HRMA Vignetting

CXO Calibration Review
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On-orbit calibration of the vignetting function has a few challenges:

- We must use ACIS for spectral sensitivity
- A bright point source is preferable, however ACIS pile-up precludes this, unless we de-focus telescope.
- The ACIS QE variations across detector must be factored out
- The image size grows as source goes off-axis, thus sampling different parts of the detector
  - complicated mixing of regions as source goes off-axis; requires fairly sophisticated modeling if one wishes to use small apertures to avoid QE variations across detector.

Experimental Setup:

- The target is G21.5, a supernova remnant.
- ACIS was shifted to keep the object at same position on the detector, independent of its off-axis angle.
- A single large aperture was used to measure the flux in the object for both the on and off-axis observations

Observational Parameters

Target:	G21.5
OBSID:	1838, 1839, 1840, 1841, 1842, 1843
Instrument:	ACIS-I
Exposure:	$\sim 8ksec$
Angular distances	$0'$, $2'$, $5'$, $10'$, $15'$, $20'$

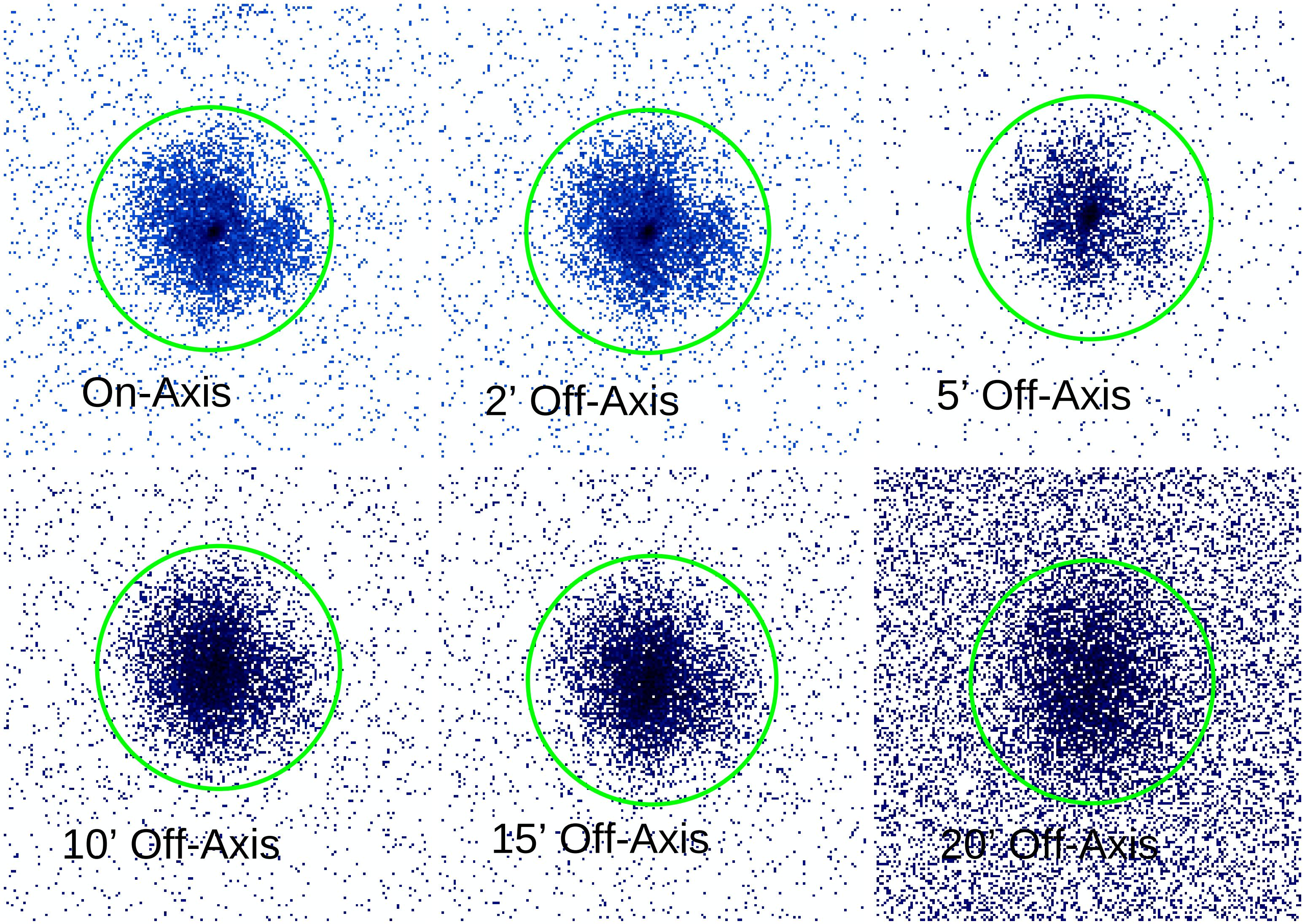
Plot Definitions

uncorrected count rates These are the rates measured from images with no exposure map corrections

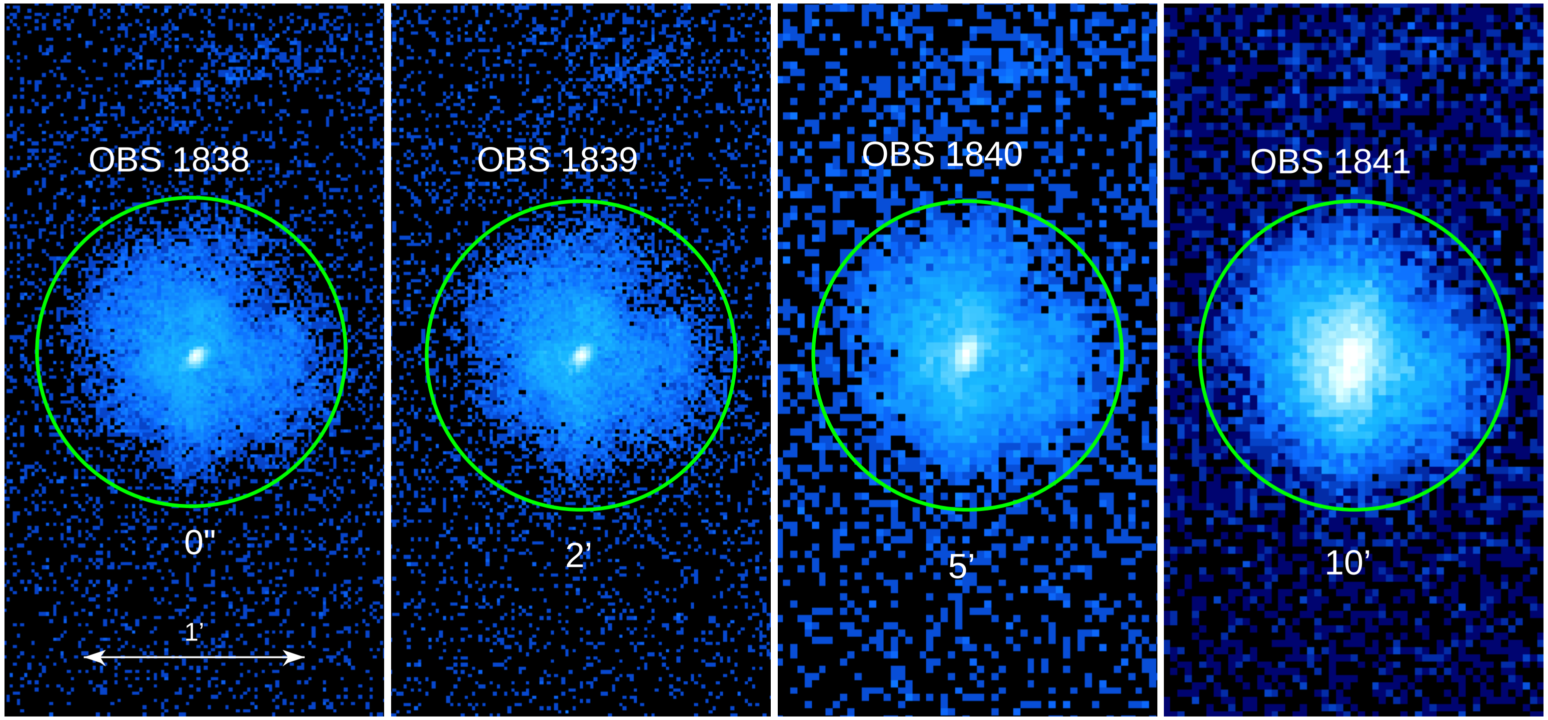
flux, detector model + HRMA EA=1 This flux is corrected for the ACIS QE, but not for HRMA vignetting. Ratios of these fluxes results in the HRMA vignetting correction.

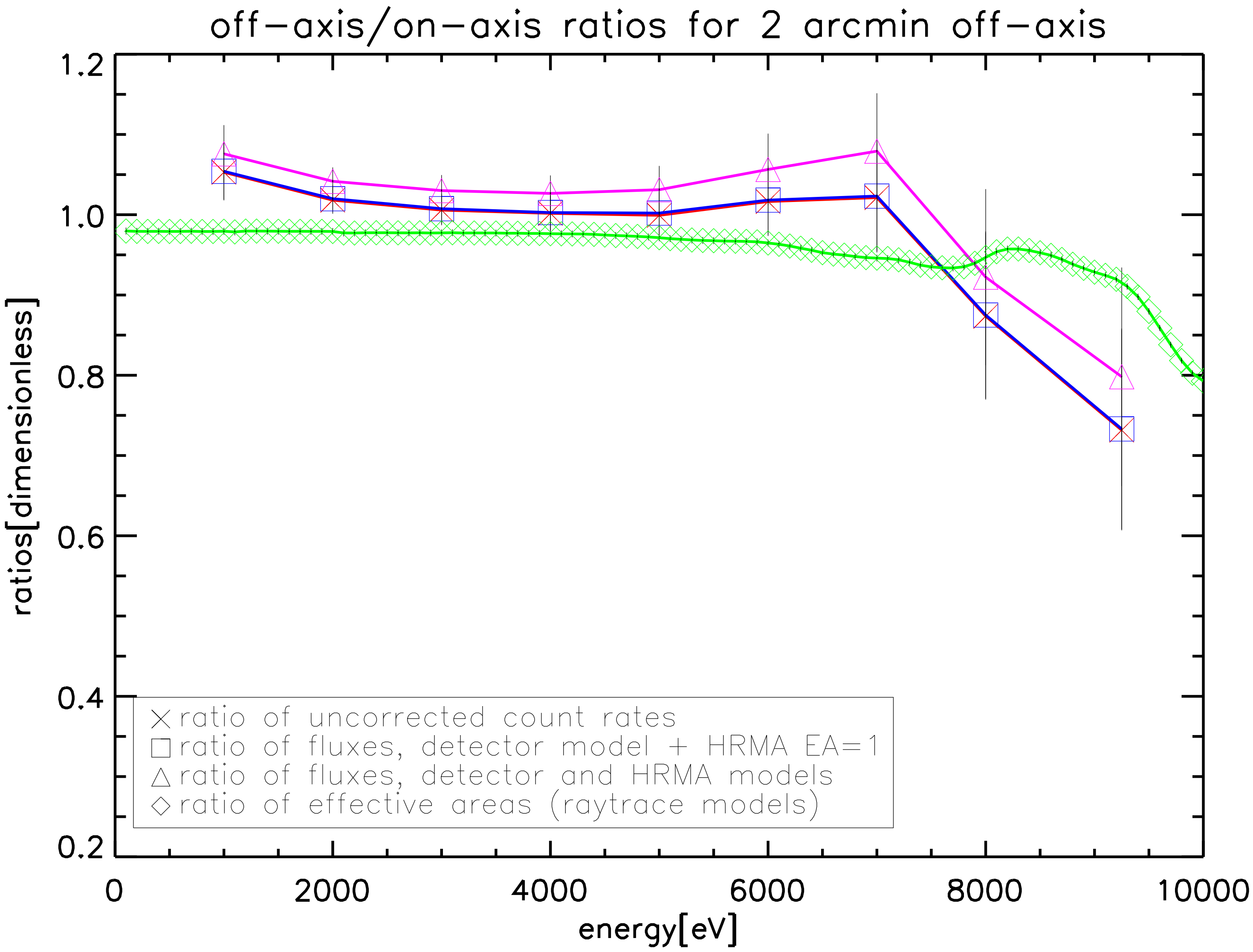
flux, detector and HRMA models This flux is corrected for the ACIS QE, and HRMA vignetting, using our HRMA model. Ratios of these fluxes should be equal to one if we are adequately correcting the vignetting and detector.

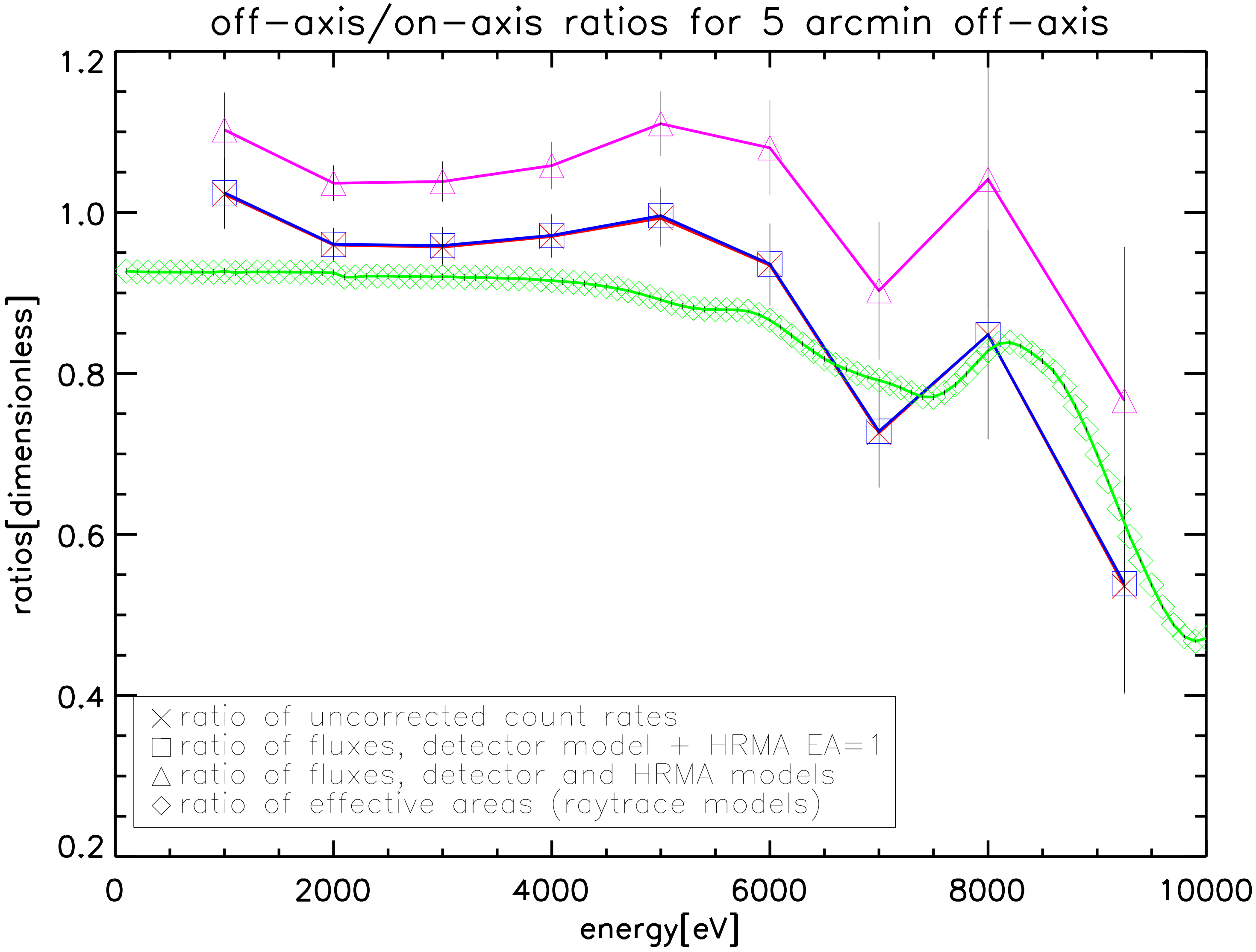
G21.5

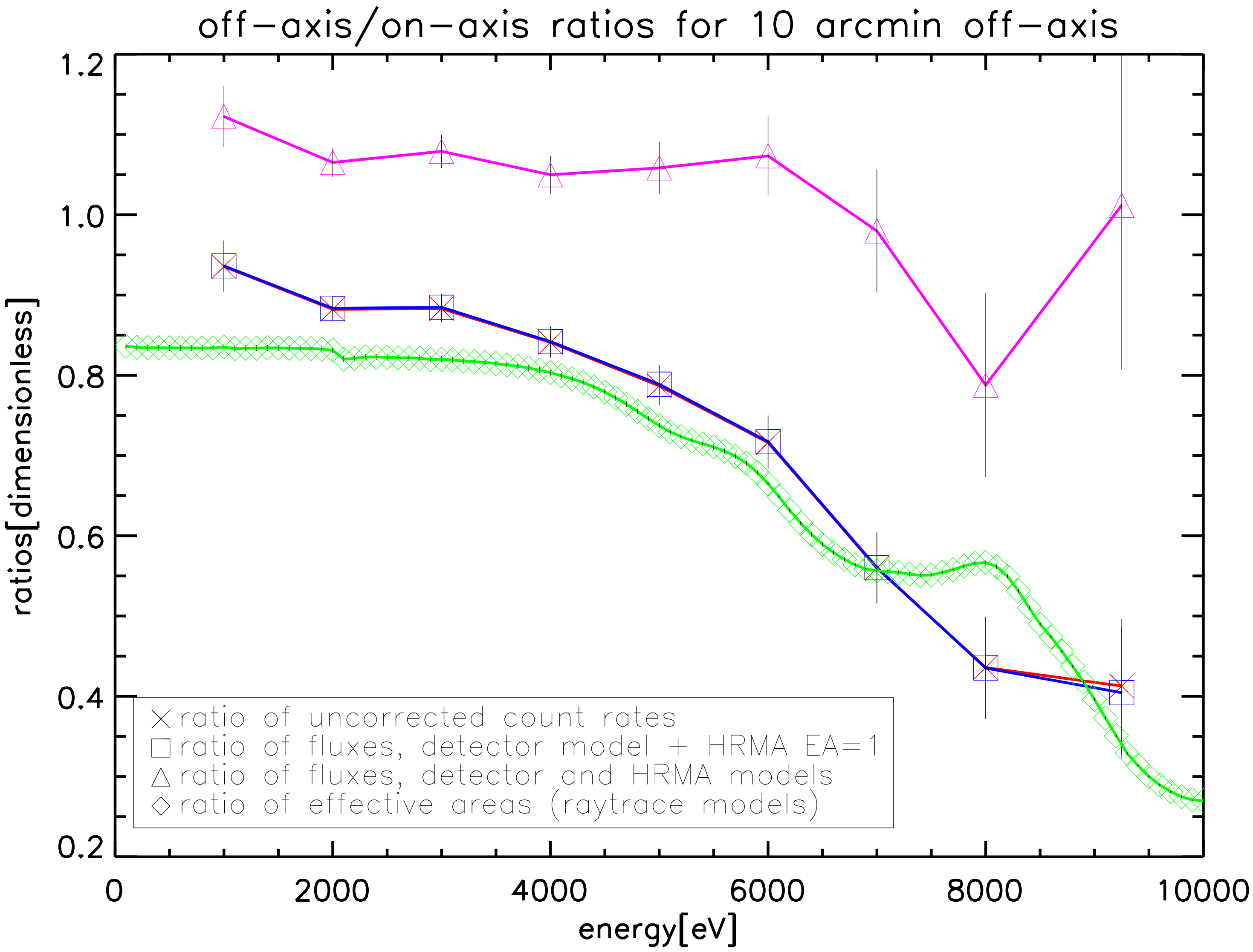


G21.5




off−axis/on−axis ratios for 2 arcmin off−axis
1.2
1.0
0.8
0.6
0.4
0.2
ratios[dimensionless]
0
2000
4000
6000
8000
10000
energy[eV]
ratio of uncorrected count rates
ratio of fluxes, detector model + HRMA EA=1
ratio of fluxes, detector and HRMA models
ratio of effective areas (raytrace models)


off−axis/on−axis ratios for 5 arcmin off−axis
1.2
1.0
0.8
0.6
0.4
0.2
ratios[dimensionless]
0
2000
4000
6000
8000
10000
energy[eV]
ratio of uncorrected count rates
ratio of fluxes, detector model + HRMA EA=1
ratio of fluxes, detector and HRMA models
ratio of effective areas (raytrace models)


off−axis/on−axis ratios for 10 arcmin off−axis
1.2
1.0
0.8
0.6
0.4
0.2
ratios[dimensionless]
0
2000
4000
6000
8000
10000
energy[eV]
ratio of uncorrected count rates
ratio of fluxes, detector model + HRMA EA=1
ratio of fluxes, detector and HRMA models
ratio of effective areas (raytrace models)

Conclusions

- The uncorrected counts and detector corrected fluxes are indentical within errors, indicating that variations in the detector QE are negligible in this analysis.
- The ratio of detector corrected fluxes should match the ratio of simulated effective areas if the latter are correct. In general the simulations indicate a larger vignetting than is measured, leading to a corrected off-axis fluxes which are higher than the on-axis flux. There seems to be better agreement where we have more data.