LABOCA mapping of the Vela C molecular cloud

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We present the first results of a large-scale map of the galactic Giant Molecular Cloud **Vela C**, in the 345-GHz continuum. The observations were carried out with the **LABOCA** bolometer array at **APEX**. We discuss the spatial distribution of dust cores in the region, their physical properties and the derived Core Mass Function.

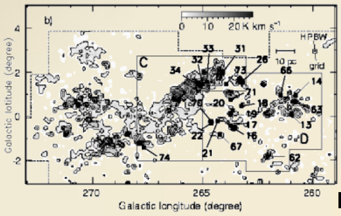
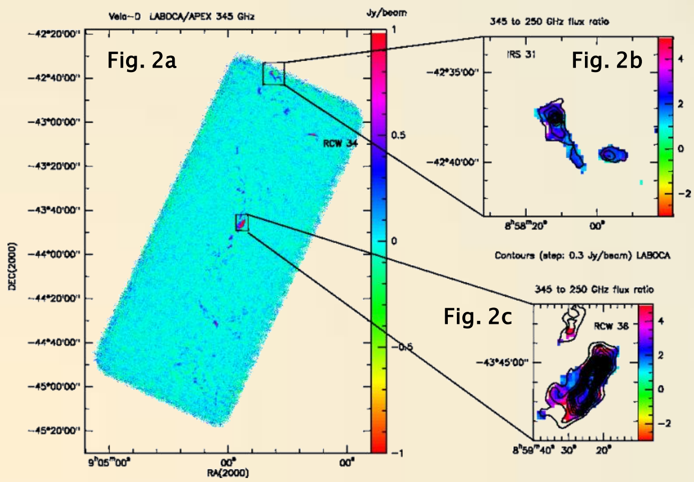


Fig. 1

The **Vela Molecular Ridge** is a Giant Molecular Cloud Complex in the Outer Galaxy (280° > l > 260°). It lies in the Galactic Plane and is composed of four main clouds called A, B, C and D (Murphy & May 1991). In particular, clouds A, C and D are located at a distance of ~ 700 pc (Liseau et al. 1992). They host active sites of intermediate-mass star formation, both in clusters and distributed (see Giannini et al. 2013, and references therein). **In Fig. 1, a large scale map of CO(1-0) emission** from NANTEN (Yamaguchi et al. 1999). The main sites of star formation in clouds C and D, are indicated following the designation of Liseau et al. (1992).

In Fig. 2a, the new map of Vela C obtained with LABOCA at APEX (345 GHz, beam 18.2 arcsec) in 2012. The pixel-to-pixel r.m.s. is ~ 0.07 Jy/beam, allowing 3σ point source detection limits of 7.5 M_{sun} (T_{dust} = 12 K) to 1.5 M_{sun} (T_{dust} = 24 K) to be obtained. A number of cores can be seen in the map, the brightest one corresponding to the HII region RCW 36. The HII region RCW 34 is also labelled, which however is further away than Vela C (~2.5 kpc; van der Valt et al. 2012). **Zooms in on RCW 36 and IRS 31**: 250 GHz maps taken with SIMBA at SEST were available for these two regions. **Figures 2b and 2c show the 345-to-250 GHz flux ratio**, overlaid with contours of the 345 GHz emission. Both maps have been resampled to the same beam (SIMBA, 24 arcsec) and pixel size. Clearly, the flux ratio is mostly >2 (~ 1 free-free, 2.6 dust thermal emission with β=1), confirming the dominant thermal nature of the emission even from RCW 36 (we estimate a free-free contamination < 20 %).

Core extraction: we used two algorithms, CLUMPFIND (Williams et al. 1994) and CuTEx (Molinari et al. 2011), to extract cores from the LABOCA map. Their mass was then determined by assuming a dust opacity at 250 GHz of 0.5 cm^2/g (Massi et al. 2007), scaled at 345 GHz using a dust emissivity index β=1, and the standard gas-to-dust ratio of 100. Based on the latest results on Vela C from HERSCHEL (Hill et al. 2011), we adopted a dust temperature of 12 K for all cores but the ones associated with RCW 36, for which we assumed 24 K. The core properties are listed in **Table 1**, below. Only a few cores are associated with 4.85 GHz radio sources in the area (namely, RCW 34 and RCW 36) from the Parkes survey (Griffith & Wright 1993). However, for RCW 36 we estimated a free-free contamination < 20 %.



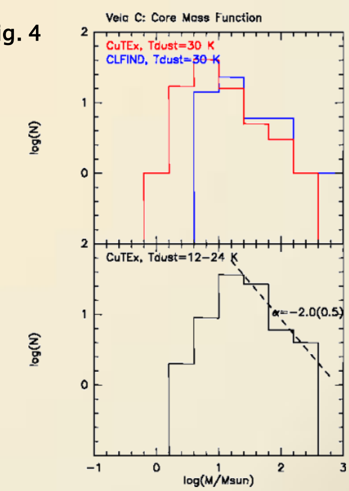


Fig. 4

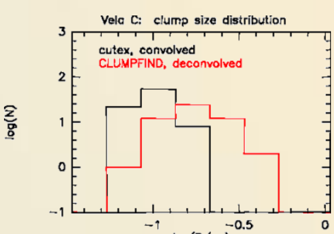
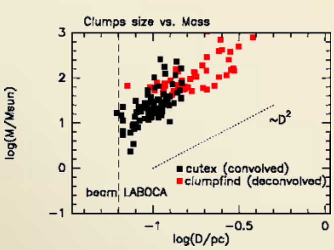


Fig. 3



In Fig. 3, the core sizes obtained with CuTEx are compared with those obtained with CLUMPFIND. The masses for CLUMPFIND cores in the lower panel are calculated for T_{dust}=24 K. Clearly, CLUMPFIND tends to find larger cores than CuTEx. **In Fig. 4, the Core Mass Function (CMF) obtained with different methods and assumptions.** Below, the CMF is shown as derived from the CuTEx output. Above, the effects of a different T_{dust} (= 30 K for all cores) assumption is shown, using both the CuTEx and the CLUMPFIND output. This plot confirms that CLUMPFIND tends to extract larger and more massive clumps (hence, less numerous), thus yields a flatter CMF.

CMF analysis: The histogram below can be fitted at the high-mass end by $dN/dM \sim M^{\alpha}$ with α=-2.0±0.5. This is consistent with Giannini et al. (2012), α=2.1±0.2 from Herschel data, and Netterfield et al. (2009), who found α=-2.55±0.20 using their BLAST observations of Vela C. Since it has become clear that fits to histograms are affected by biasses, we have used the Maximum Likelihood Estimator (following Babu & Feigelson 2006 and Clauset et al. 2009) to derive α=-2.5±0.3, in agreement with the Netterfield value. **These results can be compared with those obtained for Vela D:** α=-1.45±0.2 (Massi et al. 2007) from SIMBA data (using CLUMPFIND, hence possibly biassed as discussed above), and α=2.3±0.2 (Olmi et al. 2009) from SIMBA+BLAST data (equal to Vela C within the errors).

Morphology of Vela C: the LABOCA cores appear to be aligned in filaments. The brightest source corresponds to RCW 36 and is located at the centre of a long filament running south-east to north-west. This corresponds to the sub-regions Centre-Nest and Centre-Ridge found by Hill et al. (2011) with HERSCHEL, which depart from the hottest HERSCHEL region, i. e. RCW 36. The filament in the South-Ridge subregion of Hill et al. (2011) is also plain visible in the LABOCA map (roughly aligned in an east-west direction). In the north, coinciding with IRS 31, both LABOCA and HERSCHEL unveil a bubble-like structure .

Contrary to Vela C, **Vela D** exhibits a number of cores which appear to be located at the edge of bubble-like structures (Elia et al. 2007). This suggests that Vela C is less evolved than Vela D, which seems having already being shaped by a longer activity of star formation. However, the northern part of Vela C bears some resemblance with Vela D.

TABLE 1: Core physical properties

	CuTEx (T_{dust}=12-24 K)	CLUMPFIND (T_{dust}=24 K)
N. found :	71	51
M (M_{sun}) :	2.5-264	42-4x10^3
Size (pc) :	0.06-0.15	0.07-0.5

Note: only CLUMPFIND sizes have been deconvolved

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