Appendix A

List of Symbols

The following is a list of symbols used throughout the description of the sticky particle star formation model (see chapter 3)

α_c : Slope of the molecular cloud mass-radius relation. Eq 3.5

c_h : Sound speed of the ambient gas phase

$\epsilon_\star$: Fraction of a GMC converted to stars in a collapse. E_{51} : Energy ejected per SnII in units of 10^{51}ergs

E_b : Total energy in a supernova blast wave

E_m : Total kinetic energy in molecular clouds of mass m in a given volume

f_{cl} : Filling factor of cold clouds

$f_m(\sigma_1, \sigma_2)$: Fraction of collisions between clouds with velocity dispersions σ_1 and σ_2 that lead to mergers

$K(m, m')$: The kernel for aggregation of clouds of masses m and m'. Eq. 3.6

λ : Constant of proportionality relating cloud mass and destruction rate by thermal conduction. Eq. 3.50

Λ_N : Normalised radiative cooling rate

Λ_{net} : Net radiative cooling rate (ergs cm^{-3}s^{-1})

M_c : Mass of a molecular cloud

M_{ref} : Reference cold cloud mass. Eq 3.5

$M_{\star,min}$: Minimum allowed star mass

$M_{\star,max}$: Maximum allowed star mass

n_b : Density internal to a supernova remnant in atoms / cm^3 n_c : Density of a molecular cloud in atoms / cm^3

n_h : Density of the ambient medium in atoms / cm^3

N_{SF} : The slope of the schmidt law. Eq 3.36

$n(m, t)$: The number of clouds with masses between m and $m + dm$

$N(m, t)$: The number density of clouds with masses between m and $m + dm$

ϕ : Efficiency of destruction of cold clouds by thermal conduction

Q : Porosity of the interstellar medium. Sec. 3.2.6

r_{c} : Radius of a molecular cloud

r_{ref} : Reference cold cloud radius. Eq 3.5

r_{b} : The radius of a spherical blast wave

ρ_{c} : Mean density of molecular clouds contained in a volume

ρ_{h} : Mean density of ambient gas contained in a volume

ρ_{th} : Density at which ambient gas becomes thermally unstable

ρ_{SFR} : Volume density of star formation

η : Fraction of cloud velocity lost to 'cooling' collision

T_{b} : Mean temperature inside of a supernova remnant

T_{c} : Internal temperature of cold clouds

T_{h} : Temperature of the ambient gas phase

u_{b} : Thermal energy per unit mass of supernova remnants

u_{c} : Thermal energy per unit mass of the cold clouds

u_{h} : Thermal energy per unit mass of the ambient phase

Σ : Cross section for collision between clouds. Eq. 3.7

Σ_{cond} : Efficiency of thermal conduction. Eq 3.46

v_{app} : Relative approach velocity of two molecular clouds

v_{stick} : Maximum relative velocity for cloud merger

x : Slope of the stellar IMF

Appendix B

The Green's Function of the Finite Differenced Laplacian

For some function ϕ, defined on a regular grid at points i, with grid spacing Δ the finite-difference approximation to the Laplacian at point i is given by

$$\nabla^2\phi_i \approx \frac{\phi_{i+1} + \phi_{i-1} - 2\phi_i}{\Delta^2} \,. \tag{B.1}$$

We now note that for some function $g(x)$, $\mathfrak{F}\big(g(t)\big) = G(k)$, where the notation $\mathfrak{F}$ represents a Fourier transform, defined as

$$g(x) = \int_{\infty}^{\infty} G(k)e^{2\pi ikx}dk \,. \tag{B.2}$$

k represents a frequency, we can write

$$\nabla^2\phi = \sum_k \frac{\hat{\phi}(k)e^{i2\pi k\Delta} + \hat{\phi}(k)e^{-i2\pi k\Delta} - 2\hat{\phi}(k)}{\Delta^2}e^{2\pi ikx} \,, \tag{B.3}$$

by using $\mathfrak{F}\big(g(t-a)\big) = e^{-i2\pi ak}G(k)$. Now noting that $e^{iax} = \cos(ax) + i\sin(ax)$ we can write

$$\nabla^2\phi = \sum_k \hat{\phi}(k)\frac{\cos(2\pi k\Delta) + i\sin(2\pi k\Delta) + \cos(-2\pi k\Delta) + i\sin(-2\pi k\Delta) - 2}{\Delta^2}e^{ikx} \,, \tag{B.4}$$

which, through symmetry, becomes

$$\nabla^2\phi = \sum_k \hat{\phi}(k)\frac{2\cos(2\pi k\Delta) - 2}{\Delta^2}e^{2\pi ikx} \,. \tag{B.5}$$

and substituting in $\cos(2x) = 1 - 2\sin^2(x)$ we obtain

$$\nabla^2\phi = \frac{2}{\Delta^2}\sum \hat{\phi}(k)\sin^2(\pi k\Delta)e^{2\pi ikx} \,, \tag{B.6}$$

which is equal to the right hand side of the Poisson equation. Then we can say that (after taking a fourier transform)

$$\frac{\hat{\phi}(k)}{\hat{\mathfrak{G}}(k)} = \hat{\rho}(k) \tag{B.7}$$

where we have defined the Greens function as

$$\hat{\mathfrak{G}}_{j,k,l} = \left(\frac{2}{\Delta^2} \sin^2(\pi k \Delta) \right)^{-1} \tag{B.8}$$

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