



White dwarf (WD) and Isolated Neutron Star (INS) Working Group

Vadim Burwitz (MPE) on behalf of the working group
16th IACHEC Meeting,
El Parador de la Granja de San Ildefonso, Segovia Spain
May 16, 2024



Working Group members

- Vadim Burwitz (chair, Chandra LETG)
- Jelle Kaastra (Chandra, Modeling)
- Herman Marshall (Chandra)
- Norbert Schulz (Chandra)
- Vinay Kashyap (Chandra)
- Brad Wargelin (Chandra)
- Jeremy Drake (Chandra)
- Andy Beardmore (Swift)
- Yong Chen (Einstein Probe)
- Jelle de Plaa (XMM RGS)
- Craig Markwardt (NICER)
- Vadim Burwitz (Chandra)
- Tadayasu Dotani (Suzaku)
- Eric Miller (Suzaku, XRISM)
- Konrad Dennerl (XMM pnCCD, eROSITA)
- Michael Freyberg (XMM pnCCD, eROSITA)
- Steve Sembay

Goals of the Working Group

- Identify and characterise WD and INs standard candle objects
 - **WDs:**
 - HZ43
 - Sirius B
 - GD153
 - **Objects**
 - RX J1856.5-3754 (Work horse Spectrum)
 - PSR B0656+14
 - 1RXS J214303.7+065419 (=RXJ2143) eROSITA

IACHEC WD + INS Wiki page

<https://wikis.mit.edu/confluence/display/iachec/White+Dwarfs+and+Isolated+Neutron+Stars>

Übersicht > IACHEC > ... > White Dwarfs and Isolated Neutron Stars

Durchsuchen ▾ Anmelden Suchen

White Dwarfs and Isolated Neutron Stars

Extras ▾

4 hinzugefügt von [Eric D Miller](#), zuletzt bearbeitet von [Vadim Burwitz](#) am May 21, 2019 22:58 ([Änderung anzeigen](#))

Working Group

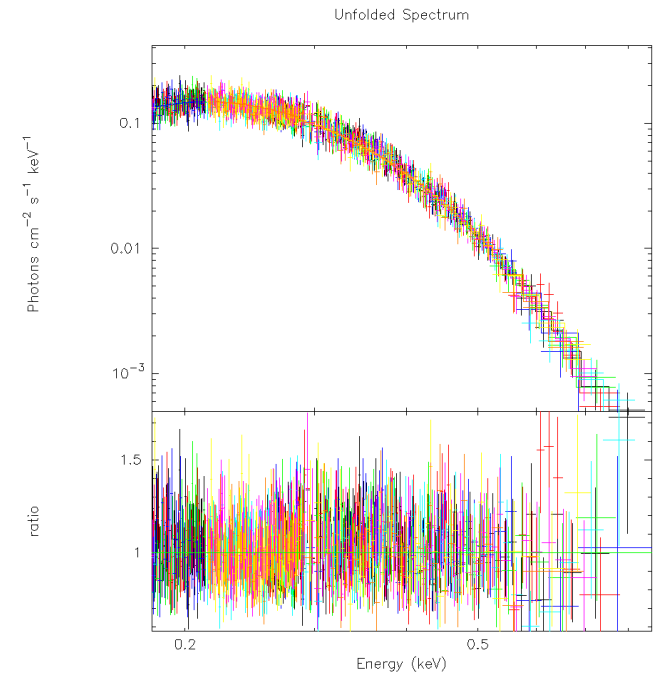
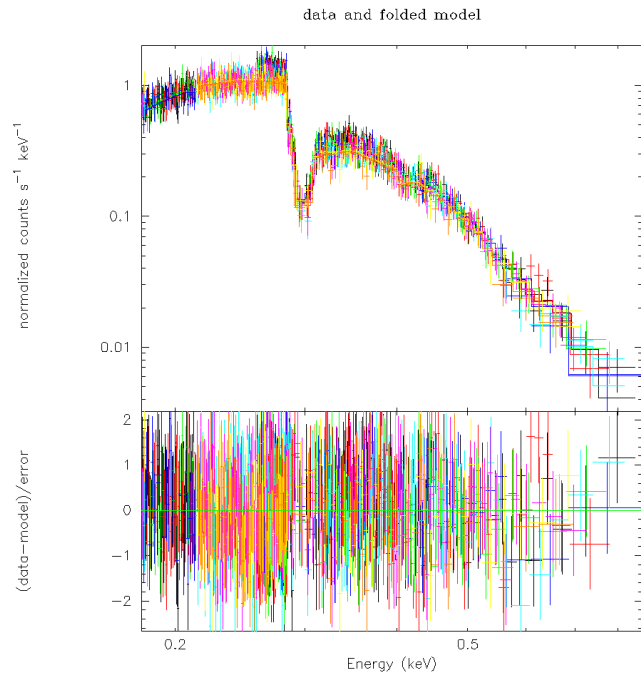
- **Models**

- **RX J1856.5-3754 based on the CHANDRA LETGS + HRCS Data**

delchisqr = 1 (= 1 sigma for 1 parameter)

- **tbabs*bbbodyrad**
 - chiqs = 692.6
 - dof = 1251
 - chired = 0.55367
 - nh = (7.24 +/- 0.34) * 1e19 cm-2**
 - kT = (62.38 +/- 0.38) eV**
 - norm = (1.580 +/- 0.064) * 1e5**

- **phabs*bbbodyrad**
 - chiqs = 696.0
 - dof = 1251
 - chired = 0.55636
 - nh = (7.37 +/- 0.35) * 1e19 cm-2**
 - kT = (62.43 +/- 0.38) eV**
 - norm = (1.576 +/- 0.065) * 1e5**



HZ 43 Fitting Function (info on Wiki page)

- ```
mdefine poly_hz43 e*(0.955968 + e*(-0.699684 + e*(0.555432 + e*(-0.292088 + e*0.069582))))+dummy
mdefine hz43 8.0525*poly_hz43(0.0)**2/kT**4/(exp(poly_hz43(0.0)/kT)-1.0)
```
- Consists of a blackbody-like curve whose energy variable is a polynomial function of true X-ray energy
- Polynomial terms found by fitting to TMAP data
- "mdefine" is suitable for use within XSPEC, or adaptable to any other spectral fitting code



# RX J1856.5-3754 Calibration Observations

## **Current Missions**

- Chandra: LETGS , ACIS
- XMM: PN, MOS, RGS
- Swift
- SUSAKU: XIS
- NICER
- Einstein Probe
- XRISM

## **Future Missions**

- SVOM (to be launched in June 2024)

# Talks given in the WG Session on May 14, 2024

- Using HZ 43 for Chandra HRC Calibration
  - Vinay Kashyap
- ACIS contaminant update using RX J1856.5-3754
  - Herman L. Marshall
- Using RX J1856.5-3754 to improve the RMF and ARF of XMM/EPIC-pn and SRG/eROSITA
  - Konrad Dennerl
- NICER Observations of WDs & INSs
  - Craig Markwardt

# Using HZ 43 for Chandra HRC Calibration

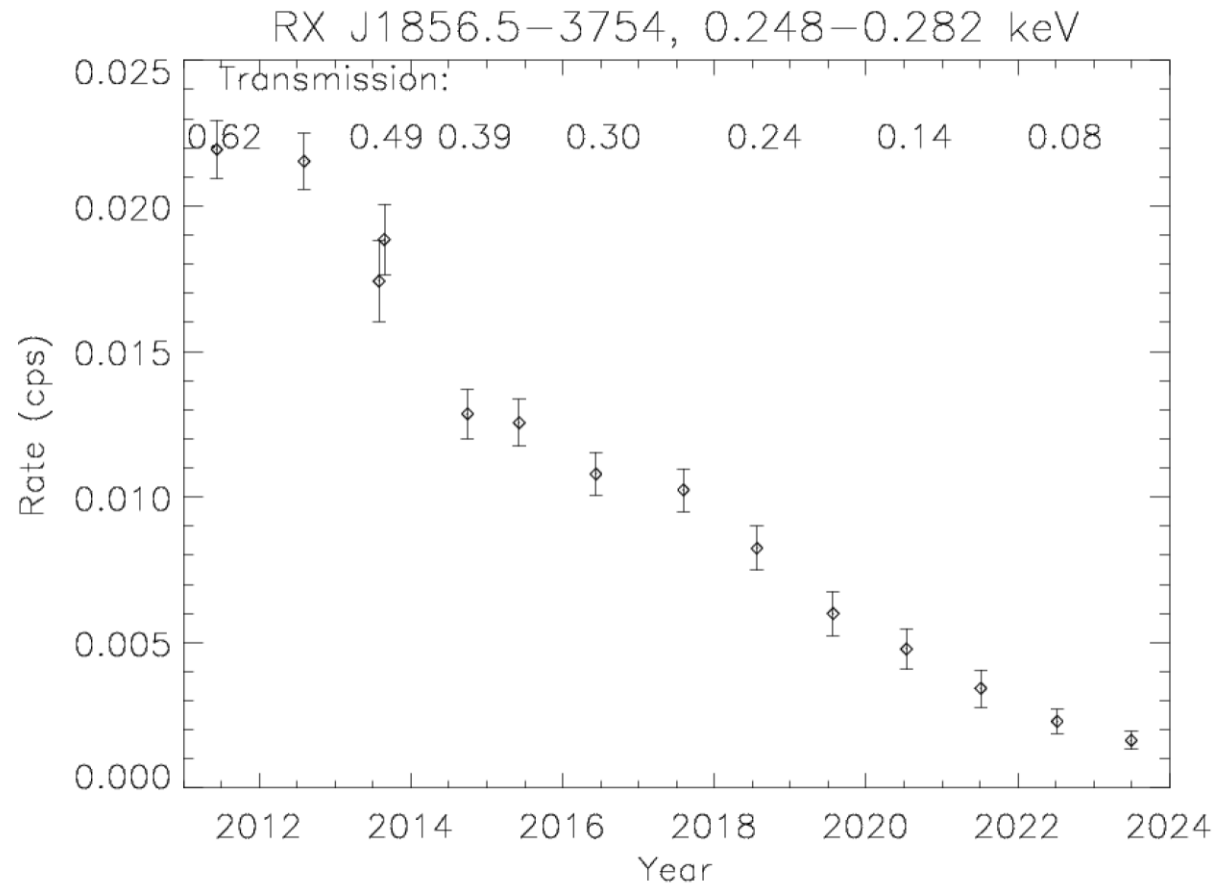
- DAwk White Dwarf at 60 pc, extremely soft source with most emission at  $\lambda > 60 \text{ \AA}$  ( $E < 0.2 \text{ keV}$ )
- $\gtrsim 2.5 \text{ ct/s}$  in HRC-I/LETGO,  $\gtrsim 6.5 \text{ ct/s}$  in HRC-S/LETGO
- Used for
  - QE (HRC-I) and QEU (HRC-S) updates at low E
  - Gain calibration for both HRC-I and HRC-S
  - PSF monitoring on both HRC-I and HRC-S
- Observed at a cadence of at least once a year, plus every time there is a planned change in detector characteristics (like voltage changes)



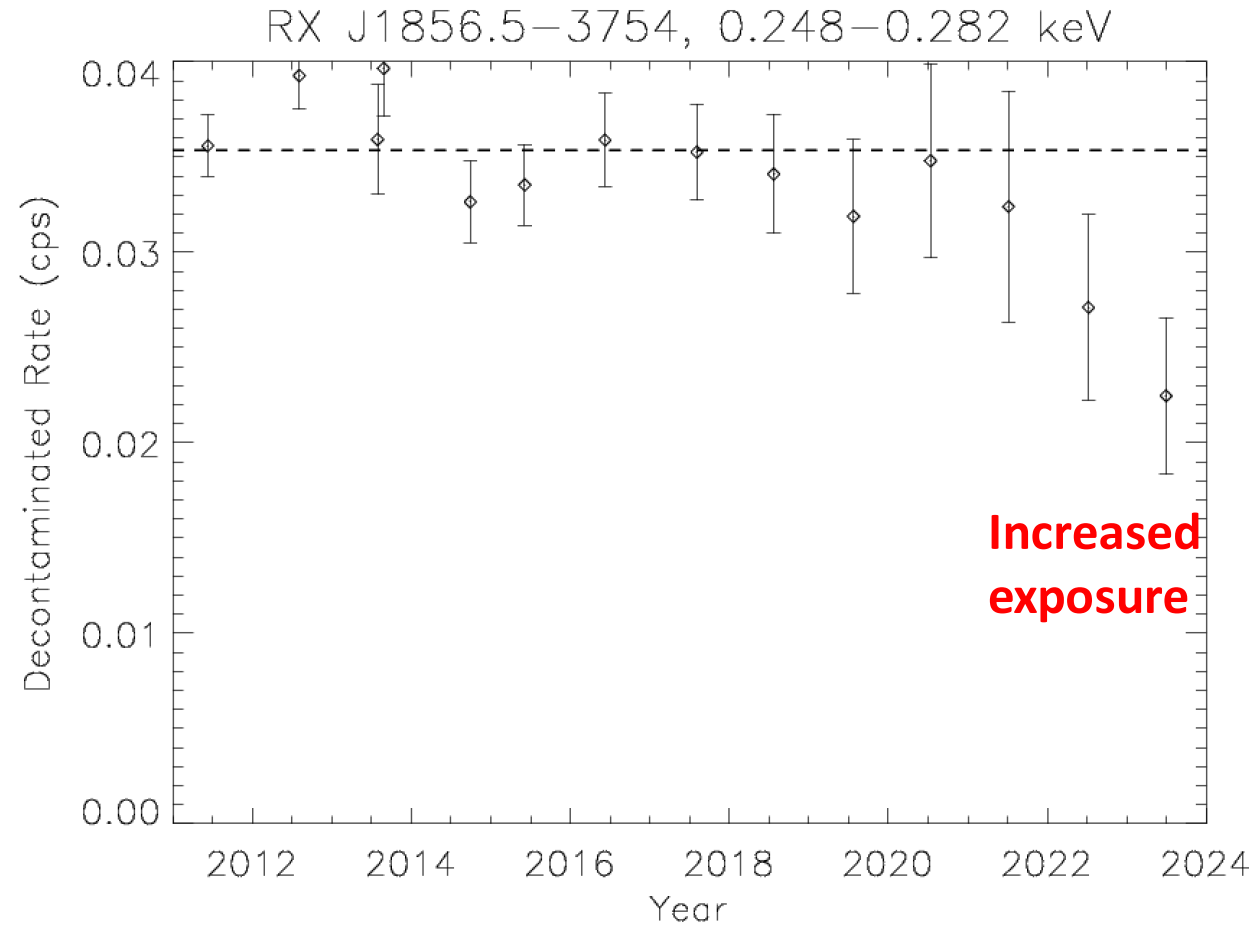


# ACIS Contamination

## Examining E < C-K



## Contamination Corrected



# ACIS Contamination Summary

- Contaminant deposition rate continues
  - Increasing above the 2015-20 linear trend
  - Model looks good
- Model does not need to be updated
- Nearing limit of how useful RX J1856 is
  - Source is still detectable in 60 ks (5.4 sigma)
  - Not including extended soft X-ray flux
  - Contaminant correction is low by 35% in 2023



# Using RX J1856.5-3754 for improving the RMF and ARF of XMM/EPIC-pn

RXJ1856

XMM/EPIC-pn

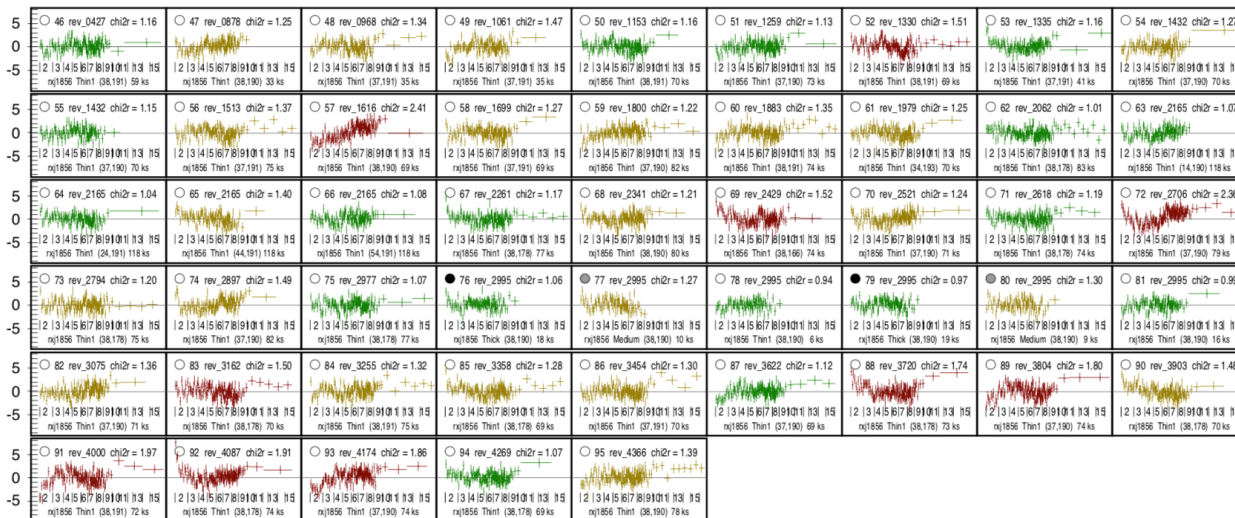
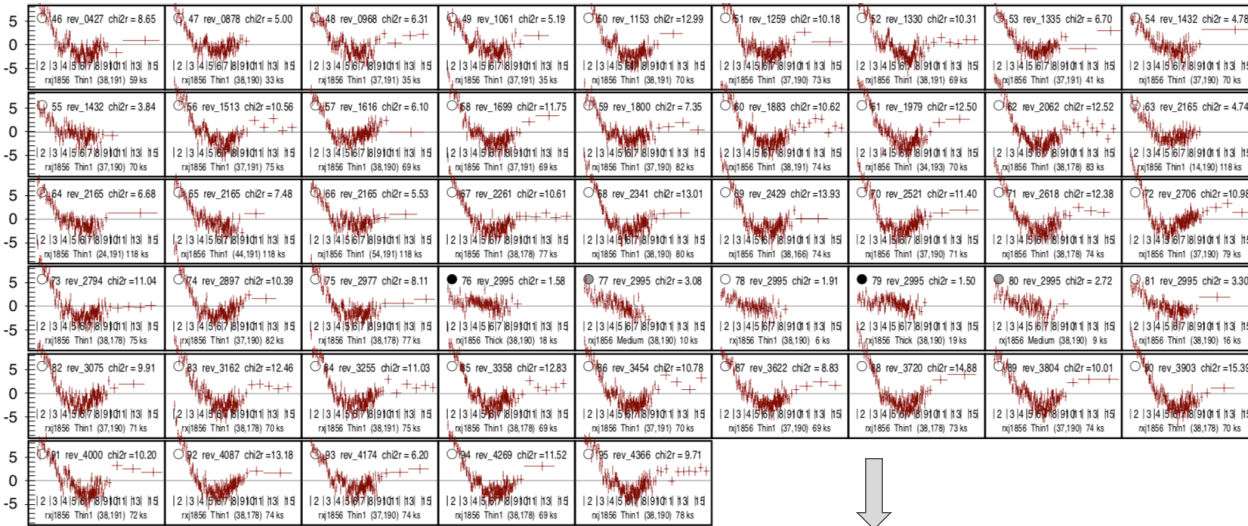
residuals resulting from Chandra model spectrum and RMFs/ARFs obtained with

rmfgen-2.8.7  
arfgen-1.104

and

alternative approach

Konrad Dennerl



# Using RX J1856.5-3754 for improving the RMF and ARF of SRG/eROSITA

- RXJ1856 matches Chandra LETG
  - norm-free, shape fixed to LETG
- After ARF and RMF adjustment
  - good spectral fits for ,TM8' & all valid patterns



# NICER Observations of WDs & INSs

- Various standard candle calibrators: NICER appears to have lower flux  $< 0.5$  keV, could be consistent with additional absorption
- RX J1856 (isolated neutron star black body)
- HZ 43 (white dwarf)
- Low energy flux offsets seem consistent with extra absorption, comparable to  $1.0 \times 10^{19} / \text{cm}^2$

