Peering towards Cosmic Dawn
Proceedings IAU Symposium No. 333, 2018
V. Jelić & T. van der Hulst, eds.

doi:10.1017/S1743921317011279

Fine structure of Galactic foreground ISM towards high-redshift AGN – utilizing Herschel PACS and SPIRE data

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Abstract. One of the most certain ways to determine star formation rate in galaxies is based on far infrared (FIR) measurements. To decide the origin of the observed FIR emission, subtracting the Galactic foreground is a crucial step. We utilized *Herschel* photometric data to determine the hydrogen column densities in three galactic latitude regions, at $b = 27°$, $50°$ and $-80°$. We applied a pixel-by-pixel fit to the spectral energy distribution (SED) for the images aquired from parallel *PACS-SPIRE* observations in all three sky areas. We determined the column densities with resolutions 45" and 6', and compared the results with values estimated from the *IRAS* dust maps. Column densities at $27°$ and $50°$ galactic latitudes determined from the *Herschel* data are in a good agreement with the literature values. However, at the highest galactic latitude we found that the column densities from the *Herschel* data exceed those derived from the *IRAS* dust map.

Keywords. infrared: ISM; ISM: dust, extinction

1. Target selection and data reduction

With the primary aim to determine the hydrogen column densities in different galactic latitude areas, we selected three sky areas based on our high-redshift active galactic nuclei (AGN) catalog (Perger *et al.*, 2017). We searched for available *Herschel PACS-SPIRE* (Griffin *et al.* 2010; Poglitsch *et al.* 2010) parallel observations in the catalog coverage, and we randomly selected images at three galactic latitude ranges, centered on the sources SDSS J085151.25+020755.9, SDSS J144713.04−012158.5 and BR J0018−3527 (see Table 1).

We converted the *PACS* 160 μm and the *SPIRE* 250 μm, 350 μm, and 500 μm images to a resolution of 45" and made $1° \times 1°$ cutouts. We fitted these with a modified black body spectral energy distribution (SED) pixel-by-pixel, applying a spectral index of $\beta = 2$

Table 1. Hydrogen column densities in the three fields.

b	$N(H)_{\rm lit}$ [cm^{-2}]	$N(H)_{45''}$ [cm^{-2}]	$N(H)_{6'}$ [cm^{-2}]
$27°$	1.6×10^{20}	3.9×10^{20}	1.8×10^{20}
$50°$	2.4×10^{20}	3.1×10^{20}	2.6×10^{20}
$-80°$	5.9×10^{19}	3.9×10^{20}	1.3×10^{20}

Notes:
Column 1 – galactic latitude, Column 2 – hydrogen column densities, $N(H)$ from literature extinction, Column 3 – $N(H)$ from the 45" *Herschel* maps. Column 4 – 6' resolution (smoothed) *Herschel* map for comparison to the previous, lower-resolution studies.

(Kohyama *et al.*, 2010). Then we derived the hydrogen column densites following Molinari *et al.* (2010). Simultaneously, we calculated column densities using extinction values from the literature (Schlaffly & Finkbeiner, 2011), by applying the equation $N(H) = 1.8 \times 10^{21} A_V$ (Predehl & Schmitt, 1995.

The *Herschel*-based column densities were scaled to HI4PI (HI4PI Collaboration *et al.*, 2016), and then we compared the values to those obtained from the literature.

2. Results

We found that the $N(H)$ values determined from *Herschel* photometry are in good agreement with column densities derived from extinction in the literature, considering the low and intermediate galactic latitude fields. However, at the highest latitude area, our analysis suggest a somewhat higher value for $N(H)$, implying some denser, filamentary structure in the line of sight.

3. Summary

We utilized *Herschel PACS-SPIRE* parallel observations in three different galactic latitude areas to determine hydrogen column densities at two resolutions: 45" and 6'. We compared our analysis to the literature $N(H)$ values originating from galactic extinction studies. Our findings in the low and intermediate latitude regime (i.e. $b = 27°$ and $b = 50°$) are consistent with the values derived by Schlafly & Finkbeiner (2011). However, the better resolution 45" *Herschel* $N(H)$ map suggests that at $b = -80°$ the column density of hydrogen is an order of magnitude higher than the literature value, implying a dense feature, most likely a filament in the structure of the ISM.

Acknowledgement

We acknowledge the support from the Hungarian National Research, Development and Innovation Office (grants OTKA NN110333 and NN111016).

References

Griffin, M. J., Abergel, A., Abreu, A., *et al.* 2010, *A&A*, 518, L3
HI4PI Collaboration, Ben Bekhti, N., Flöer, L., *et al.* 2016,*A&A*, 594, A116
Kohyama, T., Shibai, H., Fukagawa, M., & Hibi, Y. 2010, *ApJ*, 719, 873
Molinari, S., Swinyard, B., & Bally, J., *et al.* 2010, *PASP*, 122, 314
Perger, K., Frey, S., Gabányi, K. É, & Tóth, L. V. 2017, *Front. Astron. Space Sci.*, 4, 9
Poglitsch, A., Waelkens, C., Geis, N., *et al.* 2010, *A&A*, 518, L2
Predehl, P., & Schmitt, J. H. M. M. 1995,*A&A*, 293, 889
Schlafly, E. F. & Finkbeiner, D. P. 2011, *ApJ*, 737, 103