as well as IRS9, IRS13, IRS21, IRS29, IRS35 (cf. Tollestrup et al., 1989, *A.J.* **98,** 204). GZ-B may be identical with IRS16NW, while GZ-A seems to have no prominent 2-μm counterpart.

Because of the near coincidence of GZ-A and GZ-B with Sgr A*, it may well be that the two sources are indeed in the Galactic Centre. If this is the case, the observed magnitudes could be consistent with either a group of young stars or the optical radiation from an accretion disk around a black hole. The estimated luminosity in both cases would be of order $5 \cdot 10^6$ $L_\odot$ A nonthermal origin of the radiation, in particular for GZ-A, cannot be excluded either. Also the possibility of chance alignment with faint foreground objects or a physical companion of IRR1 cannot be rejected at present. Clearly, these new objects are interesting enough to deserve further detailed observations: high angular resolution imaging at different wavelengths, spectroscopy and perhaps even polarimetry.

PROFILE OF A KEY PROGRAMME

Optical Identification Content of the ROSAT All Sky Survey

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On June 1, 1990 the X-ray satellite ROSAT was launched from Cape Canaveral on a Delta II rocket (Fig. 1). The project is a collaboration between Germany, the United States and the United Kingdom with the Max Planck Institute for Extraterrestrial Physics (MPE) as the leading scientific institution. During the first 6 months of the mission, ROSAT is performing the *first all-sky survey* made with an imaging X-ray telescope. The data rights for this survey lie with MPE.

Among the instruments on board ROSAT (Fig. 2) is the Positional Sensitive Proportional Counter (PSPC) which will be used for the all-sky survey. This imaging detector has a low resolution ($\Delta E/E = 0.4$) spectral capability over the soft X-ray energy range from 01.–2 keV. This energy range is considerably softer than that of the Einstein Observatory, so that one might confidently expect different proportions of different known classes of X-ray sources to be detected and, of course, even new classes of objects.

On the basis of the Einstein Observatory Extended Medium Sensitivity Survey (EMSS) one would expect to detect ≈ 100,000 X-ray sources over the whole sky. This will enable the acquisition of X-ray data for large samples of various classes of astronomical objects, in particular stars, AGN and clusters of galaxies. Obviously, one cannot hope in the foreseeable future to optically identify 100,000 sources. Our proposal aims at defining and observing a viable subsample of the ROSAT survey in order to completely identify the X-ray sources in that sample.

During the all-sky survey, ROSAT will scan along great circles of constant ecliptic longitude roughly perpendicular to the position of the sun. As the sun moves along the ecliptic, the scan path of the satellite follows and after a period of 6 months the whole sky will be covered. The exposure time varies from ≈ 600 seconds near the ecliptic to 30,000 seconds near the ecliptic poles. Other effects mainly involving background radiation and hydrogen column density will modify this sensitivity for detecting sources in a predictable manner. Figure 3 shows a small part of the survey, a strip of $\approx 6^\circ \times 13^\circ$ centred at $\alpha = 5^h30^m$, $\delta = -57^\circ$, accumulated from five days of data from August 9 to August 14. The area shown consists of 26 square degrees on the sky and therefore represents ¼ of the ESO Key Project Field II. The bright source in the lower right hand corner is LMC X-3. So far 34 sources have been detected in this section of the all-sky survey. For weak sources (< 20 counts) a 90% confidence error radius < 1 arcmin is expected, while for strong sources this radius would be 30–40 arcsec.

The average X-ray flux limit of the ROSAT survey will be roughly 3×10^{-13} erg/cm^{2}s. The results of the identification process will provide the basis for statistical studies of the X-ray properties of stars, quasars, AGN, BL Lac objects and clusters of galaxies. In particular, log N-logS and X-ray luminosity functions will be determined. This unbiased sample will also serve to calibrate all other samples selected from the all-sky survey. The existence of the Parkes and Australia Telescope radio surveys will permit correlations with radio properties.

Our sub-sample covers an area of 575 square degrees divided into 4 regions from which, on the basis of the EMSS at high galactic latitudes, we would expect to detect ≈ 380 extragalactic objects and ≈ 610 stellar objects in our Galaxy. With 380 objects, we will have the basis for statistical studies of the proportions of quasars, AGN, BL Lac objects and clusters of galaxies. Since the areas have been defined partly because of optical work planned or in progress by others (e.g. objective prism surveys, multi-colour surveys at low N_H column density, and other multi-colour surveys) there is also the possibility of comparing samples made using completely different criteria. For example, the proportion of X-ray quiet to X-ray loud AGN is of some interest both from the point of view of physical properties of AGN themselves and from the point of view of cosmology. Another important and topical question is that of the large scale structure and distribution of extragalactic sources. Equally important will be the follow-up programme of individual objects that emerge as a result of the particular energy range of this survey.

Among the stars, again using the EMSS as a guide, we might expect the following proportions of objects: dMe, dKe – 20 %, non-accreting, active binaries – 15 %, cataclysmic variables – 2 %, pre-main-sequence stars – 4 %, B stars – 4 %. This leaves >50 % in a loose category of normal, solar-type stars. What proportion of these may be white dwarfs is not easy to predict, but it could be quite high as a result of the soft energy range of the PSPC detector. This may prove to be a highly efficient means of detecting white dwarfs.

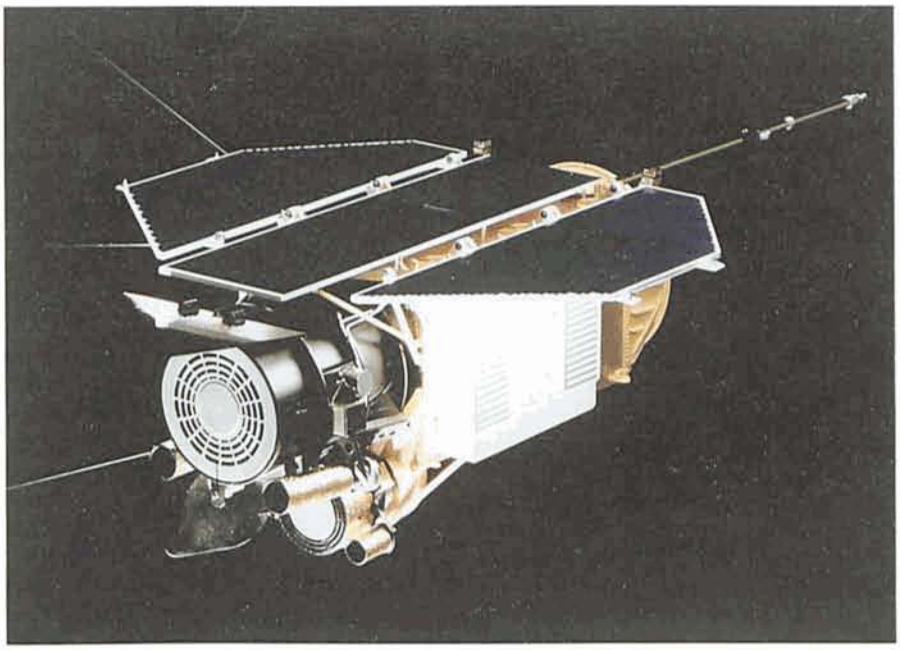

Figure 2.

Our approach to efficient optical identification will be as follows. In conjunction with the detected X-ray sources and their positional error boxes, we propose to use the following type of data, most of which are already in hand and require no further telescope time.

Candidate identification for the all-sky survey will be made by cross-correlating with the Royal Observatory Edinburgh's (ROE) already digitized catalogue of the SERC Southern Sky J Survey. However, since there is expected to be on average more than one confusing star as well as the correct identification per X-ray error box, we propose to use colour information obtained from Schmidt UR and existing J plates to isolate the most likely candidate. Since the Einstein and EXOSAT deep surveys indicate that 80 % of all identifications are likely to be quasars, AGN or M dwarfs, we can separate M dwarfs by their very red colours, and redshift $z < 2.2$ quasars (which will comprise the vast majority of the quasars) by their UV excess. Prior identification of brighter M stars would prevent longer integrations on fainter confusing stars. An increase in efficiency of a factor 2 is expected by using colour information.

Figure 1.

Digitized measurements from U and R plates covering the selected areas are virtually complete, while the J band data already exist in catalogue form.

Spectroscopy will be carried out on a variety of telescopes according to the brightness of the candidates. Using the EMSS as a reference, we estimate that of the expected 990 X-ray sources in our sample, 790 will be brighter than B = 18.5 and 200 will be fainter than 18.5 (this may be an underestimate of the proportion of fainter sources in the ROSAT survey which is expected to go deeper and to detect fainter extragalactic sources).

The 200 or more sources fainter than 18.5 must be observed with the ESO 3.6-metre and NTT. Of the 790 objects brighter than 18.5, about 325 will be stellar objects brighter than B = 15 and will be observed at low resolution with the ESO 1.52-m telescope. 230 candidates can be observed with FLAIR-2 on the UK Schmidt telescope. FLAIR-2 is a fibre-fed spectrograph which will be able to obtain spectra of up to 100 objects per exposure down to $B \approx 18.5$ and agreement has been reached to ride piggy-back on another programme working at the SGP. The remaining 235 candidates in this magnitude range in the other selected fields would need to be observed with the 2.2-m, 3.6-m or NTT.

In addition, experience from the EMSS follow-up has shown that often more than one stellar object with a reasonable f_x/f_v ratio is associated with one X-ray source. The secondary criterion for stellar X-ray identification is the presence of chromospheric emission lines or rotationally broadened absorption lines in the spectrum of the star. This will require higher-resolution spectroscopy particularly for RS CVn and W UMa binaries and solar-type stars with moderate levels of chromospheric activity. Therefore, towards the end of the survey this type of spectroscopic work will be necessary for an estimated 250 stars.

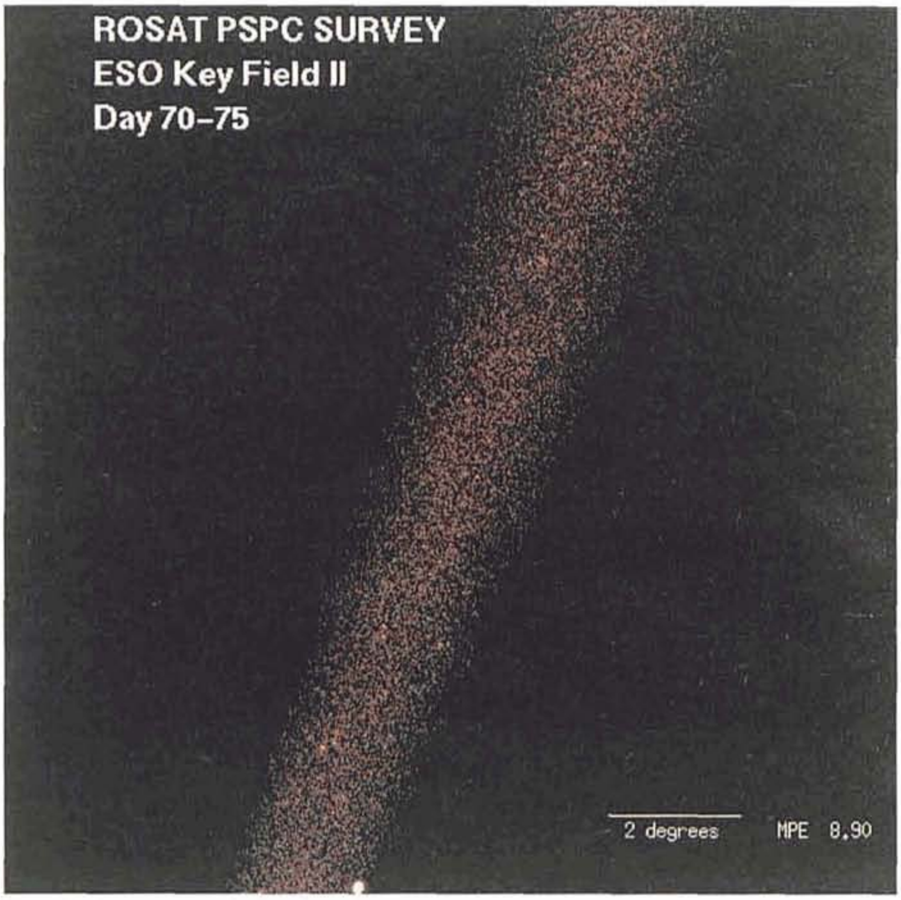

Figure 3.

All members of our team feel that it is important to allow time for follow-up observations of important, exciting, interesting or new objects as soon as possible. We have therefore requested that, contiguous with the time allotted specifically to meet the requirements of identification, an extra allocation be made to allow for follow-up. This will allow team members to profit better from the somewhat arduous tasks of survey identification.

PROFILE OF A KEY PROGRAMME

Stellar Evolution in the Galactic Bulge

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Large-scale maps at infrared wavelengths obtained with IRAS and COBE show our Milky Way as an edge-on spiral galaxy, and clearly reveal the Galactic Bulge. This separate component of our Galaxy can be considered as the nearest ellipsoidal stellar system. Studies of its stellar content are crucial not only for our understanding of stellar evolution and stellar populations in general, but also for calibrating the measurements of the colours and line strengths of the integrated light of elliptical galaxies (Whitford, 1986).

Some parts of the Galactic Bulge outside the galactic plane can be studied optically. In particular, there is a 6°.5 by 6°.5 field (900 pc by 900 pc) of low and homogeneous extinction, centred at $l = 0°$, $b = -10°$, which in the mid-fifties was chosen by Baade and Plaut as a good field to search for variable stars by photographic techniques (cf. Blaauw, 1955). It is often referred to as the Palomar-Groningen Field Nr. 3, or simply as the Baade-Plaut field. Its location is illustrated in Figure 1. Recently, Wesselink (1987) has repeated part of Plaut's painstaking work by measuring B and R Schmidt plates with an automatic measuring machine, and using a photo-electric calibration sequence. He obtained more accurate magnitudes, and confirmed Plaut's list of variable stars. As a result, nearly all Miras, Long-Period Variables, Semi-Regular Variables, and also the RR Lyrae stars have now been identified. Accurate periods and light curves have been determined for all stars with periods less than 300 days. We are extending Wesselink's work, with the aim of constructing a