually dereddened using the cluster median (i.e., $E(B - R) = 0.81 \pm 0.04$ and $E(B - R) = 1.03 \pm 0.04$ for Alicante 13 and Liu-Pang 1738, accordingly). Uncertainties conveyed for those data points in Figure 2 are the median absolute deviation linked to cluster stars.

The increased reddening for Liu-Pang 1738 can be rationalized by its sightline deviating deeper into the foreground Cygnus Rift (see Figure 3 cont. in T. M. Dame & P. Thaddeus 1985). The enhanced obscuration associated with the foreground Cygnus Rift begins near ≈700–800 pc (V. Straižys et al. 2019). Indeed, the 4° separation between the unbound clusters is ≈160 pc at their present heliocentric distance, which implies the progenitor was a giant molecular cloud (e.g., M. Heyer & T. M. Dame 2015; J. Casado & Y. Hendy 2023).

2.4. NIR Color–Magnitude Diagram

JH color–magnitude diagrams (Figure 3) were compiled for Alicante 13 and Liu-Pang 1738 using 2MASS and UKIDSS-DR6 photometry (P. W. Lucas et al. 2008). UKIDSS-DR6 saturates toward brighter magnitudes and 2MASS covers such stars. A $J = 12^m.5$ boundary was imposed between the surveys. UKIDSS-DR6 was standardized to the 2MASS system using common stars in the field. Mean photometry

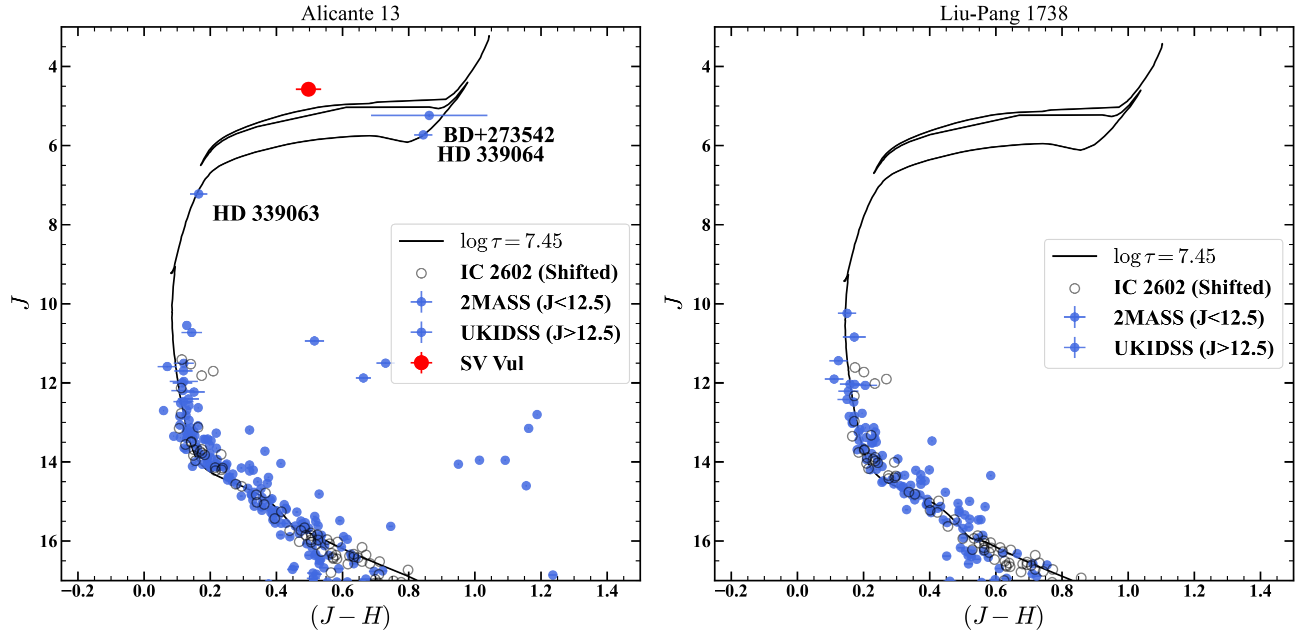

Figure 3. 2MASS-UKIDSS color–magnitude diagrams for Alicante 13 and Liu-Pang 1738 ($d = 2.30$, $2.40(\pm 0.13)$ kpc). Evolved stars BD+273542, HD 339063, and HD 339064 are highlighted (Section 2.1). Distances were derived by aligning a nearby unreddened and similarly young open cluster (IC 2602, open circles). A solar Padova PARSEC 1.2S-YBC $\log \tau = 7.45 \pm 0.10$ isochrone was deduced from a visual fit, and is comparable to a mean inferred for SV Vul from Cepheid period–age relations ($\log \tau = 7.35 \pm 0.17$). The isochrone was likewise overlaid upon Liu-Pang 1738 observations, since a similar age is supported by multiple indicators (e.g., Figure 2). A semiautomated approach to inferring cluster parameters from numerous Padova models is conveyed in Section 2.5. SV Vul appears overluminous relative to canonical isochrones (Section 2.6).

for the classical Cepheid SV Vul was evaluated using literature data (A. J. Monson & M. J. Pierce 2011; C.-C. Ngeow 2012; L. Breuval et al. 2021).

Distances for Alicante 13 and Liu-Pang 1738 were determined by matching their *JH* observations to the nearby benchmark cluster IC 2602 (turnoff/main sequence). IC 2602 was chosen owing to its negligible reddening and similar age to Alicante 13 (e.g., T. Cantat-Gaudin et al. 2020). The mean cluster reddening is $E(B_J - V) = 0.03 \pm 0.01$, as inferred from J.-C. Mermilliod (1997) UB_JV photometry[14] for B-stars unaffected by the Balmer discontinuity. The intrinsic relation stemmed from unpublished work by D. G. Turner (a coauthor of this work). A reddening slope of $E(U - B_J)/E(B_J - V) \approx 0.72$ was adopted to determine $E(B_J - V)$ in this low-obscuration case (W. A. Hiltner & H. L. Johnson 1956), and slope uncertainties are likewise relatively inconsequential as a result. The optical color excess transforms to $E(J - H) \simeq 0.01$ for IC 2602 (i.e., $E(J - H)/E(B_J - V) = 0.31 \pm 0.06$; D. Majaess et al. 2016).

NIR passbands were selected to establish the cluster distances since extinction law uncertainties are less onerous in comparison to the optical (e.g., Gaia *BGR*), and deviant trends are mitigated (D. Majaess et al. 2016). IC 2602 photometry stemmed from 2MASS, and proper motion bounds were adopted from F. van Leeuwen (2009; Hipparcos). The L21-DR3 distance for IC 2602 is $\pi = 6.646 \pm 0.012$ mas ($d = 150$ pc), which was used to anchor IC 2602 (i.e., M_J). That agrees with a result of 148.6 ± 2.0 pc from F. van Leeuwen (2009).

A visual fit using the calibrated IC 2602 yielded constraints of $E(J - H) = 0.20$, $0.26(\pm 0.03)$ and $d = 2.30$, $2.40(\pm 0.13)$ kpc for Alicante 13 and Liu-Pang 1738, respectively. The distance uncertainty was evaluated via analytical and Monte Carlo approaches, which relied on propagating uncertainties associated with R ($R_{JJH} = A_J/E(J - H) = 2.18 \pm 0.06$; D. Majaess et al. 2016), and color-excess and turnoff/main-sequence fitting. The fit emerged by shifting intrinsic data along the ordinate and abscissa to match observations, and the results are supported by the DR3 parallaxes and isochrones (Section 2.5, Table 1). The *JH* color–magnitude analysis (Figure 3) and DR3 parallaxes consistently indicate Alicante 13 is nearer than Liu-Pang 1738 (Table 1). The average offset implied by the two methods is $\simeq$0.15 kpc.

A solar Padova[15] PARSEC 1.2S-YBC $\log \tau = 7.45 \pm 0.10$ isochrone was deduced from a preliminary visual[16] fit to Alicante 13 *JH* data, and is well constrained by evolved stars (e.g., HD 339064; I. Negueruela et al. 2020). That is comparable to a mean $\log \tau = 7.35 \pm 0.17$ inferred from Cepheid period–age relations ($P \simeq 45^d$ for SV Vul; G. Bono et al. 2005; D. G. Turner 2012; R. I. Anderson et al. 2016). The choice of a solar isochrone is linked to $[\mathrm{Fe/H}] = 0.11 \pm 0.10$ for SV Vul (R. da Silva et al. 2023). Age estimates in the literature for Alicante 13 include $\log \tau = 7.44$ and 7.48 (T. Cantat-Gaudin et al. 2020; I. Negueruela et al. 2020). Similarly, for Liu-Pang 1738, estimates include $\log \tau = 7.341 \pm 0.287$ and 7.87 (W. S. Dias et al. 2021; T. Cantat-Gaudin et al. 2020). The results are summarized in Table 1.

D. G. Turner & L. N. Berdnikov (2004) contested arguments that SV Vul is traversing the instability strip for the first time since it exhibits a decreasing period (-214.3 ± 5.5 s yr^{-1}), which instead indicates it is a blueward second or fourth crosser (their Figure 2, and in Section 2 they favor the second crossing). A first crosser would display an increasing period, one that is 2 orders of magnitude greater than determined, and the disputed

[14] B_J and B are Johnson and Gaia passbands, accordingly.

[15] http://pleiadi.pd.astro.it/

[16] Separate semiautomated fits using numerous Padova isochrones are described in Section 2.5.

hypothesis is likewise contradicted by the isochrone (Figure 3). L. N. Berdnikov et al. (2026, in preparation) extend that original dP/dt determination by two decades. The analysis indicates a decreasing period at a rate of $dP/dt = -231.2 \pm 1.4$ s yr^{-1}.

2.5. Redundancies

An effort was made to mitigate confirmation bias (e.g., W. L. Freedman et al. 2025, and discussion therein), and consequently coauthor C. Bonatto carried out a semi-independent *JH* color–magnitude analysis following precepts outlined in C. Bonatto (2019). That coauthor established the ensuing parameters for Alicante 13: 2.18 $\pm$ 0.02 kpc, $\tau = 35 \pm 5$ Myr ($\log \tau = 7.54$), and $E(J - H) = 0.19 \pm 0.02$. Furthermore, coauthor D. Majaess assembled a median absolute deviation and sigma-clip algorithm to semiautomatedly fit isochrones (D. Majaess et al. 2026, in preparation), which provides yet another alternative to visual fitting using IC 2602. Means ($\pm$*stdev*) inferred for Alicante 13 from PARSEC 1.2S-YBC, YBC+new Vega, OBC, and PARSEC 2.0 base, and separately with $\omega_i = 0.4$, are $\log \tau = 7.53 \pm 0.05$, $d = 2.30 \pm 0.12$ kpc, $E(J - H) = 0.22 \pm 0.01$, and [Fe/H] $= 0 \pm 0.08$. For Liu-Pang 1738 the parameters are $\log \tau = 7.60 \pm 0.04$, $d = 2.49 \pm 0.11$ kpc, $E(J - H) = 0.26 \pm 0.01$, and [Fe/H] $= 0.06 \pm 0.09$. The lack of later-type evolved members in Liu-Pang 1738 complicates the isochrone selection, yet the $(u - g)/(g - r)$ and differentially dereddened diagrams convey the clusters share similar turnoffs (Figure 2).

Irrespective of whether the distances are anchored to IC 2602 (preferred), inferred from numerous isochrone models, or defined by Gaia L21-DR3 parallaxes, the findings are consistent.

2.6. Is SV Vul Overluminous?

I. Negueruela et al. (2020) demonstrated through cluster $G - (B - R)$ and $K_s - (J - K_s)$ color–magnitude diagrams that SV Vul was too bright relative to isochrones ($\Delta G \simeq 0\overset{m}{.}9$ and $\Delta K_s \simeq 0\overset{m}{.}6$). Matching canonical isochrones to Cepheids and their crossings remains challenging (e.g., H. Y. Xu & Y. Li 2004; G. Bono et al. 2005, 2024; R. I. Anderson et al. 2016). Yet A. G. Riess et al. (2021) and K. A. Owens et al. (2022) noted that SV Vul was an outlier in period–magnitude relations when utilizing EDR3 parallaxes (i.e., too bright).

A potential overluminosity is bolstered by several indicators concurrently: isochrone mismatches relative to a $J - (J - H)$ color–magnitude diagram ($\Delta J \simeq 0\overset{m}{.}5$, Figure 3), and via a brightness inferred from both Alicante 13 and L21-DR3 distances, which are offset from certain Cepheid period–magnitude relations. The latter optical to mid-infrared Cepheid functions can favor a nearer SV Vul distance of $\simeq$1.8–2 kpc ($\mu_0 \simeq 11.5$) (L. N. Berdnikov et al. 2000; C.-C. Ngeow 2012; D. Majaess et al. 2013), whereas a brighter Cepheid is implied by the cluster distance of 2.30 ± 0.13 kpc ($\mu_0 \simeq 11.81$) and the L21-DR3 parallax for SV Vul ($2.488^{+0.137}_{-0.124}$ kpc, $\mu_0 \simeq 11.98$).

A consensus solution could not be reached that explains the suite of trends and that simultaneously considers factors such as the absence of a B-type companion for SV Vul in data from the International Ultraviolet Explorer, the Cepheid's comparatively low γ-velocity shifts ($\Delta\gamma \approx 2$ km s^{-1}; N. R. Evans et al. 2015), marginal differential reddening, potential mass loss, ostensibly a second rather than a fourth crosser, chemical abundances, and certain evidence disfavoring rapid rotation based on turbulence and other considerations (e.g., D. G. Turner & L. N. Berdnikov 2004; R. E. Luck 2018). Consequently, a canonical massive companion or rapid rotation may not explain SV Vul's brightness. For example, perhaps a fine-tuned early merger scenario can be invoked, or alternatively certain Galactic Cepheid calibrations and canonical isochrones both require refinement, or even cluster membership could be reconsidered pending velocities for numerous cluster stars and validated DR4 parallaxes.

3. Conclusions

This study builds upon efforts to characterize SV Vul and its encompassing region (e.g., D. G. Turner 1984), namely by employing new or unused data, such as deeper UKIDSS-DR6 photometry, fainter ultraviolet UVEX observations, and Gaia DR3 data (XP spectra, astrometry, photometry). A consistent distance to SV Vul and Alicante 13 is established by multiple means, whether anchored via IC 2602 ($d = 2.30 \pm 0.13$ kpc), Padova isochrones, or L21-DR3 parallaxes (Table 1). An inspection of the broader field indicates SV Vul and Alicante 13 may potentially belong to a sizable complex that likewise includes Liu-Pang 1738 (Figure 1), and the astrometry is comparable (e.g., $\sigma_\pi \simeq 0.02$ mas, $\sigma_{\mu_\delta} \simeq 0.06$ mas yr^{-1}, Table 1). Importantly, in unison, the UVEX color–color diagrams, Gaia XP dereddened color–magnitude plots, and isochrones indicate the clusters are likewise relatively coeval (Section 2.5, Figure 2).

Going forward, an open question remains whether SV Vul is overluminous (Section 2.6). Indeed, published concerns surrounding the critical long-period Cepheids SV Vul and S Vul provide ample impetus to continue research. Second, a dynamical analysis of both clusters via radial velocities is desirable (comprehensive data presently unavailable); however, the velocity trend along the sightline (2.0–2.5 kpc) is comparatively flat. Such velocities could (in)validate certain hypotheses. Lastly, additional related overdensities may exist in the broader field (e.g., T. Palma et al. 2025).

Acknowledgments

This research relied on initiatives such as CDS, NASA ADS, arXiv, Hipparcos, UKIDSS, 2MASS, Padova isochrones, Gaia, UVEX, and kind staff at the Gaia Help Desk. TapVizieR and Gaia DR3 access were facilitated by python and Gemini 3. D. Minniti is supported by ANID Fondecyt Regular grant No. 1220724, and by the BASAL Center for Astrophysics and Associated Tecnologies (CATA) through ANID grants ACE210002 and FB210003. M.G. acknowledges support from ANID FONDECYT Regular 1240755. R.K.S. acknowledges support from CNPq/Brazil through projects 308298/2022-5 and 421034/2023-8. For L.N.B. the study was conducted under the state assignment of Lomonosov Moscow State University.

ORCID iDs

Daniel Majaess https://orcid.org/0000-0001-8803-3840
Ignacio Negueruela https://orcid.org/0000-0003-1952-3680
Charles J. Bonatto https://orcid.org/0000-0002-4102-1751
David G. Turner https://orcid.org/0000-0003-1184-1860
Dante Minniti https://orcid.org/0000-0002-7064-099X
Vittorio F. Braga https://orcid.org/0000-0001-7511-2830
Giovanni Carraro https://orcid.org/0000-0002-0155-9434
Igor Usenko https://orcid.org/0009-0009-8613-0087

Giuseppe Bono https://orcid.org/0000-0002-4896-8841
Matias Gomez https://orcid.org/0000-0002-4430-9427
Roberto K. Saito https://orcid.org/0000-0001-6878-8648
Maria G. Navarro https://orcid.org/0000-0002-1860-2304

References

Anderson, R. I., Saio, H., Ekström, S., Georgy, C., & Meynet, G. 2016, A&A, 591, A8
Andrae, R., Fouesneau, M., Sordo, R., et al. 2023, A&A, 674, A27
Berdnikov, L. N., Dambis, A. K., & Vozyakova, O. V. 2000, A&AS, 143, 211
Berdnikov, L. N., Vozyakova, O. V., & Dambis, A. K. 1996, AstL, 22, 334
Bonatto, C. 2019, MNRAS, 483, 2758
Bono, G., Braga, V. F., & Pietrinferni, A. 2024, A&ARv, 32, 4
Bono, G., Marconi, M., Cassisi, S., et al. 2005, ApJ, 621, 966
Breuval, L., Kervella, P., Wielgórski, P., et al. 2021, ApJ, 913, 38
Cantat-Gaudin, T., Anders, F., Castro-Ginard, A., et al. 2020, A&A, 640, A1
Casado, J., & Hendy, Y. 2023, MNRAS, 521, 1399
da Silva, R., D'Orazi, V., Palla, M., et al. 2023, A&A, 678, A195
Dame, T. M., & Thaddeus, P. 1985, ApJ, 297, 751
Dias, W. S., Monteiro, H., Moitinho, A., et al. 2021, MNRAS, 504, 356
Evans, N. R., Berdnikov, L., Lauer, J., et al. 2015, AJ, 150, 13
Freedman, W. L., Madore, B. F., Jang, I. S., et al. 2025, ApJ, 985, 203
Gaia Collaboration 2022, yCat, 1355, 0
Heyer, M., & Dame, T. M. 2015, ARA&A, 53, 583
Hiltner, W. A., & Johnson, H. L. 1956, ApJ, 124, 367
Lindegren, L., Bastian, U., Biermann, M., et al. 2021, A&A, 649, A4
Liu, L., & Pang, X. 2019, ApJS, 245, 32
Lucas, P. W., Hoare, M. G., Longmore, A., et al. 2008, MNRAS, 391, 136
Luck, R. E. 2018, AJ, 156, 171
Majaess, D., Turner, D., Dékány, I., Minniti, D., & Gieren, W. 2016, A&A, 593, A124
Majaess, D., & Turner, D. G. 2024, PASP, 136, 064201
Majaess, D., Turner, D. G., & Gieren, W. 2013, ApJ, 772, 130
Mermilliod, J.-C. 1997, yCat, 2168, 0
Molinaro, R., Ripepi, V., Marconi, M., et al. 2023, MNRAS, 520, 4154
Monguió, M., Greimel, R., Drew, J. E., et al. 2020, A&A, 638, A18
Monson, A. J., & Pierce, M. J. 2011, ApJS, 193, 12
Negueruela, I., Dorda, R., & Marco, A. 2020, MNRAS, 494, 3028
Ngeow, C.-C. 2012, ApJ, 747, 50
O'Donnell, J. E. 1994, ApJ, 422, 158
Owens, K. A., Freedman, W. L., Madore, B. F., & Lee, A. J. 2022, ApJ, 927, 8
Palma, T., Coenda, V., Baume, G., & Feinstein, C. 2025, A&A, 693, A218
Riess, A. G., Casertano, S., Yuan, W., et al. 2021, ApJL, 908, L6
Straižys, V., Boyle, R. P., Milašius, K., et al. 2019, A&A, 623, A22
Turner, D. G. 1984, JRASC, 78, 229
Turner, D. G. 2012, jaavso, 40, 502
Turner, D. G., & Berdnikov, L. N. 2004, A&A, 423, 335
van Leeuwen, F. 2009, A&A, 497, 209
Xu, H. Y., & Li, Y. 2004, A&A, 418, 213