Title: The Herschel-ATLAS Data Release 1 - II. Multi-wavelength counterparts to submillimetre sources

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Abstract

This paper is the second in a pair of papers presenting data release 1 (DR1) of the Herschel Astrophysical Terahertz Large Area Survey (H-ATLAS), the largest single open-time key project carried out with the Herschel Space Observatory. The H-ATLAS is a wide-area imaging survey carried out in five photometric bands at 100, 160, 250, 350 and 500 μm covering a total area of 600 deg^2. In this paper, we describe the identification of optical counterparts to submillimetre sources in DR1, comprising an area of 161 deg^2 over three equatorial fields of roughly 12 × 4.5 deg centred at 9^h, 12^h and 14{^h.}5, respectively. Of all the H-ATLAS fields, the equatorial regions benefit from the greatest overlap with current multi-wavelength surveys spanning ultraviolet (UV) to mid-infrared regimes, as well as extensive spectroscopic coverage. We use a likelihood ratio technique to identify Sloan Digital Sky Survey counterparts at $r < 22.4$ for 250-μm-selected sources detected at ≥4σ (≈28 mJy). We find `reliable' counterparts (reliability $R \geq 0.8$) for 44 835 sources (39 per cent), with an estimated completeness of 73.0 per cent and contamination rate of 4.7 per cent. Using redshifts and multi-wavelength photometry from GAMA and other public catalogues, we show that H-ATLAS-selected galaxies at $z < 0.5$ span a wide range of optical colours, total infrared (IR) luminosities and IR/UV ratios, with no strong disposition towards mid-IR-classified active galactic nuclei in comparison with optical selection. The data described herein, together with all maps and catalogues described in the companion paper, are available from the H-ATLAS website at www.h-atlas.org.