Chandra's Close Encounter with the Disintegrating Comets 73P/Schwassmann--Wachmann--3 Fragment B and C/1999 S4 (LINEAR)[1] S.J.Wolk[1], C. M. Lisse[2], D. Bodewits[3], D.J. Christian[4] and K.Dennerl[5], [1]Smithsonain Astrophysical Observatory, [2]Johns Hopkins University Applied Physics Laboratory, [3]NASA GSFC, [4]Eureka Scientific, [5]MPE - Garching.

Introduction: On May 23, 2006 we used the ACIS-S instrument on the Chandra X-ray Observatory (CXO) to study the X-ray emission from the B fragment of comet 73P/2006 (Schwassmann-Wachmann 3; SW3/B)[1]. We obtained a total of 20 ks of CXO observation time of Fragment B, and also investigated contemporaneous ACE and SOHO solar wind physical data. The CXO data allow us to spatially resolve the detailed structure of the interaction zone between the solar wind and the fragment's coma at a resolution of ~ 1,800 km, and to observe the X-ray emission due to multiple comet-like bodies. We detect a change in the spectral signature with increasing optical depth as predicted[2]. Further, we are able to understand the observed X-ray morphology in terms of non-gravitational forces on icy dust, most notably solar radiation pressure acting on 1-1000 μm sized particles ejected from the fragment as it disintegrated. We have used the results of the Chandra observations on the highly fragmented SW3/B debris field to re-analyze and interpret the mysterious emission seen from comet C/1999 S4 (LINEAR) on August 1st, 2000, after the comet had completely disrupted. We find the physical situations to be similar in both cases, with extended X-ray emission due to multiple, small outgassing bodies in the field of view. Nevertheless, the two comets interacted with completely different solar winds, resulting in distinctly different spectra[1].

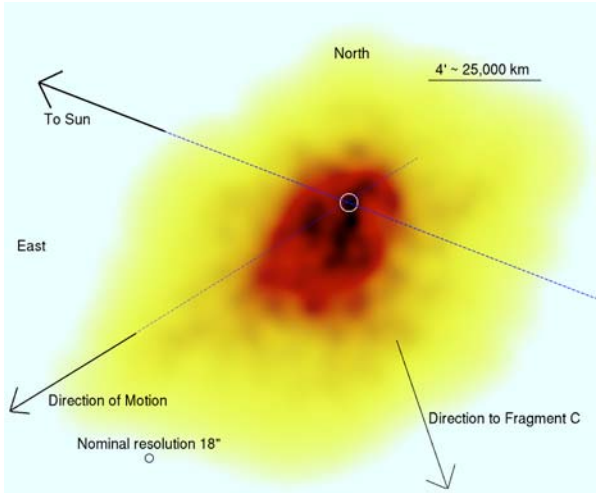

Figure 1 – X-ray (0.3-1.2 keV) image of SW3/B. The circle indicates the nominal nucleus.

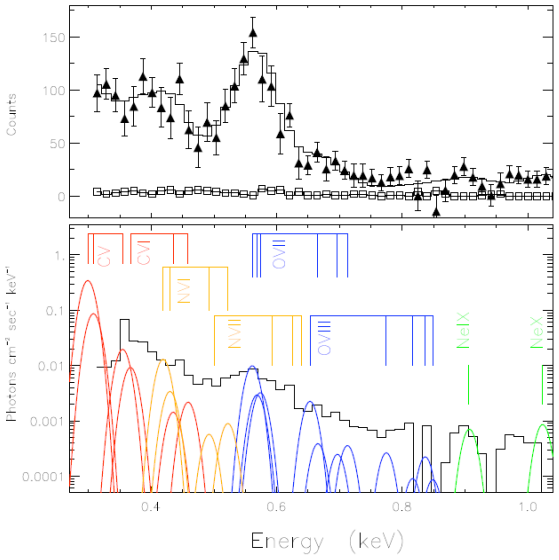

Figure 2 - Details of the CXE model fit for the spectrum of comet SW3/B: (Top) The SW3/B count rate spectrum (filled triangles), background (open squares), and best fit spectrum with the CXE model (solid histogram). (Bottom) CXE model and observed spectrum indicating the different lines in the fit and their strengths.

Conclusions -- The main difference between this comet and previous comets observed by Chandra was that it's geocentric distance at the time of observation was extremely small, allowing for almost in-situ measurements of the solar wind. We found the Chandra observations, folded through the models of Bodewits et al. [1] were consistent with the C^{6+}/O^{7+} ratio observed by ACE/SWICS. Further, we observed predicted changes in line ratio due to changes in collisional depth. However, the C^{5+}/O^{7+} ratios were highly discrepant. Since we cannot attribute the discrepancy to our knowledge of the C^{5+} cross sections, the Chandra calibration, nor differences in the local solar wind, we are left to conclude that we do not fully understand charge exchange processes at low X-ray energies[1].

References: [1] Wolk *et al.* 2008 *ApJ Submitted*
[2] Bodewits *et al.* 2007. *A&A* **469**, 1183

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