

(NASA-CR-196265) A ROSAT DEEP
SURVEY OF THE BEST STUDIED HIGH
LATITUDE AREAS Final Technical
Report, 1 Aug. - 31 Jul. 1994
(Arizona State Univ.) 2 p

N95-13722

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G3/89 0016379

Arizona State University

ANNUAL REPORT

REPORTING PERIOD: For August 1 through July 31, 1994

ROSAT Grant Number: NAG5-2322

I. PRINCIPAL INVESTIGATOR: Rogier A. Windhorst

II. INSTITUTION: Arizona State University

III. PROJECT TITLE: A ROSAT Deep Survey of the Best Studied High Latitude Areas

IV. SUMMARY OF PROJECT ACTIVITIES:

1. Brief description of the primary objectives and scope of the project:

Our first deep PSPC survey has been highly successful. We received an additional 19.2 ksec with the PSPC in another field during the AO-3 cycle. These two fields have been extensively studied in the optical ($B_J \lesssim 26$ mag) and radio ($\geq 50 \mu\text{Jy}$) from the ground. The data obtained from both fields will yield ~ 200 discrete X-ray sources down to $\sim 7 \times 10^{-15} \text{ ergs cm}^{-2} \text{ s}^{-1}$, which permits statistically significant studies of: 1) the nature of weak X-ray sources (AGN, starburst galaxies, clusters, stars); 2) the turn-off in their $\log(N)$ - $\log(S)$ plus their contribution to the XRB; 3) the X-ray-optical-radio luminosity function and its evolution with cosmic time; and 4) the effect on all these properties of the ~ 20 - 30% field-to-field fluctuations expected from deep radio-optical surveys.

2. Description of the findings to date:

Over the past decade we used Westerbork, the VLA, the Hale 200" and KPNO 4m telescopes to obtain deep multi-wavelength studies of several Selected Areas. These data include: over 1,000 weak radio sources in 8 deg^2 down to $20 \mu\text{Jy}$; nearly 100% complete optical identifications from deep contiguous CCD-mosaics down to $V \sim 26$ mag (Windhorst et al. 1987, 1991); redshifts for 300 galaxies with $V \lesssim 22.5$ mag (Koo & Kron 1988) and optically-selected AGN with $B \lesssim 23$ (Anderson & Schechter 1988). The faint radio source population consists of both giant ellipticals and actively starforming galaxies. The latter cause the excessive number of sub-mJy radio sources (Windhorst et al. 1985).

Before ROSAT's all sky survey, our best knowledge of the X-ray sky at the $\sim 10^{-13} \text{ ergs cm}^{-2} \text{ s}^{-1}$ level came from Einstein surveys (Giacconi et al. 1979; Maccacaro et al. 1982, 1991; Gioia et al. 1990; Griffiths et al. 1983, 1989), which showed the faint X-ray counts are dominated by QSO's and Seyferts (AGN), with a minority of BL-LAC's, starburst galaxies, cluster and cD galaxies. Preliminary results from 30 ksec PSPC surveys of QSO fields have shown that AGN also dominate the ROSAT number counts ($> 100 \text{ deg}^{-2}$). The faint $\log(N)$ - $\log(S)$ slope *appears* to turn over from -1.5 to about -1.2 just below the Einstein Deep Survey limit ($S_X \sim 3 \times 10^{-14} \text{ cgs}$; Shanks et al. 1991; Hasinger 1991, 1992; Anderson et al. 1992; Windhorst et al. 1992).

During AO-1, we obtained a total of 67 ksec good PSPC data on our survey field Lynx.3A. The limiting sensitivity is $\sim 6 \times 10^{-15} \text{ cgs}$ (3.5σ). Within the central $40'$ diameter PSPC region, ~ 70 sources were found down to 3.5σ . The fractional contribution to the 0.5-2 keV XRB from these *detected* discrete sources is $\sim 30\%$ in the J-band. All our candidate id's were selected by positional coincidence with our deep optical/radio images, and most are stellar or compact in appearance. About two thirds have Gunn *gri* colors typical of QSO's, consistent with the 65-80% AGN fraction of Shanks et al. (1991). The remainder of our stellar objects are red, presumably X-ray stars. We also found several compact galaxy ids, several galaxies in groups or clusters (one with estimated $z > 0.75$ from colors), and a starburst radio galaxy with known $z=0.451$.

For AO-3 we received ~ 20 ksec PSPC data on another survey field VLB. Our preliminary analysis shows ~ 30 sources within the central PSPC region. Optical spectroscopic work continues

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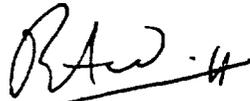
on this field to determine the likely optical candidate(s) for the X-ray sources. Work also continues on cross-correlating the X-ray sources with the radio sources.

3. Name and date (or anticipated date) of the publication of results:

We expect to submit a paper this fall (1994) to the *Astronomical Journal*. One of the key features of this paper will be the presentation of the optical identifications of the ROSAT X-ray sources as determined from spectroscopy done using the KPNO 4m HYDRA multi-fiber spectrograph and the MMT spectrograph.

4. Suggestions and additional comments:

None.

A handwritten signature in black ink, appearing to read "R. A. W. H." with a horizontal line underneath.

Signed,