Properties of compact 250 μm emission in M 33 (HERM33ES)

S. Verley[1], M. Relaño[2], C. Kramer[3], E. M. Xilouris[4], M. Boquien[5], D. Calzetti[5], F. Combes[6], C. Buchbender[3], J. Braine[7], G. Quintana-Lacaci[3], F. S. Tabatabaei[8], S. Lord[9], F. Israel[10], G. Stacey[11], P. van der Werf[10].

[1]UGR Granada, [2]IoA, [3]IRAM, [4]Athens, [5]UMASS, [6]LERMA, [7]Obs. Bordeaux, [8]MPIfR, [9]CalTech, [10]Leiden, [11]Cornell.

Abstract

Within the framework of the HERM33ES Key Project (Kramer et al. 2010), using the high resolution and sensitivity of the Herschel photometric data, we study the compact emission in the Local Group spiral galaxy M 33. We present a catalogue of 159 compact emission sources in M 33 identified by SExtractor in the 250 μm SPIRE band which is the one that provides the best spatial resolution. We also measure fluxes at 24 μm and Hα for those 159 extracted sources. We find a very strong Pearson correlation coefficient with the MIPS 24 μm emission (r_{24} = 0.94) and a rather strong correlation with the Hα emission, although with more scatter ($r_{H\alpha}$ = 0.83). Due to the very strong link between the 250 μm compact emission and the 24 μm and Hα emissions, by recovering the star formation rate from standard recipes for HII regions, we are able to provide star formation rate calibrations based on the 250 μm compact emission alone.

A catalogue of 159 compact emission sources in the Herschel SPIRE 250 μm band

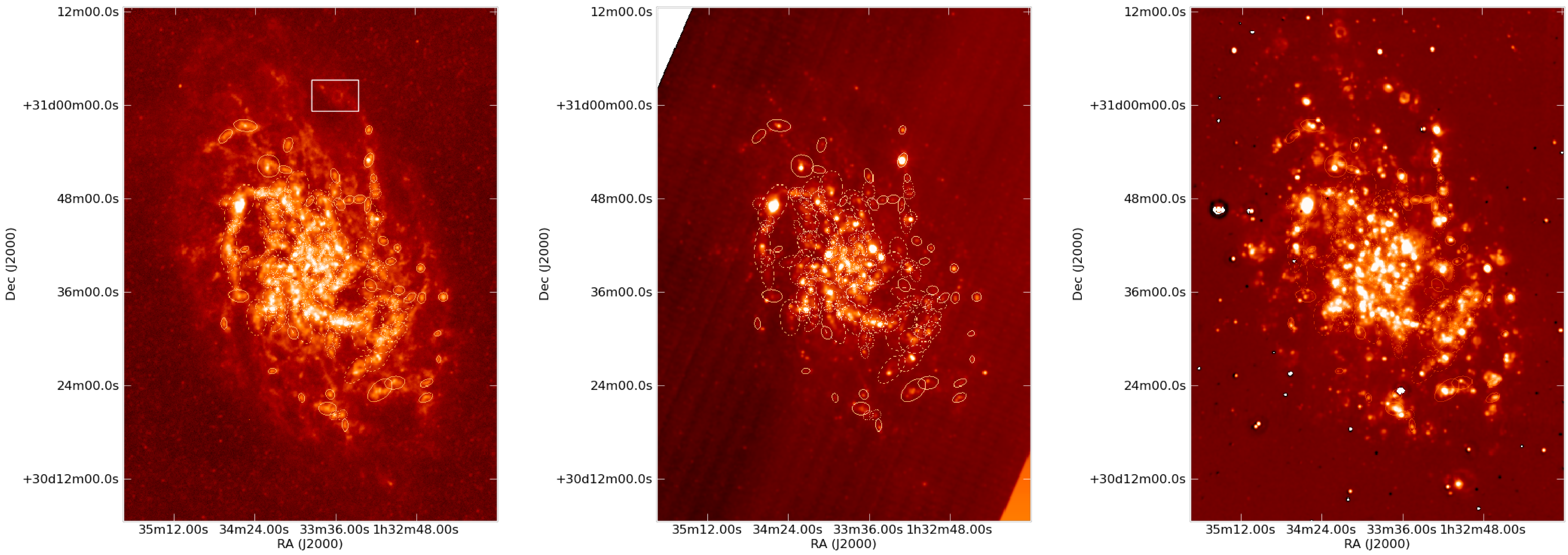

Figure: Herschel SPIRE 250 μm (left), *Spitzer* 24 μm (centre), and Hα continuum subtracted (right) images of M 33. The catalogue of extracted sources is overplotted.

In order to create a catalogue of compact emission sources in the SPIRE 250 μm band, we use the SExtractor software (Bertin & Arnouts 1996). The photometry of the 159 extracted sources is computed using the parameter FLUX_ISO given by SExtractor, which uses isophotal photometry (sum of all the pixels above a threshold given by the lowest isophot: 16 times the background r.m.s.). Since most of the extracted objects are along the spiral pattern of the galaxy, we believe many of the sources may be directly linked to SF. This suggests that the SPIRE 250 μm compact emission could be a reliable SF tracer in the vicinity of HII regions. We concentrate our preliminary work on the 250 μm compact emission and compare its properties with standard SF tracers such as the Hα emission line and the 24 μm compact emission linked to HII regions (Calzetti et al. 2005, 2007).

SPIRE 250 μm calibration of the star formation rate for HII regions in M 33

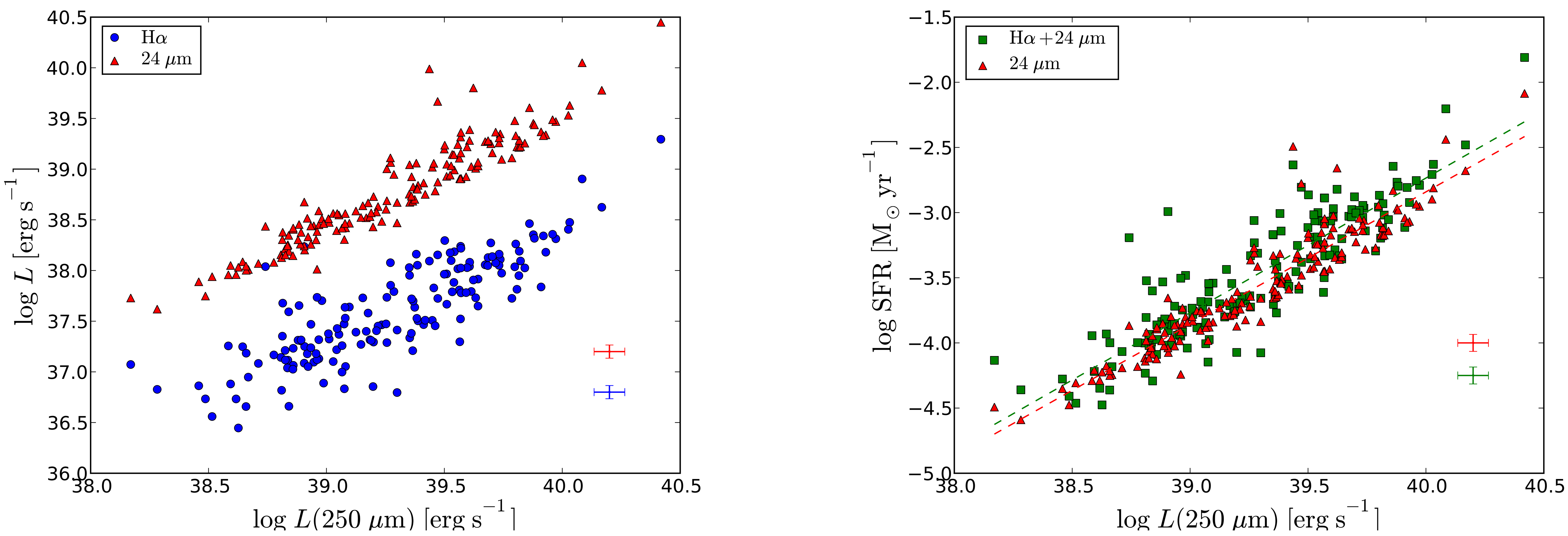

Figure: Hα and 24 μm emissions as a function of the 250 μm SPIRE emission (left). SFR from 24 μm and from Hα+24 μm emissions as a function of the 250 μm emission (right).

As the Hα and 24 μm compact emission are standard star formation rate (SFR) tracers, we can use the calibrations given by Calzetti et al. (2007, 2010) for HII regions, to obtain the SFR of these sources. To recover the Hα+24 μm SFR, our best fit leads to:

$$\mathbf{SFR\,[M_\odot\,yr^{-1}] = 8.71 \times 10^{-45} \mathit{L}(250\,\mu m)^{1.03}} \quad , \tag{1}$$

where $\mathbf{\mathit{L}(250\,\mu m)}$ is in erg s^{-1}. To recover the SFR(24), we need the following calibration:

$$\mathbf{SFR\,[M_\odot\,yr^{-1}] = 3.47 \times 10^{-44} \mathit{L}(250\,\mu m)^{1.02}} \quad , \tag{2}$$

also with $\mathbf{\mathit{L}(250\,\mu m)}$ in erg s^{-1}. The uncertainties are 0.04 and 0.03 for the exponents in Eqs. 1 and 2, respectively, while the calibration constants have uncertainties of 4.0 and 2.7%, respectively. Please, see Verley et al. (2010) for more informations.

Bertin, E. & Arnouts, S. 1996, A&AS, 117, 393
Calzetti, D. et al. 2005, ApJ, 633, 871
Calzetti, D. et al. 2007, ApJ, 666, 870
Calzetti, D. et al. 2010, ArXiv e-prints 1003.0961
Kramer, C. et al. 2010, A&A, Herschel Special Issue
Verley, S. et al. 2010, A&A, Herschel Special Issue