PROCEEDINGS OF SCIENCE

# Concluding Remarks: A Golden Age for CVs

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Although I do not have enough time to summarize all of the results presented during "The Golden Age of Cataclysmic Variables and Related Objects - VI", I would like to point out that the current Golden-Age of cataclysmic variables (CVs) is alive and well and includes not only our really great astronomical science machines like Gaia and LIGO/Virgo/KAGRA, but also the ingenuity of astronomers to use a wide range of telescopes enabling differing science. In an age of expensive science done from space platforms it is a pleasure to see the remarkable contributions of Condor to search for novae shells and novae super-shells. In addition, CV photometry has entered its own Golden Age due to the large scale studies of transients, like the Zwicky Transient Facility (ZTF), and the search for exoplanets using Kepler (K2) and the Transiting Terrestrial Exoplanet Survey Satellite (TESS). As the names imply, these programs focus on transients like supernovae, accreting black holes, gamma-ray bursts and the like, as well as for the search for planets. However, CV science surreptitiously benefits from the unprecedented light curves that are now available from these efforts.

*The Golden Age of Cataclysmic Variables and Related Objects - VI (GOLDEN2023)*
*4-9 September 2023*
*Palermo - (Mondello), Italy*

*Speaker





PoS(GOLDEN2023)047

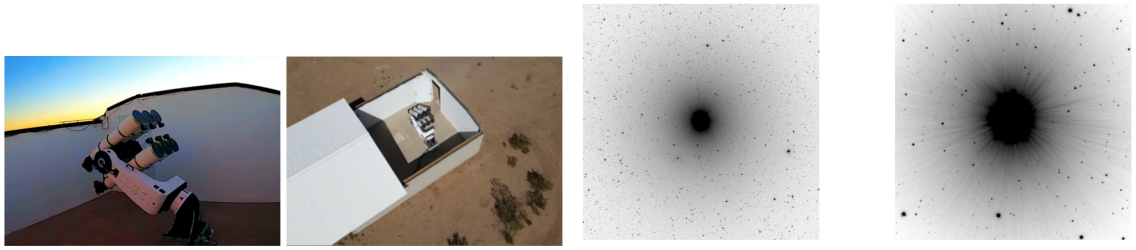

**Figure 1:** The Condor Telescope in southwestern New Mexico. Images of Vega demonstrate the high image quality, especially the absence of diffraction spikes. Credit: Lanzetta et. al. [1]



## 1. Introduction

We meet here again in September of 2023 to discuss recent developments in cataclysmic variables (CVs) and related objects. From the fantastic talks presenting the observational and theoretical accomplishments it is clear that much progress has been made and the future looks bright. We can also ask the question, is this indeed a Golden Age of Cataclysmic Variables? In the end, in my opinion the answer is an unequivocal, yes!

## 2. A New Golden-Age for CVs

In these short concluding remarks to another fantastic conference brought to us by Franco Giovannelli, I argue that it is also a larger far reaching golden age of observational astrophysics that now, more than ever before, drives CV science. Seeing the results from the work in the CV field during the past week is not only the result of tremendous technological improvements, but also due to the efforts of many investigators including those here.

The current Golden Age of observational astrophysics is the result of several revolutionary technological advances, developed in parallel, in both ground based and space based astronomical instrumentation. These accomplishments run from the LIGO/Virgo/KAGRA gravitational wave discoveries to the use, by Gaia, of the ancient astronomical tool of parallax, combined with exquisite spacecraft design to measure the precise distances hundreds of millions if not a billion stars. Gaia has, in particular, brought about a Golden Age of CVs on its own because of the vast, majority of bright CVs of all classes for which we now have reliable distances. No other quantity constrains physical models of an interacting binary more than the reliable knowledge of its distance. The interesting contrast of LIGO/Virgo/KAGRA with the many spacecraft and ground based telescopes operating at across the spectrum is unprecedented in allowing near continuous observation of the sky and providing for the quick follow up of transients. In particular, the ability to predict and then detect gravitational waves as well as their electromagnetic counterparts ranks as one of the greatest accomplishments in science, combining theoretical, experimental, and observational techniques.

Back to our familiar home in the field of binaries, the near future detection of CVs, and related systems, in particular the ultra compact binaries and the AM CVn binaries as gravitational wave sources is exciting especially as distinguishing individual sources out of the background will be challenging and rewarding. While the known variables remain beyond the scope of gravitational

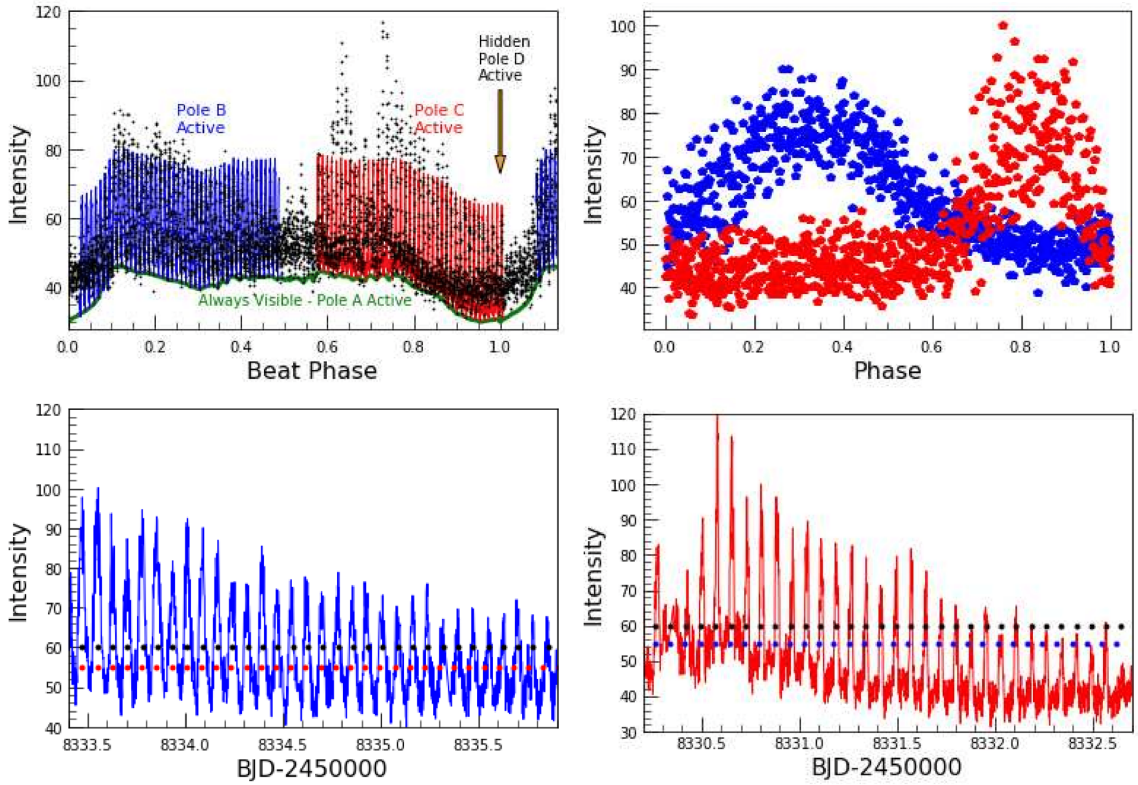


**Figure 1:** TESS provides an unprecedented view of light curves of CVs. Here CD Ind is observed to undergo pole switching continuously around the beat period. Credit: From Mason et al.[2]

wave studies for the time being, the golden age for CVs currently maintains the mission of providing multi-wavelength studies of which fast response and simultaneity are key factors in success.

Novae have been a major topic of this conference. That includes classical novae, recurrent novae, those in the Galaxy, and even extra-Galactic novae. The ability to detect and observe novae and their remnants across the electromagnetic spectrum place strong constraints on model physics. My only remark to add to those expressed, here at this conference, is that novae should not be considered a CV class. Novae are phenomena associated with CVs and not a class of CV. Novae have been observed in binaries of all proper CV classes. Also, in an age of expensive science done from space platforms it is a pleasure to see the remarkable contributions of Condor to search for novae shells and novae super-shells, see Figure 1.

It is remarkable, though not surprising, to see the ingenuity of CV astronomers to use a wide range of telescopes, including Condor [1], enabling differing science. In addition, CV photometry has entered its own Golden Age due to the large scale studies of transients, like the Zwicky Transient Facility (ZTF), and the search for exoplanets using Kepler (K2) and the Transiting Terrestrial Exoplanet Survey Satellite (TESS). As the names imply, these programs focus on transients like supernovae, accreting black holes, gamma-ray bursts and the like, as well as for the search for planets. However, CV science surreptitiously benefits from the unprecedented light curves, from missions, like TESS, that were not designed for CV studies, that are now available from these large sky surveys.

For example, TESS observations have revolutionized the study of magnetic CVs, especially the enigmatic asynchronous polars. In Figure 2, pole switching between two spots with very different light curve shapes is shown. See the narrow (red) and the broad (blue) lightcurve features shown in Figure 2. The blue light curves cover the first part of the beat cycle while the red light curves occur during the second part of the beat cycle. The gradual stepping down in brightness of both light-curve sections shown in Figure 2 may be either due to the presence of a hidden pole, which accretes during part of the beat cycle [2] and/or due to a magnetic valve [3]. And finally, the there is the very recently discovered eccentric "candidate" planet orbiting the polar V808 Aur [4], which ironically used TESS in coordination with ground based photometry from small telescopes, to discover a planet candidate not by transits, but by timing effects!

## References

[1] K.M. Lanzetta, et al., Publications of the Astronomical Society of the Pacific, 135, 015002, (2023).

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[3] P.A. Mason et al., Astrophysical Journal, 938, 142, (2022).

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