The Effelsberg–Bonn HI Survey (EBHIS)

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The new L-band 7-feed-array at the 100-m telescope in Effelsberg will be used to perform an unbiased fully sampled HI survey of the entire northern hemisphere observing the galactic and extragalactic sky using simultaneously two different backends. The integration time per position will be 10 min towards the SDSS area and 2 min for the remaining sky, thereby achieving a sensitivity competitive with the Arecibo ALFALFA and GALFA surveys but covering a much larger area of the sky.

Both backends are FPGA-based digital fast fourier transform (DFFT) spectrometers, offering a superior dynamic range and temporal resolution. The latter is crucial for a sophisticated RFI mitigation scheme (Winkel et al. 2007) but produces huge amounts of data over the projected five years of observing. Consequently, we put considerable effort into efficient data reduction. Table 1 compares the survey parameters with several recent HI surveys.

The data processing is organized making use of individual data reduction modules. Each module calculates correction factors/spectra that are stored in a database. A special merger module is used to apply all corrections to the data before the griddler produces a final data cube. The advantage of this approach is the flexibility to modify individual modules without having to recompute all corrections.

Most of the reduction modules are ready-for-use. Winkel et al. (2007) describe a very sensitive RFI detection scheme, utilizing the high temporal resolution spectra from the DFFT spectrometers. The stray-radiation correction is performed using the method of Kalberla et al. (2005). Their approach enables stray radiation correction even within the regime of the high-velocity clouds. We also implemented and improved (see Winkel & Kerp 2007) the recently proposed least-squares frequency switching (LSFS) method of Heiles (2007). Using more than two different intermediate frequency settings, one is able to calculate the baseline even for faintest HI emission with unprecedented quality. Finally, we developed a graphical user interface (GUI) optimized for the search and parametrization of galaxies in the HI data cubes. We imple-
Table 1. Parameters of several recent HI surveys in compared to EBHIS.

| Survey      | Telescope Type | Status    | Area (sq.deg.) | Beam size $z_{\text{max}}$ (arcmin) | Beam size $\Delta v$ (km/s) |
|-------------|----------------|-----------|----------------|-------------------------------------|-----------------------------|
| LAB         | Dwing/Arg      | Completed | 41 300         | 36                                  | 1.3                         |
| HIPASS      | Parkes         | Completed | 29 300         | 14.1                                | 0.05 18                     |
| GASS        | g              | Ongoing   | 20 600         | 0.8                                 |
| ALFALFA     | Arecibo        | Ongoing   | 7 100          | 3.4                                 | 0.06 11                     |
| GALFA       | g              | Ongoing   |                |                                     |
| EBHISe      | Effelsberg     | Planned   | 20 600 (8 500) | 9                                   | 0.07 7                      |
| EBHISg      | g              | Planned   |                |                                     |

Survey RMS noise $N_{\text{HI}}$ limit Mass limit Velocities Integr. time per beam (s)

| Survey   | RMS noise (mJy/Beam) | $N_{\text{HI}}$ limit $(10^{18} \text{cm}^{-2})$ | Mass limit $(10^{7} \text{M}_\odot)$ | Velocities (km/s) | Integr. time per beam (s) |
|----------|----------------------|---------------------------------|---------------------------------|-----------------|----------------------------|
| LAB      | 620                  | 3.3                             | –                               | 450...400       |                           |
| HIPASS   | 13                   | 8.7                             | –1280...12 700                 | 450             |                           |
| GASS     | 95                   | 2.6                             | –400...450                     | 90              |                           |
| ALFALFA  | 1.6                  | 0.8                             | –2000...18 000                 | 28              |                           |
| GALFA    | 13.2                 | 3.2                             | –700...700                     | 18              |                           |
| EBHISe   | 4.5 (2")             | 1.9 (0.8")                      | –2000...18 000                 | 120(600")      |                           |
| EBHISg   | 12 (5.5")            | 0.9 (0.4")                      | –500...500                     |                 |                           |

*Towards the SDSS area EBHIS has higher sensitivity.*

EBHIS will be extremely valuable for a broad range of research topics: study of the low-mass end of the HI mass function (HIMF) in the local volume, environmental and evolutionary effects (as seen in the HIMF), the search for galaxies near low-redshift Lyman-alpha absorbers, and analysis of multiphase and extraplanar gas, HI shells, and ultra-compact high-velocity-clouds (Brüns & Westmeier 2004).

References

1. P. Boyce: GammaFinder: a Java Application to Find Galaxies in Astronomical Spectral Line Datacubes. MA Thesis, Cardiff University, Cardiff (2003)
2. C. Brüns and T. Westmeier: A&A 426, L9 (2004)
3. C. Heiles: to appear in PASP (2007)
4. P.M.W. Kalberla, W.B. Burton, D. Hartmann et al: A&A. 440, 775 (2005)
5. B. Winkel, J. Kerp, and S. Stanko: Astronomische Nachrichten 328, 68 (2007)
6. B. Winkel and J. Kerp: to appear in ApJ (2007)