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Results from the Dwingeloo Obscured Galaxies Survey

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Abstract. Approximately 25% of the extragalactic sky is obscured by dust in our own Milky Way galaxy. Diligent optical and infrared surveys are successful at detecting galaxies through moderate Galactic dust extinction, but in the most heavily obscured regions near the Galactic plane, only radio surveys are effective.

The Dwingeloo Obscured Galaxies Survey (DOGS) is a 21-cm blind survey out to 4000 km s^{-1} in the northern "Zone of Avoidance" (ZOA). The DOGS project is designed to reveal hidden dynamically important nearby galaxies and to help "fill in the blanks" in the local large scale structure.

1. Introduction

To begin filling in the gaps in our knowledge of the distribution of nearby galaxies, a full survey of the northern ZOA is in progress utilizing the 25 m radiotelescope of the Netherlands Foundation for Research in Astronomy, in Dwingeloo. We report here on the initial results and the implications for our knowledge of the local large scale structure.

Some of the early survey results are reported by Henning et al. (1998, paper I) which also gives a detailed scientific justification and a more thorough discussion of the survey strategy and goals.

2. Telescope and Survey Background

The 25 m Dwingeloo telescope operating at 21 cm has a half-power-beamwidth (HPBW) of 0°.6 which may be thought of as the survey resolution. A DAS-1000

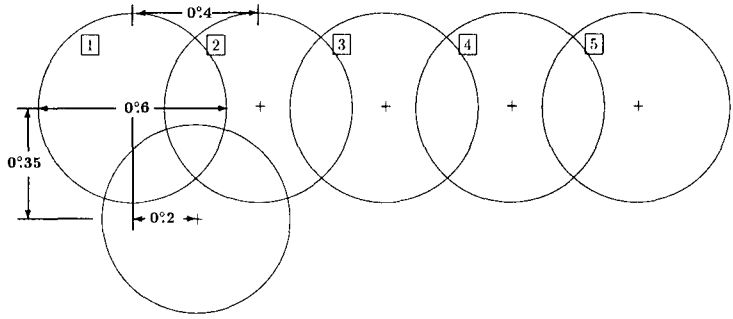

Figure 1. Distribution of survey grid points. Galactic longitude spacing is $\Delta\ell = 0°.4$ while the successive rows of constant Galactic latitude are separated by $\Delta b = 0°.35$. Each grid point is marked with a + surrounded by a circle indicating the HPBW of 0°.6.

channel autocorrelator spectrometer is utilized in the telescope backend; the rms noise per channel is typically σ_{ch}=40 mJy for a 1 hr integration.

The completed survey will incorporate 15,000 partially overlapping pointings covering a spatial range of $30° \leq \ell \leq 220°$; $|b| \leq 5°.25$. A 20 MHz bandwidth is used, covering a velocity range of $0 \leq V_{LSR} \leq 4000$ km s^{-1}, resulting in a velocity resolution of 4 km s^{-1}. Under this arrangement, the narrowest linewidth galaxies are covered by several channels.

Each DOGS observation consists of a sequence of 5 contiguous pointings at constant Galactic latitude (figure 1). Five On-Off pairs created from the sequence ensure that a real galaxy will appear twice, once as a positive signal, and again as a negative one, referenced against two independent scans. Overlapping the constant latitude grids to form a honeycombed coverage of the sky allows for detection of galaxies in adjacent pointings and facilitates a more accurate determination of their positions.

3. Results

With approximately 60% of the survey complete, 36 galaxies have been detected, 23 of which were previously unknown (no NASA/IPAC Extragalactic Database (NED) counterpart). The number of galaxies registered so far is in agreement with calculations based on survey sensitivity and an HI mass function (Zwaan et al. 1997) which predict 50 to 100 detections in the survey range. Currently, we expect the completion of this survey by the summer of 1999.

Five of the 36 sources were originally identified by the shallow survey (5 min integration per pointing, cf. paper I) including Dwingeloo 1, a member of the nearby Maffei / IC 342 group of galaxies (Kraan-Korteweg et al. 1994). Two other Maffei group galaxies were detected (Maffei 2 and MB 1, *cf.* McCall & Buta 1995) and two possible members await confirmation observations.

The most significant nearby, previously unknown galaxy identified by DOGS was Dwingeloo 1. Given the 80% coverage of the survey region by the shallow

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survey, chances are low that a massive nearby spiral was missed, since nearby galaxies appear in many adjacent pointings.

In addition to the Maffei / IC 342 detections, 11 galaxies were discovered in the Supergalactic plane crossing region; 6 of these sources are noted in NED. Known structures appear continuous across the Galactic plane ($\ell \sim 140°$ in figure 2).

The most interesting sources uncovered by DOGS are located near NGC 6946 (ℓ=95°.72, b=11°.67). Dw095.0+1.0, originally recorded as a high velocity HI cloud (Wakker, 1990), is probably a nearby dwarf galaxy. Two additional $\sim 10^7$ $M_\odot$ sources, one of which was previously known, were also found in the vicinity. All have recessional velocities $V_{LSR} \leq 250$ km s^{-1}. If these dwarf galaxies signify a new nearby galaxy group, this group would lie some 40° off the Supergalactic plane, considerably more than any other known group in the local universe.

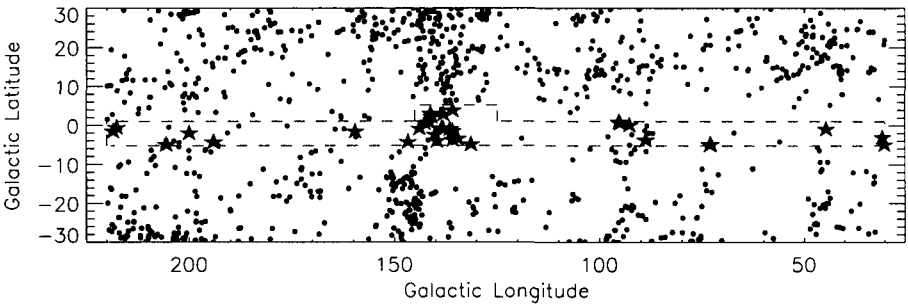

Figure 2. Spatial distribution of DOGS sources (indicated by ⋆). combined with LEDA galaxies out to $V_{LSR} \leq 4000$ km s^{-1} (•). The survey coverage to date is shown by the dashed line.

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