Effect of Contamination of the HRMA on the Optics' A_{eff}

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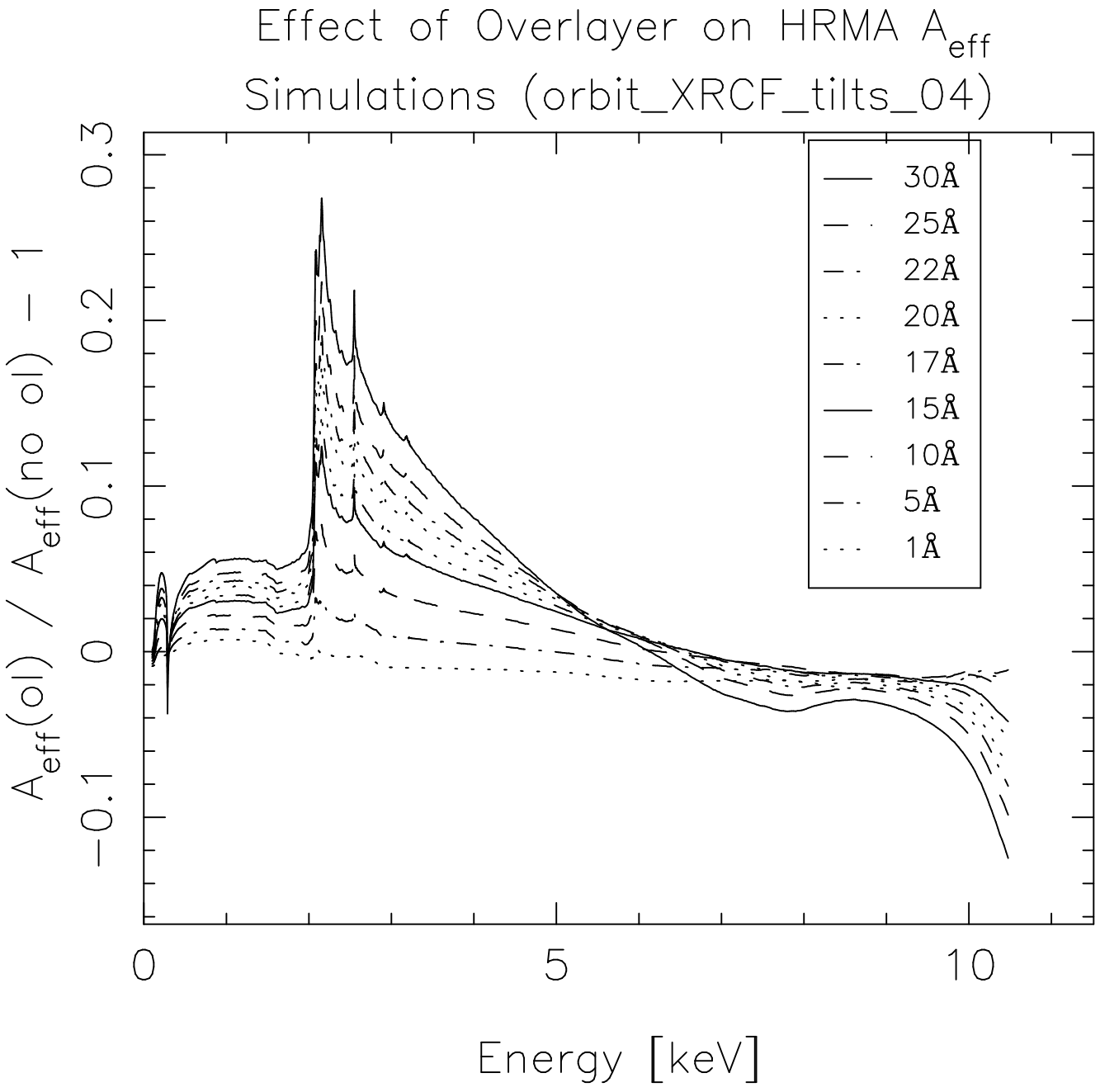
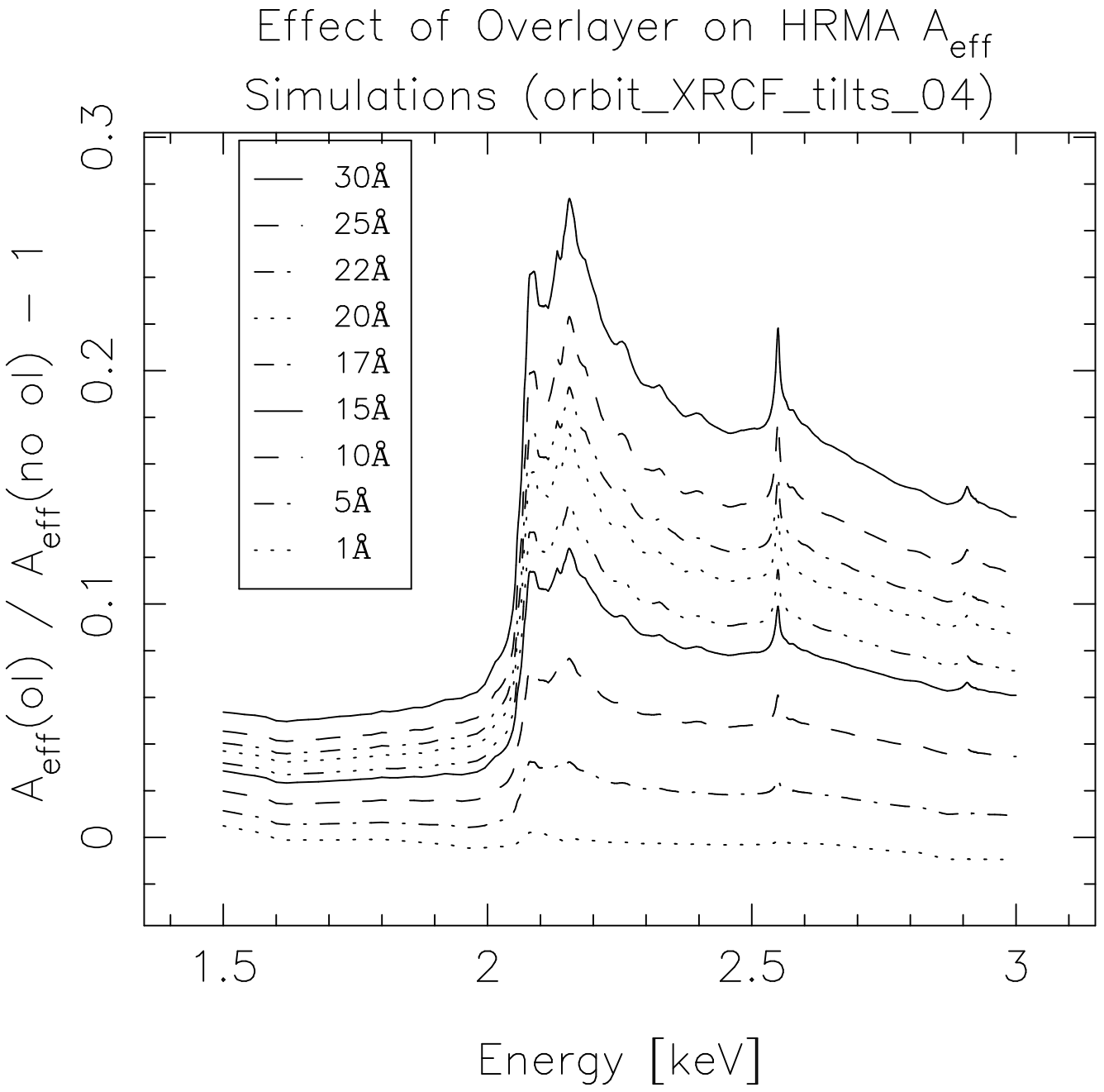
Effect of Contamination on On-axis A_{eff}

The most likely explanation for the observed discrepancy near the Ir MV edge is a thin ($\sim$ 15Å- 20Å) hydrocarbon contamination layer on the *Chandra* optics.

The optics depend upon very shallow grazing angles of the incident photons to achieve high reflectivity. These angles also increase the path length of the photons through the contamination layer, hence the sensitivity of the spectral response of the mirrors to such a thin contamination layer.


Effect of Overlayer on HRMA A_eff
Simulations (orbit_XRCF_tilts_04)
30Å
25Å
22Å
20Å
17Å
15Å
10Å
5Å
1Å
A_eff(ol) / A_eff(no ol) − 1
−0.1
0
0.1
0.2
0.3
0
5
10
Energy [keV]


Effect of Overlayer on HRMA A_eff
Simulations (orbit_XRCF_tilts_04)
30Å
25Å
22Å
20Å
17Å
15Å
10Å
5Å
1Å
A_eff(ol) / A_eff(no ol) − 1
0
0.1
0.2
0.3
1.5
2
2.5
3
Energy [keV]

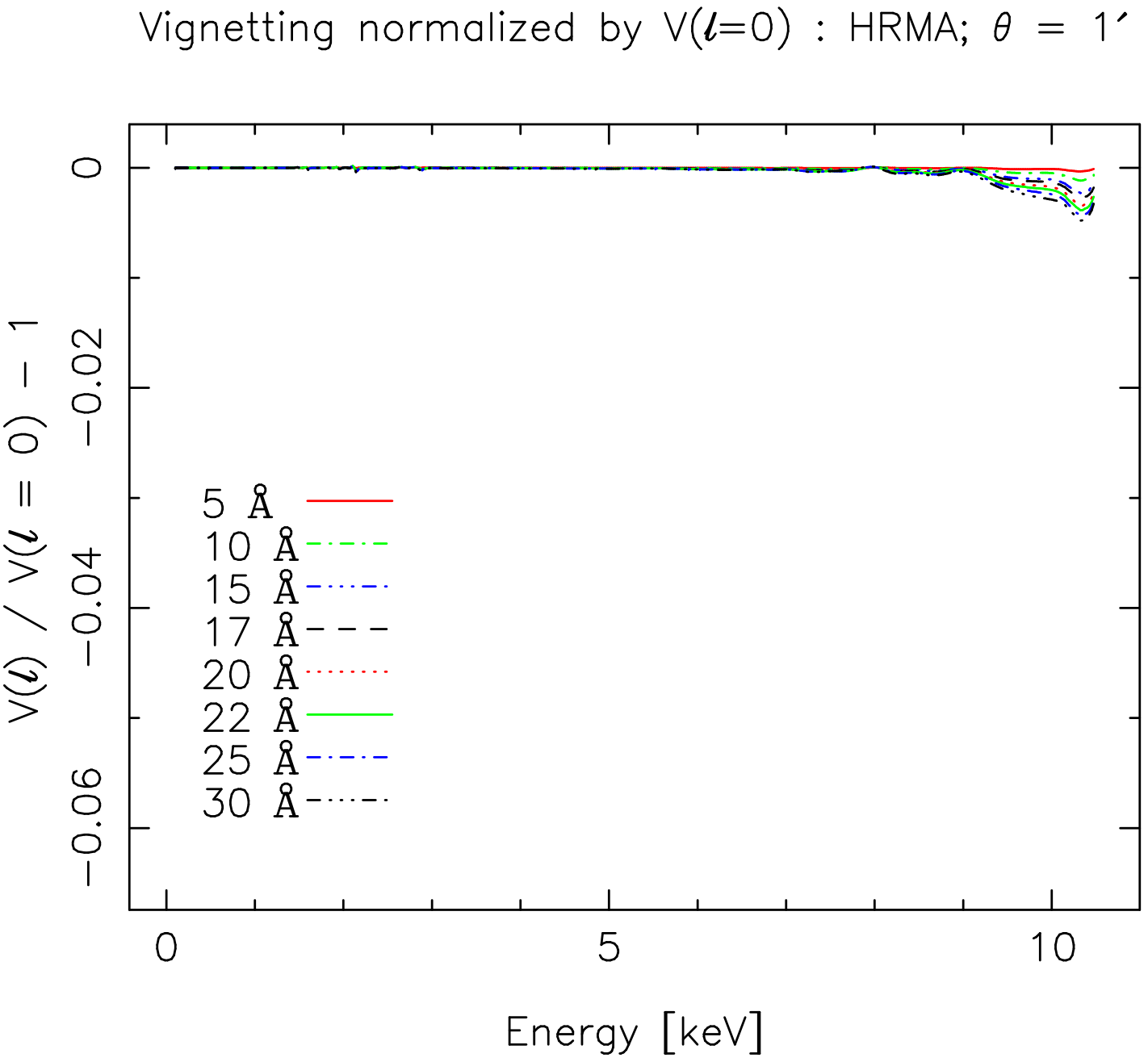
Effect of a Contamination layer on off-axis A_{eff}

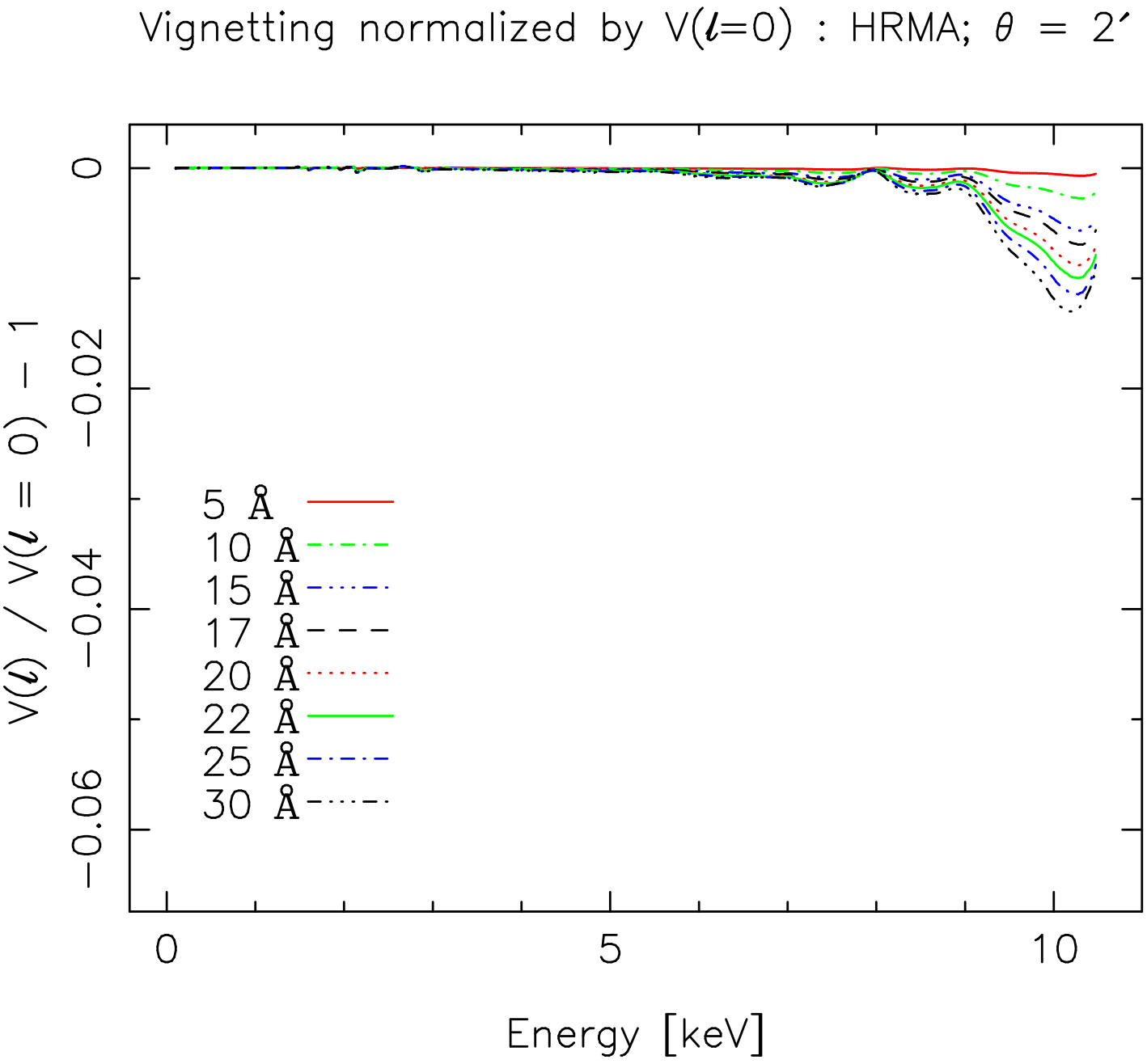
The presence of a contamination layer may affect the spatial distribution of the A_{eff}.

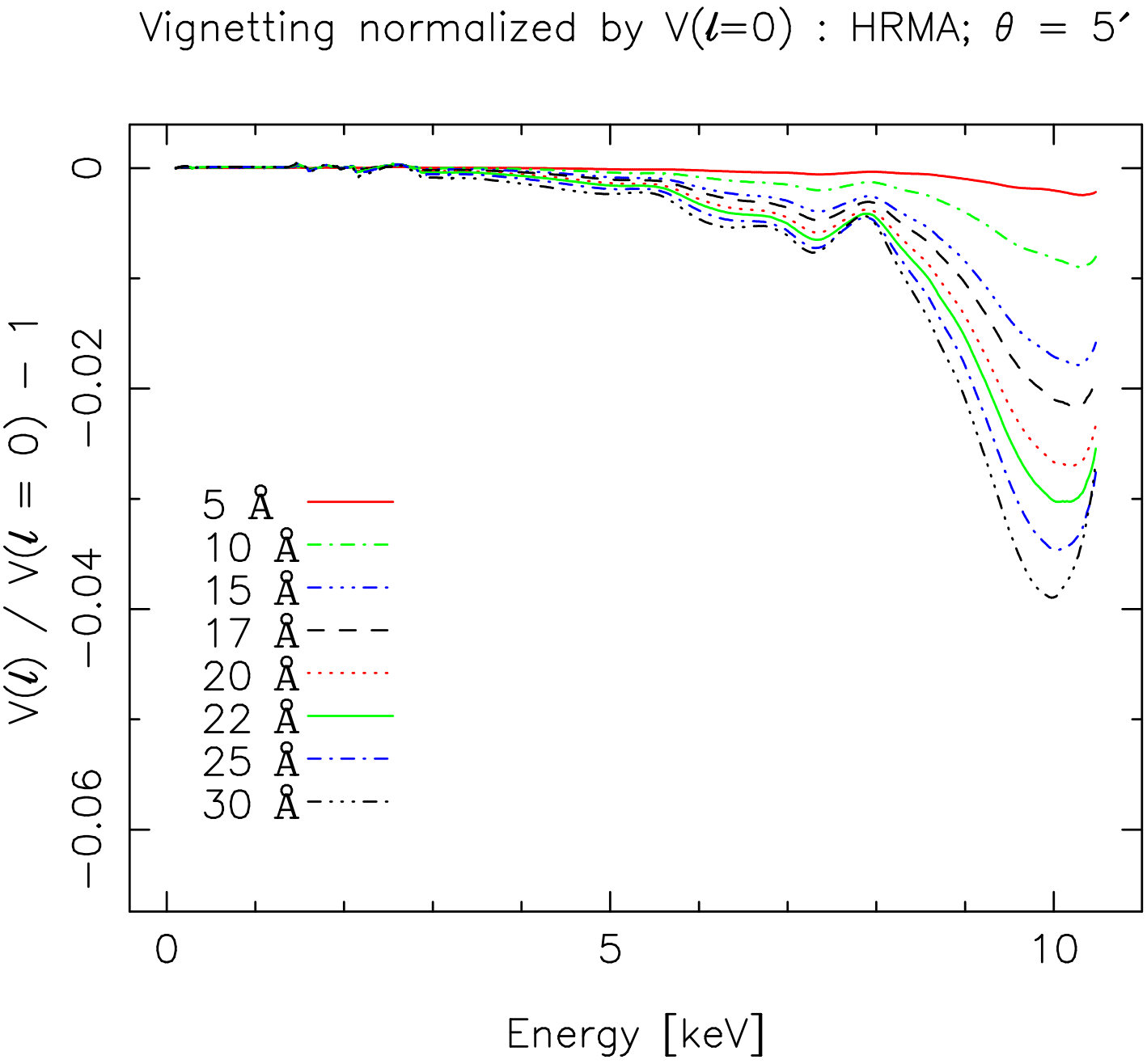
One of the concerns is that it might cause a change in the shape of the vignetting function.

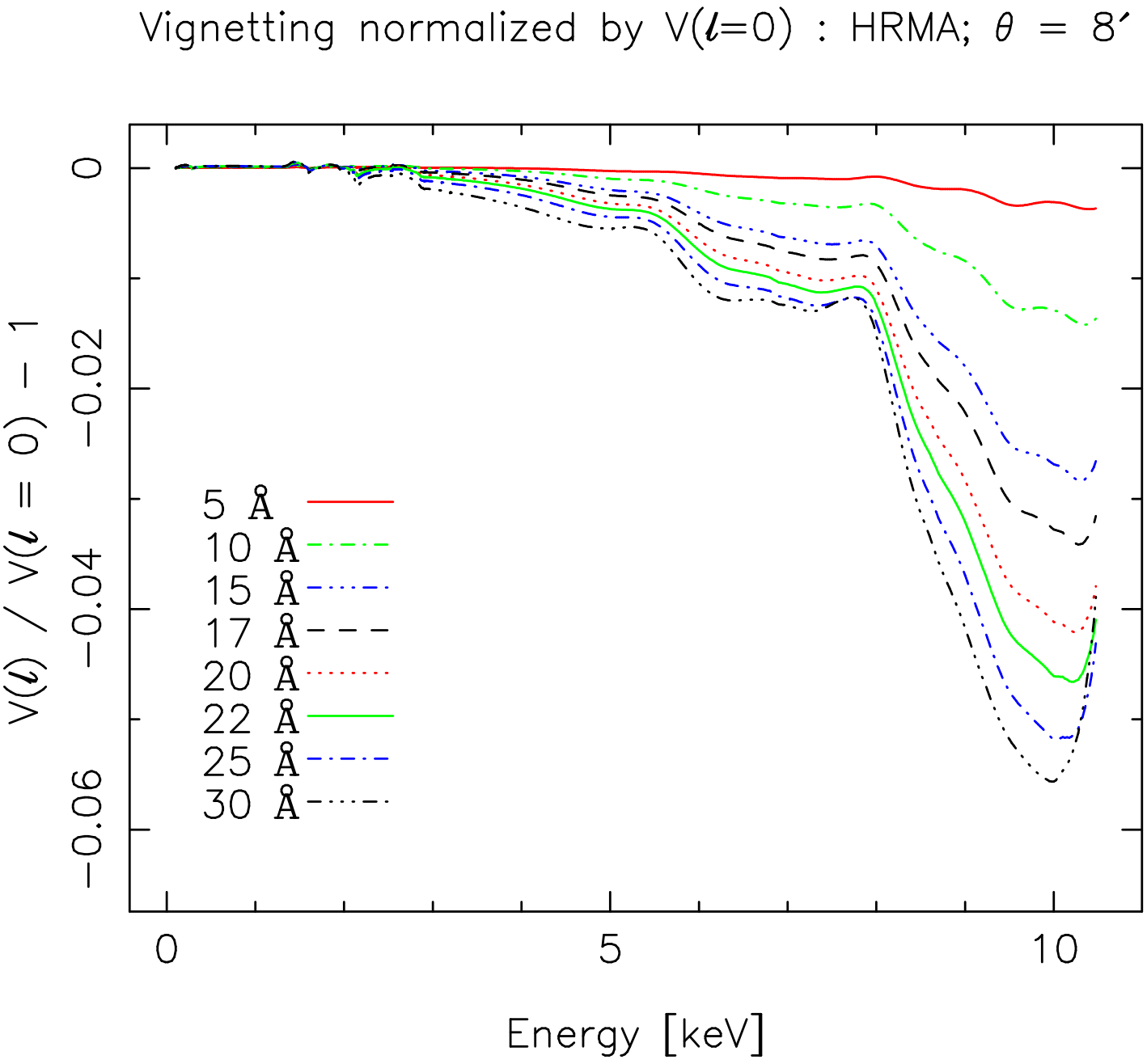
To study this, we have simulated the A_{eff} at various contamination layer thicknesses for several off-axis source positions. We compare the vignetting function (which is the ratio of the off-axis to on-axis values of A_{eff}) with and without the contamination layer

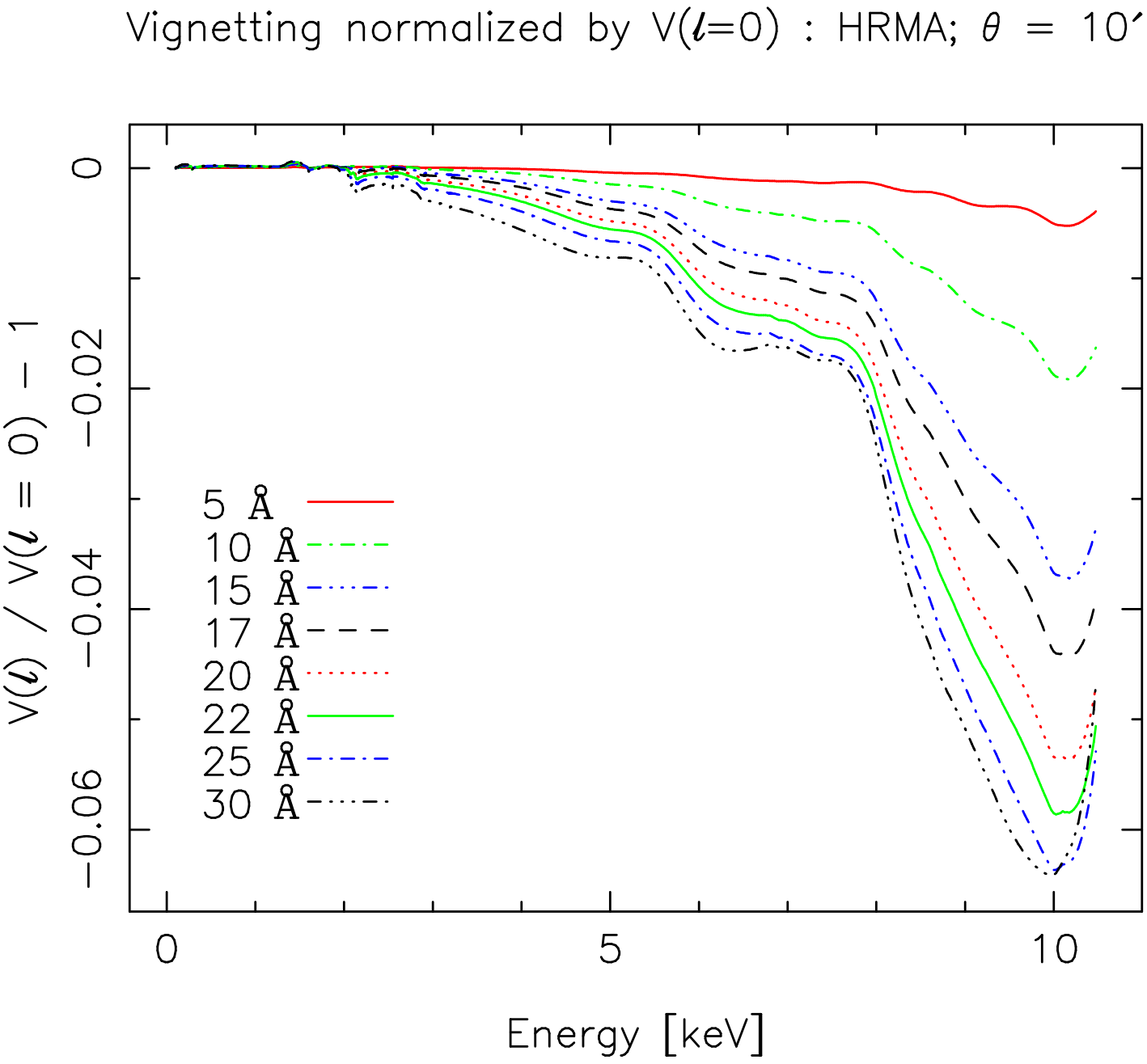
The functions have essentially the same shape; the difference is less than 1% for sources within $5'$ of the optical axis at energies below 8 keV.


Vignetting normalized by V(ℓ=0) : HRMA; θ = 1′
V(ℓ) / V(ℓ = 0) − 1
0
−0.02
−0.04
−0.06
0
5
10
Energy [keV]
5 Å
10 Å
15 Å
17 Å
20 Å
22 Å
25 Å
30 Å


Vignetting normalized by V(ℓ=0) : HRMA; θ = 2′
V(ℓ) / V(ℓ = 0) − 1
0
−0.02
−0.04
−0.06
0
5
10
Energy [keV]
5 Å
10 Å
15 Å
17 Å
20 Å
22 Å
25 Å
30 Å

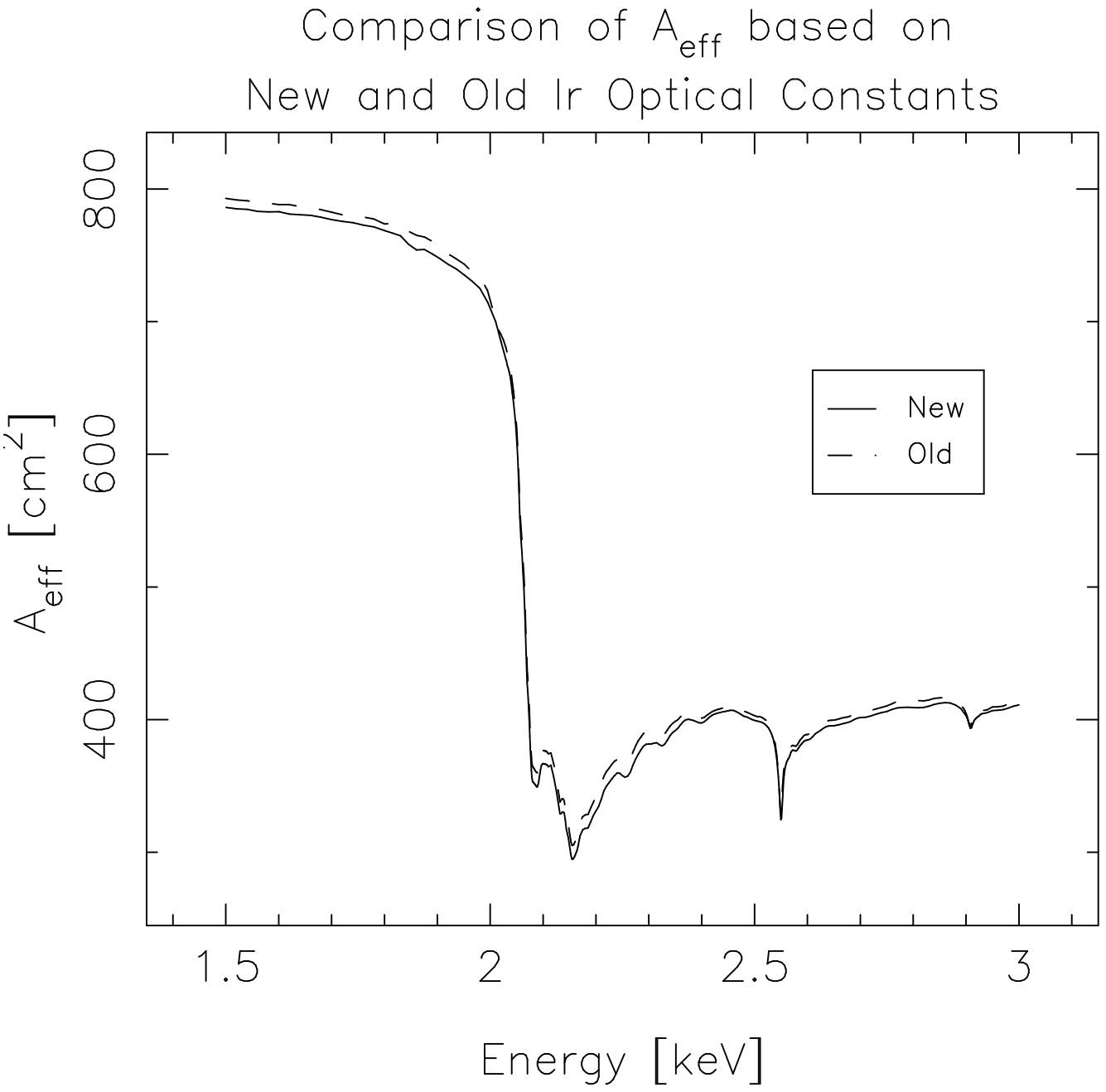

Vignetting normalized by V(ℓ=0) : HRMA; θ = 5′
V(ℓ) / V(ℓ = 0) − 1
0
−0.02
−0.04
−0.06
0
5
10
Energy [keV]
5 Å
10 Å
15 Å
17 Å
20 Å
22 Å
25 Å
30 Å

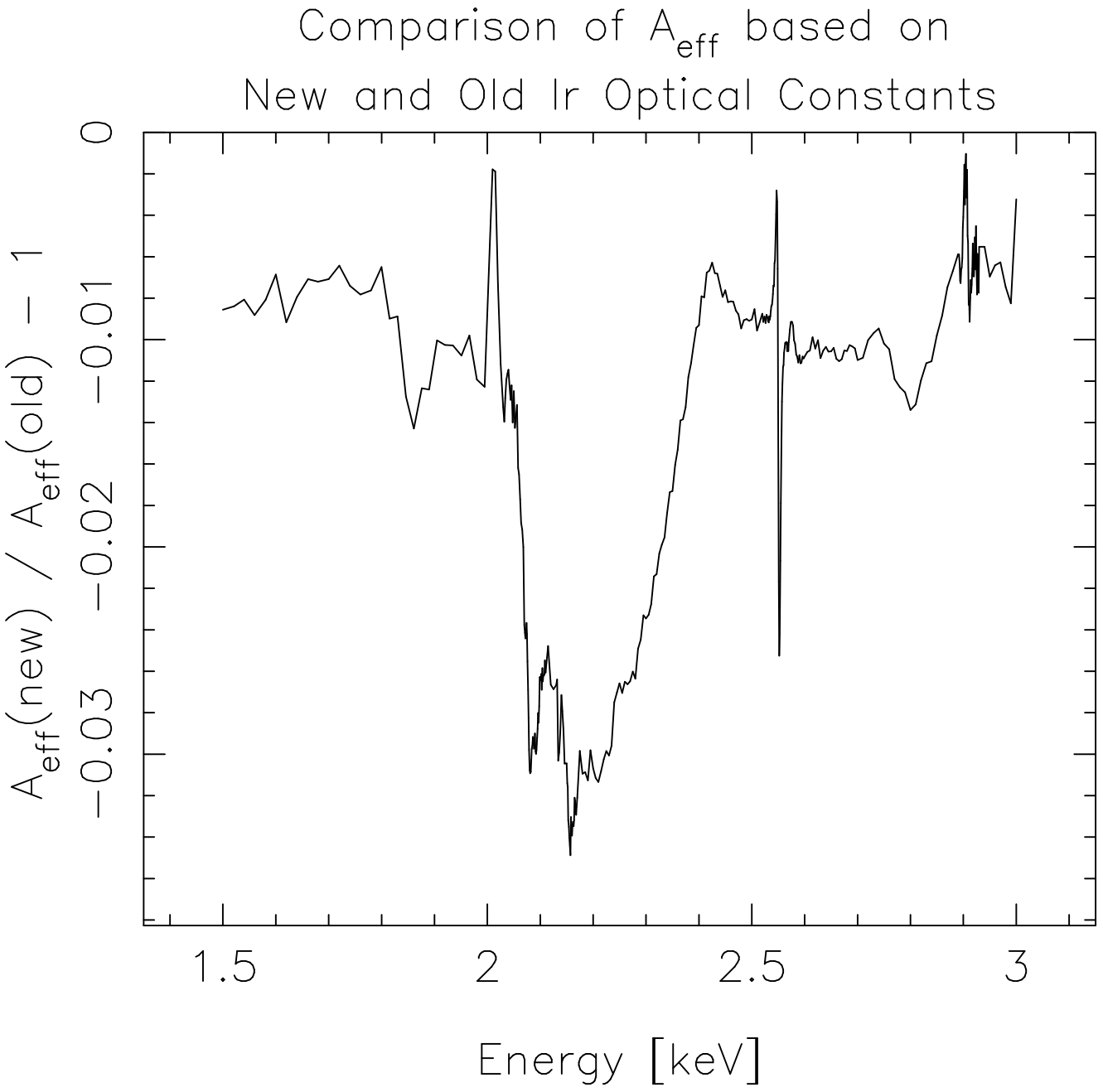

Vignetting normalized by V(ℓ=0) : HRMA; θ = 8′
V(ℓ) / V(ℓ = 0) − 1
0
−0.02
−0.04
−0.06
0
5
10
Energy [keV]
5 Å
10 Å
15 Å
17 Å
20 Å
22 Å
25 Å
30 Å


Vignetting normalized by V(ℓ=0) : HRMA; θ = 10′
V(ℓ) / V(ℓ = 0) − 1
0
−0.02
−0.04
−0.06
0
5
10
Energy [keV]
5 Å
10 Å
15 Å
17 Å
20 Å
22 Å
25 Å
30 Å

New Optical Constants

D. Graessle has released a new set of Ir optical constants, which affect the Ir MV edge region. Unfortunately, they result in a diminuation of the A_{eff}; this will require a larger contamination layer to match the observations.


Comparison of A_{eff} based on
New and Old Ir Optical Constants
A_{eff} [cm^2]
800
600
400
1.5
2
2.5
3
Energy [keV]
New
Old


Comparison of A_{eff} based on
New and Old Ir Optical Constants
A_{eff}(new) / A_{eff}(old) − 1
0
−0.01
−0.02
−0.03
1.5
2
2.5
3
Energy [keV]

Conclusions

- The addition of a contaminant layer does not significantly change the spatial distribution of focal plane vignetting within $5'$ of the otpical axis for energies below 8 keV.
- New optical constants may require a deeper contaminant layer.