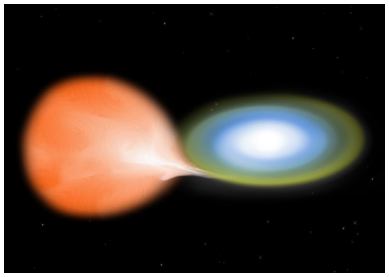
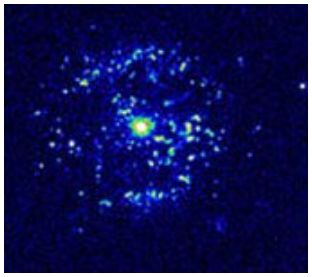
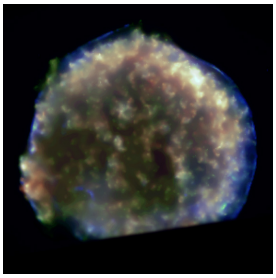
Classical Novae and Progenitors of Type Ia Supernovae



Cataclysmic Variable[1]



Nova T Pyx[2]



Tycho Supernova (X-ray)[3]

Type Ia supernovae are thought to arise from white dwarf stars (WDs) which gain mass until they reach the Chandrasekhar maximum mass. However, their relationship to the frequently observed mass-transferring binary star systems which contain a WD, called cataclysmic variables (CVs), remains obscure. By studying the various phenomena of accretion we can learn about the mass transfer history, WD mass history, and even birth conditions of these binaries. Several types of outburst other than the terminal supernova are observed, including classical nova outbursts caused by explosive hydrogen fusion on the WD surface and dwarf nova accretion disk instabilities.

The orbital period distribution of observed classical novae was calculated for the first time with a consistent interior WD state. This made it possible to quantify the two-component nature of this distribution, showing that, in terms of accretion rate, novae fall roughly into two distinct classes. High accretion rate systems account for 95% of outbursts, but the two classes contribute similar amounts of ejected mass to the interstellar medium due to the larger mass per outburst in the low accretion rate systems. For the first time the CV birth rate was calculated from the observed classical nova rate, providing an entirely new way to measure this important quantity. This birth rate is quite similar to the Type Ia supernova rate itself, giving one of the few observationally-based connections between accreting WDs and Type Ia supernovae. Study continues on what this implies for the CV and pre-CV binary mass and orbital period distributions.

Townsley, D. M. & Bildsten, L. "Classical Novae as a Probe of the Cataclysmic Variable Population", 2005 ApJ, 628, 395

Image credit: [1]NASA/CXC/M.Weiss, [2]HST, [3]Chandra.

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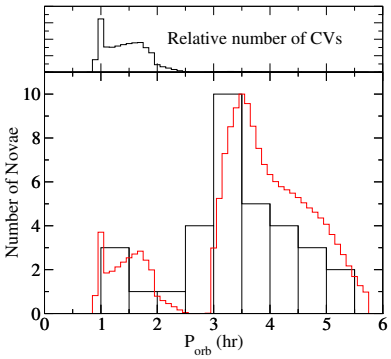
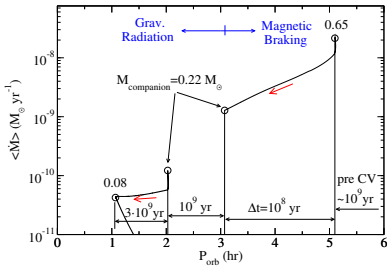
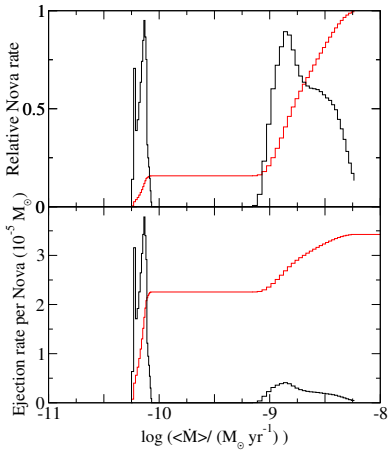


Comparison of theoretical and observed orbital period distribution for classical novae.



Mass transfer rate onto the white dwarf star in a cataclysmic variable binary, showing the various stages of evolution.



Comparison of classical nova outburst rate to matter ejection rate versus accretion rate $\langle \dot{M} \rangle$.

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