The LAB-survey: database for galactic HI emission

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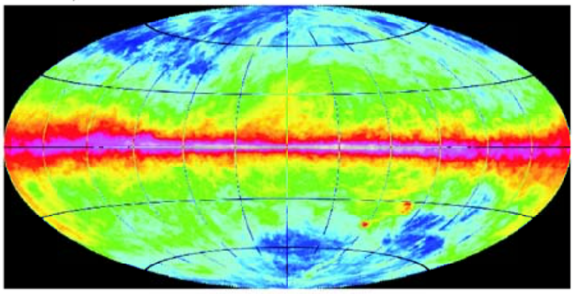
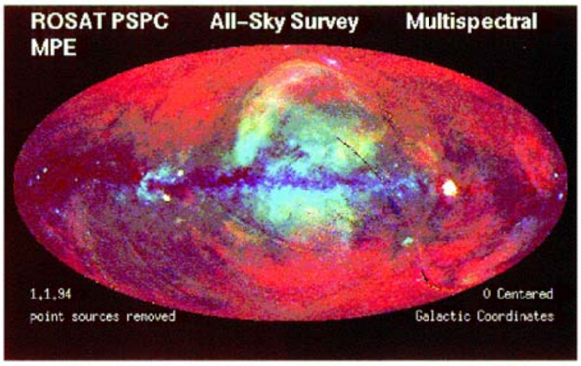
LAB survey, total column



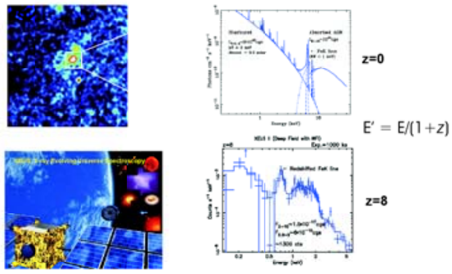


Abstract:

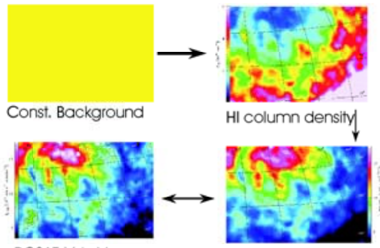
Observing the early universe means studying soft X-ray radiation ($E' = E/(1+z)$). At energies below 1 keV photoelectric absorption by the galactic interstellar medium, also towards high galactic latitudes, becomes an important quantity $\sigma \propto E^{-3}$. Today, the most sensitive X-ray observations are focussed towards the Lockman window or the Chandra deep--field south. With *XEUS* we do not like to be restricted to these windows but like to explore the whole sky (overcome cosmic conspiracy). Accordingly, we need high fidelity information on the amount of X-ray attenuating matter distributed along the line of sight. The most important X-ray absorber is the Milky Way gas.

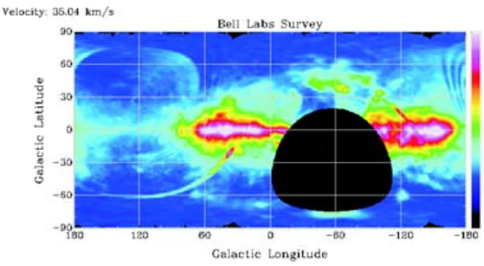
We present here an easy accessible internet tool for the determination of the amount of neutral atomic hydrogen column density in any direction of the sky. The major advantage over the popular Dickey &Lockman (1990) database is the much improved angular resolution (0.5°) and the tremendously improved accuracy. For example, instrumental artifacts could be reduced by one order of magnitude, down to a level of less than 1%.

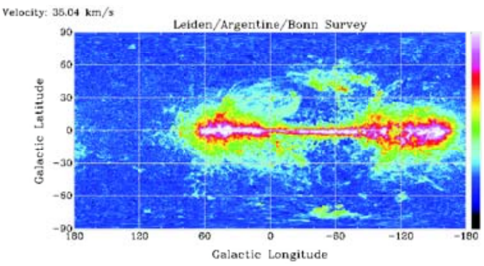
High redshift universe



Soft X-ray radiation transfer







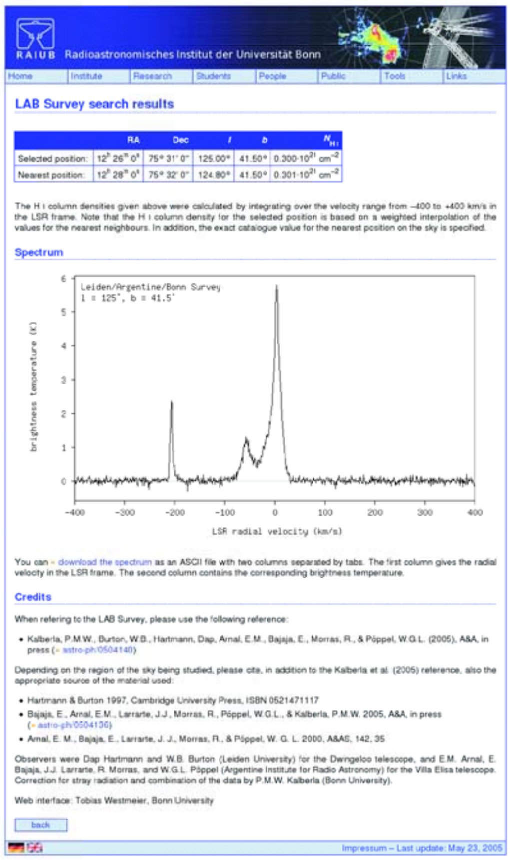
HI column densities: not easy to determine!

Radio telescopes have typically a main beam efficiency of 70%. This means that the measure HI column density is a product of the convolution of the sky with the antenna diagram. On average 30% of the received signal stems from the side-lobes (error-beam).Observations are affected in two ways: side-lobes around the mainbeam cause a blurring of the image and side-lobes far away from the beam can cause rather unexpected time variable artifacts, called stray radiation. For 21 cm line observations the stray radiation is a particulary nasty problem. The reason is the strong extended emission of the Galactic plane, observable at any time and entering side-lobes far away from the main beam. Large solid angles are affected and as aresult weak lines at high galactic latitudes are seriously affected. 50% of the total observed emission or even more can be spurious. In principle there are two ways to get rid with stray radiation. The first possibility is to increase the telescope main beam efficiency as far as possible. This can be reached with an unblocked aperture. However, in practice still some of the side-lobes are pointing to the sky. Stray radiation may amount to 0.1 - 0.25 K in case of the Green Bank Telescope (GBT) and to 0.2 - 0.4 K in case of the Bell Labs Telescope, corresponding to efficiencies between 4 and 8%. The second alternative is to use multi-purpose telescopes but remove stray radiation by means of software. This is a standard procedure for the Effelsberg 100 m telescope (Kalberla, Mebold & Reich 1980).For the LAB survey this method was adopted to the 25 m Dwingeloo telescope and the 30 m telescope in Villa Elisa. Such a correction leaves residual uncertainties of 1%, corresponding to a telescope with a main beam efficiency of 99%. These data have been used as references for the GBT.

The LAB survey

The LAB survey (Kalberla et al. 2005) contains the final data release of observations of 21-cm emission from Galactic neutral hydrogen over the entire sky, merging the Leiden/Dwingeloo Survey (LDS: Hartmann & Burton 1997) of the sky north of -30° with the nstituto Argentino de Radioastronomía Survey (IAR: Arnal et al.2000 and Bajaja et al. 2005) of the sky south of -25°. The angular resolution of the combined material is HPBW ~ 0.6°. The LSR velocity coverage spans the interval -450 km/s to +400 km/s, at a resolution of 1.3 km/s. The data were corrected for stray radiation at the Institute for radio astronomy of the University of Bonn, refining the original correction applied to the LDS. The rms brightness-temperature noise of the merged database is 0.07 - 0.09K. Residual errors in the profile wings due to defects in the correction for stray radiation are for most of the data below a level of 20 - 40 mK. The merged and refined material entering the LAB Survey of

The internet tool: http://www.astro.uni-bonn.de/~webrai



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LAB Survey search results

	RA	Dec	l	b	N_{HI}
Selected position:	$12^h 26^m 0^s$	75° 31' 0"	125.00°	41.50°	$0.300 \cdot 10^{21}$ cm^{-2}
Nearest position:	$12^h 28^m 0^s$	75° 32' 0"	124.80°	41.50°	$0.301 \cdot 10^{21}$ cm^{-2}

The H I column densities given above were calculated by integrating over the velocity range from −400 to +400 km/s in the LSR frame. Note that the H I column density for the selected position is based on a weighted interpolation of the values for the nearest neighbours. In addition, the exact catalogue value for the nearest position on the sky is specified.

Spectrum

You can » download the spectrum as an ASCII file with two columns separated by tabs. The first column gives the radial velocity in the LSR frame. The second column contains the corresponding brightness temperature.

Credits

When refering to the LAB Survey, please use the following reference:

- Kalberla, P.M.W., Burton, W.B., Hartmann, Dap, Arnal, E.M., Bajaja, E., Morras, R., & Pöppel, W.G.L. (2005), A&A, in press (» astro-ph/0504140)

Depending on the region of the sky being studied, please cite, in addition to the Kalberla et al. (2005) reference, also the appropriate source of the material used:

- Hartmann & Burton 1997, Cambridge University Press, ISBN 0521471117
- Bajaja, E., Arnal, E.M., Larrarte, J.J., Morras, R., Pöppel, W.G.L., & Kalberla, P.M.W. 2005, A&A, in press (» astro-ph/0504136)
- Arnal, E. M., Bajaja, E., Larrarte, J. J., Morras, R., & Pöppel, W. G. L. 2000, A&AS, 142, 35

Observers were Dap Hartmann and W.B. Burton (Leiden University) for the Dwingeloo telescope, and E.M. Arnal, E. Bajaja, J.J. Larrarte, R. Morras, and W.G.L. Pöppel (Argentine Institute for Radio Astronomy) for the Villa Elisa telescope. Correction for stray radiation and combination of the data by P.M.W. Kalberla (Bonn University).

Web interface: Tobias Westmeier, Bonn University

back

Impressum – Last update: May 23, 2005