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:

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<th>Team Members</th>
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<td>XMM-Newton RGS</td>
<td>Andy Pollock (Sheffield), Martin Stuhlinger (ESAC)</td>
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<td>XMM-Newton MOS</td>
<td>Steve Sembay (Leicester)</td>
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<td>XMM-Newton pn</td>
<td>Frank Haberl (MPE)</td>
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<td>Chandra ACIS</td>
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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

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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.
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

**RGS Spectra of E0102**

Counts \( s^{-1} \) cm\(^{-2} \) A\(^{-1} \)

Wavelength (A)
Comparison of E0102 Line Normalizations for MOS, pn, ACIS, XIS and XRT

MOS and pn disagree by 5-15% depending on the line, this is apparently larger than the discrepancy suggested by other analyses.
Time Dependence of ACIS S3 on axis in subarray mode
the pn in small window mode on-axis is remarkably stable

Haberl (MPE)

Time Dependence of pn in small window mode

Line Ratio

Year

0.9 0.95 1 1.05

2005 2010 2015

O VII  O VIII  Ne IX  Ne X  EPIC pn Small Window Mode

SAS 14.0
Time Dependence of MOS in large window mode

MOS1
- Norm
- OVI
- OVI
- NeIX
- NeX

MOS2
- Norm
- OVI
- OVI
- NeIX
- NeX

Sembay (Leicester)

Year

Ratio instr/IACHEC
0.90 0.95 1.00 1.05 1.10
Time Dependence of Suzaku XIS

Miller (MIT)
Time Dependence of Swift XRT in WT Mode

Beardmore (Leicester)
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

(normalized counts s⁻¹ keV⁻¹)

(data−model)/error

Energy (keV)
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**: A single pn, MOS1, MOS2 observation fit with v2.10 of the IACHEC model

**Energy (keV)**

**0.3-10.0 keV**
N132D: A single pn, MOS1, MOS2 observation fit with v2.10 of the IACHEC model

0.3-1.5 keV
N132D: A single pn, MOS1, MOS2 observation fit with v2.10 of the IACHEC model

Si XIII

S XV

Ar XVII

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
**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]