els. These result shows that if we consider off-center galactic starbursts, the mass and metal ejection efficiencies will be substantially lower than the ones that we have computed in our present paper.

It is worth mentioning that the strong winds produced by the combination of individual stellar winds and SNe explosions not only produce the GWs, but have important consequences on the star formation history of their host galaxy as well. They are the most efficient way to redistribute metals to the ISM (and/or the IGM). This produces a feedback mechanism that facilitates the gravitational collapse of the ISM to form stars. The material with higher metallicity cools more efficiently, and it therefore forms high density condensations on shorter timescales than the metal poor gas (Scannapiecco et al. 2005; Sutherland & Dopita 1993). At the same time, the energy feedback from these strong winds can heat and disrupt cold gas clouds, thus inhibiting star formation.

Observations and theory suggest (e.g., Larson 1974; White & Rees 1978; White & Frenk 1991) that large outflows should be able to develop in small systems because of their shallower potential wells. This is because, according to hierarchical galaxy formation scenarios, large systems are formed by the aggregation of smaller ones. Thus, the energy feedback from strong winds should have a more important effect for systems in the early stages of formation.

Our models provide quantitative predictions of the amount of metals which are ejected into the IGM and which are redistributed within the host galaxy. These predictions could be used in a direct way for computing models of the star formation history of the host galaxy, and could also be included in models of the history of galaxy formation.

8. CONCLUSIONS

We computed 220 numerical simulations of GWs produced by nuclear starburst energy injected inside a spherical region (of radius R_c) at the center of the disk galaxy. We used different total masses of the galaxies G1–G10, combined with different starburst energies S1–S11, all adiabatic as well as radiative (110 models each). We have performed adiabatic and radiative 3D N-Body/SPH simulations of GW models using GADGET-2. The radiative models have been calculated using a solar metallicity cooling function. Finally, the adiabatic models were calculated in order to obtain the maximum possible value of the mass and metal ejection effciency in our models of galactic winds, and do not necessarily correspond to real cases of starbursts in galaxies.

From the grid of models we obtained the mass and metal ejection efficiencies as a function of the mass of the gas in the galaxy and the total mass of the nuclear starburst.

In the same way, we computed the efficiencies of gas and metal mass that reaches at least $3H$ above the disk but remains gravitationally bound for both the adiabatic and radiative regimes. We present these efficiencies as a function of the mass of interstellar medium in the galaxies versus total mass of the nuclear starburst.

We show that for compact starburst regions (e.g., inside the SSC) with masses larger than 10^6 $M_\odot$ in the adiabatic case, the metal injected by the nuclear starburst is expelled to the IGM (at least 90% of this gas). We show that in galaxies with gas masses between 10^7 to 10^{10} $M_\odot$ and with a massive nuclear starbursts the available metals are freed from the gravitational potential of the galaxy. In the radiative case the critical SB mass at which total loss of metals occurs is around 2 or 3 times larger than in the adiabiatic one.

In addition, we have calculated the efficiency of the metal redistribution in the disk of galaxies. We find that the metal redistribution is more efficient for intermediate and low mass starburst masses ($< 10^{4.5}$ $M_\odot$) and galactic gas masses $> 10^8$ $M_\odot$ (for both the adiabatic and radiative cases).

In this paper we presented models in which we did not consider many elements that are likely to be important in starburst galaxies; among these are:

- clumpiness in the medium,
- the generation of new stars,
- a different fraction of gas in the galaxy disk,
- the effect of galactic mass loading (see Fujita et al. 2009).

Therefore, there is a large range of possibilities for future studies including differential and/or selective galactic winds (also, Pilyugin 1993 and Recchi et al. 2001, 2002).

Finally, in our paper we have presented a limited resolution study (in § 6). Our evaluation of the dependence of the computed efficiencies on resolution is limited to a range of ∼3 in resolution. This range is of course not very impressive, and questions remain as to the results that would be obtained at considerably higher resolutions (presently not possible, at least for calculating relatively extended grids of models). When such higher resolution models do