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N-Body Simulations of Galaxies: Mass-Loss from Old Stellar Populations and the Mass Budget of the Central Kiloparsec

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Abstract. We give estimates of the global mass-loss rate from bulge stars and show that this supply of gas is not negligible for the mass budget of the central kiloparsec in comparison with mass inflow rate predicted by N-body simulations of barred galaxies and mergers.

Keywords. galaxies: kinematics and dynamics, galaxies: evolution, galaxies: bulges, galaxies: active, stars: mass-loss, methods: N-body simulations

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Gas-to-stars mass ratio is one of the key factors affecting dynamics of disk galaxies: gas inflow in barred potentials increases the central mass concentration, can initiate nuclear starbursts, fuel the activity of galactic nuclei and destroy bars. Jungwiert *et al.* (2001) have studied, by means of N-body simulations, effects of long-term mass-loss from disk stars. Here, we consider mass-loss from stellar populations of galactic bulges (see also Ho, 2003). These are composed predominantly of old low-mass stars. Based on our previous fits for mass-loss rate of a single stellar population (Jungwiert 1999), we present simplified formulae for low-mass stars considering two different star formation histories. For a bulge composed of a single stellar population of age t, we find:

$$\frac{dM_{bulge}}{dt} = \frac{M_{bulge}}{t[Gyr]} \quad \frac{1}{12.9 - ln\, t[Gyr]} \cdot 10^{-9}\, M_\odot/yr$$

while for a bulge with stars formed at a constant star formation rate over time t, we get:

$$\frac{dM_{bulge}}{dt} = \frac{M_{bulge}}{t[Gyr]} \quad \frac{5.3 + ln\, t[Gyr]}{13.9 - ln\, t[Gyr]} \cdot 10^{-9}\, M_\odot/yr$$

As an example, stars in a $10^{11} M_\odot$ bulge of a 10 Gyr old S0 galaxy will lose mass at a rate of $(1-7) M_\odot/yr$, a value comparable to the mass that can be brought to the central kiloparsec from the disk by the action of stellar bar torques or as a result of mergers.

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References

Ho, L.C. 2003, in: S. Collin, F. Combes & I. Shlosman (eds.), *Active Galactic Nuclei: from Central Engine to Host Galaxy*, ASP Conference Series, Vol. 290, p. 379.

Jungwiert, B. 1999, PhD thesis, University Paris 7.

Jungwiert, B., Combes, F. & Palouš, J. 2001, *A&A 376*, 85.