DISTANCE AND METALLICITY OF HVCS

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Table 1 summarizes results of programs to determine distances and metallicities of high-velocity clouds (HVCs, see Wakker 1991, IAU Symp 144, 27 for a general review). Reliable absorption is reported for one stellar probe (BD+38 2182), giving a distance $D<5$ kpc for complex M. Other results are controversial (BT Dra), uncertain(HD 135485) or atypical (4 Lac). Non-detections reported by e.g. Lilienthal et al. (1990, A&A 240, 287), Danly et al. (1992, ApJS 81, 125) and de Boer et al. (1994, A&A 286, 925), yield lower limits up to 2 kpc for complexes A, C and M. Absorption by heavy elements in HVCs is reported for twelve extra-galactic probes. All absorptions reported in HVCs with $|v_{\rm LSR}|>90$ km/s are given in the table (abundances are from low-resolution H I data and thus uncertain).

With the UES on the WHT at La Palma we observed PG 1351+640. This QSO ($V=14.5$) lies projected between HVCs C III B and C III C. Absorption in the Ca H- and K-lines is detected at the HVC's H I velocity of $v_{LSR}\sim-150$ km/s. Data on elements other than Ca will be necessary to measure the actual heavy element content. Also, high-resolution H I data are required to reduce the uncertainties.

Mg II $\lambda\lambda$2796 and 2803 Å spectra were taken with the GHRS on HST for two probes of complex A. Absorption was not found in PG 0859+596 (BHB star; $B=15.9$; distance $\sim$5.5 kpc), nor in PG 0906+597 (sdB star; $B=15.2$; distance $\sim$2.5 kpc). This tentatively suggests that complex A is more distant than 5.5 kpc. This result awaits confirmation by: 1) a HST Mg II spectrum

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(still pending) of the Seyfert Mark 106; 2) high-resolution H I data; 3) a good determination of the stellar distances using intermediate-resolution spectroscopy.

TABLE 1. Detections of absorption lines in HVCs

Probe	type	HVC	Ref	v_{HVC}	$N_{H\,I}$	ion	N_{ion}	A[a]	Note
Mark 106	Sey	complex A	1	−157	$4.0{\cdot}10^{19}$	Ca^+	$6.7{\cdot}10^{11}$	0.007	
I Zw 18	dIrr	complex A	2	−165	$2.1{\cdot}10^{19}$	O	$2.9{\cdot}10^{15}$	0.16	
			2	−165	$2.1{\cdot}10^{19}$	Si^+	$6.6{\cdot}10^{13}$	0.07	
PG 1351+640	QSO	complex C	3	−154	$1.9{\cdot}10^{19}$	Ca^+	$5.7{\cdot}10^{11}$	0.014	1
PG 1259+592	QSO	complex C	4	−127	$6.2{\cdot}10^{19}$	Mg^+	—	—	2
Mark 205	Sey	complex C	5	−214	$1.9{\cdot}10^{19}$	Mg^+	$1.5{\cdot}10^{12}$	0.002	3
				−152	$1.4{\cdot}10^{18}$	Mg^+	$2.5{\cdot}10^{12}$	0.05	3
3C 351	QSO	complex C	4	−180	$9.0{\cdot}10^{18}$	Mg^+	—	—	2
BT Dra	RR Lyr	complex C	6	−136	$3.1{\cdot}10^{18}$	Ca^+	$6.0{\cdot}10^{11}$	0.09	4
			7	−133	$3.1{\cdot}10^{18}$	Na	$<1.5{\cdot}10^{10}$	<0.002	4
BD+38 2182	B3	complex M	8	−90	$3.5{\cdot}10^{18}$	Si^+	$>2.0{\cdot}10^{13}$	>0.16	5
PG 0043+039	QSO	Mag. Str.	4	−348	$1.9{\cdot}10^{18}$	Mg^+	$>9{\cdot}10^{12}$	>0.12	2
PKS 2251+11	QSO	Mag. Str.	4	−374	$4.8{\cdot}10^{18}$	Mg^+	$>1.1{\cdot}10^{13}$	>0.059	2
3C 454.3	QSO	Mag. Str.	4	−397	$1.2{\cdot}10^{18}$	Mg^+	$>1.5{\cdot}10^{13}$	>0.32	2
Fairall 9	QSO	Mag. Str.	9	+195	$2.0{\cdot}10^{20}$	Ca^+	$2.0{\cdot}10^{12}$	0.004	
HD 135485	B5 II	complex L	10	−98	$1.0{\cdot}10^{18}$	Ca^+	$1.5{\cdot}10^{11}$	0.07	6
4 Lac	B9Ia	100−7+100	11	+104	$3.0{\cdot}10^{18}$	Mg^+	$3.2{\cdot}10^{14}$	∼3	7
PKS 0837+12	QSO	242+17+106	12	+105	$1.4{\cdot}10^{19}$	Ca^+	$2.2{\cdot}10^{12}$	0.07	
NGC 3783	Sey	287+22+240	13	+240	$1.2{\cdot}10^{20}$	Ca^+	$5.5{\cdot}10^{11}$	0.002	
			14	+240	$1.2{\cdot}10^{20}$	S^+	$3.4{\cdot}10^{14}$	0.15	
			14	+240	$1.2{\cdot}10^{20}$	Si^+	$>2.6{\cdot}10^{13}$	>0.006	

[a] Abundance relative to solar abundance

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NOTES: 1. Preliminary value for N_{Ca}; 2. No column densities because of low velocity resolution (220 km/s); 3. Corrected values for N_{ion}; A recent WSRT map indicates N_{HI} may be $<2{\cdot}10^{18}$; 4. Disputed detections, probably spurious; 5. From line wings; detections of O and C^+ also reported; stellar distance 5 kpc; 6. Distance to star 2.4 kpc; may be circumstellar; 7. Results also given for Fe^+, Mg, O and Al^+; HVC not in the Dwingeloo survey, diameter $<<1°$; distance to star 1.2 kpc.