HETGS Line Response Function

and

Cross-Calibration "Concordance"

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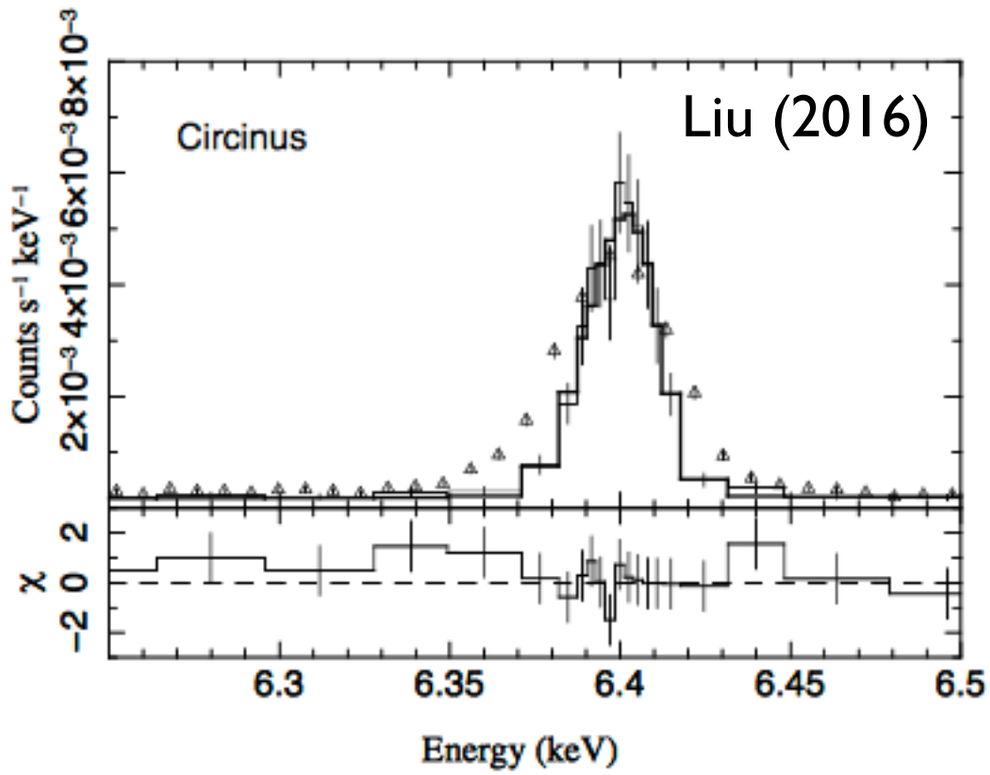
HETGS LRF Issue

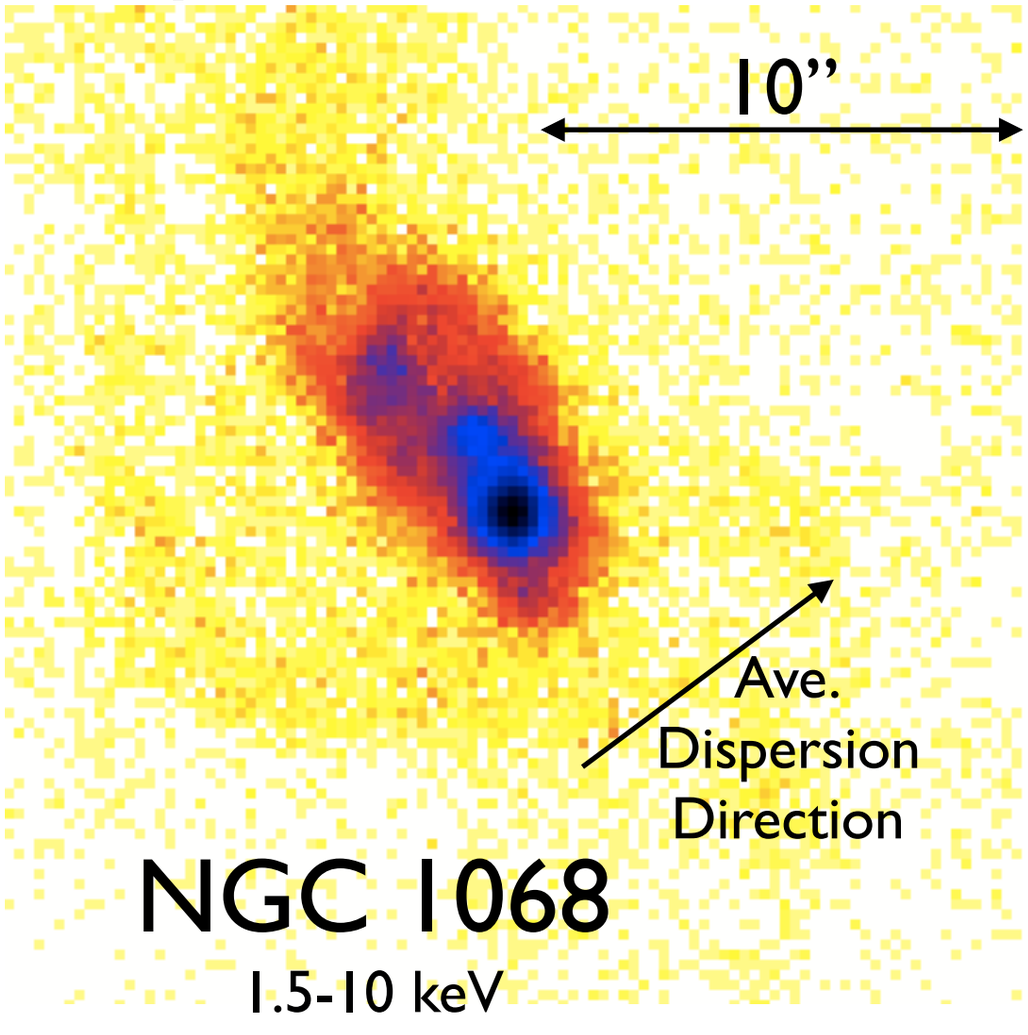
- Liu (astro-ph/1608.07351v1) claims 1st order lines are too broad
  - Data: 7 AGN Fe-Ka lines
  - Compared 1st to 2nd & 3rd orders
  - Largest effects are apparent in Circinus, Mrk 3, NGC 1068

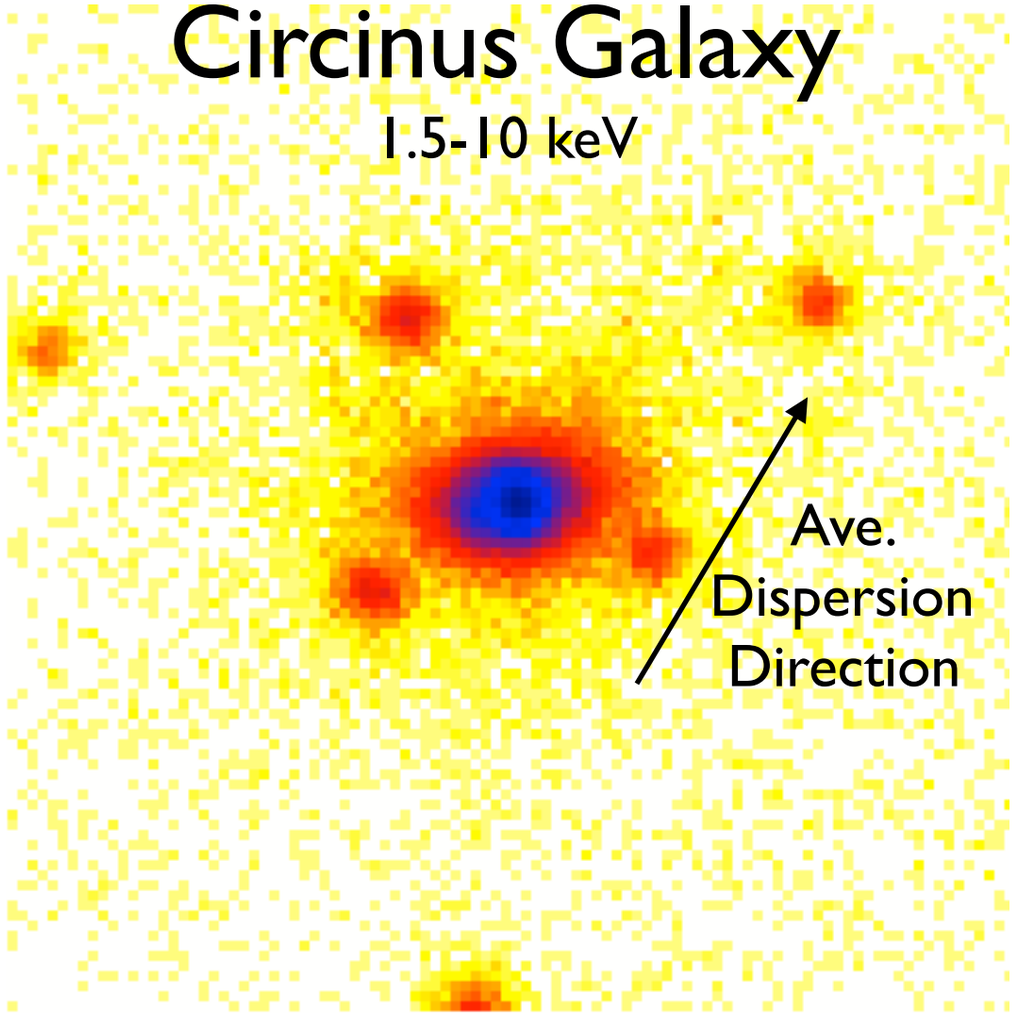


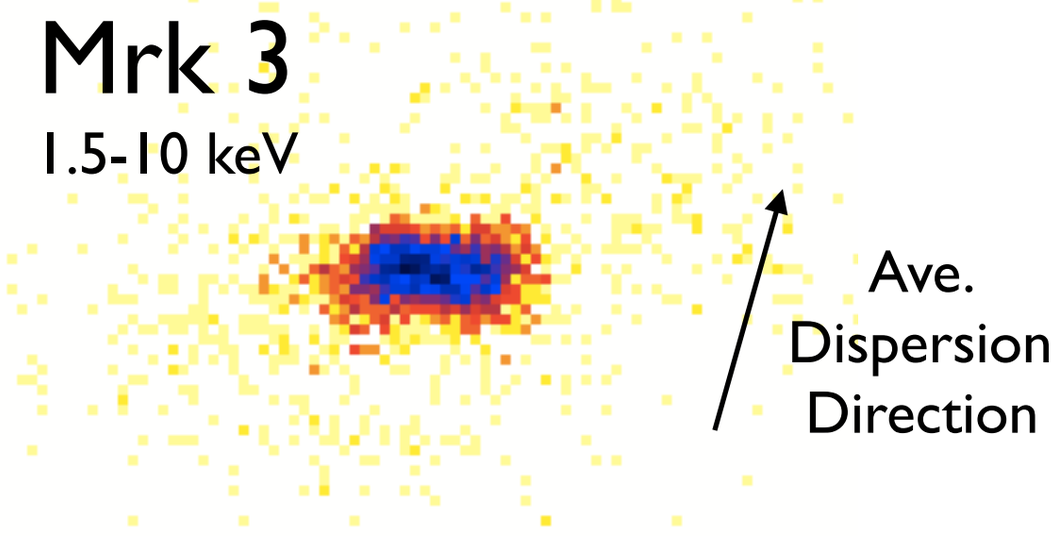
Name	$\sigma(\pm2,\pm3)$ eV	$\sigma(\pm1)$ eV	
Circinus	6.2 ± 1.4	9.8 ± 0.9	2.2σ
NGC 4151	11.4 ± 6.9	18.6 ± 2.9	
NGC 3783	11.3 ± 5.2	14.9 ± 3.0	
Mrk 3	$4.9^{+5.2}_{-4.9}$	19.0 ± 3.9	2.2σ
NGC 1068	$7.1^{+7.1}_{-7.1}$	18.0 ± 4.1	
NGC 4388	$10.0^{+7.6}_{-10.0}$	13.0 ± 7.5	
NGC 4507	$11.9^{+21.5}_{-11.9}$	14.6 ± 7.0	

Sources are Extended

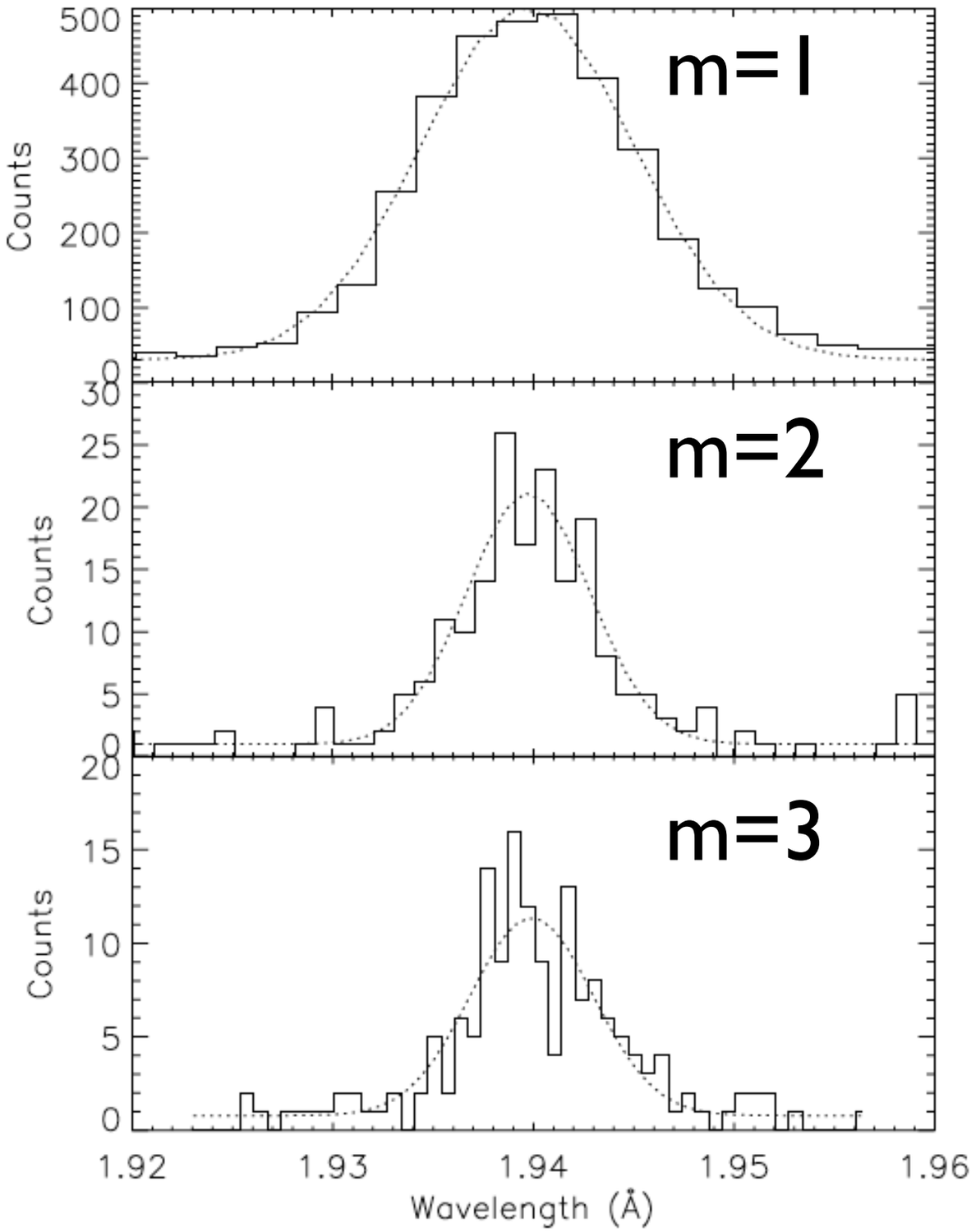
- Circinus, NGC 1068, Mrk 3 have extended photoexcited X-ray emission







Spatial v. Velocity Broadening



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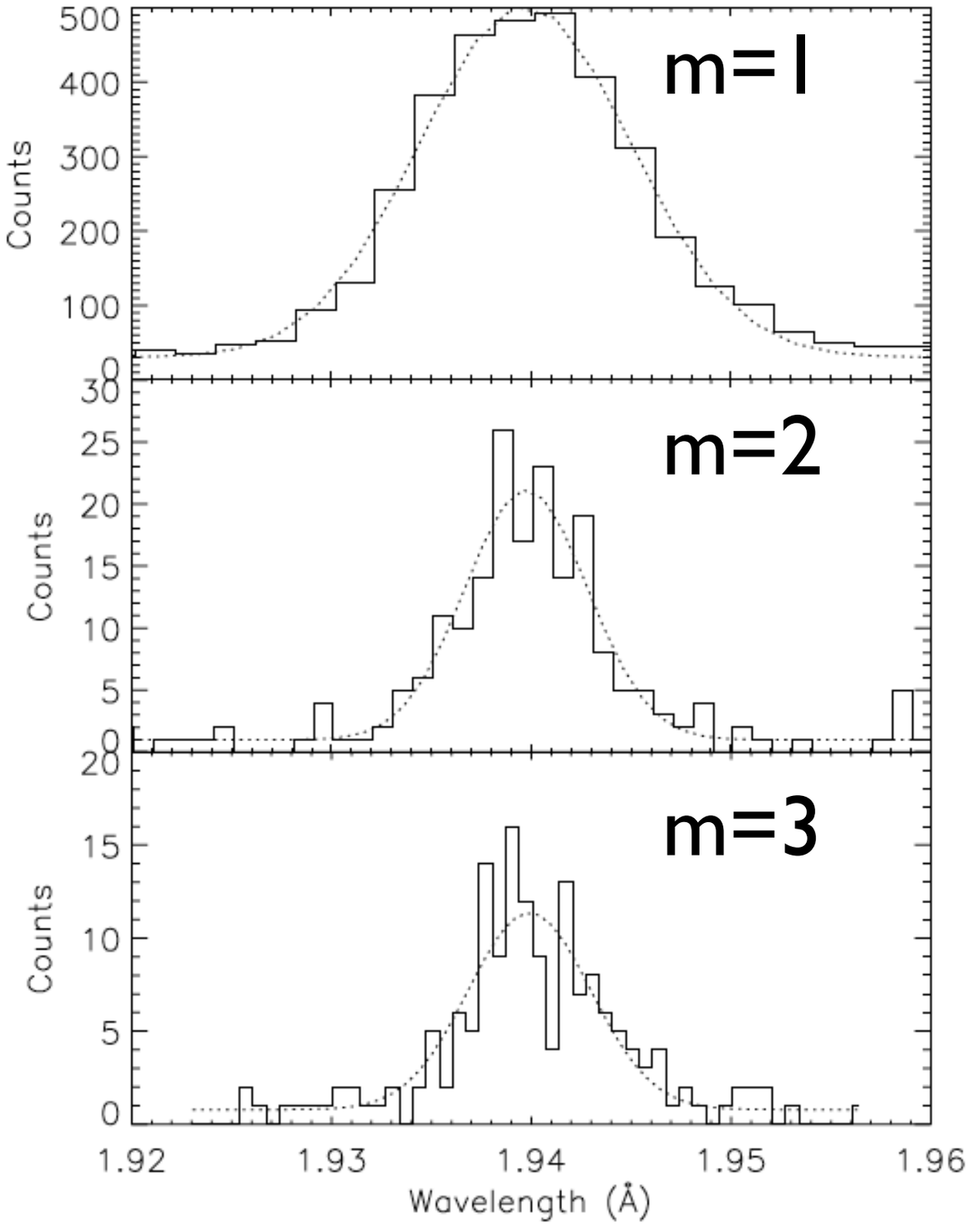
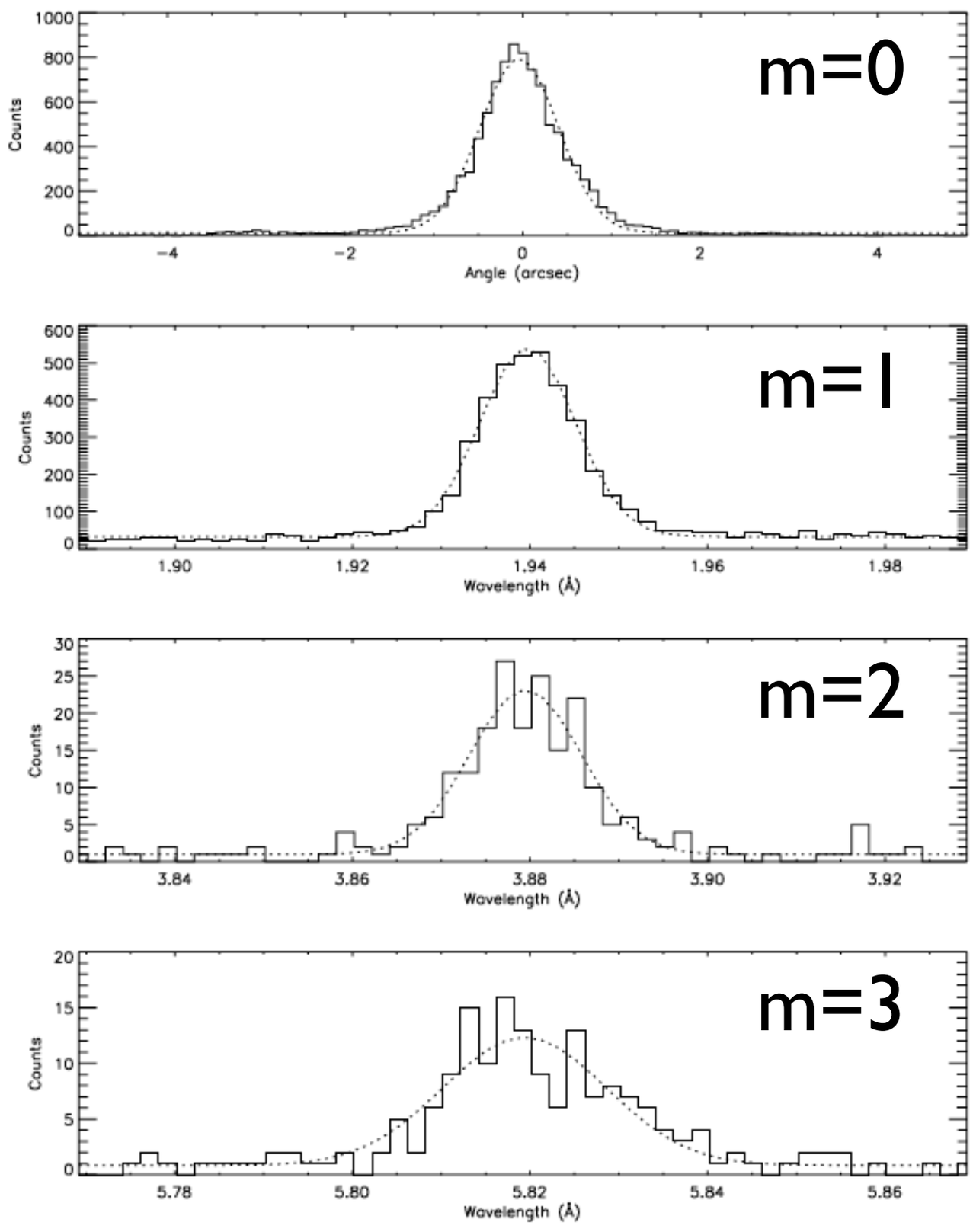
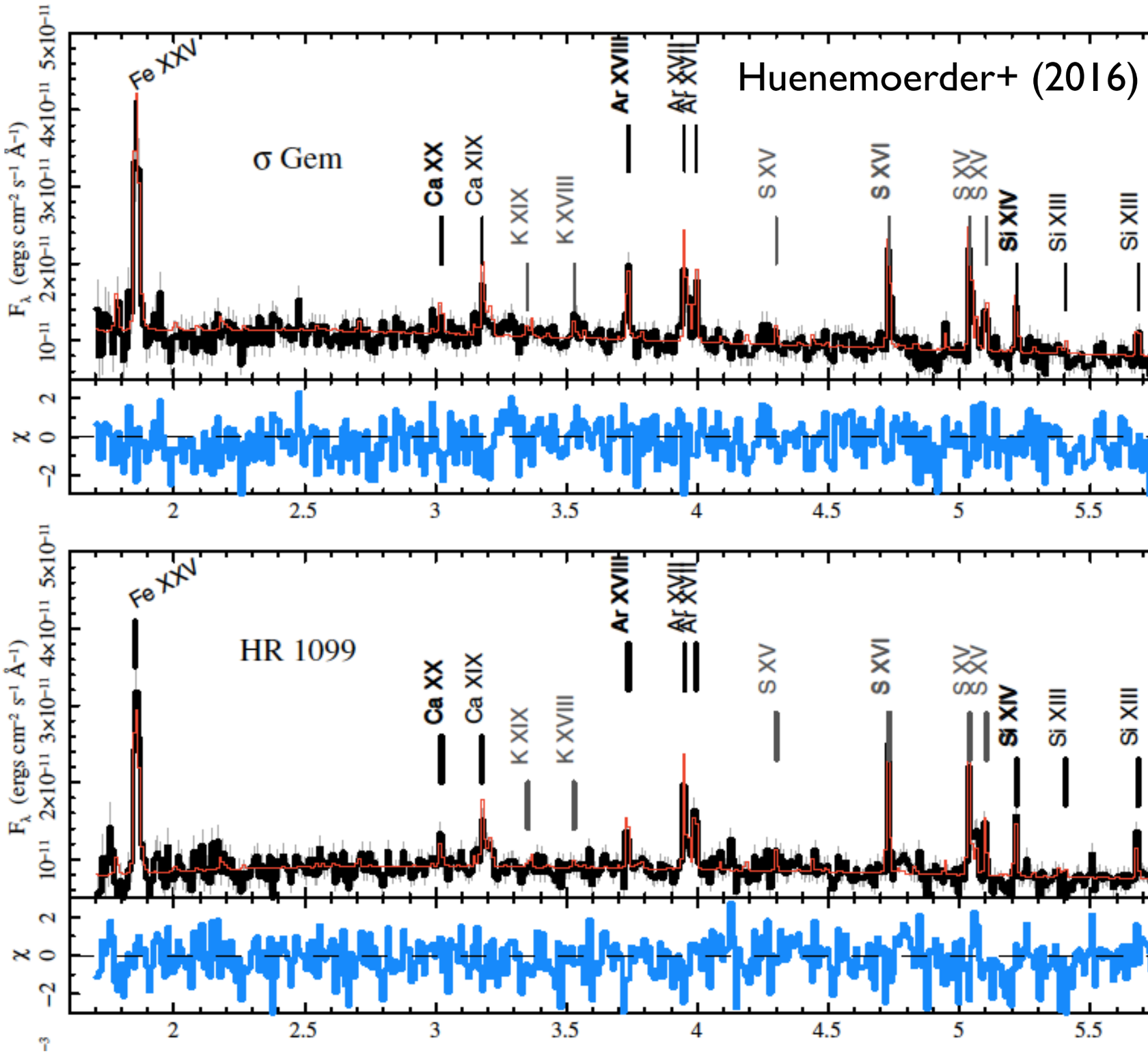




HETGS Update 9/27/16

Unresolved HETGS Lines

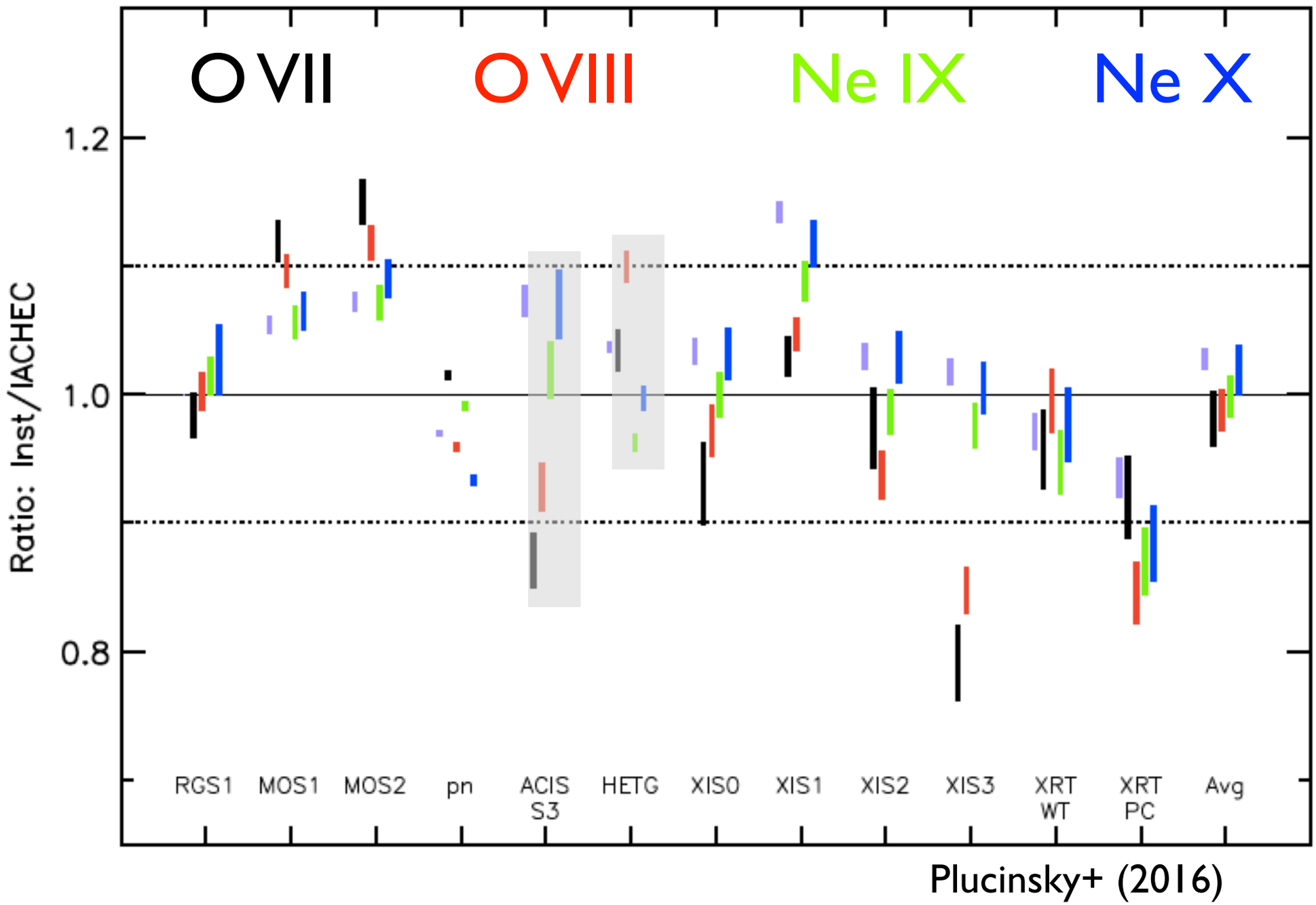
- HR 1099 HETG spectroscopy
- Fe XXV line is unresolved
- Lines fit well with released RMF



Cross-Cal Summary

- Assessment of cross-instrument calibration
  - 1E0102: Plucinsky+ ’16 (in press)
    - Lines in 0.55-1.02 keV range
    - Up to 15% differences with XMM pn
  - PKS 2155-304 & 3C 273: Madsen+ ‘16
    - LETG/ACIS and HETGS are 10% higher than all but XMM pn
    - XMM pn is 5-10% low of all but Chandra gratings
  - Cross-cal with XMM-Newton with blazars
    - Many joint observations of AGN
    - Fluxes compared in 5 narrow bandpasses
    - Analysis on hold pending XMM PSF analysis (pileup handling)
- Adjustment of EAs? — Concordance (Meng+ ’16)

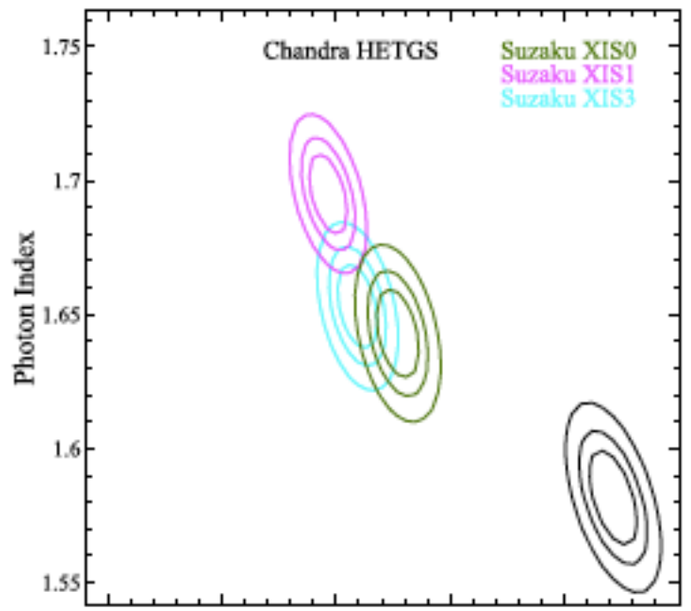
1E0102 Cross-Cal

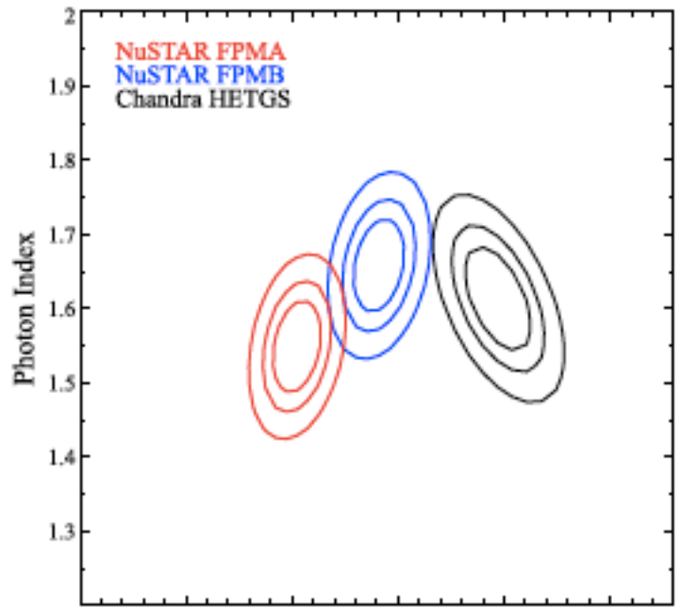


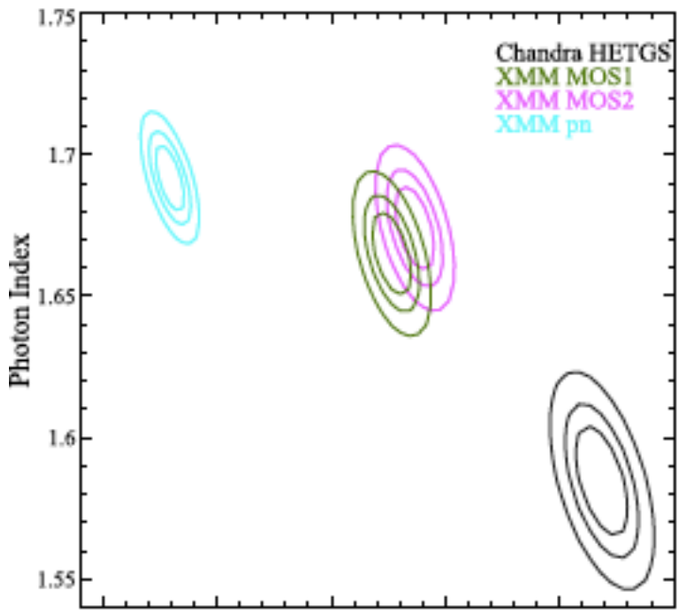
Plucinsky+ (2016)

Blazar Cross-cal Campaigns

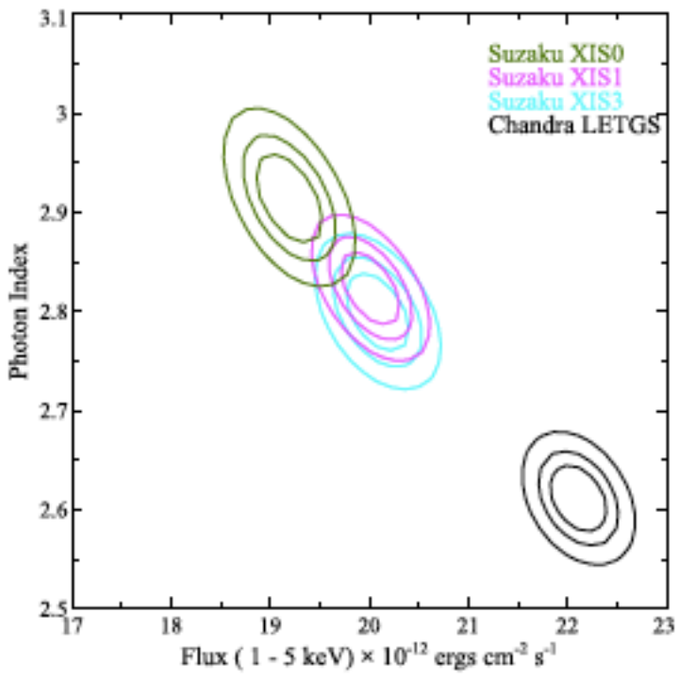
3C 273

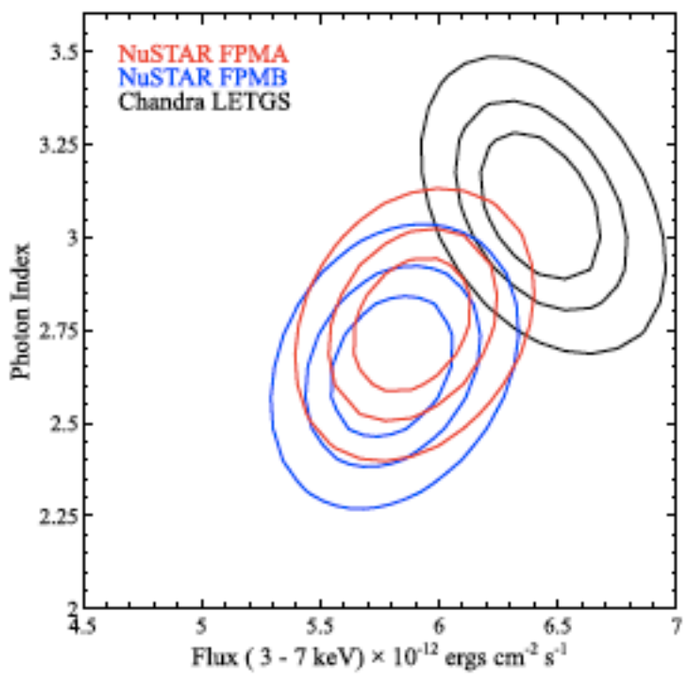


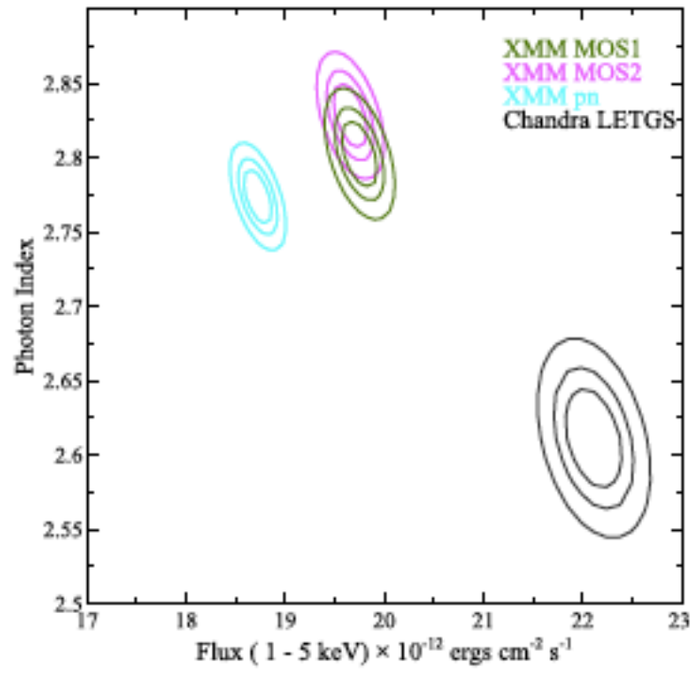




PKS 2155-304







Madsen+ (2016)

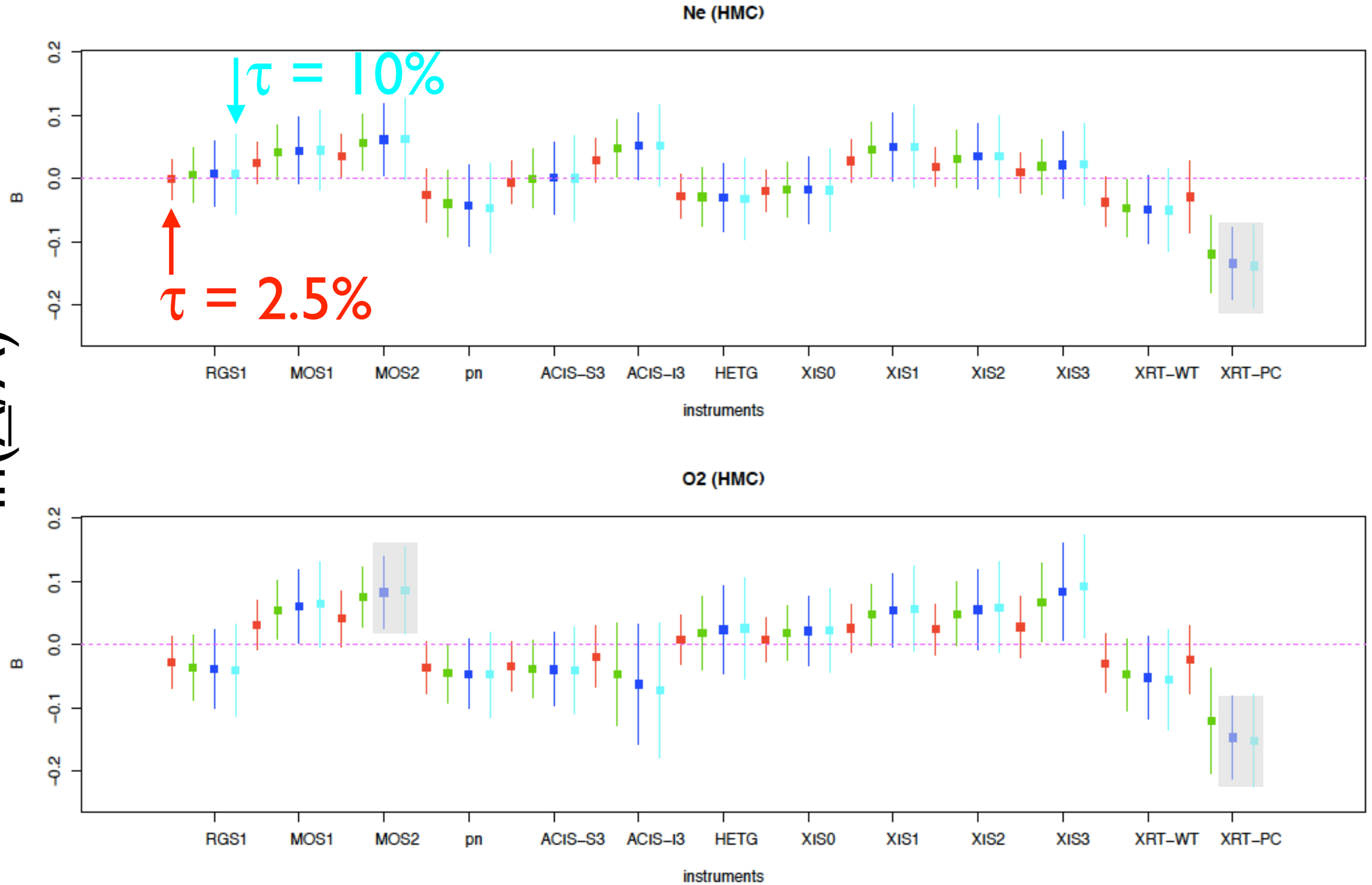
Concordance Overview

- Shrinkage method (Meng et al. 2016)
  - Start with C_{ij} = Counts for instrument i (1..N), source j (1..M)
  - Assume "true" areas A_i, "true" fluxes F_j, σ_{ij} = st. dev. in ln(C_{ij})
  - Estimate F_j by $f_j = C_{ij} / a_i$ (a_i = prior estimate of A_i)
  - Method determines "best" $\underline{F}_j$ and "better" EAs $\underline{a}_i = a_i^w (C_{ij}/\underline{F}_j)^{1-w}$
    - $w = 1/(1+M\tau^2/\sigma_{ij}^2)$, τ = "a priori" st.dev. in ln(a)
    - w = 0 means data dominate, drive change in EA
    - w = 1 means data are mediocre, EA isn't changed
    - brings $\underline{f}_j = C_{ij} / \underline{a}_i$ closer to *but not precisely* to $\underline{F}_j$
- IACHEC team sets τ, runs shrinkage analysis
  - IACHEC team recommends changes from a_i to $\underline{a}_i$
  - Process runs for each of many bandpasses "independently"

Concordance Actions & Plan

- Done:
  - Nail down the math
  - Simulate & analyze sample data sets
  - Supply "real", trial data sets (1E0102, 2XMM, XMM blazars)
  - Apply method to trial data
- Plan:
  - Publish method (Meng/Chen+ '16, Annals of Applied Statistics)
  - Publish trial results (Marshall+, AJ or PASP)
  - Add more IACHEC cross-cal results, present at IACHEC # 12
  - Add complexity
    - use smoothness from global models
    - consider handling of RMF uncertainties
    - compare to MCCAL, pyBLoCXS

Concordance 1: 1E0102

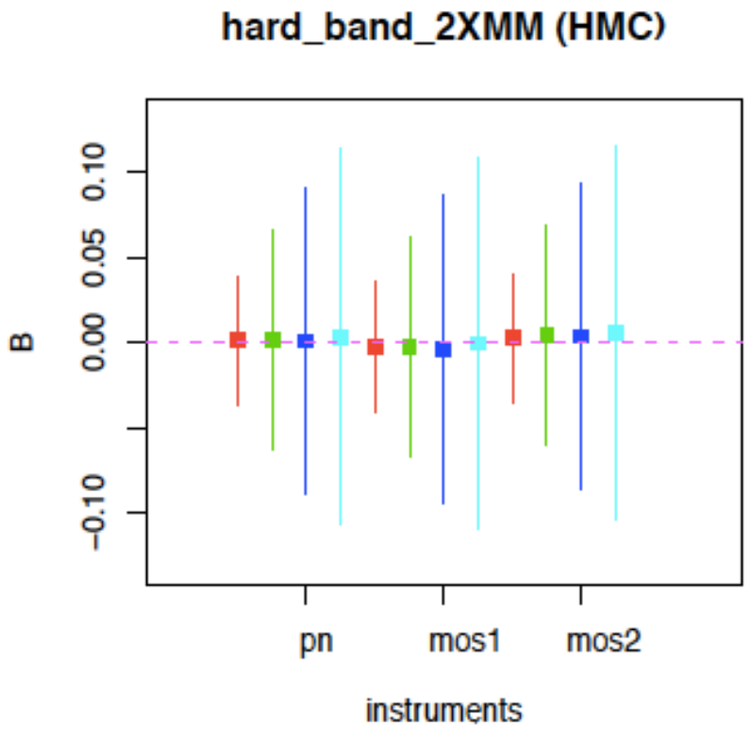


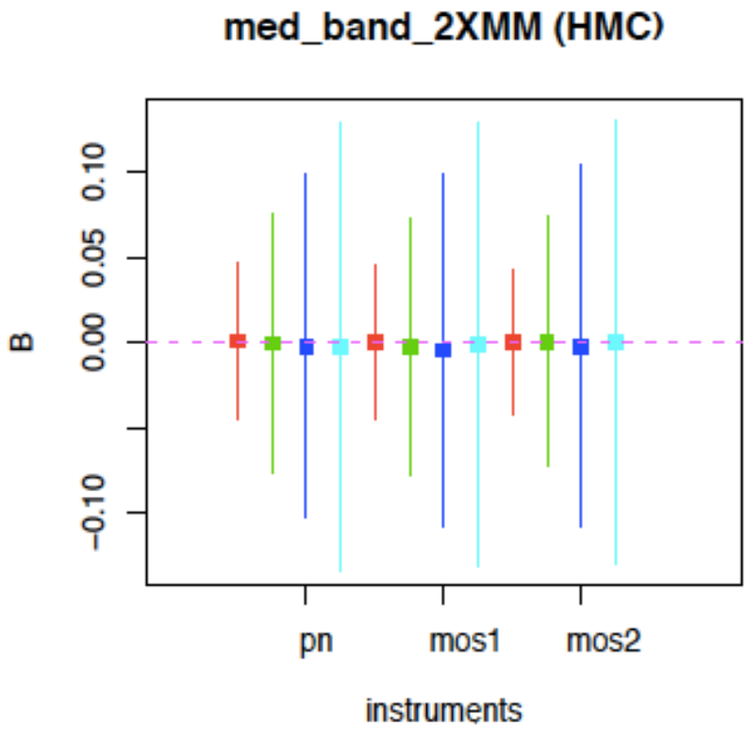
ln(A/

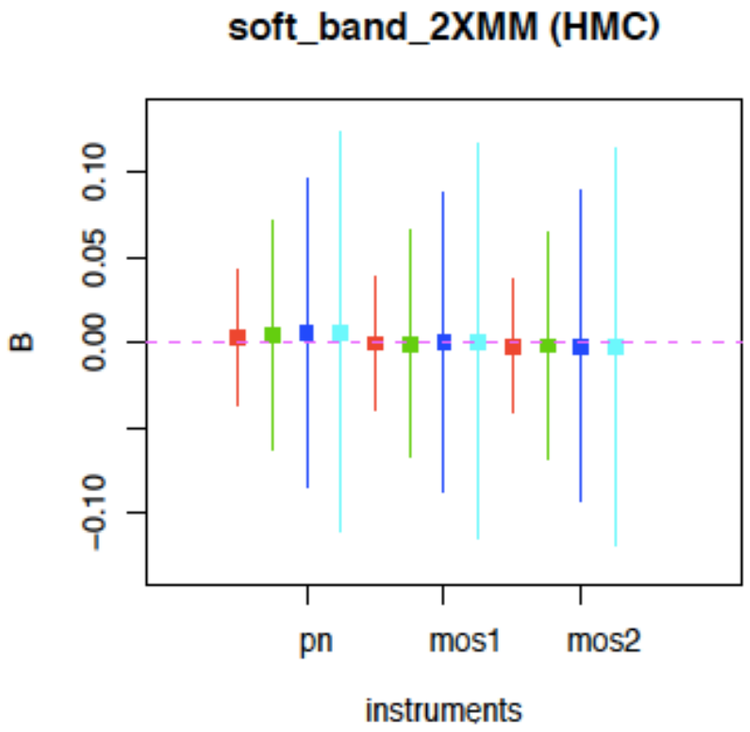
Concordance 2: 2XMM

- Data from Matteo Guainazzi
- Based on 42 sources from the 2XMM catalog
- Unaffected by pileup; no EA change required

ln(A/A)



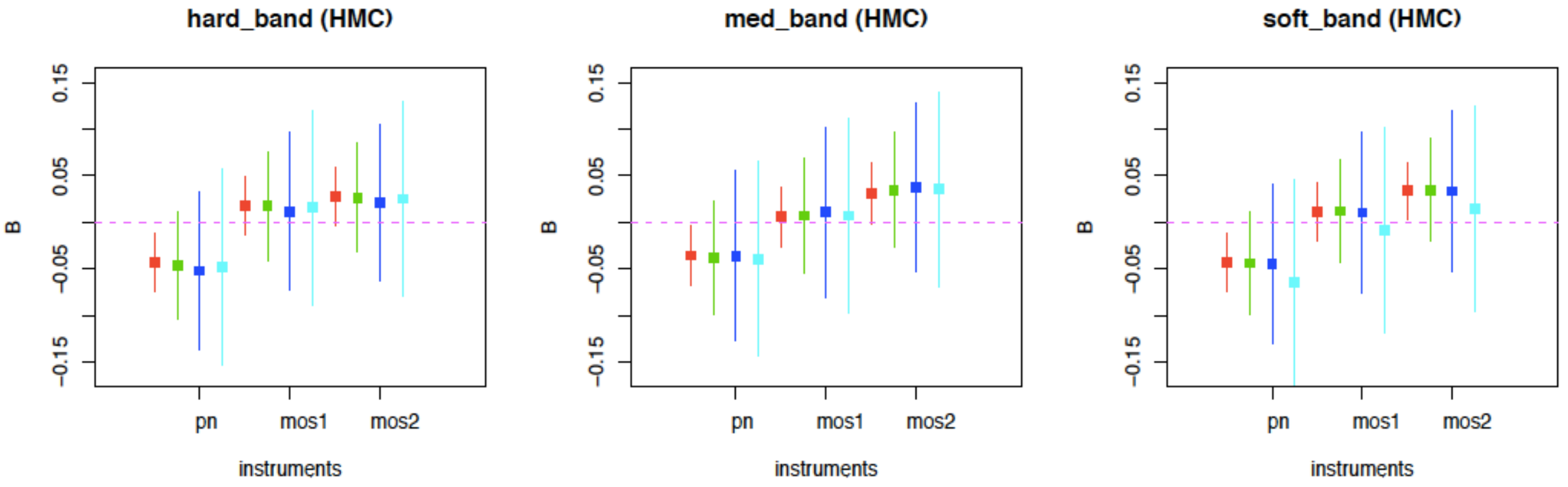




Concordance 3: XMM Blazars

- 117 bright XMM sources from Matteo Guainazzi
- PSF clipped to reduce effect of pileup
- Result: 5% adjustment to pn indicated, 1-2% for MOS

ln(A/A)



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