TWO ADDITIONS TO THE NEW CLASS OF LOW ACCRETION RATE MAGNETIC BINARIES

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Received 2006 July 7; accepted 2006 September 20

ABSTRACT

Two new magnetic white dwarf accretion binaries with extremely low mass transfer rates have been discovered in the course of the Sloan Digital Sky Survey. Measured magnetic fields are 42 and 57 MG, and one system orbits with a period of just 82 minutes. The new systems therefore significantly expand the range in properties exhibited by the small class. The measured accretion rates are very low, \(0.6-5 \times 10^{-13} M_\odot \text{ yr}^{-1}\), and multiple visits spanning more than a year confirm that this is not a short-lived characteristic. It is becoming increasingly clear that the low-\(M\) magnetic white dwarf binaries accrete by nearly complete magnetic capture of the stellar wind from the secondary star rather than by Roche lobe overflow. The accretion rates therefore provide some of the first realistic estimates of the total wind loss rates from M dwarfs. Although one or more of the eight systems known to date may be interrupted or possibly even extinct Polars, several lines of evidence suggest that most are pre-Polars whose evolution has not yet brought the secondaries into contact with their Roche surfaces. Considering the difficulties of identifying binaries over a wide range in field strength and accretion rate, it is quite possible that the space density of wind-accreting magnetic binaries exceeds that of the classical X-ray-emitting, Roche lobe overflow Polars.

Subject headings: magnetic fields — novae, cataclysmic variables — polarization — stars: individual (SDSS J103100.55+202832.2, SDSS J105905.07+272755.5)

1. INTRODUCTION

Progress toward an understanding of the common-envelope (CE) and post-common-envelope stages of binary star evolution has been slow, in part due to the difficulties of identifying and characterizing populations of white dwarf + M/L dwarf close binary systems that are sufficiently numerous and cover wide ranges in age and mass ratio. The particular questions and problems posed by the (lack of) detached binaries with a magnetic degenerate component have recently been discussed by Liebert et al. (2005). Among the cataclysmic variables (CVs), the eruptive phase that ensues for sufficiently close pairs, the strongly magnetic, circularly polarized systems (AM Herculis binaries, or Polars; see, e.g., Wickramasinghe & Ferrario 2000) have often been more useful than the nonmagnetic examples for studying the stellar components. In these systems the magnetic field disrupts the formation of an accretion disk, and most of the accretion energy emerges as X-rays/EUV radiation. Moreover, when these binaries lapse into states of low accretion, the stellar continua are almost uncontaminated by cyclotron emission. Recent optical spectroscopic surveys have uncovered a population of magnetic binaries that display remarkably isolated cyclotron harmonics and accretion rates \(<1%\) of the values typically encountered among Roche lobe overflow CVs (Reimers et al. 1999; Reimers & Hagen 2000; Schwope et al. 2002; Szkody et al. 2003; Schmidt et al. 2005b, hereafter S05). A variety of clues, including secondary stars that underfill their Roche lobes and unusually cool primary star temperatures, indicate that accretion onto the white dwarfs in these systems occurs through efficient (magnetic) capture of the stellar wind from the low-mass secondary (Webbink & Wickramasinghe 2005; S05). This process was originally explored in relation to the orbital period evolution of Polars (Webbink & Wickramasinghe 2002; Li et al. 1994, 1995), since angular momentum loss via the stellar wind of the companion is generally thought to be important for orbital periods \(P \ga 3\) hr. Because the new low accretion rate binaries appear to have not yet entered into Roche lobe contact, they have been interpreted as premagnetic CVs, or pre-Polars. If this is correct, they offer fresh insight into the products of post-CE evolution, as well as the various routes followed in the formation of magnetic CVs. In this paper we report the discovery of two new low accretion rate magnetic examples that significantly broaden the range of characteristics exhibited by the class.

2. OBSERVATIONS

Like most of the prior discoveries, the two newest low accretion rate magnetic systems were found in the course of the Sloan Digital Sky Survey (SDSS; York et al. 2000). Both sources were selected for dual-channel (blue/red) fiber spectroscopy as candidate QSOs by the automatic targeting algorithms because their \(ugriz\) photometric colors (Fukugita et al. 1996) place them well off the stellar locus (Richards et al. 2002). However, as seen in Figure 1, the optical spectra are quite different from QSOs, with SDSS J105905.07+272755.5 characterized by the spectrum of a late-type star and SDSS J103100.55+202832.2 displaying a blue underlying continuum. Cyclotron harmonics and magnetic field strengths are identified in the figure, computed under the assumption of low plasma temperatures \((kT_e \sim 1\) keV; e.g., Szkody et al. 2004). Details of the SDSS photometric and spectroscopic hardware, as well as the data reduction procedures and targeting strategy, can be found in Gunn et al. (1998, 2006), Lupton et al. (1999, 2001), Pier et al. (2003), and Stoughton et al. (2002).

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7 Hereafter, objects will be designated by SDSS \(Jhhmm:ss.ddmm\).
1.5 m Kuiper telescopes on Kitt Peak and Mount Bigelow, respectively. In the spectroscopic configuration used, the 1200 × 800 SITe CCD provides a coverage \( \sim \lambda 4000 - 8000 \) and resolution \( \sim 15 \) Å. Data were obtained in a series of 16 minute observational sequences, each sequence yielding circular polarization and total spectral flux as functions of wavelength. The results confirm the cyclotron nature of the humps, as shown in Figures 2 and 3. Imaging polarimetry was acquired of SDSS J1031+2028 with the instrument SPOL (Schmidt et al. 1992) attached to the Steward Observatory 2.3 m Bok and 1.5 m Kuiper telescopes on Kitt Peak and Mount Bigelow, respectively. In the spectroscopic configuration used, the 1200 × 800 SITe CCD provides a coverage \( \sim \lambda 4000 - 8000 \) and resolution \( \sim 15 \) Å. Data were obtained in a series of 16 minute observational sequences, each sequence yielding circular polarization and total spectral flux as functions of wavelength. The results confirm the cyclotron nature of the humps, as shown in Figures 2 and 3. Imaging polarimetry was acquired of SDSS J1031+2028 with the same instrument, using a plane mirror instead of the grating and replacing the entrance slit by a square aperture that admits a 1' square region of the sky on the 1.5 and 2.3 m telescopes. Further details of the instrumentation and analysis procedures can be found in Schmidt et al. (1992) and S05.

Finally, a run of CCD photometry on SDSS J1031+2028 was obtained with the United States Naval Observatory (USNO) 1.3 m telescope in unfiltered light within a few weeks of its discovery.}

The object was a difficult target for this small telescope and the end of the 7.5 hr run was plagued by clouds, but a periodic variation is apparent in the data. The observational histories for the two new objects are summarized in Table 1.

3. NEW LOW ACCRETION RATE MAGNETIC BINARIES

A specific accretion rate \( \dot{m} \lesssim 10^{-2} \, g \, cm^{-2} \, s^{-1} \) onto a strongly magnetic white dwarf characterizes the “bombardment” regime, where incident ions lose their kinetic energy via small-angle scatterings in the atmosphere rather than through a hydrodynamic shock. The electrons radiate efficiently in the magnetic field, and the resulting low plasma temperature produces cyclotron emission that is confined to only a few low well-defined harmonics (Woelk & Beuermann 1996). With total accretion rates \( M \lesssim 10^{-13} \, M_{\odot} \, yr^{-1} \), these magnetic systems are virtually nonexistent in X-rays and can only be discovered through deep optical surveys.

3.1. SDSS J1059+2727

The spectrum of SDSS J1059+2727 displays obvious humps centered around \( \lambda 6400 \) and \( \lambda 4750 \) that can be identified with cyclotron harmonics \( m = 3 \) and \( 4 \), respectively, in a field of 57 MG. The predicted location of the \( m = 2 \) harmonic is then just off the spectrum at \( \lambda \approx 9500 \) Å. With broadband colors of \( u - q = +1.27 \) and \( g - r = +1.84 \) (Table 2), the object falls squarely on the simulation track of low-\( M \) systems in the color-color plane at the correct field strength (Fig. 1 of S05). The point-spread function (PSF) magnitude of \( g = 22.1 \) is 0.5 mag brighter than the fiber magnitude obtained more than a year later, but orbital brightness modulations are expected, and thus far the object has always been a challenging spectroscopic target on a modest telescope. Our nearly 2 hr of spectropolarimetric observations on the Bok 2.3 m reflector measured substantial overall circular polarization in each polarimetric sequence, \( v = -8\% \) to \(-12\% \), but there appears to be no coherent dependence on time that would indicate a spin/orbital period.\(^8\) Furthermore, even though H\( \alpha \) can be recognized in emission in several observations, it is so weak that we can only set an upper limit of \( \pm 100 \, km \, s^{-1} \) on any Doppler variation through the series. We infer that the binary probably has a relatively long orbital period, \( P > 3 \) hr, and/or has a low orbital inclination.

Despite 98 minutes of total integration with the SDSS spectrograph, it is difficult to assign a spectral type to the secondary in SDSS J1059+2727 (see Fig. 1), given the combination of a

\(^8\) The circularly polarized flux in the (strongest) \( m = 3 \) harmonic is equivalent to an R magnitude of 24.1.
relatively low signal-to-noise ratio and significant contamination produced by the two cyclotron humps. A comparison with SDSS main-sequence spectral standard stars (Hawley et al. 2002) suggests a best match to an M4 spectral type, with an uncertainty of about 1 subclass. With this result, the measured flux in the interval around \( \lambda = 7500 \) Å, which is between cyclotron harmonics, can be used together with the spectrophotometric calibration of M stars from the appendix of S05 to estimate a distance to SDSS J1059+2727. The result ranges from \( D \sim 460 \) pc for an M5 secondary to 1300 pc for an M3 star. A distance estimate allows the accretion luminosity to be computed, assuming that cyclotron emission dominates the light output. The narrowness of the harmonics, \( \Delta \lambda / \lambda \sim 0.05 \), demonstrates that the plasma temperature is low, \( kT_e \sim 1 \) keV, leading to the prediction that X-ray emission from SDSS J1059+2727 will be negligible. If we use the model calculations of Ferrario et al. (2002, unpublished poster at the Cape Town IAU Colloquium 190 on magnetic cataclysmic variables; see also Ferrario et al. 2005) as a guide to the amount of radiation at unseen harmonics, we obtain an estimate for the accretion luminosity of \( L_{\text{acc}} = 0.4 - 3 \times 10^{30} \) erg s\(^{-1} \), or a total mass transfer rate of \( \dot{M} = 0.6 - 5 \times 10^{-13} M_\odot \) yr\(^{-1} \). This is nearly 3 orders of magnitude below the accretion rates of Polars during high states and comfortably among the rates determined for the previous low-\( M \) examples (see, e.g., S05).

Applying the same method that was used for SDSS J1553+5516 by Szkody et al. (2003), the observed flux between the bluest harmonics can be used to place an upper limit on the temperature of the white dwarf. For SDSS J1059+2727 we allow a rather generous level of \( F_\lambda \sim 2 \times 10^{-18} \) ergs cm\(^{-2} \) s\(^{-1} \) Å\(^{-1} \) in the range 4300–4500 Å (Fig. 1), and compare this to fluxes from Bergeron et al.’s (1995) nonmagnetic log \( g = 8 \) DA models for the typical white dwarf mass of 0.6 \( M_\odot \) \( (R_{\text{wd}} = 0.012 R_\odot) \). The result is \( T_{\text{wd}} \leq 5500 \) K for \( D = 460 \) pc and \( \leq 8500 \) K for the distant limit. These and other parameters derived for SDSS J1059+2727 are entered in Table 2.

### TABLE 2

| Parameter                  | SDSS J1031+2028 | SDSS J1059+2727 |
|----------------------------|-----------------|-----------------|
| Plate-MJD-Fiber            | 2375-53770-636  | 2359-53800-051  |
| \( g \)                    | 18.26           | 22.09           |
| \( u - g \)                | +0.09           | +1.27           |
| \( g - r \)                | −0.27           | +1.84           |
| \( r - i \)                | −0.36           | +0.35           |
| \( i - z \)                | −0.15           | +1.05           |
| \( P \) (hr)               | 1.37            | >3              |
| \( B \) (MG)               | 42              | 57              |
| \( M \) \( (\times 10^{-13} M_\odot \) yr\(^{-1} \)\) | 1.5–4 | 0.6–5 |
| \( D \) (pc)               | 270–430         | 460–1300        |
| \( T_{\text{wd}} \) (K)    | 9500 ± 1500     | \( \leq 8500 \) |
| Spectral type (secondary)  | \( \geq \) M6    | M3 – M5         |

![Time dependence of circular polarization for SDSS J1031+2028, co-added over the optical spectrum](image)
that this period is also the orbital period, but all previous low-
peria.

Thus are more indicative of stellar wind mass loss than Roche
lobe overflow. All eight binaries to date yield rates in the range
5 \times 10^{-14} - 3 \times 10^{-13} M_\odot \text{ yr}^{-1}, with no apparent
dependence on orbital period or spectral type of the donor star. These values
are \sim 2 - 10 times the current solar wind mass-loss rate of 2 \times
10^{-14} M_\odot \text{ yr}^{-1} (Hundhausen 1997), but solar variability on
periods from 11 to 2300 yr is inferred (Sonett et al. 1997). Since
previous attempts to measure the mass-loss rates from low-mass
main-sequence stars have provided only upper limits in the range
\sim 10^{-13} - 10^{-11} M_\odot \text{ yr}^{-1} (e.g., Lim & White 1996; Wargelin &
Drake 2001), the accretion rates of the low-\( M \) magnetic
binaries may actually prove to be the first realistic measurements of
stellar mass loss at the cool end of the main sequence. Of course,
the relevance of these numbers presumes that the magnetic si-
phon process is highly efficient (Li et al. 1995), and that wind
mass loss is not strongly affected by the proximity of the white
dwarf or forced rotation of the secondary.

A peculiar trait of the first six low-\( M \) magnetic systems (S05)
was their sharing of a nearly common magnetic field strength,
\( B = 60 - 68 \text{ MG} \). Model flux distributions, computed as a func-
tion of magnetic field strength by S05, were projected onto the
\((u - g, g - r)\)-plane to show that, even though fields near 60 MG
were prone to targeting of an SDSS spectroscopic fiber, other
ranges in \( B \) were also susceptible, and it was suggested that
discoveries at both significantly higher and lower field strengths
should appear. While the 57 MG field on SDSS J1059+2727 is
near the above range, SDSS J1031+2028 at 42 MG verifies that
prediction. Ironically, however, the broadband photometry of
SDSS J1031+2028 is dominated by the contribution of the white
dwarf (as well as the lack of a cool secondary component), so its
colors fall nearer to the white dwarfs in the color-color plane than
to the simulation track for the measured field strength (Fig. 1 of

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Fig. 5.—Light curve of SDSS J1031+2028 obtained with an unfiltered CCD
on the USNO 1.3 m telescope. Magnitudes are relative to comparison stars in the
same data frames. The fitted sinusoid has a semiamplitude of 0.28 mag and pe-
period of 0.0578 \pm 0.0016 days.

New among the eight low-\( M \) systems discovered thus far is
the lack of evidence for a late-type star in the optical spectrum of
SDSS J1031+2028. Instead, a blue continuum underlies the cy-
clotron features. The spectropolarimetric sequence reveals no pe-
riodic variation in the flux between harmonics (here, measured at
5000 \AA) to a limit of \pm 15\%, so we take the continuum to be from
the integrated disk of the white dwarf, as opposed to a heated ac-
cretion spot.\(^9\) For a dipolar field strength of 42 MG, the expected
surface-averaged magnetic field on the white dwarf is \sim 30 MG,
depending on limb darkening and inclination. The predicted loc-
ations of the principal Zeeman absorption features of H\(_\alpha\)
and H\(_\beta\) are shown for this field strength below the observed spectrum
in Figure 1, and the correspondence between several of the H\(_\beta\)
components with narrow dips shortward of 5000 \AA supports our
interpretation of the underlying continuum as being that of the
white dwarf. H\(_\alpha\) is more sensitive than H\(_\beta\) to the magnetic field
strength and, at a temperature of \sim 9500 K (derived below), con-
siderably weaker than H\(_\beta\) in normal DA stars, so it is not surpris-
ing that a similar correspondence is absent for H\(_\alpha\).

Again we compare the slope of the underlying component
with log \( g = 8 \) DA models of Bergeron et al. (1995) to estimate
the white dwarf temperature in SDSS J1031+2028. Shown as
crosses and plus signs in the lower panel of Figure 1 are com-
puted flux distributions at 100 \AA intervals for nonmagnetic white
dwarf continua with \( T_{\text{eff}} = 8000 \) and 11,000 K, respectively, nor-
malized to the observed flux in the gap between cyclotron harmonics
at 6000 \AA. The 8000 K model falls short of the observed flux
nearly all wavelengths short of 5000 \AA, while the 11,000 K
model significantly underpredicts the light between \( m = 3 \) and 4
around 7500 \AA. We take these models as indicative of the range
in temperature for the underlying white dwarf and quote \( T_{\text{wd}} =
9500 \pm 1500 \text{ K} \). The normalization of the spectral flux then implies
\( D = 270 - 430 \text{ pc} \). If we again take cyclotron emission to be the
dominant energy loss mechanism, we find that \( L_{\text{acc}} = 1 - 3 \times
10^{32} \text{ ergs s}^{-1} \) and \( M = 1.5 - 4 \times 10^{-13} M_\odot \text{ yr}^{-1} \). Of course, satel-
ite observations should be carried out to verify the assumption
that cyclotron cooling dominates by ruling out significant X-ray
emission from both of these new magnetic systems. We note here
that neither object corresponds to a \( \text{Röntgensatellit (ROSAT)} \) source.

The measured flux between the reddest harmonics can now
be used to constrain the nature of the secondary star in SDSS
J1031+2028. In the 7400 – 7900 \AA gap, the observed flux is \( 1.4 \times
10^{-17} \text{ ergs cm}^{-2} \text{ s}^{-1} \text{ \AA}^{-1} \). We again use the absolute spectro-
photometry of main-sequence stars with accurate parallaxes from
S05, and find that the absence of a detectable molecular band head
at 7600 \AA rules out a main-sequence secondary earlier than M7
for the 270 pc distance, or earlier than M6 if the system is at the
maximum 430 pc. It is useful to note that a main-sequence sec-
ondary earlier than M6 is also precluded by the fact that it cannot
overfill its Roche lobe in the \( P = 1.37 \text{ hr} \) binary. These and other
characteristics for SDSS J1031+2028 are listed in Table 2.

4. IMPLICATIONS AND CONCLUSIONS

With the discovery of each new low-\( M \) binary that cannot be
identified with a prior X-ray detection or variable star, it is be-
coming increasingly clear that the accretion rates measured for
many of these systems are relevant over long time intervals and
thus are more indicative of stellar wind mass loss than Roche
lobe overflow. All eight binaries to date yield rates in the range
5 \times 10^{-14} - 3 \times 10^{-13} M_\odot \text{ yr}^{-1}, with no apparent dependence
on orbital period or spectral type of the donor star. These values
are \sim 2 – 10 times the current solar wind mass-loss rate of 2 \times
10^{-14} M_\odot \text{ yr}^{-1} (Hundhausen 1997), but solar variability on
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main-sequence stars have provided only upper limits in the range
\sim 10^{-13} - 10^{-11} M_\odot \text{ yr}^{-1} (e.g., Lim & White 1996; Wargelin &
Drake 2001), the accretion rates of the low-\( M \) magnetic bina-
rias may actually prove to be the first realistic measurements of
stellar mass loss at the cool end of the main sequence. Of course,
the relevance of these numbers presumes that the magnetic si-
phon process is highly efficient (Li et al. 1995), and that wind
mass loss is not strongly affected by the proximity of the white
dwarf or forced rotation of the secondary.

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\(^9\) A hot spot that covers only a small portion of the stellar disk would imply a
smaller distance and lead to a much lower implied mass transfer rate than we
estimate below.
In any case, it appears that a ∼40 MG magnetic field on a white dwarf in a very short period binary is sufficient to efficiently engineer the magnetic siphon that channels the stellar wind onto the poles.

Earlier work has characterized the low-\(M\) magnetic systems as pre-Polars because of the very low measured accretion rates, secondary stars that underfill their Roche lobes, and relatively cool white dwarfs (S05; Schmidt 2005; Webbink & Wickramasinghe 2005). While these arguments are compelling in general, there exists the possibility that one or more of the eight members cataloged to date are nearer the opposite evolutionary extreme. That is, they might be temporarily interrupted or even extinct Polars. A well-known example of the former is EF Eridani, which was a bona fide Polar until falling into a state of near-zero accretion in 1997 (Harrison et al. 2004 and references therein), and it has only been within the past year that EF Eri has been seen in an active state (Howell et al. 2006). In fact, with an orbital period of 81 minutes, a primary at \(T_{\text{wd}} = 9500\text{ K;}\) Beuermann et al. (2000), and a brown dwarf secondary star, EF Eri bears a striking resemblance to SDSS J1031+2028. If an interrupted Polar explanation is to be applied to a nearby low-\(M\) binary like SDSS J1553+5516 \((D \sim 130\text{ pc};\) S05), the current low state must have been in place for decades in order for the system to escape discovery as a variable star (e.g., AM Her, VV Pup) or a strong X-ray source in the all-sky surveys. The low-state duration would outstrip even that displayed by EF Eri. Because of accretion-induced heating (e.g., Townsley & Bildsten 2004), the interrupted Polar explanation should be less viable for the low-\(M\) magnetic binaries that contain cool white dwarfs. Examples like SDSS J1324+0320, SDSS J2048+0050 (both with \(T_{\text{wd}} \leq 7500\text{ K;}\) S05), and SDSS J1059+2727 \((T_{\text{wd}} < 8500\text{ K})\) are cooler than the coolest white dwarfs in Polars (Sion 1999; Araujo-Betancor et al. 2005). However, if we take the cooling curve of WZ Sagittae as a guide (Godon et al. 2006), any object that has been in a continuous low state for \(\geq 3\) yr can be considered to contain a white dwarf very near the evolutionary temperature for its age. This is especially true for magnetic accretion binaries, which tend to have below-average accretion rates for their orbital periods and spend a significant fraction of the time in states of weak accretion (Ramsay et al. 2004).

Ambiguity over the state of evolution need not impact claims of wind accretion, however, since \(H\)- and \(K\)-band brightness modulations during the protracted low-state of the interrupted Polar EF Eri also appear to require low-harmonic cyclotron emission from poles accreting in the bombardment regime (Harrison et al. 2004). In addition, the detached \(\sim 90\) minute period white dwarf + brown dwarf binary SDSS J121209.31+013627.7, whose primary has \(T_{\text{wd}} = 10,000\pm 1000\text{ K}\) and a dipolar magnetic field of \(B_p \sim 13\text{ MG}\) (Schmidt et al. 2005a), can be regarded as a system closely related to the low-\(M\) magnetic binaries, now that \(K\)-band photometry (Debes et al. 2006) has found evidence for cyclotron emission fed by a wind from the L7 companion. On the other hand, during the course of publication of this paper, Burleigh et al. (2006) reported the discovery of (weak) X-ray emission and optical light modulation from SDSS J1212+0136 that suggest it may be more closely related to the interrupted polar EF Eri than to pre-Polars.

SDSS J1212+0136 was originally identified as a binary from the presence of weak Balmer emission lines produced by radiative heating and/or activity at the secondary’s surface. Only white dwarf + brown dwarf systems with the combination of a reasonably hot primary star and short orbital period are likely to show this effect, and the difficulty in identifying white dwarf + brown dwarf pairs by any technique is well documented (e.g., Debes et al. 2005; Farihi et al. 2005). The discovery of the L7 component in SDSS J1212+0136 follows only GD 165 (DA + L3–4; Becklin & Zuckerman 1988) and GD 1400 (DA + L6; Farihi & Christopher 2004). While the relatively modest 13 MG magnetic field on SDSS J1212+0136 constrains the emitting low cyclotron harmonics to the IR, optical cyclotron emission induced by accretion of the stellar wind by a strongly magnetic white dwarf offers another, possibly sensitive avenue for identifying binaries with low-mass companions and periods up to several hours. With a thus-far undetected secondary, SDSS J1031+2028 may prove to be the such first example. Allowance for the efficiencies of surveys in discovering low-\(M\) magnetic systems and for the fraction of white dwarfs that are magnetic (e.g., Lieb et al. 2003; Kawka et al. 2003) should permit the statistics of magnetic samples to be extended to white dwarf + brown dwarf pairs without regard for magnetism.

Spectral synthesis and targeting simulations by S05 revealed that even sophisticated multicolor surveys like the SDSS are blind to several field strength regimes. When these selection effects were crudely taken into account, it was found that, even though the current sample is small in number, the space density of pre-Polars may be quite significant. Indeed, wind-accreting magnetic binaries are revealing mass transfer rates so low that not only are they virtually invisible in X-rays, but the cyclotron emission component is not much brighter than either of the stellar continua. Binaries with still lower accretion rates will eventually be lost in the stellar locus regardless of field strength and fail the spectroscopic targeting algorithms. When an accurate census is finally taken, wind-accreting magnetic binaries may actually prove to be more abundant than the classical X-ray-emitting, Roche lobe overflow Polars.

The authors are grateful to P. Smith for assistance at the telescope and J. Bochanski for helping to type the spectra of cool main-sequence stars. A. A. H. thanks the USNO Flagstaff Station Director for the time allocation on the USNOFS 1.3 m telescope. Funding for the SDSS and SDSS-II has been provided by the Alfred P. Sloan Foundation, the Participating Institutions, the National Science Foundation, the U.S. Department of Energy, the National Aeronautics and Space Administration, the Japanese Monbukagakusho, the Max Planck Society, and the Higher Education Funding Council for England. The SDSS Web Site is http://www.sdss.org/. The SDSS is managed by the Astrophysical Research Consortium for the Participating Institutions. The Participating Institutions are the American Museum of Natural History, Astrophysical Institute Potsdam, University of Basel, Cambridge University, Case Western Reserve University, University of Chicago, Drexel University, Fermilab, the Institute for Advanced Study, the Japan Participation Group, The Johns Hopkins University, the Joint Institute for Nuclear Astrophysics, the Kavli Institute for Particle Astrophysics and Cosmology, the Korean Scientist Group, the Chinese Academy of Sciences (LAMOST), Los Alamos National Laboratory, the Max-Planck-Institute for Astronomy (MPIA), the Max-Planck-Institute for Astrophysics (MPA), New Mexico State University, The Ohio State University, University of Pittsburgh, University of Portsmouth, Princeton University, the United States Naval Observatory, and the University of Washington. Support is provided by the NSF for the study of magnetic stars and stellar systems at the University of Arizona through grant AST 03-06080 and for cataclysmic variables at the University of Washington through AST 02-05875.
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