[IM09] The Virial Balance of Clumps and Cores in Molecular Clouds

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We study the instantaneous virial balance of clumps and cores (CCs) in 3D simulations of driven, MHD, isothermal molecular clouds (MCs). The models represent a range of magnetic field strengths in MCs from subcritical to non-magnetic regimes. We identify CCs at different density thresholds, and for each object, we calculate all the terms that enter the Eulerian form of the virial theorem (EVT). A CC is considered gravitationally bound when the gravitational term in the EVT is larger than the amount for the system to be virialized,. We also calculate, quantities commonly used in the observations to indicate the state of gravitational boundedness of CCs such as the Jeans number J_c, the mass-to magnetic flux ratio mu_c, and the virial parameter alpha_vir. Our results show that: a) CCs are dynamical out-of-equilibrium structures. b) The surface energies are of the same order than their volume counterparts c) CCs are either in the process of being compressed or dispersed by the velocity field. Yet, not all CCs that have a compressive net kinetic energy are gravitationally bound. d) There is no 1-to-1 correspondence between the state of gravitational boundedness of a CC as described by the virial analysis or as implied by the classical indicators.

[IM10] Gravitational Runaway and Turbulence Driving in Star-Gas Galactic Disks

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Galactic disks consist of both stars and gas. The gas is more dynamically responsive than the stars, and strongly nonlinear structures and velocities can develop in the ISM even while stellar surface density perturbations remain fractionally small. We use 2D numerical simulations to explore formation of bound clouds and turbulence generation in the gas of two-component galactic disks. The two components interact through a combined gravity. Using stellar parameters typical of mid-disk conditions, we find that models with gaseous Toomre parameter $Q_g < Q_c \sim 1.4$ experience gravitational runaway and eventually form bound condensations. This Qc value is nearly the same as previously found for razor-thin, gas-only models, indicating that the destabilizing effect of live stars is offsets the reduced self-gravity of thick disks. This result is also consistent with empirical studies showing that star formation is suppressed when $Q_g >$ 1-2. The bound gaseous clouds that form have mass 6×10^7 Msun each. Self-gravity and sheared rotation also interact to drive turbulence in the gas when $Q_g > Q_c$. This turbulence is anisotropic, with more power in sheared than compressive motions. The gaseous velocity dispersion is ~ 0.6 times the thermal speed when $Q_g \sim Q_c$. This suggests that gravity is important in driving ISM turbulence in many spiral galaxies, since the low efficiency of star formation naturally leads to a state of marginal instability.