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BAR FORMATION IN COSMOLOGICAL HALOES

A. Curir [1], P. Mazzei[2], G. Murante[1]

We investigate the growth of bar instability in stellar disks embedded in fully cosmological halos. We choose a Λ-CDM cosmology (i.e. $\Omega_\Lambda = 0.7, \Omega_m = 0.3$, $H_0 = 70$ km/s/Mpc) with $25h^{-1}$ Mpc of box size. The halo was selected from a low-resolution run (128^3 particles), it doesn't suffer major mergers since $z = 5$ and it lives in a low-density environment. Then we re-simulate the halo at 8 times higher resolution, following the whole simulation box with a multi-mass tecnique to account for the large-scale tidal forces. The stellar disk is embedded in the halo at a redshift $z = 2$. The evolution of the system spans more than 10 Gyr down to $z = 0$.

The impact of the cosmological environment on topics directly related to the bar instability has recently raised an interesting and somewhat controversial debate about the angular momentum transfer between the star and Dark Matter (DM) component (Weinberg& Katz 2002; Valenzuela & Klypin 2002; El-Zant & Shlosman 2002), the role of the cosmological halos in triggering or suppressing the bar instability (Athanassoula 2001), the stability of the bar feature (Curir & Mazzei 1999), the heating of the stellar disk (Velasquez & White 1999; Navarro 2001), etc. We will use our full set of simulations, to deepen the preliminary results sketched below.

We aim to vary two parameters: the stellar to DM mass ratio and the redshift of disk immersion. This allows us to investigate different instability conditions for the disk and different evolutionary phases of the DM halo. To disentangle the role of the infall, of the tidal forces, and of the presence of significant substructure in the halo, strictly connected with the cosmological scenario, we also ran non-cosmological simulations of similar (in mass and resolution) disk+halo systems. Insights into this kind of "isolated" systems are provided by previous works (Curir & Mazzei 1999, Mazzei & Curir 2001).

The bar feature is evaluated using density contour plots, as shown in Figure 1. The long-lasting halo instability driven by the cosmological framework produces a well developed bar lasting from

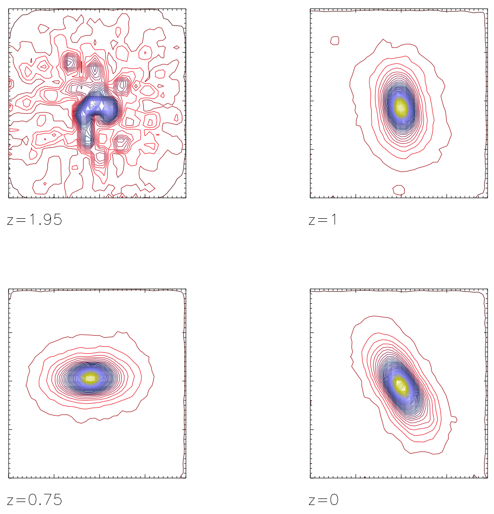

Fig. 1. Isodensity contours (60 levels, x-y projection) of the stellar component in the HM case, at different redshifts. The total density contrast is 3×10^3. The spatial range is $20 \times 20\,kpc$ and the resolution is $0.5\,kpc$

$z = 1.5$ down to $z = 0$, for our highest mass ratio (HM). In our lower mass (LM) ratio case we observe the formation of a weaker bar at $z = 1.65$, holding out to $z = 0$. The angular momentum exchange between disk and halo has been monitored during the time evolution. We estimate that 30% of specific angular momentum is lost from the disk and given to the halo component during the evolution (HM case). The pattern speed of the bar decreases, and at z=0 $\Delta\Omega/\Omega = 0.83$. This suggests that such on exchange is reflected on the slowing down of the bar. However this effect seems to have only a mild impact on the halo radial density profile which appears only slightly flatter in the central regions at low z.

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[1]INAF - Osservatorio Astronomico di Torino, strada Osservatorio 20, 10025 Pino Torinese (Torino) Italy.
[2]INAF - Osservatorio Astronomico di Padova.