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Soft X-ray emission from the classical nova AT 2018bej

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We performed a spectral analysis of the supersoft X-ray phase of the classical nova AT 2018bej in LMC, which was observed in X-rays by the *eROSITA* and *XMM-Newton* telescopes. To describe the spectrum we calculated high-gravity hot LTE model atmospheres of hot WDs with chemical compositions typical for nova SSS phases, focusing specifically on carbon abundance. The code developed by Suleimanov et al. (2024), which is based on the Kurucz's `ATLAS` code (Kurucz, 1970), was used for this aim. The $0.3-0.6\,\mathrm{keV}$ analysis yields a WD temperature $T_{\rm eff}\sim 600\,\mathrm{kK}$, gravity $\log g\sim 8.3-8.4$ and a WD radius $R\sim 8000-8700\,\mathrm{km}$, which gives luminosity $L\sim 6-6.5\times10^{37}\,\mathrm{erg/s}$. The derived WD mass is estimated to be $\sim 1.1\,M_\odot$. We traced a minor evolution of the source on a half-year timescale accompanied by a decrease in carbon abundance, decrease in temperature and increase in radius, and concluded that LTE model atmospheres are applicable for analysing X-ray spectra of classical novae during their SSS stage.

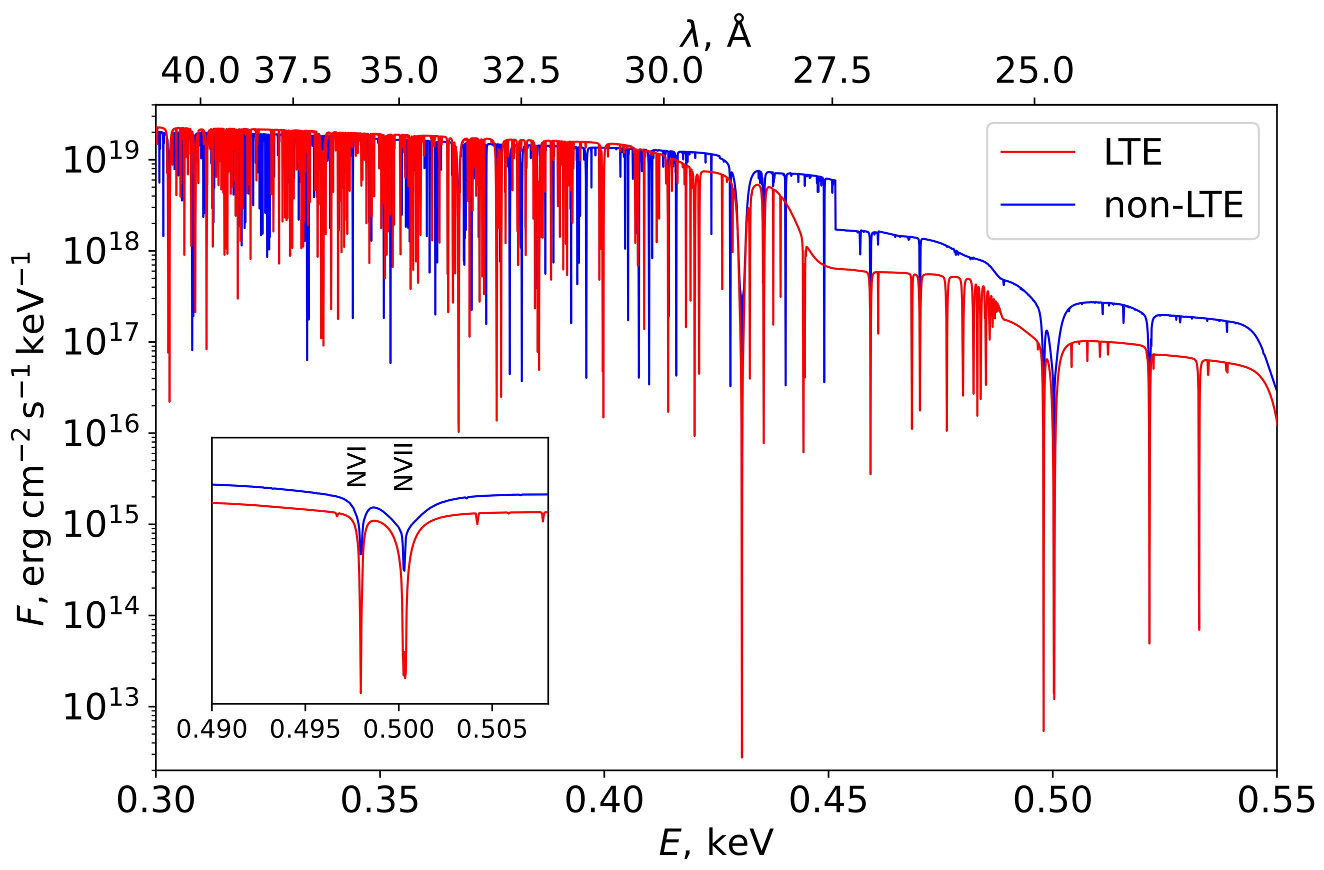

Figure 1: *Comparison of the model atmospheres spectra computed by our code (in red) and the* `TMAP` *non-LTE code (Rauch et al., 2010, in blue). Both models have* $T_{\rm eff}=600\,\mathrm{kK}$, $\log g=9$. *The chemical composition corresponds to model 006 from Rauch's grid.*

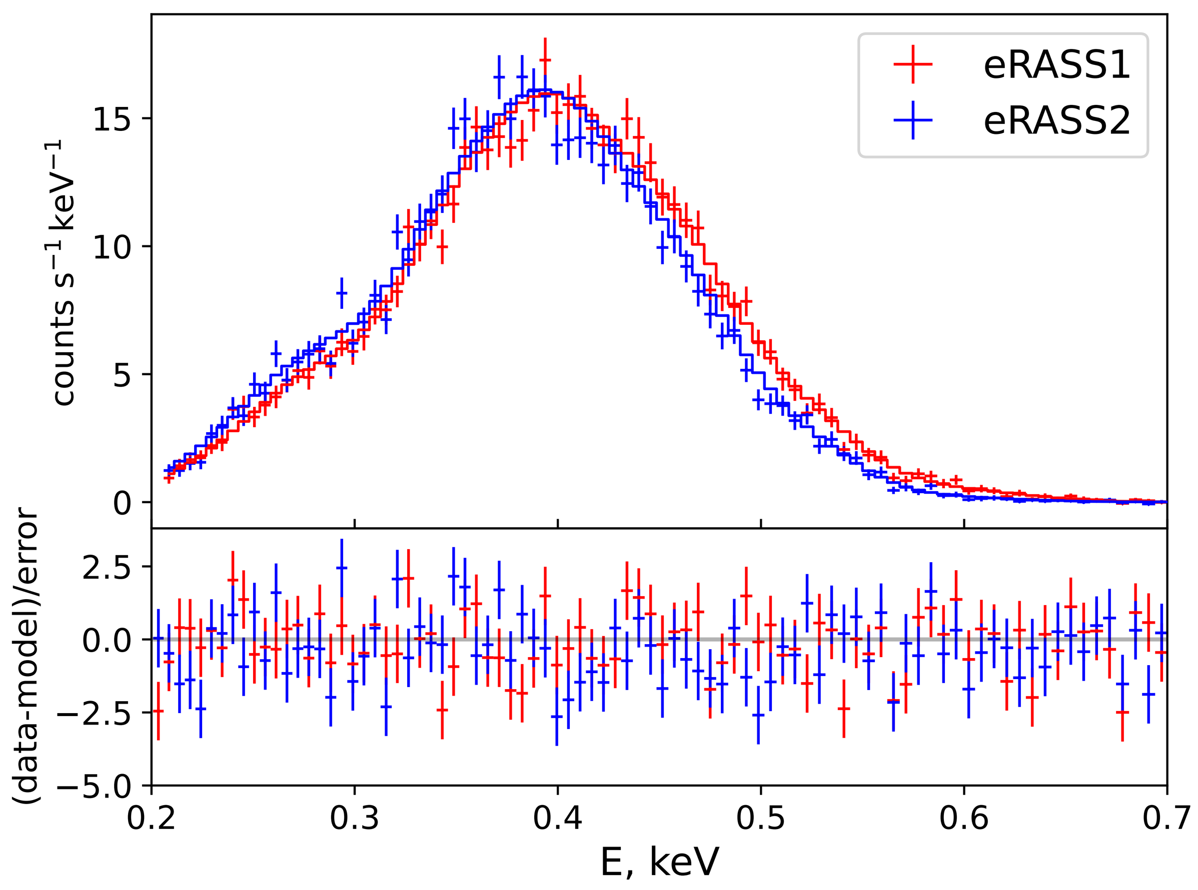

Figure 2: *Model atmosphere best-fit of the eROSITA eRASS1 (in red) and eRASS2 (in blue) spectra.*

Table 1: *Spectral parameters of the LTE model fit for AT 2018bej.*

	XMM^a	eRASS1^c	eRASS2^c
$N_{\rm H}$, $10^{20}\,\mathrm{cm}^{-2}$	5.88^a	$5.83^{+0.14}_{-0.16}$	
$T_{\rm eff}$, kK	604 ± 1	578^{+14}_{-11}	554^{+8}_{-11}
$M/M_\odot$	1.39 ± 0.01	$1.07^{+0.08}_{-0.11}$	
R^b, km	8038^{+43}_{-42}	9541^{+601}_{-750}	10393^{+678}_{-514}
L, $10^{37}\,\mathrm{erg\,s^{-1}}$	6.1 ± 0.1	$7.3^{+1.2}_{-1.3}$	$7.3^{+1.0}_{-0.9}$
$\log g$	8.46 ± 0.01	$8.19^{+0.06}_{-0.08}$	$8.12^{+0.07}_{-0.06}$
$\Delta\log g$	0.51 ± 0.01	$0.33^{+0.08}_{-0.09}$	0.33 ± 0.07
$A_{\rm C}$, sol	0.27 ± 0.01	0.21 ± 0.04	0.16 ± 0.04
$A_{\rm N}$, sol	1.14 ± 0.03	1.30 ± 0.11	1.44 ± 0.11
`cstat` (dof)	7019.75 (3324)	272.91 (252)	

Notes: (a) – hydrogen column density $N_{\rm H}$ is fixed; (b) – the distance to the LMC is assumed to be $50\,\mathrm{kpc}$; (c) – eRASS1 and eRASS2 spectra were fitted simultaneously with a common WD mass M parameter.

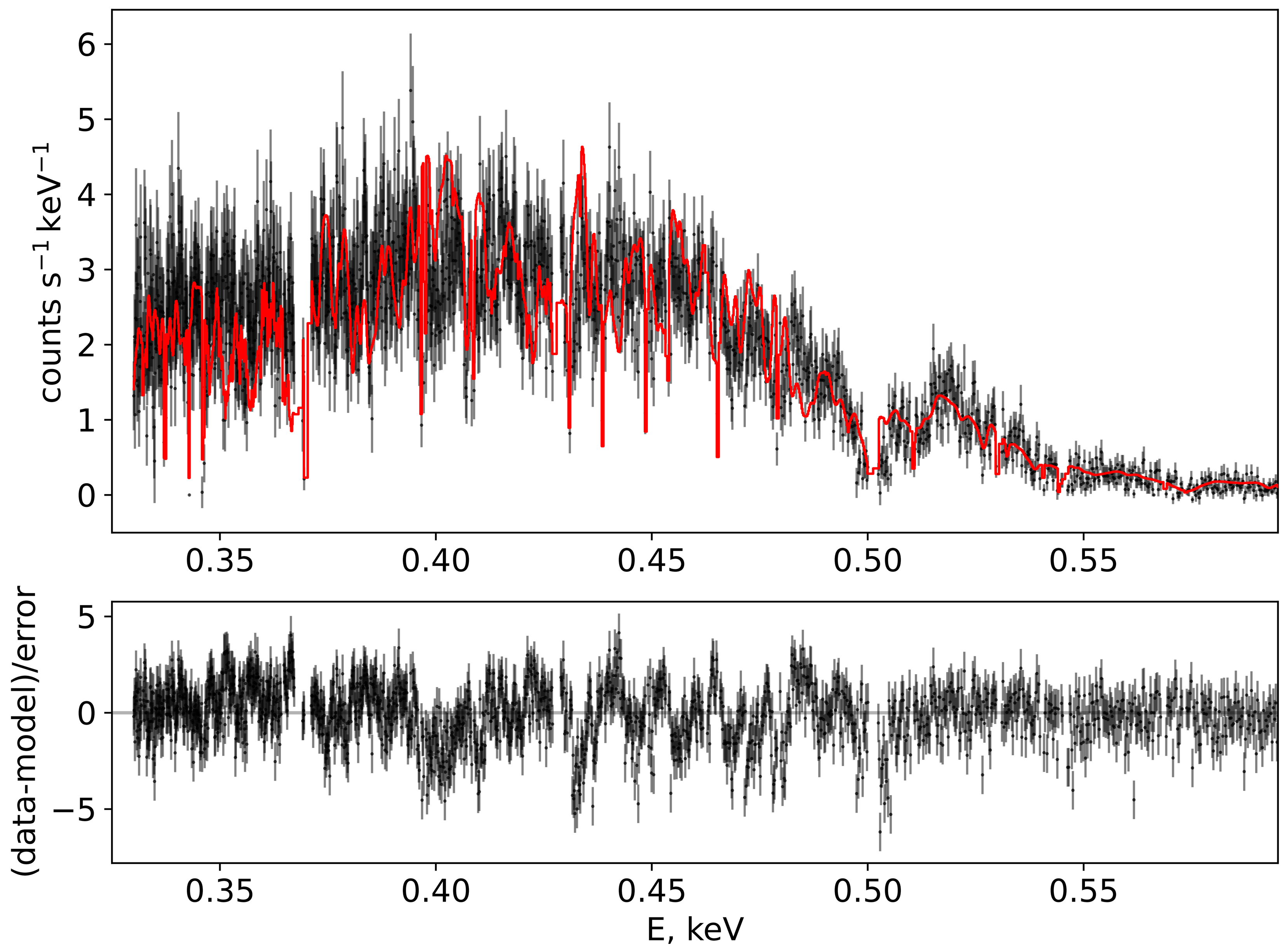

Figure 3: *The XMM-Newton RGS spectrum together with best-fit LTE model. Shown is spectrum of RGS1 instrument. The hydrogen column density is fixed at* $N_{\rm H}=5.88\times10^{20}\,\mathrm{cm}^{-2}$.

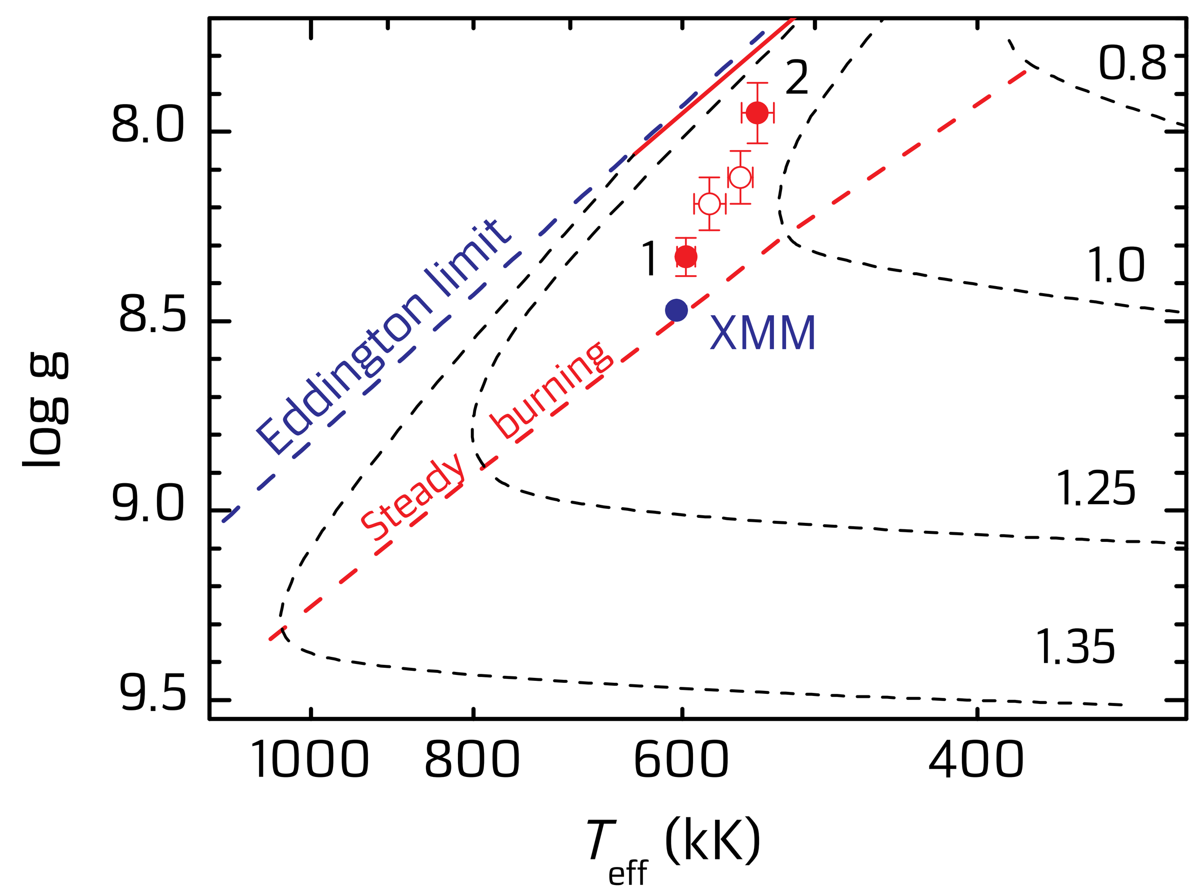

Figure 4: *Positions of the source in the* $T_{\rm eff}-\log g$ *plane according to different eRASS observations (red circles with the number 1 and 2), and according to joint fit (red empty circles). The XMM spectrum fit with fixed* $N_{\rm H}$ *is shown by blue circle. Model dependencies for various WD masses, taken from Nomoto et al. (2007), are shown by black dashed curves. The lower boundary of the stable thermonuclear burning band is shown by the dashed red line.*

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