X-RAY SPECTROSCOPY OF COMETS WITH CHANDRA X-RAY OBSERVATORY: COMPARISON OF RESULTS. V. A. Krasnopolsky, Department of Physics, Catholic University of America, 620 Michigan Avenue, N.E., Wahington, DC 20064, USA, vkrasn@verizon.net

Introduction: CXO observations resulted in significant progress in x-ray spectroscopy of comets. Except original publications by the observers, four observed comets were studied by Krasnopolsky [1, henceforth K06], and all eight comets were analyzed by Bodewits et al. [2, henceforth B07]. Here we will compare the results of those papers.

Methods. Background-corrected spectra are χ^2-fitted in K06 using a model with line energies and intensities as free parameters. Then the detected lines are converted into fluxes of the solar wind ions using excitation cross sections. B07 apply χ^2-fitting by synthetic spectra with fluxes of the solar wind ions as free parameters. Both approaches are reasonable.

The CXO count rate at the main chip S3 varied from 1.5 cts s^{-1} for comet 1999 S4 to 0.15 cts s^{-1} for comet Encke, and the background rate is 0.24 cts s^{-1}. The background typically exceeds the signal at 700-1000 eV and should be carefully subtracted.

Background spectra in B07 are taken from a chip that was not pointed to the observed comet and not completely identical to the main chip. K06 assumes a uniform background over the main chip while the signal is much higher near the chip center. The background subtraction in K06 resulted in a significant loss in the count statistics but accurate spectra at 700-1000 eV. The observed spectra extend to 150 eV and are analyzed in full by K06 and down to 300 eV in B07.

B07 adopt theoretical velocity-dependent ion cross sections in collisions with H for all cometary species and unperturbed velocities of the solar wind in comets. K06 used the measured ion cross sections in collisions with H_2O at 700 km s^{-1} and a synthetic spectrum and oxygen line distribution from [3]. B07 involved dissociation of H_2O and OH. However, velocities of H are very high after the events, and the correction for dissociation is ~5%, much less than uncertainties in gas production of comets. Results of both K06 and B07 are corrected for the secondary C^{+5} and O^{+7} ions.

Results. Retrieved ion ratios for four comets are given in Table and compared with those in the mean slow and fast solar wind [4]. Differences between K06 and B07 exceed statistical errors and reflect the model assumptions and initial data. Spectroscopic data for oxygen ions in K06 from [3] agree better than those in B07 with the high-resolution spectrum of Mars [5]. Abundances of O^{+8} are extracted from the spectra at 650-900 eV that are more accurate in K06, and O^{+8}/O^{+7} in K06 agree better with the solar wind values.

C^{+6}/C^{+5} correlate with O^{+8}/O^{+7} in K06 and agree with the solar wind values much better than those in B07. The basic emissions excited by C^{+5} are near 300 eV, and the cutoff at 300 eV in B07 might affect the results. C^{+6}/O^{+7} are rather similar in K06 and B07, and the ratios from B07 are closer to [4].

Ne^{+10} should be much less abundant than Ne^{+9}, and the results of K06 for Ne that originate from the more accurate spectra at 900-1050 eV agree with Ne^{+8} [4].

N^{+7} is very scarse in the solar wind. Emissions excited by N^{+6} are near those by C^{+6} while C^{+6} is more abundant than N^{+6} in the solar wind by a factor of ~6. Therefore, K06 did not extract abundances of N^{+6} and N^{+7} whose the values in B07 are rather uncertain and disagree with [4]. The method of K06 is poorly applicable to very faint comets in x-rays.

[1] Krasnopolsky V.A. (2006) *JGR 111,* A12102. [2] Bodewits D. et al. (2007) *A&A 469,* 1183-1195. [3] Kharchenko V. et al. (2003) *ApJ 585,* L99-L102. [4] Schwadron N.A. and Cravens T.E. (2000) *ApJ 544,* 558-566. [5] Dennerl K. et al. (2006) *A&A 451*, 709.

Table. Solar wind ion ratios in comets retrieved from the CXO observations by Krasnopolsky (2006) and Bodewits et al (2007, italic). Values smaller than 1.5σ are skipped.

Ratio	1999 S4	1999 T1	2001 Q4	Encke	Slow wind [4]	Fast wind [4]
O^{+8}/O^{+7}	0.15 ± 0.03	0.31 ± 0.04	0.06 ± 0.015	0.07 ± 0.04	0.35	0
	0.32 ± 0.03	*0.42 ± 0.04*	*0.17 ± 0.03*	*0.19 ± 0.04*		
C^{+6}/C^{+5}	0.42 ± 0.15	1.6 ± 0.6	0.2 ± 0.08	0.23 ± 0.15	1.5	0.2
	0.12 ± 0.05	*0.06 ± 0.03*	–	*0.052 ± 0.027*		
C^{+6}/O^{+7}	0.7 ± 0.2	0.7 ± 0.2	1.1 ± 0.3	2.2 ± 0.7	1.6	2.8
	1.4 ± 0.4	*0.95 ± 0.4*	–	*2.9 ± 1.1*		
$Ne^{+9}/O^{+7}\times10^3$	20 ± 7	16 ± 6	11 ± 5	–	–	–
$Ne^{+10}/O^{+7}\times10^3$	*20 ± 10*	–	*8 ± 4*	*50 ± 20*	–	–
N^{+7}/N^{+6}	–	*0.40 ± 0.22*	*0.23 ± 0.15*	–	0.1	0
N^{+6}/O^{+7}	*0.63 ± 0.21*	*0.47 ± 0.20*	*1.1 ± 0.5*	–	0.29	0.37