Astronomy in Focus, XXIXB, Focus Meeting 10
XXIXth IAU General Assembly, August 2015
Piero Benvenuti, ed.

doi:10.1017/S174392131600507X

Stellar Explosions in High-surface Density Galaxies

Evan Scannapieco[1], Sharanya Sur[1,2] and Eve C. Ostriker[3]

[1]School of Earth and Space Exploration, Arizona State University, PO Box 876004, Tempe - 85287, USA
email: evan.scannapieco@asu.edu

[2]Indian Institute of Astrophysics, 2nd Block, Koramangala, Bangalore 560034, INDIA

[3]Department of Astrophysical Sciences, Princeton University, Princeton, NJ 08544, USA

Abstract. High surface density, rapidly star-forming galaxies are observed to have $\approx 50 - 100$ km s^{-1} line-of-sight velocity dispersions, which are much higher than expected from supernova driving alone, but may arise from large-scale gravitational instabilities. Using three-dimensional simulations of local regions of the interstellar medium, we explore the impact of high velocity dispersions that arise from these disk instabilities. Parametrizing disks by their surface densities and epicyclic frequencies, we conduct a series of simulations that probe a broad range of conditions. Turbulence is driven purely horizontally and on large scales, neglecting any energy input from supernovae.

We find that such motions lead to strong global outflows in the highly-compact disks that were common at high redshifts, but weak or negligible mass loss in the more diffuse disks that are prevalent today. Substantial outflows are generated if the one-dimensional horizontal velocity dispersion exceeds -35 km s^{-1}, as occurs in the dense disks that have star formation rate densities above $\approx 0.1\ M_\odot$ yr^{-1} kpc^{-2}. These outflows are triggered by a thermal runaway, arising from the inefficient cooling of hot material coupled with successive heating from turbulent driving. Thus, even in the absence of stellar feedback, a critical value of the star-formation rate density for outflow generation can arise due to a turbulent heating instability. This suggests that in strongly self-gravitating disks, outflows may be enhanced by, but need not caused by, energy input from stellar explosions.

These results are explained in more detailed in Sur, Scannapieco, & Ostriker (2015).

Keywords. galaxies : evolution - galaxies : starburst - ISM : structure

Reference

Sur, S., Scannapieco, E., & Ostriker, E. 2015, *ApJ*, submitted