



## *Thermal SNRs Working Group Report*

*Paul Plucinsky on behalf of the IACHEC  
Thermal SNR Working Group*



## *Thermal SNR Working Group*

*One of the “Standard candle” working groups.*

*This presentation is a summary report of this group’s work:*

XMM-Newton	Andy Pollock, Matteo Guainazzi, Martin Stuhlinger (ESAC)
Chandra HETG	Dan Dewey (MIT)
XMM-Newton MOS	Steve Sembay (Leicester)
XMM-Newton pn	Frank Haberl (MPE)
Chandra ACIS	Jenny Posson-Brown & Paul Plucinsky (SAO)
Suzaku XIS	Eric Miller (MIT)
Swift XRT	Andrew Beardmore (Leicester)
Models	Adam Foster & Randall Smith (SAO)

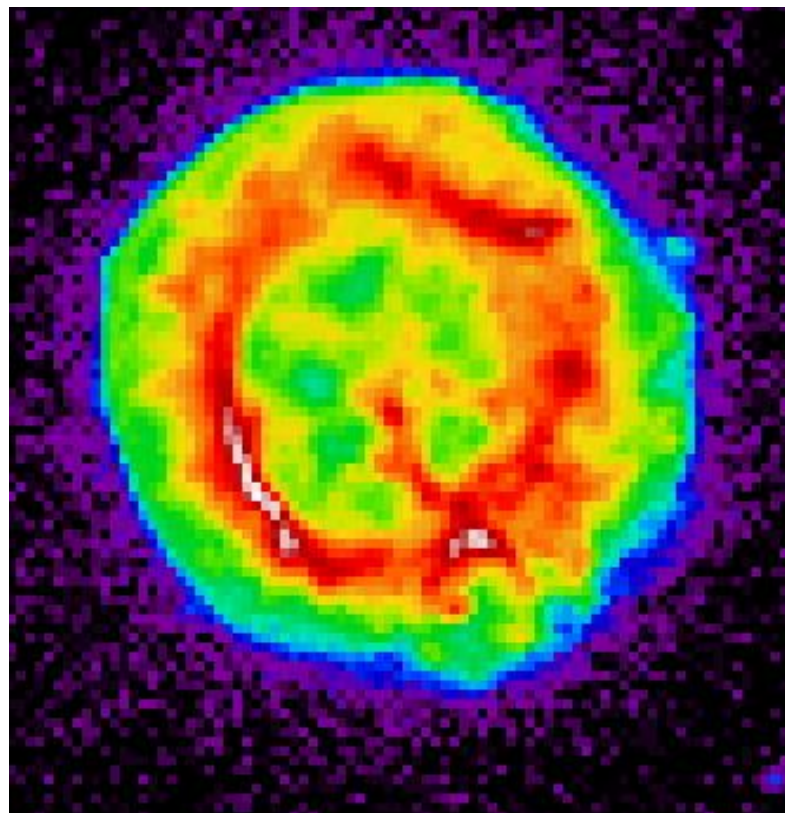
**Previous work published in 2 SPIE papers:**

**Plucinsky et al. 2008 SPIE**

**Plucinsky et al. 2012 SPIE**

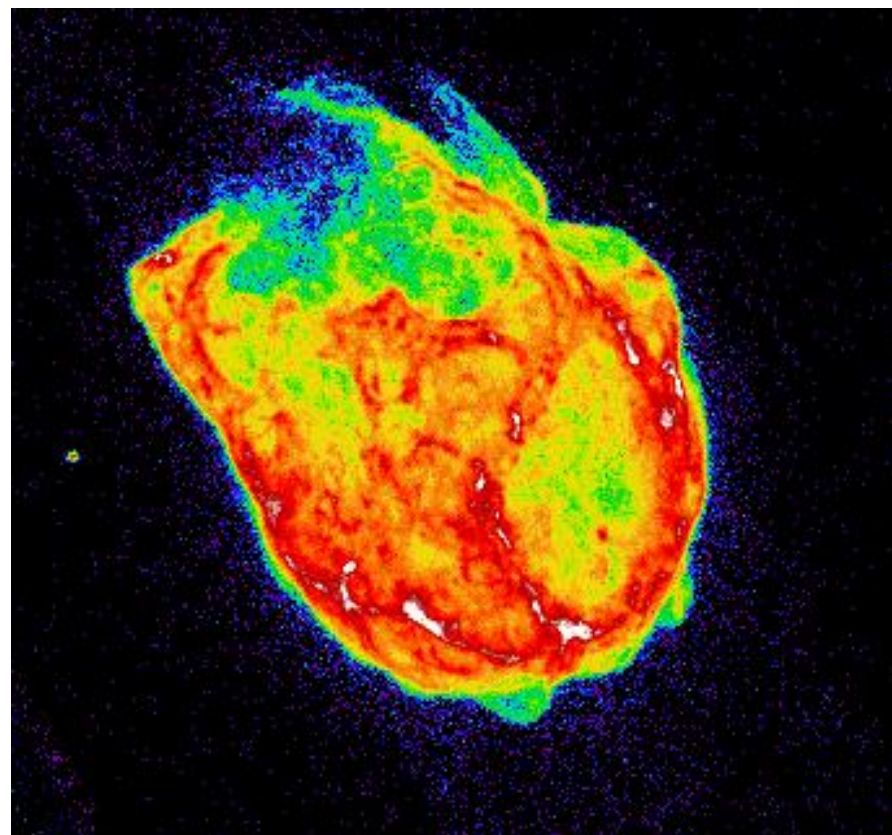


E0102: X-ray brightest in the SMC  
0.77X0.77 arcmin, 13X13 pc  
 $t \sim 1,000$  yr (Hughes et al. 2001)  
 $L_X(0.3-10.0 \text{ keV}) = 2.5 \times 10^{37} \text{ ergs s}^{-1}$   
no compact object  
“O-rich” core-collapse SNR



ACIS 0.35-8.0 keV

N132D: X-ray brightest in the LMC  
1.7X2.3 arcmin, 25x33.5 pc  
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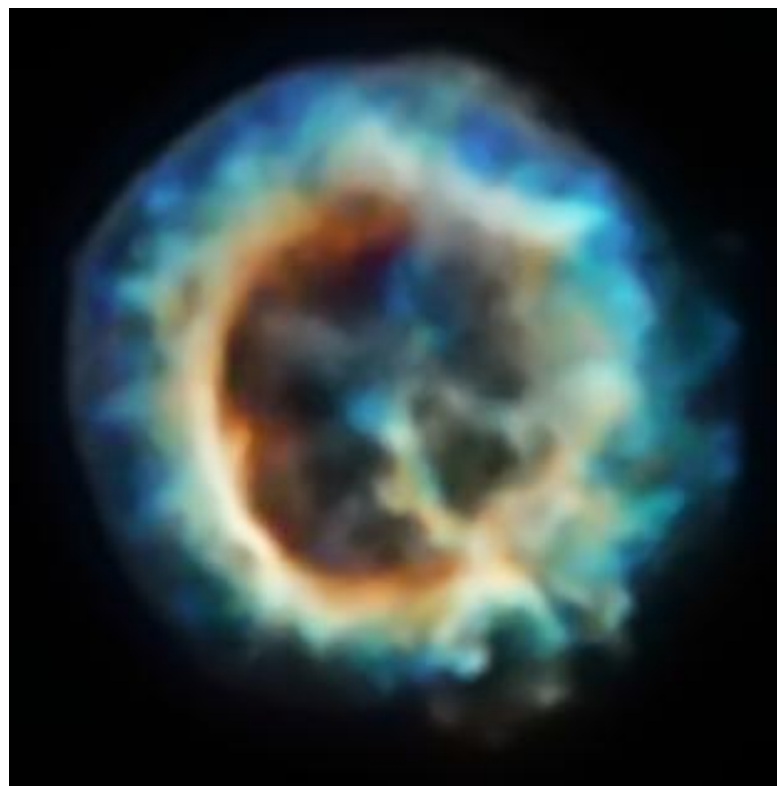


ACIS 0.35-8.0 keV

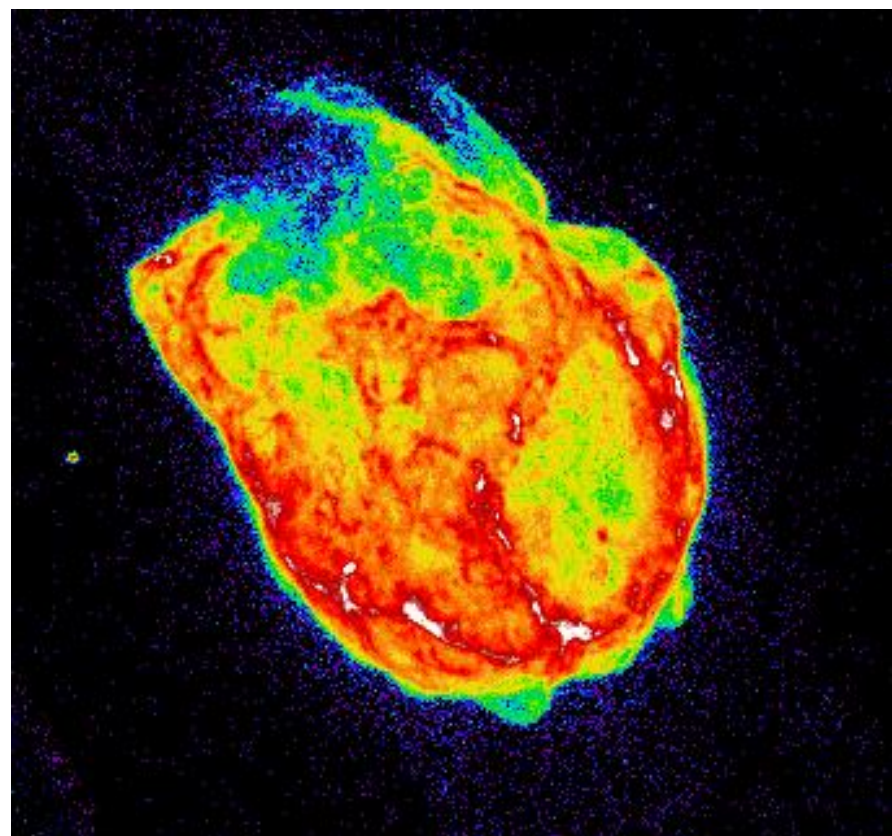


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Red (0.3-0.5 keV), Green (0.5-0.75 keV)  
Blue (0.75 – 7.0 keV)



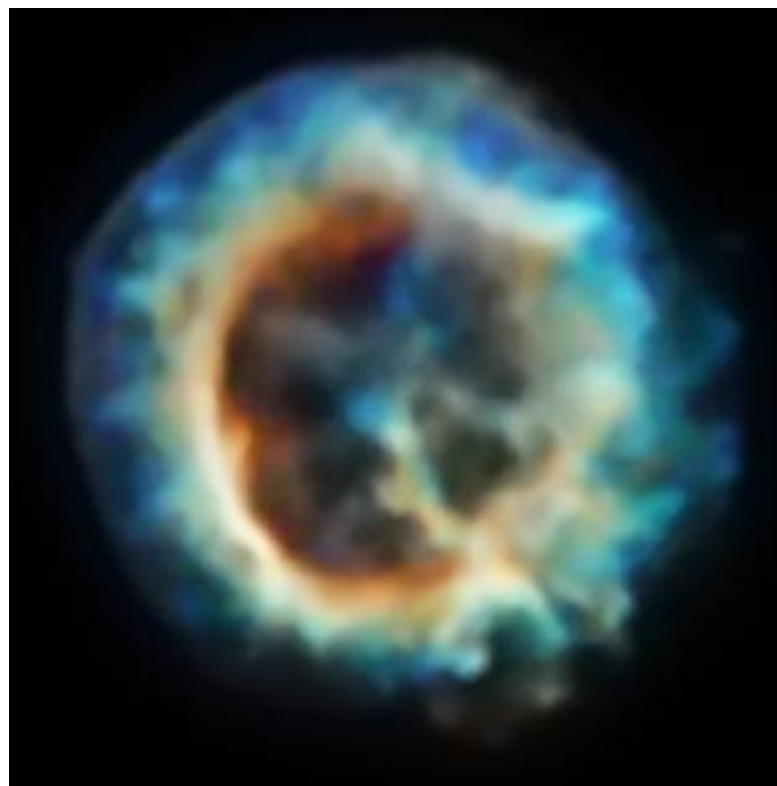
ACIS 0.35-8.0 keV



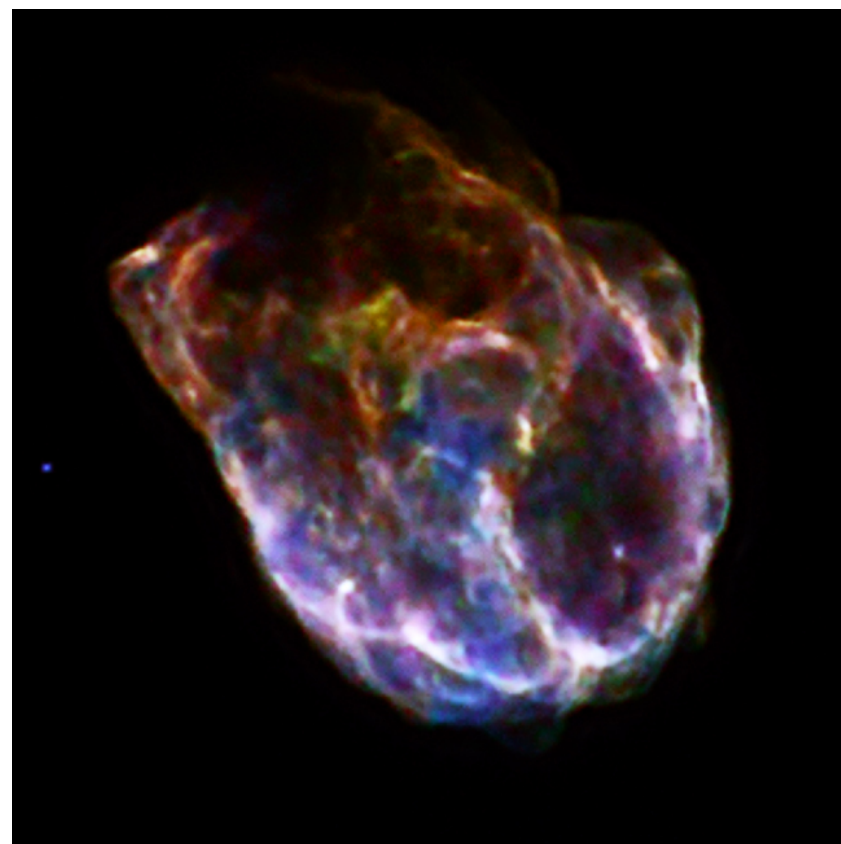


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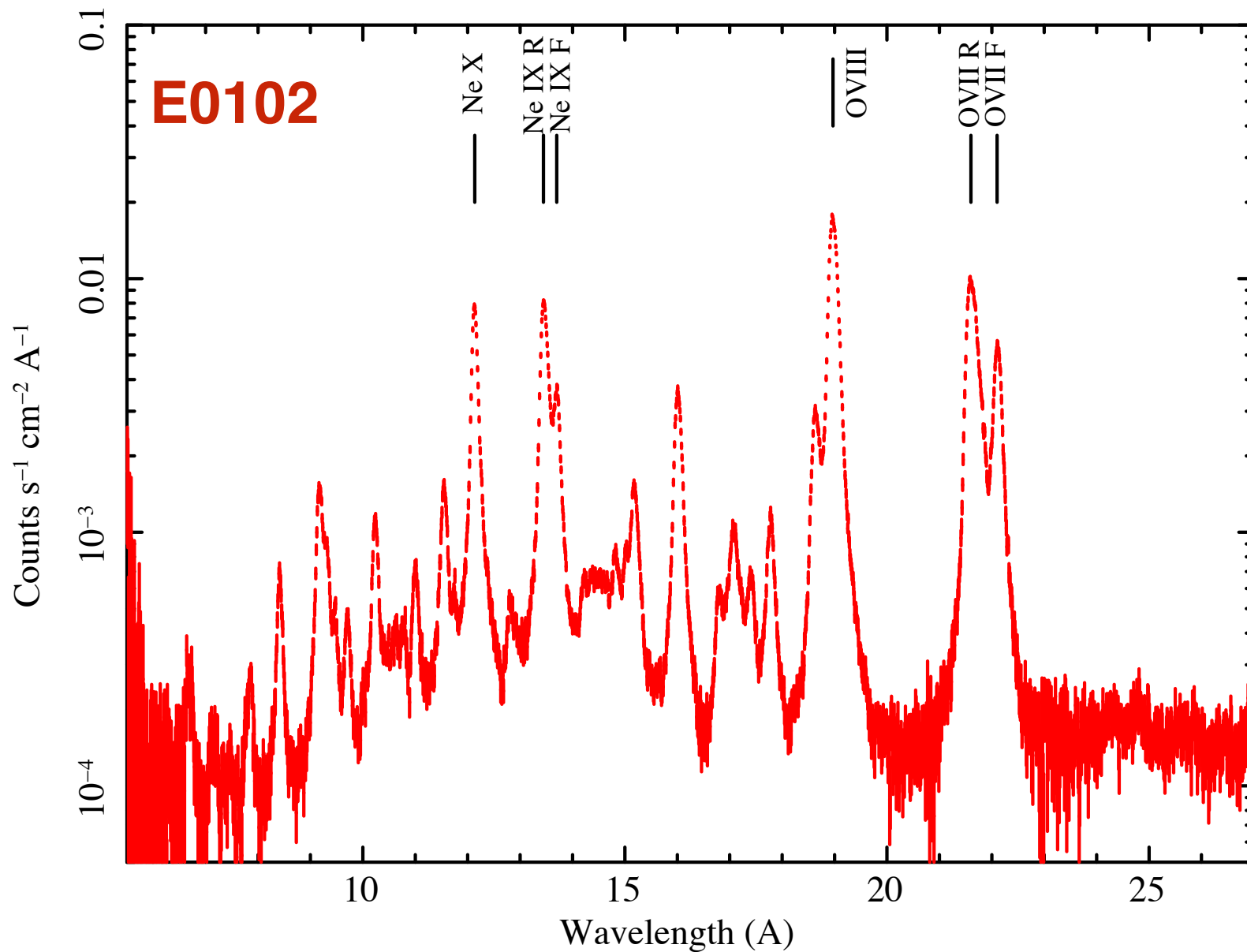


Red (0.3-0.75 keV), Green (0.8-1.1 keV),  
Blue (1.1 – 2.0 keV)



## RGS Spectra of E0102 & N132D

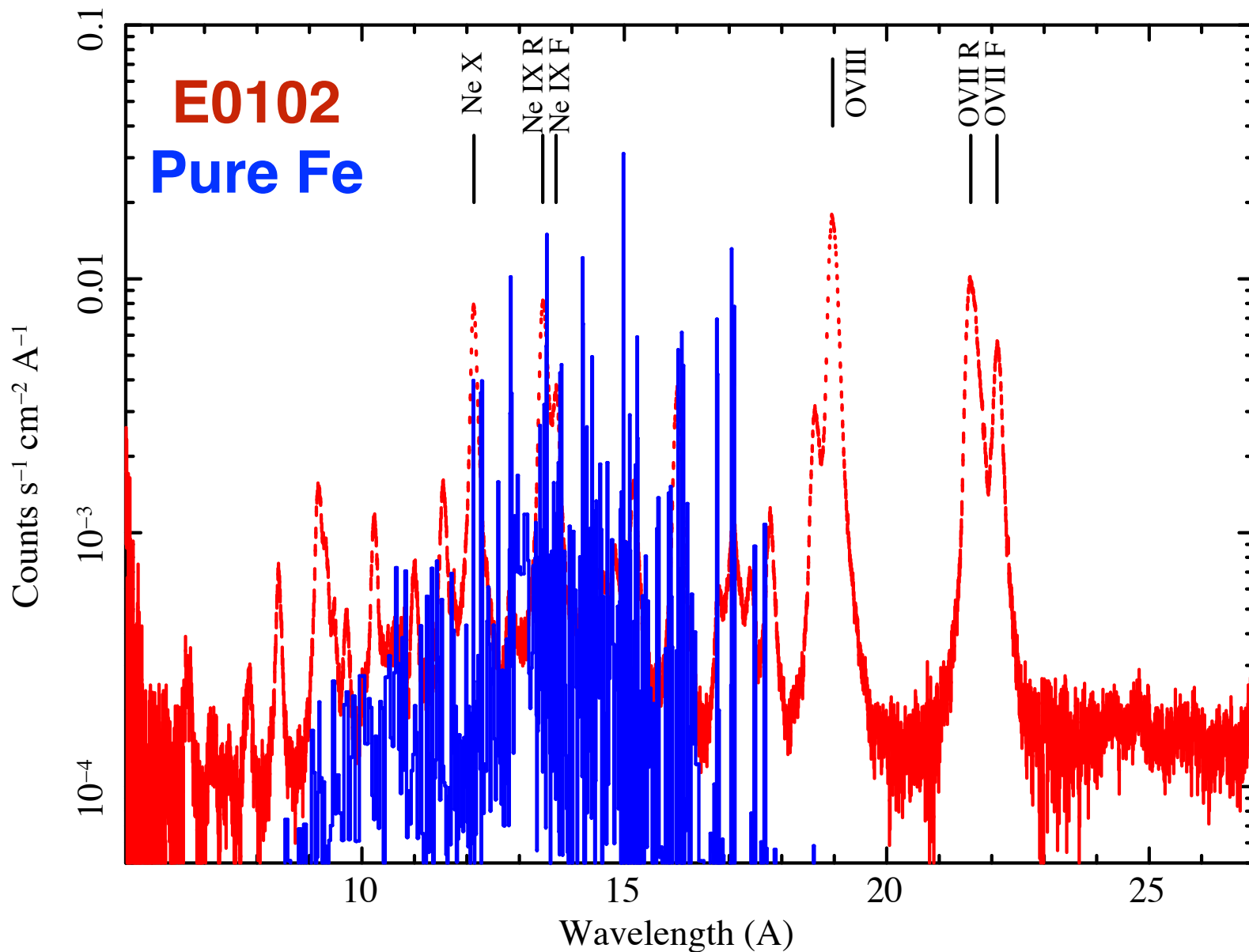
*XMM RGS*  
*Courtesy*  
*A. Pollock*  
*(ESAC)*





## RGS Spectra of E0102 & N132D

*XMM RGS*  
*Courtesy*  
*A. Pollock*  
*(ESAC)*

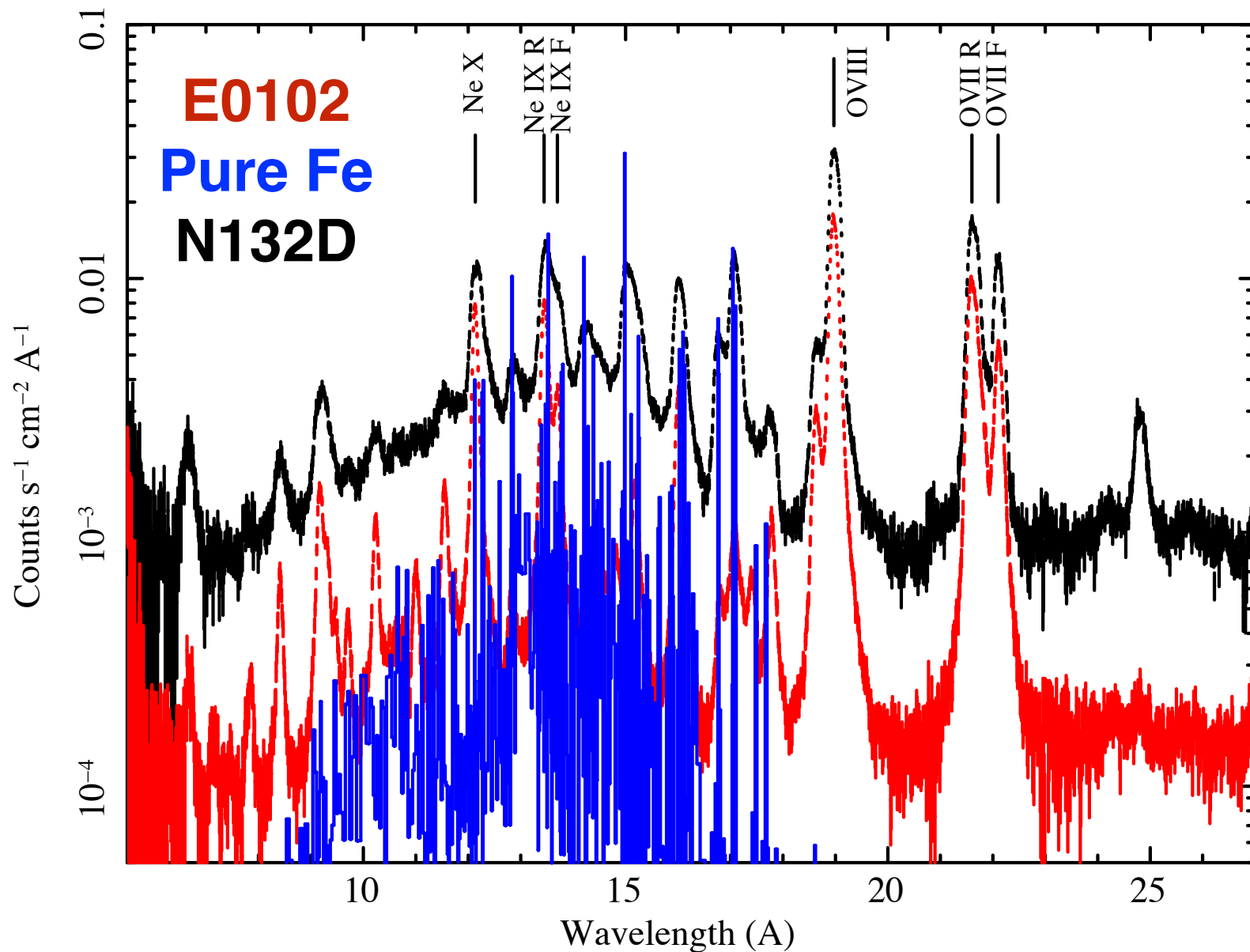




## RGS Spectra of E0102 & N132D

*XMM RGS*  
*Courtesy*  
*A. Pollock*  
*(ESAC)*

*Significant Fe*  
*in N132D's*  
*spectrum.*  
*Very little or*  
*no Fe in*  
*E0102's*  
*spectrum.*







## Comparison of Line Normalizations

Norm

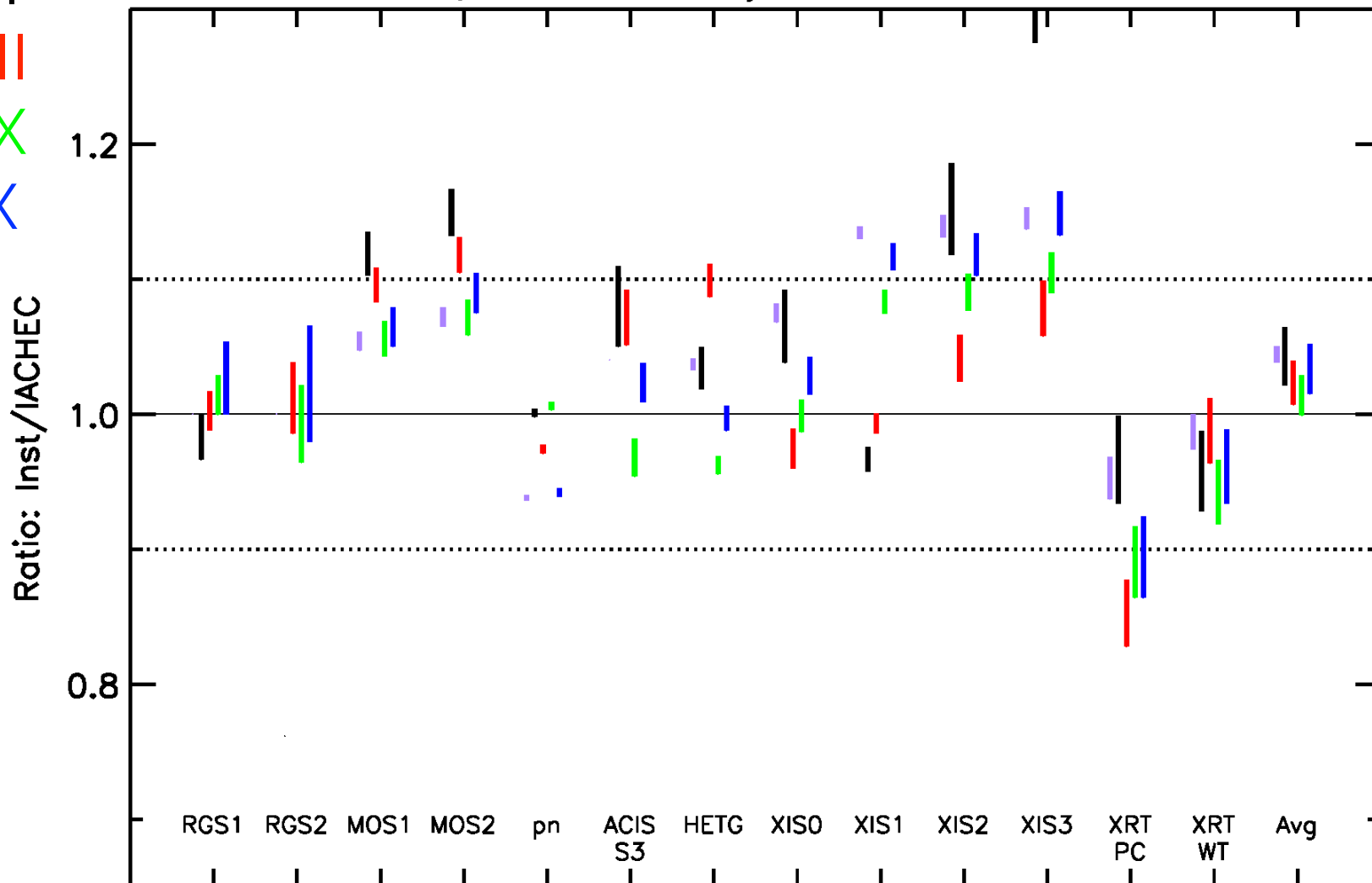
OVII

OVIII

NeIX

NeX

Updated 14 May 2014 XIS0,1,3

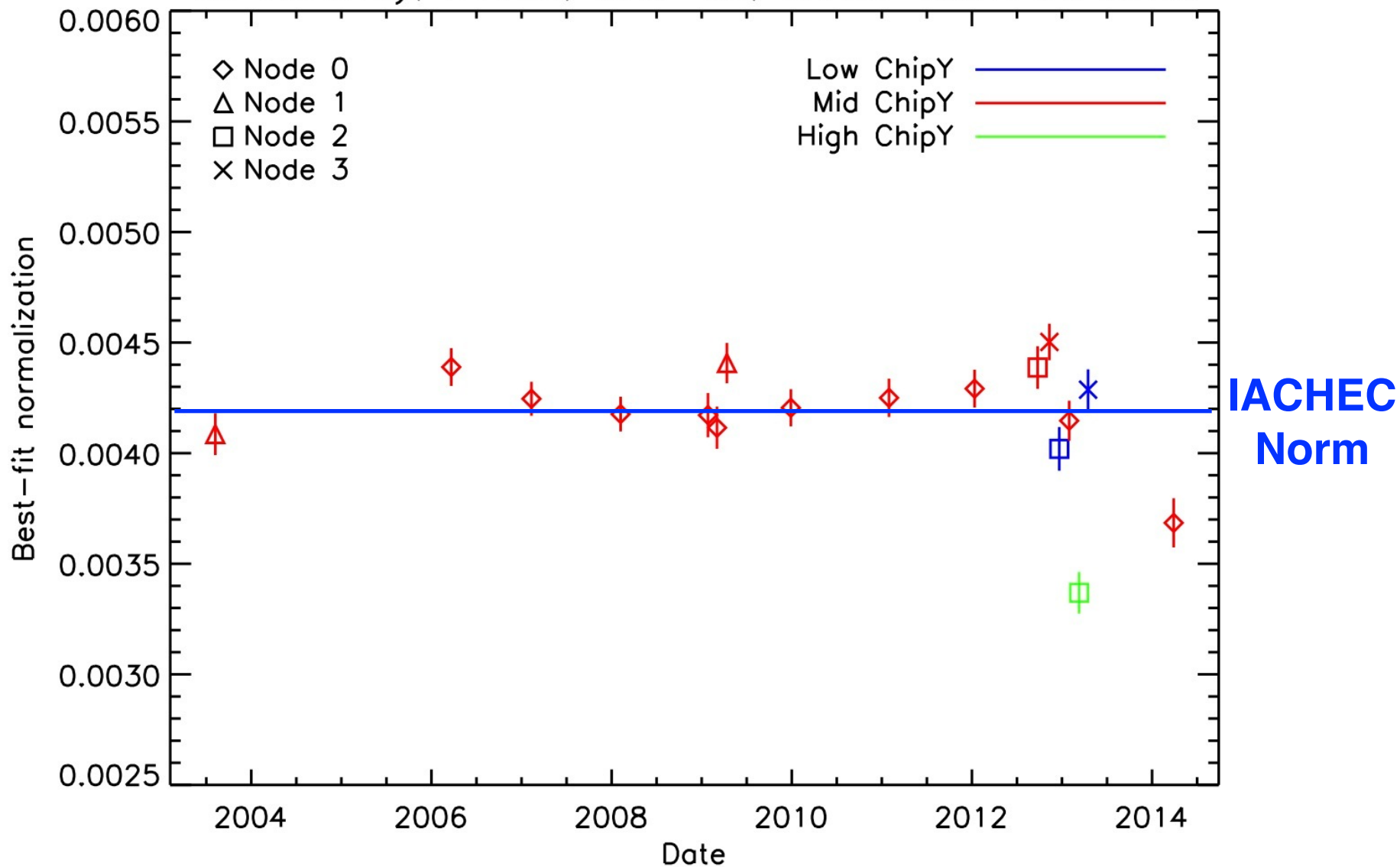


Puzzle:  
 Why are  
 MOS and  
 pn ~10%  
 different for  
 E0102, but  
 only 5%  
 different  
 for point  
 source  
 on -axis ?



## Time Dependence ACIS

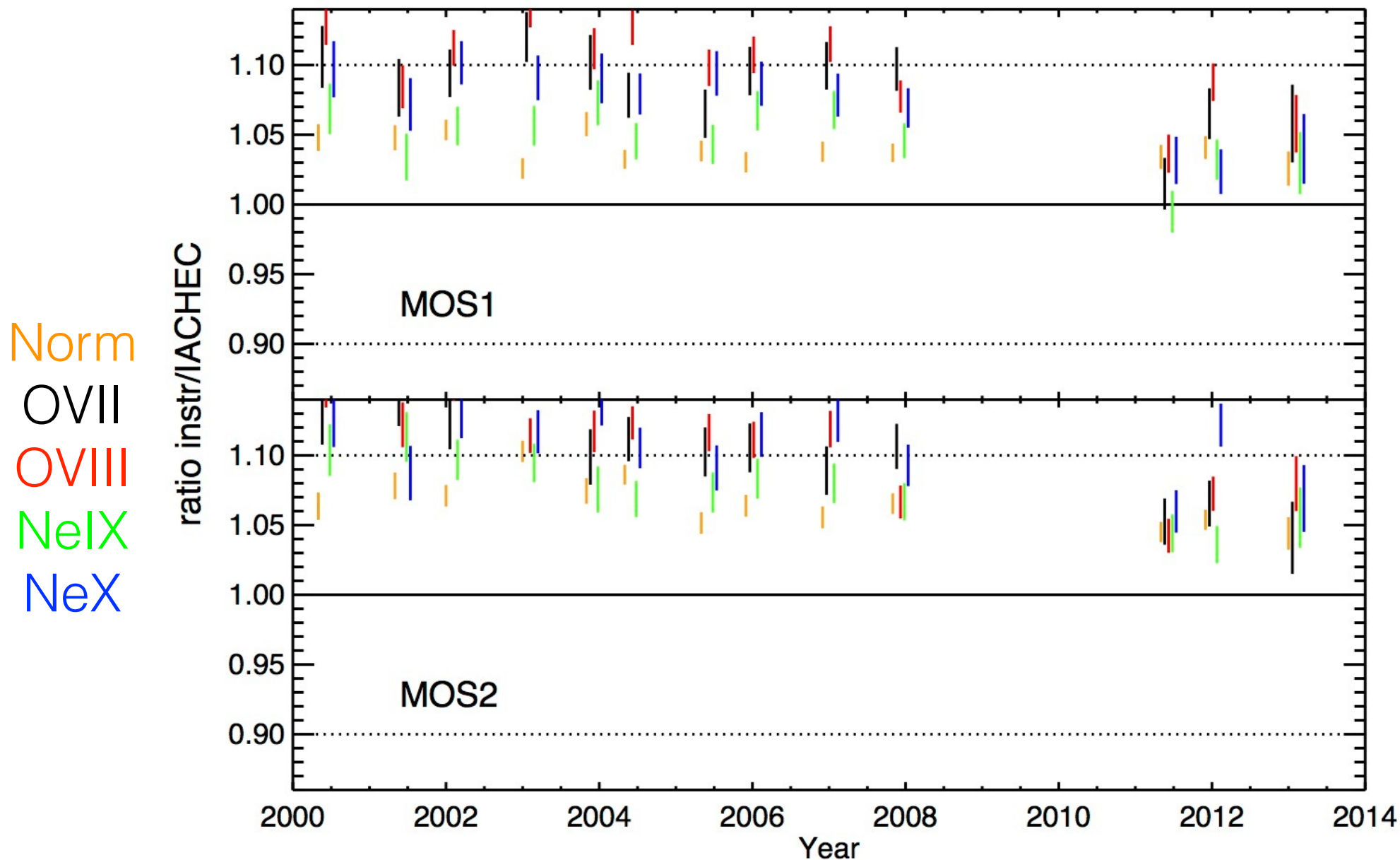
S3 subarray, N0008, CIAO 4.6, CALBD 4.6.1: 08 norm





## Time Dependence MOS

## Sembay (Leicester)

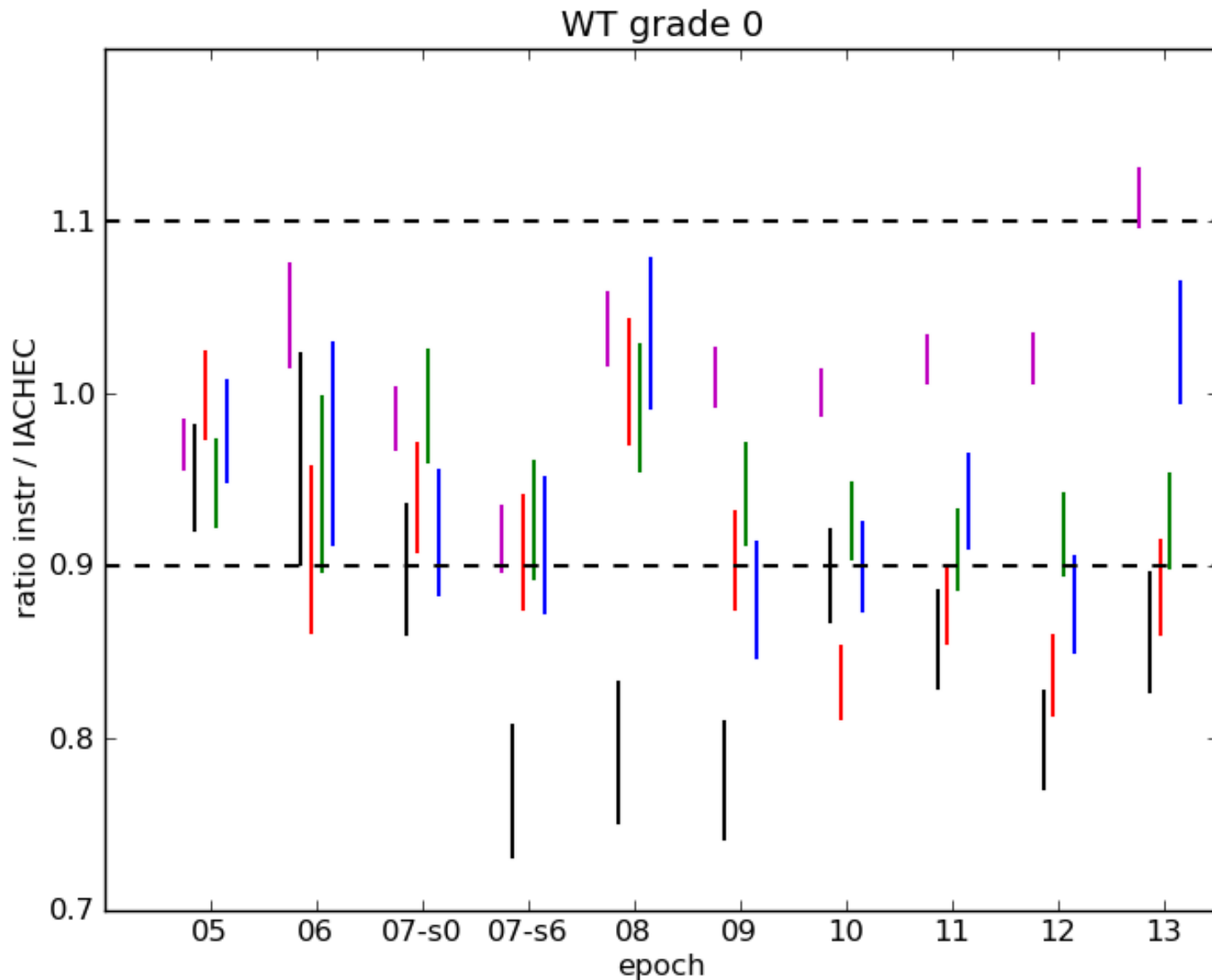




## Time Dependence XRT

**Beardmore  
(Leicester)**

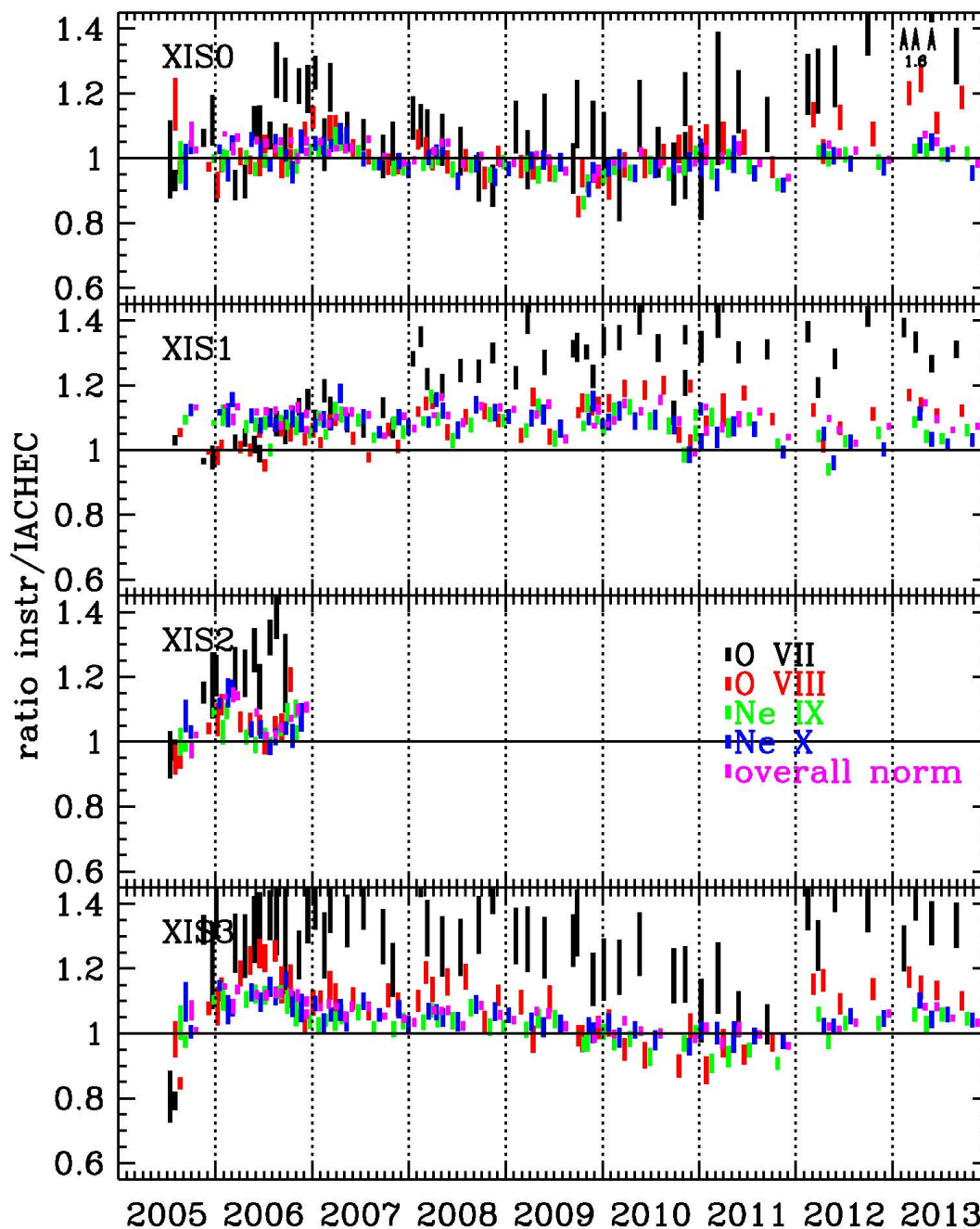
Norm  
OVII  
OVIII  
NeIX  
NeX





## Time Dependence *XIS*

Miller  
(MIT)



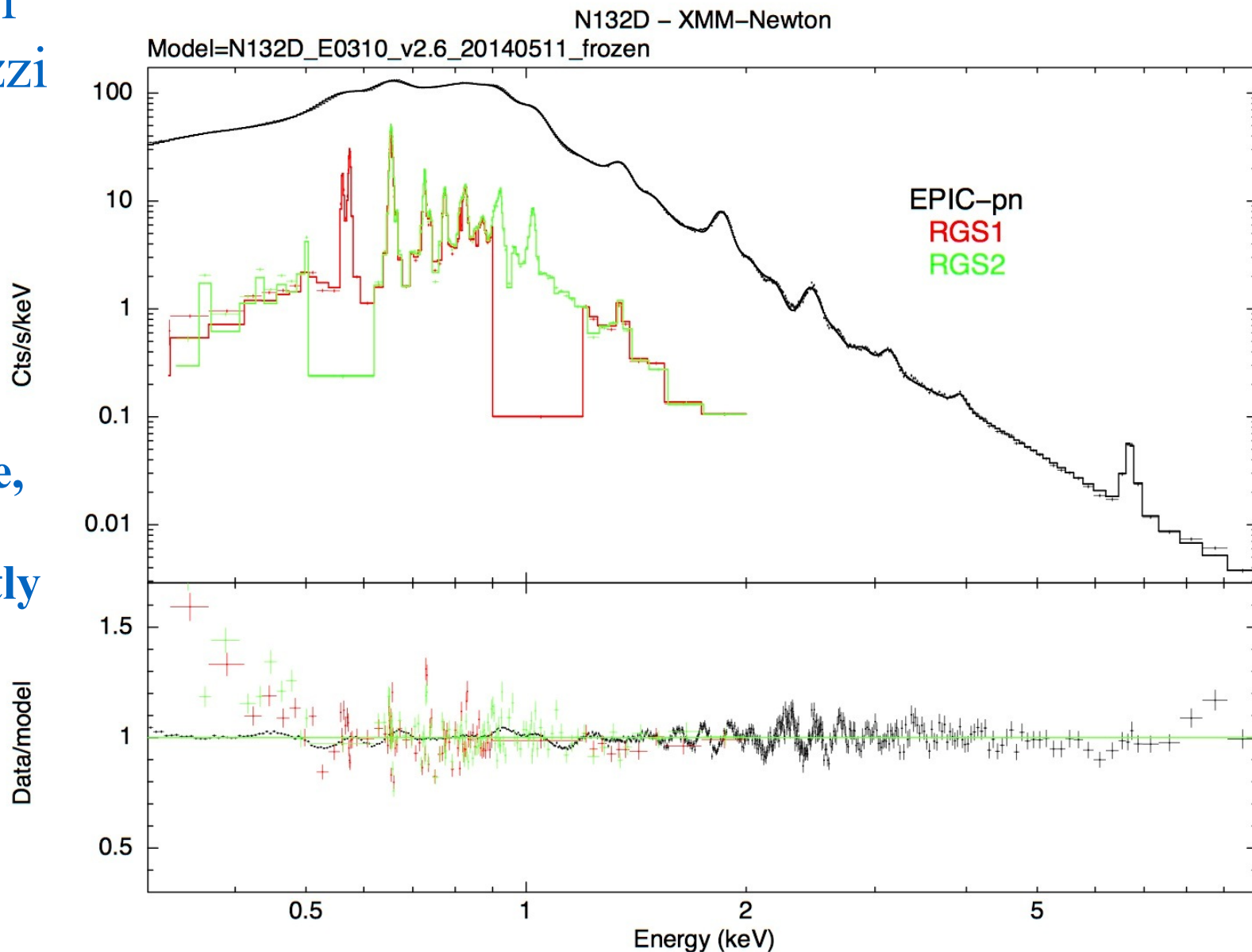




## *N132D Spectral Model*

Stuhlinger  
& Guainazzi  
(ESAC)

pn small  
window mode,  
other modes  
are significantly  
piled up

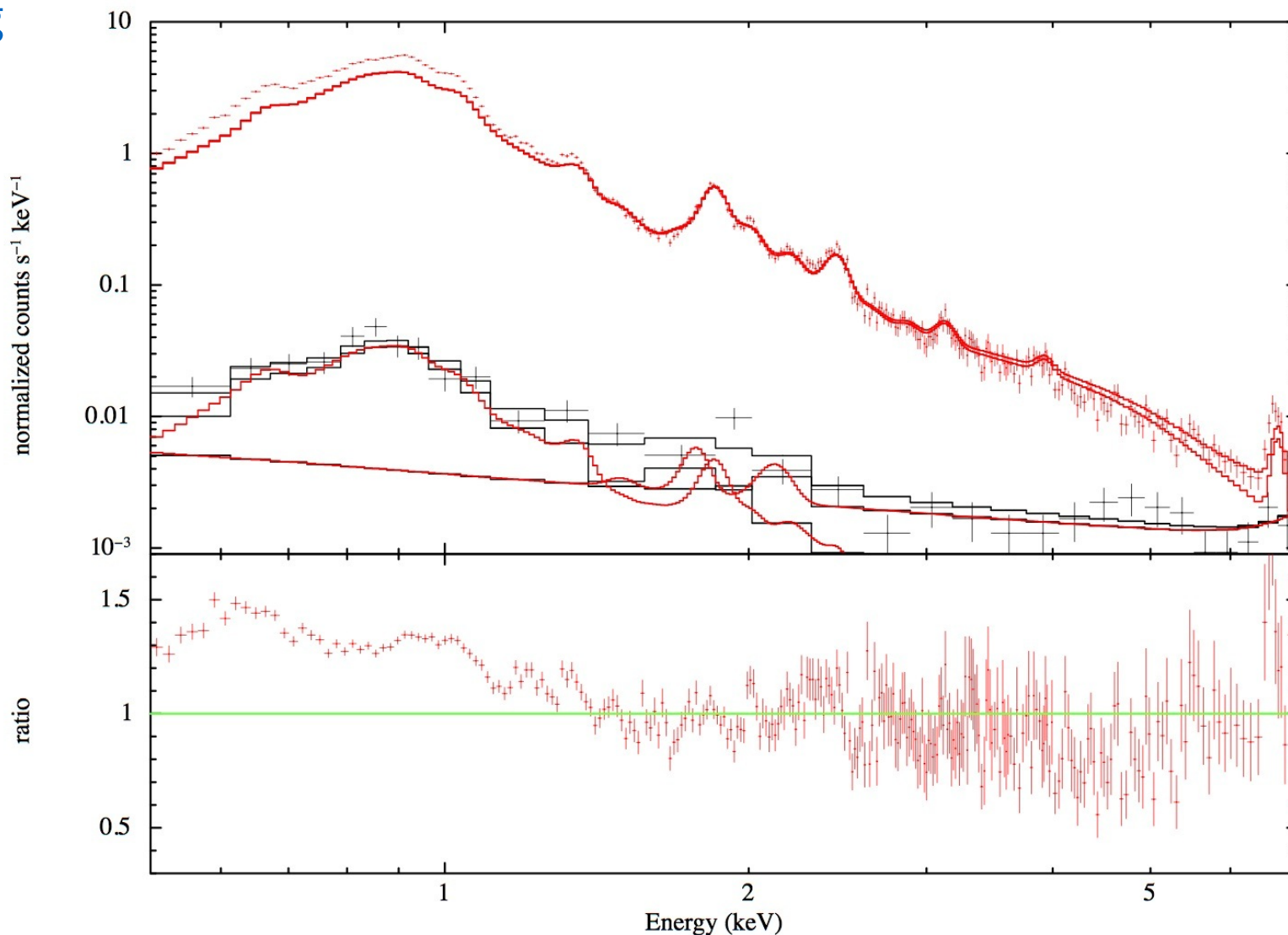




## *N132D Spectral Model Compared to ACIS/HETG 0th Order*

N132D: OBSID 1828, ACIS/HETG, overplot IACHEC v2.6 model  
Cstat=12809.6, DOF=885, chi=14012, pchi=15.8

ACIS imaging observation is significantly piled up, we used an ACIS/HETG observation. Global norm goes to 1.27 when allowed to fit

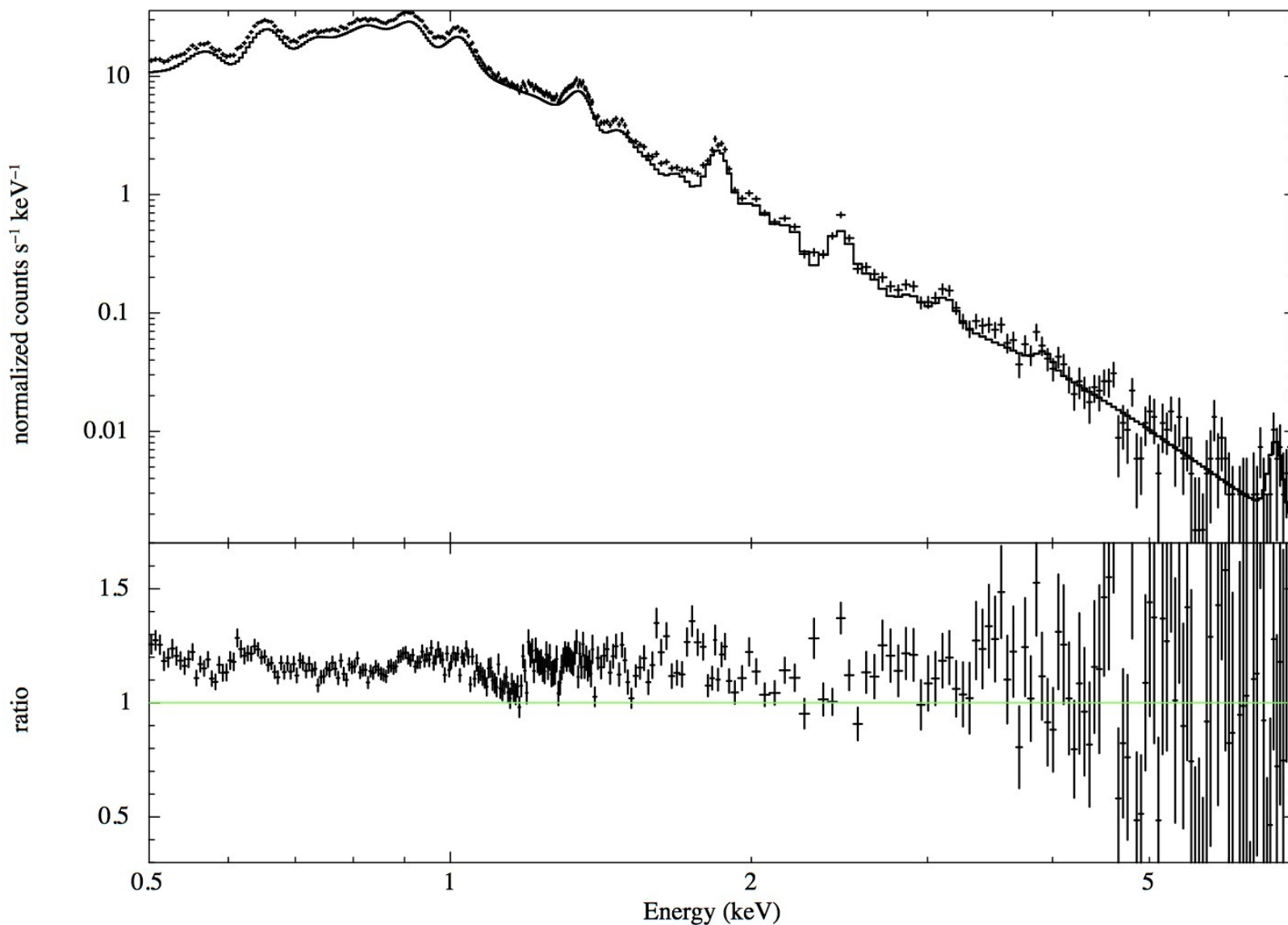




## *N132D Spectral Model Compared to MOS*

MOS1 0083 Cstat=1641.2/1291 Global=1.164

**Sembay  
(Leicester)  
Global  
norm goes  
to 1.16  
when  
allowed to  
fit**

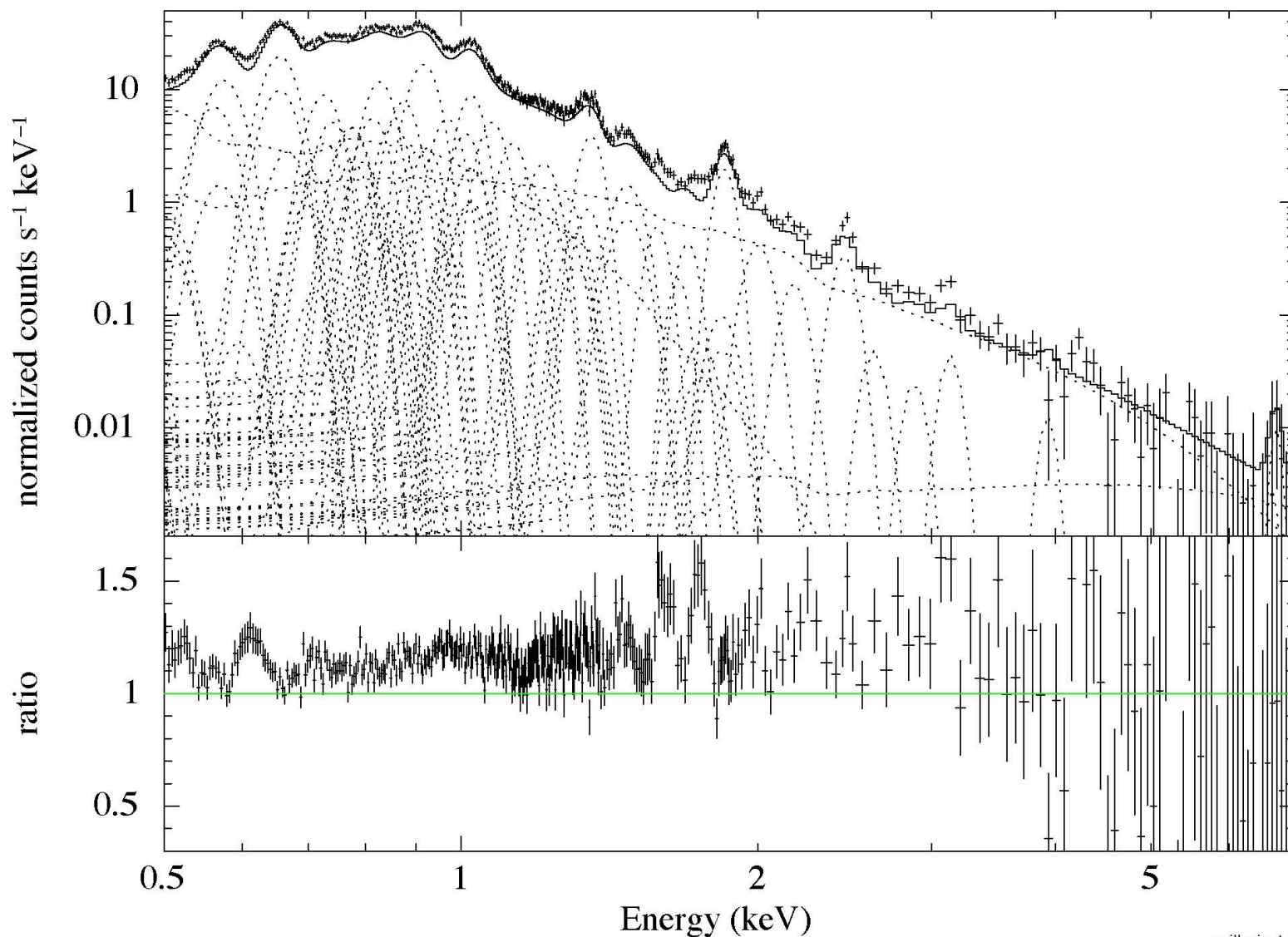




## *N132D Spectral Model Compared to XIS1*

N132D – XIS1 20050816, folded IACHEC model v2.6\_20140511, contami\_20130813

**Miller  
(MIT)  
Global  
norm goes  
to 1.14  
when  
allowed to  
fit**

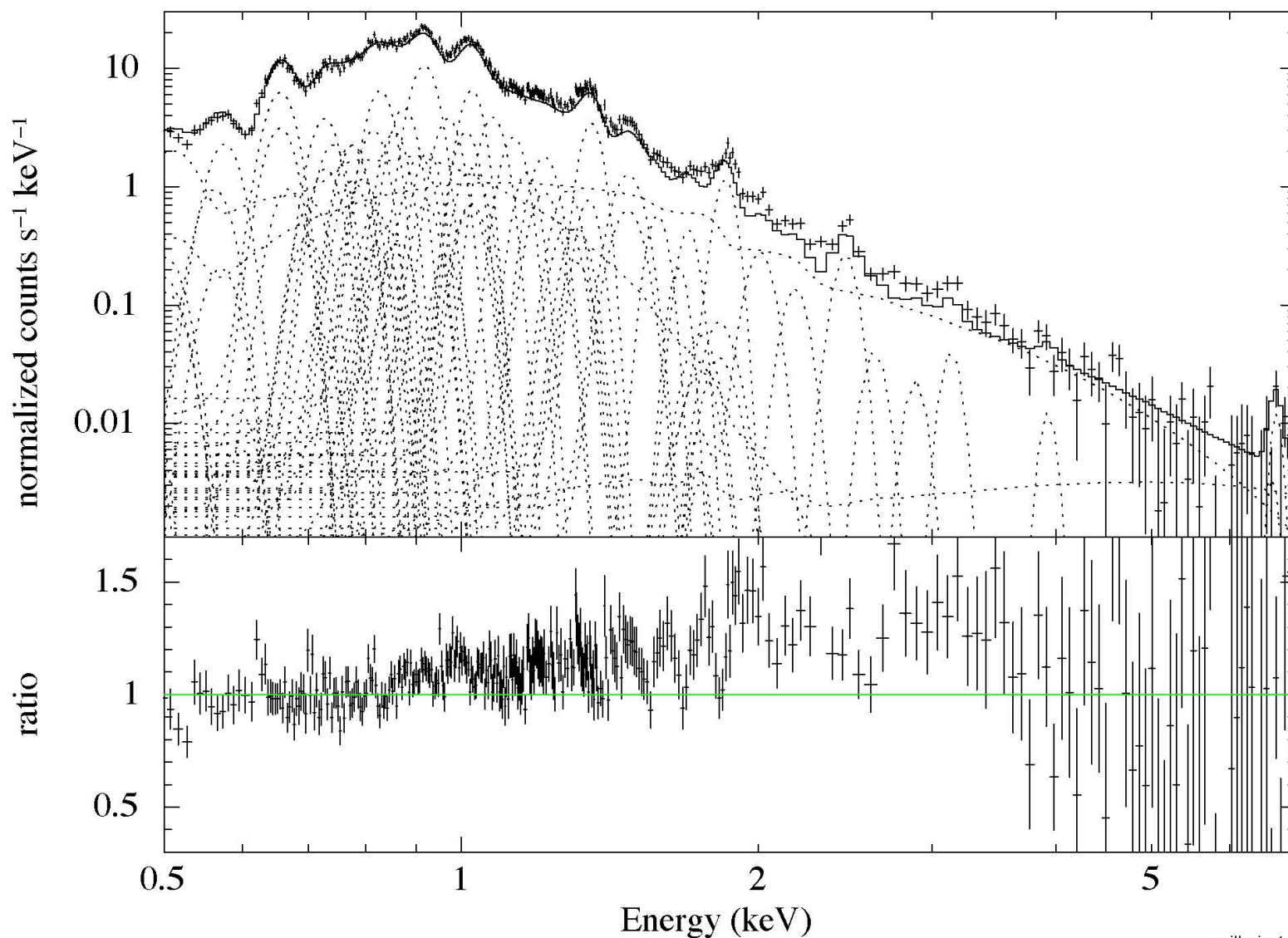




## *N132D Spectral Model Compared to XIS3*

N132D – XIS3 20050816, folded IACHEC model v2.6\_20140511, contami\_20130813

Miller  
(MIT)  
Global  
norm goes  
to 1.07  
when  
allowed to  
fit

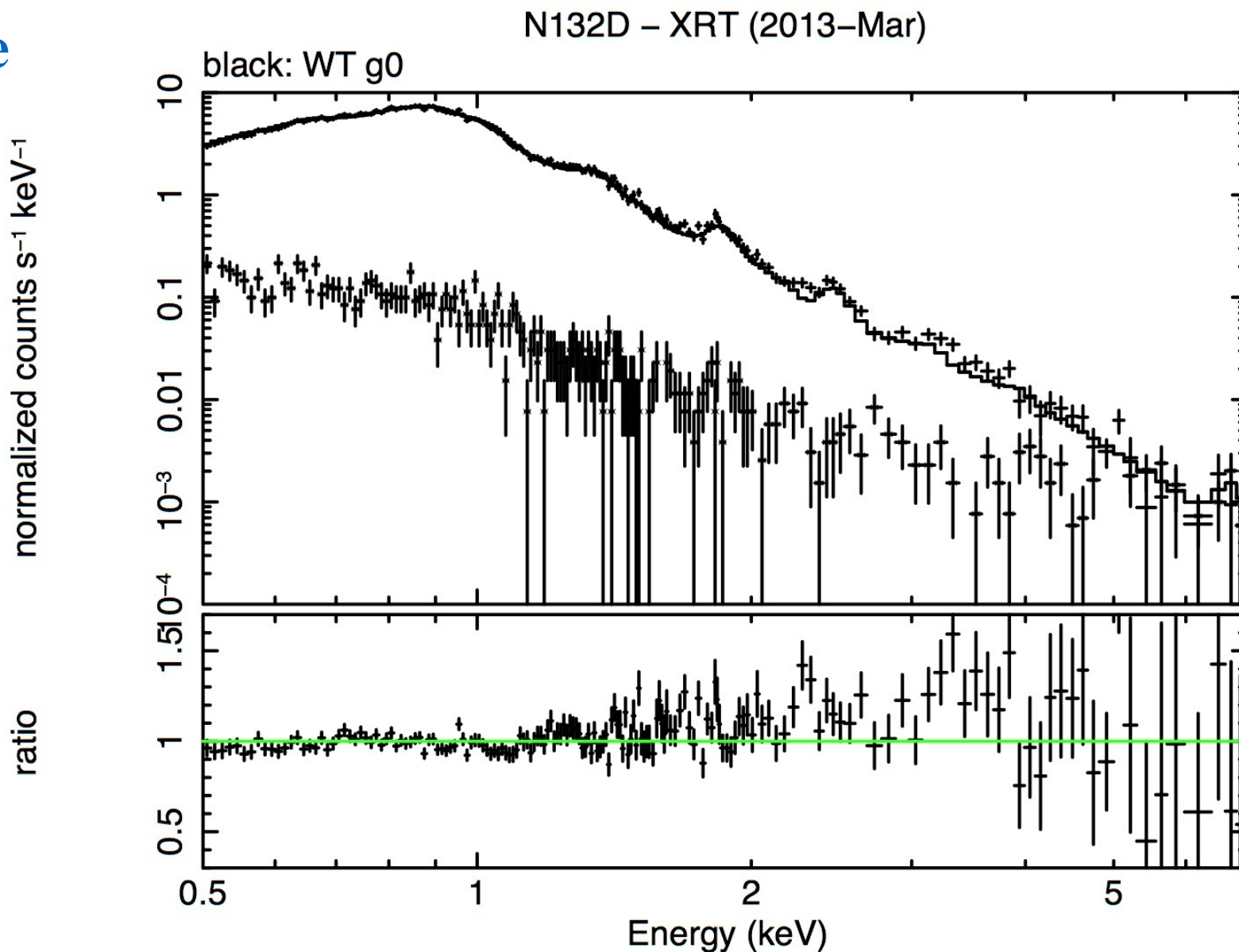






## *N132D Spectral Model Compared to XRT*

Beardmore  
(Leicester)  
Global  
norm goes  
to 0.99  
when  
allowed to  
fit





## Summary

### E0102

- *new A&A paper is under development*
- *present line norms with latest calibrations*
- *present time dependence for each instrument*

### N132D

- *initial comparison of model based on pn/RGS data was discouraging*
- *ACIS ~27% higher in soft band for ACIS/HETG 0th order*
- *MOS ~16% higher in most of the band*
- *XIS1 ~14% & XIS3 ~7% higher in most of band*
- *XRT agrees well with pn/RGS model*



# Chandra X-ray Observatory

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CXC