Discarding the Tea Leaves: What's in store for the HRMA A_{eff}

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From Then 'Til Now

SINCE the release of the latest *Chandra* A_{eff} last year, the CXC Optics group has been working on further refinements to the HRMA A_{eff}.

We have concentrated on the following areas:

- Re-analysis of the XRCF Emission Line measurements
- Improved correctoins for Pileup in the SSD Detectors
- Determining an empirical correction for scattering deficiencies in our model.

Re-analysis of XRCF Emission Line Data

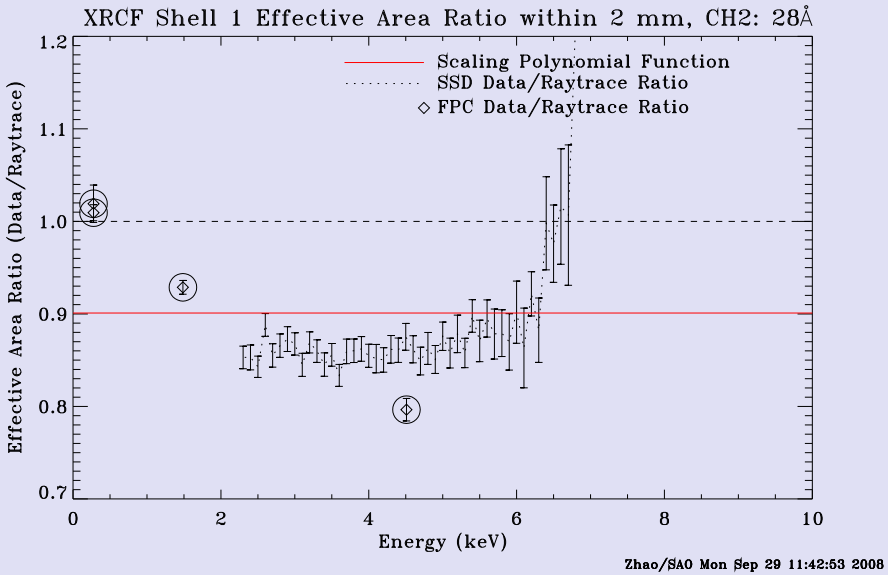
A systematic effort was made by Dick Edgar to re-analyze emission line measurements of the HRMA A_{eff} made at the XRCF.
The re-analysis

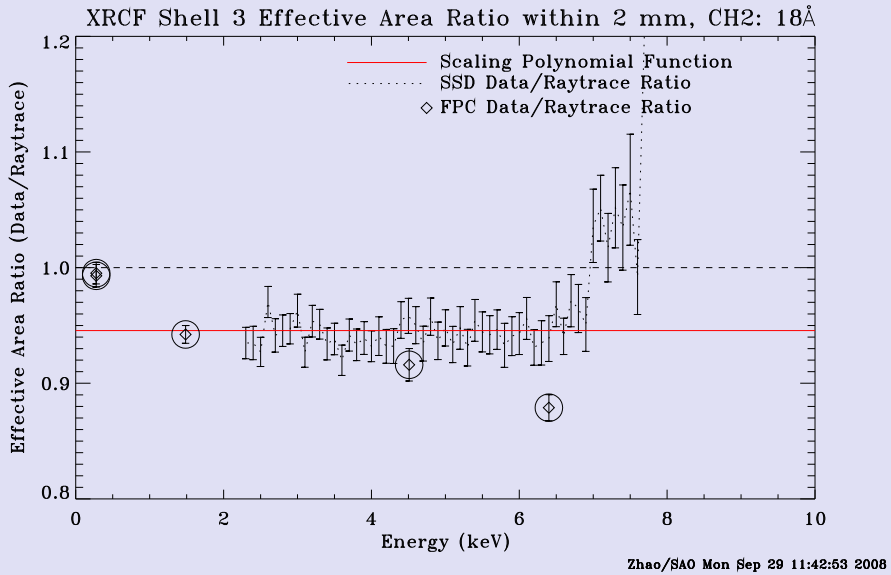
- included measurements made with all pinholes, not just the largest
- used a more complete model of the XRCF source spectrum, using a compendium of lines and relative normalizations catalogued by the gratings calibration group
- accounted for changes in the FPC detector Q.E. due to changes in the FPC gas temperatures
- incorporated a more accurate account of the time-averaged beam normalization detectors

Improved corrections for Pileup in the SSD Detectors

For some time we have had suspicions that our original analysis of XRCF continuum measurements made with the SSD detectors suffered from incomplete correction for detector pileup.

For example, note the upturn at high energies of the ratios of the SSD and FPC measurements for Shells 1 and 3 to the current HRMA A_{eff} model:





Improved Pilep correction for the SSD Continuum data

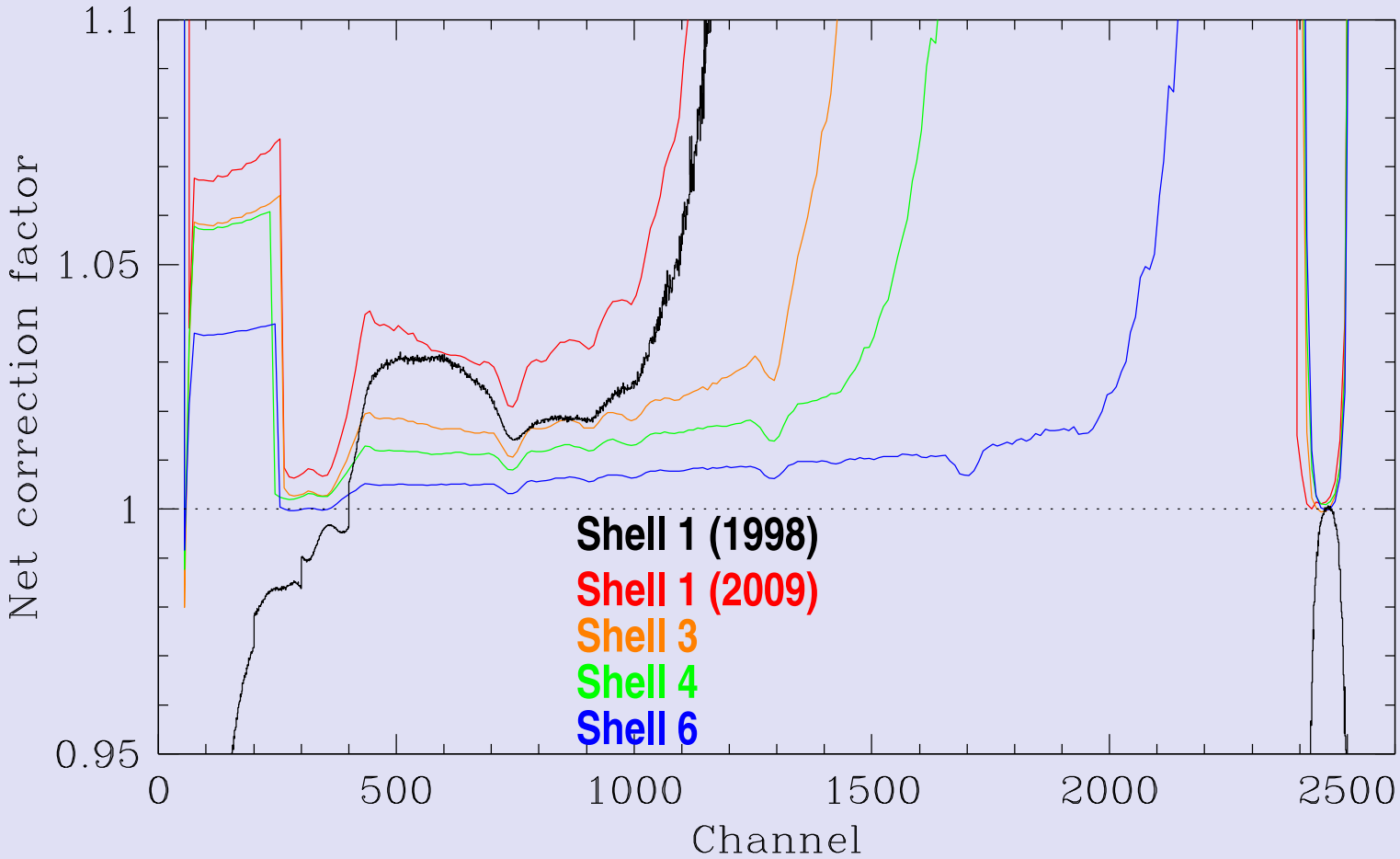
We modeled the effect of pileup using two orthogonal approaches:

	Monte Carlo	Probabilistic
What:	An event based model of the detector pileup rejection electronics was created. Multiple realizations of the input spectrum were run through the model and the output spectra were combined.	The probability of no-, two-, and three-event interactions was calculated for each possible temporal superposition of input events and energy permutations for the input. An output spectrum was generated based upon the summed probabilities.
Pro:	All possible interactions are automatically sampled Can model full detector resolution.	Exact calculations of the probabilities.
Con:	Inexact. Requires multiple realizations to build up statistics.	Calculations of higher order interactions or full detector resolution prohibitively expensive.

The Monte Carlo approach was used to validate the Probabilistic approach.

Improved corrections for Pileup in the SSD Detectors

Representative Pileup Correction Factors



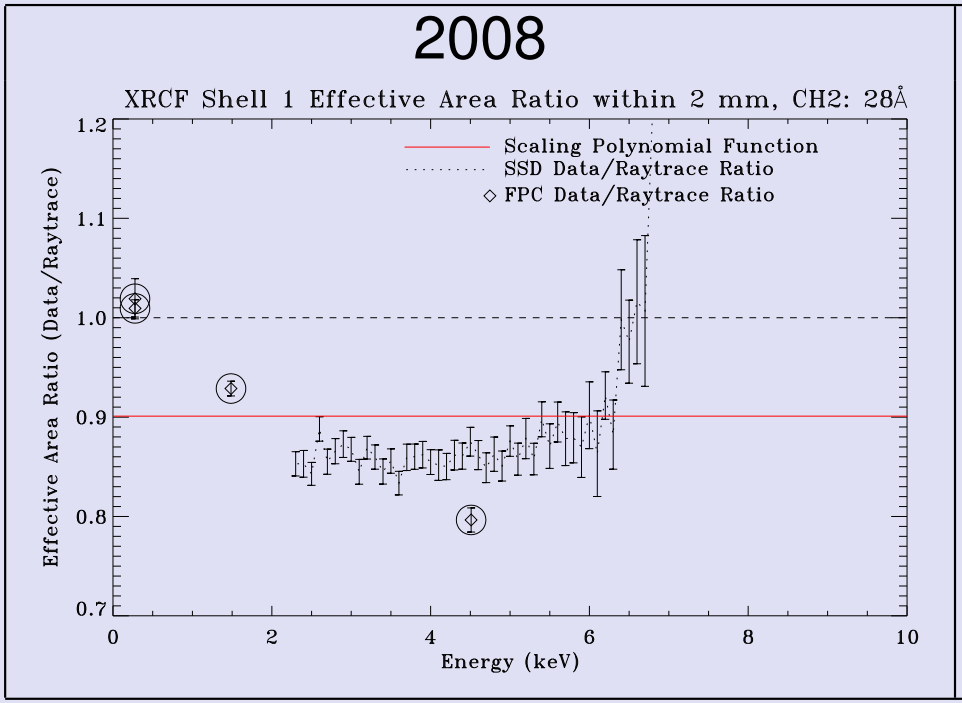
Channels below 300 (1.5keV) may be ignored as they are not used in our analysis.

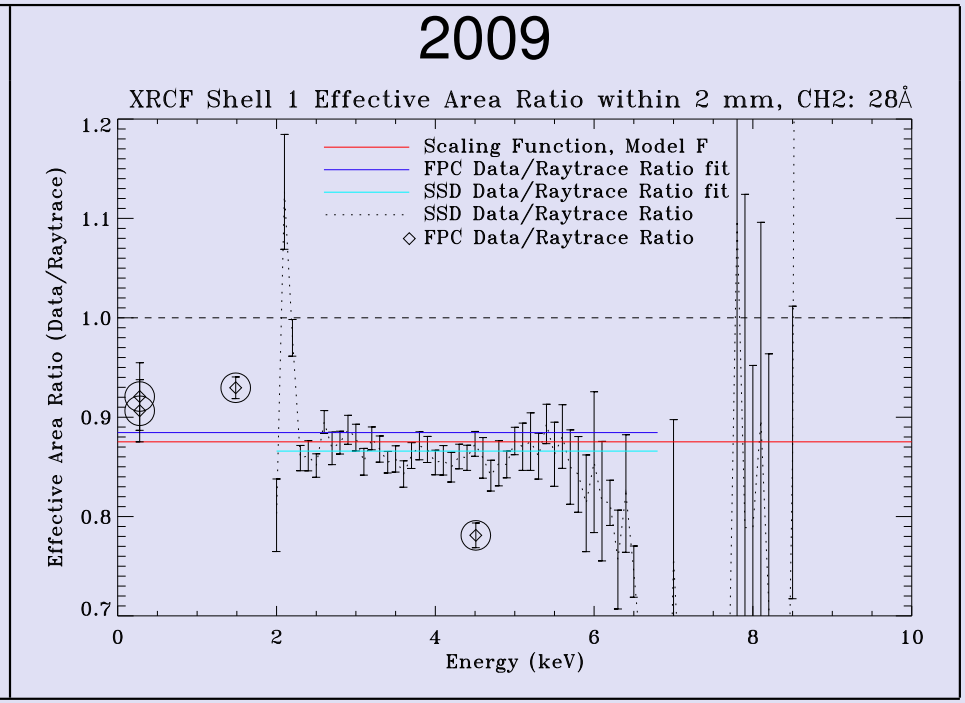
Revised A_{eff}, Shell 1

To gauge the importance of these refinements, we have performed our traditional comparison of our raytrace based model to the improved XRCF line and continuum measurements.

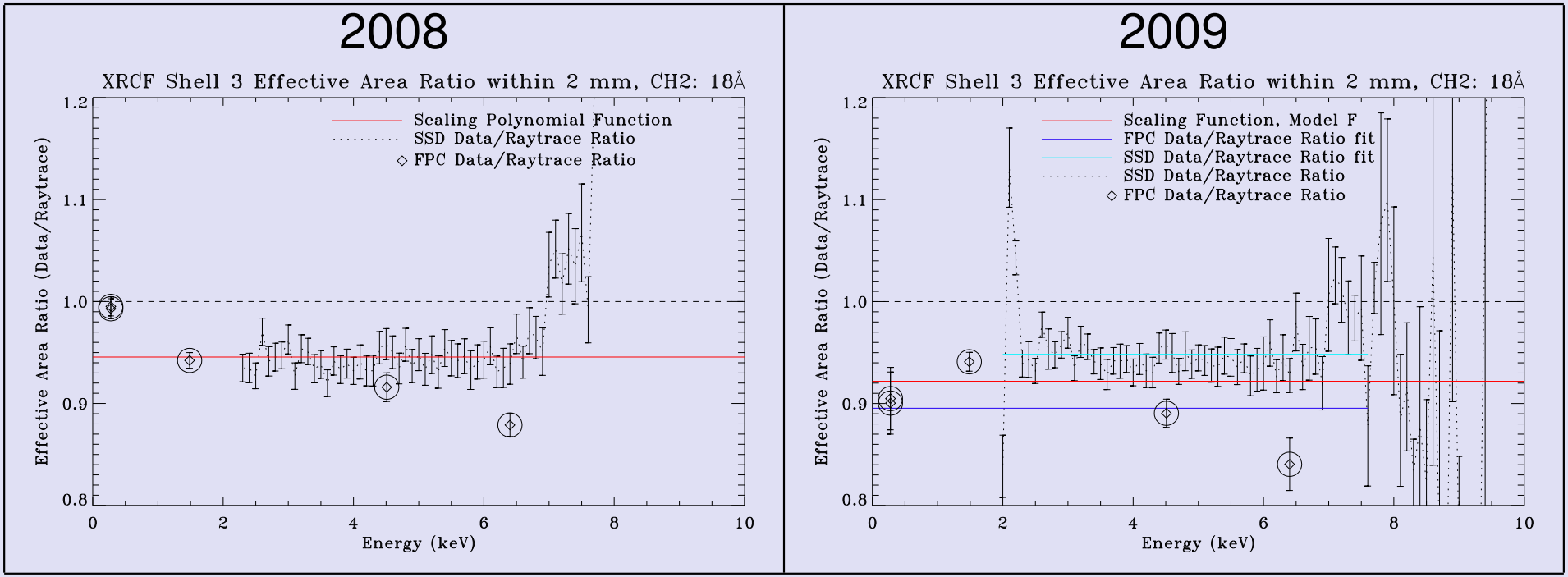
Please Note! *The following comparisons are for entertainment only and do not reflect an official* A_{eff}.

Revised A_{eff}, Shell 1

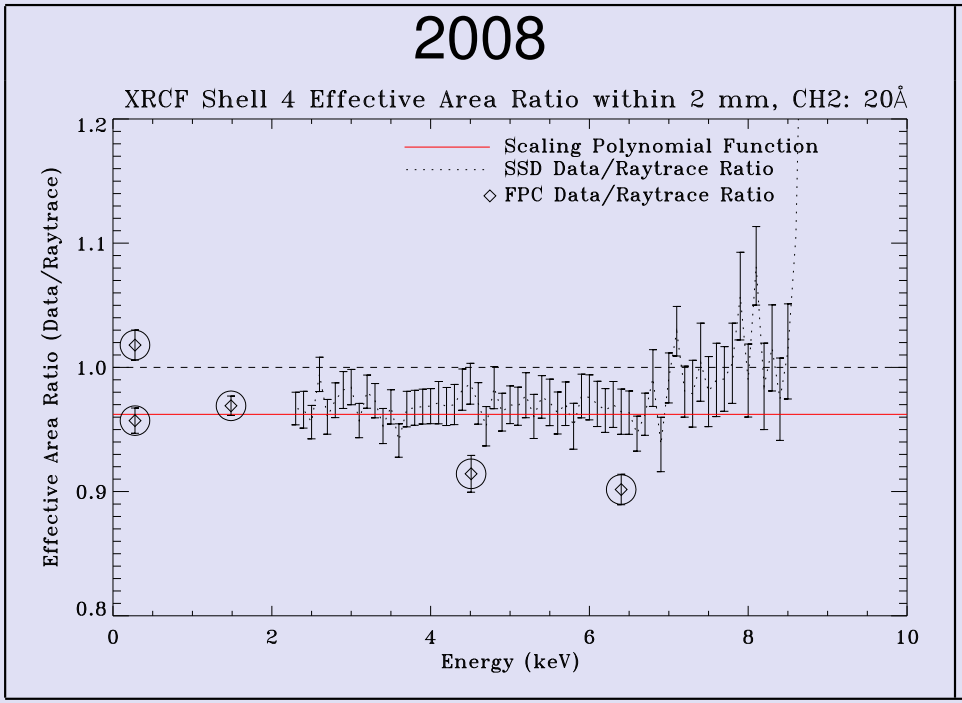


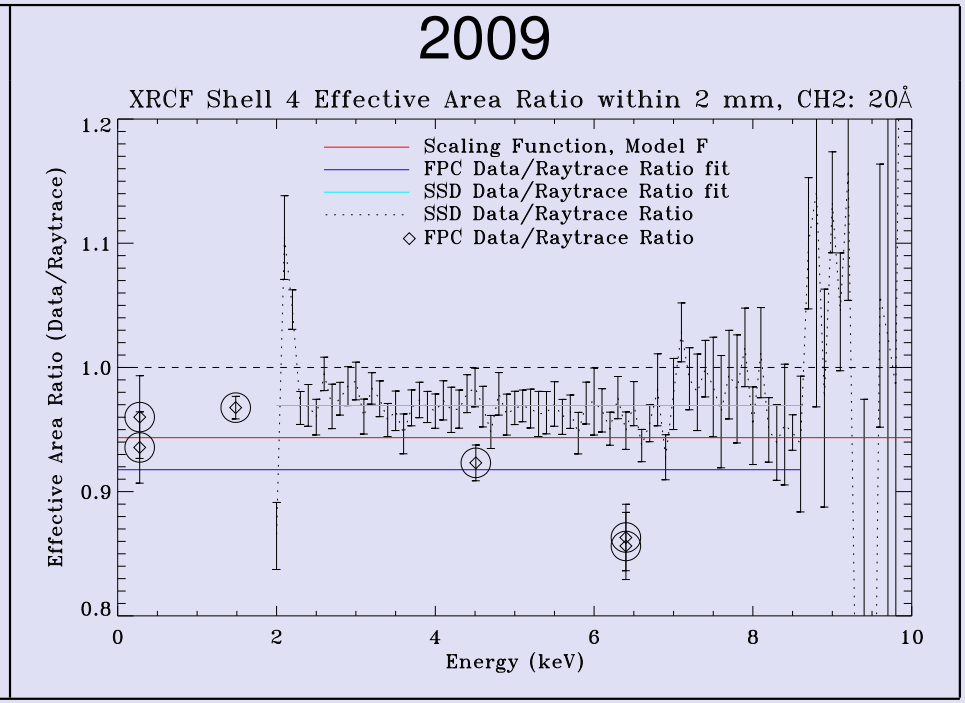


Revised A_{eff}, Shell 3

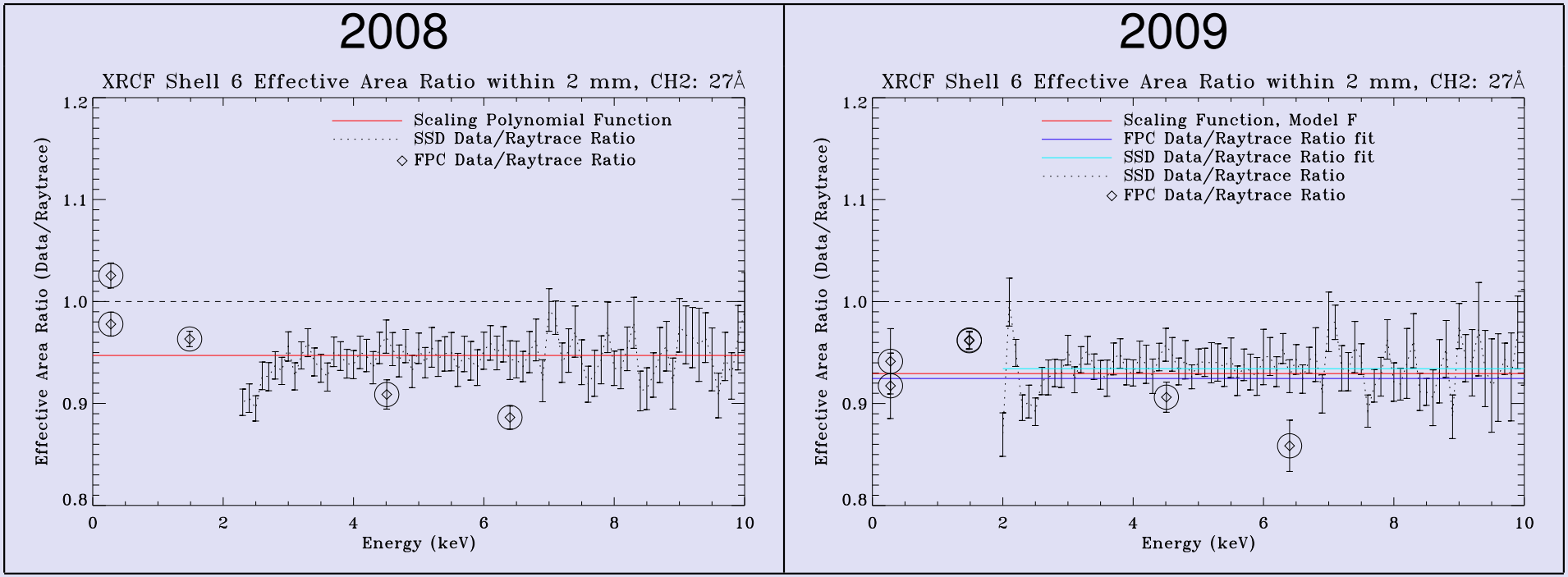


Revised A_{eff}, Shell 4



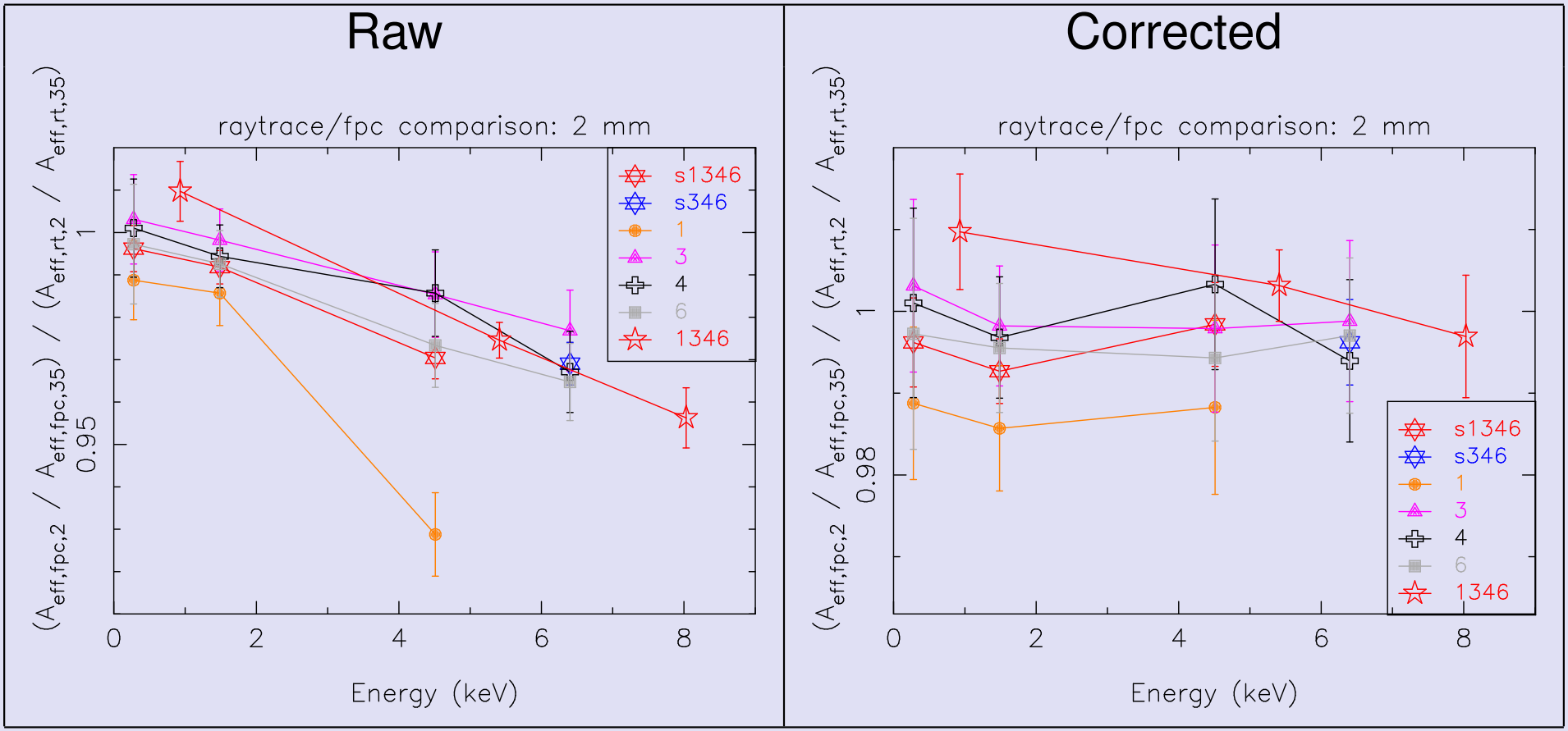


Revised A_{eff}, Shell 6



An Empirical Scattering Correction (Not yet applied)

The raytrace model underpredicts the amount of light scattered in the PSF wings, affecting the A_{eff} measurement. We can estimate the effect by comparing the difference in flux between two pinholes.



Future Efforts

- Apply the empirical scattering correction
- We have a “new” scattering model which is yet to be used in our raytrace models
- Use the newly reduced, smaller pinhole data to improve our model