ABSTRACT. A new X-ray image of the galactic plane has been produced using the 45 arcmin square field of view of the Medium Energy Instrument on EXOSAT. This image shows a total of 64 sources including 18 new ones which include the first observation of persistent emission from the globular cluster bursters Terzan 1 and Terzan 5. The most important discovery from this image is a 2° wide ridge of diffuse emission symmetrical about the plane and extending from the galactic centre to l" = ±40°. The spectrum of this emission appears to be hard (α ~ 1.2) with no significant absorption.

The Uhuru and Ariel V catalogues, (1,2) resulted from the first complete surveys of the X-ray sky, including the galactic plane. The collimated proportional counters used had relatively large fields of view (5°x0.5° and 10°x0.75° respectively) and, while revealing several hundred X-ray sources, were affected by source confusion in crowded regions, eg. the galactic centre. Later modulation collimator instruments on SAS 3 (3) gave precise positions for about 60 galactic sources and HEAO A-2 (4) with its large effective area and a field of view 3°x1.5° detected many more. The depth of these surveys varies with, inter alia, the source density. In particular, near the galactic centre the sensitivity of instruments with relatively large fields of view is reduced because of the confusing effect of a high density of strong sources. The successful launch of EXOSAT offered a new opportunity to survey the galactic plane with the much smaller field of view of the Medium Energy collimated proportional counter (0.75°x0.75°). This gives greater freedom from source confusion and better discrimination of faint emission amongst the strong sources clustered near the galactic centre.

In order to make best use of the fine control and absolute accuracy of the EXOSAT attitude control system, the survey was conducted when the anti-sun passed through the galactic centre and consisted of an overlapping series of 90° great circle slews beginning at l" = ±90°, b" = 0° and ending on the anti-sun. The motion of the anti-sun over a period of 14 days through the galactic centre region from b" = +5° to b" = -5°, resulted in a lens shaped mapped area 10° wide at the galactic centre decreasing to zero at l" = ±90°.

A new medium energy X-ray map of the galactic plane (figure 1) has been created by accumulating the data in 20'x20' pixels. In figure 1 the main features are the well known bright galactic sources strung.
along the plane and clustering towards the centre; and in addition a considerable number of fainter sources. The limiting sensitivity (5σ) of the survey is 0.7 mCrabs at 1" > 50° increasing to ~2 mCrab at the galactic centre. There are 64 sources in the map above this limit of which 18 do not appear in previous catalogues (1,2,3,4). Most of these are located within the area 1" < 40° reflecting the greater ability of EXOSAT to probe densely populated regions. The positional errors on sources in figure 1 are typically 3'x14', accurate enough for follow up studies with EXOSAT.

Notable among the new sources is the first observation of steady emission from the globular cluster X-ray bursters Terzan 1 and Terzan 5. These were originally identified as bursters by Hackucho (5) but no persistent X-ray emission has been detected before, presumably because of the proximity of bright sources, obvious in figure 1. Bursts from within globular clusters are believed to have their origin in neutron star binaries formed by capture rather than evolution (6); very few have been identified as persistent emitters (3) so that the present discovery adds significantly to this total. Terzan 5 has been observed to emit 2 bursts within 10 minutes; such a short interburst period allows insufficient accretion to provide the nuclear fuel for the second burst, which has strong implications for current models (7). The present detection of persistent flux is important in this respect, and for future studies of the relationship between burst frequency and the persistent flux. Further details of these sources will be included in a full catalogue which is in preparation.

Perhaps the most interesting aspect of this new view of the galactic plane with EXOSAT is the discovery of a ridge of unresolved X-ray emission extending along the galactic plane. It is most obvious in figure 1 in the Aquila-Serpens-Scutum region as a diffuse band about 2° wide; however it can be traced either side of the galactic centre out to 1" = 40°. There is no detectable emission beyond 1" = 40° and the ridge is centred on zero latitude. The X-ray flux from this ridge is quite large (~80 mCrab integrated overall) and it has only escaped observation in previous surveys because of the confusing effect of the bright galactic sources.

The existence of diffuse galactic emission was indicated by early observations with sounding rockets (8,9,10). These were undoubtedly affected by source confusion and the most reliable study of the ridge was made with the 3°x1.5° FOV HEAO A-2 instrument (11,12): evidence for a diffuse ridge was obtained in 14 directions along the galactic plane. However, the observations excluded the region within 1" = 50° because of bright source confusion. Assuming a distance of 10 kpc for the galactic centre this implies that the HEAO A-2 ridge observations relate to regions of the galaxy more than 8 kpc from the centre. The surface brightness distribution was best represented by a disk of emission with considerable radial dependence of intensity.

The ridge observed by EXOSAT, inside the region 1" < 40° is much brighter than the HEAO A-2 ridge observed at greater longitudes. This is broadly consistent with their supposed radial dependence of luminosity which is itself followed by other galactic parameters such as the total mass, atomic and molecular hydrogen and the diffuse γ-ray...