

# Radial Mass Inflows in Barred-Spiral Galaxies

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Barred-spiral galaxies possess interesting structures such as outer spiral arms, dust lanes, nuclear rings, and nuclear spirals. Recent numerical experiments show that dust lanes and star-forming nuclear rings are short-lived unless gas is continuously supplied to the bar regions. Angular momentum loss by a spiral potential and associated spiral shocks can be an attractive gas-fueling mechanism to the bar regions. Using high-resolution numerical simulations, we explore the effects of spiral arms on the morphologies and radial mass inflows in barred-spiral galaxies. We use a simple galaxy model where the gaseous disk is infinitesimally-thin, isothermal, self-gravitating, and unmagnetized. We consider various spiral-arm models with differing strength and pattern speed. We find that the mass inflow is significant only when the arm has a slower pattern speed than the bar. The mass inflow results from the combined effects of three agents: torque by the spiral potential, torque by the self-gravitational potential, and angular momentum loss at the shocks. The mass inflow rates to the bar regions is estimated to be  $\sim 0.1\text{--}3 M_{\odot} \text{ yr}^{-1}$ , with larger values corresponding to stronger arms in self-gravitating models. Our results suggest that the radial mass inflows induced by spiral arms can explain ubiquity of dust lanes and long-lived star formation in nuclear rings.