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Cooling Clouds by Varying Metallicities: Origin of Globular Cluster Bimodality

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ABSTRACT
Globular Clusters

Key words: globular clusters - methods:numerical

1 INTRODUCTION

2 BASIC IDEA

3 NUMERICAL MODELS

3.1 Numerical Method

This simulations were performed with the publicly available Eulerian three-dimensional hydrodynamical adaptive mesh refinement Enzo code (The Enzo Collaboration et al. 2013). The domain box size of the simulation was 150 pc with a top level root grid resolution of 128^3. Cell refinement was dictated by baryon mass and Jeans length with a maximum refinement level of 3. Our simulations included self gravity and radiative cooling using the Grackle library; details described in The Enzo Collaboration et al. (2013). The metal heating and cooling rates are provided from Haardt & Madau (2012).

3.2 Initial Conditions

Our initial conditions consisted of a cloud in pressure equilibrium with an ambient density and temperature background. The internal structure of the cloud is modeled by a Bonner-Ebert sphere Bonnor (1956); a self-gravitating isothermal gas sphere in hydrostatic equilibrium embedded in a pressurized medium. To fully describe a Bonner-Ebert sphere, a mass M_{BE}, temperature T_{BE}, and an external pressure P_{ext} must be chosen. Following our assumptions outlined in Section 2, we choosed $M_{BE} = 10^6$ M$_\odot$, $T_{BE} = 6000$ K, and $P_{ext} = 1.8 \times 10^5 \times k_B$ (k_B : Boltzmann constant). This corresponds to a cloud on the cusp where heating and cooling balance.

In addition, we add turbulence to the cloud following a power spectrum of $v_k^2 \propto k^{-4}$ for the velocity field.

4 RESULTS

4.1 No Heating Runs

4.2 Heating Runs

5 DISCUSSION

5.1 Analytic Model

5.2 Implications

5.3 Caveats

6 SUMMARY

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