Low energy uniformity in the Quantum Efficiency of the HRC-I

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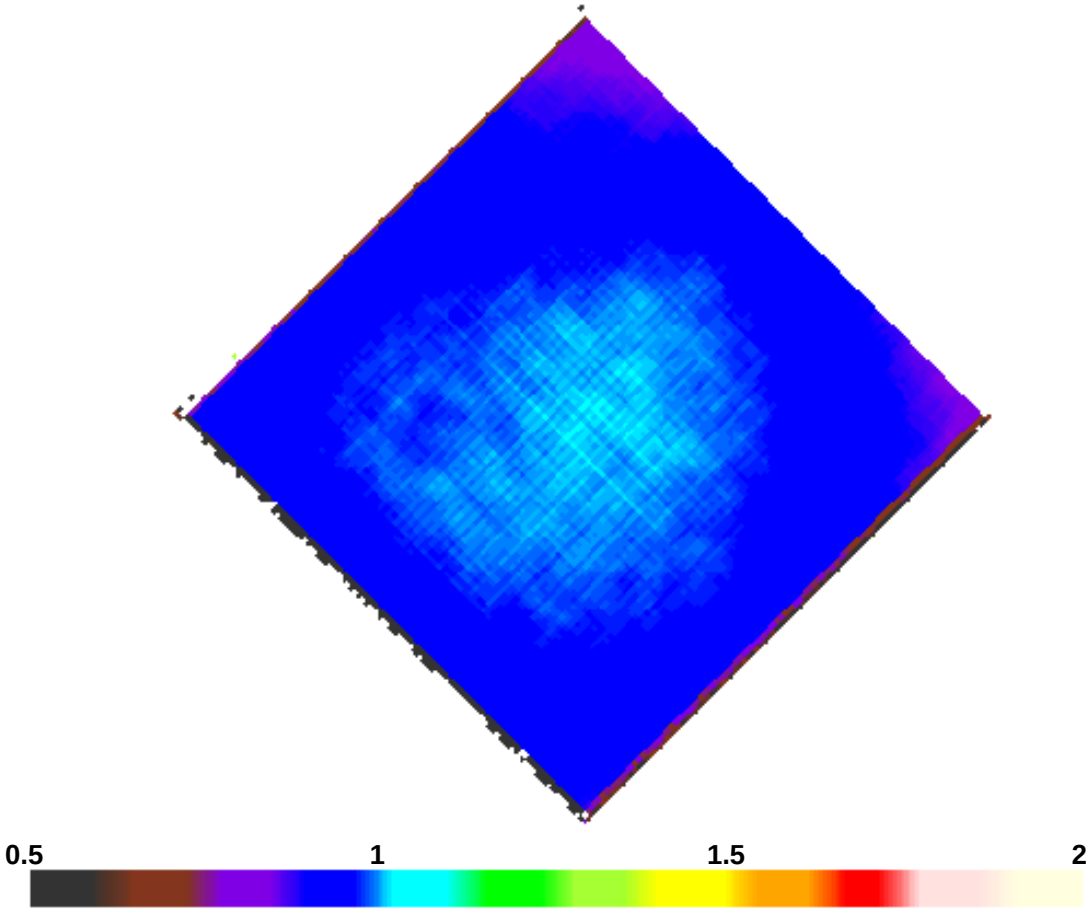


Normalized Median Uniformity of the Quantum Efficiency

The above map was developed from laboratory data taken prior to launch. The data was collected at six different energies– B(0.183 keV), C(0.277 keV), O(0.525 keV), Al(1.487 keV), Ti(4.511 keV) and Fe(6.404 keV). The standard deviations from the median map of the measured uniformity at each point are typically less than 4%, leading to a model of the uniformity that is independent of energy. Small scale variations are of order only a few percent, while the statistical uncertainties are also typically a few percent. The model is oriented and scaled above to ease comparison with later data.

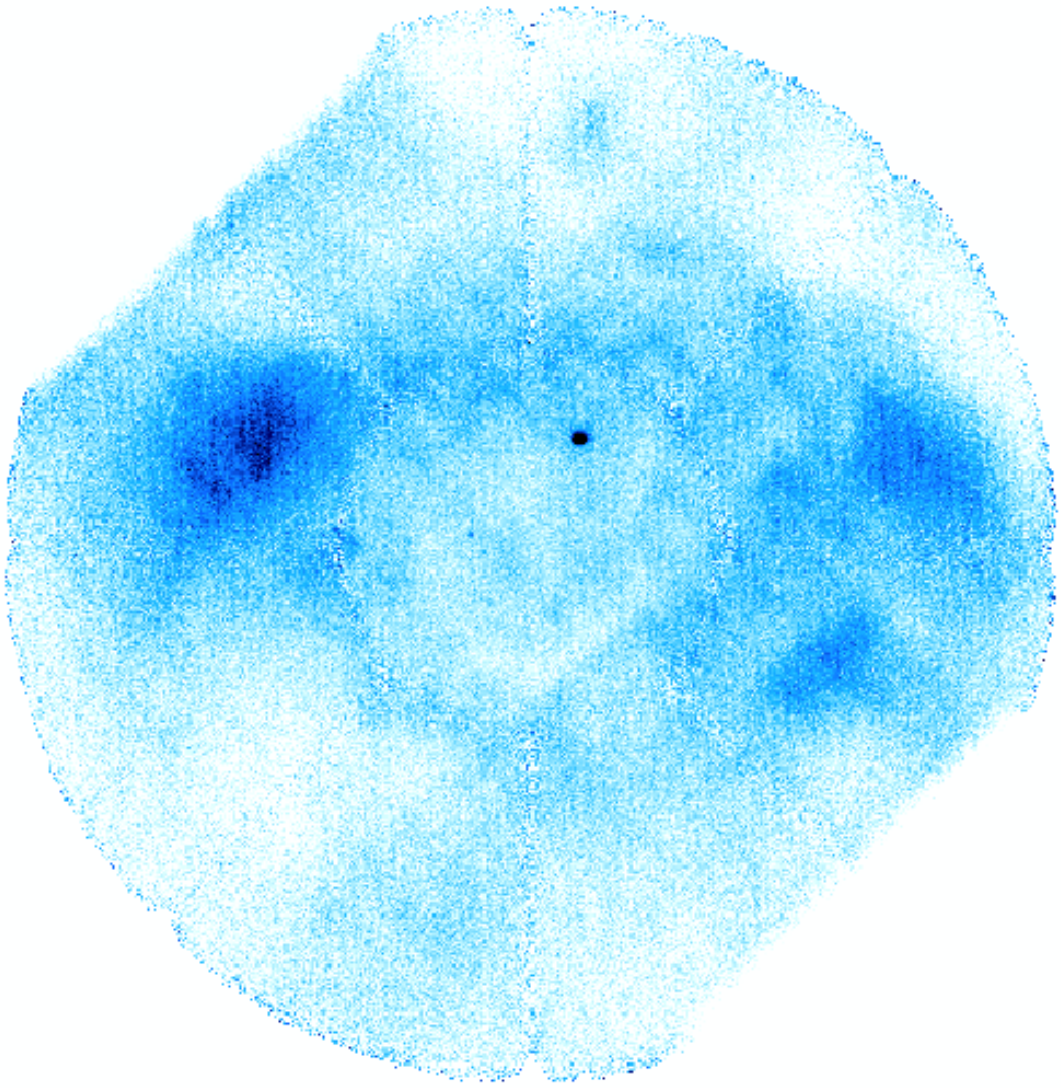
Comparison of Models with HZ43 Data

Offset Angle	Vignetting	QEU1.1	Pred	Observed
$-10'$	0.87	0.95	0.81	0.79
$+5'$	0.94	0.99	0.93	0.94
$+10'$	0.85	0.97	0.82	0.70
		B&C QEU		
		0.92	0.80!	0.79
		1.01	0.95!	0.94
		0.99	0.84!!!	0.70

Offset Angle	QEU1.1	B&C QEU	HZ43
$-10'$	0.95	0.92	0.91
$+5'$	0.99	1.01	1.00
$+10'$	0.97	0.99	0.82

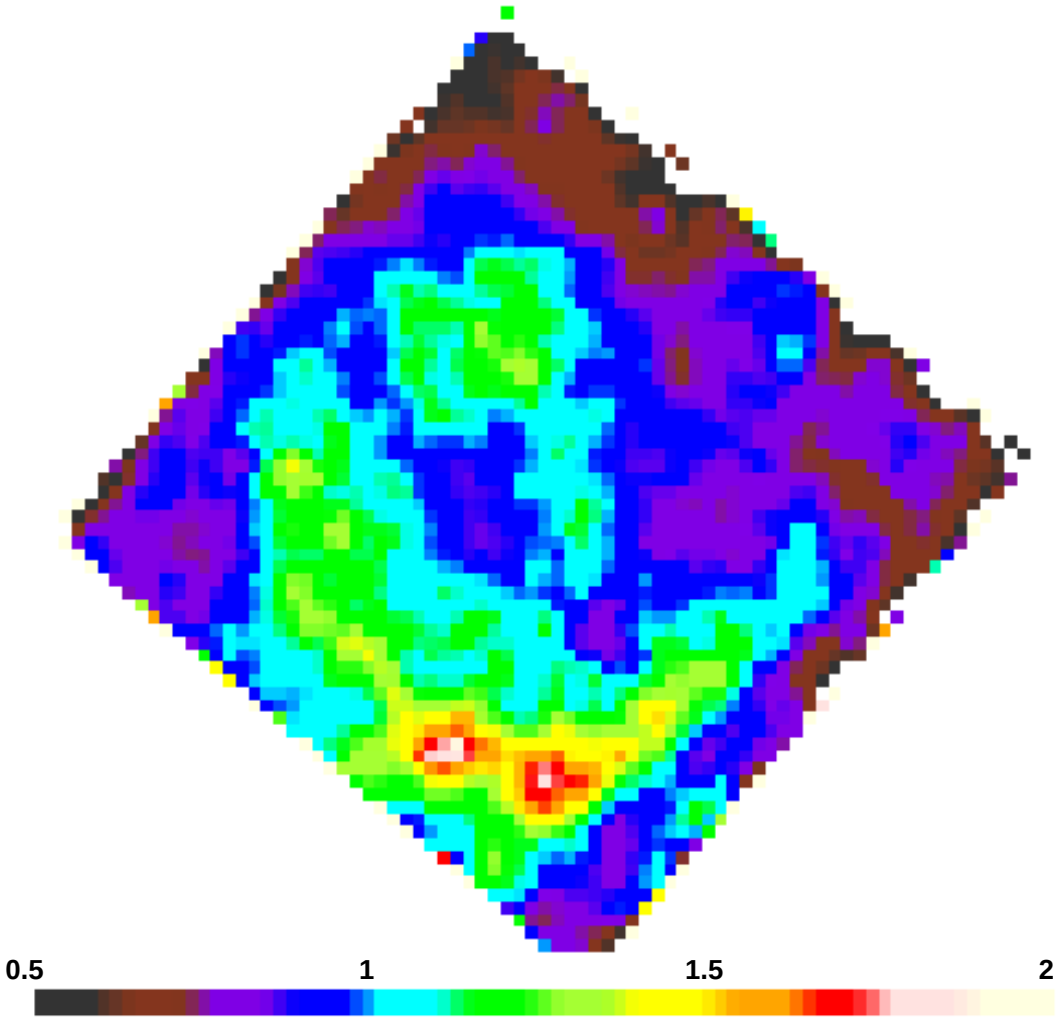
HZ43 is part the canon of monitoring sources used for the on axis QE. The source's characteristic energy is low ($\sim$ 100 eV) and it is quite bright, requiring the LETG to act as a 'neutral density filter'. In the course of trying to swing the 1^{st} order dispersed spectrum across the aimpoint, we have sampled the 0^{th} order at three location besides the aimpoint. While the pointings at $+5'$ and $-10'$ are in very good agreement with our model predictions, the $+10'$ data shows significant deviations. In the table above, each location has been normalized to the aimpoint value. We find that our HZ43 data suggest a 20% deviation at $+10'$. Other data of extended objects at higher energies (specifically that of the Coma cluster) shows no such depression in the response.

Using just the lowest energy data for the uniformity model (i.e. assuming there there is an energy dependence in the uniformity) does not resolve the discrepancy.



ROSAT PSPC Pointing at NW part of Vela SNR

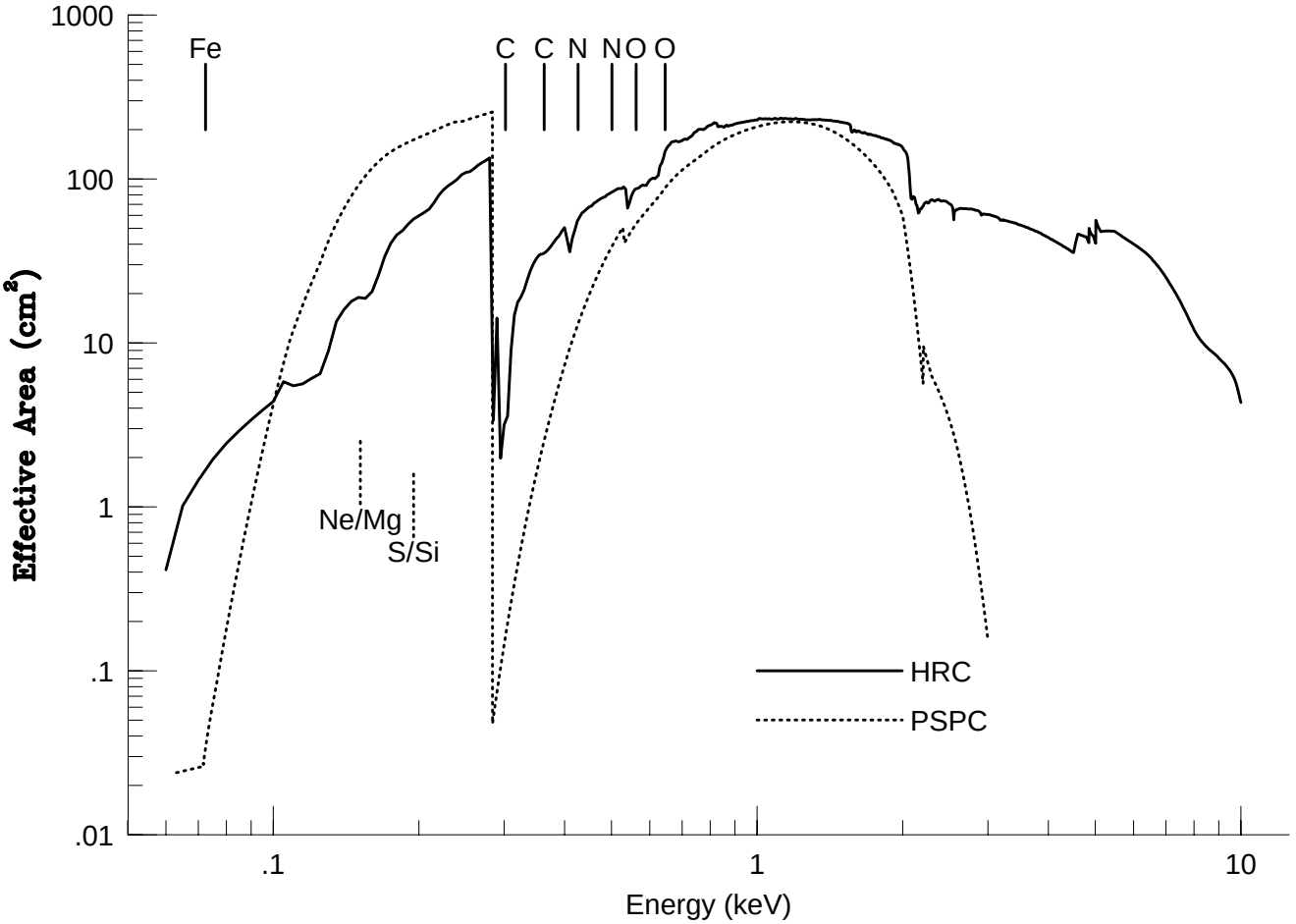
We selected a field in the Vela Supernova Remnant with relatively smooth emission for which there was ROSAT PSPC data. We expect that the emission from this field will be strongly dominated by softer X-ray emision with typical energies of 200-300 eV. The ROSAT data was vignetting corrected using the Snowden processing. We designed our CHANDRA pointing to lie within the central support ring to further minimize vignetting effects.



Normalized HRC^0/PSPC

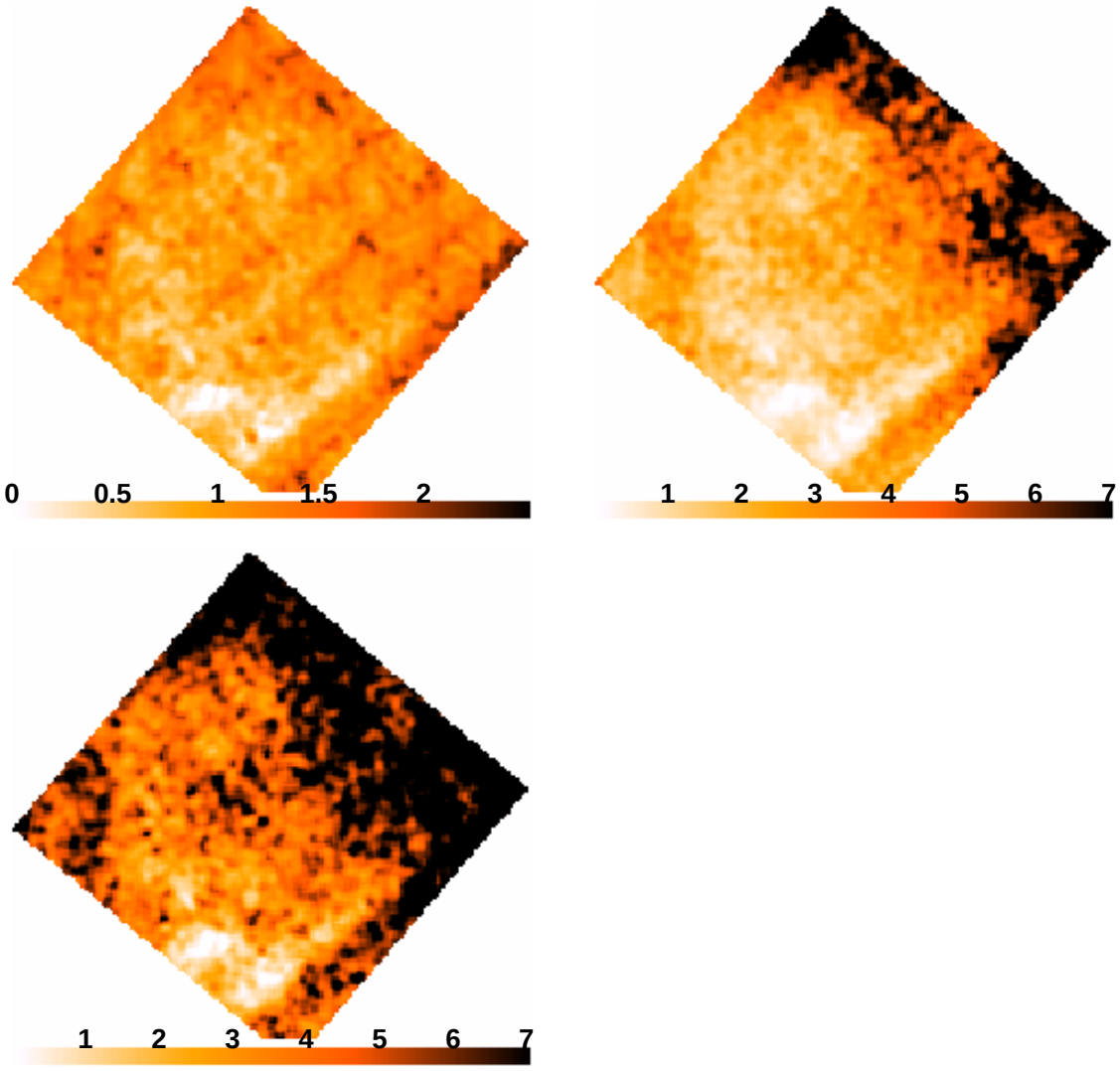
- Vela Estimates of QEU: -10=1.09, +5= 1.05, +10=1.32
  - QEU1.1: -10=0.92, +5= 1.01, +10=0.99
- HZ43 Estimates of QEU: -10=0.91, +5= 1.00, +10=0.82

By dividing the fully corrected ROSAT data into the CHANDRA data corrected only for telescope vignetting, we should nominally be able to derive the relative uniformity of response for the HRC. The figure above is that result with the same orientation and color scale as that shown in the first figure. We note that there is very poor agreement between this data and the HZ43 estimates *and* that the sense of disagreement at $+10'$ has the opposite sign!



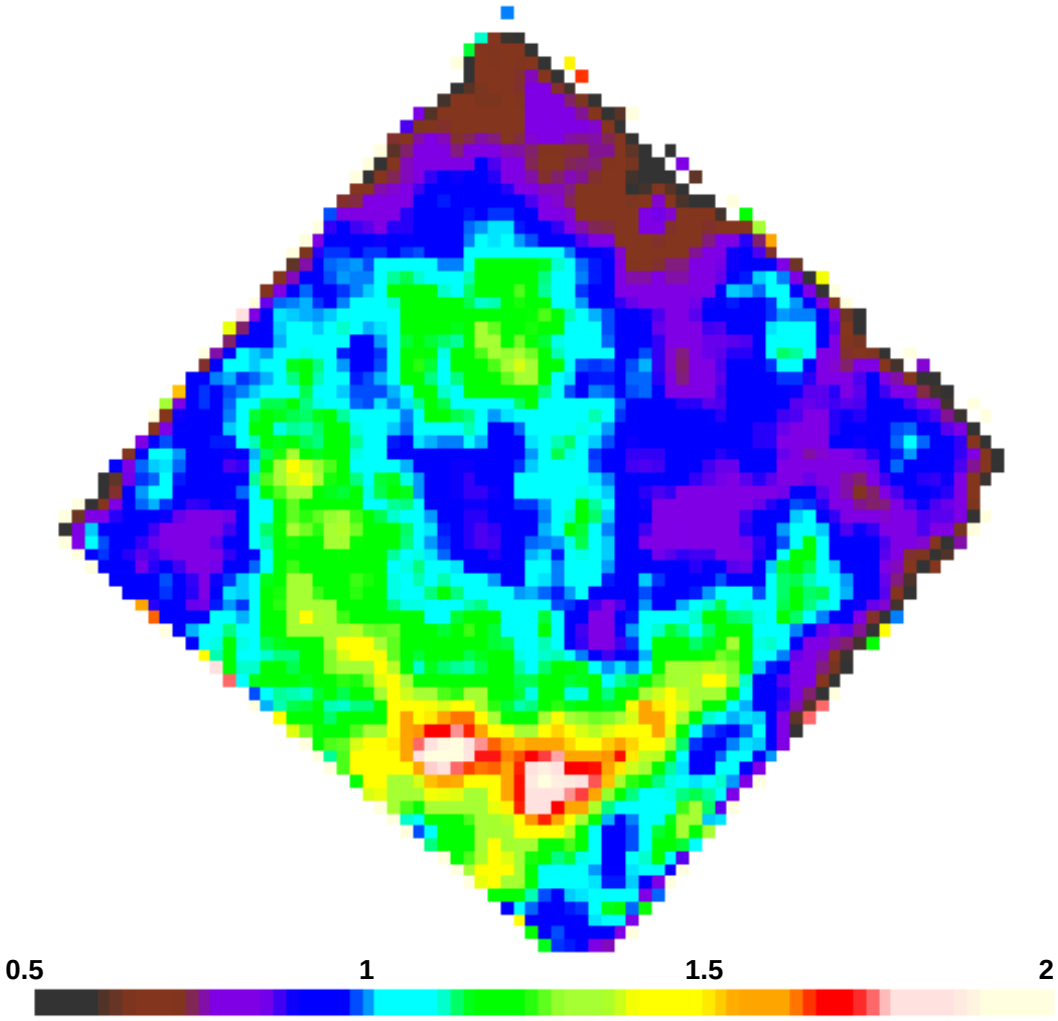
Effective Areas: CHANDRA/HRC versus ROSAT/PSPC

Examining the effective areas of the two detectors we find that the explanation of this new discrepency may lie in exactly what emission each is mapping. CHANDRA is more sensitive to the Fe, C, N and O emission while ROSAT is more sensitive to emission lines from Ne, Mg, Si and S. If these various emission lines do not have homologous distributions across the remnant this would lead to the effect we are finding.



Comparison of ROSAT bands 2/1L and 2/4 (top left and right respectively), and 2/3

Here we compare the various ROSAT bands and find features similar to those found in our results. Band 4 is above the Carbon edge, 3 spans the edge, 2 is around the peak of the ROSAT low energy sensitivity and 1L is between the Fe line energy and band 2. The similarity of the structure in the emission suggests that we are seeing non-homologous distribution of emission. Comparisons of HRC/PSPC observations of Coma, and this same field but with an off-axis pointing from ROSAT argue strongly against this being an instrumental effect from either CHANDRA or ROSAT.



Normalized HRC/PSPC

Applying our current nominal model of the uniformity we find the above map of the ratio of the CHANDRA/ROSAT response to this field. We note that the HZ43 results suggest that the 'hot spot' near the lower corner should be even more pronounced than shown here. Future observations of Vela (with different roll angles) and HZ43 will allow us to map out the uniformity in more detail, as well as to better constrain the characteristics of the emission in Vela.