

INs and WDs Working Group

Vadim Burwitz (MPE)

IACHEC #14, May 20, 2019

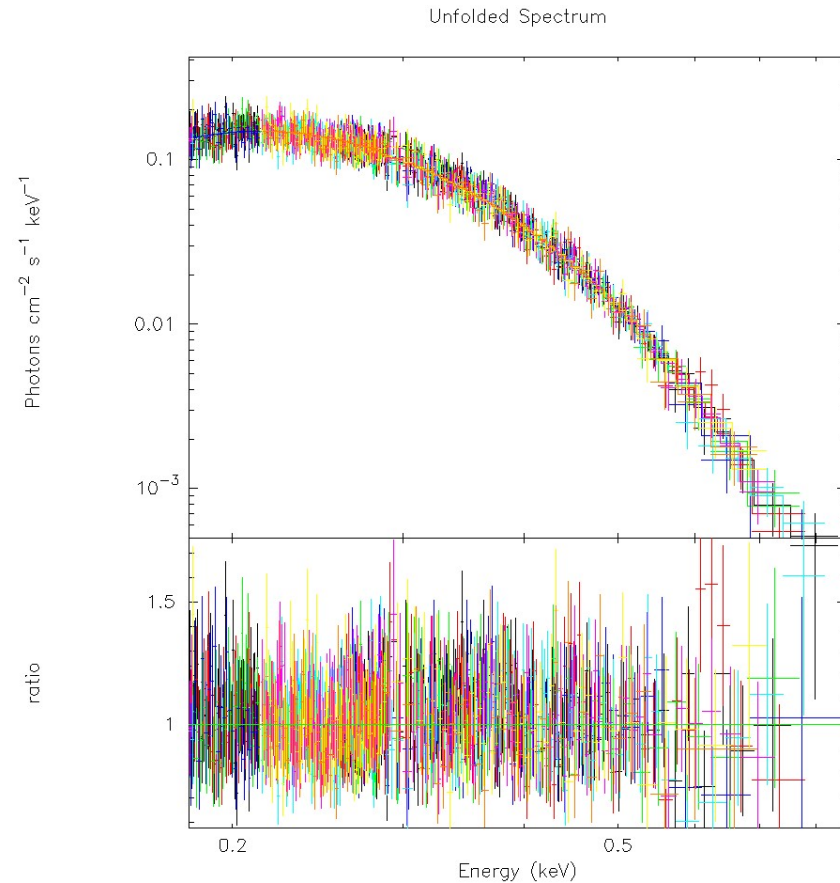
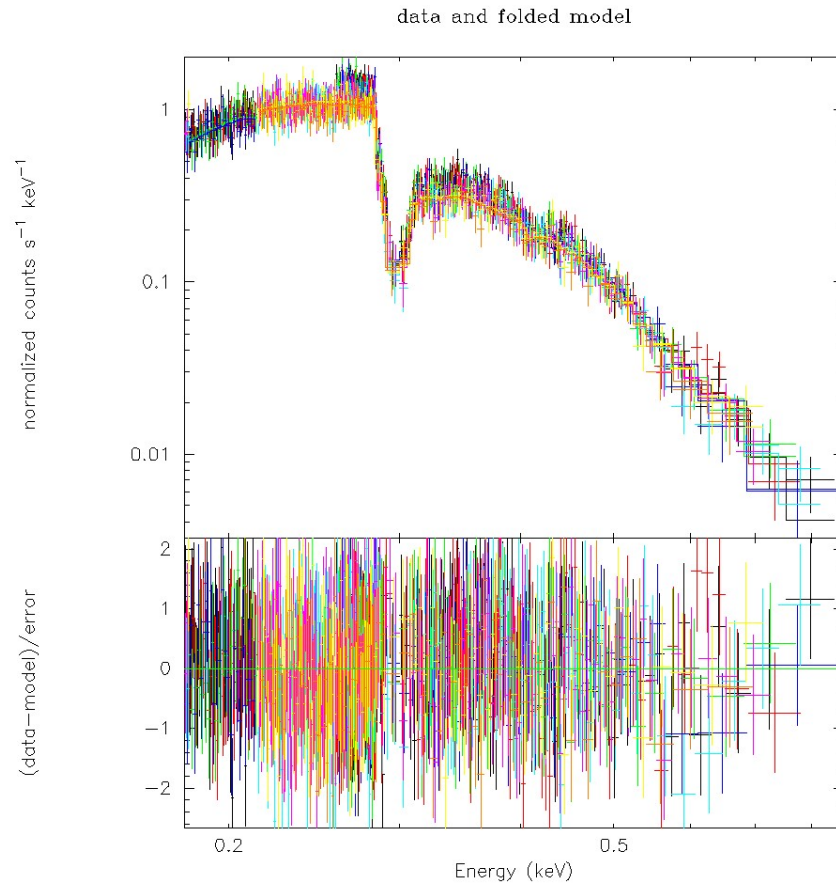
Shonan Village, Japan

Overview

- Vadim Burwitz (WG Chair):
 - Introduction – Status RXJ1856.5-3754
- Tomokage Yoneyama:
 - Universal detection of high-temperature emission in X-ray Isolated Neutron Stars
- Konrad Dennerl
 - RX J1856.5-3754: Reaching consistency between Chandra LETG and XMM-Newton/EPIC-pn



Current IACHEC Model for RX J1856.6-3756



- **Summary of fits to 4 long LETG spectra**
pos. + neg. orders of OBS IDs
3380 (164ks), 3381 (169ks), 3382 (97ks),
15293 (91ks)
processed in 2014
- **XSPEC model**
phabs * bbodyrad
chiqs = 696.0
dof = 1251
chired = 0.55636
- **Parameters:**
nH = $(7.24 \pm 0.34) \times 10^{19} \text{ cm}^{-2}$
kTbb = $(62.38 \pm 0.38) \text{ eV}$
norm = $(1.580 \pm 0.064) \times 10^5$

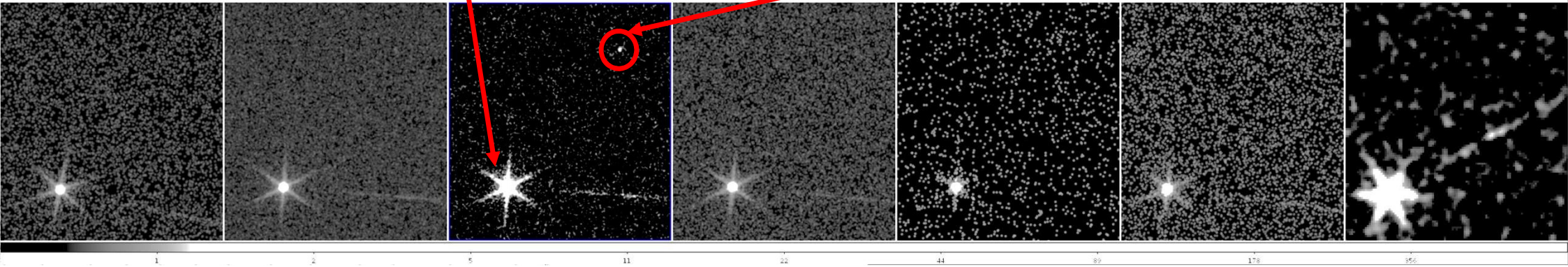
burwitz 15-May-2019 20:33

IACHEC #14, Shonan Village, Japan, May 21, 2019

RX J1856.6-3756 Zero order images

RXJ1856

Hard source 38" from RXJ1856



Select	Row	Seq Num	Obs ID	Instrument	Grating	Appr Exp	Exposure	Target Name	PI Name	RA	Dec	Status	Data Mode	Exp Mode	Avg Cnt Rate	Evt Cnt	Start Date	Public Release Date	Proposal
<input type="checkbox"/>	1	500000	113	HRC-S	LETG	50.0	55.14	RX J1856.5-3754	Predehl	18 56 35.30	-37 54 34.40	archived			45.95	2533819	2000-03-10 07:54:08	2001-04-28 09:30:00	01500003
<input type="checkbox"/>	2	500285	3380	HRC-S	LETG	170.0	164.7	RXJ1856.5-3754	Tananbaum	18 56 35.30	-37 54 34.40	archived			56.44	9295025	2001-10-10 05:05:24	2001-11-09 09:00:00	02508062
<input type="checkbox"/>	3	500285	3381	HRC-S	LETG	170.0	169.31	RXJ1856.5-3754	Tananbaum	18 56 35.30	-37 54 34.40	archived			58.90	9972590	2001-10-12 19:18:22	2001-11-09 09:00:00	02508062
<input type="checkbox"/>	4	500285	3382	HRC-S	LETG	100.5	97.72	RXJ1856.5-3754	Tananbaum	18 56 35.30	-37 54 34.40	archived			67.31	6577104	2001-10-08 08:17:45	2001-11-09 09:00:00	02508062
<input type="checkbox"/>	5	500285	3399	HRC-S	LETG	9.5	9.25	RXJ1856.5-3754	Tananbaum	18 56 35.30	-37 54 34.40	archived			49.64	459240	2001-10-15 11:46:02	2001-11-09 09:00:00	02508062
<input type="checkbox"/>	6	502023	15293	HRC-S	LETG	90.0	91.23	RX J1856.5-3754	Predehl	18 56 35.30	-37 54 34.40	archived			54.04	4929887	2013-06-12 14:28:42	2013-06-20 05:23:57	14500050
<input type="checkbox"/>	7	590518	14418	HRC-S	LETG	30.0	29.96	RXJ1856.5-3754	Calibration	18 56 35.30	-37 54 34.60	archived			60.24	1804865	2013-10-01 05:02:27	2013-10-03 05:23:55	14500075

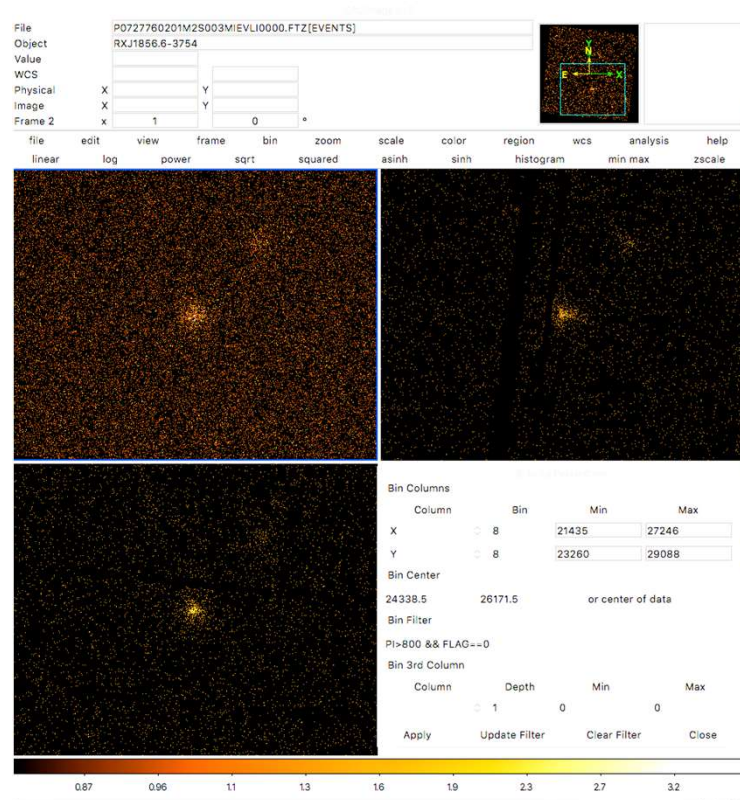
• Summary of all Chandra LETG+HRC-S

zero order images of OBS IDs

113 (55ks), 3380 (165.3ks), 3381 (169ks), 3382 (97.7), 3399 (9.5), 14418 (30ks), 15293 (91ks)
processed in 2014



RX 1856.6-3754: 38" offset transient



- XMM Measurement
 - Transient also has a soft spectrum

NICER Status at IACHEC #13

RXJ1856 and NICER

Peak Effective Area

- At 0.5 keV 1000 cm²
- at 1.5 keV 1900cm²

Model (VB)

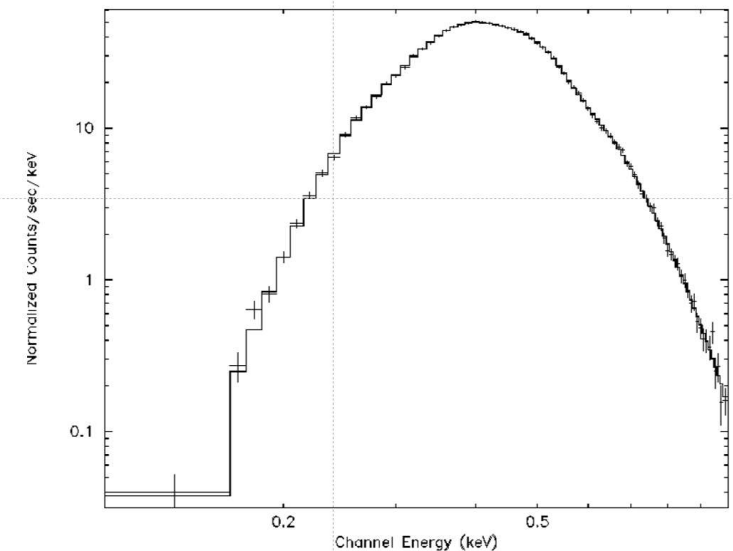
- Model predicted countrate
→ 13cts/s 0.1 -1.0 keV all detectors (FPMs)
0.24 cts/s per FPM

Summary iNS and WDs WG, IACHEC #13, Avigliano Umbro, Italy, April 10, 2018

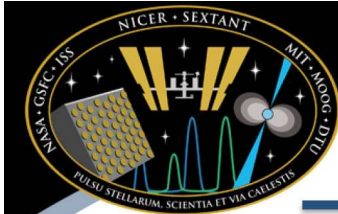
RXJ1856 and NICER

Model (VB) predicted countrate

- 13cts/s 0.1 -1.0 keV all detectors (FPMs)
0.24 cts/s per FPM

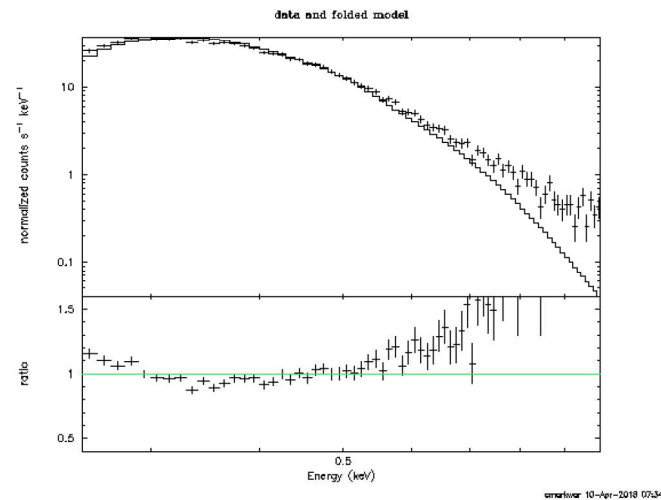


Summary iNS and WDs WG, IACHEC #13, Avigliano Umbro, Italy, April 10, 2018

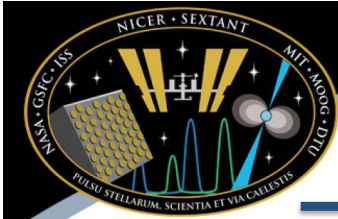


NICER ARF Performance: RX J1856.6-3754

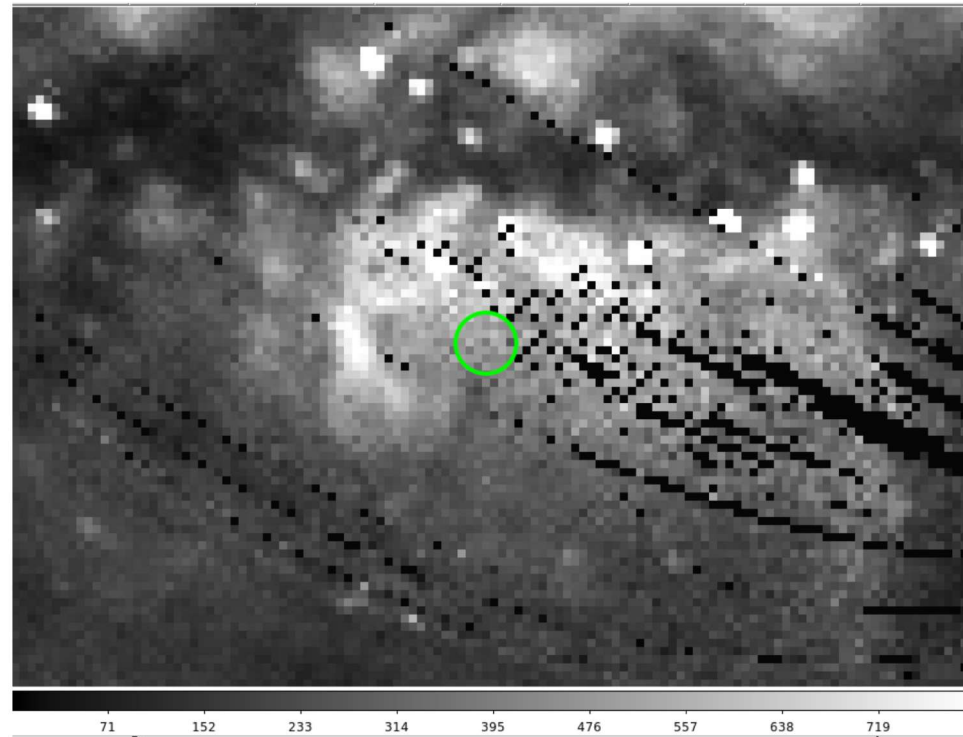
- RX J1856.6-3754: isolated neutron star
 - soft spectrum ($kT < 65$ eV, low NH)
 - constant intensity (assumed)
- Claims of a hard tail (Yoneyama+2017, Suzaku XIS)
 - NICER sees it too, but ...



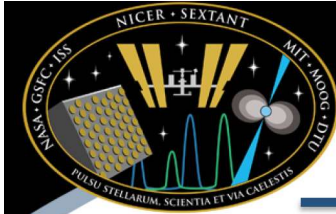
19



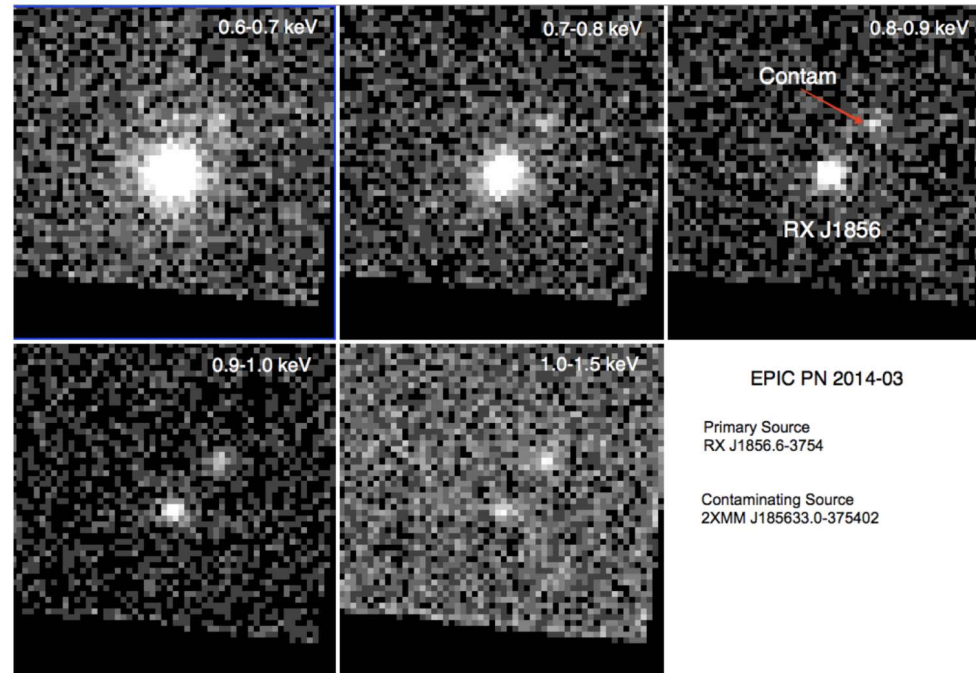
RX J1856 Diffuse Emission



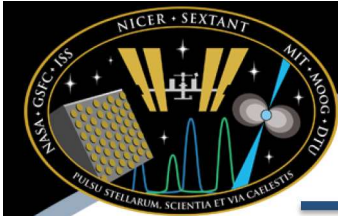
ROSAT All-Sky Survey $\frac{3}{4}$ keV ~ 500 ct/s/arcmin²



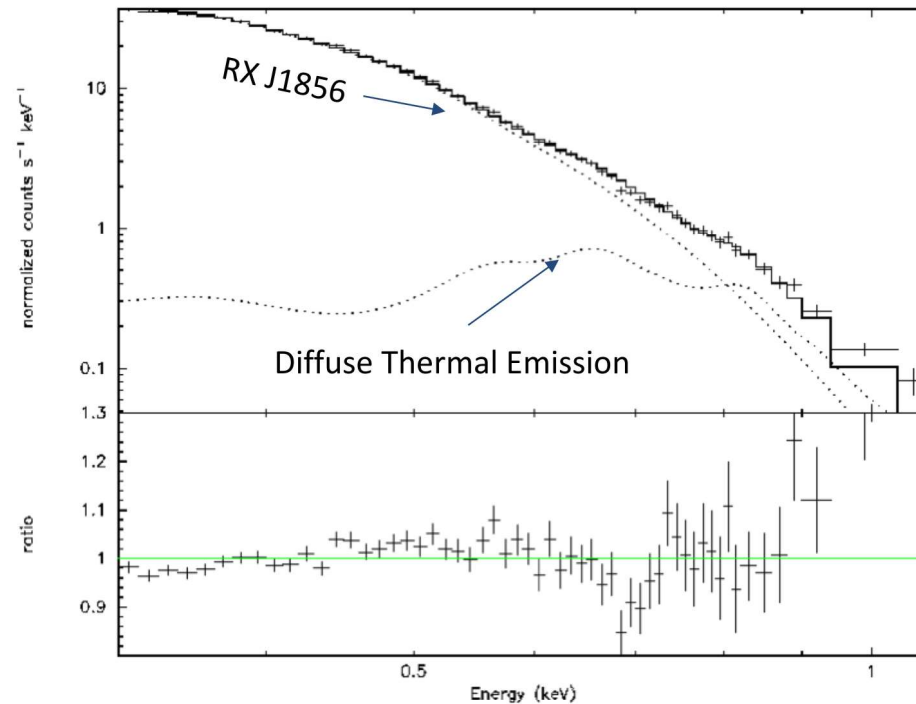
RX J1856 Nearby Contaminator



Hard source 38" from RX J1856, spectrum consistent with $kT=140$ eV, highly variable on timescale of weeks-years; likely to be excess seen by Yoneyama et al 2017; far enough away to not contaminate XMM or Chandra spectra



RX J1856 NICER Spectrum



Spectral shape fixed at IACHEC values (NICER norm 93%), diffuse emission is consistent with ROSAT levels.

The norm difference will probably be fixed after including the effect of misalignments between modules in response.

Email from Craig

OK, here is my new conclusion about the excess NICER is seeing.

I believe it is the galactic bulge thermal plasma, i.e. the ROSAT 3/4 keV and 1.5 keV emission within about 30 deg of the galactic plane.

If I model as thermal plasma I get

$kT = 0.245$ keV, norm = $1.01e-4$ (Raymond)

$kT = 0.252$ keV, norm = $1.15e-4$ (MEKAL)

$kT = 0.252$ keV, norm = $1.18e-4$ (APEC)

for a ~ 30 arcmin² aperture.

To cross check the fitted norm, I fed this temperature and flux density into WebPIMMS, and predicted the ROSAT 0.5-0.9 keV band rate. (3/4 keV band). I get about 0.0005 ct/s/arcmin² predicted based on our excess.

ROSAT all-sky survey map in the 3/4 keV band, at that pixel at the source position is about 0.0005 ct/s/cm²/arcmin² $\pm 30\%$. So this is pretty bang-on.

So this explains the NICER excess, but also possibly the Suzaku excess. Suzaku's extraction radius is smaller $2.2'$ instead of $\sim 3'$ for NICER, so Suzaku will get a smaller background level compared to NICER.


Whew! With this I get a good fit using Vadim's "IACHEC" model, the only thing I have to change is the norm, which is 93.8% instead of 100%. Not too bad. That will change a bit when we re-stack each module with its own alignment, something not done yet with this model.

NICER will measure some local background points near RX J1856 to confirm this.

Craig




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Two new GTO observations, each 86 ksec long, are planned for June 13, and July 18 this year in the context of calibrating eROSITA



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- Konrad Dennerl
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