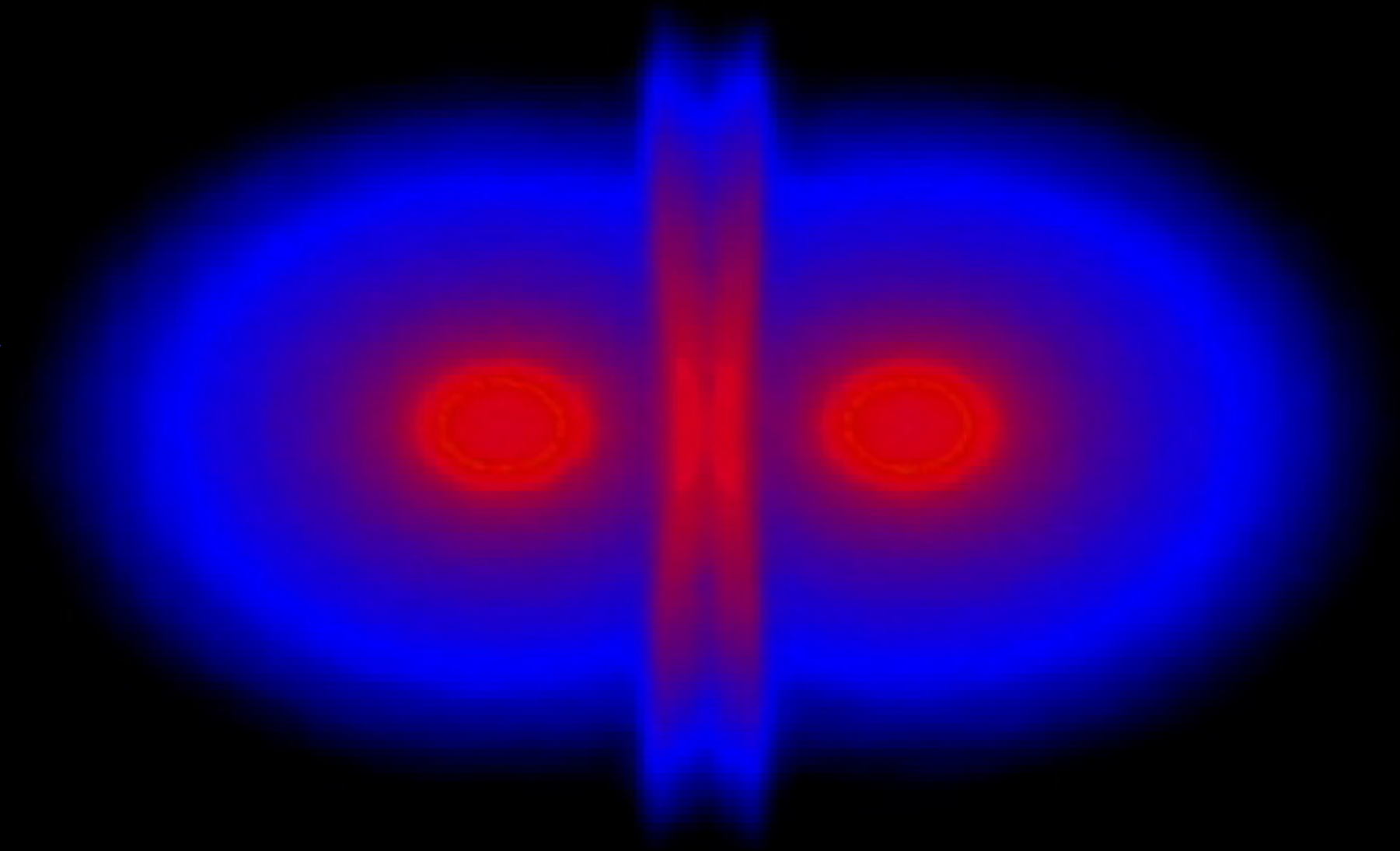
Contra viento y ...



Un homenaje a Eduardo Delgado Donate,
Estallidos 2007.

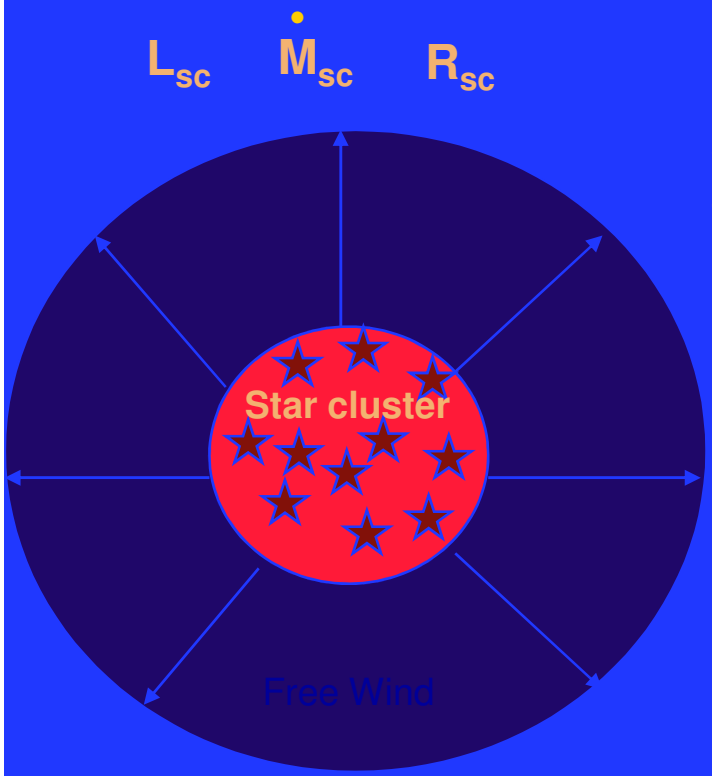
Contra viento y …….

por Eduardo Delgado Donate.

Para ver esta película, debe
disponer de QuickTime™ y de
un descompresor YUV420 codec.

On the hydrodynamics of the matter reinserted within SSCs

1. Super Star Cluster winds



The prototype model for SSC winds (Chevalier & Clegg 1985) is based on the assumption that massive stars are equally spaced within the SSC volume.

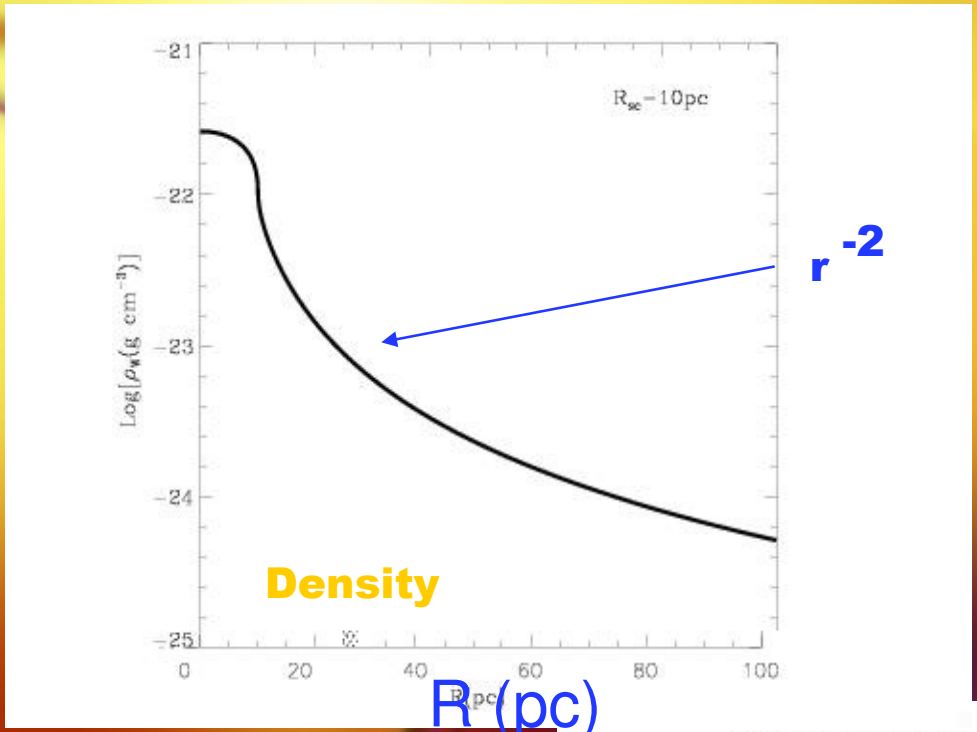
The kinetic energy deposited by massive stars is completely thermalized via random collisions of individual stellar winds and SN ejecta, within the cluster volume.

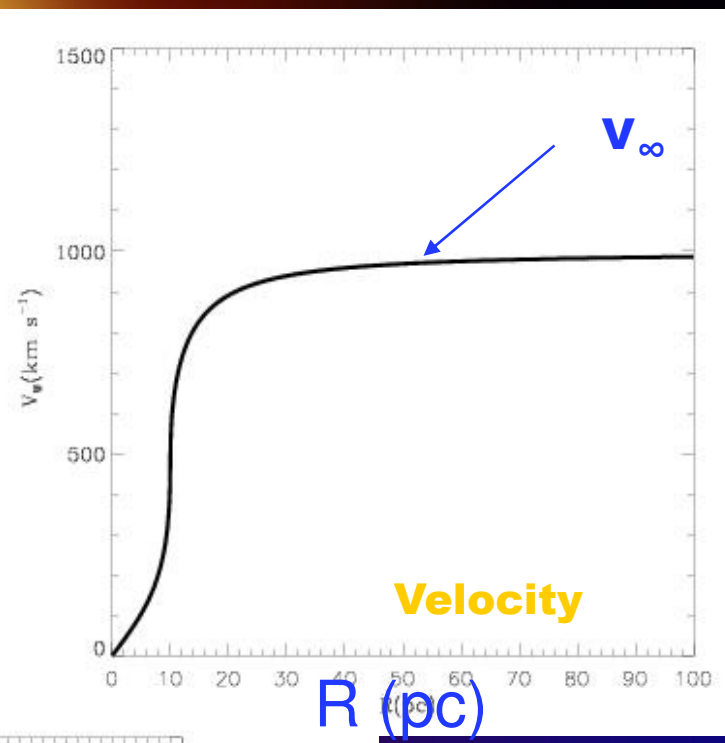
This generates the large central overpressure that accelerates the ejected matter and eventually blows it out of the star cluster in the form of the high velocity outflow – the star cluster wind.

In the adiabatic case three parameters define the distributions of the outflowing gas velocity, density, temperature and thermal pressure.

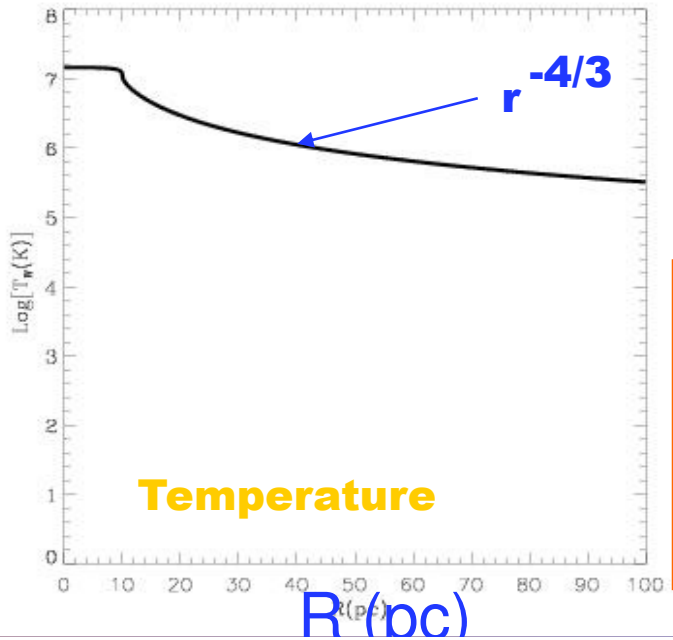
These are: The energy and mass deposition rates L_{sc} and $\dot{M}_{sc}$, and the star cluster radius R_{sc}.

The distributions of density, temperature and velocity.





In the adiabatic case at large radii (R >> Rsc) , the wind parameters approach their asymptotic values:

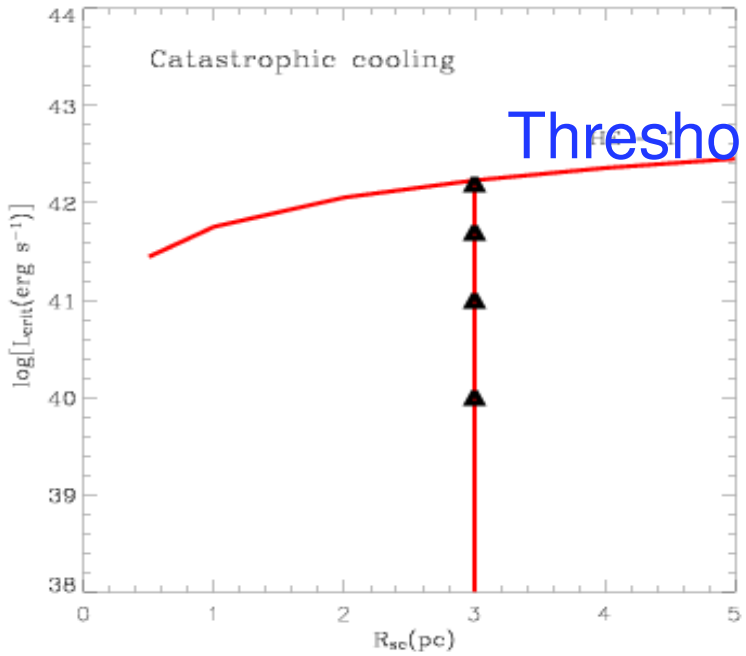


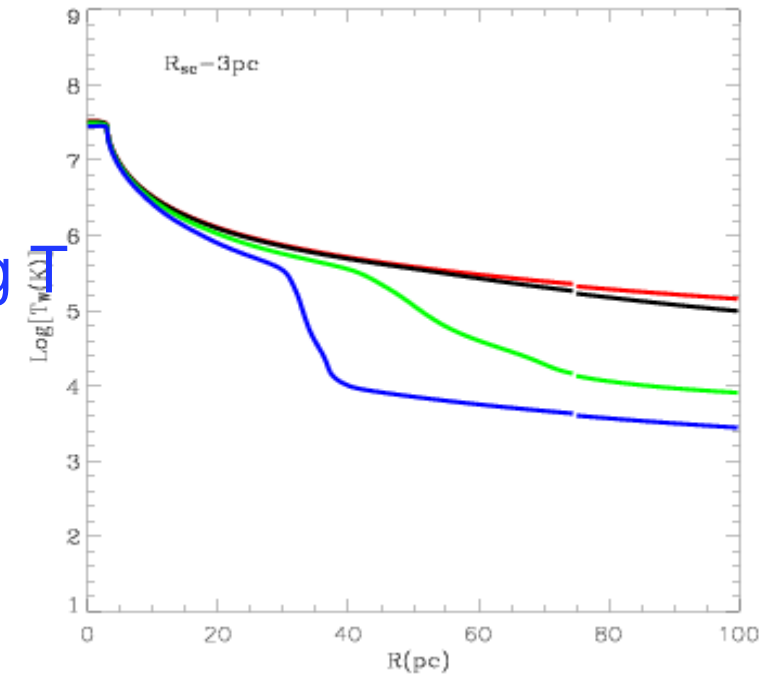
All of these solutions have the stagnation point at the center of the SSC.

The more energetic or more massive the SSCs, the more that radiative cooling impacts on the resultant winds.

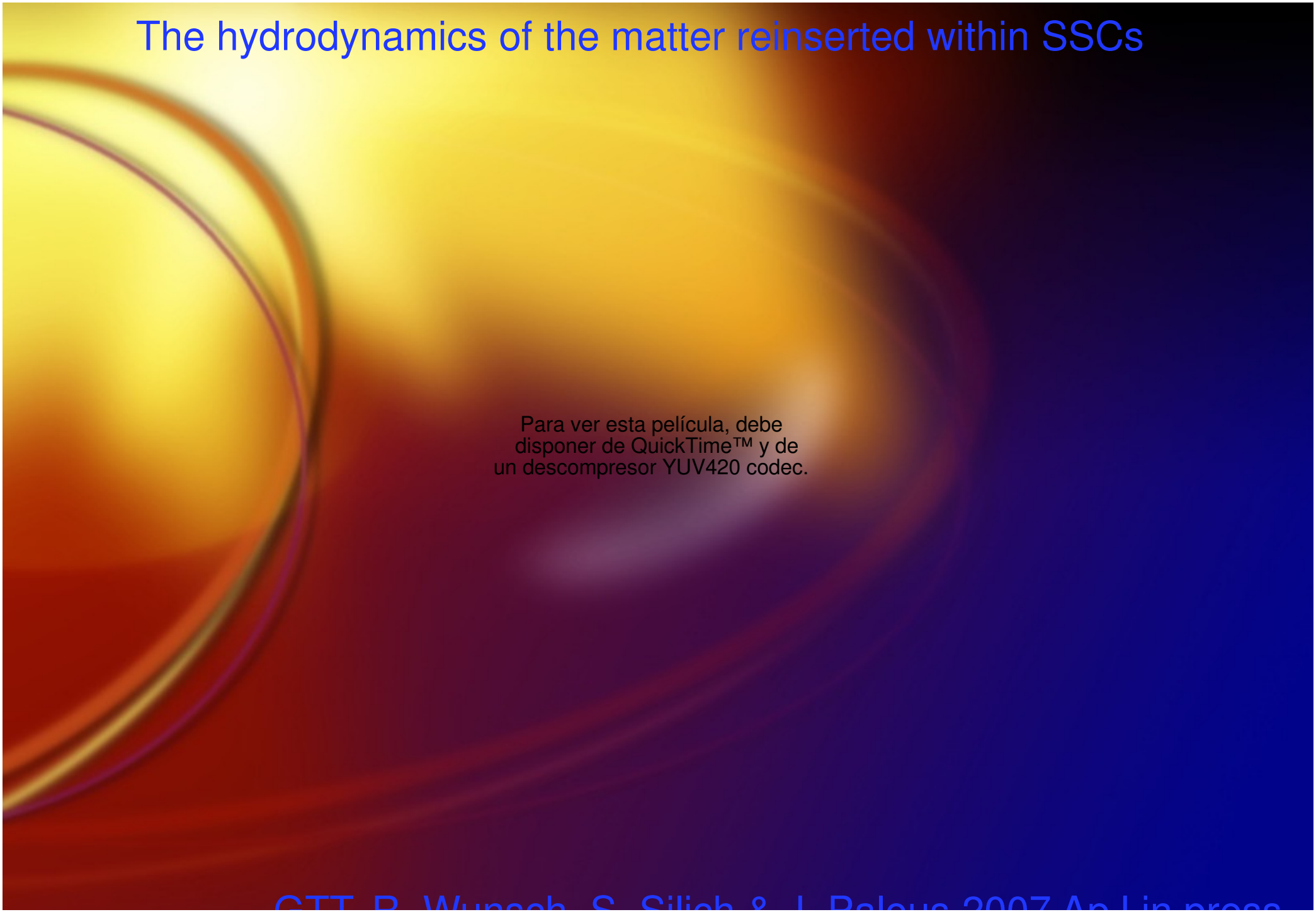
Furthermore,
the critical energy input rate for which the deposited energy is immediately radiated away from the densest central regions is reached.

This causes the stagnation radius to move towards the cluster surface, what leads to a bimodal solution in which the outer regions produce a stationary wind while the matter deposited in the central regions accumulates and becomes ready to participate in further episodes of star formation.
=>> Strong positive feedback!!!!!!





The hydrodynamics of the matter reinserted within SSCs



GTT, R. Wunsch, S. Silich & J. Palous 2007 A+A in press

Conclusions:

Clusters above the threshold line

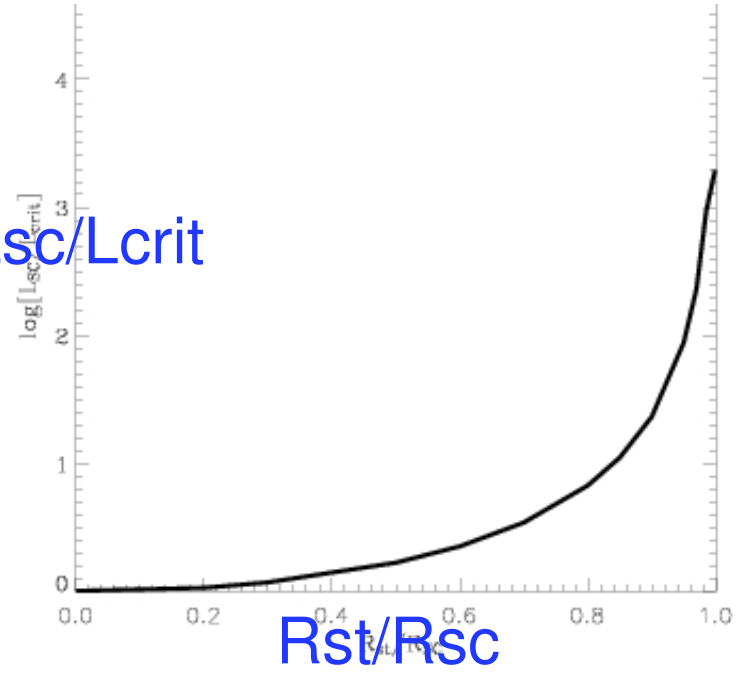
enter the catastrophic cooling

regime and cause a bimodal solution

The results are shown in these "universal diagrams" ApJ April 2007

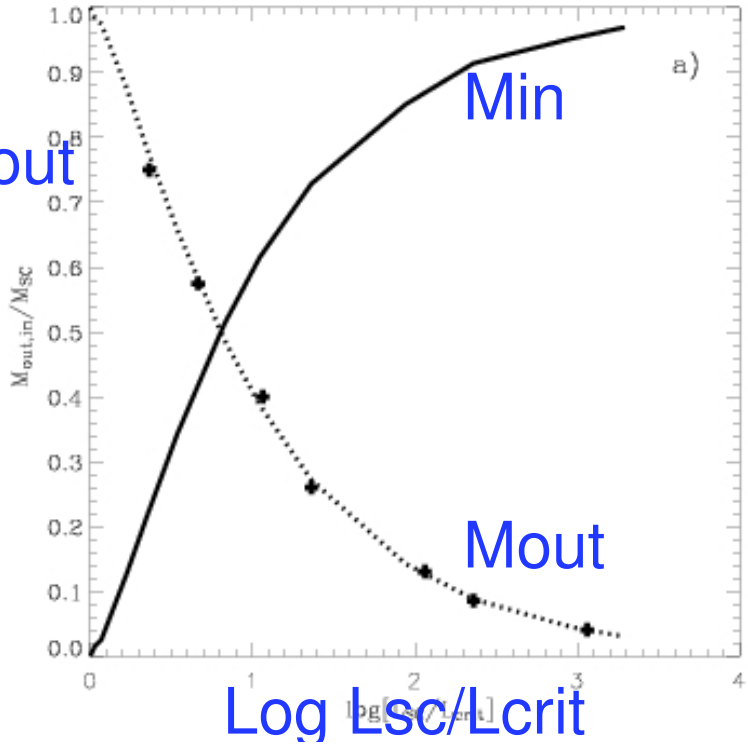
- Strong positive star formation feedback in clusters well above the threshold line ie. Further generations of star formation within the SSC volume and with the matter retuned by winds and SNe.

log Lsc/Lcrit



Rst/Rsc

Min,out /Msc



Log Lsc/Lcrit

On the mass vs metallicity relationship in galaxies.

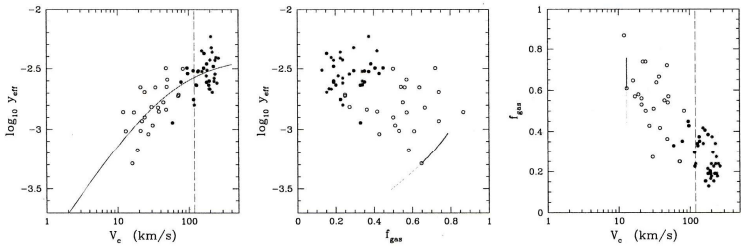


FIG. 1.— Effective yield as a function of galaxy rotation speed (left panel) and of gas mass fraction (center panel), measured at $0.4R_{25}$ by Pilyugin et al. (2004). The right panel shows the relationship between gas fraction and rotation speed for the same data. Mid-type spirals (Sbc-Sc) are plotted as stars, late-type spirals (Scd-Sd) as solid circles, and irregulars as open circles. Compared to massive spirals, the effective yield is reduced by nearly a factor of ten in low mass galaxies ($V_c < 40\,\mathrm{km\,s^{-1}}$), all of which are gas-rich ($f_{gas} > 0.3$). In the left and right panels, the vertical dashed line indicates the rotation speed below which dust lanes disappear and star formation becomes inefficient (Dalcanton et al. 2004; Verde et al. 2002). In the center and right panels, the short lines shows how y_{eff} and f_{gas} would change if the measurement of the gas mass (dashed line) or the stellar mass (solid line) were reduced by a factor of two. The solid curve in the left panel shows the fitting formula adopted in §6.

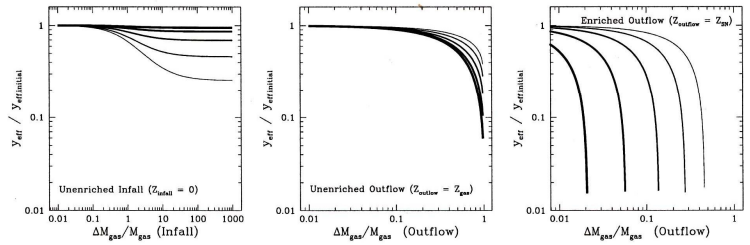


FIG. 2.— The ratio of final to initial effective yield as a function of the ratio of the fractional change in gas mass $\Delta M_{gas}/M_{gas,initial}$, for unenriched infall (left panel; $Z_{infall} = 0$), unenriched outflow (center panel; $Z_{outflow} = Z_{gas}$), and enriched outflow (right panel; $Z_{outflow} = Z_{SN}$). The solid lines show different initial gas mass fractions ($f_{gas,initial} = 0.1, 0.25, 0.5, 0.75, 0.9$, plotted from thin to thick, respectively, which is from bottom to top in the left panel, and from top to bottom in the right panels). With infall, the effective yield is suppressed when large amounts of gas are accreted onto galaxies with low initial gas mass fractions. In the two outflow cases, the effective yield is reduced by large outflows from galaxies with higher initial gas mass fractions. For unenriched outflows, a factor of ten decrease in y_{eff} can only be achieved with nearly total gas ablation from initially gas-rich systems. For enriched outflows with large initial gas mass fractions, only modest amounts of enriched outflow are required to produce the factor of ten drop in the effective yield seen in Figure 1.

1 Introduction

The closed-box model for the chemical evolution of galaxies (see Searle & Sargent 1972) assumes that galaxies evolve as isolated systems, with no infall or outflow of material. Under such circumstances, the mass of metals in the ISM of a galaxy will change with time according to:

$$\mathrm{d}(g\,z) = -\alpha\,z\,\mathrm{d}s + p\,\mathrm{d}s, \tag{1}$$

where g and s are the masses in gas and stars, respectively, z is the metallicity of the gas, α is the mass fraction of formed stars that is locked up in stellar remnants and long-lived stars, and p is the yield, the mass fraction of formed stars that is ejected as newly produced metals. This equation, together with the closed-box constraint:

$$\mathrm{d}g = -\alpha\,\mathrm{d}s, \tag{2}$$

gives:

$$\frac{\mathrm{d}g}{g} = -\frac{\mathrm{d}z}{p/\alpha}, \tag{3}$$

which can be integrated to get the gas metallicity as a function of the gas mass fraction:

$$z = (p/\alpha)\,\ln(1/f) \tag{4}$$

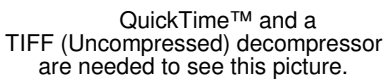
where $f = g/(g+s)$ is the gas mass fraction at a certain time.

The instantaneous recycling approximation has been used above, i.e. massive stars are assumed to return instantly their freshly produced metals to the ISM, there to get thoroughly mixed with all the existing gas. This approximation is likely to be good enough for oxygen, the element generally used as a proxy for the metallicity of the ISM, since O is mainly produced by short-lived massive stars. The constant value of p assumed above should also be a good approximation in the case of O, according to most stellar evolution calculations, although its exact value is not well known (see Table 2 in Stasińska et al. 2007).

The effective yield of a galaxy, y_{eff}, is defined as:

$$y_{\mathrm{eff}} \equiv \frac{z}{\ln(1/f)}. \tag{5}$$

The value of the effective yield can be determined observationally (though several approximations are involved; see Garnett 2002) and compared with p/α, the value expected under closed-box evolution (see eq. 4 above). The


QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Mujer respirando por los pies

por

Yolanda

Tenorio

Tagle 2006

