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On the Occurrence of Naked Singularities in General Relativity*

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Abstract. It is shown that spherically symmetric collapse can lead to singularities which are *not* hidden within "black holes".

I. Introduction

It is widely believed that, in the framework of general relativity, gravitational collapse *inevitably* leads to singularities which are hidden within "black holes"; that "naked singularities" are forbidden by some basic principles of relativity physics. We need hardly point out the fundamental importance of this conjecture (but will do so anyway): should it turn out to be false, then gravitational collapse would force far reaching revisions of present physical theory, since this would be tantamount to a disastrous breakdown of general relativity.

The conjecture (like most conjectures about gravitational collapse) is based to a large extent upon properties of the (spherically symmetric) Schwarzschild-Kruskal vacuum solution, with its singularity hidden behind the familiar horizon. Implicit in this way of thinking is the assumption that the presence of matter does not appreciably alter the character of the singularity. This is not necessarily a sensible extrapolation.

We shall show here that in fact even spherically symmetric collapse can lead to naked singularities.

Our results do not exclude the possibility that some suitably sharpened version of the conjecture may hold (there is some discussion about this below), but they certainly indicate that the conjecture cannot be taken for granted and must be scrutinized much more closely than it has been up to now.

Let us begin by defining some terms. As usual, we restrict attention to spacetimes which contain only a single object[1], and can therefore

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[1] In physical terms, this means that the collapsing object is assumed sufficiently far away from everything else in the universe so that everything else can be ignored.