To: L3 Distribution
From: F. Primini
Subject: Optimum Soft Energy Band Boundaries for Super-Soft Sources
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It has been suggested that the current L3 soft energy band boundaries (0.2 - 0.5 keV) are not optimum ***source detection*** bands for super-soft sources. To investigate this question, I have simulated super-soft spectra in ACIS-S and ACIS-I, using ***fakeit*** in ***ISIS***, and computed simple source count signal-to-noise ratios for a range of soft band boundaries. To model super-soft spectra, I used blackbody spectra with kT=30, 65, and 100 eV , and added background obtained from appropriate blank-sky datasets scaled to the source exposure time and aperture size. I used a source exposure time of 50 ksec. Typical model spectra are shown in Figure 1.

I considered two cases: a small 100 pixel source aperture, appropriate for an on-axis source, and a larger 1000 pixel aperture, appropriate for a source ~8´ off-axis. For each aperture size and blackbody temperature, I simulated 1000 spectra and computed SNR's in bands with lower energy boundaries of 0.1, 0.2, and 0.3 keV, and upper energy boundaries from 0.5 to 5 keV. Final SNR's were simple means of those computed in each of the 1000 simulations. The results are shown in Figures 2-4 (ACIS-S) and 5 (ACIS-I). I did not compute a full set of ACIS-I results since they appeared similar to the ACIS-S results.

Only for the very softest spectra (kT~30 eV) does the current soft band yield the highest SNR, although it's not clear that it's the optimum. For the higher temperature blackbodies, the optimum energy band has an upper bound of ~1 keV. There is little difference between the lower bounds of 0.1 and 0.2 keV, although a lower bound of 0.3 keV definitely reduces the SNR values. However, for small aperture sizes (i.e., on-axis), the SNR decays very slowly as the upper energy boundary increases beyond 1 keV. This simply reflects the fact that for these apertures, the spectrum is source dominated, even at 50 ksec. For the large aperture size, the SNR decays more rapidly as the upper boundary increases, indicating that these spectra are beginning to be background-dominated. However, even for these spectra, the decrease in SNR from the optimum upper bound of 1 keV to higher energies is not large.

On the basis of these tests, I conclude that except for sources with very soft spectra or very large off-axis angles, there is no strong reason to optimize the soft band to detect super-soft sources, since they will most likely be detected in the broad band anyway.

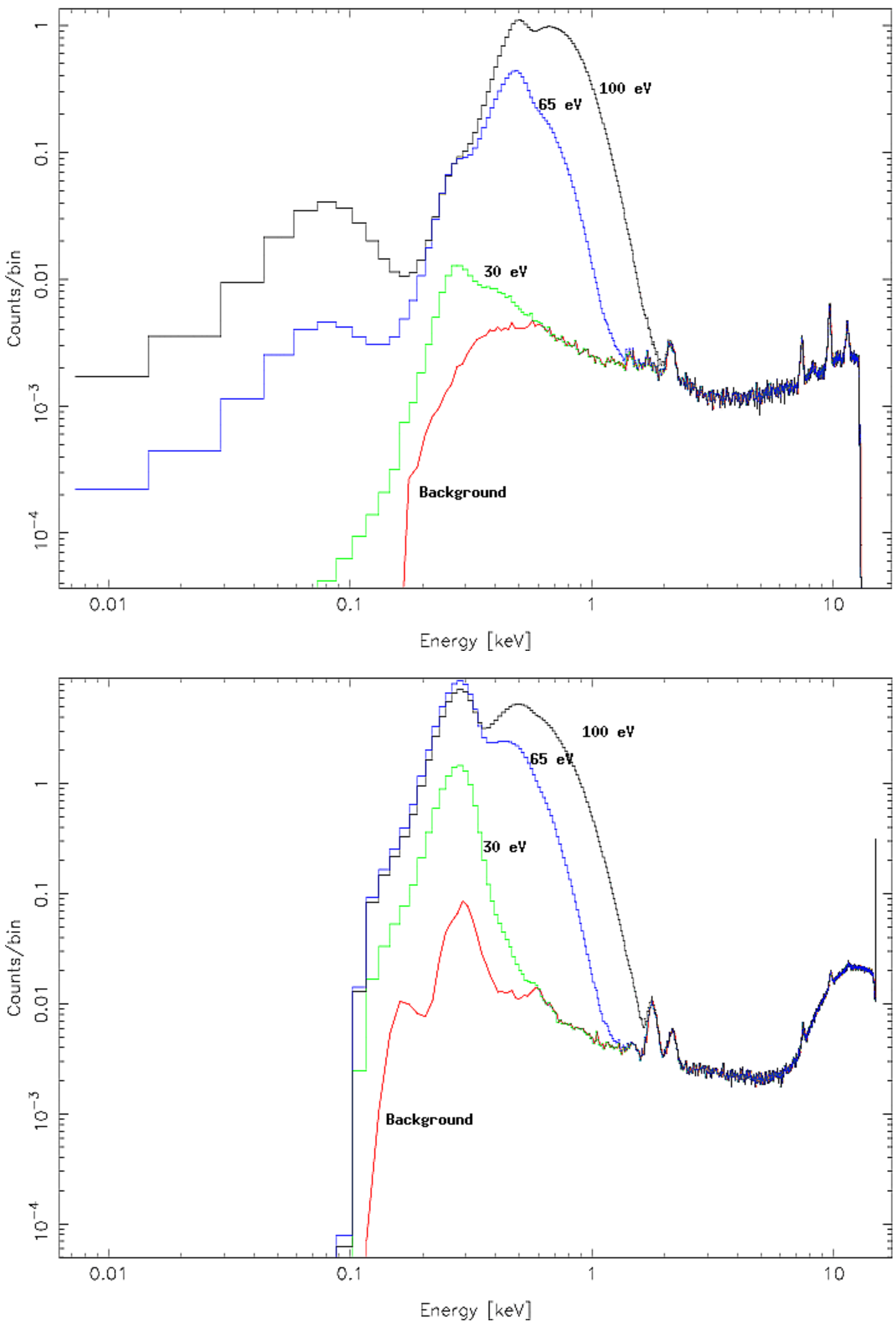

Fig. 1: Model super-soft source spectra in ACIS-I (top) and ACIS-S (bottom) for a range of blackbody temperatures. Background spectra were obtained from appropriate blank-sky datasets, scaled to the exposure time (50 ksec.) and aperture size (100 pixels) of the source. In all cases, the blackbody normalization was that which provided ~100 net counts in ACIS-S for a 65 eV blackbody.

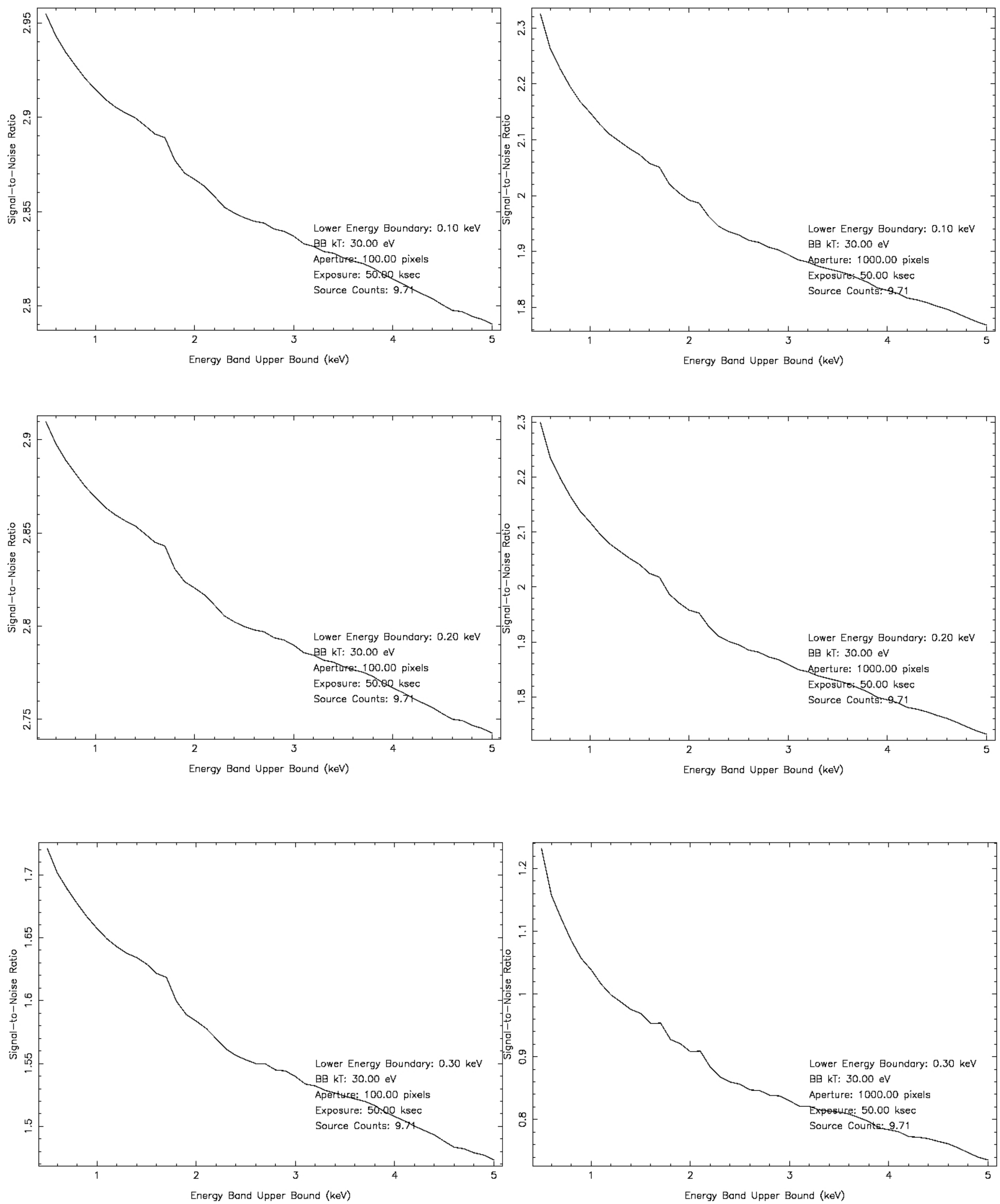

Fig. 2: SNR vs. soft band upper boundary for a 30 eV blackbody on-axis and ~8' off-axis in ACIS-S.

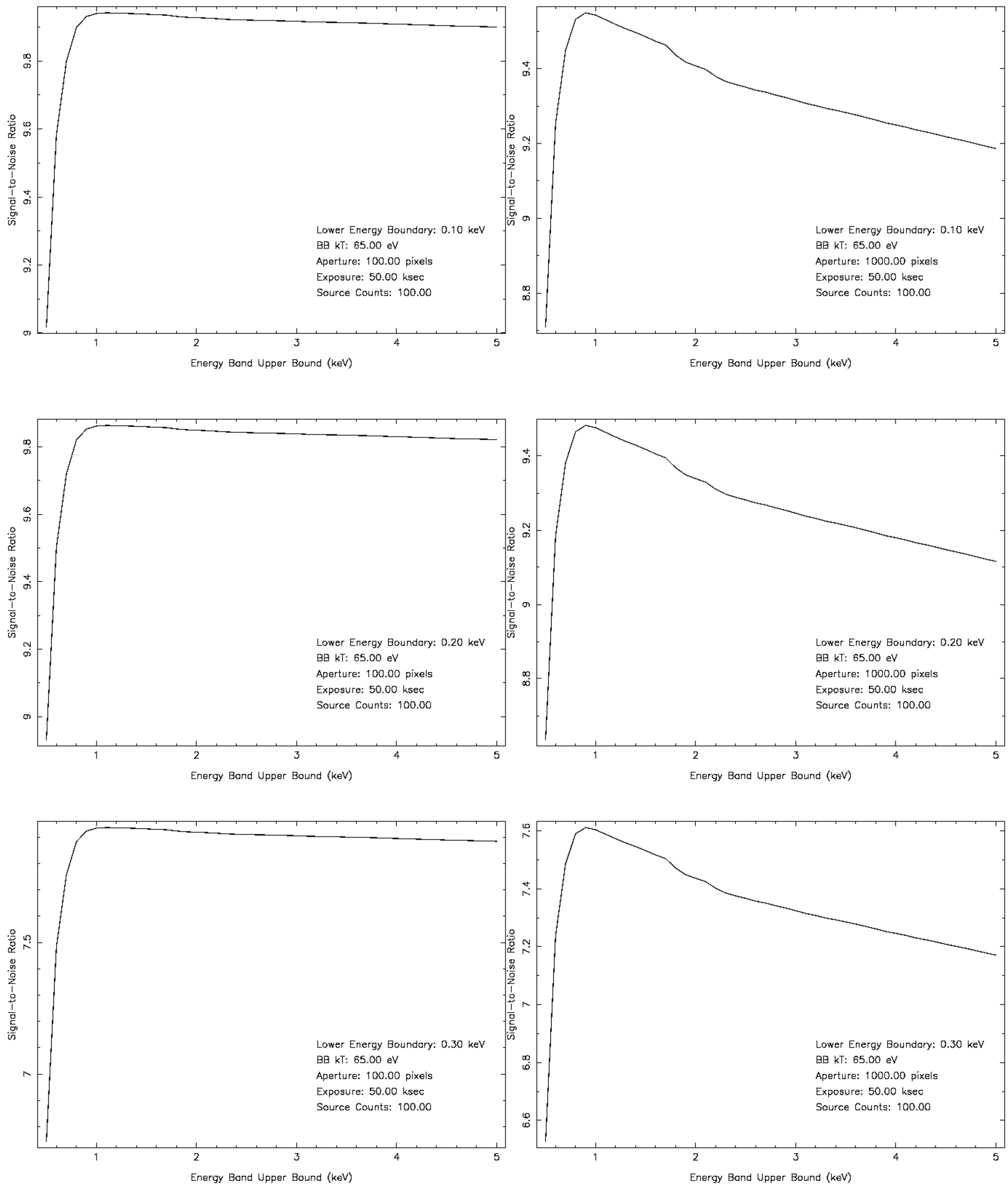

Fig. 3: SNR vs. soft band upper boundary for a 65 eV blackbody on-axis and ~8' off-axis in ACIS-S.

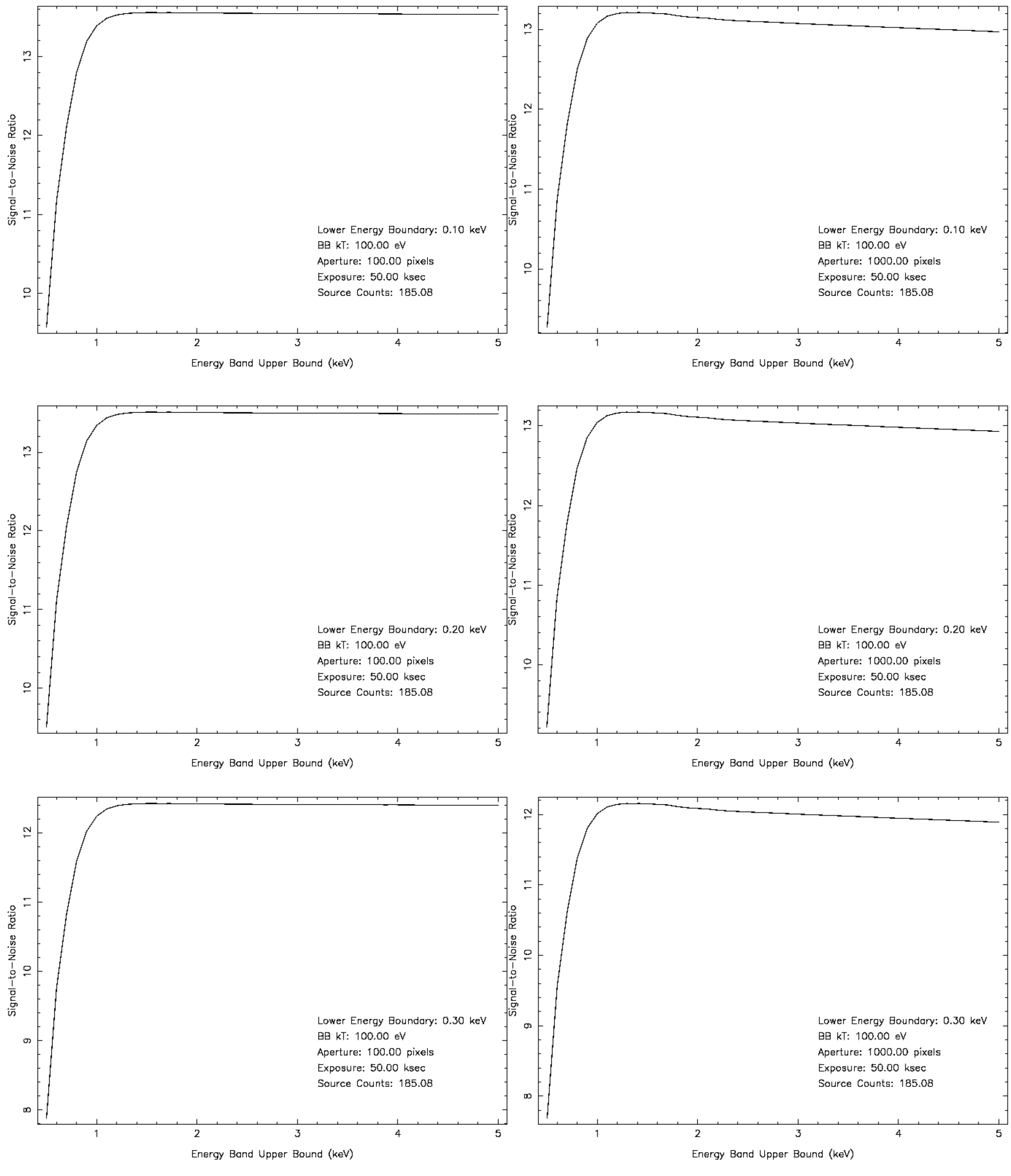

Fig. 4: SNR vs. soft band upper boundary for a 100 eV blackbody on-axis and 8' off-axis in ACIS-S.

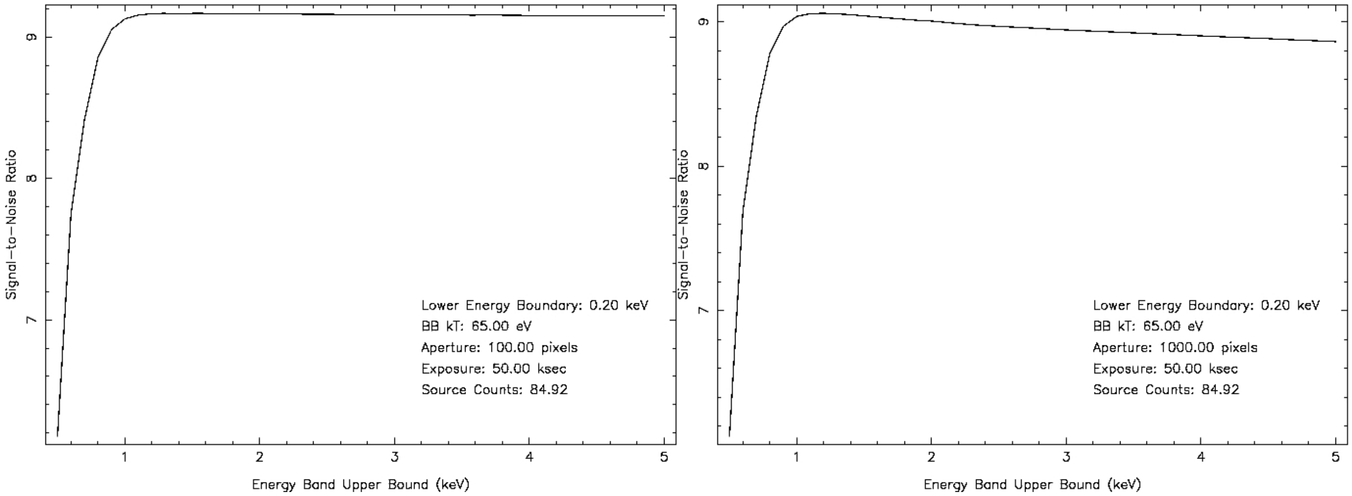

Fig. 5: SNR vs. soft band upper boundary for a 65 eV blackbody on-axis and ~8' off-axis in ACIS-I.