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 RGS   Andy Pollock(Sheffield), Martin Stuhlinger (ESAC)
XMM-Newton MOS   Steve Sembay (Leicester)
XMM-Newton pn   Frank Haberl (MPE)
Chandra ACIS   Paul Plucinsky (SAO)
Suzaku XIS   Eric Miller (MIT)
Swift XRT   Andrew Beardmore (Leicester)
Models   Adam Foster (SAO)
ASTROSAT   Sunil Chandra(TIFR)

The IACHEC E0102 Paper is Published !

Many thanks to Andy B., Adam, Frank, Eric, Andy P. and Steve for their patience

SNR 1E 0102.2-7219 as an X-ray calibration standard in the 0.5–1.0 keV bandpass and its application to the CCD instruments aboard *Chandra*, *Suzaku*, *Swift* and *XMM-Newton*

Paul P. Plucinsky[1], Andrew P. Beardmore[2], Adam Foster[1], Frank Haberl[3],
Eric D. Miller[4], Andrew M. T. Pollock[5], and Steve Sembay[2]

[1] Harvard-Smithsonian Center for Astrophysics, MS-3, 60 Garden Street, Cambridge, MA 02138, USA
   e-mail: pplucinsky@cfa.harvard.edu
[2] Department of Physics and Astronomy, University of Leicester, Leicester LE1 7RH, UK
[3] Max-Planck-Institut für Extraterrestrische Physik, Giessenbachstraße, 85748 Garching, Germany
[4] MIT Kavli Institute for Astrophysics and Space Research, Cambridge, MA 02139, USA
[5] University of Sheffield, Department of Physics and Astronomy, Hounsfield Road, Sheffield S3 7RH, UK

ABSTRACT

Context. The flight calibration of the spectral response of charge-coupled device (CCD) instruments below 1.5 keV is difficult in general because of the lack of strong lines in the on-board calibration sources typically available. This calibration is also a function of time due to the effects of radiation damage on the CCDs and/or the accumulation of a contamination layer on the filters or CCDs.
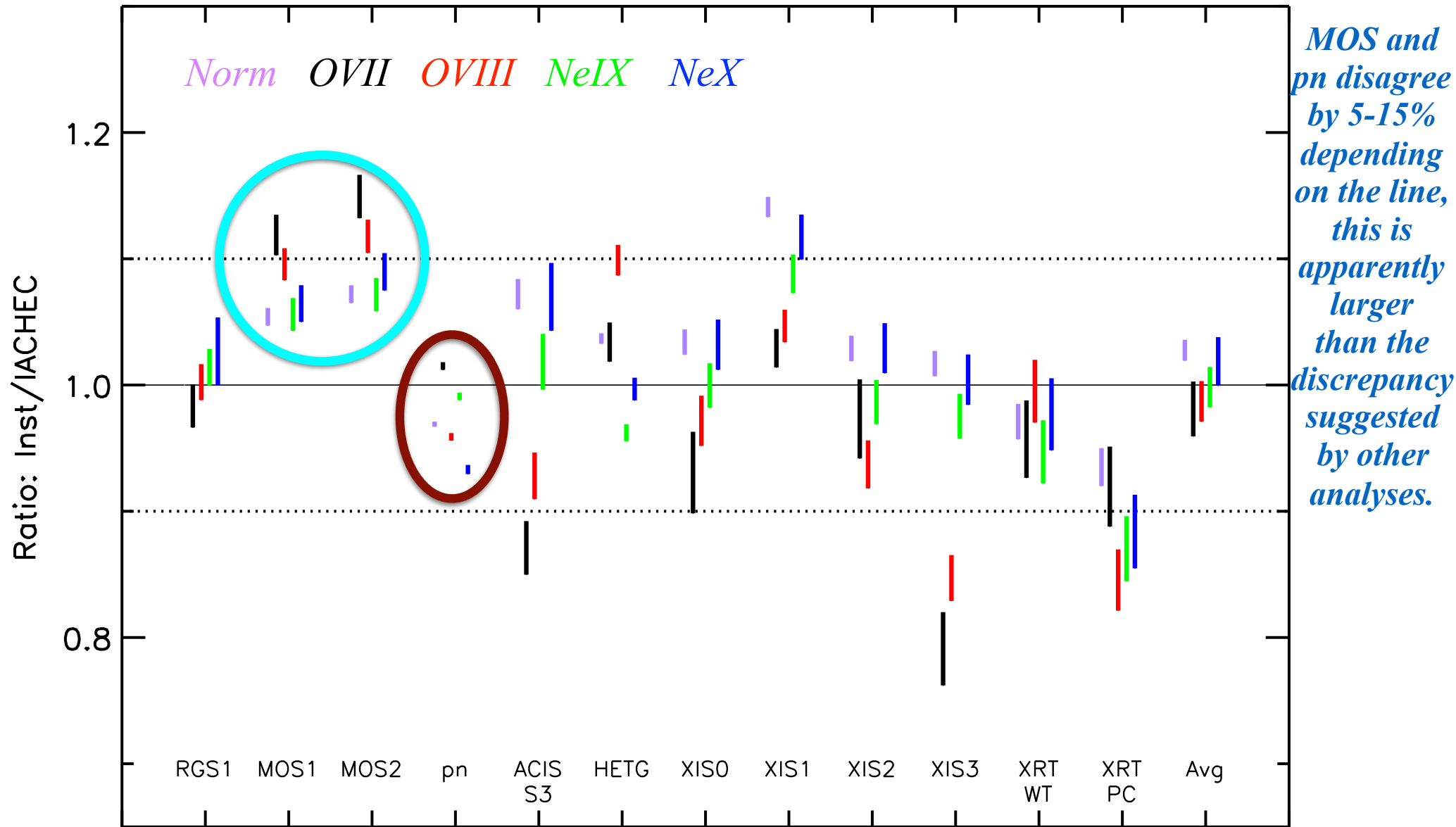
RGS Spectra of E0102

Pollock (Sheffield)

Strong well-separated lines in the 0.5-1.0 keV bandpass make this target attractive for calibration of CCD instruments
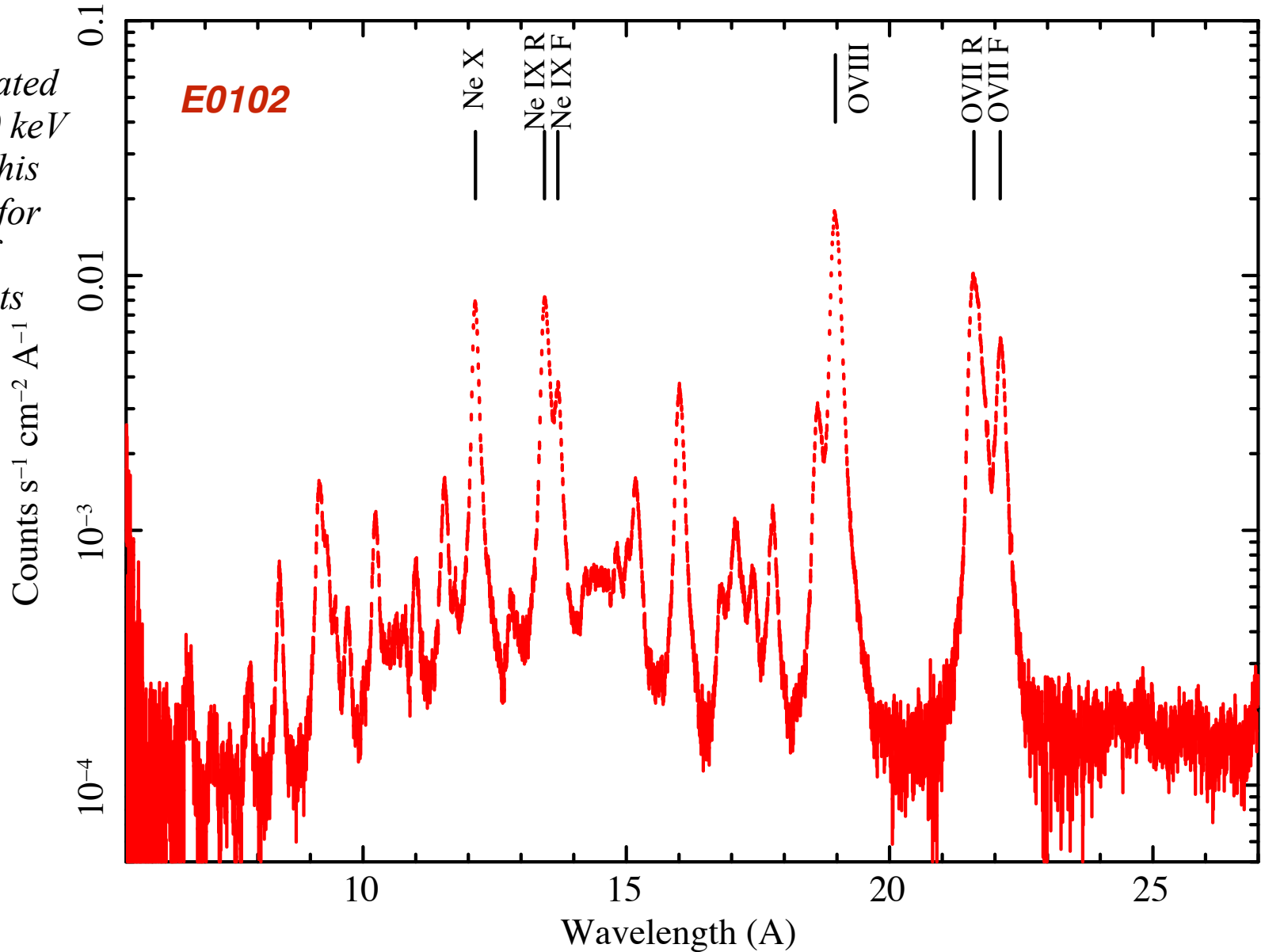
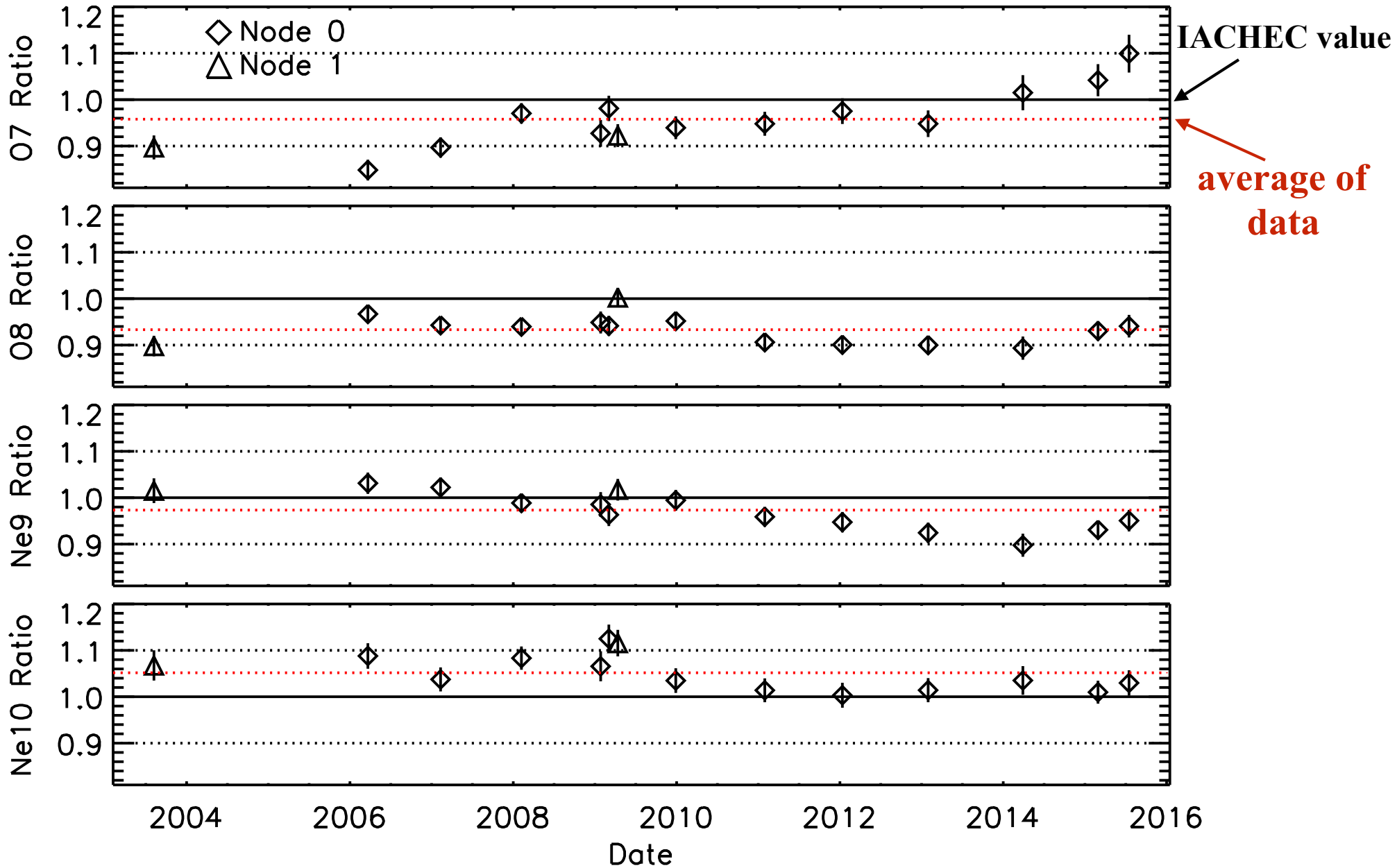*Just a reminder why we use E0102*

E0102

Ne X
Ne IX R
Ne IX F
OVIII
OVII R
OVII F

Counts s^{-1} cm^{-2} Å^{-1}

Wavelength (Å)

Comparison of E0102 Line Normalizations for MOS, pn, ACIS, XIS and XRT
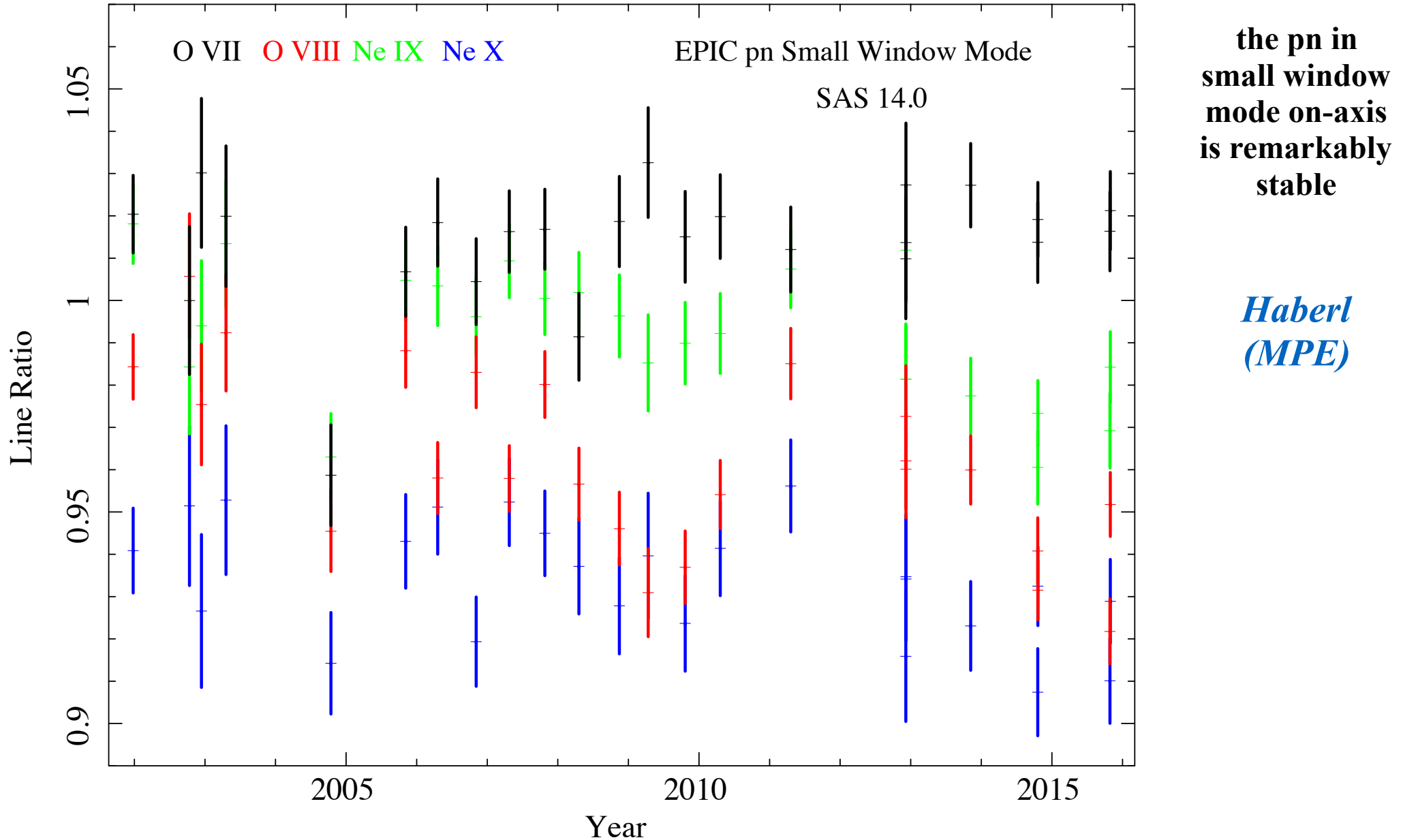
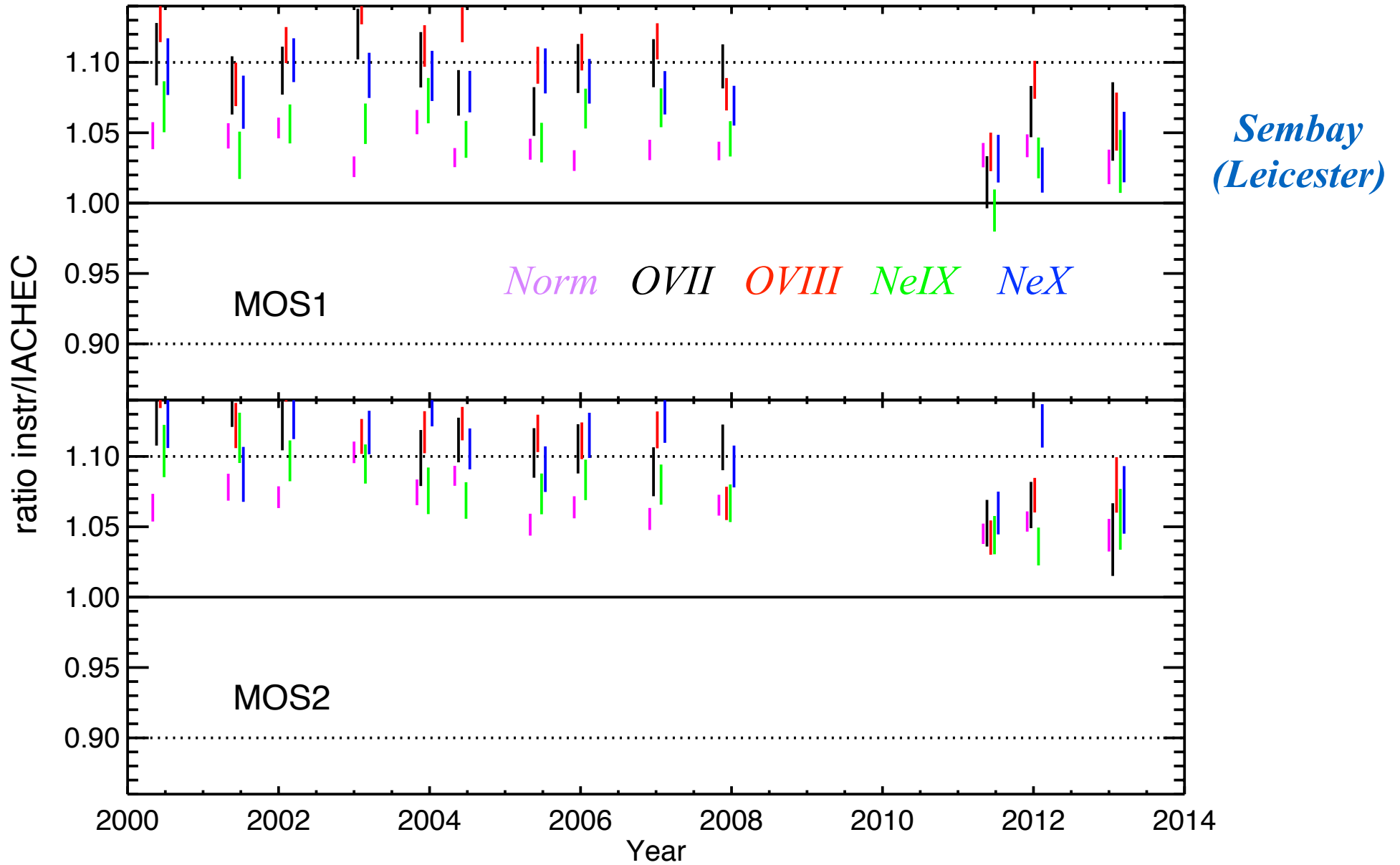# Time Dependence of ACIS S3 on axis in subarray mode

Time Dependence of pn in small window mode
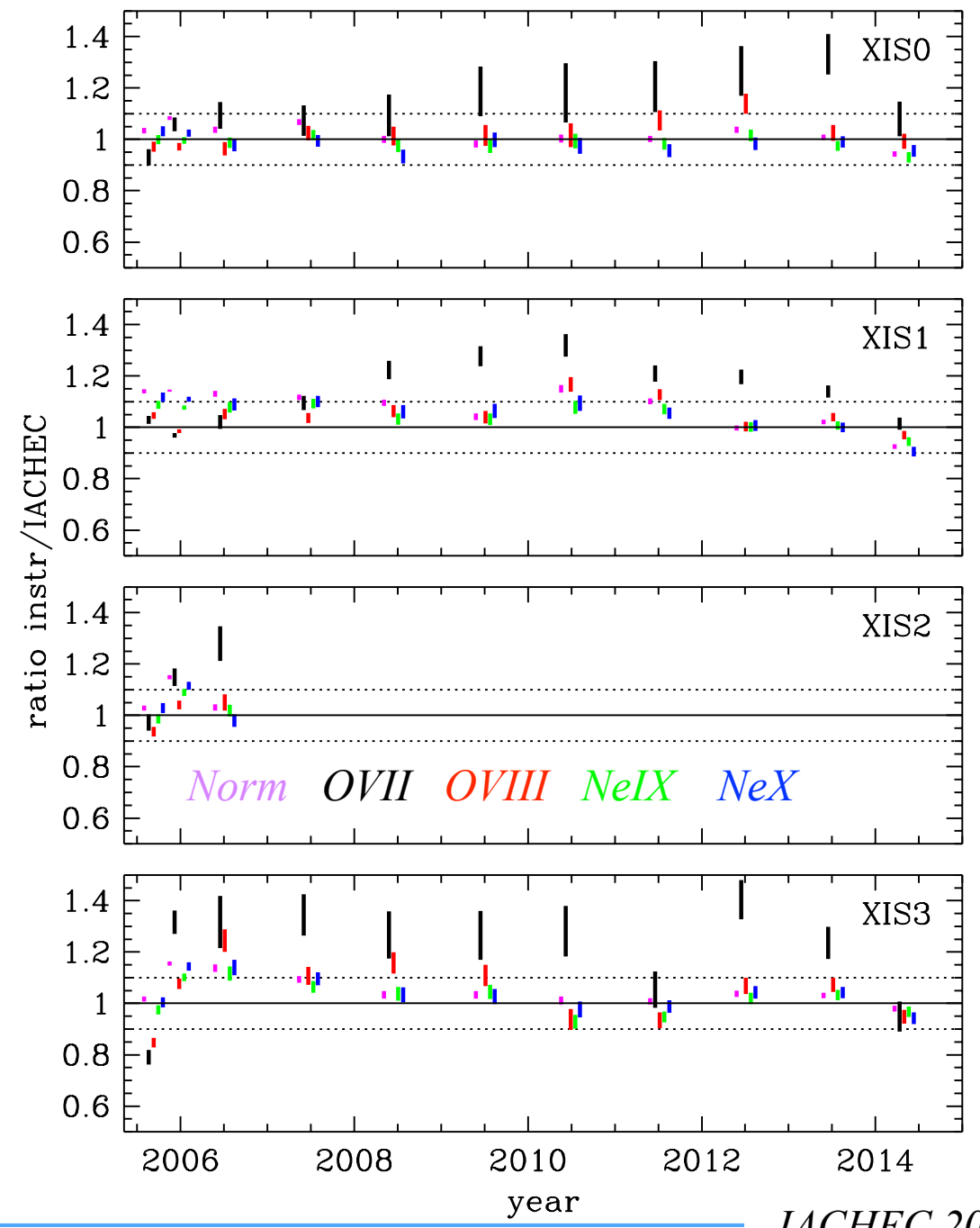
Time Dependence of MOS in large window mode

Sembay (Leicester)
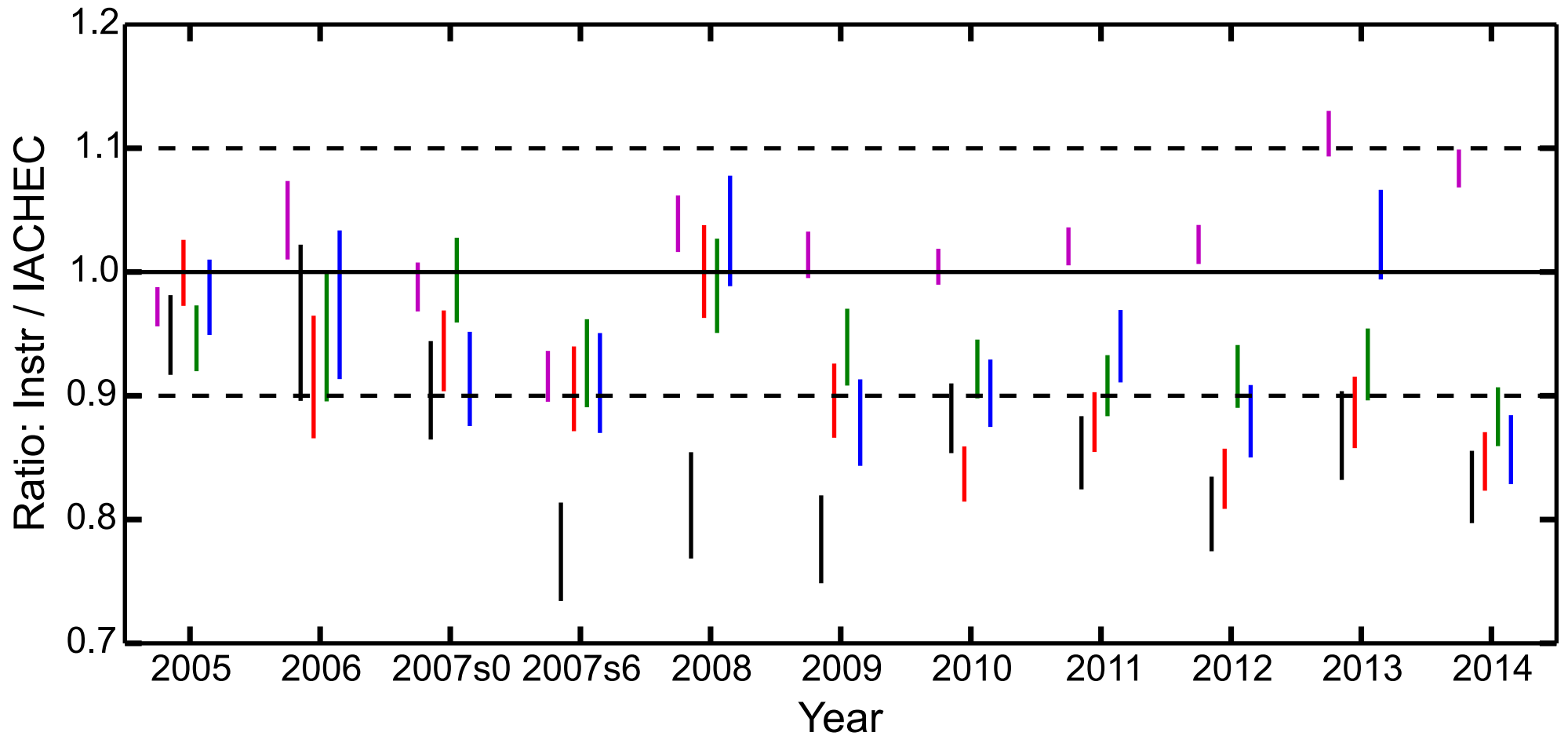
Time Dependence of Suzaku XIS

*Miller
(MIT)*

Time Dependence of Swift XRT in WT Mode

Beardmore (Leicester) *Norm* *OVII* *OVIII* *NeIX* *NeX*

Major Results of the IACHEC E0102 Paper

- comparison of on-axis effective areas in the 0.5-1.0 keV band for ACIS-S3, XMM pn, XMM MOS, Swift XRT, and Suzaku XIS in modes that minimize pileup
- characterization of the time-dependence of the QE in the 0.5-1.0 keV band for ACIS S3, XMM MOS, Swift XRT and Suzaku XIS

Please refer your colleagues to this paper if they need a reference for the comparison of the QE of the various CCD instruments and the time-dependence of the QE.

We need to promote ALL of the IACHEC papers to ensure the community knows that we are doing useful work.

If you use the IACHEC E0102 model, please refer to the model as the "IACHEC E0102 model, Plucinsky et al., A&A 2017."
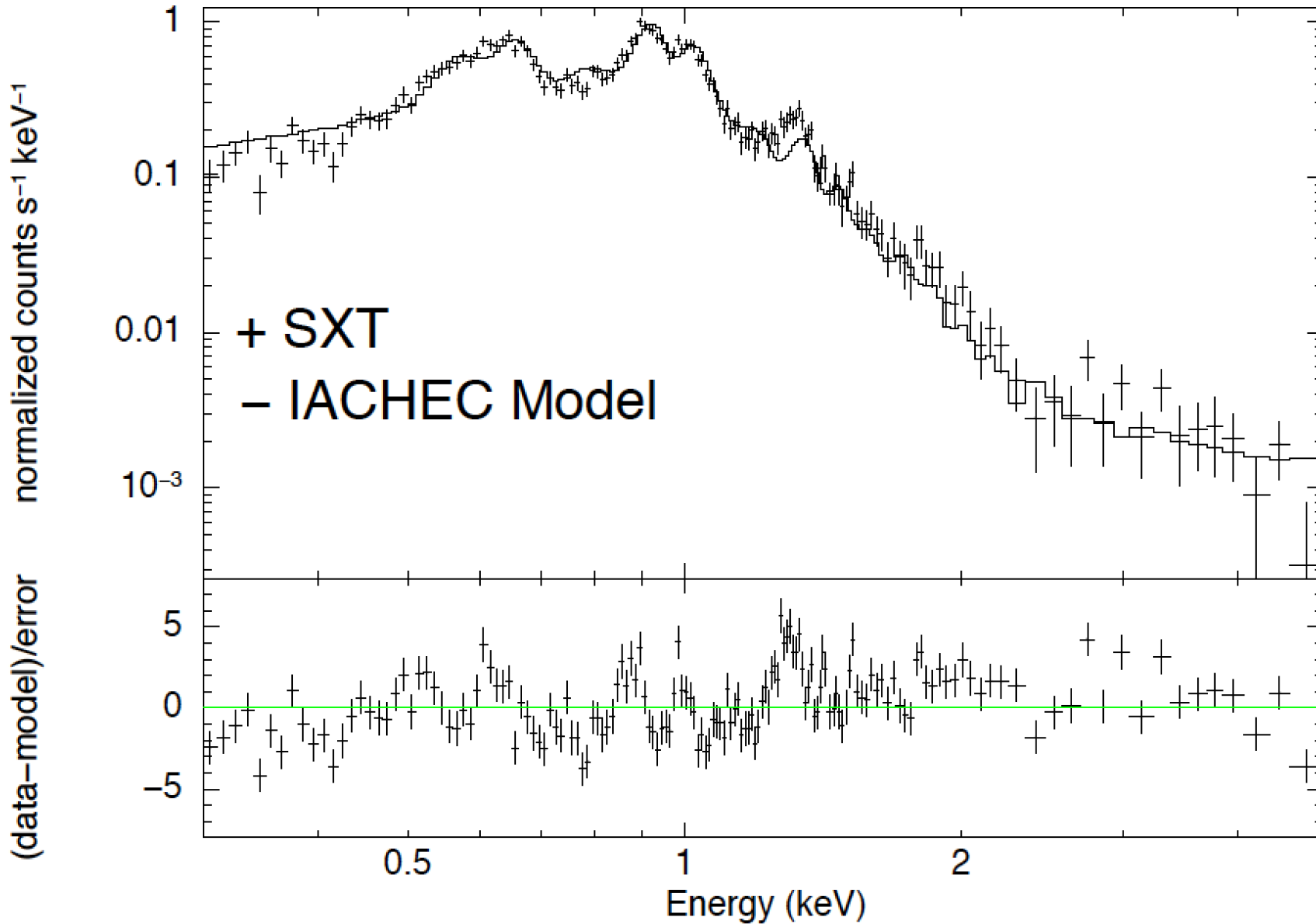*The IACHEC needs publications in referred journals and we need to encourage the community to refer to our work.*

SNR 0102–7217 Spectrum [Exp. ~35 ks]

+ SXT

– IACHEC Model

N132D IACHEC Model v2.10 Released before the IACHEC Meeting

Significant changes from v2.9 v2.10:
- *use APEC v3.0.8*
- *use "nlapec" model in XSPEC*
- *remove power-law component that was there as a crude background model*

## N132D ACTION ITEMS FROM 2015 IACHEC

- *Matteo volunteered to lead the effort to merge the v2.6 and v2.9 models to provide a good fit across the entire 0.3-10.0 keV band* **[Paul worked on the model]**
- *remove the power-law to model the sky and instrument background and each instrument will add a sky and instrument background model appropriate for their instrument* **[Done in v2.10 model]**
- *Develop a non-linear gain correction for the pn data and apply the correction to the events and do NOT use "gain fit" in XSPEC* **[Some progress]**
- *the WG will then fit N132D and compare the normalizations for Si XIII, S XV, and Ar XVII* **[preliminary results]**

N132D,v2.10 model,SAS14,0129341801,_pnS022,Med,_mos1S023,Thin1,_mos2S024,Thin1
2005–02–19,DOF=5805.0,Cstat=5984,Rchi=0.88,PNCon=0.960,M1Con=0.978,M2Con=0.946

N132D: A single pn, MOS1, MOS2 observation fit with v2.10 of the IACHEC model
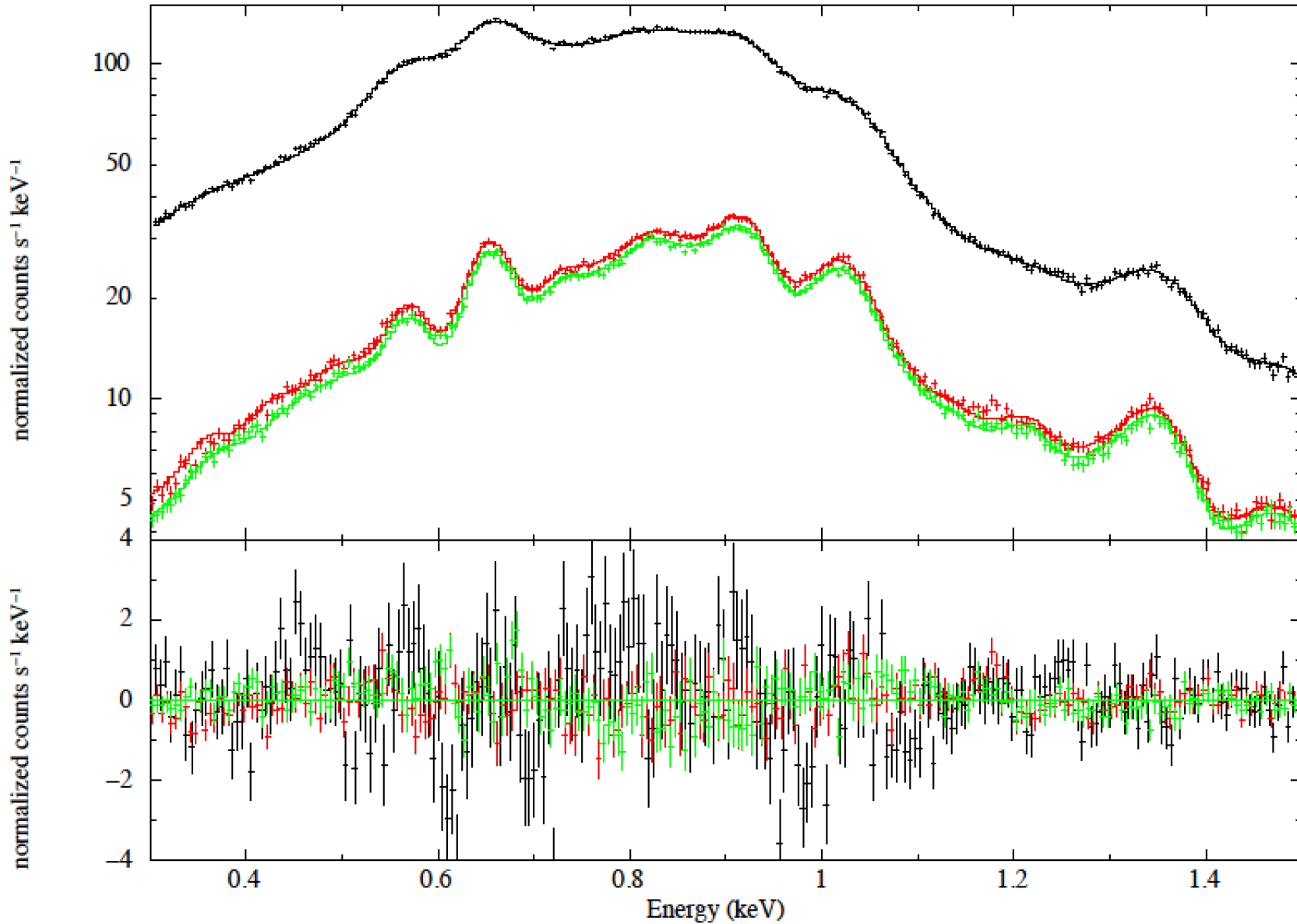
0.3-10.0 keV
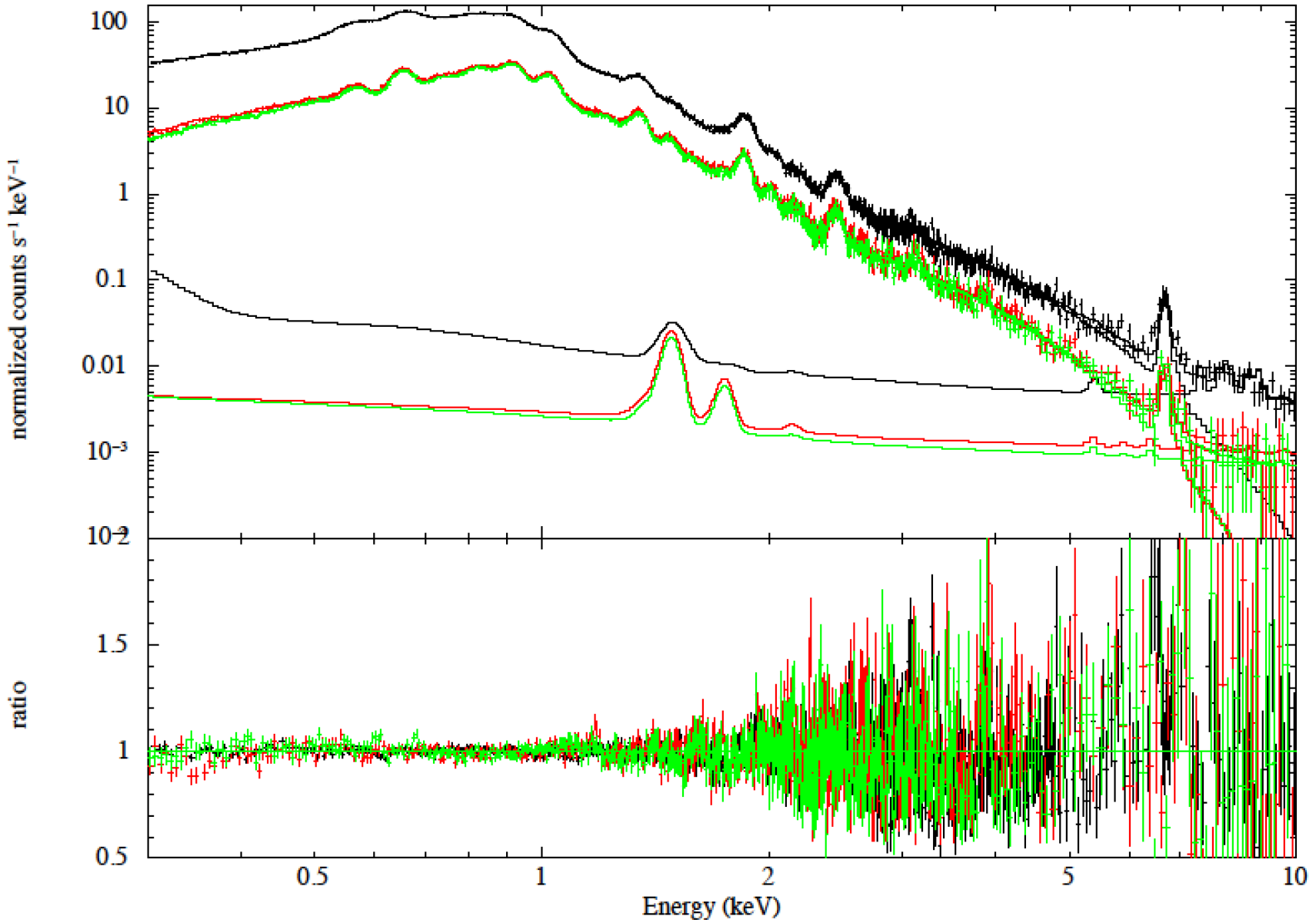
N132D,v2.10 model,SAS14,0129341801,_pnS022,Med,_mos1S023,Thin1,_mos2S024,Thin1
2005−02−19,DOF=704.0,Cstat=1052,Rchi=1.49,PNCon=0.960,M1Con=0.978,M2Con=0.946

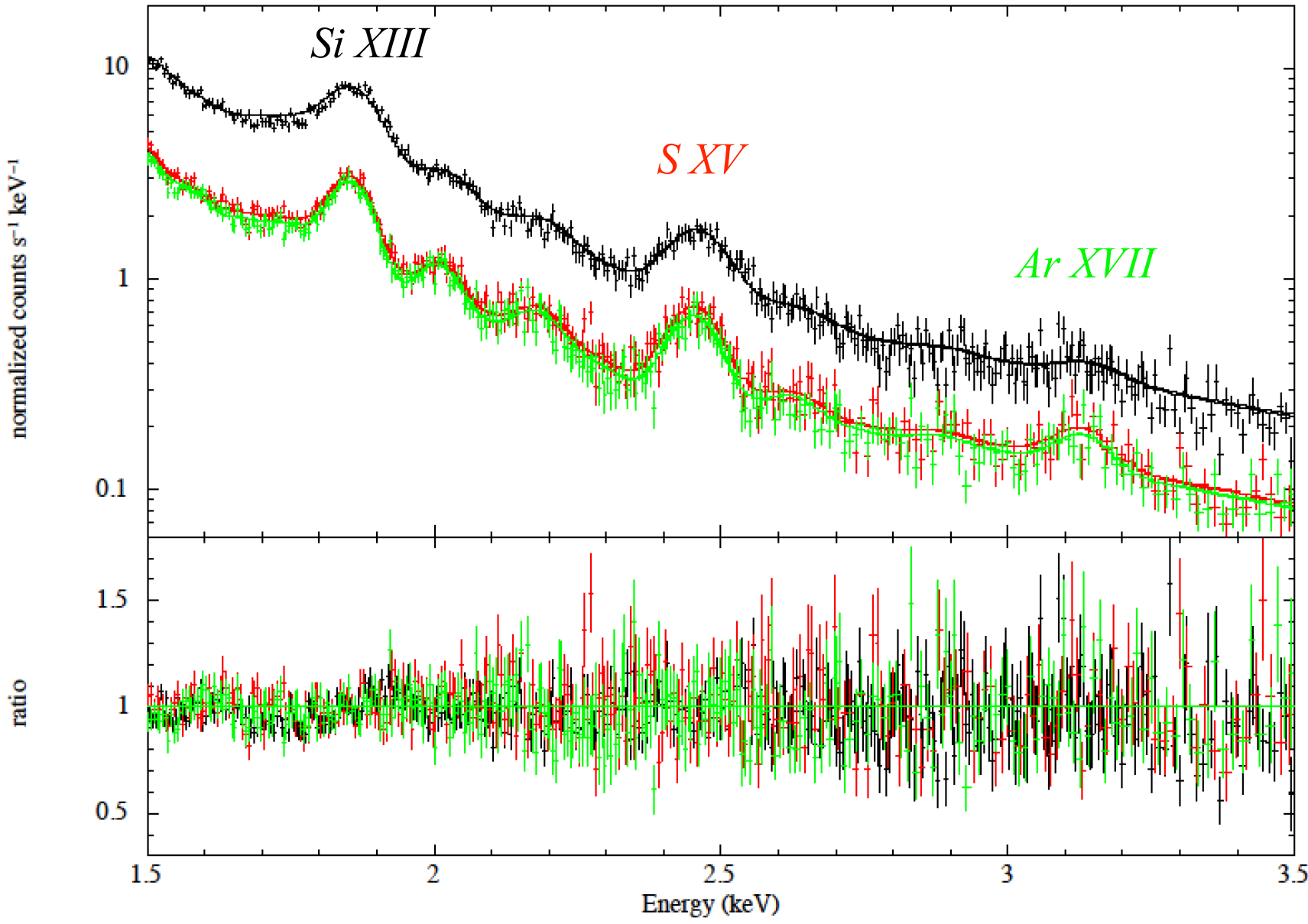**N132D: A single pn, MOS1, MOS2 observation fit with v2.10 of the IACHEC model**

0.3-1.5 keV

N132D,v2.10 model,SAS14,0129341801,_pnS022,Med,_mos1S023,Thin1,_mos2S024,Thin1
2005–02–19,DOF=1183.0,Cstat=1408,Rchi=1.30,PNCon=0.960,M1Con=0.978,M2Con=0.946

Si XIII

S XV

Ar XVII

N132D: A single pn, MOS1, MOS2 observation fit with v2.10 of the IACHEC model

1.5-3.5 keV

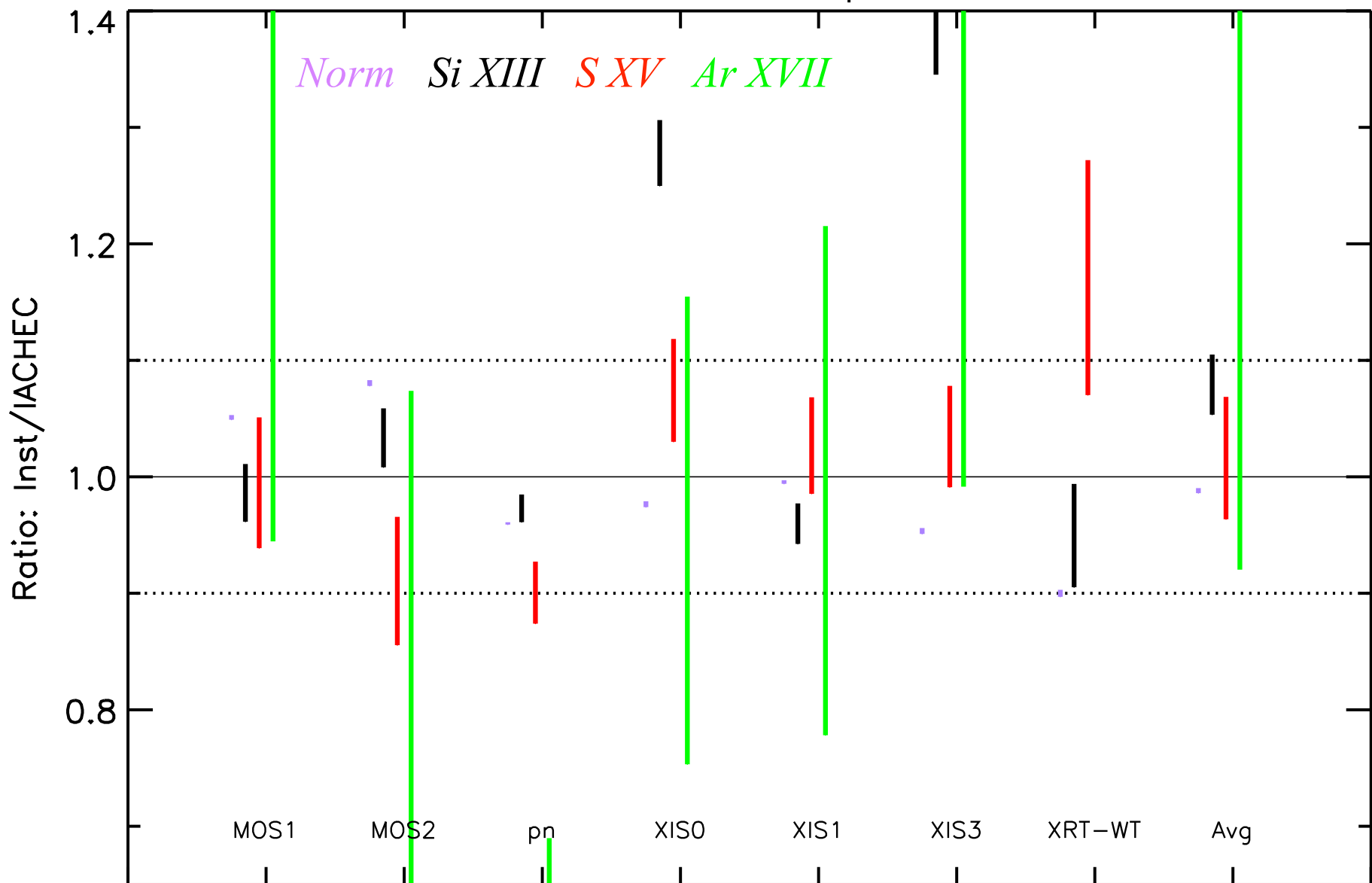## N132D: Comparison of Fitted Norms for S XIII, S XV, & Ar XVII

N132D: Si XIII, S XV, Ar XVII, Updated 27 Mar 2017

Norm Si XIII *S XV* *Ar XVII*

Ratio: Inst/IACHEC

MOS1   MOS2   pn   XIS0   XIS1   XIS3   XRT−WT   Avg

N132D IACHEC Model Development

Objective is to develop a standard IACHEC model, like the E0102 model, that can be used for multiple calibration purposes in the 1.5 - 3.5 keV band.

N132D ACTION ITEMS FROM 2017 IACHEC

- *Update the line widths and normalizations for weak lines using early mission data from the RGS* **[Andy Pollock]**
- *use background from the outboard CCDs in the MOS* **[Steve Sembay]**
- *Check the MOS data for evidence of pileup* **[Steve, Paul, Adam]**
- *experiment with fitting in narrow bandpasses and allowing the continuum shape and normalization to change* **[ALL]**