

Theoretical expectations for quiescent CV colors

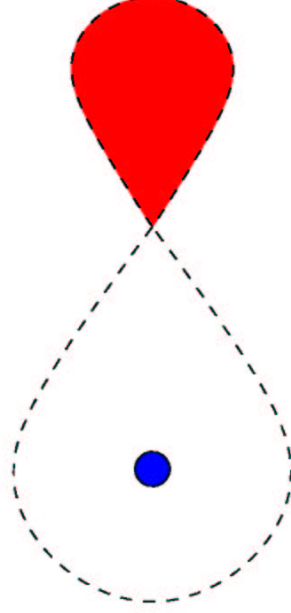
Dean Townsley

University of California, Santa Barbara

Advisor: Lars Bildsten, KITP, UCSB

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CV Light Components



Old: \dot{J}_{binary} = Gravitational Wave emission

Companion: Roche Lobe filling

Quiescent Light:

• **WD thermal**

• **Red companion**

Companion Evolution



Binary Evolution

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WD Thermal Component

Observed timescales in DN:

Disk Outburst: days-month
Between Outbursts: month-years

No accretion light in quiescent state, only WD thermal emission.

Ideally would like to predict

$$T_{\text{eff}}(M, \langle \dot{M} \rangle)$$

which would tie the WD evolution to that of the binary.

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Accreting WD Envelope

Envelope thermal time

$$\sim 10^3 \text{ yr}$$

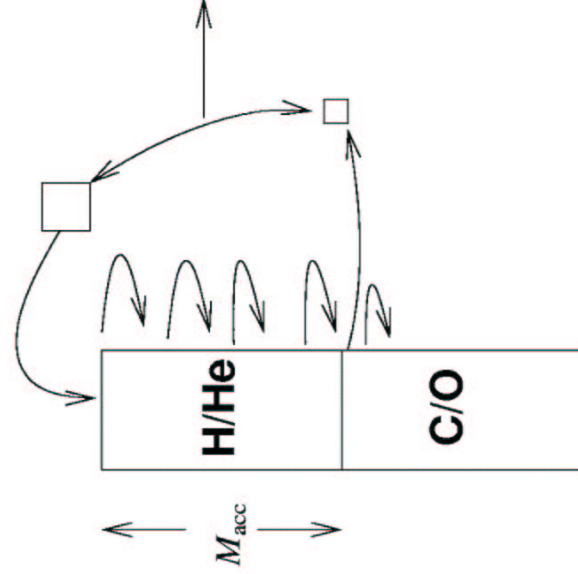
quasi-static envelope;
local derivatives give

$$L_{\text{env}} \sim gh \langle \dot{M} \rangle$$

$$\sim \langle \dot{M} \rangle \frac{kT_c}{\mu m_p}$$

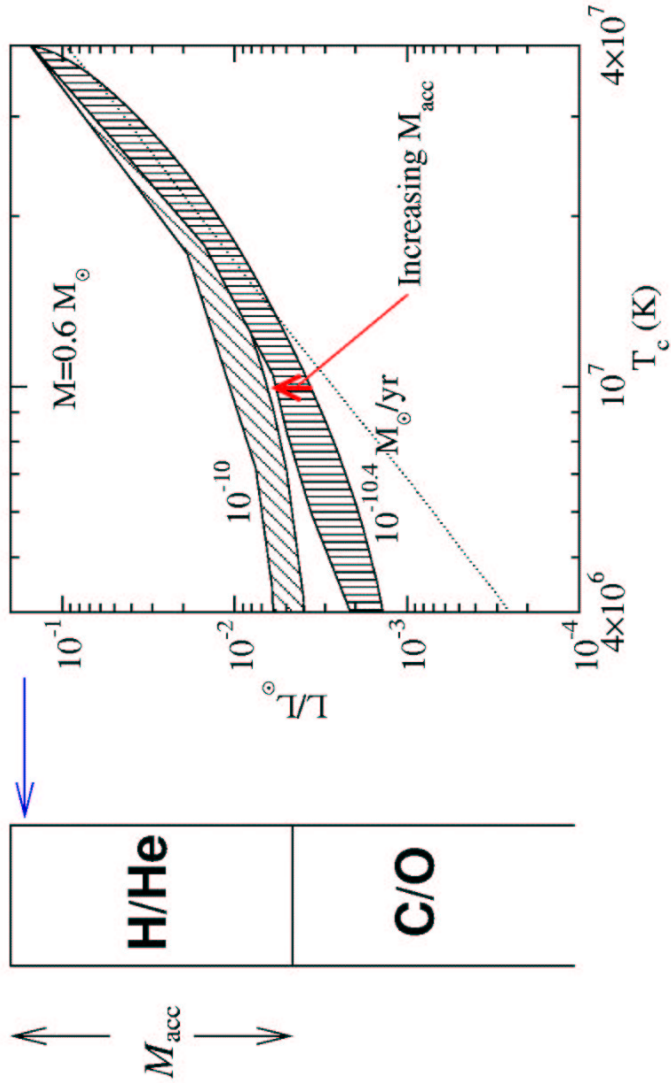
So actually:

$$T_{\text{eff}}(M, \langle \dot{M} \rangle, M_{\text{acc}}, T_c)$$



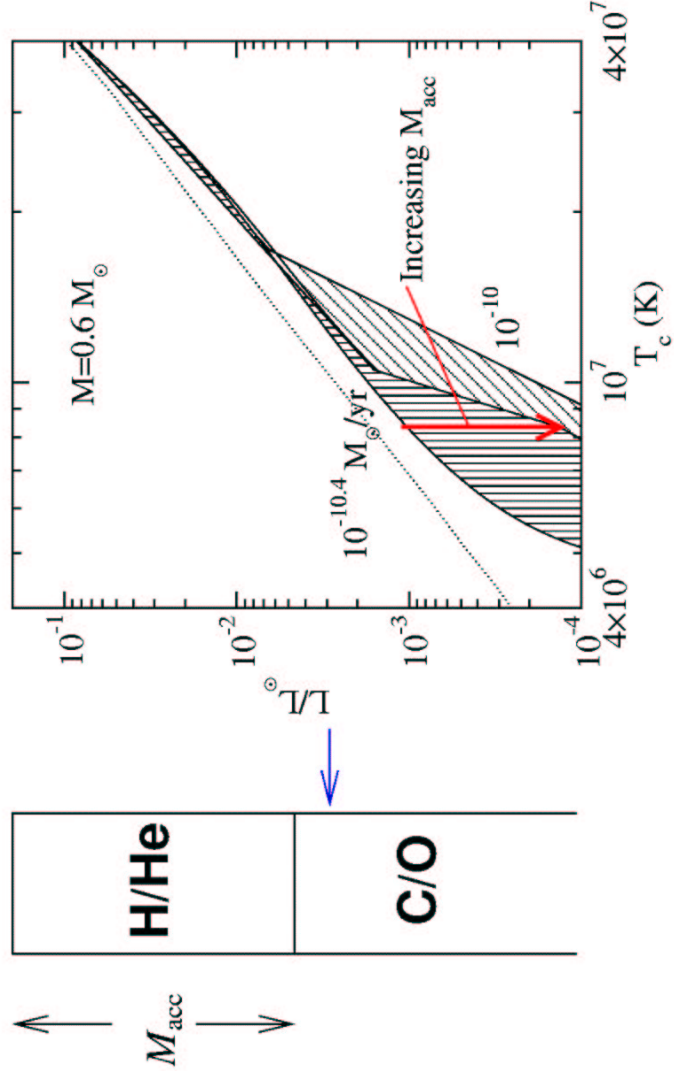
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T_{eff} dependence on T_c



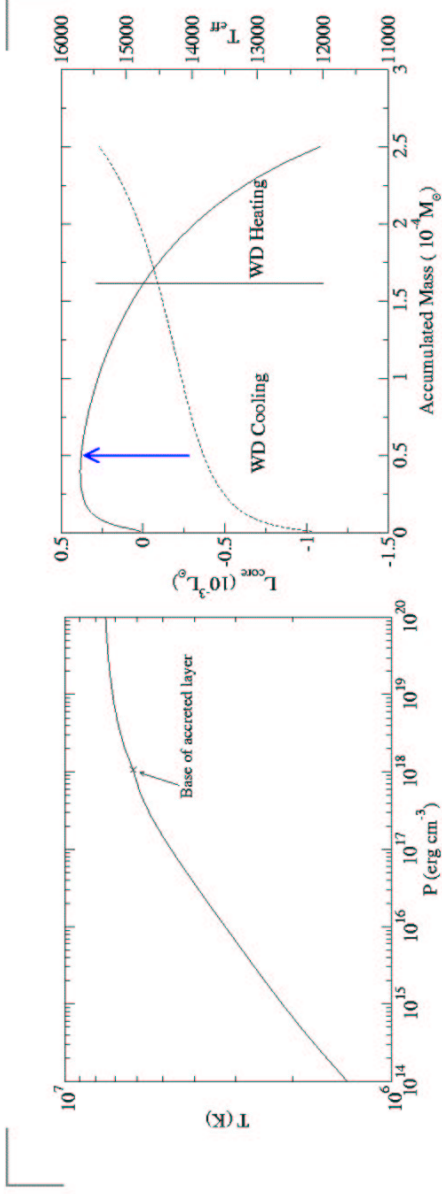
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L_{core} dependence on T_c



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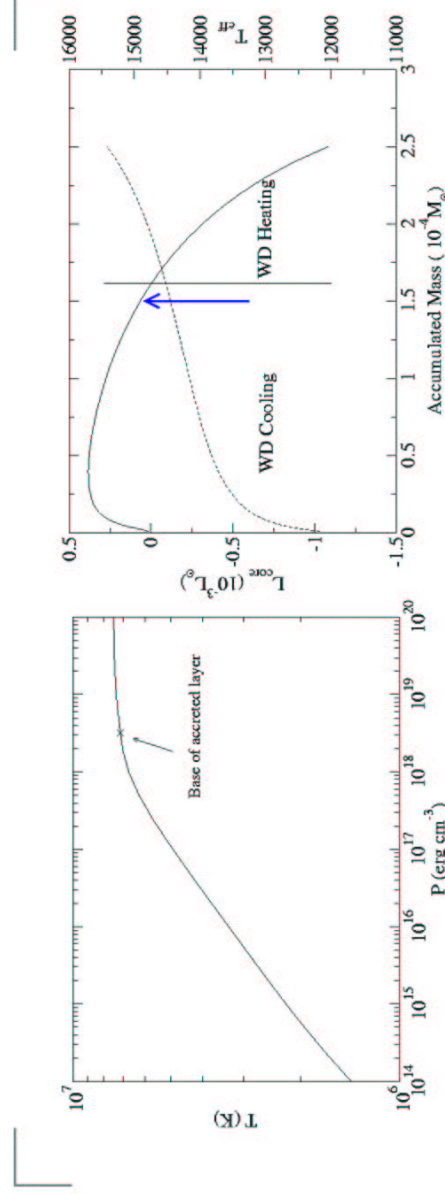
Cooling-Heating Cycle



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- Core will be **Reheated** until equilibrium is reached.
Core thermal time $\sim 10^8$ yr
- Thus we obtain $T_{\text{eff}}(M, \langle \dot{M} \rangle)$
→ WD T_{eff} tied to binary evolution.

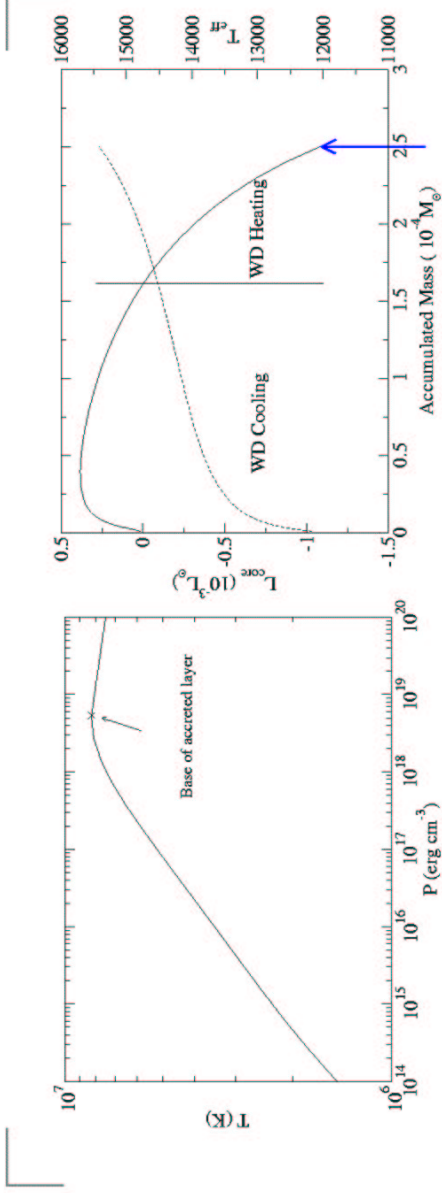
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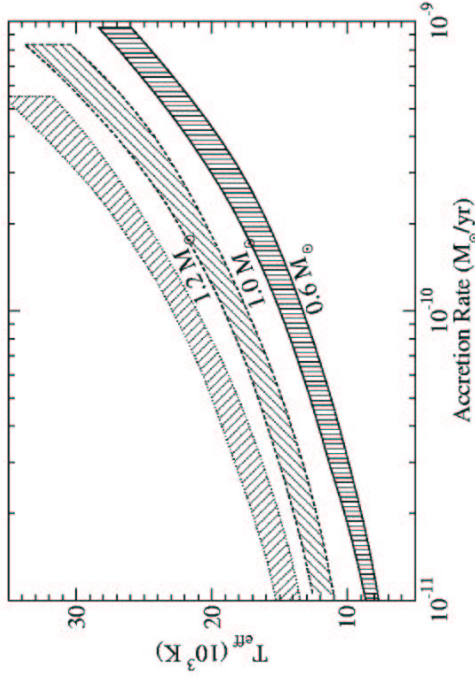
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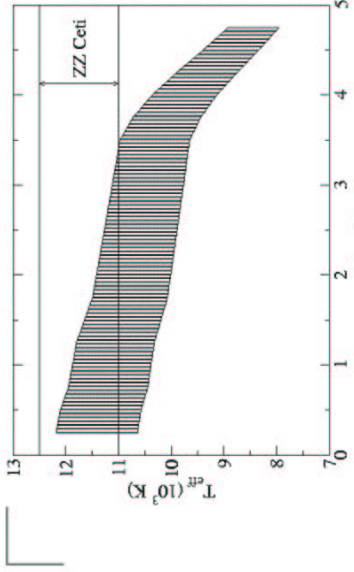
Predicted T_{eff}



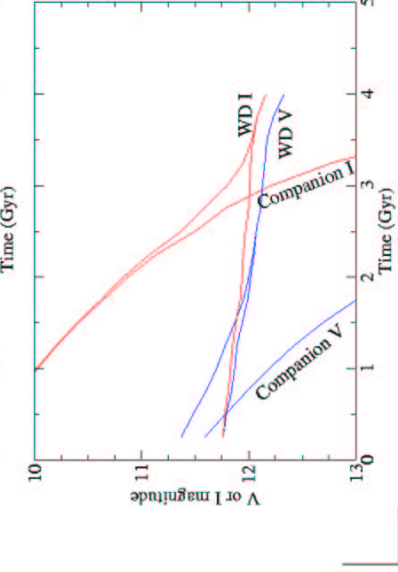
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Relates broadband fluxes for quiescent or hibernating CV systems to binary evolution.

T_{eff} Evolution



$M = 0.6 M_{\odot}$,
 \dot{J}_{binary} from grav. waves
 $\implies \langle \dot{M} \rangle (t)$
 (Kolb & Baraffe 1999, MNRAS, 309, 1034)



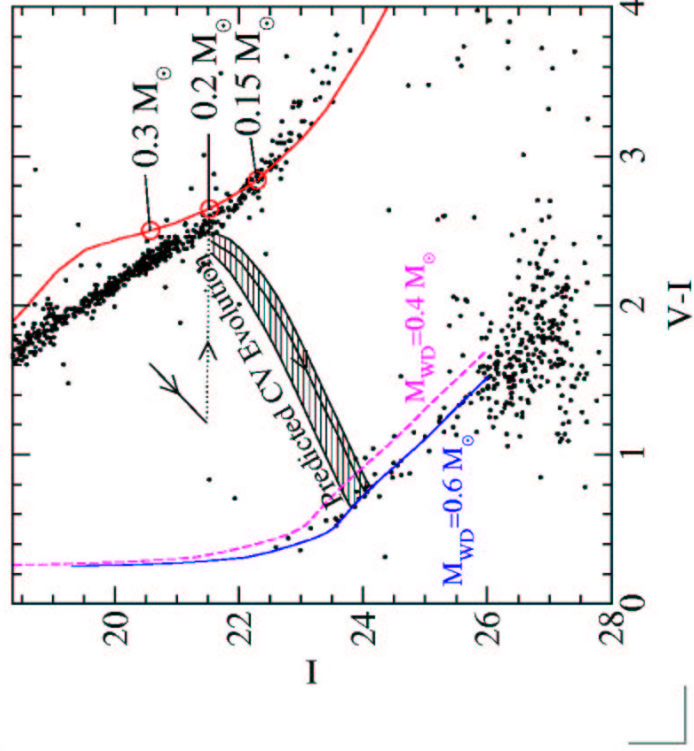
Transition from main sequence
 broadband fluxes to those of a
 WD.

Companion Mag. from
 (Brocato, Cassisi, & Castellani 1998, MNRAS,
 295, 711);
 WD Mag from
 (Bergeron, Wesemael, & Beauchamp 1995,
 PASP, 107, 1047)

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Old CV evolution on CMD

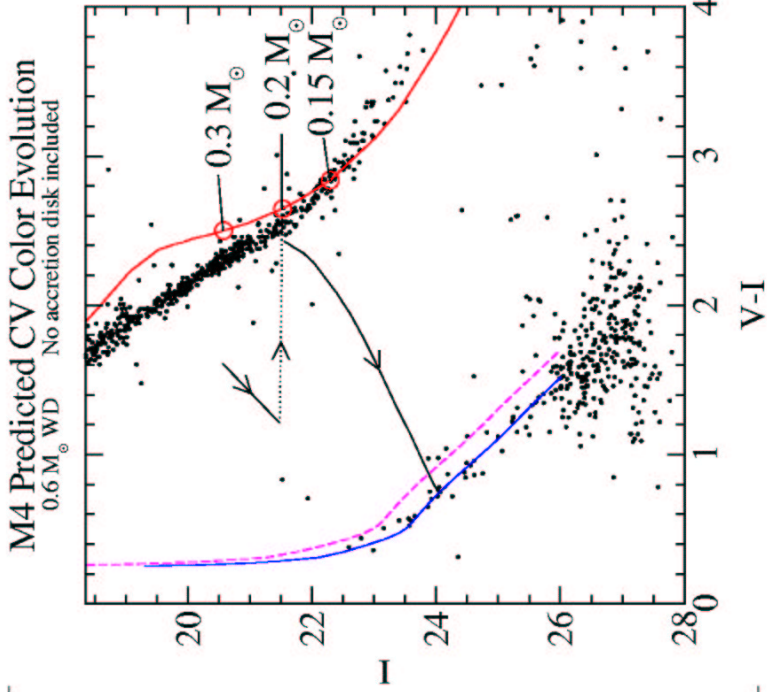
M4 Predicted CV Color Evolution
 0.6 M_{\odot} WD No accretion disk included



Proper-motion
 selected members
 of M4 at 4 core radii
 (Richer et al. 2002, ApJ, 574L,
 151)

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Old CV evolution on CMD

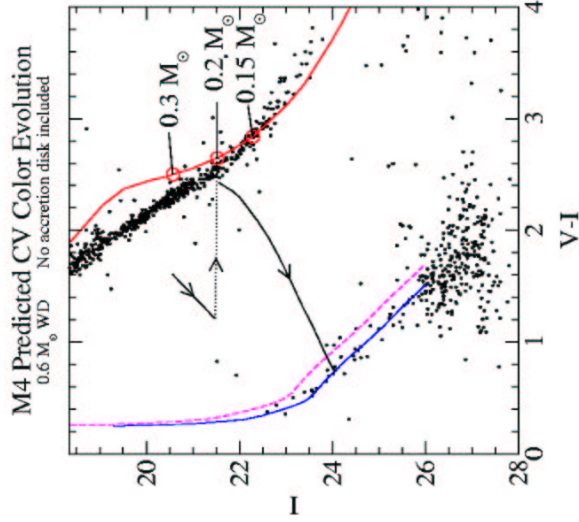


Proper-motion
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Conclusions:

- We predict quiescent CV
 WD $T_{\text{eff}}(M, \langle \dot{M} \rangle)$, allowing
 for additional observational
 constraints on the binary
- Reheated CV primaries
 intertwined with younger,
 isolated WDs
- Modern deep observations
 of GCs offer opportunity to
 study old CV population



GC03 - p.1171