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A search for transient X-ray sources with *Ariel 5* Experiment C

L. Chiappetti and S. J. Bell Burnell *Mullard Space Science Laboratory, University College London, Holmbury St Mary, Dorking, Surrey*

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Summary. The *Ariel 5* MSSL Experiment C data bank has been systematically searched for transient and variable X-ray sources. Nineteen objects (many of which cannot be identified with previously known X-ray sources) have been detected. Spectra and other properties of these transients are reported.

1 Introduction

With the *Ariel 5* satellite came the realization that transient X-ray sources were a normal feature of the X-ray sky (e.g. Eyles *et al.* 1975; Ives, Sanford & Bell Burnell 1975; Rosenberg *et al.* 1975; Elvis *et al.* 1975). These observations, however, were biased towards bright, long-lived transients whose outbursts were sufficiently dramatic to be noticed at the time. Recently McHardy & Pye (1981) have reported the detection by the *Ariel 5* SSI also of bright, fast transients.

In order to obtain a more complete sample, including weaker outbursts and on all time-scales > 90 min, we have systematically searched the *Ariel 5* Experiment C data bank (i.e. ~ 29 000 orbits, of which about half are in spectral mode, spanning ~ 5 yr) for transient X-ray sources and unusual brightenings of weak sources. We have found 19 such events, for which we report the spectrum and discuss the possible identifications with known X-ray sources. Data on previously identified and candidate transients have also been examined.

2 Observations and search techniques

Ariel 5 Experiment C is a collimated multiwire proportional counter spectrometer, operating in the energy range ~ 2–20 keV, and with a 5° radius (FWZH) field of view (Sanford & Ives 1976). It is primarily a spectrometer and has only limited ability to position X-ray sources, especially in confused fields of view (for a discussion of the positioning of sources and the limitations thereof see and compare Davison 1977; Davison, Watson & Pye 1977). When operating in spectral mode the shortest integration time available is one satellite orbit (~ 90 min).

Two search strategies have been adopted: (a) a search for further sightings of known fast transients and transient outbursts from objects like RS CVn stars; and (b) a systematic search for detections of new transient events (either new sources or flares of known weak sources). The latter strategy has been much more successful.

2.1 THE SEARCH FOR KNOWN AND CANDIDATE FAST TRANSIENTS

The list of target objects was taken from: (a) the *Ariel 5* SSI list of rapid transients (McHardy & Pye 1981); (b) a list of X-ray emitting RS CVn stars (Walter *et al.* 1980); and (c) a miscellaneous list of other (mainly soft) X-ray transients, but not including long-term transients bright enough to have been noted at the time. RS CVn stars were considered possible candidates for X-ray transients since some have been observed to flare in a harder (2–10 keV) X-ray band (e.g. Garcia *et al.* 1980; McHardy & Pye 1981). For those sources for which unconfused observations were available X-ray fluxes or 3σ upper limits to the 2–10 keV flux were obtained.

2.2 THE SYSTEMATIC SEARCH FOR SERENDIPITOUS TRANSIENT SOURCES

The *Ariel 5* Experiment C is slightly offset from the spin axis of the satellite, which is spinning with a period of ~ 5 s. The counts are collected in four quadrants; a point source, provided it is not too close ($< 0.5^\circ$) to the spin axis, should produce a modulation in the count rate in different quadrants. This is used to separate the signal from the (isotropic) background (Sanford & Ives 1976). While the problems could arise when two or more sources of equal strength are present in the field of view, a bright source will be clearly revealed against a 'background' which includes contributions from weaker sources.

The data bank was searched for orbits where there was a significant excess count rate in one (or two adjacent) quadrant(s) which could not be accounted for by catalogued sources (within the limits of their catalogued intensities). The source of emission was positioned, as well as Experiment C allowed, and the spectrum determined. The data bank was searched for other observations of the source position to extract as much information as possible about source variability.

3 Results

3.1 KNOWN AND CANDIDATE FAST TRANSIENTS

Most of the objects in the lists described above were not detected by Experiment C. For those which fall in unconfused fields of view a significant upper limit can be obtained and is reported in Table 1. Two objects were detected and their fluxes are also reported in Table 1.

Table 1. 2–10 keV flux for previously known X-ray transients and X-ray emitting RS CVn stars. Upper limits are 3σ.

Source name	Date of observations	2–10 keV flux (ph cm^{-2} s^{-1}) $\times 10^{-2}$	Equivalent *Uhuru* counts s^{-1}	Reference
4U 0042 + 32	1976 Jul 6	1.6 ± 0.4	6.5	(1)
SAO 015338	1976 Dec 27–30	<0.2	<0.5	(2)
HD 5303	1976 Aug 12–13	1.1 ± 0.1	4.7	(3)
HD 5303	1976 Aug 15–16	1.7 ± 0.1	6.8	
HR 5110	1977 Jan 9–12	<0.1	<0.4	(3)
V532 Cen	1976 Jan 14–16	<0.2	<0.6	(2)
3A 1956 + 041	1976 May 9–10	<0.7	<2.2	(2)
II Peg	1975 Jun 23–26	<0.4	<1.4	(2)

References
(1) Watson & Ricketts (1978); (2) McHardy & Pye (1981); (3) Walter *et al.* (1980).

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Table 2. The *Ariel 5* Experiment C list of transient and variable X-ray sources in order of right ascension. For each observation two different spectral fits are reported. The top line refers to the power law model, the bottom line to the thermal + Gaunt one. The number of degrees of freedom is the same in both cases. The 2–10 keV flux is from the direct deconvolution method and is therefore independent of spectral fit. An asterisk marks those cases where the actual energy range was 3–10 keV. A letter in the first column indicates which observation are plotted in Fig. 1.

Fig.	Source name and ident.	Epoch of observation	Best fit results				2-10 keV flux (ph cm^{-2} s^{-1}) x 10^{-2}		Equiv. Uhuru counts s^{-1}
			Spectral index or kT (keV)	Hydrogen column density in 10^{22} cm^{-2}	χ^2	Dof	flux	error	
	T 0028+60	6- 8 Jul 75	1.6(+0.2,-0.2)	1.5(+2.1,-1.5)	19.5	23	6.0	0.4	24
	4U 0027+59		22.0(,-8.1)	1.2(+2.1,-1.2)	18.1				
	3A 0026+593	12-17 Jul 75	1.9(+0.2,-0.1)	1.0(+0.6,-0.9)	16.9	15	* 6.0	0.2	23
			12.0(+3.2,-3.8)	0.0(+0.6,)	21.9				
a		13-16 Jul 75	1.7(+0.1,-0.1)	0.5(+0.8,-0.5)	37.9	27	9.0	0.2	30
			17.0(,-4.5)	0.0(+0.7,)	39.2				
b	T 0048+40	10-12 Jul 76	1.9(+0.3,-0.3)	0.0(+1.3,)	9.4	15	2.0	0.1	6
			9.0(+7.6,-2.8)	0.0(+1.1,)	10.8				
c	T 0118-31	30 May 78	4.2(+0.6,-0.6)	0.0(+1.1,)	3.0	6	3.9	0.3	9
			1.0(+0.3,-0.2)	0.0(+1.2,)	6.9				
d	T 0654-07	5- 6 Oct 75	1.8(+0.2,-0.2)	7.0(+1.2,-1.3)	29.4	23	3.3	0.1	13
	MX 0656-07		14.0(+9.2,-5.3)	6.0(+1.2,-0.7)	29.7				
	3A 0656-072	7- 8 Oct 75	1.7(+0.1,-0.1)	4.0(+0.9,-1.0)	19.7	20	* 2.2	0.1	9
			>14.8	3.0(+1.1,-0.7)	23.5				
e	T 0757-38	2 Sep 78	3.4(+0.6,-0.5)	0.0(+1.0,)	7.0	7	3.2	0.1	7
			1.6(+0.6,-0.4)	0.0(+1.0,)	11.1				
		4 Sep 78	> 4.6	<13.0	11.2	8	1.9	0.3	5
			0.8(+0.5,-0.3)	3.0(+8.2,-3.0)	10.8				
		24 Sep 78	> 4.7	< 5.5	8.0	8	2.3	0.2	4
			0.7(+0.5,-0.4)	0.0(+8.1,)	7.7				
f	T 0808-51	4, 5, 7 Apr 79	1.3(+0.2,-0.2)	0.0(+0.7,)	31.3	26	3.4	0.2	12
			>22.0	< 1.3	39.9				
g	T 0925-61	29 Jun 77	3.4(+0.6,-1.2)	2.0(+1.6,-1.3)	1.5	4	13.3	0.9	36
			2.7(+5.0,-1.0)	0.0(+1.6,)	1.4				
		3- 4 Sep 77					< 0.8		< 4
		8- 9 Sep 77					< 1.0		< 4
	T 0930-42	11 Feb 79	0.8(+0.5,-0.5)	0.0(+2.6,)	28.7	10	2.0	0.3	7
			>12.7	< 7.3	40.5				
h		11-14 Feb 79	2.6(+0.3,-0.1)	0.0(+0.2,)	108.7	25	20.3	0.8	50
			4.2(+0.7,-0.5)	0.0(+0.1,)	184.5				
		15 Feb 79	5.0(+0.2,-0.3)	4.0(+0.2,-0.7)	85.5	25	8.6	1.4	23
			0.5(+0.1,-0.1)	12.0(+0.9,-1.6)	68.7				
	T 1025-59	17-19 Dec 74	2.2(+0.1,-0.3)	0.0(+1.1,)	42.2	25	3.9	0.1	9
			8.0(+2.4,-2.4)	0.0(+0.4,)	53.3				
i		12 Jan 75	1.6(+0.4,-0.4)	0.0(+2.5,)	8.8	7	7.4	0.5	26
			> 8.0	0.0(+2.2,)	9.1				
		23-25 Nov 75	2.2(+0.2,-0.2)	1.0(+1.1,-0.9)	30.0	25	1.9	0.1	6
			8.0(+2.7,-2.5)	0.0(+0.7,)	33.8				
j	T 1206-61	9 Oct 77	no power law fit possible (a<0)				6.0	0.4	36
			no thermal fit possible						
			a blackbody fit follows						
			3.4(+0.2,-0.2)	40.0(+4.0,-5.0)	12.5	19			
		23-24 Sep 77					< 0.2		< 1
		6 Oct 77					< 0.4		< 2
k	T 1248-59	2- 3 Jan 75	2.4(+0.1,-0.1)	1.2(+0.7,-0.4)	27.9	24	20.6	0.3	61
	4U 1246-58 ?		6.2(+0.8,-0.5)	0.0(+0.5,)	18.0				
	A 1244-60 ?	13 Jan 75	3.4(+0.5,-0.6)	5.0(+4.8,-3.8)	33.2	11	11.1	0.9	34
			3.0(+1.8,-0.8)	2.0(+3.2,-2.0)	32.1				
		13 Jan 75					< 2.6		< 7
l	T 1302-64	25 Jan 76	0.8(+0.4,-0.4)	1.0(+4.2,-1.0)	4.6	5	4.2	0.4	16
			>10.6	8.0(+7.1,-4.9)	9.3				
	T 1337-63	17-19 May 77	1.3(+0.5,-0.6)	0.0(+3.4,)	41.2	18	1.6	0.1	5
			>11.5	< 4.5	43.5				
m		14-15 Nov 77	1.7(+0.2,-0.2)	0.0(+0.8,)	29.9	16	3.7	0.1	12
			14.0(+10.,-4.9)	0.0(+0.6,)	30.3				
n	T 1434-63	9-10 Nov 77	2.6(+0.5,-0.4)	0.0(+1.5,)	10.0	6	1.4	0.1	4
	3A 1438-626 ?		3.0(+1.5,-1.0)	0.0(+0.8,)	12.9				
	4U 1425-61 ?								
o	T 1629-76	3- 5 Feb 76	no fit possible				0.8	0.1	3
	T 1631-50	22-23 Feb 76	2.4(+0.1,-0.2)	8.0(+1.3,-1.1)	12.6	12	34.0	0.8	130
			8.0(+1.7,-1.5)	5.0(+1.2,-1.0)	11.3				
p		23 Feb 76	2.6(+0.1,-0.1)	10.0(+0.5,-0.6)	54.9	26	34.0	0.4	130
			5.5(+0.4,-0.3)	7.5(+0.6,-0.6)	39.2				
	T 1648-56	18 Feb 76	no fit possible				4.2	0.6	15
q		18-19 Feb 76	2.3(+0.3,-0.3)	3.5(+2.3,-1.7)	8.7	13	6.2	0.3	22
			7.0(+4.3,-1.8)	2.0(+2.0,-1.7)	7.8				
r	T 1725-38	15-16 Feb 75	2.4(+0.2,-1.5)	3.0(+1.1,-0.6)	19.0	17	4.3	0.1	14
			7.0(+2.2,-1.6)	1.0(+1.0,-0.6)	18.5				
		16-17 Feb 75	2.9(+0.3,-0.3)	7.0(+2.0,-2.1)	23.4	19	* 2.4	0.1	9
			5.0(+1.3,-0.7)	3.0(+2.1,-1.7)	24.2				
s	T 1832-05	29 Apr 76	1.2(+0.4,-0.5)	0.0(+1.1,)	27.4	18	2.6	0.1	10
	3A 1833-078 ?		>13.5	< 2.0	30.8				
	4U 1832-05 ?	30 Apr 76	2.5(+2.3,-1.9)	20.0(+30.,-12.9)	21.3	11	0.9	0.3	4
			no thermal fit possible						
		30 Apr 76	no fit possible				1.7	0.1	7
		1 May 76	no fit possible				1.7	0.2	7

The emission line star 4U 0042 + 32 was generally not detectable by Experiment C, and even when detected the data quality is bad and does not allow any spectral analysis. For the RS CVn star HD 5303 we obtain a flat (photon spectral index ~ 1) spectrum with little absorption. The spectrum could be affected by systematic errors due to the contamination of nearby sources. HD 5303 is in fact in the same field of view as the X-ray binary SMC X-1 and visible only during the eclipse of the latter. However, at the same times the Seyfert galaxy ESO 012 – G21 (Hayes, Culhane & Bell Burnell 1980) is also visible in this field of view.

3.2 SERENDIPITOUS DETECTIONS

The results of the search are reported in Table 2. For each source we use a coordinate designation corresponding to the Experiment C best position, and we also indicate possible identification with known X-ray sources. We stress that the positioning capability of Experiment C can be quite inaccurate, and thus we neither quote any error on the positions not attempt optical identifications.

Fig. 1 (on *Microfiche* MN 202/3) shows for each source the spectrum, produced using the Blissett & Cruise (1979) restoration technique, and the parameters of the best fit single power law and single temperature thermal (with Gaunt factor) spectra together with confidence contours on these fits (Lampton, Margon & Bowyer 1976). The hydrogen column densities assume the Fireman (1974) absorption cross-sections.

In Table 2 the errors (or upper or lower limits) are obtained from the intersection of the 90 per cent confidence contour with straight lines passing through the best fit and parallel to the axes. The 2–10 keV flux is obtained as part of the spectral restoration and, like the spectrum, is not biased by any presupposition about the spectral form or source emission mechanism. The errors do not take into account the uncertainty in souce position. The equivalent *Uhuru* counts are obtained from the 2–10 keV energy flux assuming 1 *Uhuru* count $s^{-1} = 1.3 \times 10^{-2}$ keV $cm^{-2} s^{-1}$.

We have searched a list of gamma-ray bursts (Cline, private communication; Klebesadel, private communication; Mazets & Golenetskii 1981) for temporal coincidences, with negative results. We have also inspected the NOAA Solar and Geophysical Reports, to check for solar X-ray activity at the time of our observations, and found no solar contamination.

3.3 DISCUSSION OF INDIVIDUAL SOURCES

Section 3.3 appears on *Microfiche* MN 202/3.

4 Discussion

The definition of what is meant by 'transient' is open to debate. Among the known transients there is a large range in time-scale, from the classical, long-lived transients (for a review see Cominsky *et al.* 1978) to the fast transients (McHardy & Pye 1981); in energy range, from the extremes of gamma-ray bursts to the soft X-ray transients. There is also great variety in spectral shape. Known X-ray transients appear a quite heterogeneous group, and from a first glance at the spectra in Fig. 1 the same would appear to be true for our transients. However, the classical X-ray transients in fact appear to be divisible into two groups, according to their spectral hardness, with a lack of transients with temperatures between 7 and 15 keV (Cominksy *et al.* 1978; Kaluzienski *et al.* 1977). This division is probably also a division into high- and low-mass X-ray sources, with the hard spectra transients being Population I massive binaries (Maraschi, Treves & Van den Heuvel 1976, 1977) and the soft transients belonging to the Population II group along with X-ray bursters and Sco X-1-like objects (Fabbiano & Branduardi 1979).

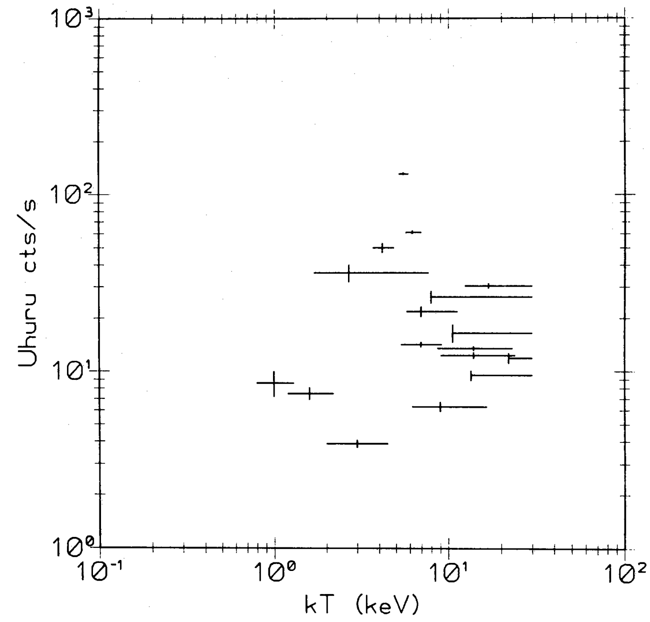

Figure 2. The intensity of the transients listed in Table 2 plotted versus the best fit thermal temperature. Only the brightest observation has been plotted for each object; transients T 1206 – 61 and T 1629 – 76, for which no thermal best fit exist, have been excluded.

With the exception of T 1206 – 61 none of the spectra reported here requires a black-body fit. Such a spectrum would be required (assuming little post-emission modification) if the origin of the outburst were thermonuclear (as in X-ray and, perhaps also, gamma-ray burst sources). The distribution of bremsstrahlung temperatures or spectral index for our objects does not appear strongly bimodal. If, however, we attempt to correlate the intensity with the temperature (see Fig. 2), we find three groups: very soft ($kT < 2$ keV) and weak sources, soft ($2 < kT < 7$ keV) strong sources and harder, medium intensity sources. We are unable to produce light curves for our sources and we have no real indication of their variability time-scale or decay time, other than the duration of our observations. Some of them could well be just irregular sources. We note, however, that the single orbit events are not amongst the faintest or the strongest objects.

The tacit assumption that the observed intensity is an indication of the luminosity can be partially justified by the strong concentration of the sources in the galactic plane. All but three sources lies within $|b| < 10°$ (and half of these within 2° from the galactic equator); the weak T 0035 + 28 and T 1629 – 76 are at $b \sim -20°$ and only T 0018 – 31 is at high latitude (– 48°). With the exception of two anticentre sources and one source at $l = 26°$, all other objects lie within 220° and 360°. (Limited observation of the low longitudes probably accounts for the absence of detections in that region of the plane.) This concentration in the galactic plane, which cannot be accounted for in terms of the relative exposures at high and low galactic latitudes, is very different from the isotropic distribution of fast transients (McHardy & Pye 1981); we note that the only high galactic latitude object found, T 0118 – 31, is indeed a single orbit event.

We have detected and determined the spectra of 19 objects, of which two-thirds are certainly transient or highly variable X-ray sources, while the others are in regions which have been observed only once. They appear strongly concentrated in the galactic plane and encompass a wide range of spectral slopes. Our observations suggest that there could exist transients whose spectral and temporal properties are intermediate, falling between the previous categories of hard and soft spectra and short- and long-lived transients. More light on the nature of transient X-ray sources could, however, be shed only by systematic monitoring using a dedicated satellite mission, capable of high-time-resolution spectral studies.

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References

Blissett, R. J. & Cruise, A. M., 1979. *Mon. Not. R. astr. Soc.*, **186**, 45.
Carpenter, G. F., Eyles, C. J., Skinner, G. K. *et al.*, 1975. *IAU Circ. 2852.*
Carpenter, G. F., Eyles, C. J., Skinner, G. K. *et al.*, 1977. *Mon. Not. R. astr. Soc.*, **179**, 27P.
Clark, G. K., 1975. *IAU Circ. 2843.*
Clark, D. H. & Caswell, J. L., 1976. *Mon. Not. R. astr. Soc.*, **174**, 267.
Cominsky, L., Jones, C., Forman, W. & Tananbaum, H., 1978. *Astrophys. J.*, **224**, 46.
Davison, P. J. N., 1977. *Mon. Not. R. astr. Soc.*, **179**, 35P.
Davison, P. J. N., Watson, M. G. & Pye, J. P., 1977. *Mon. Not. R. astr. Soc.*, **181**, 73P.
Elvis, M., Page, G. C., Pounds, K. A. *et al.* 1975. *Nature*, **257**, 656.
Eyles, C. J., Skinner, G. K., Willmore, A. P. & Rosenberg, F. D., 1975. *Nature*, **254**, 577.
Fabbiano, G. & Branduardi, G., 1979. *Astrophys. J.*, **227**, 294.
Fireman, E. L., 1974. *Astrophys. J.*, **187**, 57.
Forman, W., Jones, C., Cominsky, L. *et al.* 1978. *Astrophys. J. Suppl.*, **38**, 357.
Garcia, M., Baliunas, S. L., Conroy, M. *et al.* 1980. *Astrophys. J.*, **240**, L107.
Hayes, M. J. C., Culhane, J. L. & Bell Burnell, S. J., 1980. *Mon. Not. R. astr. Soc.*, **192**, 1P.
Hoffmann, J. A., Lewin, W. H. G. & Doty, J., 1977. *Astrophys. J.*, **217**, L23.
Ives, J. C., Sanford, P. W. & Bell Burnell, S. J., 1975. *Nature*, **254**, 578.
Jones, C., Forman, W., Tananbaum, H. & Turner, M. J. L., 1976. *Astrophys. J.*, **210**, L9.
Kaluzienski, L. J. *et al.*, 1976. *IAU Circ. 2935.*
Kaluzienski, L. J., Holt, S. S., Boldt, E. A. & Serlemitsos, P. J., 1977. *Astrophys. J.*, **212**, 203.
Lampton, L., Margon, B. & Bowyer, S., 1976. *Astrophys. J.*, **208**, 177.
McHardy, I. M. & Pye, J. P., 1981. *Space Sci. Rev.*, **30**, 457.
McHardy, I. M., Lawrence, A., Pye, J. P. & Pounds, K. A., 1981. *Mon. Not. R. astr. Soc.*, **197**, 893.
Maraschi, L., Treves, A. & Van den Heuvel, E. P. J., 1976. *Nature*, **259**, 292.
Maraschi, L., Treves, A. & Van den Heuvel, E. P. J., 1977. *Astrophys. J.*, **216**, 819.
Mazets, E. P. & Golenetskii, S. V., 1981. *Astrophys. Space Sci.*, **75**, 47.
Rosenberg, F. D., Eyles, C. J., Skinner, G. K. & Willmore, A. P., 1975. *Nature*, **256**, 628.
Sanford, P. W. & Ives, J. C., 1976. *Proc. R. Soc. Lond.*, **A350**, 491.
Seward, F. D., Page, C. G., Turner, M. J. L. & Pounds, K. A., 1976. *Mon. Not. R. astr. Soc.*, **177**, 13P.
Walter, F. M., Cash, W., Charles, P. A. & Bowyer, C. S., 1980. *Astrophys. J.*, **236**, 212.
Warwick, R. S., Marshall, N., Fraser, G. W. *et al.* 1981. *Mon. Not. R. astr. Soc.*, **197**, 865.
Watson, M. G. & Ricketts, M. J., 1978. *Mon. Not. R. astr. Soc.*, **183**, 35P.
Winkler, P. F., 1978. *Astrophys. J.*, **221**, 220.

Microfiche 202/3

Figure 1. The spectra of the transient and variable X-ray sources. The restored spectra are in units of log photons cm^{-2} s^{-1} keV^{-1} versus energy in keV. The upper limits are plotted at the 3 sigma level. The confidence contour plots refer to the power law (top) and thermal + Gaunt (bottom) fits (with the exception of T 1206 – 61, for which only a blackbody fit is presented in the lower box). The y-scale is hydrogen column density in units of 10^{22} cm^{-2}, the x-scale respectively photon spectral index and kT (keV). The best fit is indicated by a circlet. The confidence contours are plotted at the 68 (χ^2_{min} + 2.3) and 90 (χ^2_{min} + 4.6) per cent confidence levels.

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3.3 Discussion of individual sources

The 3A (Warwick *et al.* 1981; McHardy *et al.* 1981) and 4U (Forman *et al.* 1978) catalogues have been used to check for identifications with previously known sources and for potentially confusing sources. We note all catalogued sources which lie in the same field of view as each transient, but we stress that, with the exception of those sources explicitly identified with the transients, our positional analysis suggests all other catalogued sources were ′inactive′.

a) T 0028+60

We identify this source with 3A 0026+593 which was reported by Carpenter *et al.* (1977) to be flaring at this time (and was observed by the SSI on Ariel 5 to remain in a high state for another six weeks; Warwick *et al.* 1981). The increase in flux between the first observation and the one illustrated is possibly due to a decrease in the low energy absorption.

b) T 0048+40

No catalogued sources fall within at least 2° of the best position (and the nearest catalogued source is M31).

Since the observed intensity is constant, and there are no other observations of this region of sky, this source might be a weak uncatalogued source rather than a transient.

c) T 0118-31

This source was visible for one orbit (90 minutes) only; it was not significantly detected in adjacent orbits. There are no other observations of this area of sky and no known sources in the field of view.

d) T 0654-07

We identify this object with the variable source MX 0656-07, reported as flaring at this time by Carpenter *et al.* (1975) and Clark (1975), and subsequently observed by Kaluzienski *et al.* (1976) and Warwick *et al.* (1981). The spectrum clearly shows low energy absorption and there is an indication of a feature at ~7 keV. Threefold variations in intensity were observed from orbit to orbit.

e) T 0757-38

In the first observation the source appears strongly variable on an orbit-by-orbit timescale; the second and third observations are each of single orbit duration only.

The source 4U 0813-38 (0.6-2.8 Uhuru counts s^{-1}) is in the field of view, but at some distance from the transient position.

f) T 0808-51

This observation consists of 3 orbits of good data taken in a three-day interval. The source is at constant intensity ; there are no other observations of this region of sky. There is possibly a 7 keV feature in the spectrum. 4U 0750-49 (0.8-5.4 Uhuru counts s^{-1}) and 4U 0814-56 (1.4-2.8 Uhuru counts s^{-1}) are also in the field of view but not within the confidence contour.

g) T 0925-61

This is a single orbit observation with no adjacent data. The position of the transient is uncertain and close to the edge of the field of view so that the source intensity quoted is liable to large error. The nominal position for the Sco X-1 like source 3A 0921-63 is just outside the field of view. The sources 4U 0919-54 (5.4 Uhuru counts s^{-1}, very small error box) and A 1014-57 (4.5 Uhuru counts s^{-1}, Seward et al. 1976, not confirmed in 3A) are in the field of view, but far outside the confidence contour for the transient.

h) T 0930-42

These observations consist of only four orbits, spanning 5 days. The source appears to have varied considerably in intensity over that interval. The position is not consistent with 4U 0913-46 (0.7-4.0 Uhuru counts s^{-1}). Simple power law and single temperature thermal spectra are totally unsatisfactory fits to the data, possibly because of the presence of a flatter high-energy component.

i) T 1025-59

No catalogued sources occur within at least 2° of the position for this event. The closest one is 4U1036-56, which is known to be highly variable. We were able to observe T 1025-59 at a lower level on two other occasions, so it is more likely a variable source than a true transient. We note that while the spectra in the two weaker observations are remarkably similar, in the brightest observation it is harder. The presence of a 7 keV feature is suggested by the restored spectrum.

j) T 1206-61

This object has a remarkable spectrum to which we are only able to fit a blackbody spectrum and a large hydrogen column density. An absorption edge at ~7 keV would be consistent with the large column density. Contamination by a confusing source on the opposite side of the field of view could produce this spectral slope, but we have searched for and found no clear evidence for any such source. 4U 1210-64 (4.5-5.2 Uhuru counts s^{-1}, precise position) and A 1215-59 (4.5 Uhuru counts s^{-1}, Seward *et al.* 1976, not confirmed in 3A) are excluded as possible identifications for this event.

k) T 1248-59

We tentatively identify this event with a flare of 4U 1246-58 (= A 1246-58). This source, and the neighbouring A 1244-60, were both active at this time (see Carpenter *et al.* 1977 for the light curves). Although the Experiment C position eliminates A 1244-60 as the source of this event, there remains the possibility that it is contributing at a low level to the observed spectrum. During the first observation the intensity of T 1248-59 was constant or slowly declining. Ten days later it was found (for a single orbit) at about half that intensity with a different spectrum (in particular with more low energy absorption);

immediately after its intensity dropped very sharply.

l) T 1302-64

This is a single orbit observation with no adjacent unconfused observations. The closest source, 4U 1314-64 (9.6 Uhuru counts s^{-1}; not detected by SSI), is outside the confidence contour.

m) T 1337-63

This source was observed twice, at different intensities, so it is probably a weak, variable source rather than a transient. During the observation where it was brighter its intensity remained constant. Its position is not consistent with any of the closest sources: 4U 1323-62 (3.6-4.2 Uhuru counts s^{-1}), 4U 1344-60 (2.3-4.0 Uhuru counts s^{-1}) and MX 1353-64 (4.5 Uhuru counts s^{-1}). The humps in the restored spectrum are probably real since they are present in both observations ; they may account for the bad quality of the spectral fits.

n) T 1434-63

Since the region of sky containing this object was observed only once its long-term behaviour is unknown. Two catalogued sources fall just outside the confidence contour: the poorly positioned 4U 1425-61 (2.4 Uhuru counts s^{-1}) and A 1439-61 (=3A 1438-62, 3 Uhuru counts s^{-1}), identified (Winkler 1978) with the SNR MSH 14-6$\underline{3}$ (Clark and Caswell 1976). Variability of this source made Winkler postulate that it was a point source within the SNR. The flux reported here is constant during the observation, at a lower level than that observed by Winkler.

o) T 1629-76

This is a very weak source. Outside the large confidence contour lie 4U 1659-76 (~2 Uhuru counts s^{-1}) and 3A 1612-75 (2.7 Uhuru counts s^{-1}). Spectral fitting has not been attempted because of poor statistics.

p) T 1631-50

This is the brightest object found in the search. The Experiment C position is close to but not compatible with 4U 1624-49 (50 Uhuru counts s^{-1} maximum; variable by a factor 2), whereas analysis of the Experiment A data indicates that

4U 1630-47, which was known to be flaring a month earlier (Jones et al. 1976), was still active at this time. However, the position obtained for T 1631-50 is not consistent with 4U 1630-47. The source appears constant during the observation. Moderate absorption at low energies is seen.

q) T 1648-56

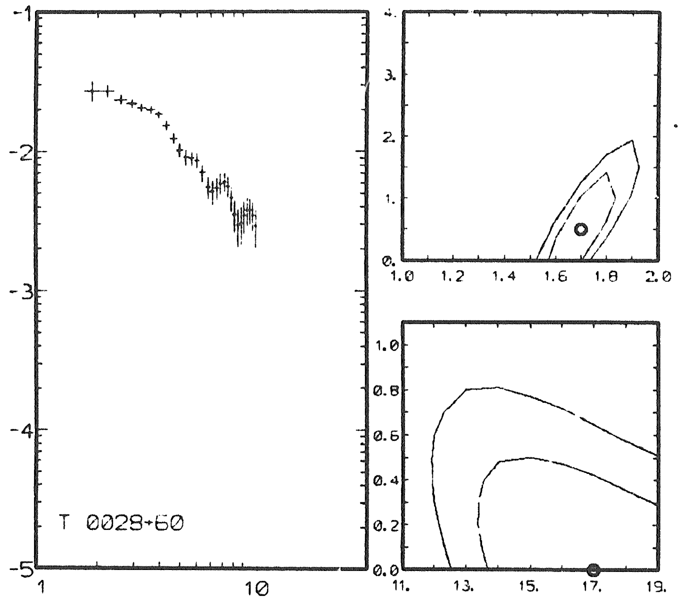
The burst source 4U 1636-53 (e.g. Hoffmann, Lewin & Doty 1977) is clearly outside the confidence contour of this event and appears to have been in a low state at the time of this observation. During this observation the flux of T 1648-56 increased and then remained steady at that level.

r) T 1725-38

There are no catalogued sources within 2° of this event, the next closest being 4U 1715-39 (13 Uhuru counts s^{-1}). The restored spectrum clearly shows a 7 keV feature. A gamma-ray burst occurred on 16 February at 22:51 (Cline, private communication) but we believe its contribution to this longer time-scale, constant intensity observation to be negligible.

s) T 1832-05

The source 3A 1833-078 (variable between 2 and 28 Uhuru counts s^{-1}) is within the confidence contour in one observation; 4U 1832-05 (3.3 Uhuru counts s^{-1}) is near by. We note the presence of a 7 keV feature in the restored spectrum. The intensity of the source decreased between the first and second observations.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15.
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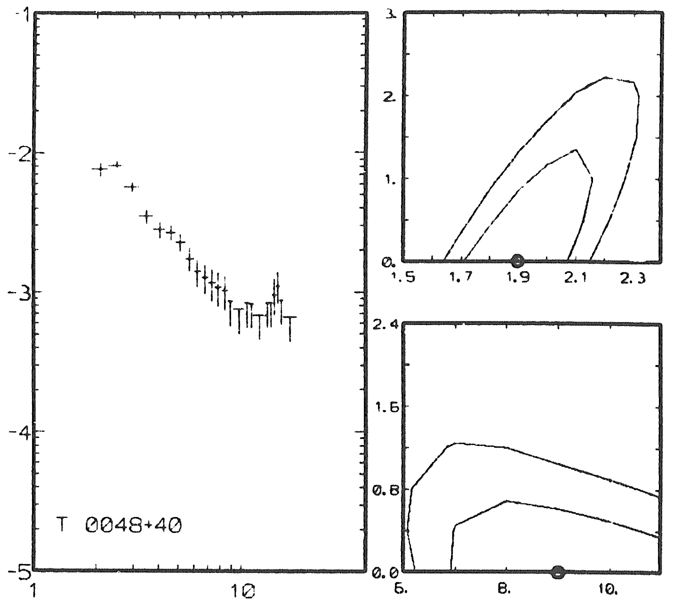
19.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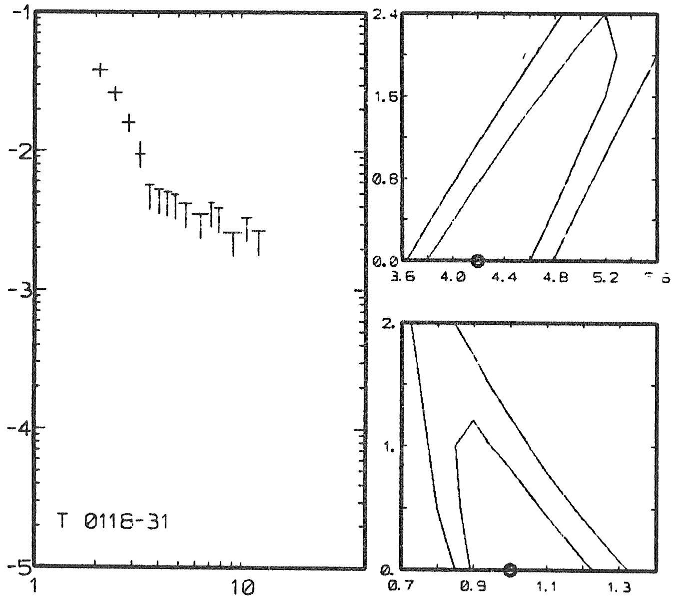
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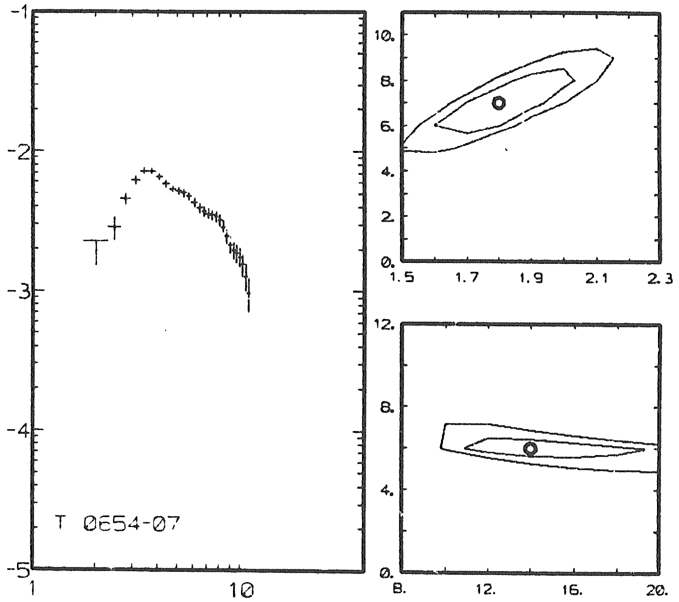
1.3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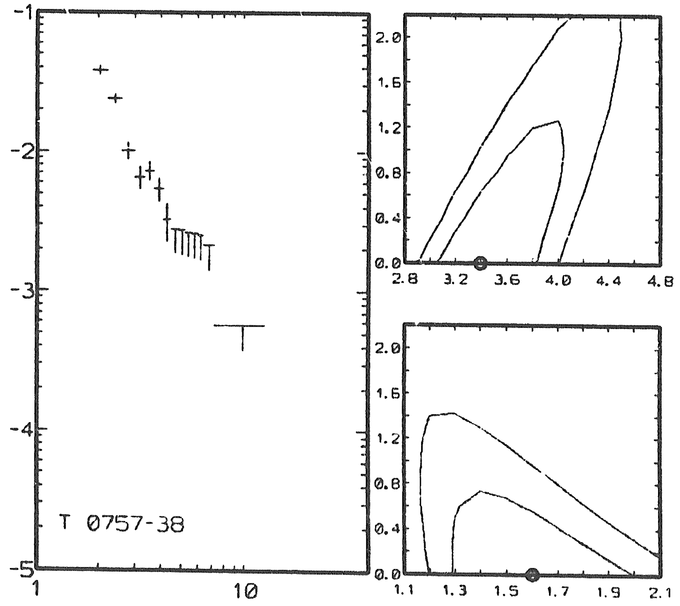
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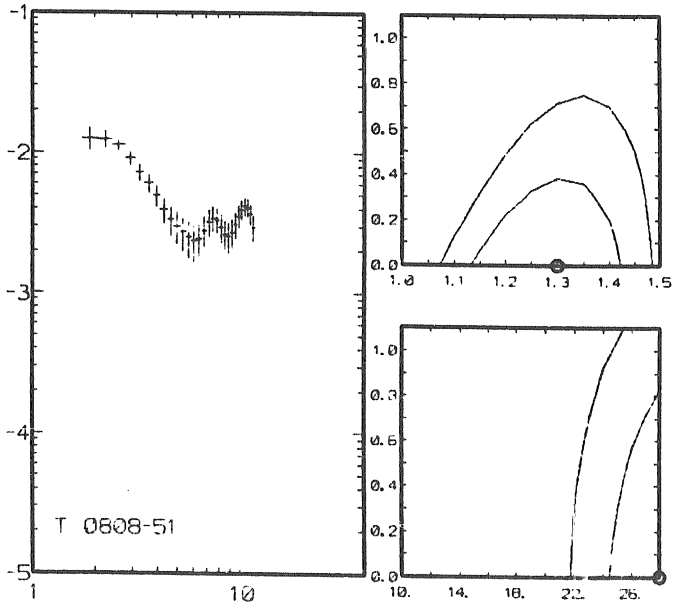
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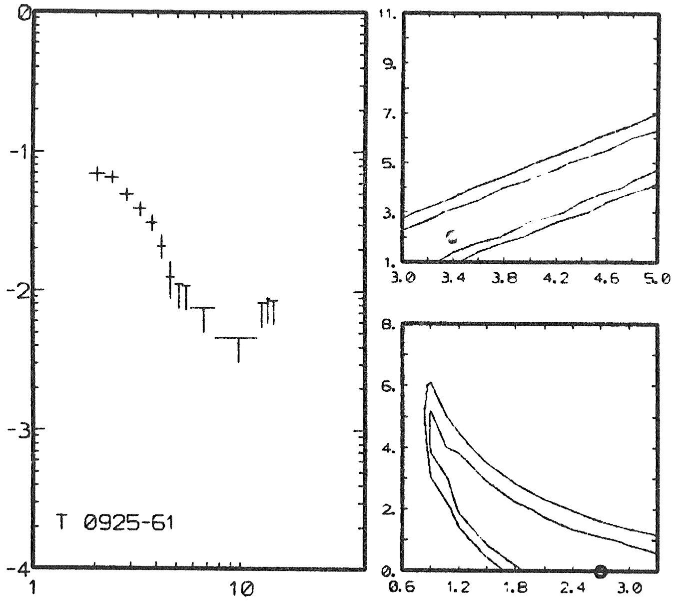
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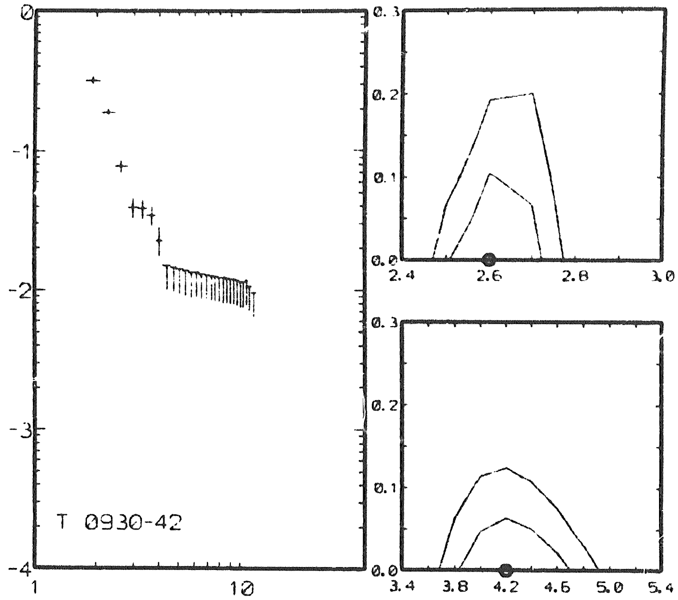
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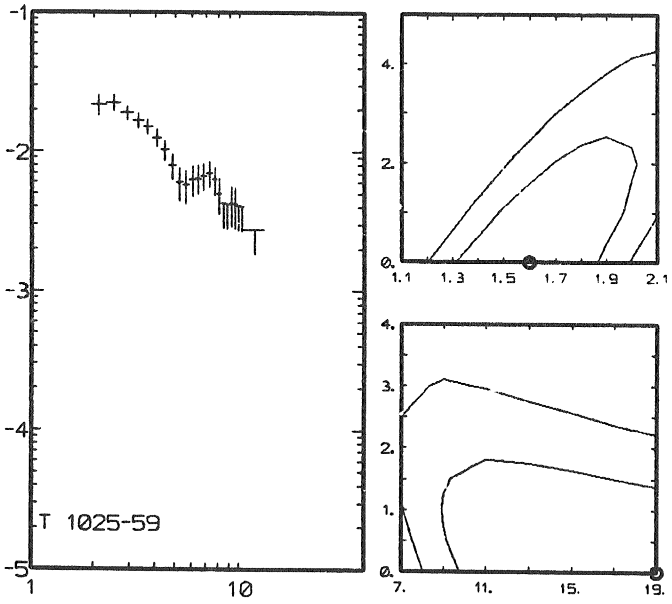
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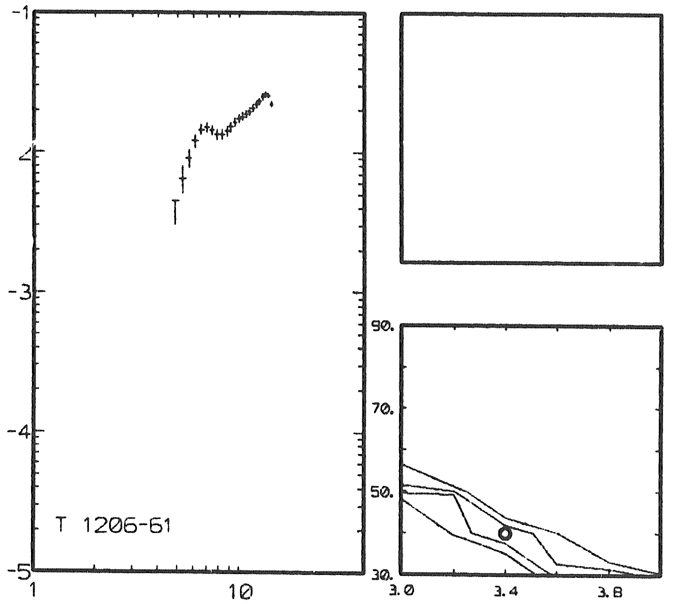
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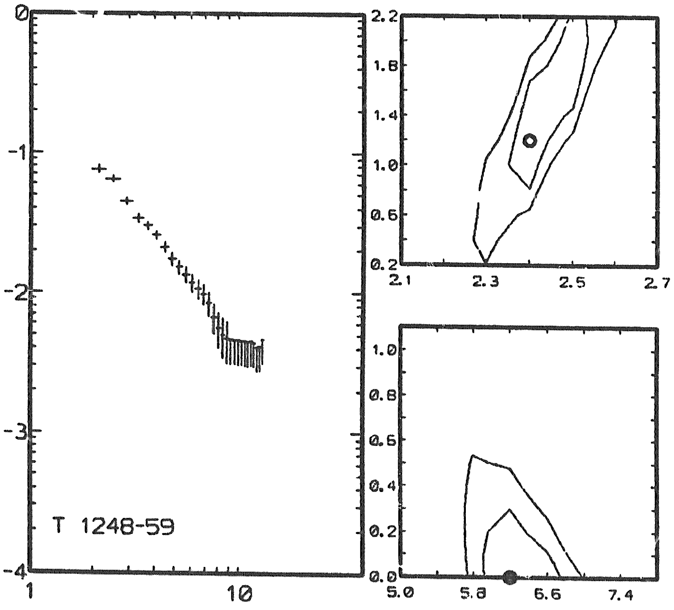
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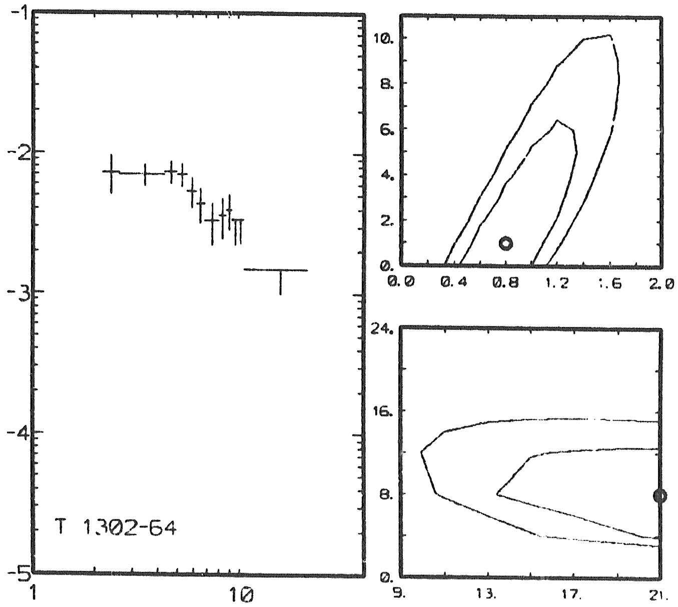
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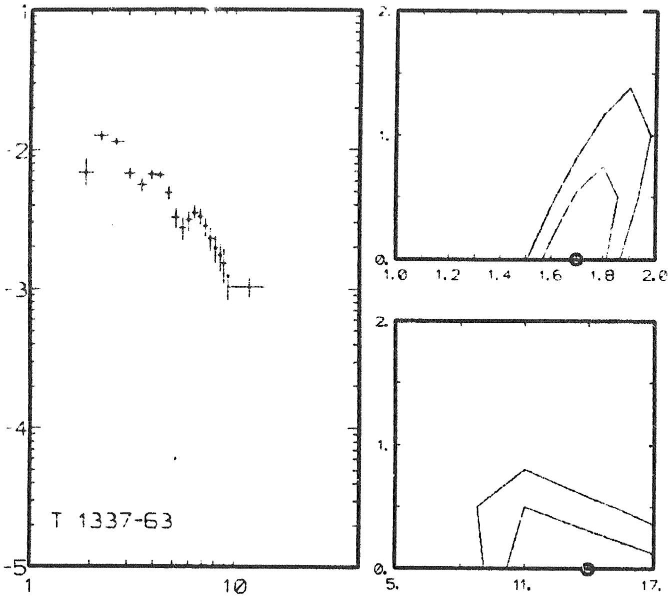
0.
9. 13. 17. 21.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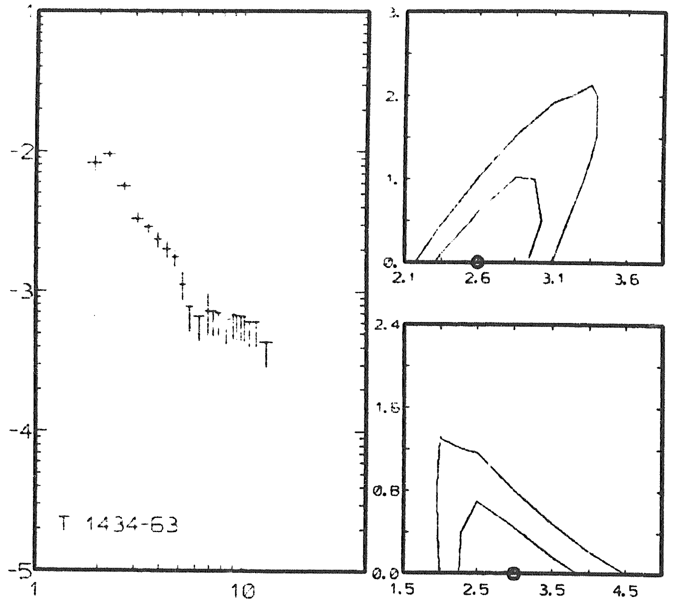
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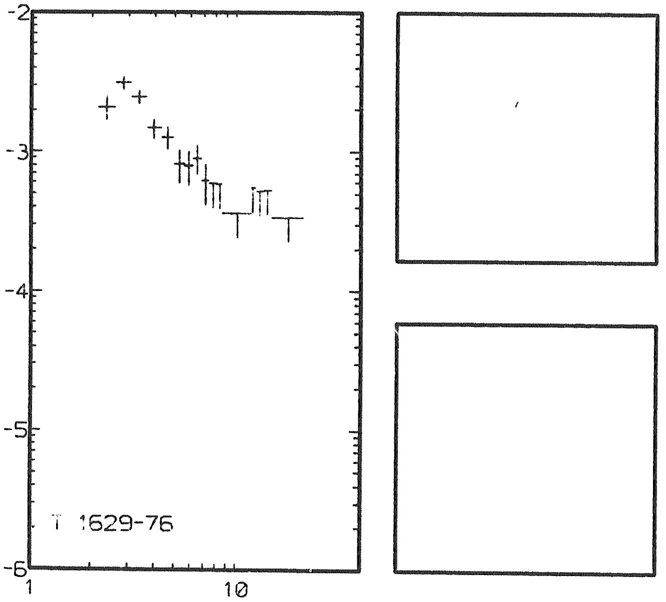
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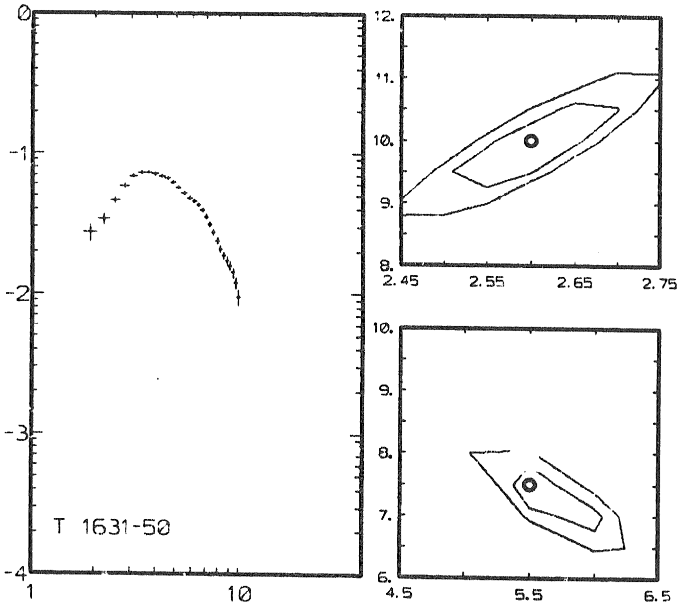
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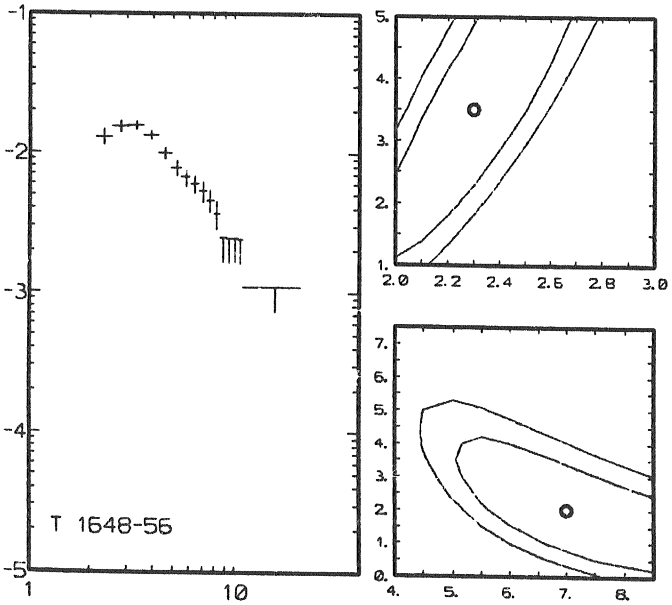
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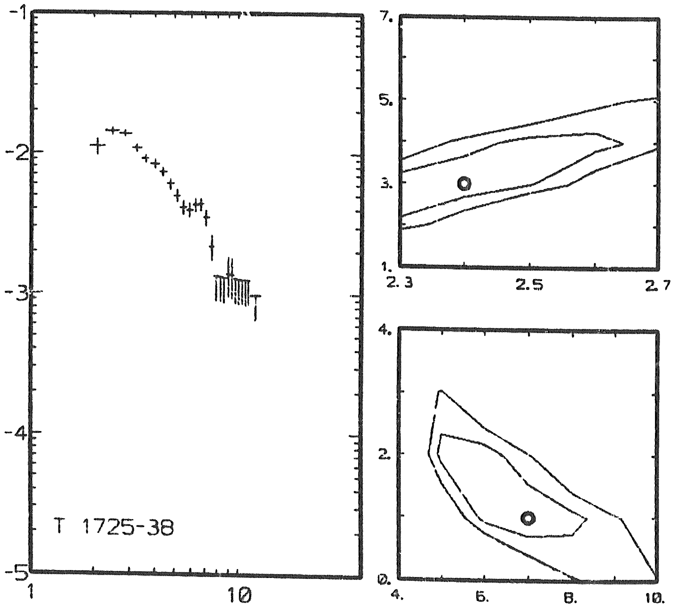
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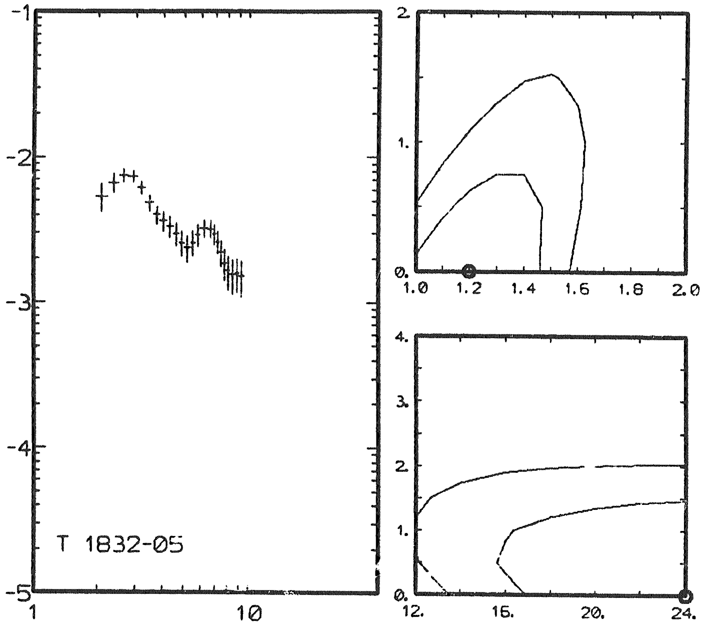

Figure 1. The spectra of the transient and variable X-ray sources. The restored spectra are in units of log photons cm^{-2} s^{-1} keV^{-1} versus energy in keV. The upper limits are plotted at the 3 sigma level. The confidence contour plots refer to the power law (top) and thermal + Gaunt (bottom) fits (with the exception of T 1206-61, for which only a blackbody fit is presented in the lower box). The y-scale is hydrogen column density in units of $10^{22} cm^{-2}$, the x-scale respectively photon spectral index and kT (keV). The best fit is indicated by a circlet. The confidence contours are plotted at the 68 $(\chi^2_{min} + 2.3)$ and 90$(\chi^2_{min} + 4.6)$ per cent confidence levels.