EFFECTS OF BARYONIC MASS LOSS ON GALACTIC DARK MATTER HALOS.

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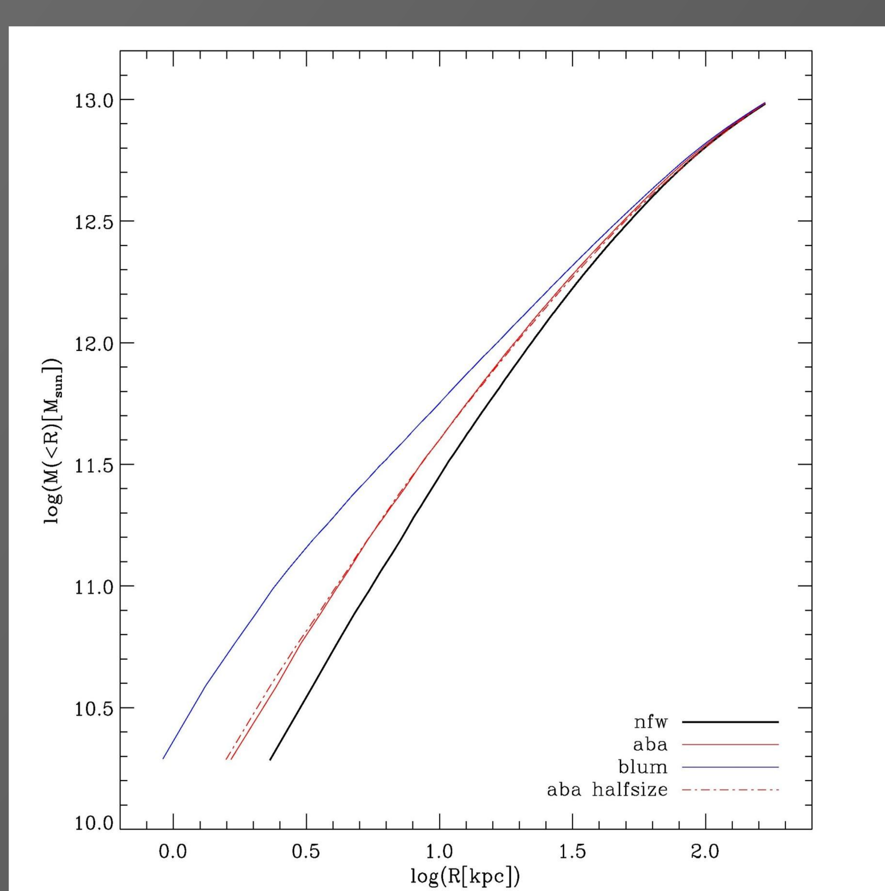
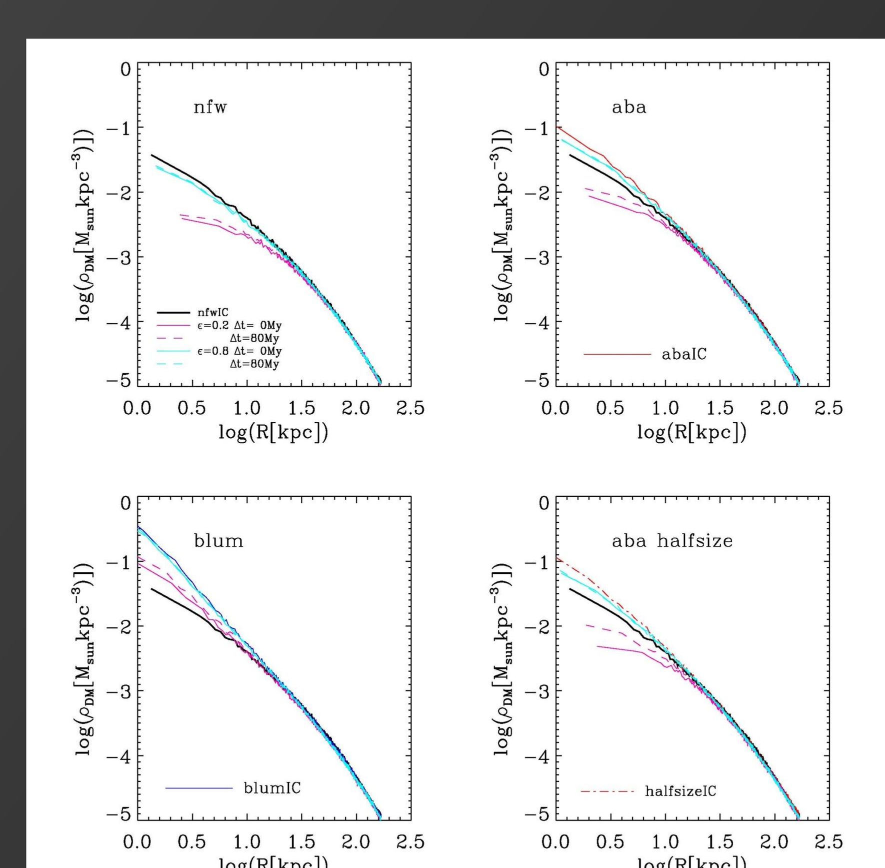
We perform controlled numerical experiments (using the code GADGET-2) to asses the effect of baryon mass loss on the inner structure of large galactic dark matter halos. This mass expulsion is intended to mimic both the supernovae and AGN feedbacks, as well as the evolution of stellar populations. In this study we are interested in particular on AGN feedback, which has been proposed to remove on a short timescale, of the order of a few dynamical times, a substantial fraction of the baryonic mass in massive forming spheroidal systems. In a previous study we have evaluated the observational consequences of this process on the galactic structure (Ragone-Figueroa & Granato 2011), while here we focus on the distribution of dark matter in the galactic region. It is shown that the inner density profile of dark matter is flattened by a sizeable amount, with little dependence on the expulsion timescale, at variance with recent claims (Ogiya & Mori 2011).

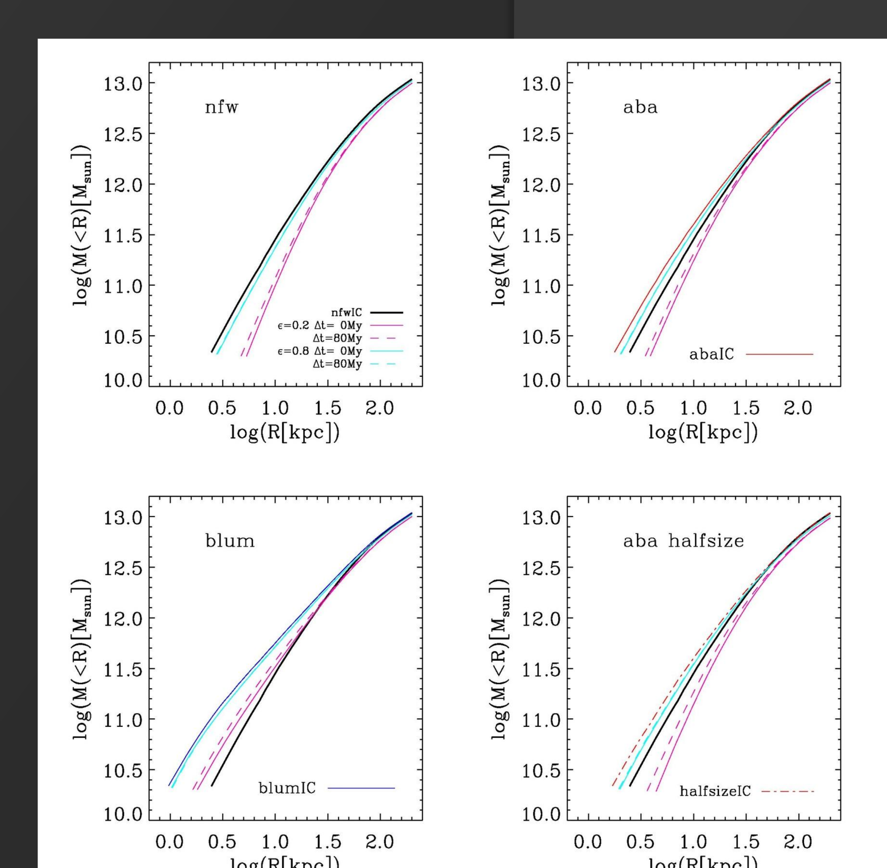


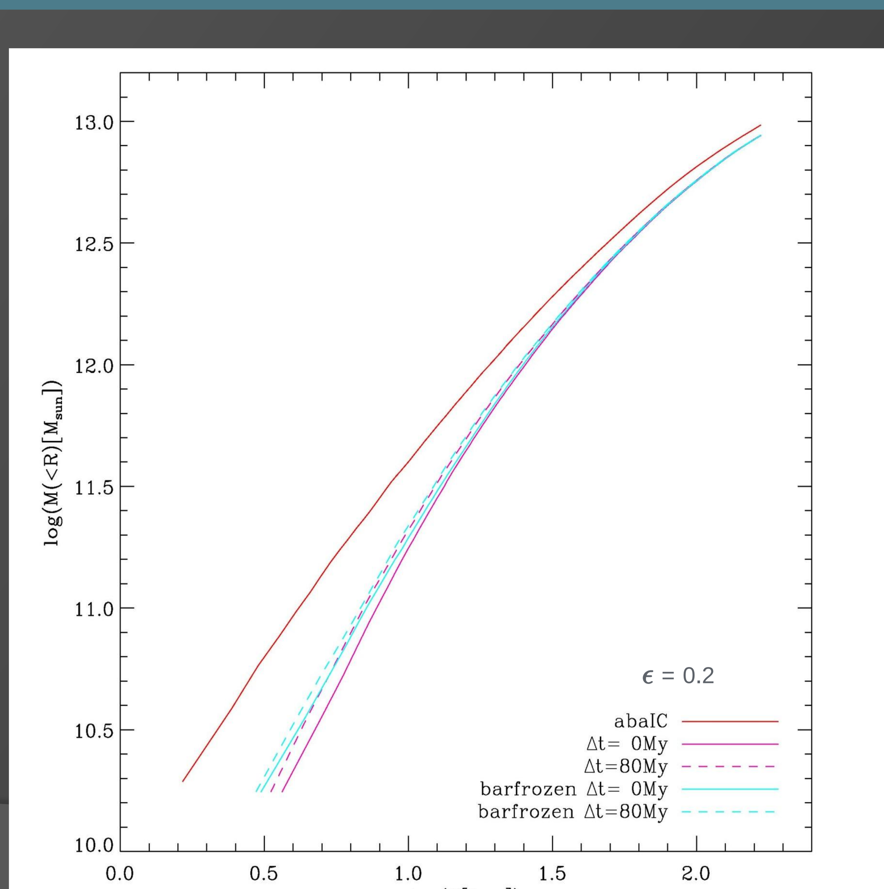
INITIAL CONDITIONS: The initial conditions for the numerical experiment consist in a DM halo embedding a spheroidal galaxy (500000 particles in each component). We set $M_{vir}=10^{13}$ M_{sun} in all the simulations (total mass within the virial radius), with a reference value for the initial (i.e. before any mass loss) ratio of virial mass to baryonic mass of 25.

The density profile for the baryonic component follows the Hernquist law (half mass radius=3.6 kpc), while for the DM we test several possibilities shown in the figure. We set $M_{vir}=10^{13}$ M_{sun} in all the simulations. Besides a standard NFW profile (nfw; R_{vir}=170 kpc, c=4), we used profiles obtained from the same NFW, but taking into account its contraction caused by the condensation of baryons in the centre (i.e. galaxy formation). This contraction has been computed both according to the numerical results by Abadi et al. 2010 (aba), as well as following the classical analytical approximation by Blumenthal et al. 1986 (blum). The latter is much more pronounced, and it is widely believed to be an overestimate of the real effect. We performed also runs in which the baryons are two times more concentrated (half mass r=1.8 kpc) and the DM is again contracted according to Abadi et al 2010 (aba halfsize). This contraction slightly depends on the density run of the baryon component.

After the ejection of a fraction (1-ϵ) of the baryonic mass, causing an expansion of the distribution of the leftover baryons (as quantitatively studied in Ragone-Figueroa & Granato 2011), also the density profile of the DM component is affected in the innermost "galactic" region. The system recovers a quasi-equilibrium state whose mass distribution and density profiles are shown in the figures (after 1Gyr after the mass expulsion), for the various adopted initial conditions (see above), and for two representative values of ϵ and of the ejection timescale Δt. We find that, quite independently of the latter, the flattening of the profile is significant whenever the leftover mass is <50%. In each frame, we show for ease of comparison also the standard initial NFW profile.







A commonly made approximation in similar studies is that of treating the baryonic component as a potential that changes in intensity without any variation in shape. In this figure it is shown that this approximation leads to a non negligible underestimates of the density profile slope flattening.

Bibliography:

Abadi M.G., Navarro J., Fardal M., Babul A., Steinmetz M., 2010, MNRAS 407, 435.

Blumenthal G.R, Faber S.M., Flores R., Primack J.R., ApJ, 301, 27

Ogiya G. & Mori M., arXiv:1106.2864

Ragone-Figueroa C. & Granato G.L., 2011, MNRAS, 414, 3690.