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HVCs, infall and the Galactic Fountain

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Abstract. High-velocity clouds (HVCs) consist of gas that does not take part in normal Galactic rotation, having velocities deviating by up to 400 km s^{-1} from those expected from rotation. Over the past five decades, studies have shown they these clouds trace a number of different processes, including the Galactic Fountain, tidal streams, and infall. Here, I summarize some recent results concerning measurements of cloud metallicities and distances and how these are used to understand individual clouds and derive the conclusion above.

Keywords. ISM: general, ISM: HVCs, Galaxy: corona

Observations using the ultraviolet spectrographs on the *Hubble Space Telescope* (HST), as well as with the *Far Ultraviolet Spectroscopic Explorer* (FUSE) have now yielded measurements of the S II $\lambda\lambda$1250, 1253, 1259 and many O I lines. Because the ionization potentials of O I and H I are similar and because most of the oxygen is in the gas phase, the O I/H I ratio is usually the same as the O/H ratio. Similarly, SII/H I is usually close to S/H, although sometimes a (small) ionization correction is needed.

Most published results so far concentrate on measurements toward HVC complex C (see Fox *et al.* 2004 for a summary) and the Magellanic Stream (Gibson *et al.* 2000; Fox *et al.* 2005). From our HST Cycle 18 program, as well as an analysis of the FUSE+HST archive we now have 17 different clouds toward which the metallicity of a HVC has been measured, with values ranging from 1/20th solar to solar. There is no exact correlation between velocity and metallicity. Values of 1/20th, 1/10th and 1 times solar are found for intermediate-velocity clouds (HVCs with $|v| < 90$ km s^{-1}); values ranging from 1/10th to 1/4 solar are found in the Magellanic Stream; while for clouds with $|v| < 90$ km s^{-1} the metallicities range from 1/10th solar to solar. The cloud metallicities allow us to associate individual clouds with one of the main processes summarized above.

To find distances to HVCs requires a set of stellar targets situated both behind and in front of the star. Such targets need to have clean spectra and known distance. Starting with the SDSS and 2MASS surveys, we defined a sample of 3000 candidate probes toward 60 HVCs. We now have good distances for some 15 HVCs, using intermediate-resolution (1 Å) spectra from the SDSS (∼800 stars), spectra taken by us using the APO (∼1200 stars), photometry from the SDSS (∼500 stars), our own photometry program on the WIYN 0.9m (160 nights, ∼100 stars), as well as high-resolution (∼6 km^{-1}) spectra for 125 stars taken with Keck/HIRES and the VLT/UVES. These distances reveal that the lower-velocity clouds ($|v|$<90 km s^{-1}) tend to be located up ∼1-5 kpc above the Galactic disk, while higher-velocity clouds range in distance from 3 to 25 kpc (some of these results were shown in Wakker *et al.* (2007, 2008). The three most massive HVCs for which we determined a distance are about 7 kpc above the plane. Fig. 1 shows an image of the Milky Way, with the locations of the HVCs with known distances overlaid.

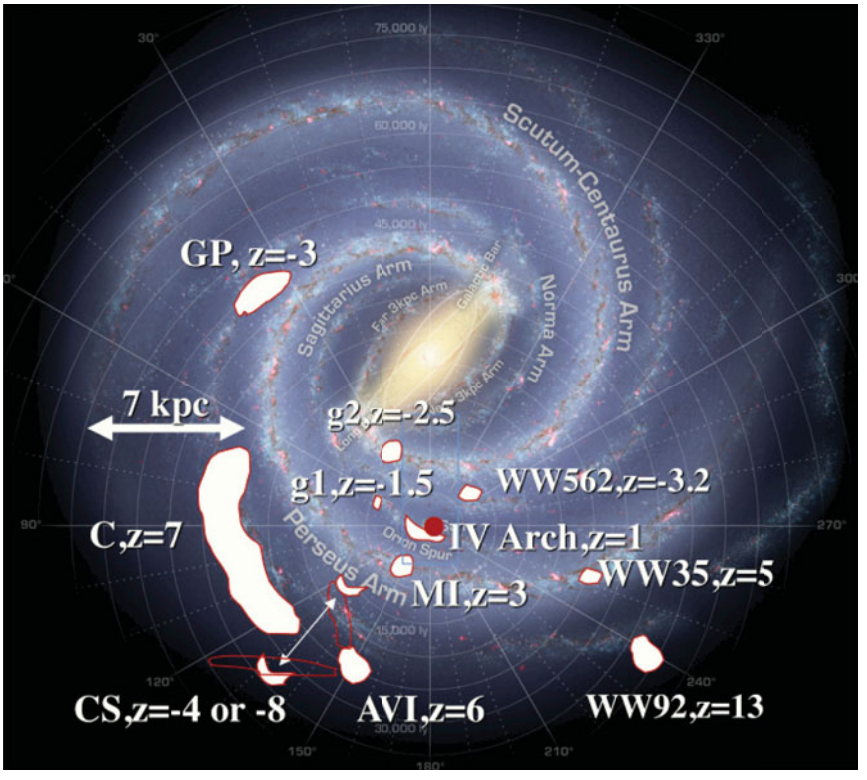

Figure 1. Artist impression image of the Milky Way, with the locations of the HVCs with known distances overlaid

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