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Reconstructing the ZOA from Galaxy Peculiar Velocities

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Abstract. Galaxy peculiar velocity data provide important dynamical clues to the structures obscured by the Zone of Avoidance (hereafter, ZOA) with resolution $\gtrsim 500\,\mathrm{km\,s^{-1}}$. This indirect probe complements the very challenging approach of directly mapping of the distribution of galaxies behind the Milky Way. In this work, the Wiener filter method is applied to reconstruct the 3D density and velocity distributions of the universe, within $\lesssim 8000\,\mathrm{km\,s^{-1}}$, using SEcat the largest peculiar velocity catalog yet. This catalog is a combination of the SFI spiral galaxy peculiar velocity catalog and the newly completed nearby early-type galaxy peculiar velocity catalog, ENEAR. The recovered density is smoothed with $900\,\mathrm{km\,s^{-1}}$ Gaussian. The main reconstructed structures are consistent with those extracted from the IRAS 1.2-Jy redshift galaxy catalogs. The revealed structures within the ZOA are identified and their robustness and significance are discussed.

1. Introduction

Extinction due to the galactic plane obscures about 25% of the optically visible universe. In order to account for the Local Group motion relative to the Cosmic Microwave Background (CMB), the flow of galaxies in the Great-Attractor (hereafter, GA) area and other similar phenomena, the full distribution of matter, especially in the local universe, is essential. Direct measurement of the distribution of matter/galaxies requires extensive, tedious and dedicated observational programs in all the available electromagnetic wave-bands (see review by Kraan-Korteweg & Lahav 2000 and references therein).

However, a complementary approach for studying the universe behind the Milky Way is to use the available dynamical data, e.g., galaxy peculiar velocity catalogs, together with statistical reconstruction methods, e.g., Wiener filtering (WF), in order to uncover the mass density distribution, with resolution scale $\gtrsim 500\,\mathrm{km\,s^{-1}}$, hence, singling out the dynamically most significant structures.

Peculiar velocities of galaxies enable a direct and reliable measurement of the *underlying* mass distribution, under the natural assumption that galaxies are unbiased tracers of the large-scale, gravitationally induced, velocity field. Furthermore, since peculiar velocities are non-local and have contributions from different scales and different regions, analysis of the peculiar velocity field provides information on regions not covered by the data, e.g., the ZOA (Kolatt