Current Status of the Blank Field Templates for the PN Timing Mode

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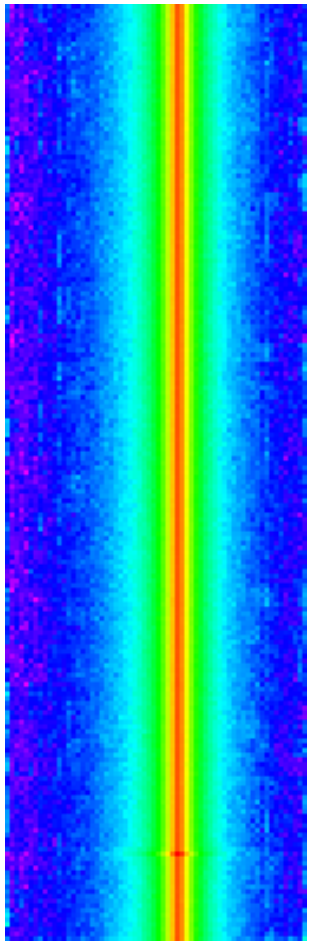
Outline

1. Why do we need a PN TM background template?
2. How can we get a Blank Field?
   - Check with PN data
   - Check with MOS data
3. Location of the Blank Fields
4. RGS background count rate - A gauge
5. Summary and Outlook

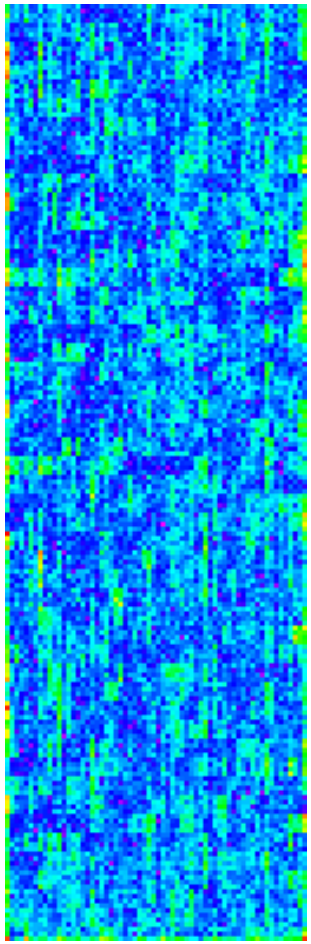
Reminder: Background for PN TM Observations



Problems

- most counts in the central region
- also source photons at the border of the ccd
- no "blank" region to extract background

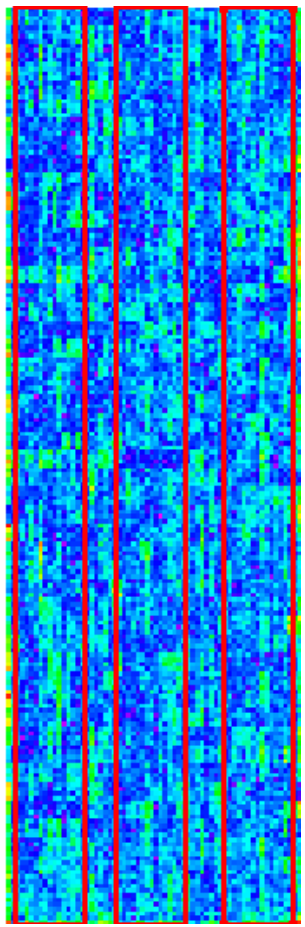
Reminder: Background for PN TM Observations



Solution

- examine all observations performed in Timing Mode
  ($>$ 200 public available)
- check for "Blank Fields"
  ($\sim$ 60)
- check if they are really blank

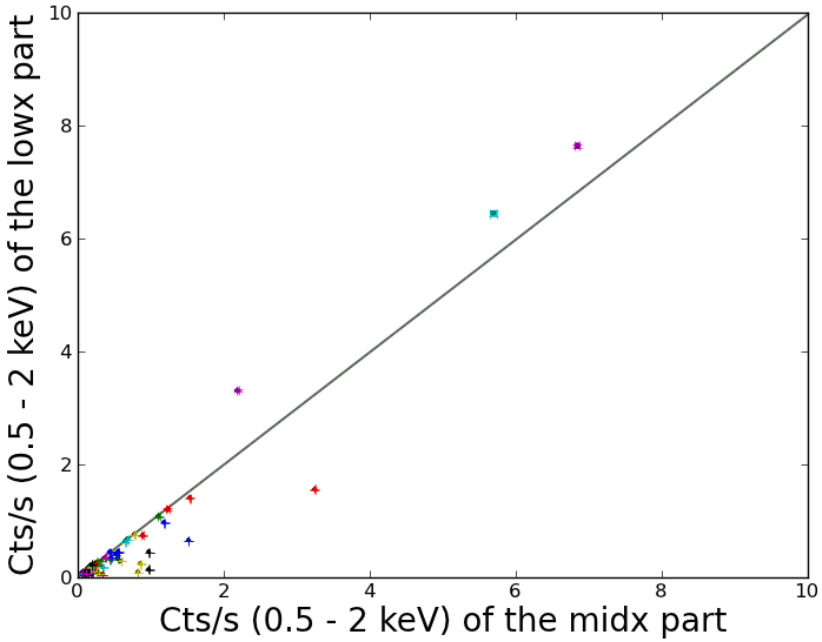
Check if They are Really Blank



Blank Field check

- Count rate of 3 detector parts
- in 3 energy ranges:
  0.5 – 2.0 keV
  2.0 – 5.0 keV
  5.0 – 10.0 keV
- compare the count rate ratios of the three regions
- get the expected ratio with help of the effective area

Check if They are Really Blank



Blank Field check

Calculate the ratios for lowx vs midx, highx vs midx and lowx vs highx

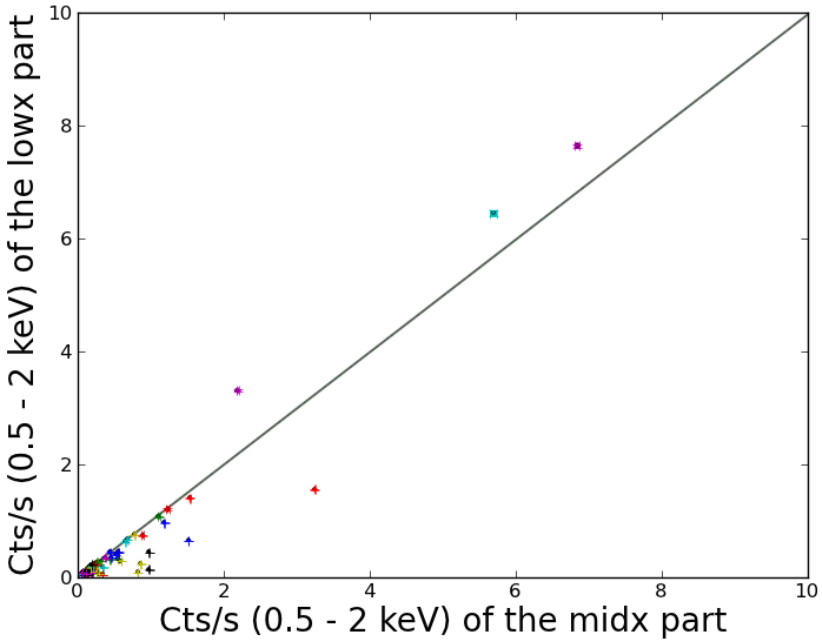
Notstrict

Screening criterion valid for lowx vs midx and highx vs midx

Strict

Screening criterion valid for lowx vs midx, highx vs midx and lowx vs highx

Check if They are Really Blank



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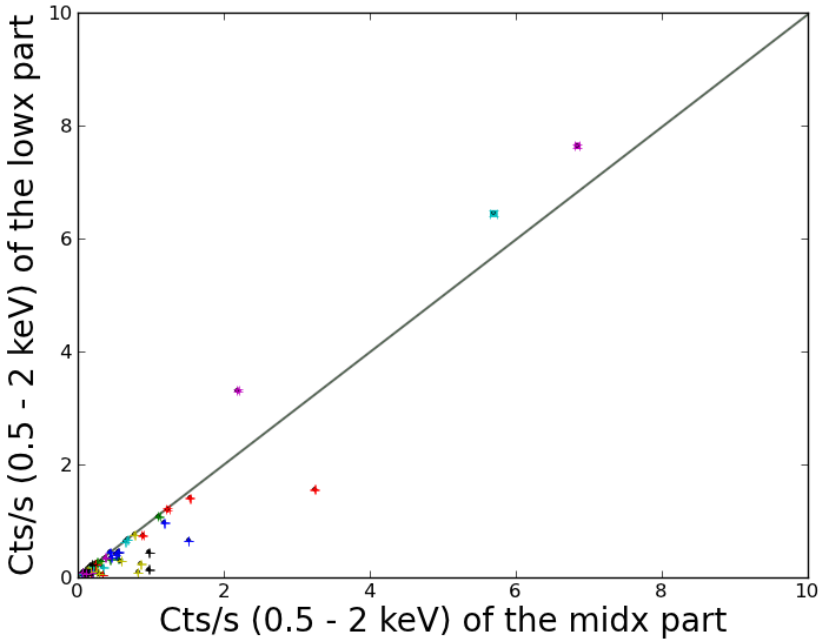
$\rightarrow$ 30 observations classified as "blank" (not strict)

Check if They are Really Blank



Blank Field check

Calculate the ratios for lowx vs midx, highx vs midx and lowx vs highx

Notstrict

Screening criterion valid for lowx vs midx and highx vs midx

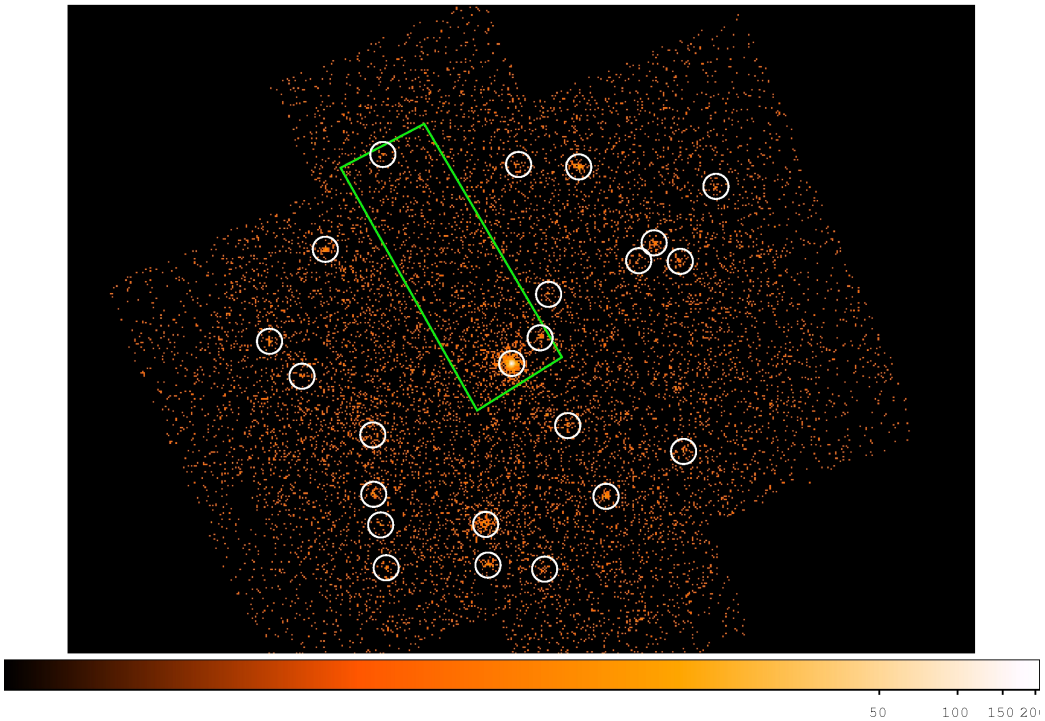
Strict

Screening criterion valid for lowx vs midx, highx vs midx and lowx vs highx

$\rightarrow$ 30 observations classified as "blank" (not strict)

$\rightarrow$ 16 observations classified as "blank" (strict)

Sources Detected in MOS?



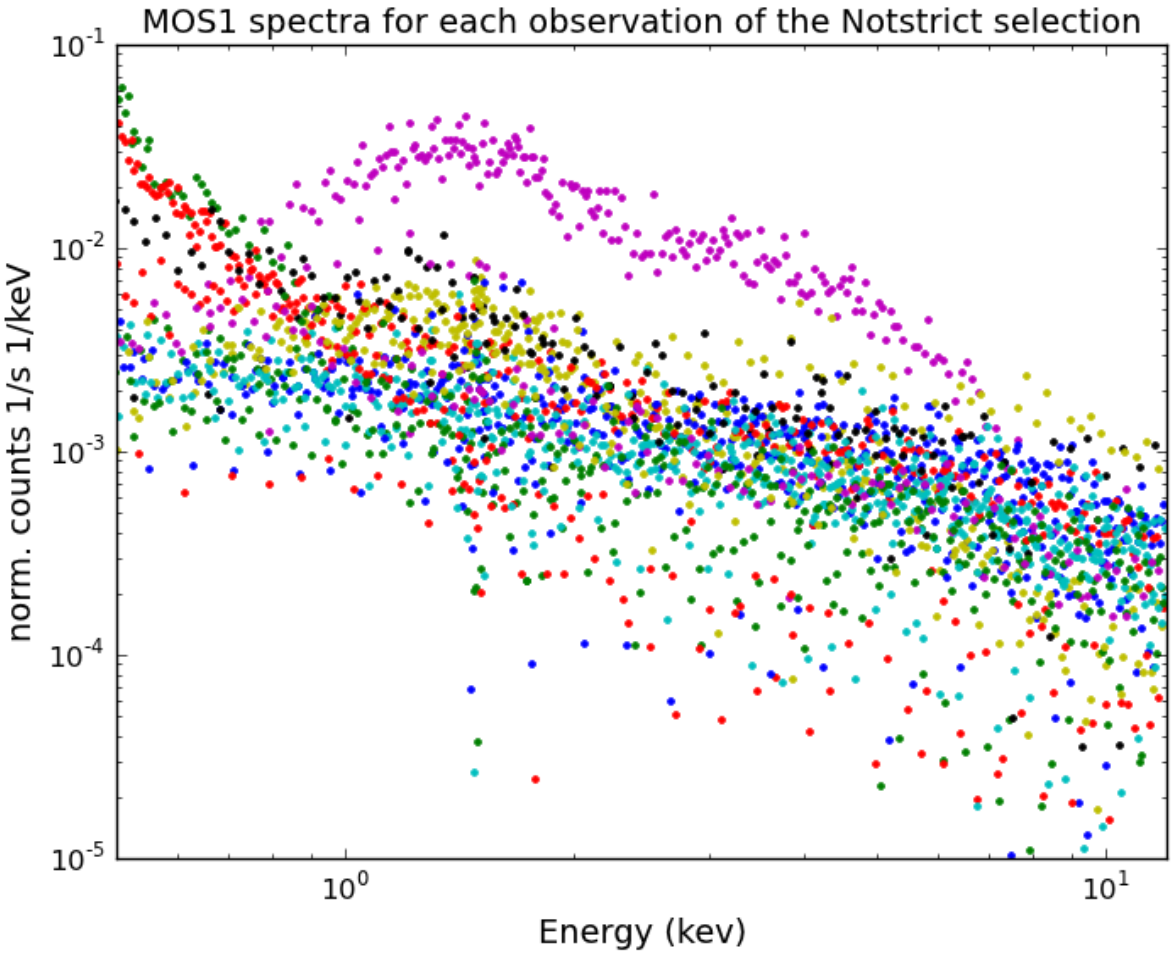
MOS data

- run edetect_chain on available MOS data for the same observations
- nearly all observations (even those that look Blank in TM) show a source

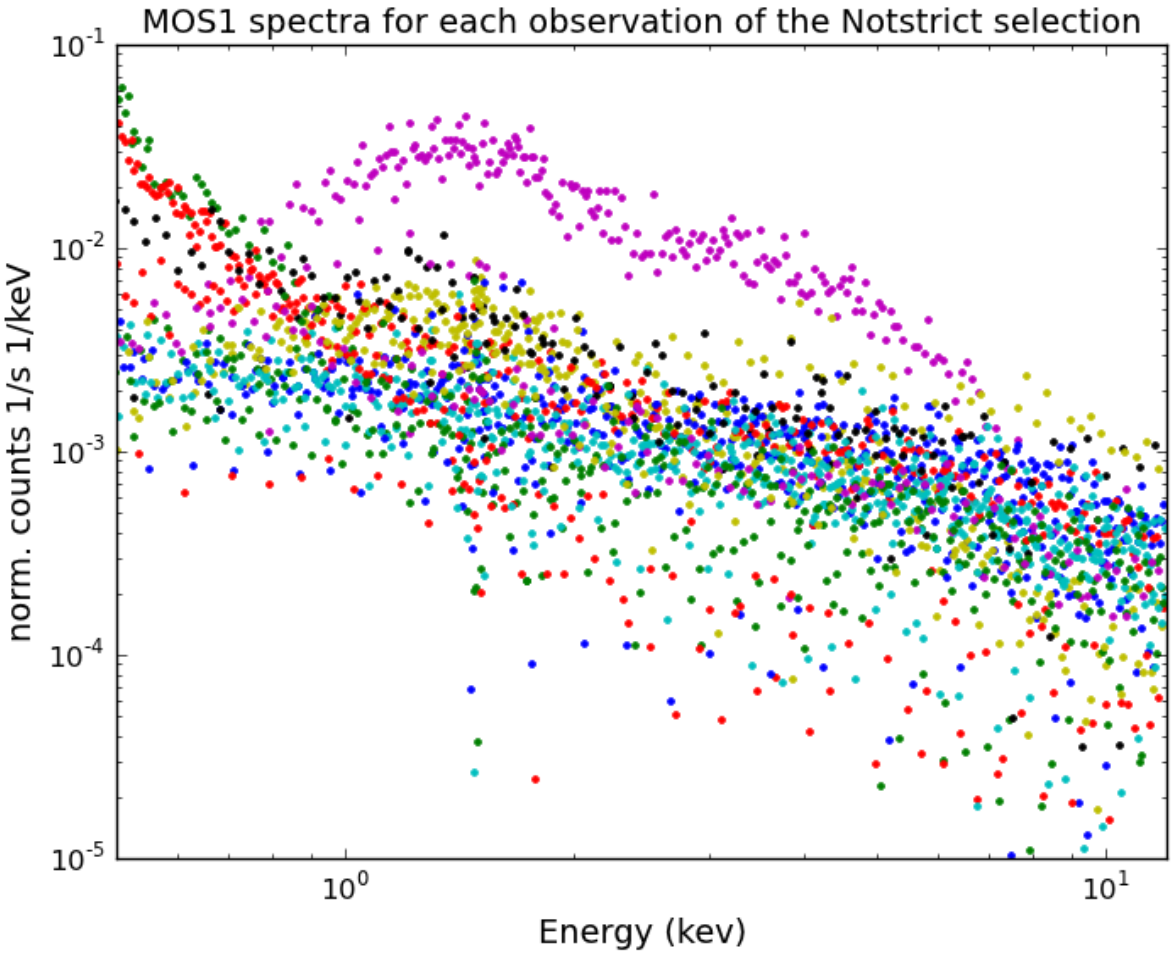
The Corresponding MOS Spectra

- sum up the spectra of all sources in the view of sight of the midx region of the PN CCD #4
- use Filter Wheel Closed Data of MOS1 and MOS2 to deal with internal background of the same regions
- fit simple model (bbody + powerlaw) to the summed spectra
- reduced χ^2 should be close to 1
- countercheck with MOS2 data
- fake PN spectrum and subtract from the "Blank Field"

The Corresponding MOS Spectra

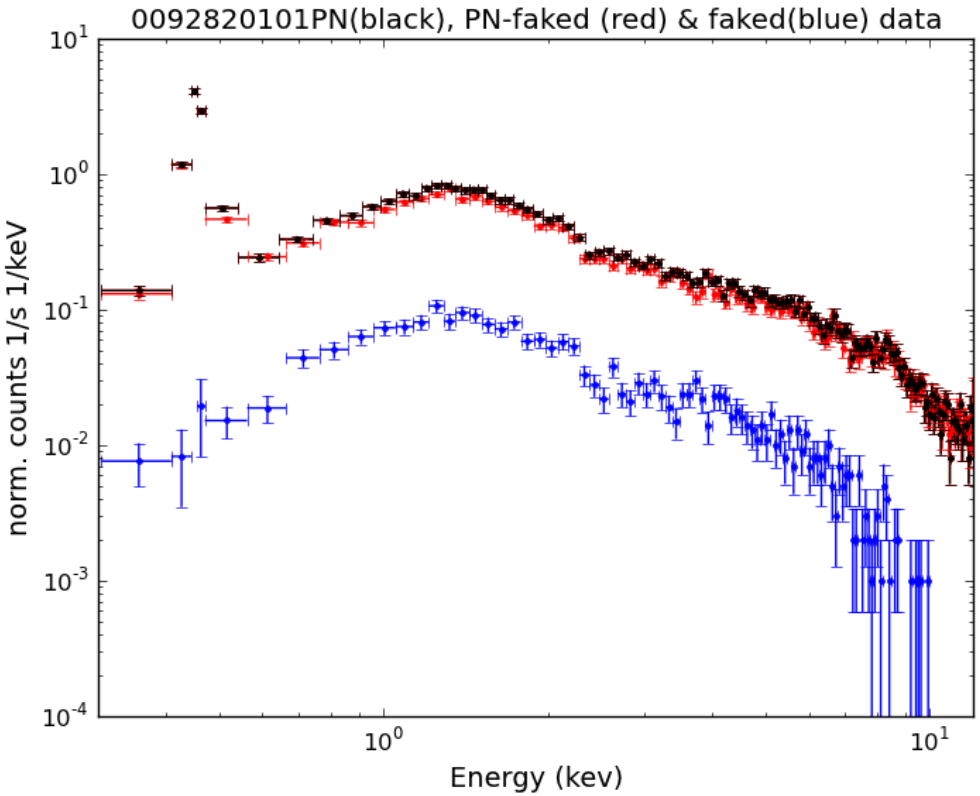


The Corresponding MOS Spectra



$\rightarrow$ take out one "non-blank" observation of the "Blank Fields"

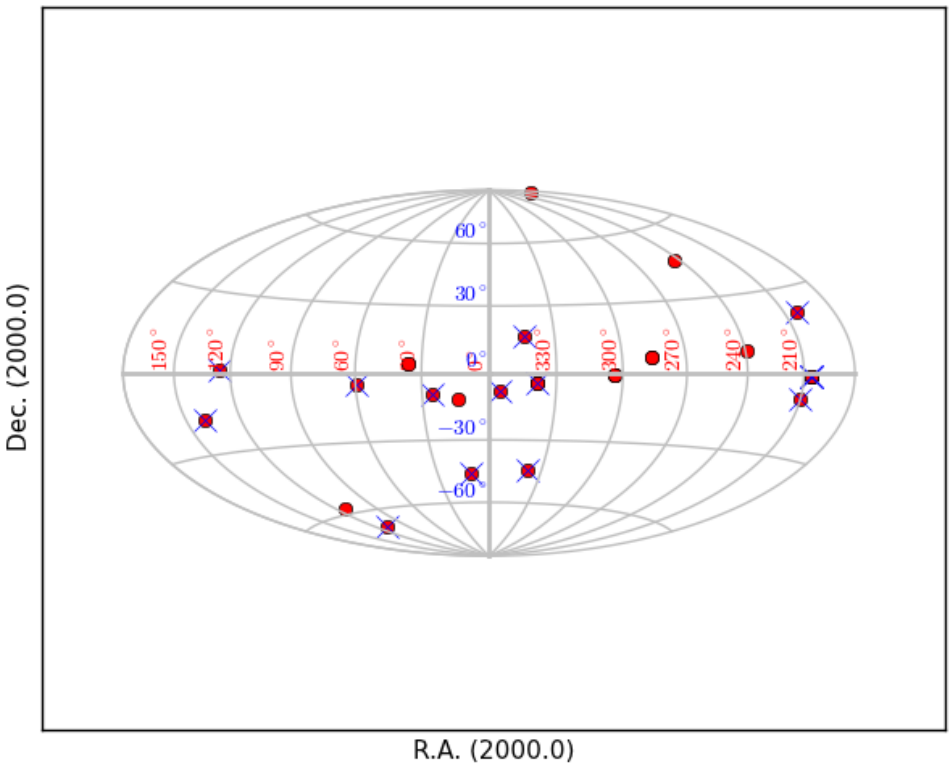
Blank Fields - Faked Spectra - Subtracted Spectra



- faked PN spectra exhibit typically a count rate of 10% of the "Blank Field"
- Subtraction does not change the spectrum significantly

Remaining Blank Fields in Galactic Coordinates

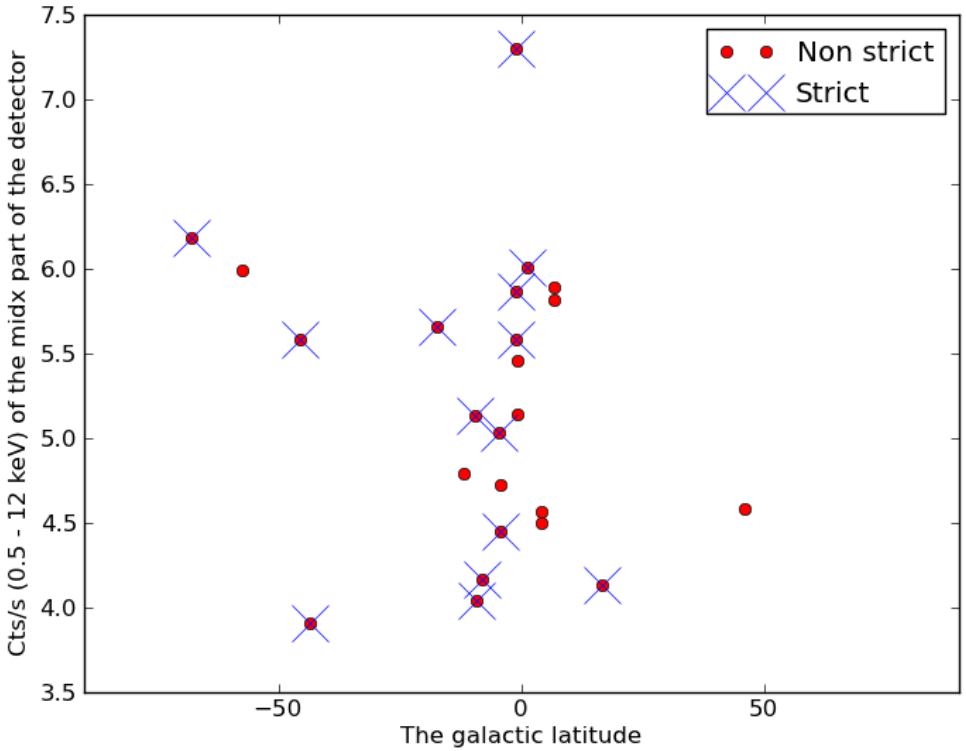
Fig. 1: Blank field observations



red points - Non strict
blue crosses - Strict

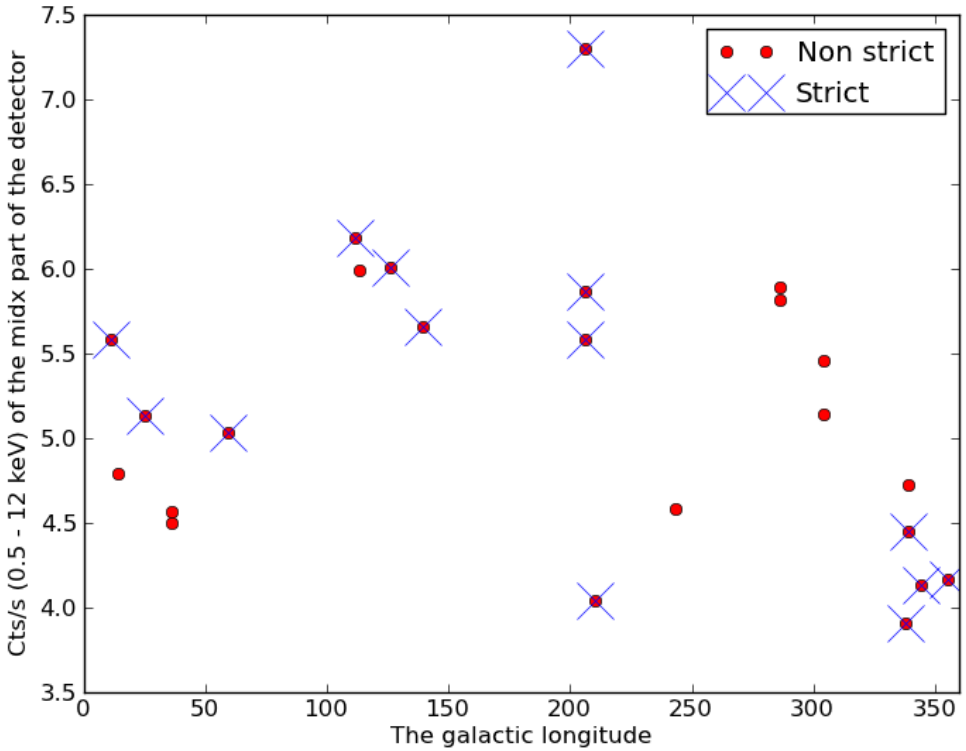
- no clustering of the observations

Remaining Blank Fields in Galactic Coordinates



- no clustering of the observations
- background shows no dependence on the galactic latitude

Remaining Blank Fields in Galactic Coordinates



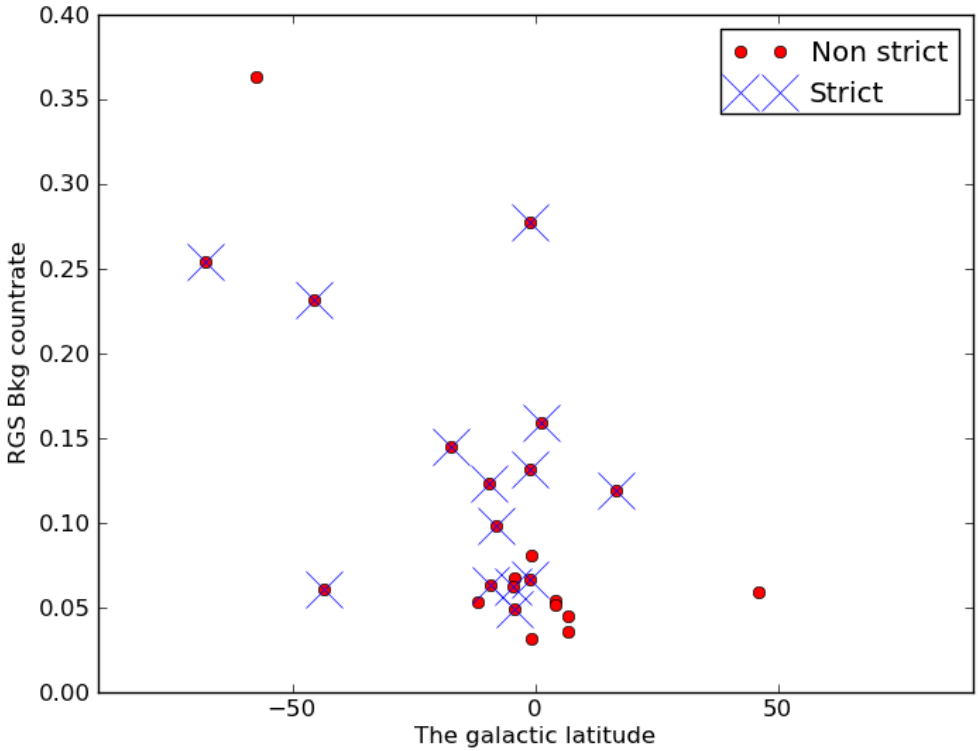
- no clustering of the observations
- background shows no dependence on the galactic latitude
- background shows no dependence on the galactic longitude

We Need a Gauge for the Background

Idea

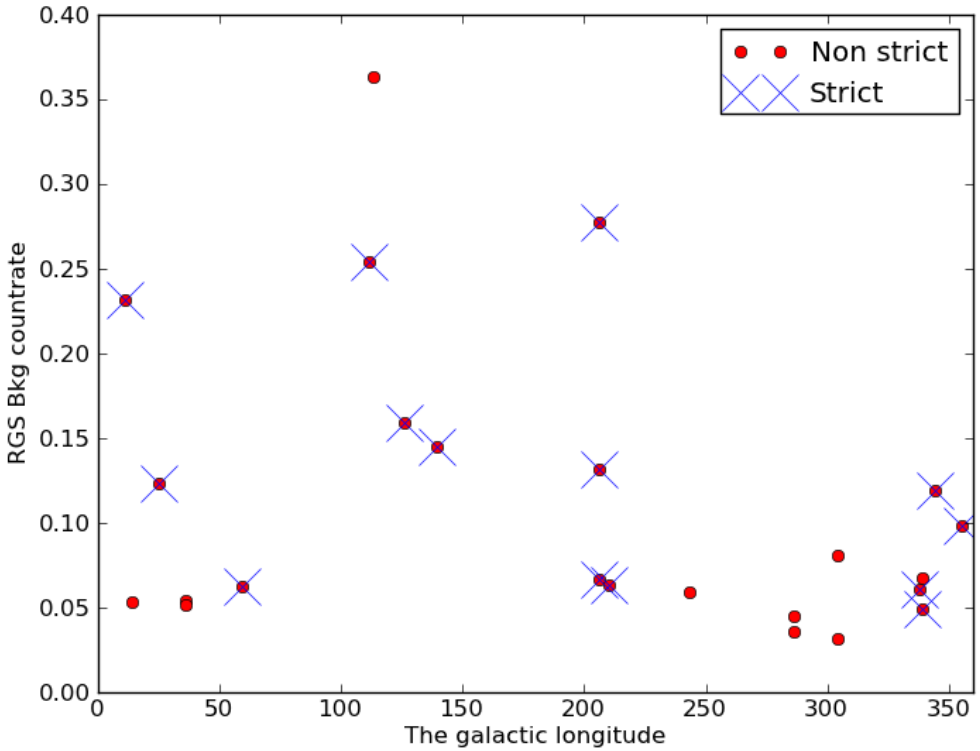
- use RGS background count rate as gauge which Blank Field template we have to use
- independent measure for the background
- check for dependence of the PN spectra on the RGS background count rate

RGS Background Count Rate - Galactic Coordinates



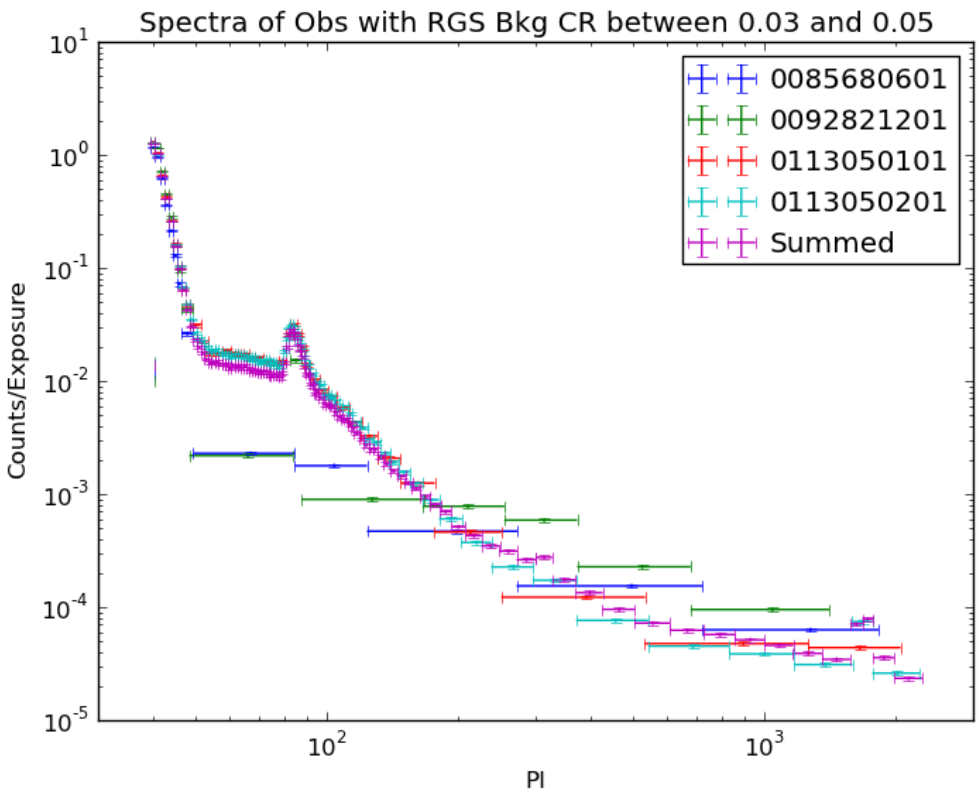
Check for the galactic distribution of the RGS background count rate

RGS Background Count Rate - Galactic Coordinates



Check for the galactic distribution of the RGS background count rate

The Blank Fields - RGS Dependence



- the RGS background count rate is taken from the RGS CCD 9
- the RGS Bkg CR is divided into 4 CR intervals [cts/s]:
  0.03 – 0.05
  0.05 – 0.07
  0.07 – 0.20
  0.20 – 0.40

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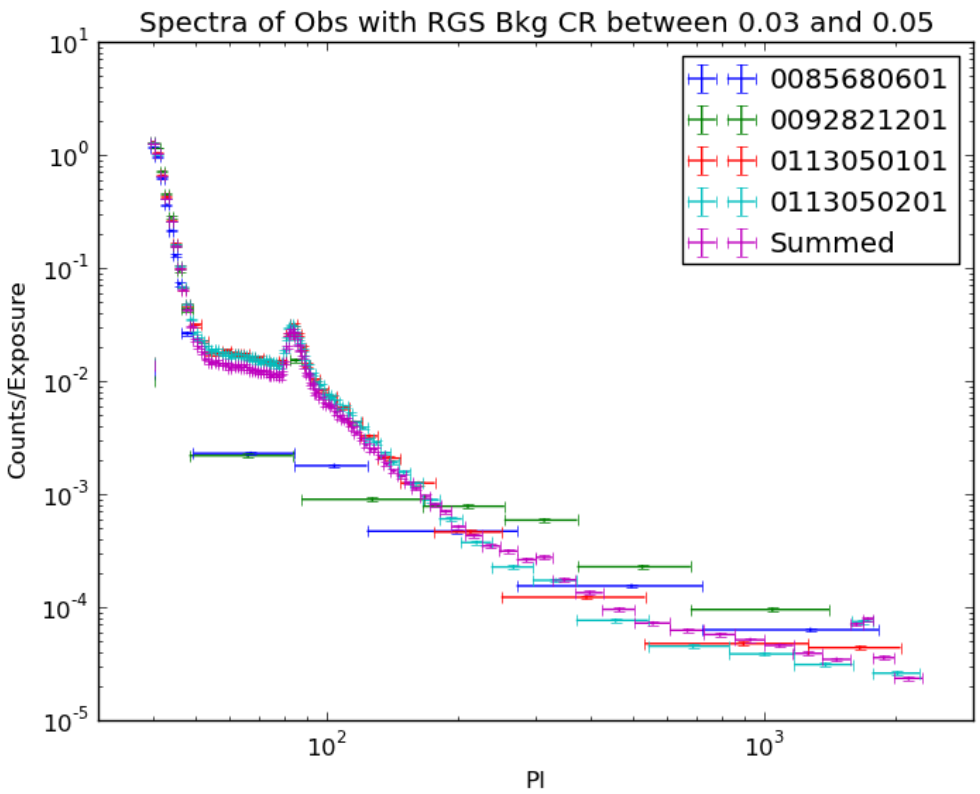

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→ take out two "non-blank" observations of the "Blank Fields"

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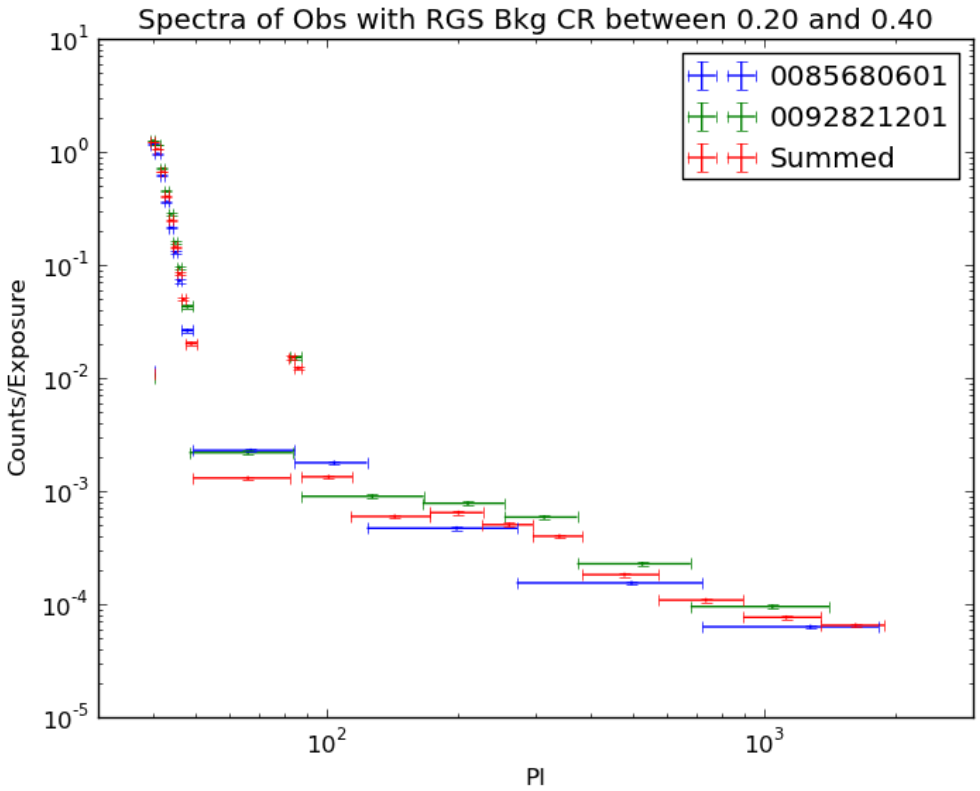

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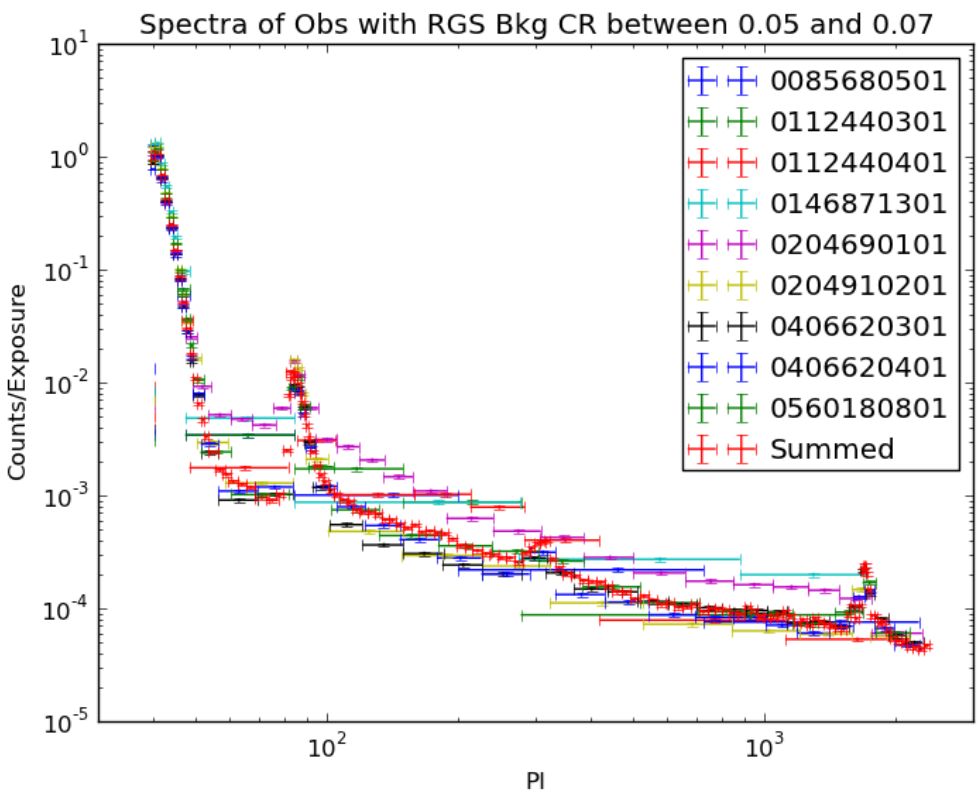

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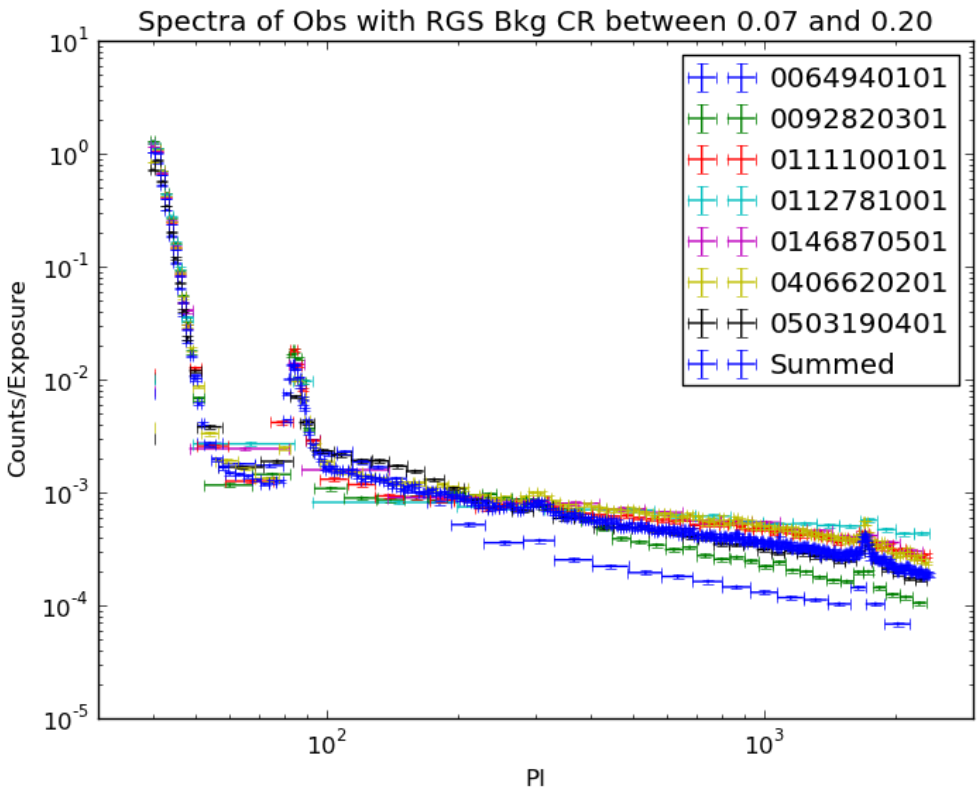

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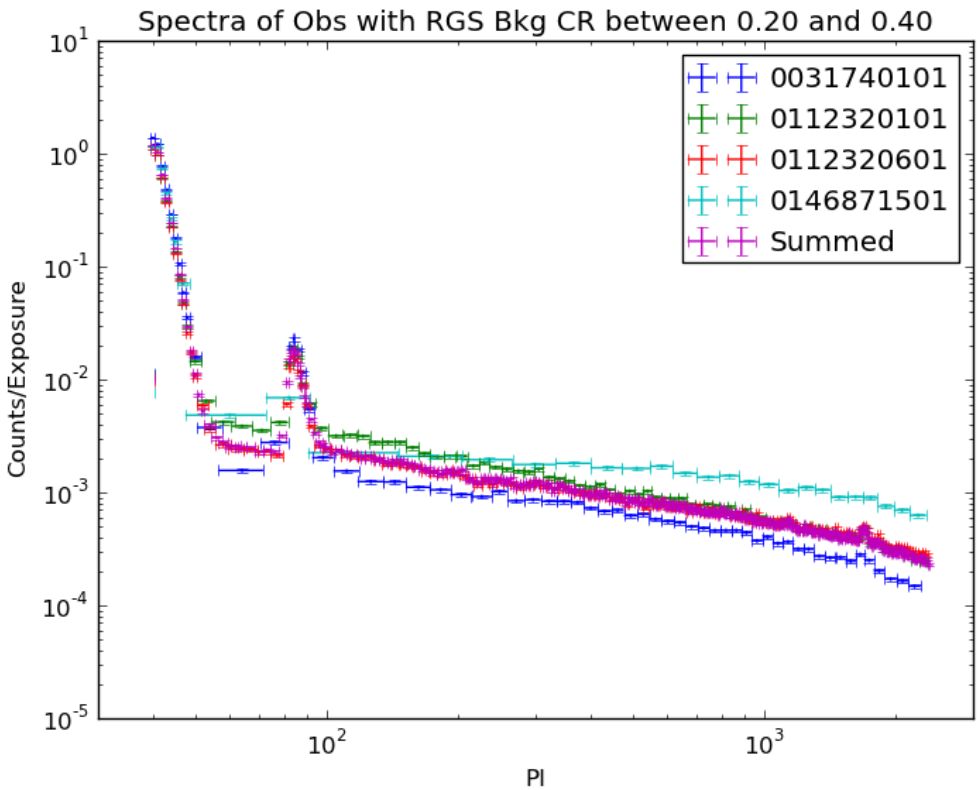

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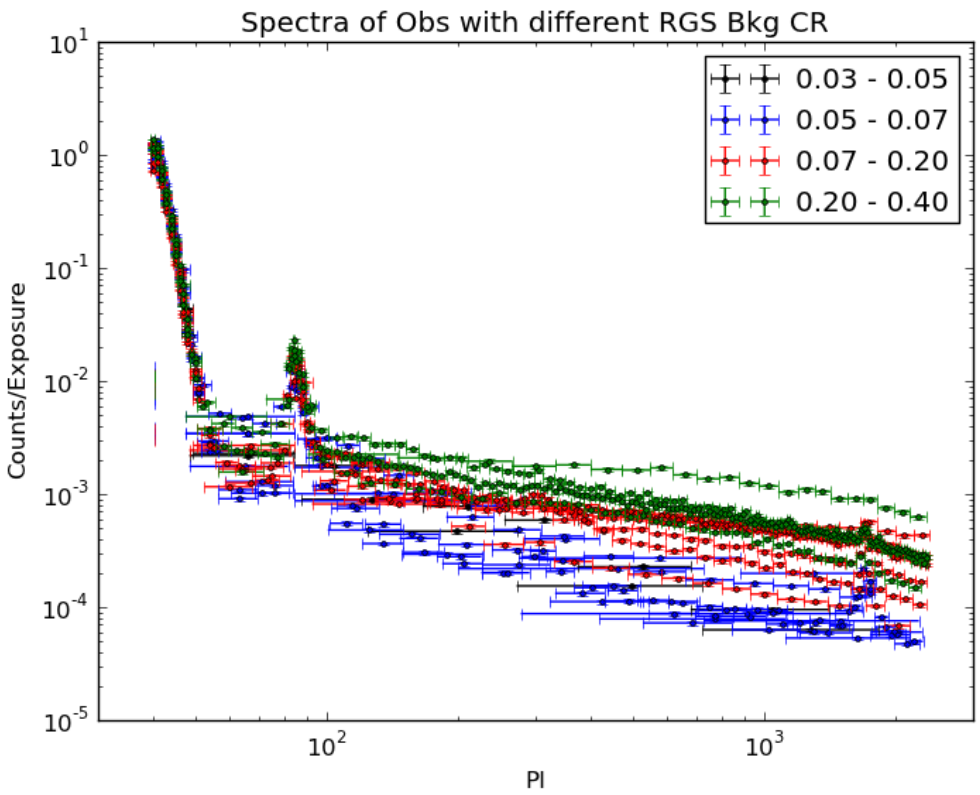

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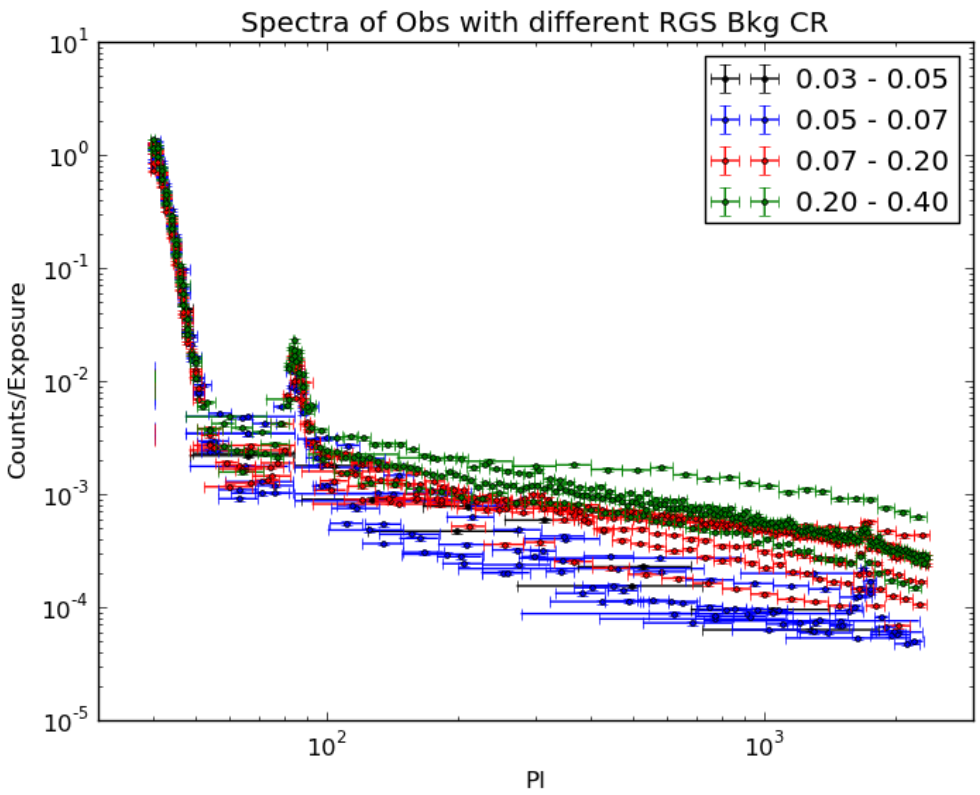

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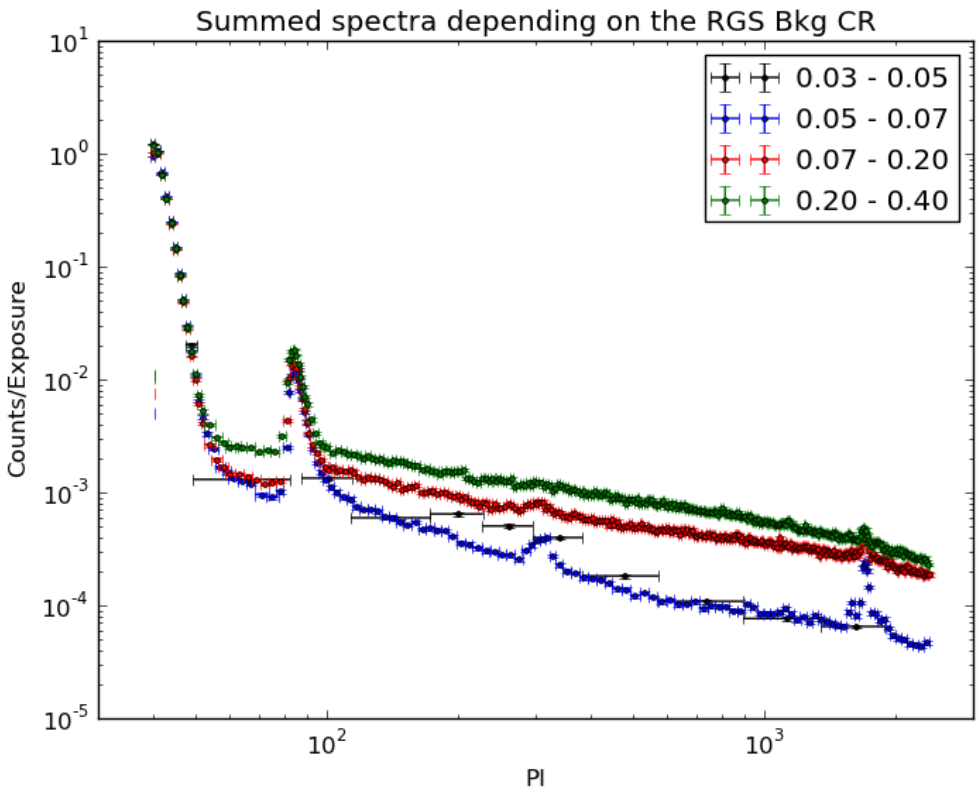
→ Spectrum gets harder for higher RGS Bkg count rates

The Blank Fields - RGS Dependence



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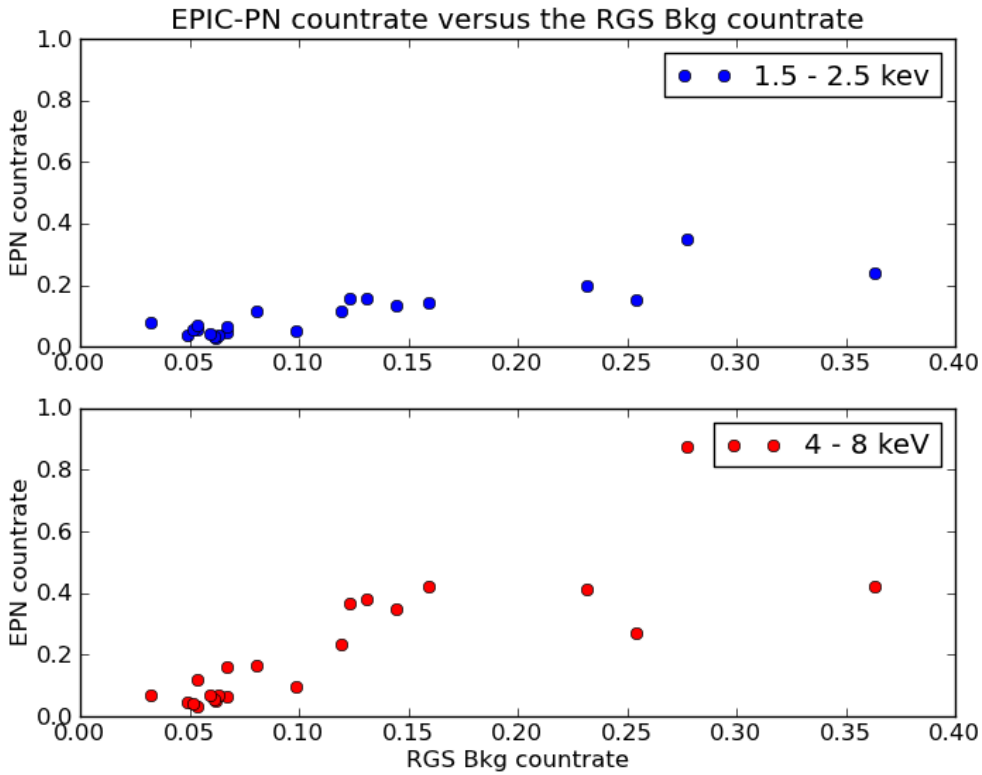
The Blank Fields - RGS Dependence for Different Energies



- The PN count rate is calculated for two different energy intervals:
  1.5 – 2.5 keV
  4.0 – 8.0 keV

Summary & Outlook

Summary

- scanned whole dataset of Timing Mode observations
- checked if they are really blank
- found source contamination and subtracted it
- found RGS Bkg CR dependence

Outlook

- create templates for different background conditions to extract the PN TM background
- normalisation of the templates with the 12–15 keV continuum or with the help of the copper line intensity
- testing on a sample of obscured X-ray binaries