Hɪ absorption towards nearby compact radio sources

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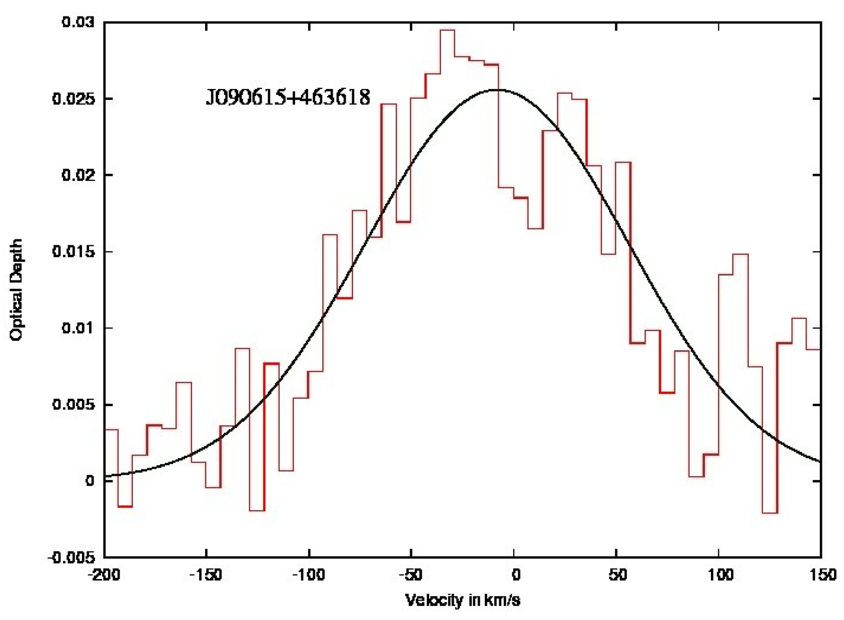
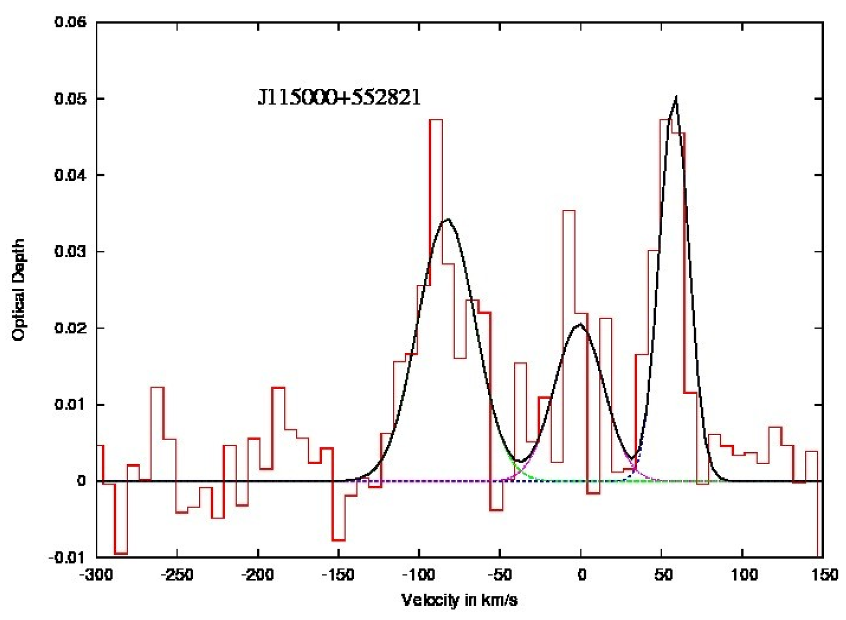
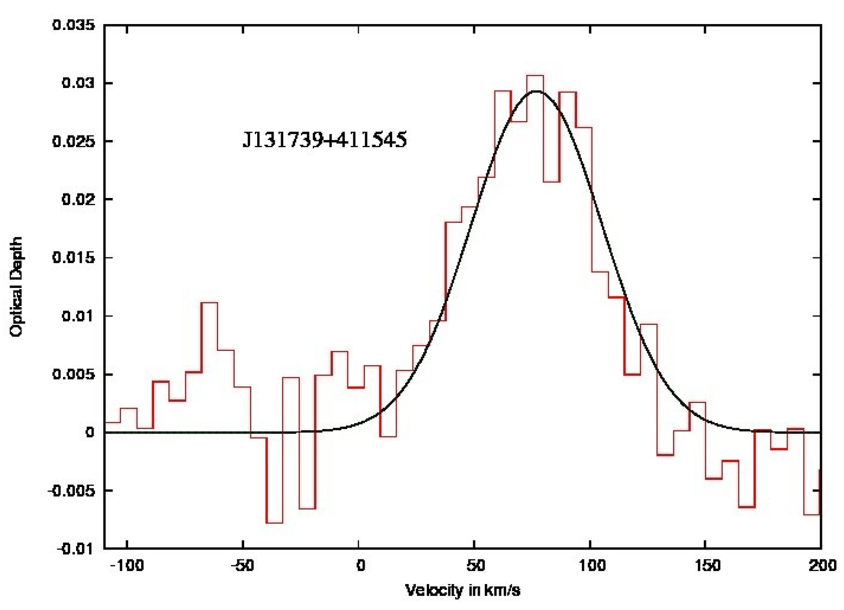
INTRODUCTION

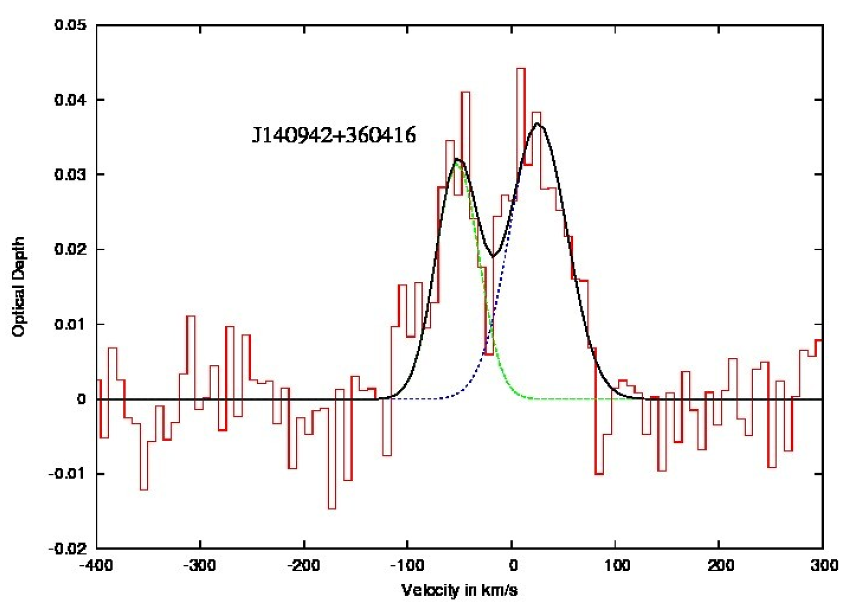
An understanding of the distribution and kinematics of Hɪ gas over a large range of red-shifts and /or luminosities of radio sources can provide valuable information on evolution of its (Hɪ gas) properties with source size (age), radio luminosity and cosmic epoch. We present the results of Hɪ absorption measurements towards a sample of nearby Compact Steep Spectrum(CSS) and Giga-Hertz Peaked Spectrum (GPS) radio sources, the CORALZ sample, using the Giant Metrewave Radio Telescope (GMRT). We observed a sample of 18 sources and find 7 new detections. These sources are of lower luminosity than earlier studies of CSS and GPS objects and we investigate any dependence of Hɪ absorption features on linear size, radio luminosity and red-shift.

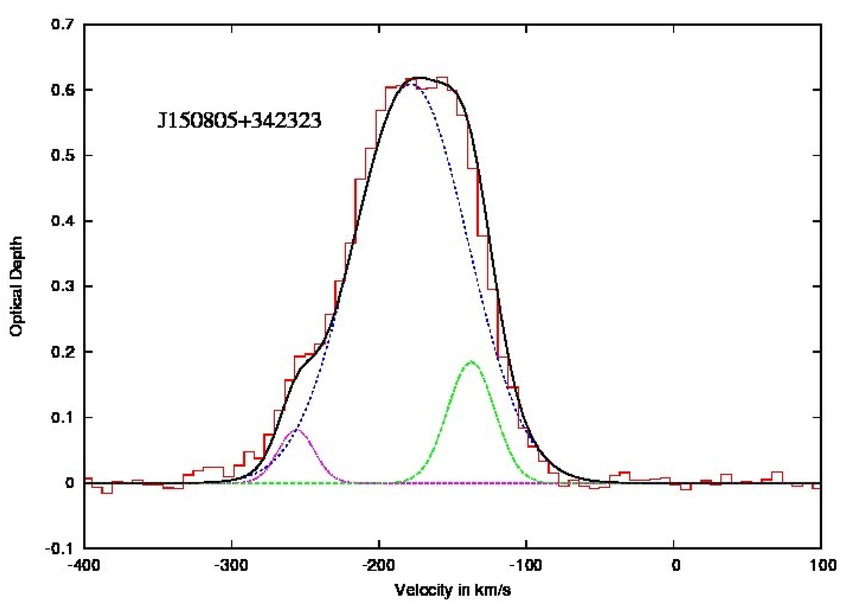
RESULTS (DETECTIONS)

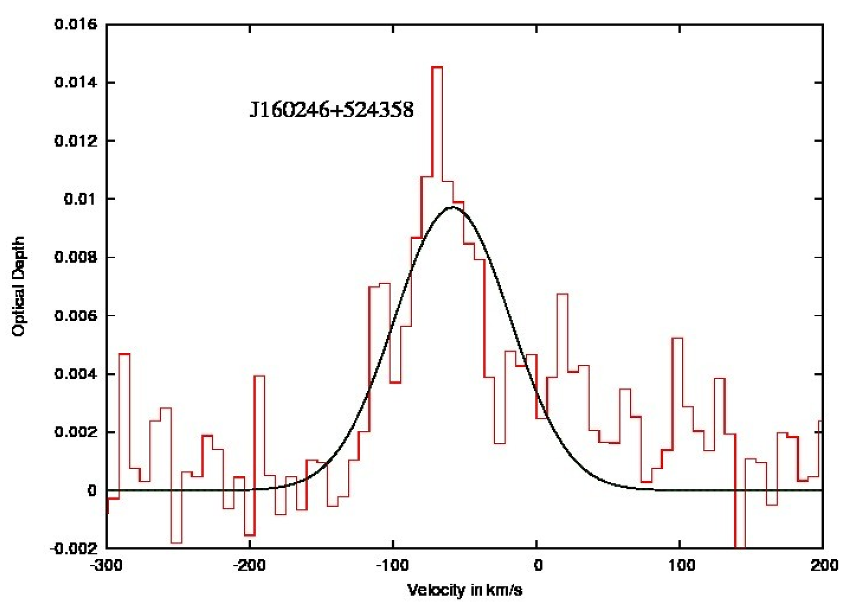


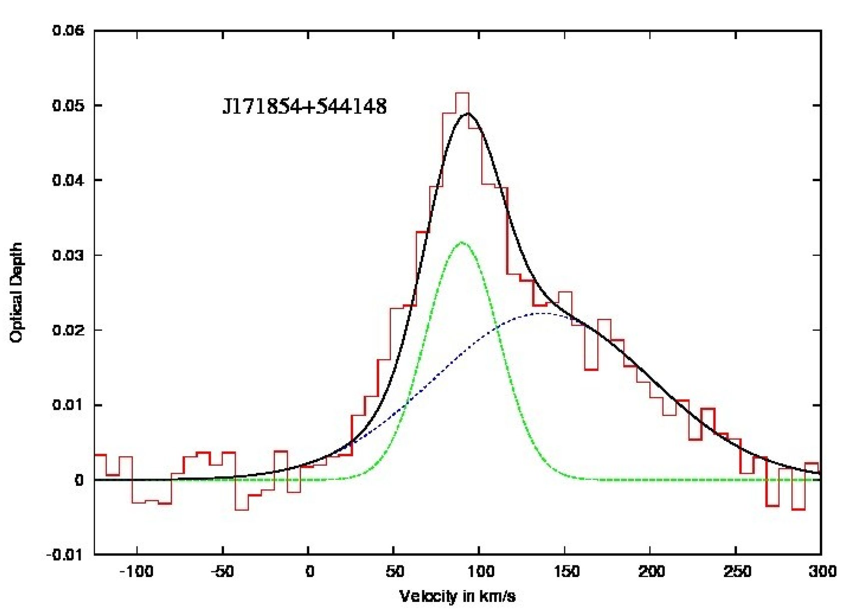












We have 7 new cases of Hɪ in absorption. Of these seven, three are GPS and four are CSS sources. The rate of detection is higher in GPS (~50%) sources than in CSS (~36%) sources. Spectral resolution in the spectrum is ~7 km s^{-1} and the typical channel rms is ~ 1.3 mJy.

Above plots show the optical depth of the Hɪ absorbers vs velocity in km s^{-1} relative to the systemic velocity.

CHARACTERISTICS OF THE SOURCES

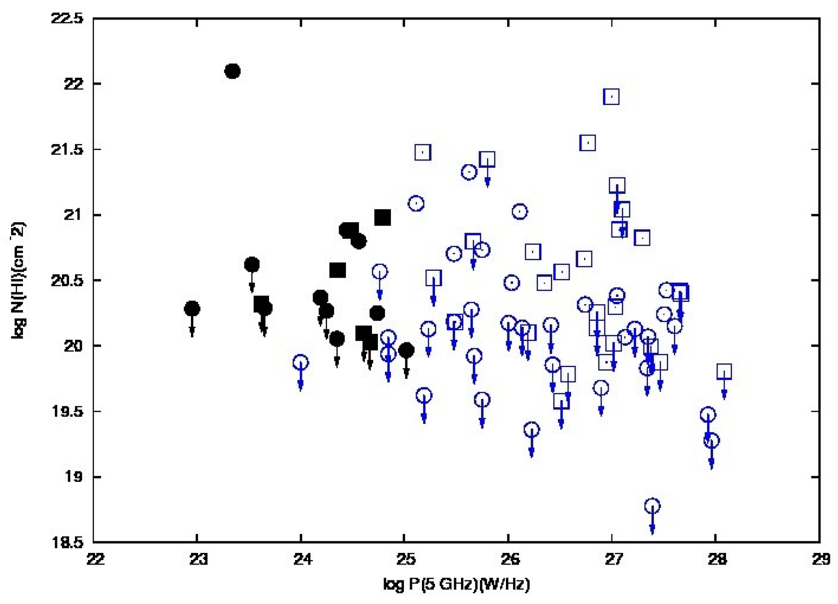
Source name	Opt. ID	z	Refs.	$S_{1.4GHz}$ mJy	L_{5GHz} 10^{25} W/Hz	θ	LS (pc)	Spectral Class	N (H ɪ) 10^{20} cm $^{-2}$
J073328+560541	G	0.1040	1	348	0.467	80	151	GPS	<1.076
J073934+495438	G	0.0540	1, 2	107	0.042	<2	<2.1	GPS	<2.097
J083139+460800	G	0.1311	3	131	0.408	9	20.7	GPS	<1.256
J083637+440109	G	0.0554	3	139	0.045	1600	1699	CSS	<1.945
J090615+463618	G	0.0848	1, 3	314	0.302	31	48.9	GPS	7.482
J102618+454618	G	0.1517	3	105	0.347	17	44.7	CFS	<3.617
J103719+433515	G	0.0247	3, 4	129	0.009	19	8.7	CSS	<1.932
J115000+552821	G	0.1385	3	143	0.363	41	93.9	CSS	6.31
J120902+411559	G	0.0950	2	147	0.178	20	34.8	CSS	<1.854
J131739+411545	G	0.0662	1, 3	249	0.229	4	5	GPS	3.785
J140051+521606	G	0.1180	3	174	0.224	<150	<316	CSS	<1.139
J140942+360416	G	0.1484	3	143	0.276	27	69.2	CSS	7.667
J143521+505122	G	0.0997	3	141	0.155	<150	<271	CSS	<2.339
J150805+342323	G	0.0456	5	130	0.022	170	148	CSS	125.183
J160246+524358	G	0.1057	3	576	0.549	180	345	CSS	1.781
J161148+404020	G	0.1520	2	553	1.048	1300	3400	CSS	<0.929
J170330+454047	G	0.0604	6	119	0.034	<7.3	<8.4	CSS	<4.165
J171854+544148	G	0.1470	1, 7	329	0.617	68	172.9	GPS	9.541

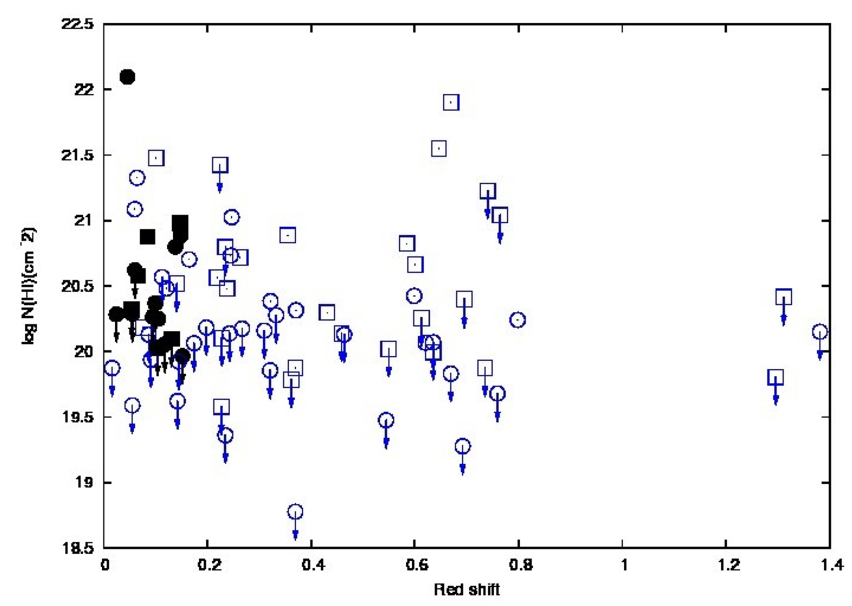
The redshifts, z , are from NED with the original references being listed in Column 4, while the flux densities are from the FIRST survey. The luminosities from Snellen et al. (2004) have been re-estimated in the cosmology (H_0 = 71 km s^{-1} Mpc^{-1}, Ω_m= 0.27, Ω_Λ= 0.73) used here. The largest angular sizes θ are from de Vries et al. (2009) except for J073328+560541 (Bondi et al. 2001) and J170330+454047 (Gu & Chen 2010). LS denotes the corresponding linear sizes.

References for redshifts: 1 Labiano et al. (2007); 2 Snellen et al. (2004); 3 SDSS (Adelman-McCarthy et al. 2008 and references therein); 4 Falco et al. (1999); 5 Mazzarella et al. (1993); 6 de Grijp et al. (1992); 7 Kim & Sanders (1998)

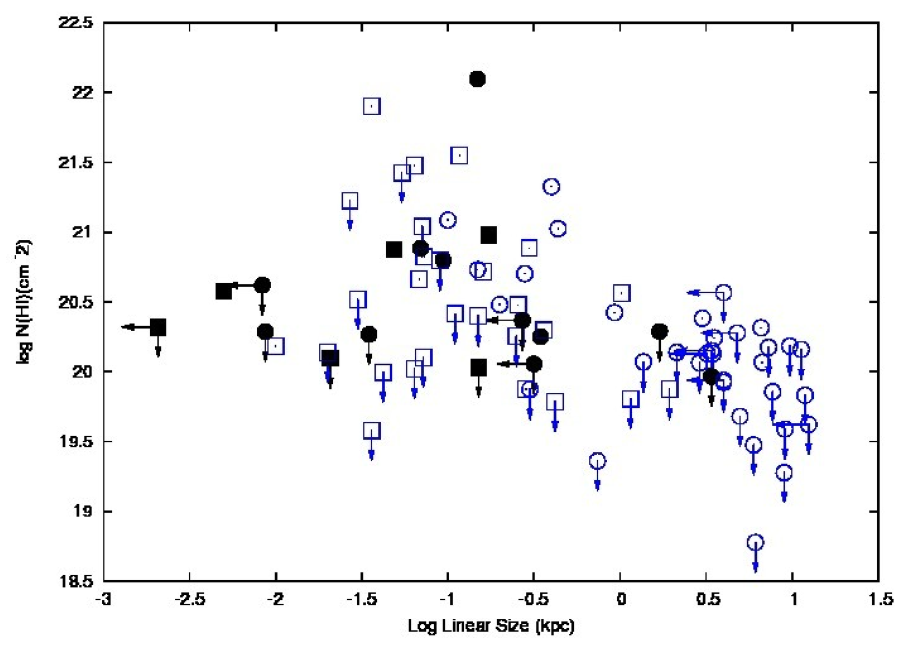
Table from Chandola, Sirothia and Saikia, 2011, arXiv:1108.2242

COMPARISON WITH EARLIER RESULTS



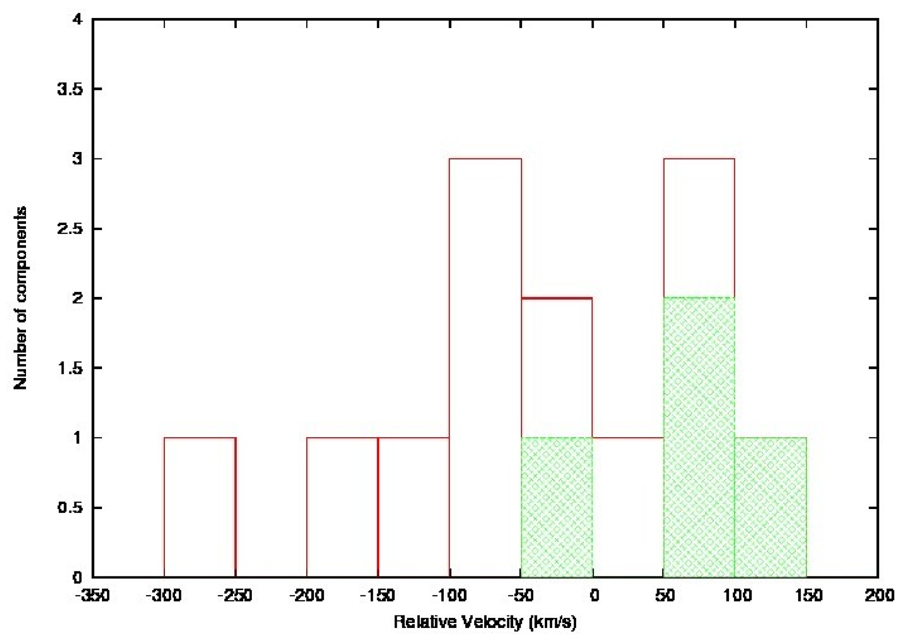


Above two plots show Hɪ column density vs. log radio power at 5GHz and redshift. There appears to be no evidence of any dependence of Hɪ column density on either luminosity or redshift.



The weaker CSS and GPS objects are also consistent with the known inverse relation of Hɪ column density with projected linear size as shown in the plot on the left.

In the above plots, the colors and symbols denote the following: blue for Gupta et al. 2006 and references therein; black for sources observed by us; circles for CSS and squares for GPS



The histogram on the left shows the distribution of the velocity of the different Hɪ absorbing components relative to the systemic velocities of the host galaxies. The GPS sources are shown shaded.

The relative velocity of the blue-shifted absorption features, which may be due to jet cloud interactions, extend to only ~ 250 kms^{-1} for these CORALZ sources compared with values of over ~1000 kms^{-1} for the more luminous CSS and GPS objects. This could be due to weaker jets in these low-luminosity objects, although this needs confirmation from a larger sample of objects.

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