Astronomy in Focus, XXIXB, Focus Meeting 18
XXIXth IAU General Assembly, August 2015
Piero Benvenuti, ed.

doi:10.1017/S1743921316006499

Gravity, turbulence and the scaling "laws" in molecular clouds

Javier Ballesteros-Paredes

Instituto de Radioastronomía y Astrofísica, UNAM, Campus Morelia
Antigua Carretera a Pátzcuaro 8701, Morelia, Michoacán, México. 58090.
email: j.ballesteros@crya.unam.mx

Abstract. The so-called Larson (1981) scaling laws found empirically in molecular clouds have been generally interpreted as evidence that the clouds are turbulent and fractal. In the present contribution we discussed how recent observations and models of cloud formation suggest that:

(*a*) these relations are the result of strong observational biases due to the cloud definition itself: since the filling factor of the dense structures is small, by thresholding the column density the computed mean density between clouds is nearly constant, and nearly the same as the threshold (Ballesteros-Paredes *et al.* 2012).

(*b*) When accounting for column density variations, the velocity dispersion-size relation does not appears anymore. Instead, dense cores populate the upper-left corner of the $\delta v - R$ diagram (Ballesteros-Paredes *et al.* 2011a).

(*c*) Instead of a $\delta v - R$ relation, a more appropriate relation seems to be $\delta v^2/R = 2GM\Sigma$, which suggest that clouds are in collapse, rather than supported by turbulence (Ballesteros-Paredes *et al.* 2011a).

(*d*) These results, along with the shapes of the star formation histories (Hartmann, Ballesteros-Paredes & Heitsch 2012), line profiles of collapsing clouds in numerical simulations (Heitsch, Ballesteros-Paredes & Hartmann 2009), core-to-core velocity dispersions (Heitsch, Ballesteros-Paredes & Hartmann 2009), time-evolution of the column density PDFs (Ballesteros-Paredes *et al.* 2011b), etc., strongly suggest that the actual source of the non-thermal motions is gravitational collapse of the clouds, so that the turbulent, chaotic component of the motions is only a by-product of the collapse, with no significant "support" role for the clouds. This result calls into question if the scale-free nature of the motions has a turbulent, origin (Ballesteros-Paredes *et al.* 2011a; Ballesteros-Paredes *et al.* 2011b, Ballesteros-Paredes *et al.* 2012).

References

Ballesteros-Paredes, J., D'Alessio, P., & Hartmann, L. 2012, *MNRAS* 427, 2562
Ballesteros-Paredes, J., Hartmann, L. W., Vázquez-Semadeni, E., Heitsch, F., & Zamora-Avilés, M. A. 2011, *MNRAS*, 411, 65
Ballesteros-Paredes, J., Vázquez-Semadeni, E., Gazol, A., *et al.* 2011, *MNRAS*, 416, 1436
Hartmann, L., Ballesteros-Paredes, J., & Heitsch, F. 2012, *ApJ*, 420, 1457
Heitsch, F., Ballesteros-Paredes, J., & Hartmann, L. 2009, *ApJ*, 704, 1735
Larson, R. B. 1981, *MNRAS*, 194, 809