EXPLORING THE HOT GALACTIC HALO

USING SHADOWS OF HIGH LATITUDE CLOUDS

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FINAL REPORT

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The objective of this proposal was to measure variations in the 1/4 keV emission from the galactic halo, using ROSAT PSPC observations toward known enhancements in the absorbing column density along the line-of-sight out of the Galaxy. Target directions were selected to have a low total hydrogen column density but to also show significant gradients in the amount of absorbing material, as traced by IRAS 100 micron emission, on angular scales that would be contained within the PSPC field of view. In addition, we restricted the galactic latitude of the target directions to be greater than 60 degrees or less than -60 degrees in order to enable a cleaner separation of Galactic halo emission from that of the Galactic disk. The observations would also provide a measurement of the brightness of the emission from the Local Bubble.

Five of six targets from the proposal were granted and received observing time. We supplemented these observations with additional pointings from the ROSAT PSPC archive. The data were filtered to remove times of high rates from particle or solar backgrounds and brightness images in the 1/4 keV band were produced. Estimated contributions from internal and external non-x-ray backgrounds and scattered solar x-rays were subtracted from the brightness images. Finally, point sources and discrete extended sources were removed from the images to produce images of the 1/4 keV brightness of the diffuse emission.

Initially the 1/4 keV sky brightness images were correlated with IRAS 100 micron images obtained through the HEASARC. Most of the target directions showed an anticorrelation between the 1/4 kev brightness and the 100 micron brightness, indicating the presence of emission form behind the material responsible for the 100 micron emission. By assuming an extremely simple model for the distribution of the material responsible of the 1/4 kev emission and absorption, a local emitting region and a single distant emitting region separated by all the absorbing material, fits to the anticorrelation could be made. Unfortunately, while the relative brightness of the IRAS 100 micron emission on small angular scales was reasonably well calibrated, the absolute level was not. The brightness of the distant, absorbed 1/4 keV emission could only be determined by adding or subtracting a constant addition term in the absorption column density; where the constant was calculated to make up the difference between the scaled IRAS 100 micron brightness and the hydrogen column density derived from lower angular resolution 21 cm measurements. Later, a rescaled version of the IRAS 100 micron data from Schlegel, Finkbeiner, and Davis, (1998, ApJ, 500, 525) allowed the anticorrelation fits to be performed without this added uncertainty. On average 80% of the total observed 1/4 keV diffuse emission is generated by the local, unabsorbed emission region (the Local Bubble). The distant, absorbed component (the local Galactic halo) is brighter at the northern Galactic pole than the southern. In the northern directions we examined that are away from the North Polar Spur the halo brightness varies by a factor of four from faintest to brightest. The average northern brightness is 0.001 counts/s/square-arcmin; in the south the average halo brightness is about 2/3 this value.

There are a few limitations and complications to this work. The distribution of the emitting and absorbing material that we assumed is quite simple. More complex arrangements with several emitting regions separated by absorbers having gradients in different directions across the field or with intermixed absorbing and emitting gas could produce an anticorrelation between the 1/4 keV and 100 micron brightnesses but it would be significantly more difficult to interpret. We do not know the distance to the absorption enhancements traced by the 100 micron emission and it is only the gradient in it that generates the anticorrelation we observe. Obtaining distances to these clouds would help in

establishing the validity of the assumed geometry. Even in our simple geometry the distant emitting component is not exclusively due to emission from the halo, a contribution should come from the extragalactic cosmic x-ray background. The extragalactic contribution is of unknown size and is not likely to be constant within the PSPC field of view.

Results of these analyses were presented at scientific meetings in the following papers:

- "ROSAT PSPC Observations of Clouds at High Galactic Latitude", M. Juda, D. McCammon, W. T. Sanders, and S. L. Snowden, 182th Meeting of the A.A.S., Berkeley, CA, June 1993.

- "Emission from the Local Galactic Halo in the 1/4 keV Band", M. Juda, 185th Meeting of the A.A.S., Tucson, AZ, January 1995.

- "Mapping the Distribution of 10^6 K Gas Toward the Galactic Poles", M.Juda, 188th Meeting of the A.A.S., Madison, WI, June 1996.

- "Intensity of the 1/4 keV Emission from the Local Galactic Halo", M. Juda, Meeting of the High Energy Astrophysics Division of the A.A.S., Estes Park, CO, November 1997.

- A draft of a paper for submission for publication in the Astrophysical Journal is in work but progress has been slowed by outside pressures.