ABSTRACT BOOK

SUPERSOFT X-RAY SOURCES - NEW DEVELOPMENTS

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Swift observations of CSS081007:030559+054715

Beardmore, Andrew[1]; Osborne, Julian[1]; Page, Kim[1]; Schwarz, Greg[2]; Starrfield, Sumner[3]; Balman, Solen [4]; Hakala, Pasi[5]; Ness, Jan-Uwe[6];
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CSS081007:030559+054715 was discovered by the Catalina Real-time Transient Survey as an object which had brightened by 4 mag over a year. Optical spectroscopy revealed a multi-peaked H-α emission line profile with radial velocities exceeding 1500 km/s, as well as strong Ne emission, suggestive of a neon nova.

We have monitored the source extensively with the Swift satellite, obtaining a unique dataset spanning 130 days in the soft X-ray and UV bands. The data reveal a soft, blackbody-like spectrum with a temperature around 30 to 35 eV, variable X-ray and UV light curves with a 1.77 day period in both the X-ray and UV bands, and a slowly declining trend in the soft X-ray and UV flux.

We discuss the Swift observations fully and their implications for the SSS nature of this object.

The Outbursts of Classical and Recurrent Novae

Bode, Michael[1];
[1] *ARI, Liverpool JMU;*

In this talk I will give an overview of the state of our knowledge of the outbursts of Classical Novae and the related class of Recurrent Novae. Their study is important for furthering our understanding of a wide range of topics including accretion processes, nuclear astrophysics, rapid formation of dust, and the interaction of ejecta with circumstellar matter. Recurrent Novae in particular have also been proposed as potential progenitors of Type Ia supernovae.

Super Soft AGNs and their relations to Galactic binaries

Boller, Thomas[1];
[1] *MPE Garching, Germany;*

Supersoft Narrow-Line Seyfert 1 Galaxies, first detected with the ROSAT satellite and now with XMM-Newton, Suzaku and Chandra, exhibit many similarities with respect to supersoft Galactic sources. Especially the steep soft X-ray spectra of Galactic supersoft sources in their high state raises the question whether they are analogies to their extragalactic counterparts. I summarize our present knowledge on NLS1s and discuss pro and con's of a unique underlying physical process between Galactic and Extragalactic Super Soft Sources.

Comparison of X-ray bright states in the supersoft source RXJ0513.9-6951

Burwitz, Vadim[1]; Reinsch, Klaus [2]; Greiner, Jochen[1]; Walter, Frederick M.[3]; Mennickent, Ronald E.[4]; Meyer-Hofmeister, Emmi[5]; Rauch, Thomas[6];
[1] *Max-Planck-Institut für extraterrestrische Physik, Garching, Germany;* [2] *Institut für Astrophysik, Göttingen, Germany;* [3] *Department of Physics and Astronomy, SUNY at Stony Brook, USA;* [4] *Departamento de Fisica, Universidad de Concepción, Chile;* [5] *Max-Planck-Institut für Astrophysik, Garching, Germany;* [6] *Institut für Astronomie und Astrophysik, Tübingen, Germany;*

We discuss Chandra, XMM, and ROSAT target of opportunity observations of the accreting binary supersoft X-ray source RXJ0513.9-6951 in the LMC during its X-ray bright states. We analyse both the low and high spectral resolution data and compare the results with theoretical predictions from white dwarf atmosphere codes. The X-ray spectrum reveals complex structures which are probably a mixture of emission and absorption lines on a continuum. These features could be understood as X-ray emission from a hot high-gravity stellar atmosphere with the superposition of emission from an optically thin corona-like plasma that enshrouds the white dwarf. Also the temporal evolution of the X-ray bright phase will be discussed.

Optical Spectroscopy of Novae in M31

Di Mille, Francesco[1]; Bianchini, Antonio [1]; Ciroi, Stefano [1]; Orio, Marina[2,3]; Rafanelli, Piero[1];

[1] *Padova University;* [2] *INAF/Oapd;* [3] *University of Wisconsin at Madison;*

We report results of a spectrophotometric survey of novae in M31. The observations were carried out using the 1.82 m telescope of the INAF/Oapd at Asiago observatory and the TNG at La Palma. Low resolution spectroscopy of the novae, obtained mainly in the early decline phase, allowed us to classify the objects according the Tololo scheme (Williams 1992,AJ,104,725) . Since the M31 novae are currently monitored in X-rays, we are beginning to correlate the spectral type with X-ray turn-on and turn-off time of the supersoft X-ray source, testing the nova models. We will also discuss optimal observing strategies and synergies for future survey.

Chandra Observations of SSSs in Galaxies: What we have learned about Type Ia progenitors and intermediate-mass black holes

Di Stefano, Rosanne[1];

[1] *Harvard-Smithsonian Center for Astrophysics, Cambridge, MA 02138;*

The study of thousands of supersoft x-ray sources in a wide range of galactic environments has allowed us to establish the statistics of the class while at the same time identifying its most extreme and intriguing members. We will review what Chandra observations of 400 galaxies have taught us about the role supersoft sources play in generating Type Ia supernovae and in pointing the way to detailed tests of intermediate-mass black hole models.

Spectral Study of CAL87

Ebisawa, Ken [1]; Rauch, Thomas[2]; Takei, Dai[3];
[1] *JAXA/ISAS1;* [2] *University of Tuebingen;* [3] *Rikkyo University;*

We present spectral modeling of CAL87 observed with XMM-Newton and Chandra, following a provisonal study by ASCA which indicated a presence of the strong OVIII edge. The strong absorption edge was confimred more clearly with XMM CCDs, while numerous emission lines have been found with XMM and Chandra gratings which had not been resolved by CCD resolution. We consider the absorption edge is from the optically thick white dwarf atmosphere, while the emission lines are from optically thin Accretion Disk Corona (ADC). We apply the latest astomospheric model and corona model to the observed spectra, and try to constrain the system parameters.

The relation between VY Scl stars and supersoft X-ray sources

Greiner, Jochen [1];
[1] *MPE Garching, 85748 Garching, Germany;*

It has been conjectured that VY Scl stars during their optical low-states exhibit phases of supersoft X-ray emission. I will report on the attempts to verify this conjecture. After summarizing earlier (already published) indications, I will concentrate on the observing campaigns of V504 Cen and VY Scl.

A light curve model of the shortest supersoft X-ray source phase of V2491 Cygni

Hachisu, Izumi[1]; Kato, Mariko[2];
[1] *University of Tokyo, Tokyo, Japan;* [2] *Keio University, Yokohama, Japan;*

V2491 Cygni was detected as a transient supersoft X-ray source with the Swift XRT as early as 40 days after the outburst and it lasted only 10 days, the shortest one among novae ever detected, suggesting a very massive white dwarf (WD) close to the Chandrasekhar limit. We present a unified model of near infrared, optical, and X-ray light curves for V2491 Cyg, and have estimated, from our best-fit model, the WD mass to be 1.3 +- 0.02 M_sun with an assumed chemical composition of the envelope, X=0.20, Y= 0.48, X_CNO=0.20, X_Ne=0.10, and Z=0.02 by mass weight. We strongly recommend detailed composition analysis of the ejecta in X-ray because some enrichment of the WD matter suggests that the WD mass does not increase like in RS Oph, which is a candidate of Type Ia supernova progenitors. V2491 Cyg shows a peculiar secondary maximum in the optical light curve as well as V1493 Aql and V2362 Cyg. Introducing magnetic activity as an adding energy source to nuclear burning, we propose a physical mechanism of the secondary maxima. We also recommend search for magnetic activities in X-ray for these three novae even in quiescence.

Supersoft X-ray sources and classical novae in M 31 globular clusters

Henze, Martin[1]; Pietsch, Wolfgang[1]; Haberl, Frank[1]; Sala, Gloria[1]; Quimby, Robert[2]; Hernanz, Margarita[3]; Della Valle, Massimo[4]; Milne, Peter[5]; Williams, G. Grant[5]; Burwitz, Vadim[1];

[1] *Max-Planck-Institut für extraterrestrische Physik, D-85748 Garching, Germany;* [2] *University of Texas, Austin TX, 78712, USA;* [3] *Institut de Ciències de l'Espai (CSIC-IEEC), E-08193 Bellaterra, Spain;* [4] *European Southern Observatory (ESO), D-85748 Garching, Germany;* [5] *Steward Observatory, 933 North Cherry Avenue, Tucson, AZ 85721, USA;*

Classical novae (CNe) recently have been found to represent the major class of supersoft X-ray sources (SSSs) in our neighbour galaxy M 31.

We present the two first SSSs ever discovered in the M 31 globular cluster (GC) system. We have used XMM-Newton, *Chandra* and *Swift* observations of the centre region of M 31 to discover both SSSs and to determine X-ray light curves and spectra. We performed detailed analysis of XMM-Newton EPIC PN spectra of the source in the GC Bol 111 (SS1) using blackbody and NLTE white dwarf atmosphere models.

We identify SS1 with the CN M31N 2007-06b recently discovered in the M 31 GC Bol 111. For the SSS in the GC Bol 194 we used optical monitoring data to search for an optical outburst. We did not find evidence for a recent nova outburst and can only provide useful constraints on the time of the outburst of a hypothetical nova. We discuss the impact of our observations on the nova rate for the M 31 GC system.

X-ray observations of classical novae - Theoretical implications

Hernanz, Margarita[1];

[1] *Institut de Ciencies de l'Espai (CSIC-IEEC);*

Detection of X-rays from classical novae, both in outburst and post-outburst, provides unique and crucial information about the explosion mechanism. Soft X-rays reveal the hot white dwarf photosphere, whenever H-nuclear burning is still on, whereas harder X-rays give information about the ejecta and/or the accretion flow in the reborn cataclysmic variable. The duration of the supersoft X-ray emission phase is related to the turn-off of the classical nova, i.e., of the H-burning on top of the white dwarf core. A review of X-ray observations will be presented, with a special emphasis on the implications for the duration of post-outburst steady H-burning and its theoretical explanation. The particular case of recurrent novae (both the "standard" objects and the recently discovered ones) will also be reviewed, in terms of theoretical feasibility of short recurrence periods, as well as regarding implications for scenarios of type Ia supernovae.

Accreting white dwarfs as supersoft X-ray sources

Kato, Mariko[1];
[1]*Keio University, Japan;*

Accreting WDs become a transient supersoft X-ray source (SSXS) during the nova outburst (when the mass-accretion rate is smaller than a few times 1.E-7 M_sun/yr), a persistent SSXS with steady hydrogen burning (larger than a few times 1.E-7 M_sun/yr), or an intermittent SSXS like V Sge (with higher mass-accretion rates). In the most cases above, optically thick winds (Kato and Hachisu 1994) occur from the surface of the WD, which governs long term evolution of the binary system, i.e., the WD mass is decreasing or increasing toward an SN Ia explosion.

For nova outbursts, the main emitting wavelength region of radiation shifts from optical to ultraviolet, and finally to supersoft X-ray. These timescales including X-ray turn on/off times are determined by the strength of optically thick winds which strongly depends on the WD mass and secondary on the chemical composition of the envelope. Therefore, multiwavelength observations including X-ray are the best way to estimate WD mass and examine whether or not its WD mass is growing.

Outburst properties of AM CVn stars

Kotko, Iwona[1]; Dubus, Guillaume[2,3]; Lasota, Jean-Pierre [1,3];
[1]*Astronomical Observatory, Jagiellonian University;* [2]*Laboratoire d'Astrophysique de Grenoble;* [3]*Institut d'Astrophysique de Paris;*

Helium discs of AM CVn stars are subject to a thermal-viscous instability similar to that driving dwarf-nova outbursts. We will show how abundances and disc sizes affect the stability criteria and outburst properties.

SSS in young stellar populations: progenitors of the "prompt" SNe Ia?

Nelson, Thomas[1]; Orio, Marina[2,3]; Di Mille, Francesco [4]; Gallagher, Jay [3]; Harbeck, Daniel[5];
[1] *CRESST/UMBC/GSFC, Greenbelt, USA;* [2] *INAF OAPD, Padova, Italy;* [3] *University of Wisconsin, Madison, USA;* [4] *Universita di Padova, Padova, Italy;* [5] *NOAO, Tucson, USA;*

We will present the results of a multiwavelength search for the counterparts of the SSS population in the nearby galaxy M31 using UV and optical data. We find that only a small subset (∼20%) of M31 SSS have a candidate UV counterpart within the X-ray spatial error circle. Follow up spectroscopic and photometric observations have revealed that a number of these UV sources are B or Be stars in M31, providing further evidence that some SSS are a phenomenon of young stellar populations. We argue that these young systems can appear as SSS if there is an unseen accreting white dwarf companion which experiences a thermonuclear runaway on its surface. We will discuss the possibility that these sources are the progenitors of the so-called "prompt" component of SNe Ia that seems to occur within 10^8 yrs of an episode of star formation.

The SSS phase of the Classical Nova V2491 Cyg

Ness, Jan-Uwe[1];
[1] *ESAC;*

The Classical Nova V2491 Cyg has been observed twice with XMM-Newton during the supersoft source phase, and the RGS count rate was 13.2 on day 39.9 after outburst and 2.5 cps on day 49.7. The SSS spectra of novae are much brighter than those of the canonical SSSs, yielding more detailed information. In the grating spectra of V2491 Cyg, deep absorption lines from oxygen and nitrogen appear which are shifted by 3200 km/s. Furthermore, the interstellar lines of OI and NI can be identified. A number of unidentified absorption lines are present. Models to the SSS spectra are not trivial, and the expanding nature of the atmosphere has to be taken into account.

A Census of Supersoft X-ray Sources in M31

Orio, Marina[1]; Nelson, Thomas[2];
[1] *INAF-Padova (Italy) and University of Wisconsin (USA);* [2] *CRESST/UMBC/GSFC, Greenbelt, USA ;*

I will present the census of supersoft X-ray sources in M31. Out of about 90 sources, 8 supernova remnants, 1 background AGN and 19 classical or recurrent novae have been identified. I will present evidence that up to half of the sources may be classical or recurrent novae. What are the other sources? Only about 10% of them resemble systems like Cal 83, and I will describe three of them in all the known details. Up to 20% of the sources are associated instead with star forming regions, and may be high mass X-ray binaries (HMXB). Are they a new type of HMXB containing a massive white dwarf? The subject will be continued in Thomas Nelson's talk. I will also present a comparison between novae as supersoft X-ray sources in the Galaxy and in M31.

Swift observations of supersoft emission from novae

Osborne, Julian[1]; Page, Kim[1]; Beardmore, Andrew[1]; Ness, Jan-Uwe[2]; Bode, Michael[3]; Schwarz, Greg[4]; Starrfield, Sumner[5];
[1] *University of Leicester, GB;* [2] *ESAC, ESA;* [3] *Liverrpool John Moores University, GB;* [4] *West Chester University, USA;* [5] *Arizona State University, USA;*

Swift has made a major contribution to the study of novae in recent years by the expenditure of over 150 ksec on each of four novae with strong super-soft X-ray emission (RS Oph, V458 Vul, V2491 Cyg & CSS 081007). These studies have revealed both massive variability and periodic modulations. The super-soft X-ray phase turn-off time of eight novae has also been measured. I will describe the rich phenomenology of the nova super-soft phase, and consider potential explanations for the behaviour seen.

X-ray emission from optical novae in M 31

Pietsch, Wolfgang [1];
[1] *Max Planck Institut für extraterrestrische Physik;*

The first M 31 supersoft source (SSS) identification with an optical nova was based on ROSAT observations. In a search for X-ray counterparts of optical novae in M 31 and M 33 using archival ROSAT, XMM-Newton and Chandra observations obtained before July 2002 we detected 20 additional candidates in M 31 (mostly identified as SSS by their hardness ratios). This proved that optical novae constitute the major class of SSS in M 31. Analysing archival Chandra HRC-I and ACIS-I observations obtained from July 2004 to February 2005 we could demonstrate that M 31 nova SSS states lasted from months to about 10 y. Several novae showed short X-ray outbursts starting within 50 d after the optical outburst and lasting only two to three months. The number of optical novae detected in soft X-rays was more than 30%. We also will report results of dedicated XMM-Newton/Chandra monitoring programs covering the central area of M 31 (complemented by SWIFT TOO observations) to search for optical nova counterparts. Several new nova counterparts were detected, some of them with very short SSS phases. Together with optical information the SSS light curves can be used to estimate the mass of the white dwarf, of the ejecta and the burned mass in the outburst.

Supersoft X-ray sources and the progenitors of Type Ia supernovae

Podsiadlowski, Philipp[1];
[1] *University of Oxford, Oxford, UK;*

Type Ia supernovae (SNe Ia) have been used successfully as cosmological distance probes, although the nature of their progenitors is still not understood. In this talk I summarize our present understanding of SN Ia progenitors and some of the key issues in this debate. Supersoft sources are one of the most promising progenitors, at least for relatively prompt SNe Ia. I review some of the key problems with the supersoft scenario and possible observational tests thereof.

Evolutionary Scenarios of SSSs: the Current State of Affairs

Politano, Michael[1];
[1] *Dept. of Physics, Marquette Univ., Milwaukee, Wisconsin, U.S.A.;*

I briefly review the current evolutionary scenarios for supersoft X-ray sources. I identify what I believe are important unresolved questions in understanding their formation and evolution and I suggest future observations that may be helpful in providing answers to these questions.

Non-LTE model atmospheres for super soft X-ray sources

Rauch, Thomas[1]; Klaus, Werner[1];
[1] *Institute for Astronomy and Astrophysics, Tübingen, Germany;*

In the last decade, X-ray observations of hot stellar objects became available with unprecedented resolution and S/N ratio. For their adequate interpretation, fully metal-line blanketed Non-LTE model-atmosphere are necessary. The Tübingen Non-LTE Model Atmosphere Package (TMAP) can calculate such model atmospheres at a high level of sophistication.

Although TMAP is not especially designed for the calculation of spectral energy distributions (SEDs) at extreme photospheric parameters, it can be employed for the spectral analysis of burst spectra of novae like V4743 Sgr or line identifications in observations of neutron stars with low magnetic fields in low-mass X-ray binaries (LMXBs) like EXO 0748−676.

V5116 Sgr: a disc-eclisped SSS post-outburst nova?

Sala, Gloria[1]; Hernanz, Margarita[2]; Ferri, Carlo[2]; Greiner, Jochen[3];
[1] *UPC-IEEC;* [2] *CSIC-IEEC;* [3] *MPE;*

The Nova V5116 Sgr 2005 No. 2, discovered on 2005 July 4,was observed with XMM-Newton in March 2007, 20 months after the optical outburst. The X-ray spectrum showed that the nova had evolved to a pure supersoft X-ray source, indicative of residual H-burning on top of the white dwarf. The X-ray light-curve shows abrupt decreases and increases of the flux by a factor 8 with a periodicity of 2.97 h, consistent with the possible orbital period of the system. The EPIC spectra are well fit with an ONe white dwarf atmosphere model, with the same temperature both in the low and the high flux periods. This rules out an intrinsic variation of the X-ray source as the origin of the flux changes, and points to a possible partial eclipse as the origin of the variable light curve. The RGS high resolution spectra show a number of absorption and emission features, some of them evolving between the low and the high states. Swift monitoring showed the SSS decline in June 2008. A new XMM-Newton observation in March 2009 can provide a final test on the origin of the variability in this SSS nova.

XMM monitoring of the state transition of the transient supersoft source CAL 83

Schwarz, Robert[1]; Greiner, Jochen [2];
[1] *Astrophysikalisches Institut Potsdam;* [2] *MPE Garching;*

CAL 83 is the canonical close-binary supersoft X-ray source and also among the two rare systems to show repeated on/off X-ray states. These systematic changes are anti-correlated with the optical brightness and closely connected to dynamical processes occuring at near Eddington accretion rates. We present results of an optically triggered XMM monitoring campaign of CAL 83 following its evolution through different phases of the state transition. Contrary to the regular and quasi-periodic variation of RXJ0513-69, the variability pattern of CAL 83 is much more complex showing intermediate brightness states and temporary re-brightenings. This is also reflected by the X-ray variability of the source, which instead of a simple on/off pattern, displays a wide luminosity range. Low-resolution X-ray spectra during the intermediate brightness state can be well fitted by blackbodys. There is indication for a correlation of the blackbody temperature with the observed X-ray flux. Such temperature changes are expected for limit-cycle models that include variations of the effective radius of the white dwarf. We find no evidence for absorption in the X-ray spectra, which would support models that propose the existence of a strong variable wind.

Quasi-Steady Shell Burning in Symbiotic Binary Stars

Sokoloski, Jennifer[1];
[1] *Columbia Astrophysics Laboratory;*

Although only a handful of symbiotic stars produce X-ray emission with the characteristic supersoft spectrum, most of the known symbiotics are nonetheless powered by quasi-steady thermonuclear burning on the surface of an accreting white dwarf. I will review the evidence for nuclear shell burning in symbiotic stars as well as the similarities and differences among symbiotic stars and classical supersoft sources. In this context, I will examine several topics relevant to the presence of quasi-steady burning in symbiotic stars – the nature of symbiotic-star outbursts, the relationship between shell burning and jet production, magnetic accretion onto a white dwarf with quasi-steady shell burning, and the supernova Ia progenitor status of symbiotic stars.

SSSs in M 31: Comparing the XMM-Newton Deep Survey, ROSAT and Chandra catalogues

Stiele, Holger[1]; Pietsch, Wolfgang[1]; Haberl, Frank[1]; for the XMM-Newton, M 31 large program collaboration;
[1] *MPE Garching;*

To investigate the transient nature of supersoft sources (SSSs) in M 31, we compared SSS candidates of the XMM-Newton Deep Survey, ROSAT PSPC surveys and the Chandra catalogues in the same field.

We found 43 SSSs in the XMM-Newton observations. While 12 of the XMM-Newton sources were brighter than the limiting flux of the ROSAT PSPC survey, two were detected with ROSAT ∼10 yr earlier. Five correlate with recent optical novae which explains why they were not detected by ROSAT.

The remaining 31 XMM-Newton SSSs have fluxes below the ROSAT detection threshold. Nevertheless we found four correlations with ROSAT sources which had significantly larger fluxes than during the XMM-Newton observations.

Ten of the XMM-Newton SSSs were detected by Chandra with <1–∼6 yr between the observations. Five were also classified as SSSs by Chandra.

Of the 30 ROSAT SSSs three were confirmed with XMM-Newton, while for 11 sources other classifications are suggested. Of the remaining 16 sources one correlates with an optical nova.

Of the 42 Chandra very-soft sources five are classified as XMM-Newton SSSs, while for 22 we suggest other classifications. Of the remaining 15 sources, nine are classified as transient by Chandra, one of them correlates with an optical nova.

Study of super-hard X-ray emission from the classical nova V2491 Cygni

Takei, Dai[1]; Tsujimoto, Masahiro[2]; Kitamoto, Shunji[1]; Ness, Jan-Uwe[3]; Drake, Jeremy[4]; Takahashi, Hiromitsu[5];
[1] *Rikkyo University;* [2] *ISAS/JAXA;* [3] *ESA/ESAC;* [4] *SAO;* [5] *Hiroshima University;*

We report the discovery of super-hard X-ray emission from classical novae V2491 Cygni with a ToO observation of Suzaku (Takei et al. 2009, ApJL, submitted). V2491 Cygni was discovered in April 2008 (Nakano et al. 2008). Initial Swift observations showed a hard spectrum (Kuulkers et al. 2008). The nova is peculiar for its pre-nova X-ray activity (Ibarra et al. 2009) and a secondary peak in the optical light curve, which infers a magnetic nature of the white dwarf (Hachisu & Kato 2009). We conducted ToO observations 9 and 29 days after the outburst with Suzaku. As a result, a super-hard continuum emission extending up to 70 keV was detected on day 9, but it was not present on day 29. This is the highest energy at which X-rays have been detected from a classical nova. The spectrum is well fitted by a flat (photon index of 0.1) power-law model, but not by a thermal bremsstrahlung model with a reasonable temperature. The power-law emission indicates the presence of an accelerated population of electrons with a non-thermal energy distribution. The extremely flat photon index is too hard for standard diffusive shock acceleration, suggesting that other mechanisms might take place.

Expanding atmosphere models for SSS

van Rossum, Daan[1];
[1] *Hamburger Sternwarte, Hamburg, Germany;*

SSS spectra taken with the X-ray gratings XMM-Newton/RGS or Chandra/LETGS reveal complex detail of the sources. With the help of model atmospheres, these spectra allow to find sensible constraints to the physical conditions of the expanding nova ejecta. However, present model fits with hydrostatic white dwarf model atmospheres show strong absorption edges which are absent in the observations. In such models the important aspect of the expansion is neglected. We present expanding atmosphere models that are capable of explaining the absence of absorption edges of CVI, OVII, and NVI without the need to reduce the elemental abundances. The models demonstrate the impact of expansion, and we call for caution with the interpretation of static white dwarf model fits to the SSS spectra.

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