



ATHENA - WFI

Title **PREPARATION OF BACKGROUND FILES**

Subtitle

No. WFI-MPE-ANA-
Background_20150327

Issue 5D1

Date 27.03.2015

Author(s): A.RAU

.....
Name Date Signature

Approved: N.N. .

.....
Name Date Signature

Released: N.N.

.....
Name Date Signature

CHANGE RECORD

ISSUE	DATE	SECTION/PARAGRAPH AFFECTED	REASON/INITIATION DOCUMENTS/REMARKS
1D0	05.04.2013	All	First Release
2D0	09.04.2013	4,6,7	simulations redone with new WFI responses; fraction of 80% of resolved sources assumed for extra-galactic background emission; removed specification of background units in section 3.2; corrected erroneous units in Tab. 1
3D0	27.08.2013	6,7,8	Changed CXB photon model from Lumb to McCammon et al. 2002; specified integration area
3D1	13.01.2014	1	Changed document name following document identification rules described in WFI-MPE-TNO-0010-0d1-Configuration-and-Document-Management
4D0	07.02.2014	7,8,9	Added separate background files for extended sources ($\alpha_{\min}^2$) and point sources (5" radius aperture). Included reference to description for different extraction areas, response matrices, focal length by adopting text from X-IFU document IAPS-XIFU-TN-2013-002.
4D1	13.02.2014	8,9,deliverables	Changed ATOMDB version from 1.3.1 to 2.0.2, which has an impact on the low energy (0.1-0.3keV) diffuse background component. Removed unused parameter (const=0.2) from Table 1.
5D1	27.03.2015	all	Updated to new detector geometry. New responses for mirror model trade-off study exercise.

DOCUMENT DISTRIBUTION



ATHENA - WFI
Preparation of Background
Files

Doc-No: WFI-MPE-ANA-
Issue: Background_20150327
Date: 5D1
Page: 27.03.2015
3 of 11

Issue:		0D1	1				
Name	Company						
N.N.	MPE	X					
N.N.	MPE	X					
N.N.		X					



1 Scope

This document summarises the preparation of the photonic and particle background files for ATHENA/WFI.



TABLE OF CONTENTS

1	Scope	4
2	Introduction.....	6
2.1	Detector Layout	6
3	Background Files.....	6
3.1	Response Matrices.....	6
3.2	Deliveries.....	7
3.3	Cosmic X-ray Background and Galactic Foreground	8
3.4	Particle Background	8
3.5	Total Background	9
4	Applicable and Reference Documents	10
4.1	Applicable Documents.....	10
4.2	Reference Documents.....	10
APPENDIX 1: Abbreviations and Acronyms		11

2 Introduction

2.1 Detector Layout

Fig 2-1 shows the WFI design assumed for the background calculations – a focal plane position for wide field applications formed by four quadratic large DEPFETs and a second position for with a single DEPFET optimized for high count rate applications.

Both DEPFETs will use $130 \times 130 \mu\text{m}^2$ pixels with a thickness of $450 \mu\text{m}$. The four large DEPFETs are 512×512 pixels each with an insensitive gap within between. The high-count rate DEPFET has a size of 64×64 pixels.

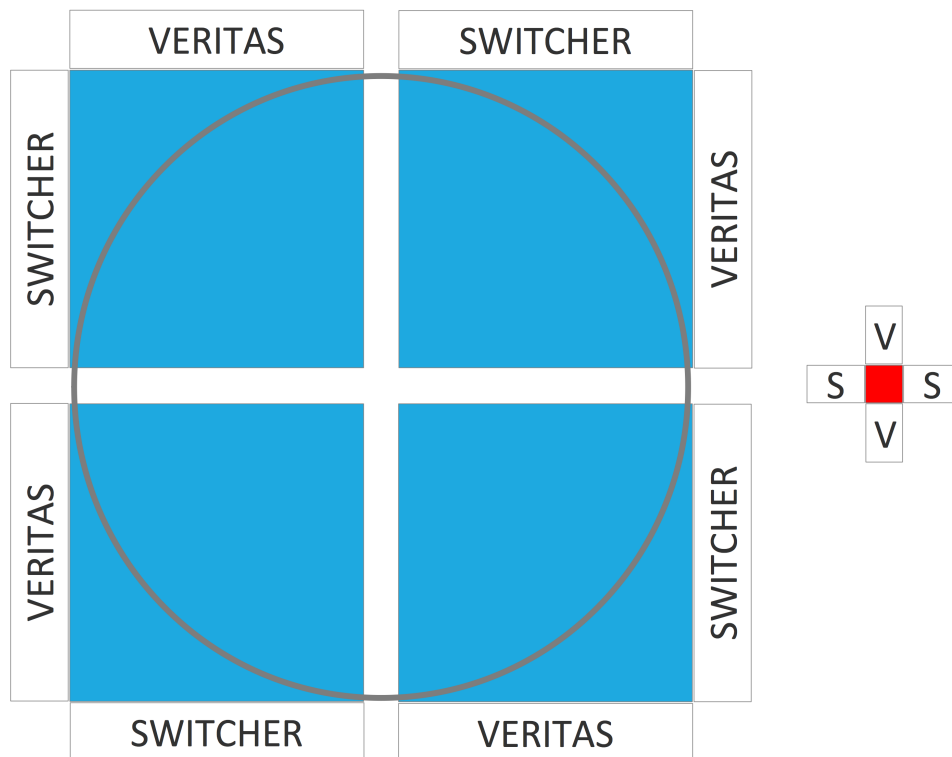


Figure 2-1: Schematic WFI layout.

3 Background Files

3.1 Response Matrices



The following response matrices described in [RD1] have been used.

Filename	Contents
athena_wfi_1190_fovavg_w_filter_v20150326.rsp	R_{max} = 1190 mm mirror module radius, 2.3mm rib spacing, averaged over 40x40amin FoV incl. gaps, external light blocking filter incl.
athena_wfi_1190_onaxis_w_filter_v20150326.rsp	R_{max} = 1190 mm mirror module radius, 2.3mm rib spacing, on-axis, external light blocking filter incl.
athena_wfi_1469_fovavg_w_filter_v20150326.rsp	R_{max} = 1469 mm mirror module radius, 2.3mm rib spacing, averaged over 40x40amin FoV incl. gaps, external light blocking filter incl.
athena_wfi_1469_onaxis_w_filter_v20150326.rsp	R_{max} = 1469 mm mirror module radius, 2.3mm rib spacing, on-axis, external light blocking filter incl.

For the particle background calculation, athena_wfi_rmfi_v20150326.rmfi [RD1] was used.

3.2 Deliveries

The following files are provide:

Filename	Contents
athena_wfi_1469_bkgd_sum_extended_onaxis_w_filter_20150327.pha athena_wfi_1190_bkgd_sum_extended_onaxis_w_filter_20150327.pha	sum of instrumental and diffuse background for extended sources on-axis response
athena_wfi_1469_bkgd_sum_psf_onaxis_w_filter_20150327.pha athena_wfi_1190_bkgd_sum_psf_onaxis_w_filter_20150327.pha	sum of instrumental and diffuse background for point sources and on-axis response
athena_wfi_1469_bkgd_sum_extended_fovavg_w_filter_20150327.pha athena_wfi_1190_bkgd_sum_extended_fovavg_w_filter_20150327.pha	sum of instrumental and diffuse background for extended sources and field of view averaged response
athena_wfi_1469_bkgd_sum_psf_fovavg_w_filter_20150327.pha athena_wfi_1190_bkgd_sum_psf_fovavg_w_filter_20150327.pha	sum of instrumental and diffuse background for point sources and field of view averaged response

The background files for extended sources are normalized to 1 arcmin² while the background files for point sources are for a 5" radius extraction region.



3.3 Cosmic X-ray Background and Galactic Foreground

The cosmic photon background consists of the integrated emission from unresolved extragalactic point sources and the diffuse Galactic foreground. The calculations have been performed using the following model:

model apec+wabs(apec+powerlaw)

The parameter values are given in Table 1. The fraction of resolved sources was assumed to be 80%

Table 1: XSPEC model parameters for the photon background. Normalizations refer to 1 amin².

Model	Parameter	Value	Unit
apec	kT	9.9E-2	keV
apec	abundance	1	
apec	redshift	0	
apec	norm	1.7E-6	$(10^{-14}/(4\pi(D_A(1+z))^2)) \int n_e n_H dV$ ¹⁾
wabs	N _H	0.018	10 ²² cm ⁻²
apec	kT	0.225	keV
apec	abundance	1	
apec	redshift	0	
apec	norm	7.3E-7	
powerlaw	photon index	1.45	
powerlaw	norm	2.0E-7	pho/keV/cm ² /s @ 1 keV

¹⁾: where D_A is the angular size distance to the source (cm), and n_e and n_H are the electron and H densities (cm⁻³)

3.4 Particle Background

A flat particle background of 5x10⁻³ cnt/keV/s/cm² (corresponding to 6x10⁻⁴ cnt/keV/s/amin²) was used.

3.5 Total Background

The individual background components as well as the sum are shown in Fig.3-1.

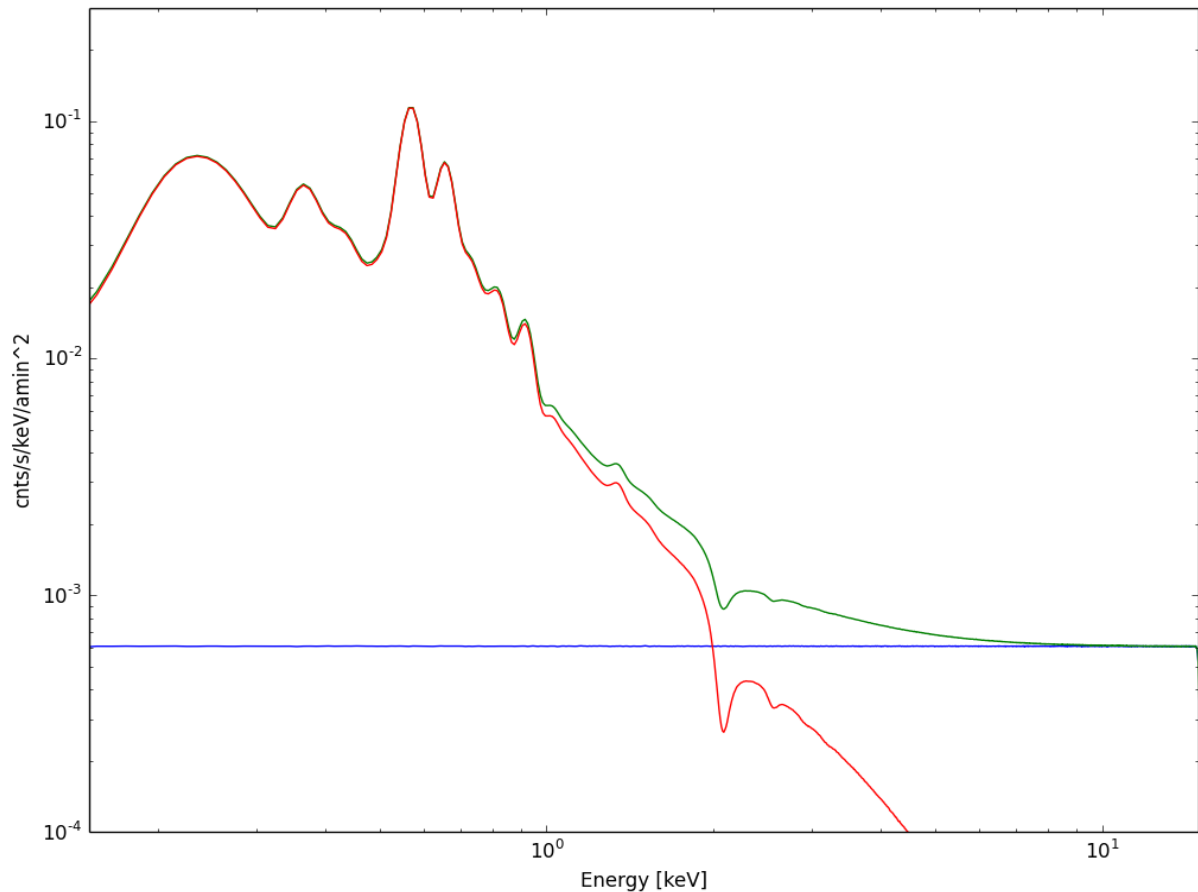


Figure 3-1: WFI background models for extended sources in units of $\text{cnt s}^{-1} \text{keV}^{-1} \text{amin}^{-2}$. The photon background (red), the particle background (blue), and the sum of both (green) are shown.



4 Applicable and Reference Documents

4.1 Applicable Documents

AD Doc.-No and Title		Issue	Date
[AD1]			
[AD2]			
[AD3]			

4.2 Reference Documents

RD Doc.-No. and Title		Issue	Date
[RD1]	ECAP-ATHENA-WFI-RSP20150326	4	2015-03-26



APPENDIX 1: Abbreviations and Acronyms

This document employs several abbreviations and acronyms to refer concisely to an item, after it has been introduced. The following list is aimed to help the reader in recalling the extended meaning of each short expression:

ATHENA	Advanced Telescope for High ENergy Astrophysics
DEPFET	Depleted P-channel Field-Effect Transistor
WFI	Wide Field Imager
X-IFU	X-ray Integral Field Unit