The Structure of Naked Singularity in Self-Similar Gravitational Collapse

P. S. Joshi and I. H. Dwivedi ★

Tata Institute of Fundamental Research, Homi Bhabha Road, Bombay 400 005, India

Abstract. We study the structure and formation of naked singularities in self-similar gravitational collapse for an adiabatic perfect fluid. Conditions are obtained for the singularity to be either locally or globally naked and for the families of non-spacelike geodesics to terminate at the singularity in past. This is shown to be a strong curvature naked singularity in a powerful sense and an interesting relationship is pointed out between positivity of energy and occurrence of naked singularity.

1. Introduction

Recent work on spherically symmetric gravitational collapse such as the Vaidya null dust solutions for imploding radiations [1, 2], Tolman-Bondi dust solutions [3, 4], and self-similar collapse in general relativity [5] has shown that these situations admit the occurrence of a naked singularity as a final outcome of collapse. Such a scenario violates, in a certain sense, the cosmic censorship conjecture [6, 7] which requires that singularity must not be either locally or globally naked. When a singularity is only locally naked, non-spacelike trajectories can come out of it, however, the causal influence is precluded in the asymptotic regions of spacetimes. On the other hand, the strong form of the conjecture demands that the singularity must be spacelike.

The cosmic censorship hypothesis in the above form lies at the foundation of the currently well-accepted and applied theory of blackholes and it also rules out the violation of predictability in spacetime arising due to naked singularities. However, the attempts for a rigorous formulation and proof for the same have not

---

★ Permanent address: Institute of Basic Sciences, Agra University, Khandari, Agra, India