

# *Accretion-Powered Compact Binaries*

Proceedings of the 11th North American Workshop on  
Cataclysmic Variables and Low Mass X-ray Binaries,  
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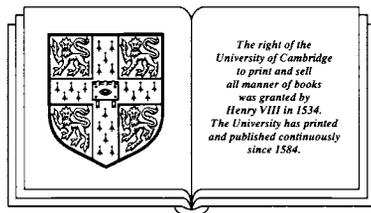
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## A Short History of the CV Workshops

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The North American Workshops on Cataclysmic Variable Stars (“CV” Workshops) are topical meetings held nearly every year. While the cataclysmic binaries comprise the largest focus of these Workshops, other, similarly active close binaries, especially symbiotic stars and low mass X-ray binaries, are frequently included. The Workshops are sited wherever there is interest in organizing them. This, the Santa Fe Workshop, is the eleventh in the series.

Perhaps surprisingly, no astronomer has been present at all of the CV Workshops. The prize for highest attendance goes to Sumner Starrfield (Arizona State Univ.), who, because of an *IUE* run, missed only the Seattle Workshop. Over half of the ~130 Santa Fe Workshop participants were new to the Workshops. This means that the history of the Workshops is in danger of becoming extinct. To preserve this history, we wanted to include a brief account of the past CV Workshops. This record is also meant to be a tribute to Workshop organizers who have provided invaluable forums for dissemination of knowledge in the field and notably enhanced the climate for interaction and new research directions. The following table is a synopsis of the CV Workshop particulars.

No.	Year	Place	Organizers
1	1976	Urbana, IL	S. Starrfield, J. Truran
2	1977	Boulder, CO	C. Hansen, B. Warner
3	1978	Tempe, AZ	S. Starrfield
4	1979	Rochester, NY	M. Savedoff, H. Van Horn
5	1980	Austin, TX	E. Robinson, E. Nather
6	1981	Santa Cruz, CA	J. Faulkner
7	1983	Cambridge, MA	J. Patterson, D. Lamb
8	1984	Baton Rouge, LA	H. Bond, G. Chanmugam, and J. Tohline
9	1985	Seattle, WA	P. Szkody
10	1987	Aspen, CO	J. Patterson, D. Lamb
11	1989	Santa Fe, NM	F. Córdova, C. Mauche, and W. Priedhorsky

The idea for the first CV Workshop is attributed to Sumner Starrfield and Jim

Truran (Univ. of Illinois) who got together about 15 people in 1976 to discuss, informally, their research on cataclysmic variables. Jim Pringle was visiting Illinois that year from the Institute of Astronomy at Cambridge, England, so even the first Workshop had an international flavor. There were no formal talks. The “hot” topic was the quasi-periodic oscillations detected in the optical by Rob Robinson and Ed Nather (Univ. of Texas, Austin) and Brian Warner (Univ. of Capetown). This was the year that Robinson and Warner independently published their comprehensive reviews of the field.

The first meeting was inspiring enough that Carl Hansen (Univ. of Colorado) and Brian Warner, who was spending a sabbatical at Boulder, organized the second CV Workshop a year later at the University of Colorado. Again, there were no formal talks.

The first formal talks on CVs were given the following year at the third CV Workshop, this time in Tempe. The meeting was organized by Sumner Starrfield. It was at this meeting that new wavelengths were introduced into the discussions: the IR was represented by Paula Szkody (Univ. of Washington, Seattle) and Ed Ney (Univ. of Minnesota); the X-ray was represented by France Córdoba (then at CalTech); and the radio by Bob Hjellming (NRAO).

In 1979, Malcolm Savedoff organized an IAU Colloquium on “White Dwarfs and Variable Degenerate Stars” in Rochester. Hugh Van Horn (Univ. of Rochester) was a co-organizer for this meeting and appended a CV Workshop. The Proceedings of the Colloquium, edited by Van Horn and V. Weidemann, included the papers presented at the Workshop. It was dedicated to Jesse Greenstein (CalTech) on the occasion of his seventieth birthday, and represented the first published CV Workshop proceedings.

A cataclysmic event associated with the Rochester meeting occurred during Howard Bond’s (then at Louisiana State Univ.) presentation. Howard was saying something suspicious like, “all CVs are descended from wide binaries that have gone through a common-envelope interaction,” when a loud thunderclap sounded, lending the speaker an unusual degree of authority. The hot, pulsating, C-O white dwarf PG 1159–035 was first announced at this Workshop. It was also anticipated at the meeting that the 1980s would see the launch of XUV instruments that would survey the XUV sky—an expectation that still has not been realized a decade later. The excitation of CV QPOs eluded us then, as it continues to do.

One remembrance of the Rochester meeting that continues to inspire us is that of John Whelan (Univ. of Cambridge), who was the popular choice to give the Workshop summary. It was a job only a great diplomat like John could do because some of the debate had been fractious and a few issues were unresolved. A young man when he died soon thereafter of cancer, John was simply the nicest person many of us have ever met. He reflected a deep joy and serenity that were captivating.

The next year Rob Robinson and Ed Nather (Univ. of Texas, Austin) organized the fifth CV meeting. A summary of the meeting appears in *Nature*, 1980, Vol. 286. Joe Patterson (then at Univ. of Texas, Austin) gave three talks (on 2A 0311-227,

HT Cas, and rapid oscillations), establishing a pattern of conspicuous presence at CV meetings, and a prescription for outrageous artwork and patter in scientific presentations. Joe's aphorisms have taken on a life of their own, resurrecting their paraphrased selves at subsequent CV Workshops. The Austin meeting was the first one in which we confronted the problem that the interpretation of the amplitudes of the radial velocity curves of CVs was more difficult than had been assumed. We are beginning to understand the absorption-line velocities, but, even now, only limited progress has been made in understanding the emission-line velocities. At this meeting, there was a lot of interest in the new *IUE* data as well as the problem of interpreting the SU UMa phenomena. Ron Webbink (Univ. of Illinois) led a complex path through common-envelope evolution with graphically explicit viewgraphs in living color.

The longest CV Workshop was organized by John Faulkner (UC, Santa Cruz) as part of Santa Cruz's series of summer workshops. It lasted three weeks, included a partial lunar eclipse (which went unrecognized by some X-ray astronomers who apparently didn't know which way the Earth rotated), and provided plenty of time for roller coaster rides on the boardwalk and hiking in the surrounding forested countryside. This meeting is famous for its genesis (in the person of Jim Pringle) of the idea for the effective temperature – surface density diagram (“S”-curve) for accretion disk instabilities. It is also memorable for Bob Kraft's (UC, Santa Cruz) introductory, historical talk, which was the story of the founding of the subject by the founder himself. The audience especially enjoyed his tale of holding up the single-trailed spectrogram of WZ Sge, still dripping wet, and discovering the emission-line “S-wave.” Kraft's talk was followed by an extraordinary review of the current state of the subject by Brian Warner, who shares responsibility for shaping the field. Ron Webbink presented a scholarly paper on very old novae, casually mentioning having consulted the original sources (written, of course, in Latin and French).

One of the traditional social events at the Santa Cruz Conference is the wine-tasting organized and led by Joe Miller, a noted Santa Cruz researcher in both AGNs and oenology. The Santa Cruz CV Workshop started, like so many Santa Cruz Workshops before it, with Miller's presentation of young red and white wines chosen from a number of local vineyards. CV people, however, have sometimes been accused of being a bit boorish and their behavior that evening was consistent with this reputation: not long into an “unassuming little Red,” the group went unstable. The Italian CV astronomers had brought an ocarina and, under the influence of an exuberant Antonio Bianchini, led the group in a number of dances. A highlight was Jim Pringle's exhibition of his own instability during the “bunny hop.” The evening was brought to a finish when Bob Williams, who runs circles around CTIO, yelled to Miller “I'll drink no wine that I can't unscrew.” This evening was also noteworthy for the introduction of Paula Szkody's daughter, Allison, born one week earlier.

Joe Patterson and Don Lamb (both then at the Harvard-Smithsonian CfA) organized the seventh, and coldest, CV Workshop, which followed the 1983 Boston

AAS meeting. The organizers ambitiously welcomed the obstreperous low mass X-ray binary crowd to share ideas about accretion onto compact stars. They noted that in spite of the similarities between the parameters of white dwarf and neutron star binaries, there was little overlap in the research programs on these active binaries. The desire was to stimulate interaction by bringing the two groups together. In the preface to their proceedings, the organizers asked, “Did it work? Well, we had a well-attended and highly successful conference. We heard a number of excellent review talks on various aspects of CV’s and LMXB’s . . . But we are inclined to think that the basic *goal* of the conference, a synthesis of the two fields, didn’t really quite happen . . . we identified few exchanges in which the CV’s met the LMXB’s to their mutual enlightenment. On at least two occasions, questioners who proposed such a comparison were actually scolded for comparing ‘apples and oranges.’ So it seems pretty clear that the time for such a synthesis has not yet come . . . ” Since that meeting, LMXRB talks have figured in the CV Workshops.

The loudest, most colorful meeting to date was the Baton Rouge CV Workshop, organized to coincide with the 1984 Mardi Gras season by Howard Bond (now STScI), Ganesh Channugam and Joel Tohline (both Louisiana State Univ.). Many of the participants arrived in a classic thunderstorm and were diverted to other airports, having to fend for themselves to get to the meeting on time. The other problem that plagued the meeting was the nature of the soft X-ray emission from the AM Herculis variables. Observational data presented by John Heise (Utrecht) revealed that the hard and soft X-rays might have their origins in different poles of the magnetic, accreting white dwarf star. Keith Horne (STScI) introduced the CV world to Doppler tomography of accretion disks. During an expedition to New Orleans, Bill Priedhorsky (Los Alamos) distinguished himself by collecting the most Mardi Gras necklaces, thrown by revelers from parade floats—not a mean feat, considering the competition from other CV festival goers. The following day, back in Baton Rouge, Mike Shara (STScI) maintained the festive mood when he opened his CV talk by throwing trinkets from a cigar box to an audience of scrambling astronomers. John Faulkner got his comeuppance for years of bad jokes from an anonymous poster paper debunking “The Theories that Jack Built.”

Paula Szkody provided the most rural setting for a CV Workshop: a 330-acre army fort on the Olympic Peninsula which had been converted to a State Park. The logistics of hiring rental cars and ferries to reach this remote area did not preclude a strong showing by the European contingent. The Victorian houses which used to be the Officers Quarters provided some different housing accommodations (there was a “Janet House” in which Janet Drew, Janet Wood, and Janet Mattei stayed). The meeting took place in the army Chapel. The mess hall brought back bad memories of school cafeterias. The Parade Grounds was the site of a CV softball game, which followed in the tradition of cricket games in the U.K. at close binary star meetings. The Olympic game ended in an unfortunate “bouncer ball” striking a player, establishing a tradition of sports injury which was continued at the later Aspen Workshop.

A cold wind made the salmon barbecue on the beach the shortest conference dinner in Workshop history as everyone scurried for warm shelter.

The science of this ninth CV Workshop involved continuing discussions of the disk instability and superhump problems in dwarf novae and the oscillations and evolution of magnetic systems. For the 65 participants, there was a large concentration of the primary people involved modeling spectral line formation: Allen Shafter, Keith Horne, Rick Hessman, John Clarke, Don Ferguson, John Raymond, and Janet Drew provided descriptions of the complexities of the optical and UV emission within a single session. This was also the first Workshop in which several members of the AAVSO participated, since the AAVSO semi-annual meeting had taken place the previous weekend in Seattle. Paula edited a proceedings for this, the ninth CV Workshop.

There was not another North American CV Workshop for two years. In the intervening year, 1986, a CV Colloquium was held in Bamberg, West Germany.

Some organizers seem to enjoy the job: Joe Patterson and Don Lamb organized their second CV Workshop in 1987, this one in Aspen, Colorado. Afternoons were reserved for hiking in the beautiful Aspen mountains. CV evolution and the recent Supernova 1987A were important focuses of this, the tenth Workshop.

The Los Alamos, New Mexico, contingent of CV astronomers had been promising for a long time to host a Workshop and finally made good on this in October of 1989. These Proceedings contain much of the work presented at this meeting, held in Santa Fe. The meeting was organized by France Córdoba, Christopher Mauche, and Bill Priedhorsky (Los Alamos). It was so large, with  $\sim 130$  astronomers from 16 countries, that it gave some participants pause to wonder where the field was headed. It was generally concluded that meetings both large and small, interspersed, would be best for the discipline: small meetings on specific topics to preserve the flavor of a “workshop,” and larger meetings to introduce more young people to the field and to examine connections between subtopics. The meeting was held during Albuquerque’s famous International Hot Air Balloon Fiesta. The day after the meeting found some amazed participants lost in a great tide of colorful, expanding, and rising balloons. Jets carrying other participants home carefully negotiated their way past the precisely drifting balloons, which formed a giant box pattern in a perfect blue sky.

In 13 years and 11 North American CV Workshops, the field of cataclysmic variables has seen dramatic change.

X-ray space research has enhanced significantly a whole new field of CV inquiry: the magnetic, accreting white dwarf binary. Today, observational and theoretical research on AM Herculis and DQ Herculis variables in every wavelength band forms a significant contribution to the literature on CVs. Another important result on CVs during this interval was the discovery, using *HEAO 1*, of X-ray oscillations from dwarf novae, an affirmation that the optical QPOs reflect the presence of a high-energy source. The surprise was that the X-ray oscillations were also quasi-periodic. The *Einstein* satellite observations confirmed that X-ray emission is ubiquitous among all

classes of CVs. *EXOSAT* satellite results more recently revealed that low mass X-ray binaries also exhibit quasi-periodic X-ray oscillations, although with much smaller amplitudes and higher frequencies than the CV pulsations.

The technique of Doppler imaging has given us remarkable new pictures of the CV accretion disk and sources of the optical emission. New theoretical inquiries into accretion disk instabilities, evolution, and the production of winds from disk geometries, have greatly enhanced our naïve understanding of a decade ago. The *IUE* satellite has given us a new picture of the nature of the dwarf nova outburst, the contribution of the white dwarf, the relative importance of X-ray heating and disk reprocessing, as well as the genesis of the high-velocity winds seen in luminous CVs.

This volume testifies to the enormous growth in the field. It looks to the 1990s for new understanding of CVs that should result from space- and ground-based ventures of unprecedented resolution, sensitivity, or temporal coverage in virtually every wavelength band.

Topical meetings like the CV Workshops have more purposes than sharing information. As one CV astronomer put it, “The nicest feature of the five Workshops that I have attended was the opportunity to meet again with old friends, and to make new ones. There has always been a wonderful feeling of community and camaraderie among those astronomers fascinated by the marvelous zoo of cataclysmic variables.”

The organizers of the CV Workshops gratefully acknowledge their host institutions, the NSF, NASA, and the DOE for financial support for the meetings. The entire CV community acknowledges a debt to Janet Mattei and Frank Bateson who lead the largest amateur astronomer organizations in this country and New Zealand, respectively. The amateur astronomers have provided essential data for many kinds of research; their support for satellite UV and X-ray observations of CVs has been invaluable.

*Nothing* would please that indefatigable punster Howard Bond more than my acknowledgment of his contribution of remembrances to this history. Remembrances were also kindly shared by Ganesh Chanmugam, Rob Robinson, Sumner Starrfield, and Paula Szkody.