# Structure formation in the Draco nebula

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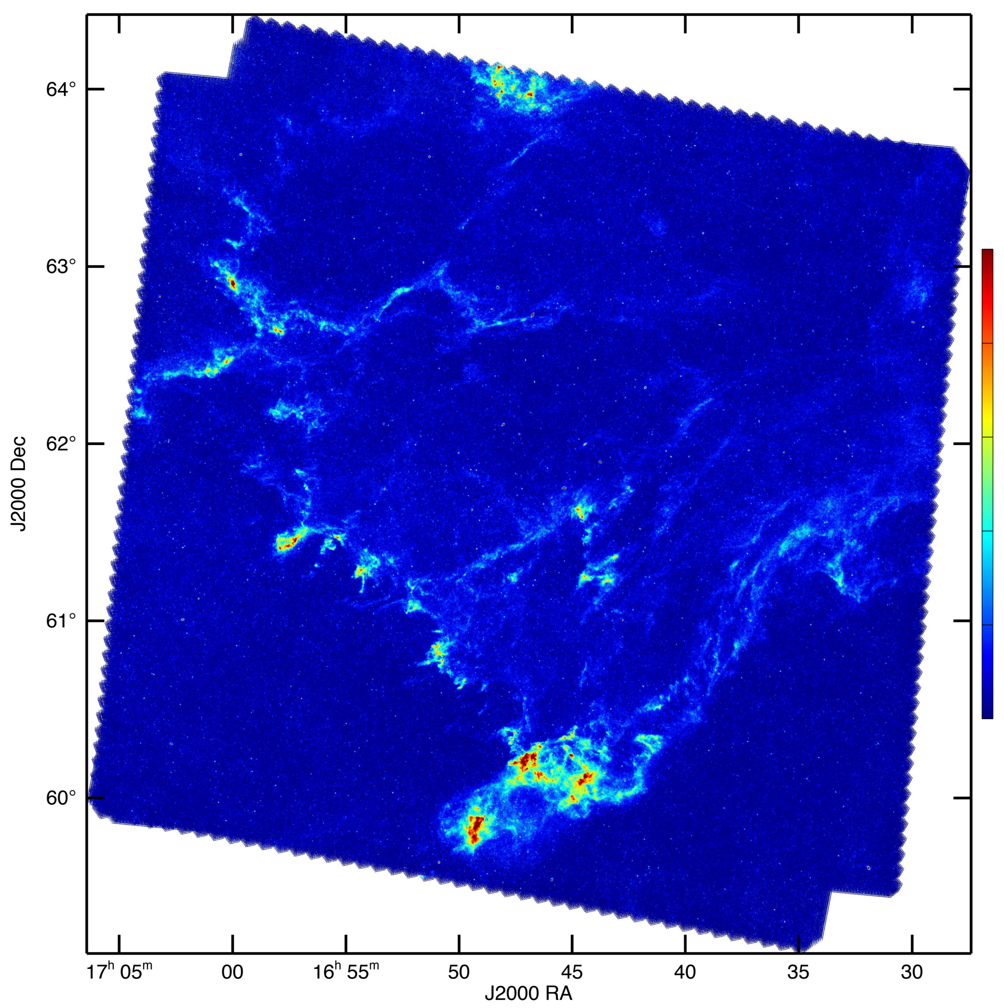
## Main issue

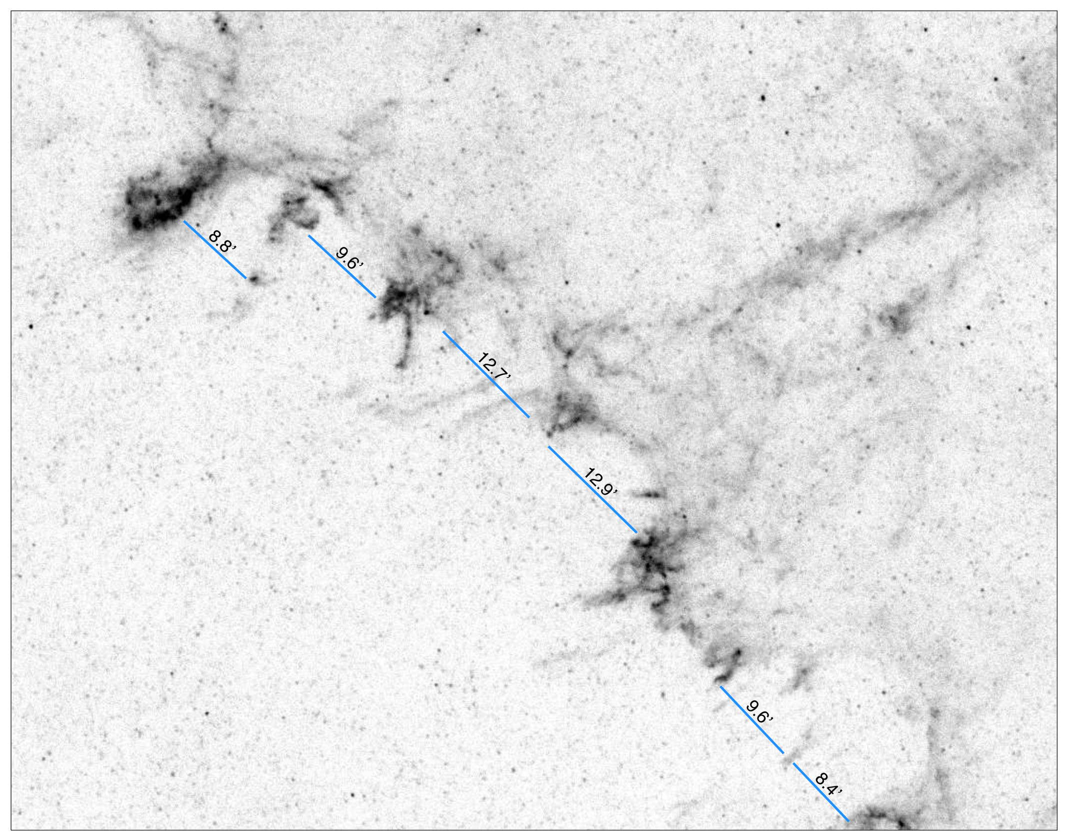
The Draco nebula is the most studied diffuse intermediate-velocity cloud (IVC) at **high Galactic latitude** (b ≈ 38°). HI data at 21cm show **three velocity components**: the IVC, the high-velocity cloud (HVC) and the local velocity cloud (LVC; solar neighbourhood) [1, 2]. Most of the gas is in molecular form and shows **strong CO emission** at the boundary [3, 4, 5]. We adopt a distance of 600 pc, meaning that Draco is located in the upper part of the diffuse Galactic disc (z = 370 pc).

## Herschel-SPIRE data



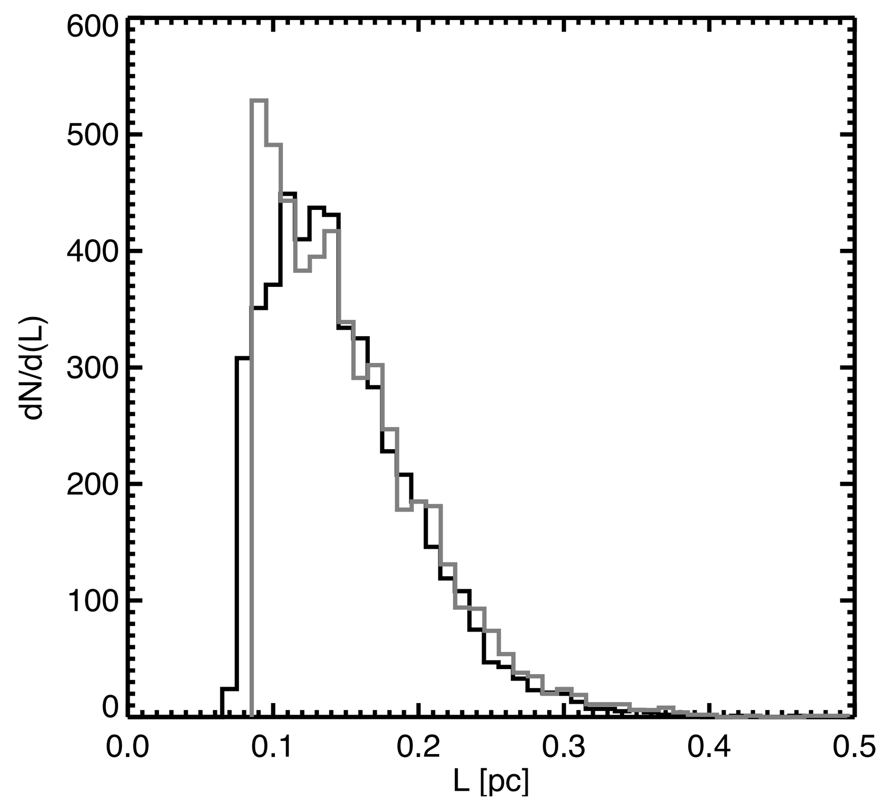

Draco was observed with *Herschel* PACS (110 and 170 $\mu$m) and SPIRE (250, 350 and 500 $\mu$m). We mostly present the 250 $\mu$m SPIRE data, with an angular resolution (17.6″).

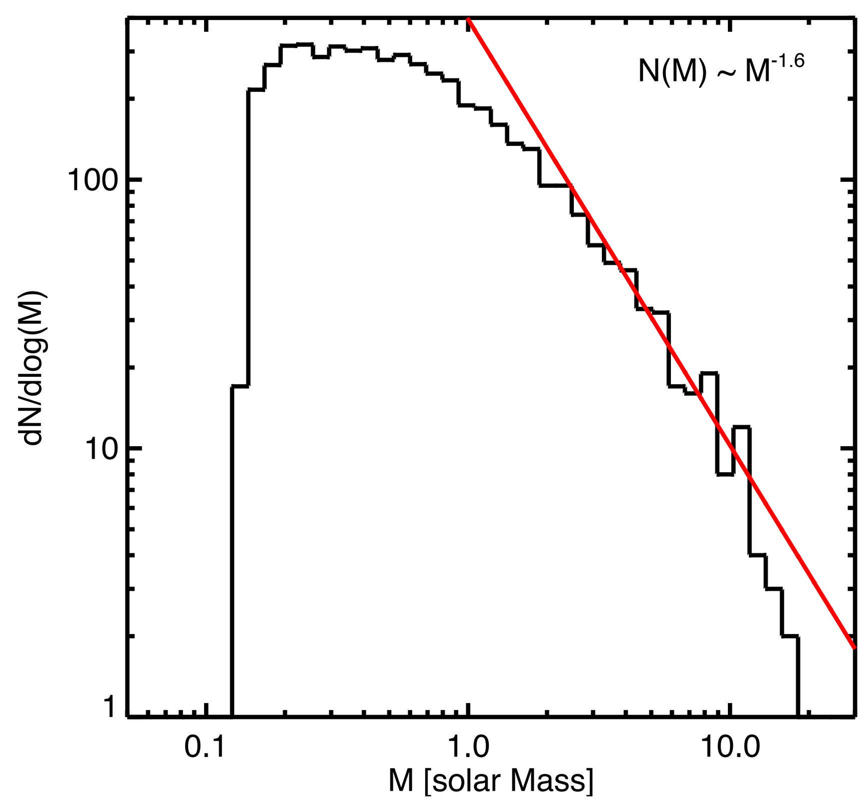
The structure of matter in Draco is revealed at physical scales down to 0.05 pc. The structure of the front that shows **periodic half shells** that are similar to structures produced by **the Rayleigh-Taylor instability** (average angular size of 10.3′ ≈ 1.8 pc). These fingers show clumpy small scales structures.

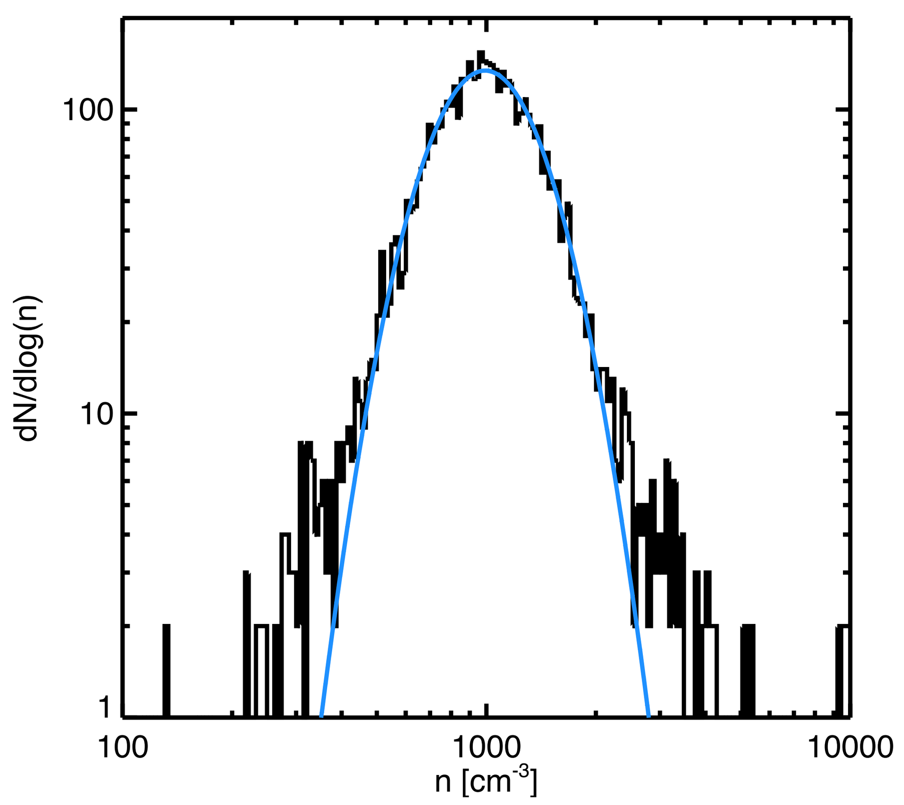


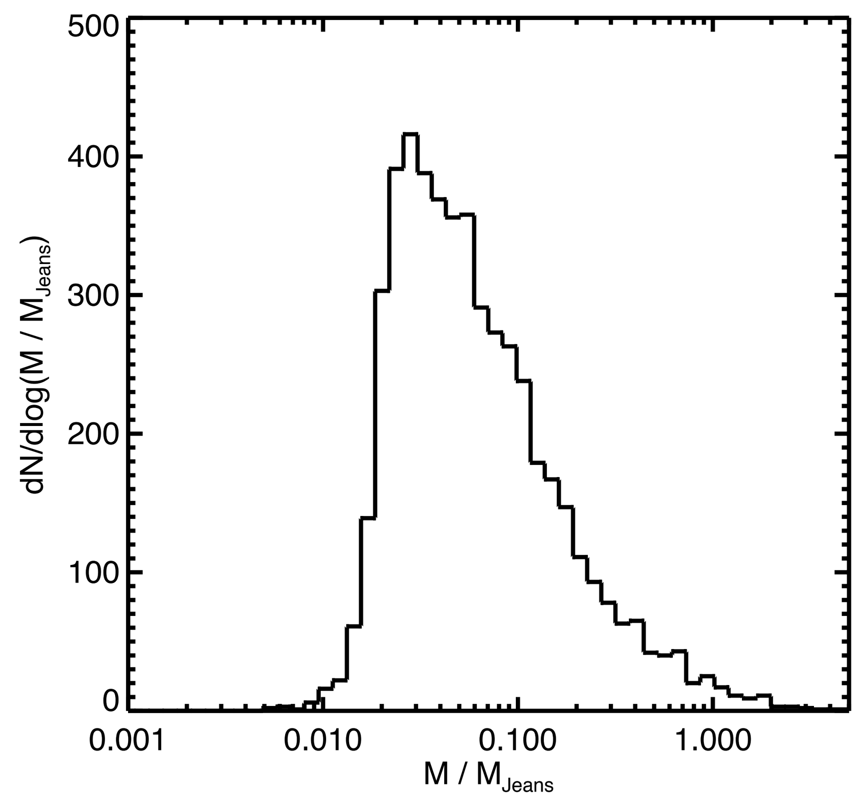
## Small scale structures

We used the *clumpfind* algorithm [6] on the 250 $\mu$m map to identify the brightest structures. To minimise the effect of noise, we apply *clumpfind* on a map smoothed by a factor of two (from 17.6″ to 35.2″).




The total mass in the structures is ~ $5.2 \times 10^3$ $M_\odot$. The PDF has a slope of the order of the clump mass function. The median density is $1.0 \times 10^3$ cm$^{-3}$, most of the structures having a density higher than the CO(1-0) critical density. The log-normal shape of the PDF is characteristic of supersonic turbulence.

Only 1% of the structures has a mass larger than the Jeans mass. Structure formation is driven by turbulence.

## Formation scenario

Draco seems to be the result of the compression of gas in the outer part of the WNM layer due to the **collision with a cloud falling from the halo** [4, 8].

The morphology of the three HI components could suggest that Draco is the result of the dynamical interaction between gas from the halo and the LVC.

Whatever the origin of the infalling cloud, it seems likely that it has **accelerated and pressurised WNM gas** at rest in the Galactic layer.

Draco shows both an atomic and molecular components. This bi-phase is due to the **thermal instability**.

## Characterise turbulence

The RT instability occurs when **two fluids are accelerated towards each other**. Bubbles of the light fluid rise into the heavy fluid forming finger structures. the RT instability typical length is given by [9]:

$$\lambda_{max} = 4\pi \left( \frac{\nu_{kin}^2 A}{a} \right)^{1/3} \quad (1)$$

We use the RT typical length, combined with velocity information from the 21cm data, to estimate parameters of interstellar turbulence:

| Quantity | Symbol | Value | Units |
|---|---|---|---|
| Largest scale | L | 30 | pc |
| Average velocity | $\bar{v}_l$ | 11.2 | km.s$^{-1}$ |
| RT length | $\lambda_{max}$ | 1.8 | pc |
| Viscosity | $\nu_{kin}$ | $4.7 \times 10^{22}$ | cm$^2$.s$^{-1}$ |
| Reynolds number | Re | 2100 | |
| Energy transfer rate | $\epsilon$ | $7.6 \times 10^{-3}$ | $L_\odot$.$M_\odot^{-1}$ |
| Dissipation scale | $l_d$ | 0.1 | pc |

## References

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