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Concluding Remarks; What CVs Can Teach Us About Other Astrophysical Sources

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I briefly discuss some personal views developed from the talks and topics covered at this meeting. Specifically, I address a process-oriented theme that focuses on relevant processes independent of scale or source type. For example, magnetism, accretion disk formation, and stellar evolution work in a wide variety of source types, independent of human-made classification schemes. I suggest a process-centered approach where lessons learned about phenomena that are well observed in one source class are sensibly applied elsewhere. Features of one class of accreting binary may appear in another class in a related but distinct way. Several examples that were highlighted in this meeting are discussed.

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I was impressed by the connection discussed in several talks between both close and widely separated types of accreting sources. Magnetic fields direct accretion onto both white dwarfs and neutron stars. The process happens relatively similarly in each case despite occuring over a huge range of magnetic and gravitiational field strengths. The significant difference between low-mass X-ray binary (LMXB) accretion and CV accretion is that in LMXBs, the gravitational well is much stronger than in CVs, hence most of the LMXB radiation is at X-ray wavelengths, while radiation in CVs is mostly UV/optical/IR wavelengths [1]. Consequently, the time scales for processes occuring in LMXBs are a few orders of magnitude faster. Specifically, accretor spin rates, free-fall times, and radiation variability are much faster in LMXBs. The study of the variable emission from accretion disks across many orders of magnitude in scale and source types is key to the wider understanding of accretion flows generally.

Radio observations of magnetic CVs (mCVs) have finally reached a point where constraints may be placed on the mechanism of radio emission. It is clear that non-magnetic CVs are not radio emitters in quiescence, although they do emit during outburst. However, mCVs seem to be radio emitters as a class. Improvements in technology have facilitated enhanced sensitivity for radio observations. Recently the number of radio detections of mCVs has increased tenfold [2]. Continued observations with the Jansky Very Large Array and other modern radio telescopes, and the prospect of future arrays, promises to elucidate the processes involved in radio emission from mCVs. This is likely connected to the fast rotation of fully convective main sequence stars that are single or in binary systems. As this field matures, becoming aware of the advances in the study of radio emission from other accreting sources, such as young stellar objects, is well advised.

Consider the recent discovery of the nature of the ultraluminous X-ray source (ULX) in the nearby galaxy M82. ULXs are likely a heterogeneous mixture of object types. Because of the very high accretion rates involved, as a class, ULXs have long thought to be accreting intermediate mass black holes. However, M82 X-2 is a neutron star accreting at about 100 times the Eddington limit. Despite this interesting discovery, many other ULXs may contain black holes. The fact that such high accretion rates are possible makes distinguishing between neutron star accretion and intermediate mass black hole accretion difficult, unless, as in the case of M82 X-2, a signature like the 1.4 second coherent pulsation reveals the presence of a rotating magnetized neutron star [3].

While spotting similarities between source types is instructive, as is typically addressed by investigators, it is also important to consider that source types have intrinsic differences. Analysis of astrophysical processes which operate accross a variety of scales benefits from this process-centered approach. Only by examining sources from different classes can we determine which sources are most well-suited for the study of a particular astrophysical process. Given the brevity of this summary, I cannot go into detail as to how important processes work on vastly different scales. Just to mention a single but important example, astrophysical jets operate apparently similarly in a wide variety of systems ranging over an enormous range of scale, from young stellar objects to CVs, X-ray binaries, ULXs and even AGN. Whether the accreting object is a tiny white dwarf, a neutron star, or even a supermassive black hole, astrophysical processes are universal and ubiquitous in the universe.

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References

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