The FIR/SMM Luminosity Function and the Obscured Star Formation History of the Universe : Results from the HerMES Survey and Prospects for Euclid/SKA Studies

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Abstract

The evolution with cosmic time of the star formation rate, black hole mass and stellar mass functions has recently been advancing rapidly thanks to deep multi-band UV/Optical/NIR surveys on one side and MIR/FIR/SMM surveys on the other. The former allow us to probe unobscured star formation rates and stellar masses, whereas the latter provide us with star formation rate estimates relatively immune to dust absorption.

The Herschel Multi-tiered Extragalactic Survey (HerMES), in particular, has charted the obscured star formation and its evolution in galaxies throughout cosmic history. HerMES mapped the sky using two instruments, Herschel-SPIRE (at 250, 350 and 500 micron) and Herschel-PACS (at 100 and 160 micron), in a nested set of fields closely coordinated with the PACS Evolutionary Probe (PEP) survey, thus bringing unprecedented depth and breadth to galaxy evolution studies. Individual fields range in size from 0.01 to 250 deg^2 and total 350 deg^2.

HerMES fields are some of the best studied sky areas, making maximum use of ancillary surveys from radio to X-ray wavelengths, allowing us to measure the total infrared emission of tens of thousands of galaxies, study the evolution of their luminosity function, measure their clustering properties, and probe galaxy populations below the confusion limit through lensing and statistical techniques.

After a brief introduction to the goals of the survey, I will discuss the evolutionary properties of Herschel sources, focusing on the evolution of the far-infrared/sub-millimetre luminosity functions of sources detected in SPIRE channels and on their contribution to the bolometric luminosity density and thus to the star formation rate density at 0¡z¡5.

Albeit limited by source confusion, SPIRE is more effective at detecting high-redshift sources than PACS, and HerMES fields enjoy substantially better multi-wavelength data than available in other SPIRE wide-area survey fields, thus offering the best chance as yet to carry out a complete census of obscured star formation at 2.5¡z¡5

I will then detail how these results compare with current galaxy formation models and interpret our estimates for the infrared comoving emissivity in terms of the contributions of Star Formation and AGN gravitational accretion. I will finally go on to describe how the combination of Euclid, SKA pathfinders and eventually SKA surveys will allow to pursue these studies in unprecedented detail thanks to their sensitivity and very wide area coverage.