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A Deep Study of the 3C 273 Field in γ-rays

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Abstract. 3C 273 is one of the brightest and best studied quasars. It has been observed for 770 ks with the imager IBIS (FoV 12 deg) on board INTEGRAL. To achieve the best possible S/N the dataset has been screened using several criteria indicating the quality of the data (i.e., number of good time intervals, etc). We describe the necessary tools and methods to analyze data of deep fields.

Keywords. galaxies: active, gamma rays: observations, methods: data analysis.

1. Introduction

Low sensitivity of former missions has prevented a detailed study of the hard cosmic X-ray background. As in soft X-rays it has been resolved to AGN (Giacconi *et al.* 2002), a similar situation is anticipated for soft γ-rays (Worsley *et al.* 2004; Krivonos *et al.* 2005). 3C 273 has been observed regularly twice a year by INTEGRAL since 2003. We have used all data available to us (June 2005) within 15° of 3C 273 between revolutions 28 and 207 with a total exposure time of 774 ks in 371 science windows (ScW).

2. Data Analysis and Results

To avoid instrumental background lines which are located between 59.3 keV and 84.9 keV (W and Pb fluorescence) and a blend of several flurocence lines of Cd and Te around 24 keV (Terrier *et al.* 2003), we selected a band from 26-51 keV for our analysis, while using data from 13-26 keV and 51-105 keV to assess the background level.
Data reduction was done with OSA 5 as distributed by the ISDC. We rejected ScWs due to: unacceptable artefacts in the deconvolved image (17), average good time interval less than 10 seconds long (6), and an unusual background level if in 2 of 3 energy bands $|\xi_i - \chi| > \frac{1}{N}\sum_i |\xi_i - \chi|$ (53 ScWs). ξ_i denotes the median pixel countrate in the shadowgram and χ the median over those ξ_i, the index i is running over the ScWs. In total 66 ScWs were excluded, mostly from revolution 28-32 when the bottom veto shield of IBIS was turned off (see Fig. 1).
Due to the dithering strategy the exposure time varies in the mosaic from 633 s to 838 ks, therefore the source detection was limited to a field of $\sim$1 800 deg^2 for which $T_{\rm exp} > 150\,ks$. In order to emphasize source signal with respect to the background we convolved the field with a gaussian core and searched for the local maxima in the folded image. The FWHM of the gaussian core was calibrated on 3C 273. We searched for sources with a core volume larger than 4.5 and round in shape.

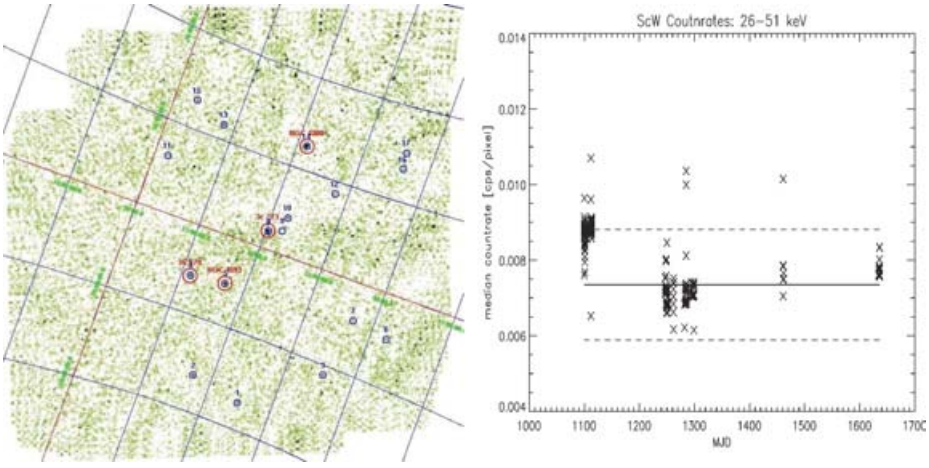

Figure 1. Left: S/N image of the 3C 273 field. Right: Evolution of the background with time.

#	Ra	Dec	Possible Identifier	ΔPos	S/N	Type
1 *	12 15 18	−17 17 19	—	—	4.63	—
2 *	12 39 03	−16 08 27	XSS J12389-1614	5.9’	5.63	X
3	11 43 32	−11 03 57	—	—	4.81	—
4 *	12 56 09	−05 46 58	3C 279	0.6’	5.88	QSO
5 *	12 39 40	−05 19 33	NGC 4593	1.1’	20.44	Sy2
6	11 23 20	−04 48 42	—	—	4.24	—
7	11 39 21	−04 11 29	AC0 1334	1.9’	7.5’	GiC
8 *	12 29 07	+02 02 14	3C 273	—	37.05	QSO
9 *	12 23 18	+02 38 12	Mrk50	2.8’	2.99	Sy1
10 *	12 22 32	+04 18 10	NGC 4303	10.3’	4.62	Sy2
11	13 24 22	+06 12 25	—	—	4.17	—
12	12 05 49	+08 37 45	—	—	3.51	—
13	13 05 18	+11 41 42	—	—	5.81	—
14 *	12 25 52	+12 37 38	NGC 4388	2.5’	39.08	Sy2
15 *	13 20 28	+13 07 34	1RXS J132036.6+131527	8.1’	4.64	X
16	11 41 17	+13 29 26	—	—	3.91	—
17	11 42 03	+15 17 52	—	—	4.50	—

Table 1. Counterparts have been searched within 10’ in SIMBAD. ‘*’ denotes detections that have been found in the extended 26-105 keV band as well.

To assess the validity of these detections we performed the same search in the joined 26-105 keV mosaic, resulting in 24 detections, 9 coincident with detections from the 26-51 keV band. A search for negative excesses in the 26-51 keV band resulted in 10 detections. Therefore it is possible that most of the non identified sources are false detections.

This preliminary analysis shows that a detection of weak sources is possible, but the statistics are low and the weak sources are highly background dominated. With the availability of more data on this field these faint sources can be studied in more detail.

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